UNCLASSIFIED

News You Should Know About Hearing Health: Overview of New 3-D Ear Model, Management Techniques for Hearing Loss, & More

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Disclosure

- Dr. Schulz and Dr. Esquivel have no relevant financial or non-financial relationships to disclose relating to the content of this activity.
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Learning Objectives

At the end of this presentation, participants will be able to:

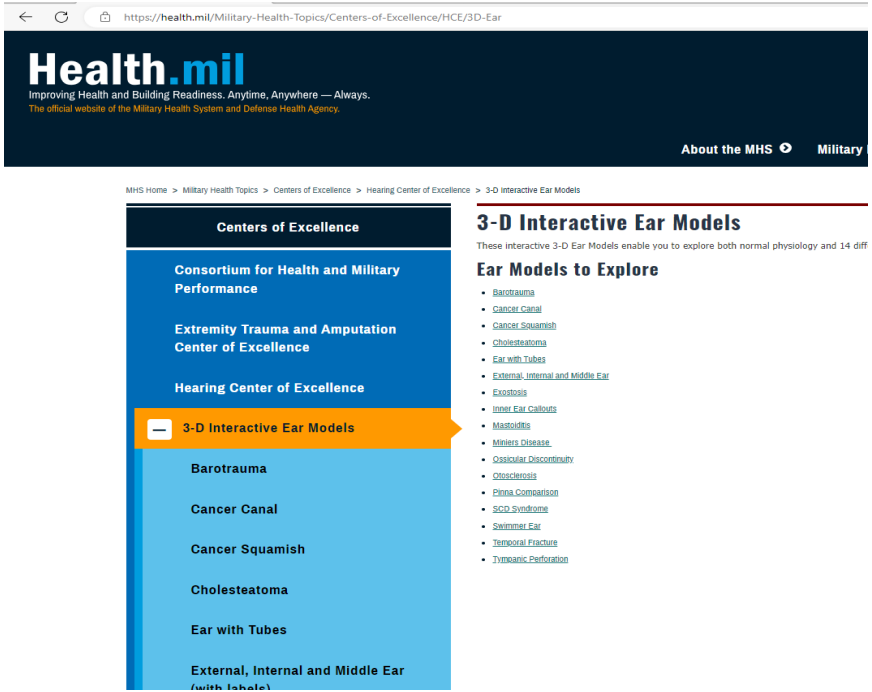
1. Apply use of 3-D ear models to improve patient care.
2. Describe implications of the Hearing Center of Excellence's clinical study.
3. Define Sudden Sensorineural Hearing loss (SSNHL).
4. Recognize clinical presentation of SSNHL.
5. Execute appropriate treatment and referral for SSNHL.
6. Summarize clinical presentation of acute noise induced hearing loss (aNIHL).
7. Describe treatment recommendations for aNIHL.

Headlines

- Management of SSNHL
- New tools for exploration of ear anatomy and pathologies
- New requirement to fit test hearing protectors

https://news.iu.edu/live/news/26324-free-access-to-the-new-york-times-now-available-at

3-D Ear Model



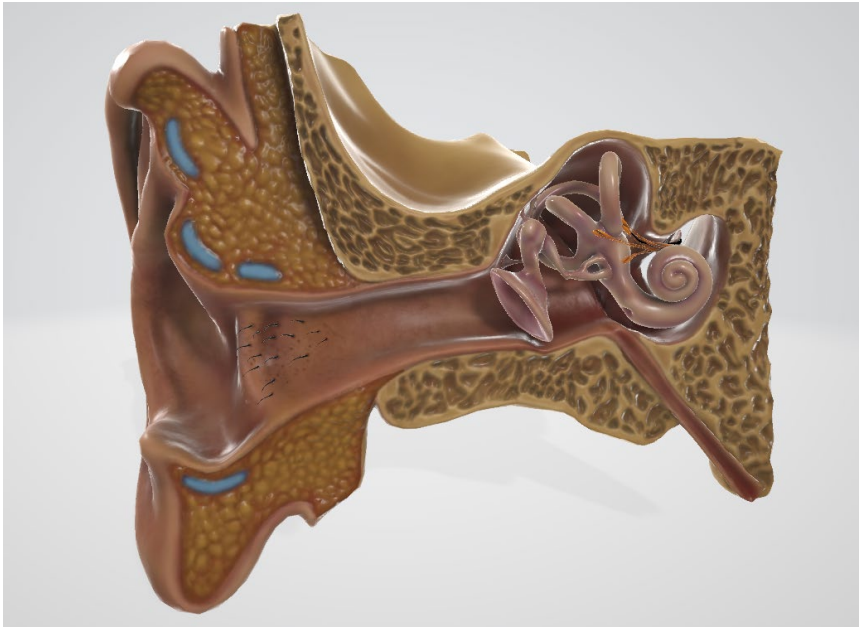
- [3-D Interactive Ear Models | Health.mil]
- 17 3-D files
  - ✓ Two normal anatomy (labeled/unlabeled)
  - ✓Fourteen pathologies
  - ✓ Inner ear anatomy
  - ✓ Pinna pull (opening the ear canal)

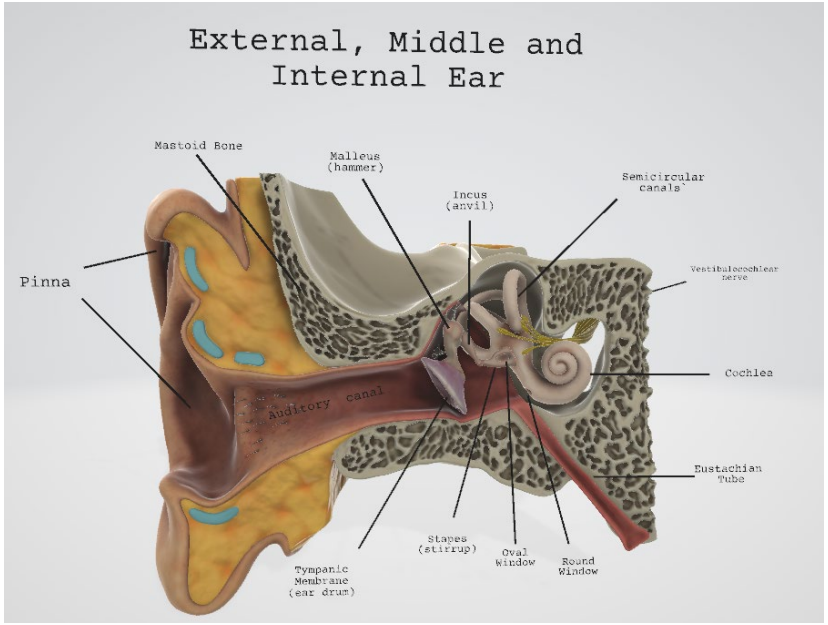
https://health.mil/Military-Health-Topics/Centers-of-Excellence/HCE/3D-Ear

