

SELECTED ABSTRACTS

**ORAL
PRESENTATIONS**
IN ORDER OF PRESENTATION



151st Annual Meeting
AMERICAN OTOLOGICAL SOCIETY

April 20-21, 2018
Gaylord National Resort
National Harbor, MD

Vestibular Function and Hippocampal Volume in the Baltimore Longitudinal Study of Aging (BLSA)

*Rebecca J. Kamil, MD; Athira Jacob, MS
Tilak Ratnanather, PhD; Yuri Agrawal, MD, MPH*

Objective: This study evaluated whether vestibular hypofunction in aging adults is associated with hippocampal atrophy.

Study Design: Cross-sectional study design using data from the Baltimore Longitudinal Study of Aging (BLSA), a long-running longitudinal cohort study of healthy aging.

Setting: Community-dwelling older adults.

Patients: Eligible participants were age ≥ 60 years and had both vestibular physiological testing and brain MRI on the same visit.

Intervention: Vestibular function testing consisted of the cervical vestibular-evoked myogenic potential (cVEMP) to assess saccular function, the ocular VEMP (oVEMP) to assess utricular function, and the video head-impulse test (VHIT) to assess the horizontal semicircular canal vestibulo-ocular reflex (VOR). Brain MRI scans were performed on a 3T Philips Achieva scanner.

Main Outcome Measure: Vestibular function quantified by cVEMP, oVEMP, and VOR gain and hippocampal volume calculated using diffeomorphometry.

Results: The study sample included a total of 74 participants with mean (\pm SD) age of 77.0 (\pm 8.15) years and mean hippocampal volume of 3102.8 (\pm 371.5) mm³. Multivariate linear regression models showed that every 1 μ V amplitude increase of cVEMP was associated with a significant increase of 258.0 mm³ ($p=0.049$) in mean hippocampal volume. This significant relationship was not observed with oVEMP amplitude or VOR gain.

Conclusions: We observed a significant association between cVEMP amplitude and mean hippocampal volume in adjusted models, which is in line with prior work demonstrating a link between saccular function and spatial cognition. Hippocampal atrophy may be a mechanism by which vestibular loss contributes to impaired spatial cognition in older adults.

Define Professional Practice Gap & Educational Need: Vestibular loss in aging adults has been linked to decline in spatial cognition. Several animal and human experiments have shown that vestibular information is critical for accurate spatial memory and navigation behaviors. The hippocampus is a vital component of the network of brain regions involved in spatial cognition, and is known to receive peripheral vestibular input, but the relationship between the vestibular function and hippocampal volume has not been fully elucidated.

Learning Objective: The learning objective of this study is to better understand the relationship between vestibular function and hippocampal volume in older adults.

Desired Result: The results of this study support that vestibular hypofunction is associated with hippocampal atrophy.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Cognitive Predictors of Cochlear Implant Outcomes in Adults

*Aaron C. Moberly, MD; Kara Vasil, AuD
Michael S. Harris, MD; Irina Castellanos, PhD
David Pisoni, PhD*

Hypothesis: Significant variability in speech recognition outcomes is a challenging clinical problem in postlingually deafened adults with cochlear implants (CIs). The hypothesis tested in this study was that several core neurocognitive processes measured in a non-auditory fashion would serve as predictors of speech recognition outcomes.

Background: Neurocognitive functions, such as working memory capacity, information processing speed, and inhibition-concentration, have been identified as contributors to speech recognition in adults with hearing loss. This study examined these and additional neurocognitive factors as predictors of sentence recognition, both in adults who were experienced CI users as well as in CI candidates.

Methods: Forty postlingually deafened adults who were experienced CI users (ECIs) and fifteen CI candidates (CICs) were enrolled. Participants were assessed using non-auditory measures of working memory capacity, information processing speed, inhibitory control, and nonverbal reasoning. Sentence recognition in quiet was assessed for ECIs during the same testing session, and for CICs 6 months after implantation.

Results: Sentence recognition scores correlated significantly with scores of information processing speed, inhibitory control, and nonverbal reasoning in ECI participants. Similarly, for CIC participants, pre-implant neurocognitive skills of information processing speed and nonverbal reasoning predicted scores of sentence recognition 6 months after implantation.

Conclusions: Findings provide further converging evidence that neurocognitive factors contribute to speech processing by experienced adult CI users, and that non-auditory neurocognitive measures can predict speech recognition outcomes preoperatively for CI candidates.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge regarding factors that predict speech recognition outcomes after adult cochlear implantation.

Learning Objective: To develop a better understanding of cognitive factors that contribute to and predict cochlear implant outcomes in adults.

Desired Result: Attendees will consider incorporating preoperative cognitive testing to help prognosticate outcomes for adult patients who receive cochlear implants.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Nonverbal Reasoning as a Contributor to Speech Recognition Outcomes in Adults with Cochlear Implants

*Jameson K. Mattingly, MD; Irina Castellanos, PhD
David B. Pisoni, PhD, Aaron C. Moberly, MD*

Hypothesis: Significant variability in speech recognition persists among postlingually deafened adults with cochlear implants (CIs). We hypothesize that nonverbal fluid reasoning testing can predict sentence recognition in adult CI users.

Background: Neurocognitive functions contribute to speech recognition outcomes in adults with hearing loss. These functions may be particularly important for CI users who constantly hear degraded speech signals. This study used a visual measure of fluid reasoning (the ability to solve novel problems), Raven's Progressive Matrices, to determine its ability to predict sentence recognition in both CI users and normal-hearing (NH) controls listening to spectrally degraded speech.

Methods: Participants were 39 postlingually deafened adults with CIs and 43 age-matched NH controls. CI users were assessed for recognition of words in sentences in quiet, and NH controls listened to 8-channel vocoded versions to simulate the degraded signal delivered by CIs. A computerized visual task of Raven's Progressive Matrices, requiring participants to identify the correct missing piece in a 3 x 3 matrix of geometric designs, was also performed.

Results: Overall number and percent of items answered correctly significantly correlated with sentence recognition for CI users ($r=0.34-0.55$) and NH controls ($0.35-0.58$). Response times and total number of items completed did not correlate with outcomes. Particular items were also evaluated for their ability to predict sentence recognition.

Conclusions: Nonverbal reasoning predicted sentence recognition in both CI and NH subjects. Our findings provide further converging evidence that neurocognitive factors contribute to speech processing by adult CI users and can help explain variability in outcomes.

Define Professional Practice Gap & Educational Need: Our inability as a field to explain variability in cochlear implant outcomes among postlingually deafened adults.

Learning Objective: To develop a better understanding of neurocognitive factors that contribute to speech recognition outcomes in adults with cochlear implants.

Desired Result: The participant will be better equipped to understand and describe neurocognitive factors as they relate to speech recognition, particularly in adults with cochlear implants.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Hearing Loss Predicts Brain Activity in Patients with Alzheimer's Disease Dementia

*Richard K. Gurgel, MD; Susan R. Naidu, PhD
Jeff S. Anderson, MD, PhD; Jace B. King
Keith G. Jones; Norman L. Foster*

Objective: To determine whether hearing ability in noise predicts brain activity in adults with Alzheimer's disease (AD) dementia.

Study design: Prospective, interventional study

Setting: Tertiary referral center

Patients: Patients with AD who had individual-ear pure tone averages ≤ 40 dB HL. Patients underwent comprehensive peripheral and central audiometric testing.

Intervention(s): While in a functional MRI (fMRI) scanner, subjects listened to favorite familiar musical pieces (active state) and were also examined with resting state fMRI in which they listened to nonsensical, reversed music with two runs of 10 minutes each.

Main outcome measure(s): Functional MRI connectivity in 361 distinct gray matter brain regions of interest (ROIs) during active and resting states. Average global connectivity was calculated as mean functional connectivity between an ROI and the other 360 regions, a quantitative marker representing overall functional connectivity in the brain.