Ear Models to Explore

- Barotrauma
- Cancer Canal
- Cancer Squamous cell
- Cholesteatoma
- Ear with Tubes
- External, Internal and Middle Ear
  - Labeled
  - Unlabeled
- Exostosis
- Inner Ear Callouts
- Mastoiditis
- Meniere's Disease
- Ossicular Discontinuity
- Otosclerosis
- Pinna Comparison
- Superior Canal Dehiscence Syndrome
- Swimmer's Ear
- Temporal Fracture
- Tympanic Perforation

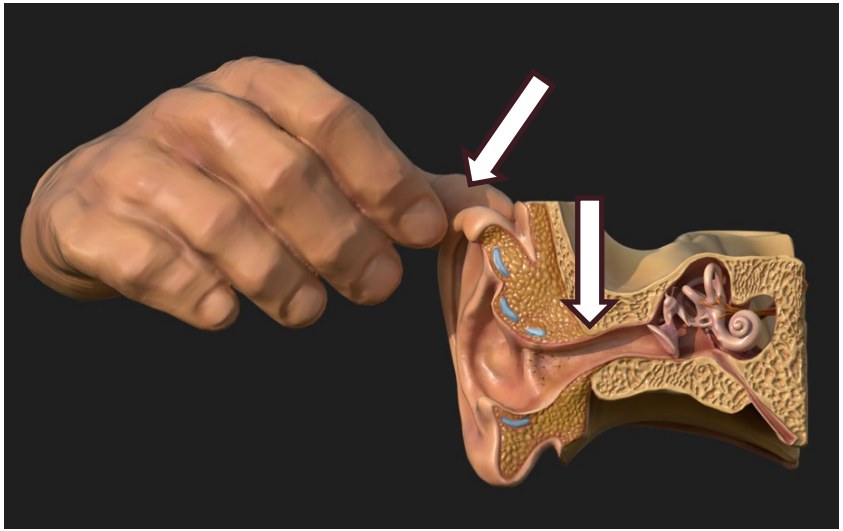
Ear Cross Section Models

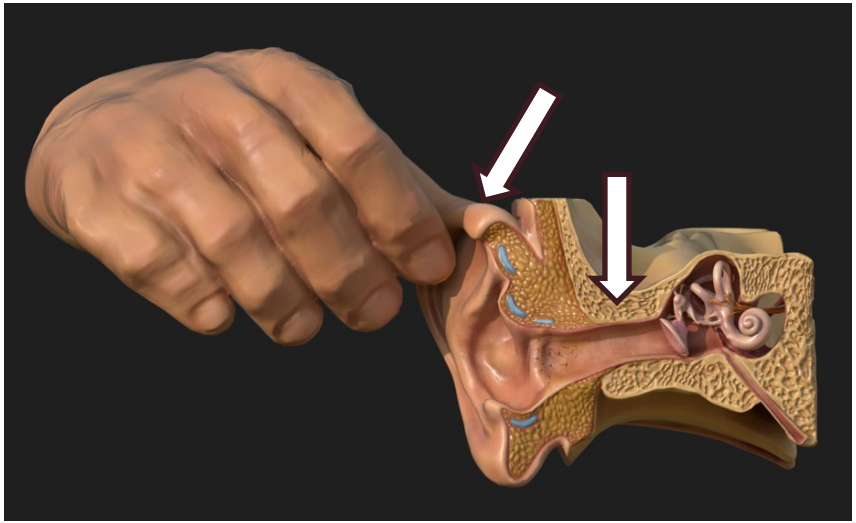




https://health.mil/Military-Health-Topics/Centers-of-Excellence/HCE/3D-Ear/Entire-Ear

Pinna Pull to Open Ear Canal to insert Hearing Protection Device (HPD)





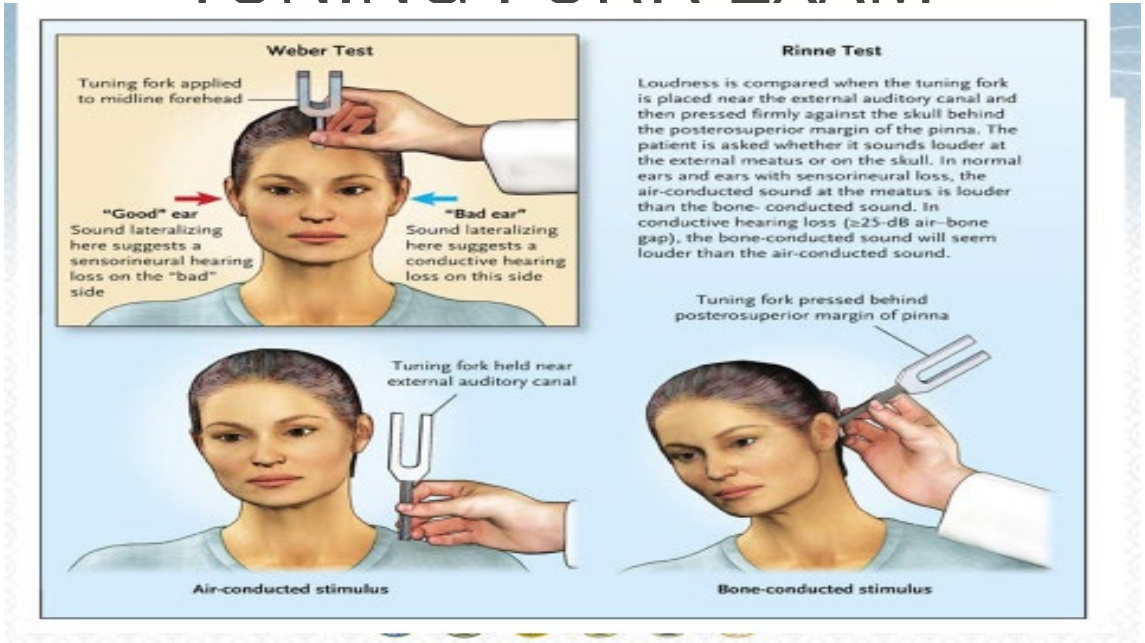
https://health.mil/Military-Health-Topics/Centers-of-Excellence/HCE/3D-Ear

Use Stories

- Patient education
- Resident education
- Technician education
- Sharing with family members

Results Physical Exam

TUNING FORK EXAM



(Stachler et al., 2012)

Sudden Sensorineural Hearing Loss

- SSNHL is defined as sudden hearing loss with no identifiable cause despite adequate investigation.
- American Academy of Otolaryngology – Head and Neck Surgery (AAO-HNS) Clinical Practice Guidelines (CPG)- 30 dB or greater SNHL over at least three consecutive frequencies
- Hearing loss is related to the opposite ear's thresholds or previous audiogram, if available.
- Rapid onset over a 72-hour period.
- Difficult for health care providers to diagnose and treat.

Sudden Sensorineural Hearing Loss Epidemiology

- Incidence 5-20 per 100,000
- 4,000 cases per year in the U.S.
- Highest among 50–60-year-olds
- Male=Female
- 2% Bilateral
- 90%+ are idiopathic

Sudden Sensorineural Hearing Loss Causes

- Viral infections
- Autoimmune
- Vascular compromise

SSNHL History and Physical

- SSNHL is considered to be a true otologic emergency, given the observation that there is less recovery of hearing when there is delay in treatment
- The primary goal is to rule out any treatable causes
- The otologic exam is NORMAL

Clinical Presentation of SSNHL

- Tinnitus occurs in 80%
- Vertigo, associated peripheral vestibular dysfunction in 30%
- About one third noticed hearing loss upon first awakening
- 80% report a feeling of ear **FULLNESS**

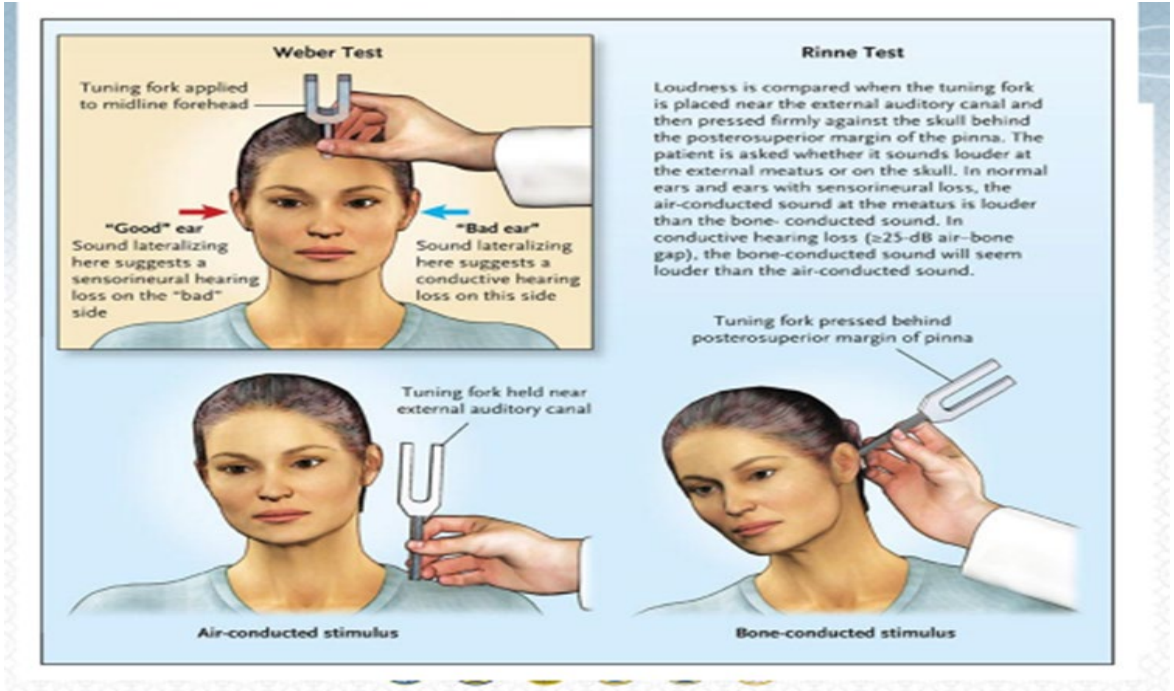
SSNHL History and Physical

- Time course i.e. – When did this start? Days or months?
- Associated Symptoms:
  - Vertigo/dizziness
  - Aural fullness (cerumen)/Eustachian Tube Dysfunction (ETD)
  - Tinnitus
- Ototoxic drug use
- Symptoms of a viral infection
- History of – trauma, noise exposure, straining, sneezing, head trauma
- Ask about recent air travel or water sports

SSNHL History and Physical

(Stachler et al., 2012)

SSNHL History and Physical



(Stachler et al., 2012)