Results: Sixteen subjects had adequate fMRI and hearing data. The average age was 71.5 years old (± 6.0). The average Dichotic Sentence Identification (DSI) test, which measures central auditory processing, for the left ear was 40% ($\pm 34\%$) compared to 90% ($\pm 10\%$) in the right ear ($p < 0.001$). Of the fMRI ROIs, 289 of the 361 had significant correlations between global connectivity and DSI of the left ear ($p = 0.0039$, $r^2 = 0.4597$), and all 289 showed higher functional connectivity for individuals with higher left DSI score.

Conclusions: The DSI can predict functional connectivity in patients with AD. Moreover, auditory input from the left ear was more susceptible to impairment, suggesting that side-specific auditory input may influence central auditory processing.

Define Professional Practice Gap & Educational Need: 1. Lack of awareness how certain hearing tests can predict brain activity in patients with Alzheimer's disease dementia 2. Lack of contemporary knowledge about the mechanisms between hearing loss and Alzheimer's disease dementia.

Learning Objective: To educate about the correlation between performance on hearing tests can predict brain activity in patients with Alzheimer's disease.

Desired Result: For attendees to recognize how clinical hearing testing can be utilized to identify those with diminished brain activity.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Long-term Outcomes of Ossiculoplasty with and without an Intact Malleus

*Joshua C. Page, MD; Matthew D. Cox, MD
Tristan Allsopp, MD; John L. Dornhoffer, MD*

Objective: To compare long-term hearing outcomes following ossiculoplasty with cartilage tympanoplasty with (M⁺) and without (M⁻) the malleus present

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

Patients: 126 patients (18-88 years of age) undergoing ossiculoplasty with tympanoplasty or tympanomastoidectomy using cartilage tympanic membrane grafts from 1998 to 2012 with at least 5 years of documented postoperative follow-up.

Main Outcome Measures: Short-term hearing results (pure-tone average air-bone gap [PTA-ABG] measured between 60 days and 1 year after surgery), long-term hearing results (PTA-ABG measured ≥ 5 years after surgery), Ossiculoplasty Outcome Parameter Staging (OOPS) index and complications

Results: 46 patients were included in the M⁺ group along with 80 in the M⁻ group. Pre-operative PTA-ABG was 23.8 dB for M⁺ and 34.5 dB for M⁻ (p=.00001). Short-term PTA-ABG was 19.3 dB for M⁺ and 18.5 dB for M⁻ (p=.727). Long-term PTA-ABG was 18.2 dB for M⁺ and 19.6 dB for M⁻ (p=.500). OOPS index was 4.11 and 6.41 for M⁺ and M⁻, respectively (p=.00001). 13 patients (10.3%) experienced complications.

Conclusion: Our data suggest that the malleus is not statistically significant with regard to its impact on final audiometric outcome following ossiculoplasty when a total cartilage island flap technique is used. This has implications in our clinic, particularly in our use of the OOPS index as a preoperative staging system and will likely lead to its revision. This data may further support the coupling theory of acoustic gain and weaken the catenary lever theory.

Define Professional Practice Gap & Educational Need: Lack of consensus on the importance of the malleus in long-term hearing outcome in ossiculoplasty.

Learning Objective: To compare our clinic's long-term hearing outcomes following ossiculoplasty with total cartilage island flap tympanoplasty with and without the malleus present.

Desired Result: Our hope is that attendees have a better understanding of the role the malleus plays in reconstruction in ossiculoplasty and the mechanisms that contribute to acoustic gain of the middle ear system.

Level of Evidence: LEVEL V - Case series, studies with no controls

IRB: Approved

Variation in Tympanoplasty Cost in a Multihospital Network

*Geoffrey C. Casazza, MD; Andrew J. Thomas, MD
Richard K. Gurgel, MD; Clough Shelton, MD
Jeremy D. Meier, MD*

Objectives: Identify costs and operative times for tympanoplasty, and evaluate factors influencing cost and time variation.

Study Design: Retrospective cohort study

Setting: Multihospital network

Patients: Patients undergoing tympanoplasty from 2013 to 2017. Subjects with additional procedures were excluded.

Interventions: A multihospital network's standardized activity-based accounting system was used to determine costs and operative times of tympanoplasty.

Main Outcome Measures: Correlation between variable factors and cost were calculated by Spearman correlation coefficients. Statistical comparisons of cost and time were made between surgeons and hospitals using an ANOVA test (Kruskal-Wallis) followed by Dunn's test to correct for multiple comparisons. All providers or hospitals with single cases were excluded for statistical comparison.

Results: The study cohort included 487 tympanoplasties performed by 44 surgeons at 13 hospitals. Mean patient age was 18.2 ± 17.4 years. Mean cut-to-close time was 85.8 ± 56.7 minutes. Mean total encounter cost was $\$3491 \pm \$1,627$, mean surgical-supply cost was $\$285 \pm \292 , and operating room supplies was $\$450 \pm \862 . Significant factors correlating with increased cost were surgical-supply cost ($r = 0.886$, 95% CI 0.861-0.906; $p < 0.0001$) and operating room supplies ($r = 0.853$, 95% CI 0.818-0.881; $p < 0.0001$). Laser utilization (mean cost $\$541 \pm \343) and artificial graft material (mean cost $\$199 \pm \94) were the major surgical-supply costs. Cut-to-close time was less correlated with increased cost ($r = 0.312$, 95% CI 0.216-0.402; $p < 0.0001$),

Conclusion: Significant variation in tympanoplasty costs exists among different surgeons and hospitals within a multihospital network. Reducing variation in costs while maintaining outcomes may improve healthcare value and eliminate waste.

Define Professional Practice Gap & Educational Need: Lack of awareness for the variations in cost and time for tympanoplasty surgery.

Learning Objective: Identify costs and operative times for tympanoplasty, and evaluate factors influencing cost and time variation.

Desired Result: Understand and explain variations in cost for tympanoplasty surgery.

Level of Evidence: LEVEL IV - Historical cohort or case-control studies

IRB: Approved

BAHA Skin Complications in the Pediatric Population: Systematic Review with Meta-Analysis

Scott Shapiro, MD; Jad Ramadan, MS; Adam Cassis, MD

Objective: Compare the incidence of skin and surgical site complications for pediatric patients undergoing percutaneous and transcutaneous bone conduction implant (pBCI and tBCI) surgery via systematic review of the literature and meta-analysis.

Data Sources: 1) Search of English language articles in PubMed, Web of Science, and EBSCOhost databases from January 2012 to April 2017. 2) Review of references of studies meeting initial screening criteria.

Study Selection: Inclusion criteria were studies that 1) involved pediatric patients (<18 yo) undergoing tBCI or pBCI surgery and 2) reported surgical complications including skin complications, implant loss, and revision surgery. Exclusion criteria were use of a previous generation implant.

Data Extraction: Multiple study characteristics were extracted but primary outcomes were incidence of skin complication, implant loss, and re-operation. Newcastle Ottawa scale was used for bias assessment.

Data Synthesis: Twenty-two studies (14 tBCI, 8 pBCI) met criteria. Meta-analyses were performed using random effects model. Cochran's Q score and I^2 inconsistency were used to assess heterogeneity. The overall skin complication rate for tBCIs was 6.3% and 31.3% for pBCIs ($p = 4 \times 10^{-12}$). Implant loss was 1.7% for tBCIs and 5.6% for pBCIs ($p = 0.004$). The re-operation rate was 2.9% for tBCIs and 6.0% for pBCIs ($p = 0.00002$).

Conclusions: There is strong evidence to suggest that in pediatric patients, the incidence of skin complications, implant loss, and rate of re-operation are higher for pBCIs compared to tBCIs. This information should be part of any discussion about BCI surgery on pediatric patients.

Define Professional Practice Gap & Educational Need: Lack of knowledge of skin complications, implant loss, and re-operation rates in the two main bone conduction implant systems in the pediatric population.

Learning Objective: Highlight the difference in skin complications in the two main bone conduction implant systems in the pediatric population to help guide surgical decision making.

Desired Result: Counsel families appropriately regarding the potential for skin and surgical site complications of bone conduction implant surgery in pediatric patients.

Level of Evidence: LEVEL II - Small RCTs with unclear results

IRB: Exempt

Cell Proliferation Patterns in The Healing Mouse Tympanic Membrane

*Divya A. Chari, MD; Stacey M. Frumm, BS
Aaron D. Tward, MD, PhD*

Aim: To better elucidate the cellular dynamics and mechanisms by which perforations in the tympanic membrane (TM) are healed.

Background: Under normal conditions, epidermal cells are born then migrate from the handle of the malleus located near the center of the TM in a radial direction toward the annulus. In the condition of perforation healing, it is unknown how the normal pattern of proliferation and migration is altered.

Methods: Thirty-six female mice were used in this study. Ethynyl deoxyuridine (EdU), a thymidine analogue that labels proliferating cells, was injected intraperitoneally into each mouse and supplied in the drinking water, thus labelling any newly born cell. Acute perforations were performed on the right TM using a micropick under a surgical microscope. The left TM served as the control and remained intact. The animals were sacrificed at six time points between 2 hours and 6 days. We analyzed distribution of proliferating cells in the control and perforated TMs using confocal microscopy. EdU was detected with a fluorescent azide.

Results: In control TMs, proliferating cells were detected around the malleus handle then migrated radially outward over time. Perforated TMs showed significantly pronounced proliferation over the malleus handle and the region of the annulus adjacent the perforation and an increased number of newly born cells even in regions of the TM far from the perforation.

Conclusions: Perforation of the TM alters the cellular dynamics throughout the entire TM, rather than simply adjacent to the perforation. This finding argues that long distance signaling occurs in the perforated TM.

Define Professional Practice Gap & Educational Need: 1) Lack of contemporary knowledge about the cellular dynamics and mechanisms by which perforations in the tympanic membrane are healed. 2) Lack of understanding regarding the mechanism by which cellular proliferation occurs in the tympanic membrane, particularly in the perforated condition. 3) Absence of therapies that target cellular mechanisms of tympanic membrane cell proliferation and migration.

Learning Objective: To better elucidate the cellular mechanisms by which tympanic membrane perforations are healed.

Desired Result: Attendees will obtain a deeper understanding of the cellular dynamics of the tympanic membrane which may lead to broad spread applications in targeted molecular therapy to increase proliferation and healing in a perforated tympanic membrane.

Level of Evidence: LEVEL II - Small RCTs with unclear results

IRB: Approved

Treatment of Ciprofloxacin-Resistant Ear Infections

*Kathryn Y. Noonan, MD; Soo Yeon Kim
Lye-Yeng Wong; Joseph D. Schwartzman, MD
James E. Saunders, MD*

Objective: Ciprofloxacin-resistance has been reported in 4.5% of patients with otorrhea. Additionally, ciprofloxacin-resistance is increasing in prevalence. Due to ototoxicity, only fluoroquinolones are FDA approved for topical therapy in the middle ear. Furthermore, there is an assumption that antibiotic resistance patterns are not relevant to topical therapy because topical concentrations are much higher than the MIC used to determine resistance. This study investigates ciprofloxacin-resistant infections and seeks to develop a better understanding of treatment options and outcomes.

Study design: Retrospective review of 141 ciprofloxacin-resistant otologic infections.

Setting: Primary care and specialty outpatient clinics at a tertiary-care hospital.

Patients: All patients with culture-proven ciprofloxacin-resistant otologic infections from 2009-2017.

Intervention(s): Antibiotic treatment with ciprofloxacin topical drops, ciprofloxacin plus oral antibiotics, and non-ciprofloxacin topical drops were studied.

Main outcome measure(s): Bacteriology for ciprofloxacin-resistant infections and treatment effectiveness of various therapies.

Results: MRSA (33%), *Corynebacterium striatum* (19%), and non-MRSA *Staphylococcus aureus* (11%) are the most frequent causes of ciprofloxacin-resistant infections. Topical ciprofloxacin monotherapy was successful in 2.7% of infections compared to a 64.7% success rate with the addition of an oral antibiotic ($p < 0.001$). Non-ciprofloxacin drops are more effective with a 70% cure rate compared to the 2.7% of the ciprofloxacin drops $p < 0.001$. There was no difference in treatment efficacy when comparing non-ciprofloxacin topical therapy (70% cure) to non-ciprofloxacin topical therapy plus oral antibiotic (83% cure) $p = 0.13$.

Conclusions: Using ciprofloxacin drops to treat ciprofloxacin-resistant bacteria is ineffective and patients do significantly better with alternative therapy. This finding supports the conclusion that high concentrations achieved in topical applications are not sufficient to overcome antibiotic resistance.

Define Professional Practice Gap & Educational Need: Ciprofloxacin-resistance has been reported in 4.5% of patients with otorrhea. Additionally, ciprofloxacin-resistance is increasing in prevalence. Due to ototoxicity, only fluoroquinolones are FDA approved for topical therapy in the middle ear. There is a practice gap in proper management of these resistant infections and as a result infections are currently being treated with a wide assortment of therapies. Furthermore, there is an assumption that antibiotic resistance patterns are not relevant to topical therapy because topical concentrations are much higher than the MIC used to determine resistance. This study seeks to investigate the current treatment patterns for ciprofloxacin-resistant infections and the successful therapies that can be utilized.

Learning Objective: 1. Understand safe and adequate therapy for ciprofloxacin-resistant otologic infections 2. Topical ciprofloxacin drops are not adequate monotherapy for ciprofloxacin-resistant infections.

Desired Result: Improved decision-making process due to informed management of ciprofloxacin-resistant otologic infections.

Level of Evidence: LEVEL IV - Historical cohort or case-control studies

IRB: Approved

Acute Otitis Media and Associated Complications in United States Emergency Departments

*Yin Ren, MD, PhD; Rosh K.V. Sethi, MD, MPH
Konstantina M. Stankovic, MD, PhD*

Objective: Complications associated with acute otitis media (AOM), while rare, are associated with significant morbidity and not well characterized from an epidemiological perspective. We analyze the pattern of presentation and emergency department (ED) utilization in patients with AOM and associated complications.

Study Design: Retrospective analysis of the Nationwide Emergency Department Sample (NEDS) from 2009 to 2011.

Setting: Emergency Department.

Patients: Patients who presented with a primary diagnosis of AOM or acute mastoiditis.

Intervention: Diagnostic.

Main outcome measures: NEDS was queried for patient encounters with a diagnosis of AOM or acute mastoiditis based on ICD-9 codes. Complications of severe infection, including petrositis, Gradenigo's syndrome, facial paresis, labyrinthitis, meningitis, intracranial abscess, venous sinus thrombosis, and cerebrospinal fluid leak were assessed. Weighted estimates for demographics, types of complications, socioeconomic status, and trends over time were extracted.

Results: A weighted total of 5,811,127 ED visits were identified. Most were less than 18 years old (79.9%) with an average age of 10.1 years. Most were discharged (99.4%). 15,243 (0.26%) patients presented with a complication. The most common complications were acute mastoiditis (0.16%), labyrinthitis (0.06%) and facial paresis (0.03%). Patients with complicated AOM were older (37 vs. 10 years old), insured by Medicare (18% vs. 2.1%), and more likely to be admitted (43.6% vs. 0.4%) than those with uncomplicated AOM ($p < 0.0001$, respectively).