Physical Exam

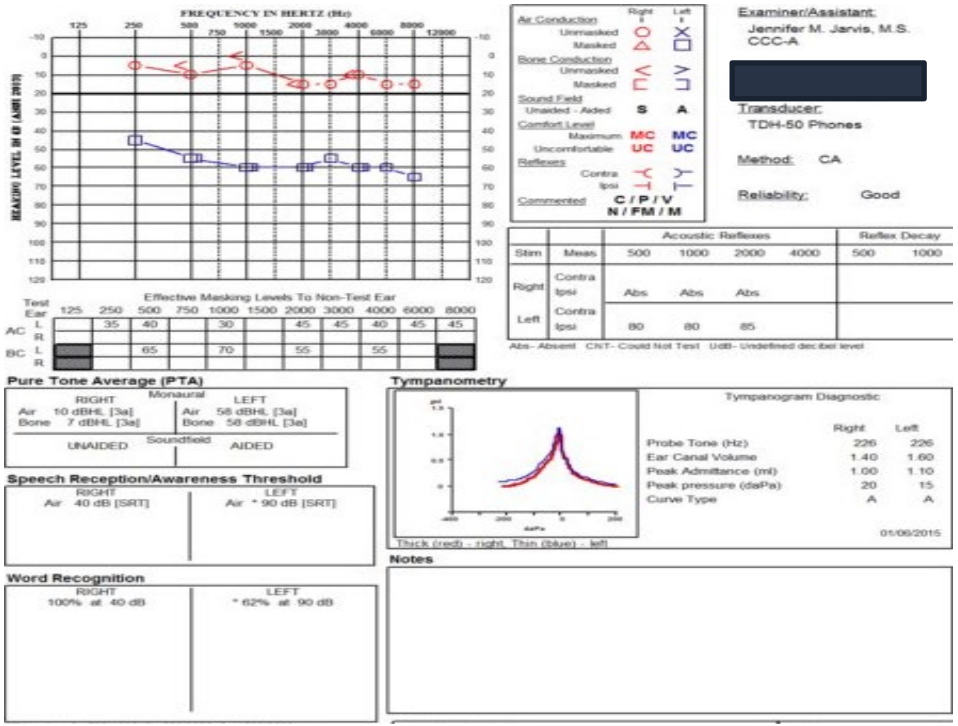
Weber

- Vibrating tuning midline
- Ask where the sound is heard, normal
- If lateralized to one: conductive hearing loss (CHL) to that ear of SNHL in the opposite

Rinne

- Vibrating tuning fork to mastoid area, move to the area of external auditory canal (EAC)
- Sound should be heard better at the EAC
- If sound is heard better at mastoid area = CHL

Audiometric Test



(Hughes et al., 2018)

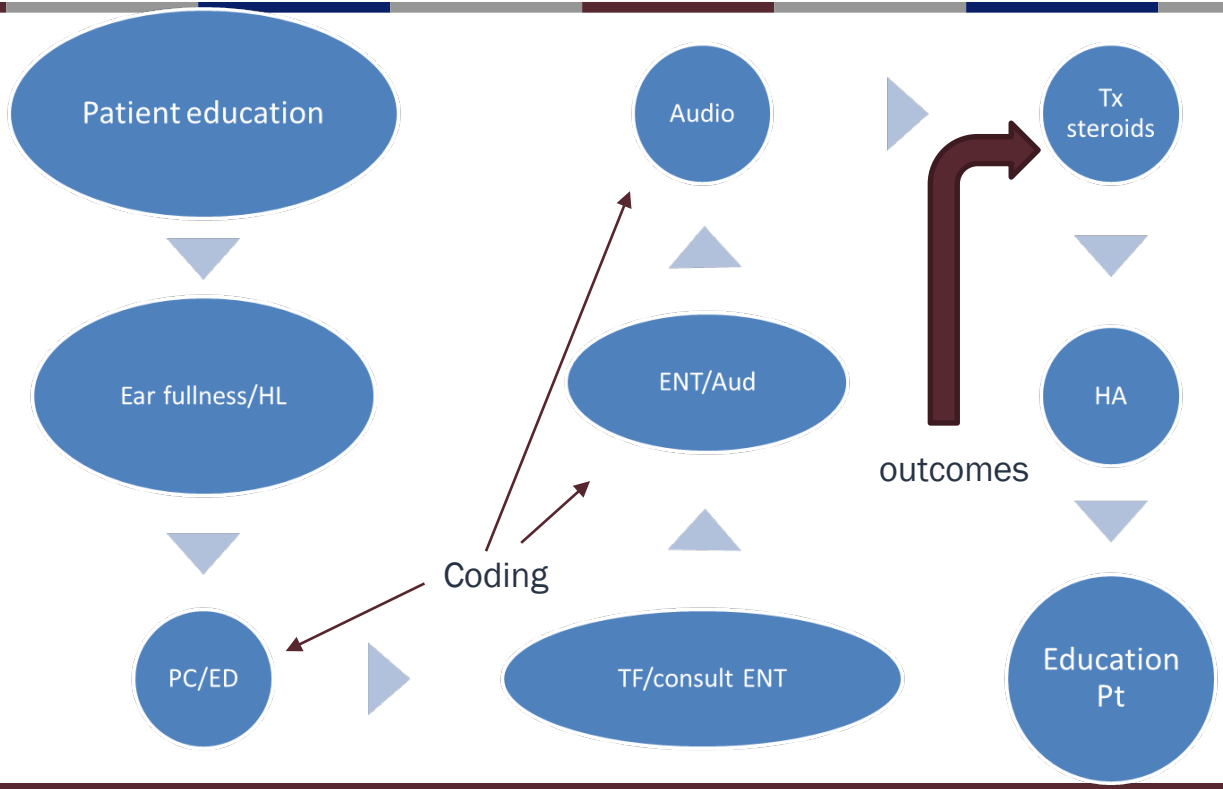
AAO-HNS Guideline Summary Statements

- Diagnosis
  - Exclusion of CHL
  - Computerized Tomography (CT): Strong recommendation against
  - Audiometric testing
  - Laboratory testing: Strong recommendation against
  - Magnetic resonance imaging (MRI) to rule out Pathology.
  - Shared decision making, patient education.
- Treatment
  - Oral Corticosteroids: Option
  - Hyperbaric oxygen (HBO) therapy: Option
  - Other Pharmacologic therapy: strong recommendation against
  - Outcomes assessment. Recommendation
  - Rehabilitation: Strong Recommendation

HCE SSNHL Study

- Evaluated the percentage of patients with SSNHL treated according to the AAO-HNS CPG.
- Assessed cost of testing methods, unnecessary appointments, referrals and NOT recommended treatments/incorrect dosage of treatments.
- Evaluated provider education to their patients, follow-up and number of patients that received amplification devices.
- Compared the percentage of patients with diagnosis of SSNHL to CPG definition.
- Compared how many patients got educated on their diagnosis.
- Compared how many patients received amplification devices.