Conclusions: ED visits related to AOM or mastoiditis are common and complications are rare. A comprehensive analysis on a national level is useful for assessing healthcare utilization trends.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge about the burden of acute otitis media and associated complications on a national level.

Learning Objective: To provide a comprehensive analysis on the demographics, presentation patterns, timing and geographic distribution of ED visits with AOM or mastoiditis. In addition, to identify clinical features in patients who develop complications from AOM.

Desired Result: A comprehensive overview of AOM and associated complications at a national level will highlight patterns of healthcare utilization in the ED setting, and improve our understanding of the disease presentation to ultimately guide triage and resource allocation.

Level of Evidence: LEVEL IV - Historical cohort or case-control studies

IRB: Exempt

**Assessing Cochlear Implant Performance in Older Adults
Using a Single, Universal Outcome Measure Created
via Imputation in a National Web-Based Database**

*Rahul K. Sharma, BS; Stephanie Y. Chen, MD
Jedidiah J. Grisel, MD; Justin S. Golub, MD, MS*

Objectives: The existence of multiple cochlear implant (CI) outcome measures makes it difficult to pool data across institutions. We use a large, national CI database to generate mathematical models that can interconvert different outcome test scores. We then use CNCw as a universal outcome to study performance in older adults as a proof-of-principle.

Study Design: Prospective, national, web-based CI database (HERMES); imputation was performed with linear regression to predict missing CNCw values based on AzBio, HINT, or BKB-SIN.

Setting: Thirty-two US private practice and academic institutions

Patients: Older (≥ 75 years, $n=166$) or younger (<75 years, $n=297$) adult CI patients ($n=463$ total, $n=508$ ears)

Main Outcome Measures: CNCw, usage

Results: Older adults ($n=32-80$) had lower performance on CNCw testing (1 mo: 37%; 3 mo: 45%; 6 mo: 49%; 12 mo: 54%; 24 mo: 57%) than younger adults ($n=49-146$; 1 mo: 48%; 3 mo: 50%; 6 mo: 58%; 12 mo: 64%; 24 mo: 71%). This was significant at all timepoints (Mann-Whitney; $p<0.05$) except 3 mo ($p=0.12$). However, on multivariable regression, age was not a significant predictor of CNCw scores ($p = 0.380$) after controlling for sex, hearing loss duration, use, and postoperative follow-up duration. There was no difference in CI usage between older and younger patients at any timepoint ($p>0.05$).

Conclusions: Using imputation, we converted incompatible outcome scores to CNCw scores, allowing one of the largest analyses of performance in older adults to date. We confirm that older age is not a significant predictor of usage or performance when controlling for confounders.

Define Professional Practice Gap & Educational Need: Professional Practice Gaps: The outcomes of cochlear implantation in very old patients is not thoroughly understood. Additionally, it is difficult to study this problem nationally given numerous non-compatible outcome measures. Educational Needs: Clinicians must understand whether age predicts CI performance into later life. Additionally, clinicians must understand how this question can be answered using national databases despite multiple non-compatible outcome measures.

Learning Objective: To understand whether age predicts CI performance into later life. To understand how this question can be answered using statistical techniques in a national database despite multiple non-compatible outcome measures.

Desired Result: Clinicians will understand that older age alone is not a significant predictor for performance. Additionally, clinicians will understand how questions can be better answered if a universal outcome measure can be created.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

**Adolescent Obesity is an Independent Risk Factor
for Sensorineural Hearing Loss: Results from the National Health
and Nutrition Examination Survey (NHANES) 2005-2010**

*Gavriel D. Kohlberg, MD; Ryan T. Demmer, PhD
Anil K. Lalwani, MD*

Objective: We investigated the hypothesis that childhood obesity is a risk factor for SNHL independent of other metabolic risk factors.

Study Design: A complex, multistage, stratified geographic area design for collecting representative data from noninstitutionalized U.S. population.

Methods: A total of 3723 adolescent participants between the ages of 12–19 from the NHANES database (2005-2010) were studied. Subjects were classified as obese if their BMI \geq 95th percentile. SNHL was defined as average pure-tone greater than 15dB HL for 0.5, 1 and 2kHz or 3, 4, 6, and 8 kHz in at least one ear. Multivariable logistic regression models assessed incident hearing loss odds across obese patients in comparison to normal weight individuals (5th–85th percentile). Models included age, sex, socio-economic status, race, smoke exposure and diet. Additional models individually included metabolic risk factors: high-density lipoprotein level, triglyceride level, systolic blood pressure measurement, diabetes status, hemoglobin A1C level and C-reactive protein level.

Results: The rate of SNHL was 22.02% in obese and 13.82% in normal weight adolescents ($p < 0.0001$). In multivariate analyses, obesity was associated with 1.73 fold increase in the odds of SNHL (95% CI: 1.28–2.37, p -value = 0.001). Metabolic risk factors had minimal effect on odds of SNHL in obese study participants (OR range of 1.7–1.81, all p -values $< .002$).

Conclusions: Obesity is a risk factor for SNHL in adolescents independent of other metabolic risk factors. This has implications for control of obesity as a primary means to protect against hearing loss.

Define Professional Practice Gap & Educational Need: Lack of awareness of the association between obesity and adolescent hearing loss

Learning Objective: Understand the evidence linking obesity with adolescent hearing loss

Desired Result: Promote awareness of the strengthening evidence of the association between obesity and adolescent hearing loss

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Feasibility of a Direct-to-Patient Electronic Survey for the Diagnosis of BPPV

*David R. Friedland, MD, PhD; Heidi A. Richburg, MS
Richard J. Povinelli, PhD*

Objective: To assess the utility of an electronic direct-to-patient survey for predicting BPPV.

Study design: Prospective application of an electronic vestibular survey with subsequent machine learning analyses. Level III

Setting: Tertiary referral center

Patients: Patients presenting to vestibular therapy for dizziness or imbalance.

Intervention: Machine learning assessment of survey responses using J48 decision tree analyses, 10-fold cross validation, and wrapper approach.

Main outcome measures: Accuracy, sensitivity, and specificity of decision trees for predicting BPPV.

Results: 58 subjects complete the survey of which 23 had clinical evidence of BPPV and 35 did not. The first version of the survey included 84 questions of which 72 were yes/no and 12 were multiple choice. Analyses identified 41 questions which did not provide significant differentiation between affected and non-affected patients. There were 15 questions of notable significance which were analyzed with a wrapper. This identified a 4-node 5-branch decision tree categorizing BPPV patients with an accuracy of 90%, sensitivity of 87%, and specificity of 91%. The root of this tree queried whether lying in bed or rolling over triggered symptoms. Interestingly, the subsequent nodes of the tree related to the presence of migraine headache or symptoms of vestibular hypofunction.

Conclusions: A direct-to-patient electronic survey shows strong potential for predicting a diagnosis of BPPV. Refinement of the survey may afford for a quick screening protocol that can be used in primary care offices and emergency departments to reduce the high rates of BPPV misdiagnosis.

Define Professional Practice Gap & Educational Need: 1) Poor recognition of diagnostic features of BPPV 2) Poor recognition of vestibular conditions mistaken for BPPV

Learning Objective: 1) To recognize patient reported features correlating with the diagnosis of BPPV

Desired Result: Attendees will better be able to recognize and correctly diagnose BPPV in their clinics.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Risk of Sensorineural Hearing Loss with Short-term Azithromycin Therapy: A Retrospective Cohort Study

*Adel A. Alrwisan, PhD; Patrick J. Antonelli, MD
Babette A. Brumback, PhD; Yu-Jung Wei, PhD
Almut G. Winterstein, PhD*

Objective: Chronic use of azithromycin has been linked to sensorineural hearing loss (SNHL). We sought to examine whether short-term use of azithromycin increases the risk of SNHL.

Study Design: A retrospective cohort study using Medicaid claims data, 1999 - 2010

Patients: Adults (18-64 years old) with continuous enrollment for 12 months prior to the date of first study oral antibiotic dispensation (index date).

Intervention: Azithromycin or amoxicillin (\pm clavulanate) treatment for uncomplicated infections.

Main outcome measure: A charge for audiometry followed by a new diagnosis of SNHL within 30 days of audiometry, within 120 days of the index date. We adjusted for the baseline covariates through propensity scores matching. The hazard of SNHL in azithromycin-exposed adults was compared to those who had amoxicillin using a Cox proportional hazard model. We performed several sensitivity analyses by varying the follow-up time, SNHL definition, adjusting for cumulative antibiotic use, and switching between exposure status during the follow-up period.

Results: 493,774 patients entered the study cohort. The unadjusted incidence rates of SNHL were 38 and 41 cases per 10,000 patient-years following exposure to azithromycin and amoxicillin, respectively. The adjusted hazard ratio of SNHL for azithromycin vs. amoxicillin was 0.91 (95% CI, 0.77-1.07). The sensitivity analyses findings were consistent with the primary analysis.

Conclusion: Short-term use of azithromycin is not associated with an increased risk of SNHL compared to amoxicillin.

Define Professional Practice Gap & Educational Need: Recently, a systematic review of case reports and case series concluded that azithromycin short-term use might be associated with the risk of sensorineural hearing loss. However, with a lack of comparison group several confounding might arise. To date, no controlled studies have evaluated the association between azithromycin short-term use and sensorineural hearing loss.

Learning Objective: To provide evidence on whether azithromycin use is associated with increased risk of sensorineural hearing loss or not.

Desired Result: The lack of an association between azithromycin short-term use for acute infections and SNHL found in this study might be reassuring for clinicians.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Idiopathic Sudden Sensorineural Hearing Loss is Not a Sentinel Event for Acute Myocardial Infarction

*Matthew G. Crowson, MD; Alan W. Langman, MD
Walter T. Lee, MD, MHS; Kourosh Parham, MD, PhD
Kristine Schulz, MPH, DrPH; Jennifer J. Shin, MD
Andrea Vambutas, MD*

Objective: Given ongoing debate about the suggested association, the primary objective was to determine if idiopathic sudden sensorineural hearing loss (ISSNHL) was a sentinel event for acute myocardial infarction (AMI) in adults.

Study Design: Case-control study.

Setting: United States MarketScan administrative health claims database.

Patients: Aged 18 years or older, had a diagnosis of ISSNHL on or after January 1st 2011 and had sufficient follow-up data available to assess for AMI occurrence.

Intervention: N/A

Main Outcome Measures: Incidence rates (per 1,000 patient years) of AMI for cases and controls was computed. Adjusted and unadjusted Cox proportional hazards models were created to explore possible associations between ISSNHL and initial AMI.

Results: A total of 10,749 ISSNHL cases and 10,749 matched controls were included. There were no significant differences in the incidence rate of AMI between ISSNHL cases (8.29 events/1000 person-years) and controls (9.25 events/1000 person-years), nor were there differences within age groups, gender or comorbidity status (overall incidence rate ratio 0.90; 95% CI 0.70-1.15 $p = 0.39$). The unadjusted and adjusted Cox proportional hazards models did not demonstrate an association between ISSNHL and initial AMI (HR: 0.90, 95% CI: 0.70-1.15; HR: 0.86, 95% CI: 0.67-1.10, respectively).

Conclusions: ISSNHL is not a predictor of an initial AMI in adult patients from the United States. Considerable inconsistencies in associations between cardiovascular risk factors and ISSNHL exist in the literature. Further work is needed to confirm or refute direct associations between cardiovascular disease risk factors and ISSNHL before definitive mechanistic conclusions can be made.

Define Professional Practice Gap & Educational Need: There is a lack of consensus for the role for idiopathic sudden sensorineural hearing loss (ISSNHL) as a sentinel event for acute myocardial infarction in adult patients. The most common pathological mechanisms studied for ISSNHL to date include infectious (viral and bacterial), cardiovascular disease, inflammation and immunological, genetic mutations, and central nervous system abnormalities. Interestingly, two prior database studies from Taiwan reported a significant association between ISSNHL and acute myocardial infarction. As of the writing of this abstract, no evidence has been published explaining a mechanistic connection between ISSNHL and AMI. Moreover, no population-level analysis exploring ISSNHL and AMI has been completed using data from the United States.

Learning Objective: At the conclusion of this activity, the participant should be able to: 1) Critically examine population-level data that suggests there is no significant relationship between patients presenting with idiopathic sudden sensorineural hearing loss as occurring to acute myocardial infarction versus patients without a history of idiopathic sudden sensorineural hearing loss, and 2) Demonstrate an awareness of the limitations of population-level health care claims data in making generalizable statements about medical condition associations.

Desired Result: At the conclusion of this activity, the participant should be able to apply this knowledge to: 1) Develop and design rigorous claims-data research methodologies to compare conditions of relevance to Otolaryngology, and 2) Counsel patients that there is conflicting evidence regarding a higher incidence of acute myocardial infarction after idiopathic sudden sensorineural hearing loss.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Exempt

Rational Cochlear Implant Electrode Design Based upon Temporal Bone Histopathology

*Akira Ishiyama, MD; Ivan Lopez, PhD
Gail Ishiyama, MD; Fred Linthicum, MD*

Objective: To evaluate the histopathology of human temporal bones with a history of cochlear implant to determine the localization of fibrosis and damage to cochlear structures.

Background: This study addresses the histopathological findings of cochlear implantation in order to better guide the design of electrodes for cochlear implant and surgical approaches.

Material and methods: Fifty-five celloidin embedded archival human temporal bone pairs from patients with unilateral cochlear implants were studied to understand the mechanism of cochlear damage following surgery and long-term implantation. The histopathological findings were compared between the implanted side and the contralateral unimplanted side.

Results: The insertion of a cochlear implant electrode through the round window approach was associated with a significantly lesser degree of fibrosis compared with cochleostomy insertion. The temporal bone surrounding perilymphatic and endolymphatic compartments contained fibrous tissue that was in some cases, localized, and in other cases, widespread and ossified in proximity to the cochleostomy. In some cases of implants with longer electrodes, there was fibrosis in areas where the electrodes encountered the anterior bend of the first cochlear segment. Seven temporal bones demonstrated erosive changes of the lateral wall consistent with secondary degeneration due to long term use of the electrode.

Conclusion: The temporal bone histopathology findings implicate that the round window electrode insertion method is preferred over cochleostomy due to the apparent inciting of fibrosis and in severe cases, ossification near the cochleostomy site. In addition, the findings implicate that the perimodiolar electrode design is recommended to avoid secondary changes to the lateral wall for long term use.

Define Professional Practice Gap & Educational Need: Provide evidence for rational cochlear implant design based upon temporal bone histopathology.

Learning Objective: To improve the surgical out come in cochlear implantation based upon temporal bone histopathology.

Desired Result: Perform cochlear implantation through round window approach and select perimodiolar cochlear implant electrode.

Level of Evidence: LEVEL I - Large RCTs with clear cut results

IRB: Approved

Safety and Outcomes of Children Implanted under 36 Months

*Stephen R. Hoff, MD; Denise Thomas, AuD, CCC-A
Elizabeth Tournis, AuD; Hannah Kenny
Maura Ryan, MD; Nancy M. Young, MD*

Objective: Determine safety and outcomes of cochlear implantation of children under age 36 months, including those implanted below age 12 months.

Study design: Retrospective review

Setting: Tertiary care children's medical center

Patients: Children receiving a cochlear implant (CI) before age 36 months; 27 implanted below age 12 months (Group <12m) and 141 between 12 and 36 months (Group 12-36m). Mean ages at first CI were 9.1mos (5.9-11.8) and 23.4mos (12.1-36.8), respectively. All of Group <12m received bilateral implants as did 70.2% of Group 12-36m. Mean length of follow-up and age at last follow-up did not differ significantly between groups (follow-up 6.6yrs vs 6.3yrs; age 7.4yrs vs 8.3yrs, respectively).