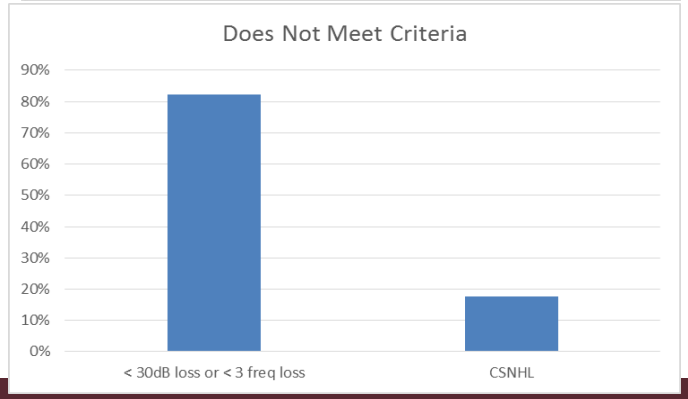
Care Path SSNHL



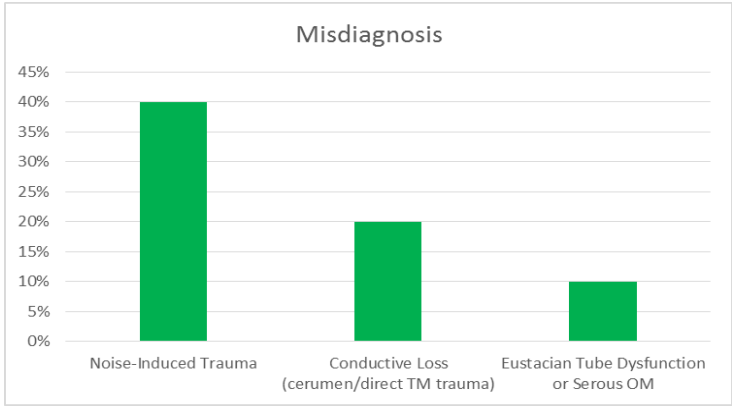
Methodology

- Retrospective chart review
- Patients diagnosed with ICD-9 code 388.2 (SSNHL) from June 2013 to September 2015 were included in the analysis
- Data extracted from eligible Armed Forces Health Longitudinal Technology Application (AHLTA) records
- Data collected includes diagnosis, hearing loss, treatment and follow-up of SSNHL patients

HCE SSNHL

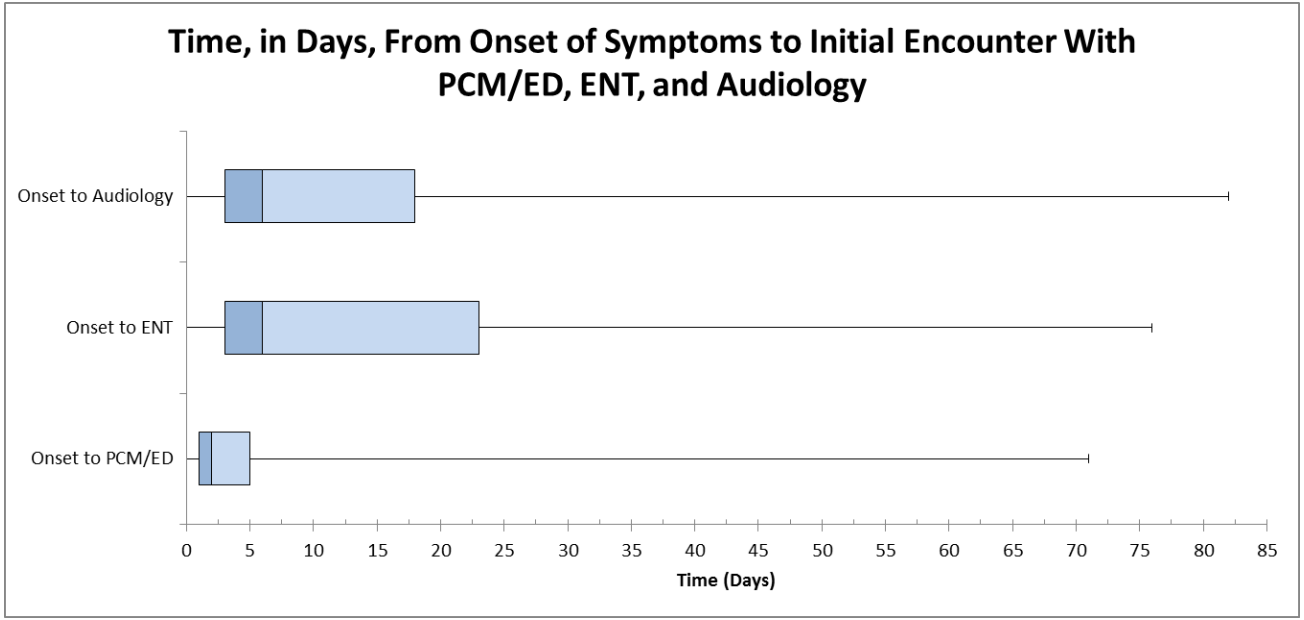


- 327 total subjects screened
- 166 subjects excluded



(Hughes et al., 2018)

Results



(Hughes et al., 2018)

Guidance for Primary Care

- SSNL Standard Procedures for the Military Health System (MHS)
  - Guidance for Primary Care (Recommendations from the HCE)

https://hearing.health.mil/

Gaps in Care

Specialties	GAP
Primary Care (PC), Emergency Department (ED)	Recognition of SSNHL and Referral Criteria
All Specialties	Documentation, Diagnosis Code, and Procedural coding
Ear, nose, throat (ENT)	Standardized steroid dosage- oral and intratympanic (IT)
Audiology (AUD)	Standardized documentation of word list

Preliminary Results - Treatment

TREATMENT	SUBJECTS
HBO	2
ORAL STEROIDS	109
IT STEROIDS	53
Medication	70

Primary Care Clinical Presentation

Patients present with a full or blocked ear after awakening. Tinnitus may occur as well as vertigo. They describe symptoms such as: “It feels like I have water in my ear” or “I can’t clear my ear”.