Interventions: Unilateral, sequential or simultaneous bilateral cochlear implantation

Main outcome measures: Surgical complications, open-set speech discrimination, primary communication mode(s).

Results: Cerebral spinal fluid leak occurred in 3 ears (2 in Group <12m) and wound infection in one (Group 12-36m). All children in Group <12m achieved open-set ability in each ear, including 3 children with complicating medical conditions associated with developmental delay and communication disorders. 91.9% of 124 tested in Group 12-36m achieved open-set, including 10 of 13 children with complicating conditions. Those implanted at <12m were significantly more likely to develop spoken language as sole communication mode than those implanted older (85.2% vs 56.8%, $p \leq .005$).

Conclusions: Children implanted below age 12 months do not have an increased rate of surgical complications. Early implantation was associated with attainment of open-set ability in both ears and spoken language as sole communication mode.

Define Professional Practice Gap & Educational Need: 1. Lack of contemporary knowledge and awareness outcomes of cochlear implantation of children under 12 months of age. 2. Provide contemporary knowledge of safety of implantation of infants below 12 months of age

Learning Objective: 1. Will increase knowledge of impact of implantation between 12 and 36 months on speech perception and communication mode outcomes, including children with complicating conditions. 2. Will increase knowledge of complications of cochlear implantation of children below 37 months

Desired Result: Attendees will improve their understanding of the advantages early cochlear implantation of children with and without complicating conditions, including those implanted below age 12 months

Level of Evidence: LEVEL V - Case series, studies with no controls

IRB: Approved

Beyond Sentence Recognition in Quiet for Older Adults: Implications for Cochlear Implant Candidacy

Emily Zhang, BA; Daniel H. Coelho, MD

Objective: To study post-operative hearing outcomes in older adult cochlear implant recipients who did not meet Medicare candidacy criteria by sentence testing in quiet.

Study Design: Case Control Series

Setting: University Based Tertiary Referral Cochlear Implant Center

Patients: 54 Patients age 60 or greater with bilateral moderate to profound sensorineural hearing loss who underwent cochlear implantation. Patients were divided into three groups by pre-operative testing scores; 1) sentence recognition in quiet and monosyllabic word recognition scores < 40%, 2) sentence recognition in quiet scores > 40% and sentence recognition in noise scores < 40%, and 3) sentence recognition in quiet scores > 40% and monosyllabic word recognition scores < 40% in the ear to be implanted.

Intervention(s): Cochlear Implantation

Main outcome measure(s): Pre- vs. post-operative sentence and word recognition scores.

Results: All 3 groups received a statistically significant benefit from their cochlear implant as measured by both post-operative sentence and word recognition. When comparing post-operative sentence recognition scores between groups, there were no statistically significant differences between groups. (Group 1: Mean 83.1%, SD +/- 17.4%; Group 2: Mean 90.1%, SD +/- 8.0%; Group 3: Mean 90.6%, SD +/- 6.9%). When comparing post-operative monosyllabic word recognition scores, there were no statistically significant differences between groups. (Group 1: Mean 60.3%, SD +/- 19.6%; Group 2: Mean 66.8%, SD +/- 20.0%; Group 3: Mean 70.0%, SD +/- 18.8%).

Conclusions: Results of this study demonstrate that older patients who do not meet current Medicare candidacy criteria derive significant long-term benefit from cochlear implantation when either sentence in noise or monosyllabic word recognition in quiet <40% is used to determine candidacy. Further research and greater numbers are needed to better characterize the role of monosyllabic word recognition in cochlear implant candidacy.

Define Professional Practice Gap & Educational Need: 1. General lack of awareness of cochlear implant candidacy 2. Lack of awareness of cochlear implant candidacy in older adults 3. Specific lack of awareness of Medicare's cochlear implant candidacy

Learning Objective: By the end of this presentation, the audience member will understand the current Medicare criteria for cochlear implantation. They will also understand that even patients who do not meet current criteria still benefit from cochlear implantation. Therefore, sentence testing in noise and monosyllabic word testing to determine candidacy are appropriate for this patient population.

Desired Result: Attendees may change their pre-operative testing algorithms, ideally opening cochlear implantation to many more potential candidates who could benefit from this life-changing technology.

Level of Evidence: Level III - Cohort and case-control studies

IRB: Approved

Further Evidence of the Relationship between Cochlear Implant Electrode Positioning and Hearing Outcomes

*Jack H. Noble, PhD; René H. Gifford, PhD
Benoit M. Dawant, PhD; Brendan O'Connell, MD
Jianing Wang, MS; Robert F. Labadie, MD, PhD*

Hypothesis: Intra-cochlear positioning of cochlear implants (CI) has a significant relationship with audiological outcomes.

Background: Post-operative imaging studies by numerous groups have revealed that final CI electrode position impacts audiological outcomes with scalar location consistently shown to be an important factor but modiolar proximity less extensively studied. Findings regarding the effect of insertion depth have been inconsistent.

Methods: Using previously developed automated algorithms, we determined CI electrode position in an IRB-approved database of 161 CI ears. Generalized linear models (GLM) were used to analyze the relationship between audiological outcomes and other factors including age, duration of CI use, device type, and electrode position.

Results: For 85 pre-curved arrays, GLM revealed that age, scalar position, and modiolar distance were significant ($p < 0.0001$) factors for CNC words ($R = 0.44$) and BKB-SIN ($R = 0.57$). Other factors were not significant after controlling for other variables in the model. For 76 straight arrays, we found insertion depth to be the only significant ($p < 0.016$) factor (CNC $R = 0.28$; BKB-SIN $R = 0.23$). When ordered according to significant electrode position factors, the mean scores for the top 25% versus bottom 75% were 68% versus 48% (CNC) and 8.7dB versus 15.1dB (BKB-SIN) for pre-curved arrays and 52.5% versus 38.7% and 12.9dB versus 15.5dB for straight electrodes.

Conclusion: These findings suggest that optimal audiological outcomes are associated with pre-curved electrodes that stay within scala tympani and are positioned close to the modiulus. For straight electrodes, deeper insertion depths are associated with better outcomes. Analyses on our continually expanding dataset will be presented at the conference.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge on how intra-cochlear position of cochlear implant electrodes relate to outcomes.

Learning Objective: Attendees will learn how cochlear implant positioning correlates with outcomes.

Desired Result: Attendees will apply this knowledge when considering electrode insertion techniques and cochlear implant designs.

Level of Evidence: LEVEL IV - Historical cohort or case-control studies

IRB: Approved

Earphone and Aided Word Recognition Differences in Cochlear Implant Evaluations

*Theodore R. McRackan, MD, MSCR; Jane Burton, AuD
Joshua E. Fabie, BS, Jayne B Ahlstrom, MS
Meredith E. Holcomb, AuD, Ted A. Meyer, MD, PhD
Paul R. Lambert, MD, Judy R. Dubno, PhD*

Objective: Compare word recognition scores for adults undergoing cochlear implant evaluation (CIE) measured using earphones and with hearing aids (HA)

Study design: Retrospective review of data obtained during adult CIEs.

Setting: Tertiary cochlear implant center

Patients: 338 ears in 174 subjects with greater than 10% earphone word recognition scores.

Interventions/Main outcomes measured: Pre-operative earphone and aided pure tone thresholds and word recognition scores.