- Patients may not be able to lateralize the ear affected by hearing loss at first presentation. Precise questioning of the patient hearing status is warranted.
- You may ask “Has your hearing changed?” or “Can you use your mobile device/phone on the symptomatic ear?”.

(Hughes et al., 2018)

Primary Care Presentation

- It is important to ask if patients have experienced recent trauma, external ear and canal pain, drainage, fever, or other systemic symptoms. Patients with SSNHL do not present with the above symptoms.
- Clinical exam is normal with no obvious explanation to the ear fullness or hearing loss (for example: cerumen impaction, otitis externa, otitis media, tympanic membrane perforation, etc.).
- It is recommended that a Weber or Rinne test be performed with a 512-Hz/256-Hz tuning fork. In lieu of a tuning fork, clinicians may also ask the patient to hum, which will be heard in the better hearing ear, opposite of the symptomatic ear.

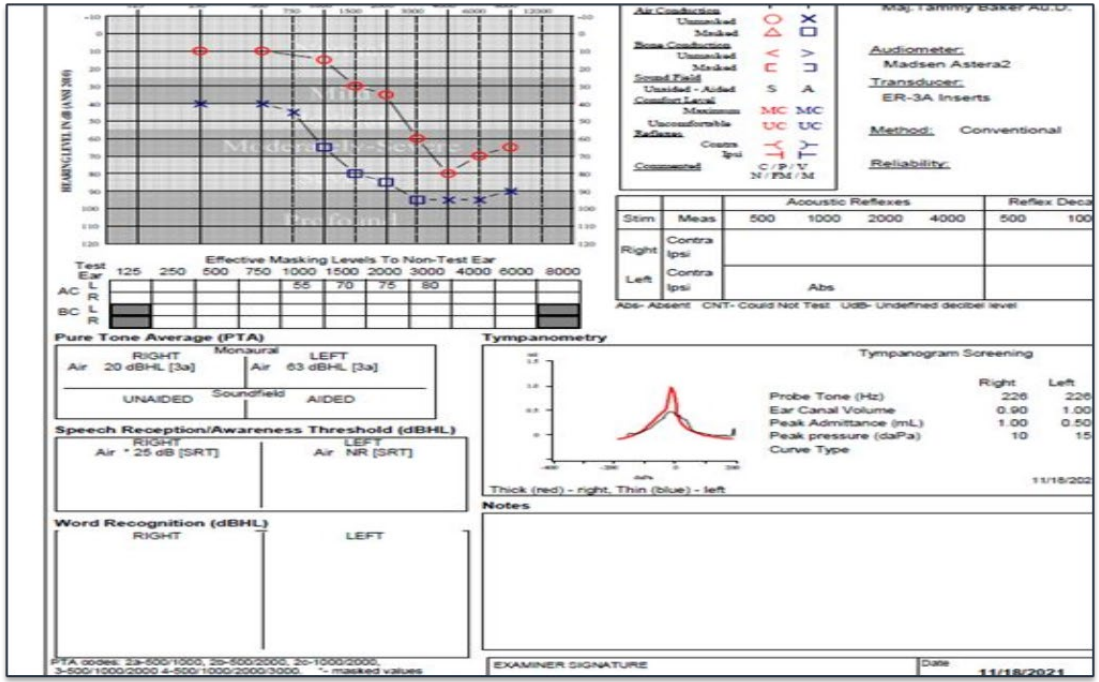
Clinical Care

- Patients should be referred to ENT/Audiology on same day/within 72 hours
- If Audiology is available should be seen first
- If warranted start oral prednisone at 60mg qd for 7-10 days with a taper
- Every effort should be made to consult ENT/Audiology within 72 hours of starting medications
- Imaging studies or labs are not warranted at this stage of evaluation
- Primary care should use the code H91.90- Unspecified hearing loss
- If Audiometric studies confirm SSNHL code H91.20 Sudden hearing loss

Impact of Noise in the Military

- Acute Noise-Induced Hearing Loss (aNIHL)

Sudden Hearing Loss



(Sheffield et al., 2017)

DODI 6055.12 Hearing Conservation Program (HCP)

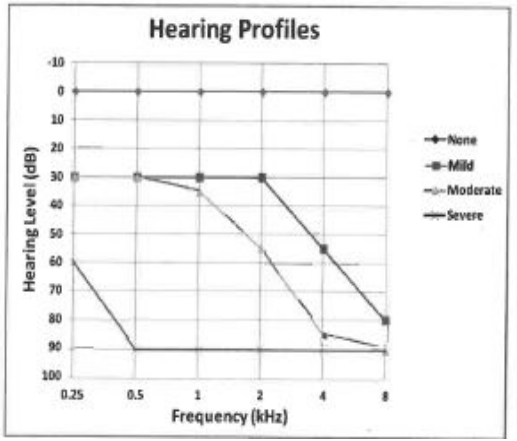
- Program implementation guidelines
- Noise measurement and analysis
- Noise abatement
- Personal hearing protectors
- Education
- Audiometric testing
- Access to information, training material, and records
- Recordkeeping

Operational Hearing

- Soldiers with hearing loss, Hearing Protection Device (HPD), able to detect combat related sounds. (Price & Hodge, 1976)
- M1A1 Tank Simulator- combat effectiveness was significantly degraded when individuals were hearing impaired. (Peters & Garinther, 1990)
- Cadets combat performance was evaluated when hearing was manipulated with HPD. (Casali et al., 2009)
- Combat related outcomes in relation to survivability, lethality or outcome of simulated combat understanding.

Operational Hearing

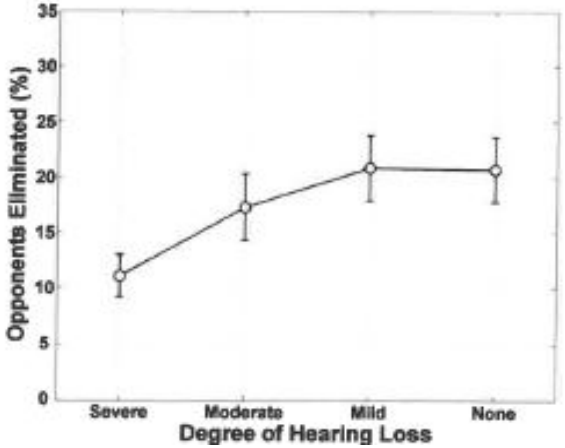
- Sheffield et al. (2017) studied the impact of hearing loss on performance in a more realistic environment
- 43 participants at two locations (USMA and Ft. Detrick) used a hearing loss simulator during a paint ball combat simulation
- Last man standing scenario -40 rounds of 4X4
- Measured where opponents eliminated, wins, and order of elimination

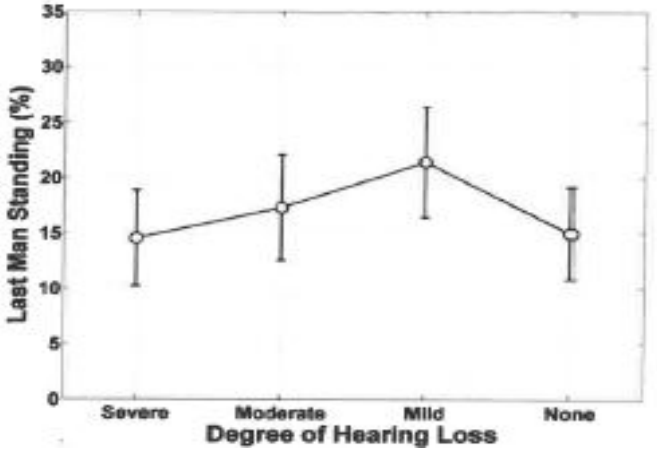


(Sheffield et al., 2017)

Operational Hearing

- Significant decrease in situational awareness and impact on lethality
- No impact on survivability or being the last person standing





(Sheffield et. al., 2017)

Introduction

- Service members suffer a significant loss of hearing from acute and/or chronic noise exposure.
- Audiometric testing may reveal a standard threshold shift (STS).
- The Occupational Safety and Health Administration (OSHA) defines STS an average 10 (10dB) at 2,3,4 k. OSHA ensures the safe and healthful working conditions for workers by setting and enforcing standards and by providing training, outreach, education and assistance.
- Permanent threshold shift (PTS) may result.
- There may be potential to prevent PTS with treatment?

Acute Noise-Induced Hearing Loss

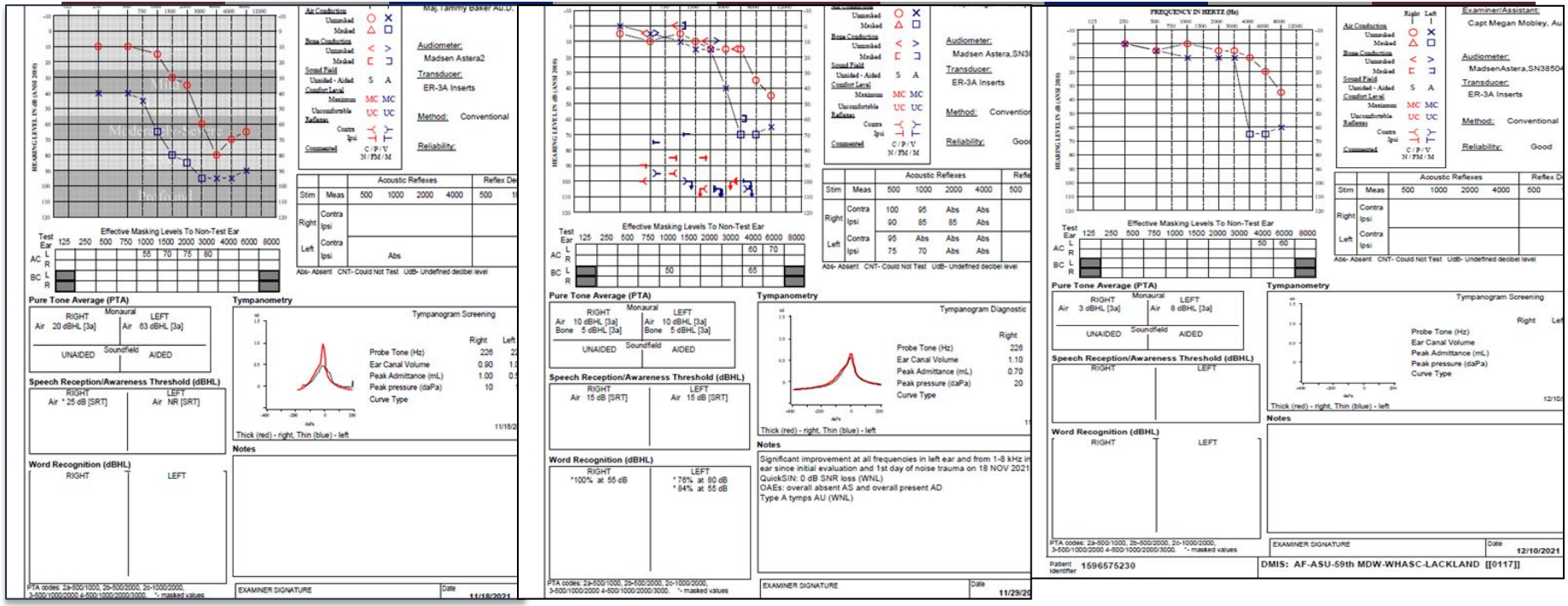
aNIHL is defined as injury to the inner ear caused by impulse noise (140dB or greater), rising sharp peak, rapidly fading, and with short duration.