Results: A review of audiological data obtained from 2012-2016 during adult CIEs was conducted. Overall, a low positive correlation ($r=0.39$, 95% CI 0.30-0.48, $p=0.002$) was observed between word recognition scores measured with earphones and in the sound field with hearing aids. Earphone to aided differences (EAD) (McRackan, et al., 2016) ranged from -59% to +87% (mean $3.3\pm 24.3\%$). Consistent with EADs, 75 ears (22.2%) had earphone scores that were significantly higher than aided word recognition scores (+EAD), as determined by 95% confidence intervals; for 57 ears (16.9%), earphone scores were significantly lower than aided scores (-EAD). Using a multivariable regression model, EAD increased with pure-tone average (OR 0.31, 95% CI 0.12-0.50, $p=0.001$).

Conclusion: These results demonstrate the limited diagnostic value of word recognition scores measured under earphones. Nevertheless, aided word recognition is rarely measured outside of CIEs. Earlier and routine measurement of aided word recognition may help guide clinical decision making by determining whether patients are achieving maximum benefit with their hearing aids or should consider cochlear implantation.

Define Professional Practice Gap & Educational Need: 1) Lack of knowledge regarding the low correlation between word recognition scores measured with earphones and in the sound field with hearing aids. 2) Lack of understanding of how measures of aided word recognition in the clinical test battery can inform clinical decision making for cochlear implantation candidacy.

Learning Objective: 1) Attendees will learn the poor association between word recognition measured with earphones and in the sound field with hearing aids and implications for clinical decision making. 2) Attendees will learn that measures of aided word recognition provide better estimates of functional communication abilities, which is important for determining whether patients should consider cochlear implantation.

Desired Result: 1) Aided word recognition may be incorporated into the standard audiologic test battery to provide better estimates of functional communication abilities for patients who use hearing aids. 2) Aided word recognition will guide clinical decision making and improve patient care.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Inappropriate Use of Systemic Antibiotics for Acute Otitis Externa: Impact of the 2006 Clinical Practice Guideline

*Xi Wang, MPH; Almut G. Winterstein, PhD
Yan Li, MS; Yanmin Zhu, BS
Patrick J. Antonelli, MD*

Objective: We aimed to examine the extent of inappropriate use of systemic antibiotics among acute otitis externa (AOE) patients, as well as the enforcement of clinical practice guideline among Medicaid beneficiaries.

Study Design: Interrupted time series study using Medicaid claims data, 1999-2010

Patients: Children and adults with 12 months continuous Medicaid enrollment prior to the first diagnosis of AOE (index date) and antibiotic prescriptions within one day of index date

Intervention: Clinical practice guideline published in 2006 by the American Academy of Otolaryngology-Head and Neck Surgery Foundation

Main outcome measure: The primary outcome was the proportion of the systemic antibiotic use v. any antibiotic treatment for AOE. Segmented regression analysis of interrupted time series was used to evaluate changes in the primary outcome before and after the 2006 clinical practice guideline publication. Stratified analyses by age group (children and adults) were conducted.

Results: 624,368 AOE patients had at least one systemic or topical antibiotic use from January 2002 to December 2010. In the segmented regression, we did not observe any immediate (-0.021; P=0.675) or delayed (0.002; P=0.769) drop on the proportion of AOE patients with systemic antibiotic treatment associated with publication of 2006 guideline. The stratified analyses findings were consistent with the primary analysis.

Conclusion: The clinical guideline did not lead to a decline in systemic antibiotic prescriptions as initial AOE treatment. Additional efforts will be needed to curb inappropriate, systemic antibiotic treatment of AOE.

Define Professional Practice Gap & Educational Need: Avoidance of inappropriate use of systemic antibiotics among AOE patients has been a measurement in National Quality Strategy (NQS) to evaluate effectiveness of clinical care. Previous evidence was limited to insufficient observation period, small sample size, use of weak study design and statistical tests, as well as generalizability of the study population.

Learning Objective: To provide evidence on whether there is change in the trends of inappropriate use of systemic antibiotics from 2002-2010 among Medicaid beneficiaries after the 2006 guideline published.

Desired Result: Results of this study might be of interest as targets for policymakers and public health interventions, particularly more evaluation about the quality measurement of AOE for hospitals.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

**A Case-Control Study of Hearing Outcomes between Middle Fossa Craniotomy
and Transmastoid Approach for Surgical Repair
of Superior Semicircular Canal Dehiscence Syndrome**

*Lisa Zhang, BS; Francis X. Creighton Jr, MD
Bryan Ward, MD; Stephen Bowditch, AuD, CCC-A
John P. Carey, MD*

Objective: To compare postoperative hearing outcomes for transmastoid (TM) approach to middle cranial fossa (MCF) approach for surgical repair of superior semicircular canal dehiscence syndrome (SCDS).

Study Design: Historical case-control study

Setting: Tertiary referral center

Patients: 13 consecutive cases with SCDS who underwent TM plugging of the superior canal; “controls” were 15 audiogram-matched patients who underwent MCF plugging and resurfacing of the canal.

Main Outcome Measures: Differences between preoperative, 7-day postoperative, and long-term (>6 weeks) postoperative air and bone conduction, speech discrimination scores (SDS), and pure tone averages (PTA) in TM cases vs MCF controls.

Methods: Controls were selected from a larger pool of MCF cases by matching preoperative BC thresholds from the TM cases within 10-dBs of BC thresholds in $\geq 80\%$ of recorded frequencies. Wilcoxon signed-rank tests were performed to compare main measurement outcomes between matches

Results: No statistically significant differences were found in >6 week post-operative air and bone conduction thresholds at any frequency. Similarly, there were no differences in long-term SDS or PTA between TM and MCF patients ($p=0.43$ and $p=0.38$, respectively). However, at 7-day follow-up, patients who underwent TM surgical repair had significantly lower SDS than those who underwent MCF repair ($p<0.05$). This may reflect greater incidence of middle ear/mastoid effusions 7 days after surgery in the TM approach.

Define Professional Practice Gap & Educational Need: Understanding effects on hearing outcomes from different surgical approaches for SCDS.

Learning Objective: No long-term differences in hearing were observed between transmastoid and MFC approaches for SCDS surgical repair in this pilot study.

Desired Result: A better understanding of hearing outcomes from different surgical techniques could better inform management of SCDS.

Level of Evidence: LEVEL IV - Historical cohort or case-control studies

IRB: Approved

**Next-generation Sequencing of Sporadic Vestibular Schwannoma:
Necessity of The Two-Hit Mechanism and Implications
of Accessory non-NF2 Alterations**

*Matthew L. Carlson, MD; Michael J. Link, MD
James B. Smadbeck, PhD; Eric W. Klee, PhD
Lisa A. Schimmenti, MD; George Vasmatazis, PhD*

Objectives: 1) Describe the genetic alterations discovered in a series of sporadic vestibular schwannomas (VS). 2) Identify if more clinically aggressive variants possessed different genetic alterations compared to more indolent behaving VS.

Methods: Fresh frozen tumor and matched leukocytes from 23 cases of sporadic VS were analyzed using whole-exome sequencing, whole transcriptome expression profiling (mRNA-Seq) of tumor and mate-pair sequencing of tumor. Source cases included tumors with fast preoperative growth, giant tumors in young patients, tumors with macrocystic change, recurrent tumors following radiation or microsurgery, and indolent small tumors with minimal or no growth prior to surgery.

Results: A double hit to the *NF2* gene was discovered in all specimens and none of these mutations occurred in the peripheral blood. Thirteen tumors had complete loss of one chromosome 22 (ch22). Four tumors had loss of heterozygosity of ch22. Thirty-one unique mutations in the *NF2* gene were discovered: 10 essential splice site, 11 frame shift, 6 stop gain, 2 nonsynonymous and 2 in-frame mutations. No other common gene mutations were found. However, several other chromosomal aberrations were discovered including 2 tumors also had loss of a ch21, 3 had loss of an X or Y chromosome, 1 lost ch15 and 1 had loss of ch18p and ch16q. All of these other major chromosomal abnormalities only occurred in tumors demonstrating a more aggressive phenotype.

Conclusions: Using high-throughput sequencing, "two-hit" alterations in the *NF2* gene were identified in all cases. Type of *NF2* gene alteration and accessory mutations outside the *NF2* locus may predict phenotypic expression.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge regarding genomic landscape of sporadic vestibular schwannoma

Learning Objective: By the conclusion of this session, participants should be able to: 1) describe patterns of the "double-hit" mechanism in the *NF2* gene for cases of sporadic vestibular schwannoma; 2) Discuss non-*NF2* gene alterations associated with more aggressive phenotype.

Desired Result: These data may be used in future studies examining genotype-phenotype correlation and, ultimately, for use in patient counseling and prediction of aggressive phenotype in order to tailor therapy.

Level of Evidence: LEVEL IV - Historical cohort or case-control studies

IRB: Approved

Immunolocalization of the Amiloride-Sensitive Epithelium Sodium Channel Beta Subunit (ENaC β) in Human Vestibular End Organs in Normative and Meniere's Disease

*Michele M. Gandolfi, MD; Gail Ishiyama, MD
Ivan A. Lopez, PhD Akira Ishiyama, MD*

Hypothesis: The Amiloride-sensitive epithelium sodium channel beta subunit (ENaC β) in the human inner ear will immunolocalize to areas within the crista ampullaris and macula utricule. Its expression will be altered in intractable Meniere's disease.

Background: ENaC is a member of the epithelial sodium channel (ENaC/Degenerin (DEG) superfamily of ion channels. ENaC subunit expression has been previously investigated in the inner ear of several rodent animal models. There are no immunolocalization studies of ENaC expression in human vestibular end organs.

Methods: Vestibular endorgans were harvested within 6 to 12 hours post mortem from individuals with no history of ear pathologies (n=5). Vestibular endorgans from patients with intractable Meniere's disease (n=3) and acoustic neuroma (n = 3) were harvested. Twenty-micron thick cryostat sections were incubated with a rabbit antiserum against the ENaC β subunit. Specimens were analyzed using fluorescent microscopy.

Results: In the crista ampullaris and macula utricule, ENaC β immunoreactivity localized in the transitional epithelial cells at the periphery of the vestibular sensory epithelia. Hair cells and supporting cells were not immunoreactive. Colocalization of ENaC β with Na⁺K⁺ATPase corroborates the localization of ENaC β in non-sensory epithelial cells. ENaC β immunoreactivity was also seen in fibroblast of the crista and utricule stroma.

Conclusions: These findings validate that animal studies of ENaC in aldosterone-modulation of vascular endothelial function are likely relevant to human inner ear physiology. The lack of alteration of expression of ENaC in intractable Meniere's disease may be significant given the lack of effectiveness of low salt diet or diuretics in these intractable cases.

Define Professional Practice Gap & Educational Need: 1. Lack of understanding of molecular and cellular biology of the human inner ear 2. Lack of understanding of the etiology of intractable Meniere's disease

Learning Objective: 1. Understanding of the molecular and cellular biology of the human inner ear 2. Understanding of the etiology of intractable Meniere's disease

Desired Result: Through increased understanding of the molecular and cellular physiology of the human inner ear comes improved clinical management and care of patients with inner ear pathologies.

Level of Evidence: LEVEL III - Cohort and case-control studies

IRB: Approved

Perceptions from Adult Individuals with Hearing Loss When Communicating in The Healthcare Setting

*Madelyn N. Stevens, BA; Judy Dubno, PhD
Margaret I. Wallhagen, PhD; Debara L. Tucci, MD*

Objective: To characterize communication difficulty and unmet needs in the healthcare setting for younger and middle-aged adults with hearing loss.

Study Design: Large-scale anonymous survey

Setting: Primary care clinic

Patients: Individuals 18-65 years of age with hearing loss, with or without amplification device(s)

Main outcome measures: Likert-type variables assessing communication difficulty in situations related to the clinic setting and communication with specific providers.

Results: 587 adults aged 18-65 with self-reported hearing loss responded to the survey. The majority reported using hearing aids (65%), followed by cochlear implants (14%), no device (11%), and both devices (10%). Respondents communicated most frequently with physicians, nurses, receptionists, and pharmacists, and over 50% of respondents reported moderate or significant communication difficulties with each provider. Three situations resulted in respondents sometimes or often having difficulty understanding spoken communications: the waiting room, when the speaker's back was turned, and when communicating by telephone. Of the over 90% of individuals who made clinic staff aware of their hearing impairment, 32% reported no additional special arrangements were made.

Conclusions: This study clearly demonstrates the ongoing difficulties faced by young and middle-aged adult patients with hearing loss as they attempt to navigate both providers and situations associated with a clinical setting. For this population in particular, providers may not expect patients to have significant hearing loss and therefore may not make additional efforts to appropriately communicate, even when made aware of the patient's hearing impairment. Provider-led changes to communication strategies for effective healthcare delivery should be encouraged and further explored.

Define Professional Practice Gap & Educational Need: 1. Lack of awareness of issue 3. Inconsistent provider response to communication difficulties

Learning Objective: Understand the communication difficulties described by patients seeking healthcare Understand potential gaps in effective clinical care as a result of miscommunication

Desired Result: Engage with patients to explore potential miscommunication and unmet needs Lead clinical team in modeling effective communication with patients

Level of Evidence: LEVEL V - Case series, studies with no controls

IRB: Approved

Flat Panel Computed Tomography in the Diagnosis of Superior Canal Dehiscence Syndrome

*Alexandra E. Tunkel; John P. Carey, MD
Monica S. Pearl, MD, DABR*

Hypothesis: Flat Panel Computed Tomography (FPCT) provides more accurate estimates of dimensions for Superior Canal Dehiscence (SCD) than multi-slice CT (MSCT).

Background: SCD syndrome occurs when a bony defect of the superior semicircular canal causes an array of vestibular and auditory symptoms. MSCT has been shown to overestimate the size of SCD. Over-diagnosis of SCD and suboptimal selection of surgical approach could occur due to these overestimates. FPCT, with higher resolution for temporal bone imaging, should have smaller error.

Methods: Radiographic and surgical findings were compared and correlated in 15 patients (age 38-62) with clinical SCDS confirmed at surgery. 20-second FPCT scans were acquired prior to surgery with parameters: 109Kv, small focus, 200° rotation angle, and 0.4°/frame angulation step. Dehiscence dimensions were measured from orthogonal multiplanar reconstructions on a high-resolution LCD monitor and compared with actual measurements recorded during microsurgery.

Results: Average±SD SCD dimensions by FPCT (x) were 2.6±1.5 mm for length and 0.64±0.26 for width. The surgical measurements (y) were 2.6±1.5 mm for length and 0.62±0.34 mm for width. Linear fits between x and y yielded R² values of 0.95 (length) and 0.71 (width). Our previous study using MSCT had R² values of 0.28 (length) and 0.48 (width). The average difference between each FPCT corresponding surgical measurement was not significantly different from zero.

Conclusion: FPCT can provide more accurate measurements of SCD compared to MSCT. Clinicians should consider using FPCT for the workup of SCDS in order to avoid errors in detecting SCD and in estimating its size.

Define Professional Practice Gap & Educational Need: Multi-slice CT is typically used in the diagnosis of Superior Canal Dehiscence (SCD) syndrome, but this technique has been shown to be imprecise in the measurement of superior canal defects.

Learning Objective: Flat Panel CT (FPCT) provides higher resolution images of the superior canal with less radiation exposure. The learning objective of this study is to show that FPCT is a better technique for imaging SCD.

Desired Result: The desired result is increased use of FPCT for SCD imaging, providing more accurate SCD diagnosis and surgical treatment planning.

Level of Evidence: LEVEL IV - Historical cohort or case-control studies

IRB: Approved