- Symptoms of hearing loss, tinnitus, and ear fullness can result.
- Hearing loss is typically 3k-6k frequency.

Research Study Purpose:

- A retrospective analysis of audiometric thresholds within the MHS to include coding and treatment practices of clinical providers after aNIHL diagnosis.

Acute Hearing Loss



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Clinical Presentation of aNIHL

- Tinnitus
- Patients report a feeling of ear **FULLNESS**
- **May take several days before report of hearing loss**
- **Exam is normal**

Acute Noise-Induced Hearing Loss

- ICD-9 code – 388.10
- ICD-10 code - S09.311A
- ICD-10 code -- H83.3x9– noise effects on inner ear, acoustic –trauma of inner code, noise-induced hearing loss of inner ear
- H83.3x1 right ear
- H83.3x2 left ear
- H83.3x3 bilateral ears
- H83.3x9 unspecified ear

Acute Noise-Induced Hearing Loss

Target Patient: (aNIHL cohort is extracted based on the criteria below)

- Age: 18-64
- Active Duty, National Guard/Reserve, Inactive National Guard/Reserve
- ICD-9-CM: 388.10, 388.12
- ICD-10- CM: H83.3X1, H83.3X2, H83.3X3, H83.3X9, S09.311A, S09.311, S09.312A, S09.312, S09.313A, S09.313, S09.319A, S09.319
- Date range: Jan 1, 2012 to Dec 31, 2018 with one year lookback period
- Treated at DOD Military Treatment Facility
- Audiogram available at time of injury

Acute Noise-Induced Hearing Loss

CATEGORY	NUMBER	PERCENTAGE
Laterality		
Right Ear	43	22.05%
Both Ear	46	23.59%
Left Ear	106	54.36%
Munition	170	87.18%
Other Noise	16	8.21%

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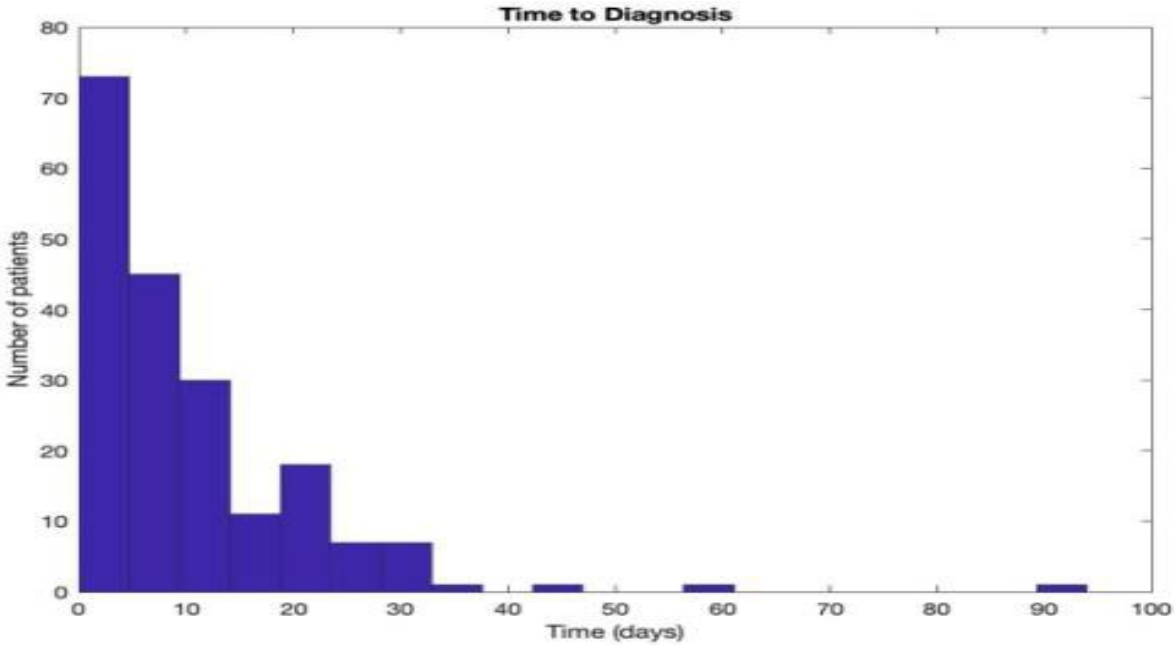
Acute Noise-Induced Hearing Loss



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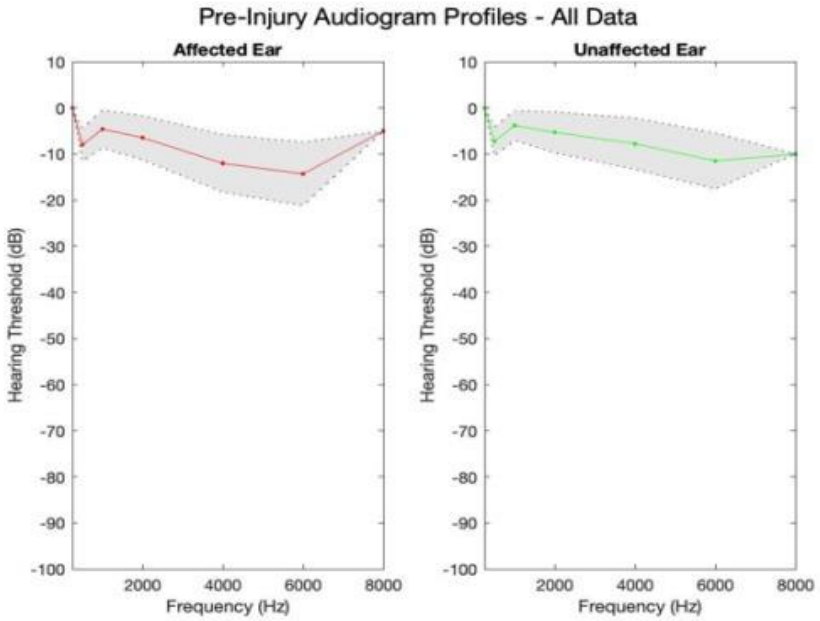

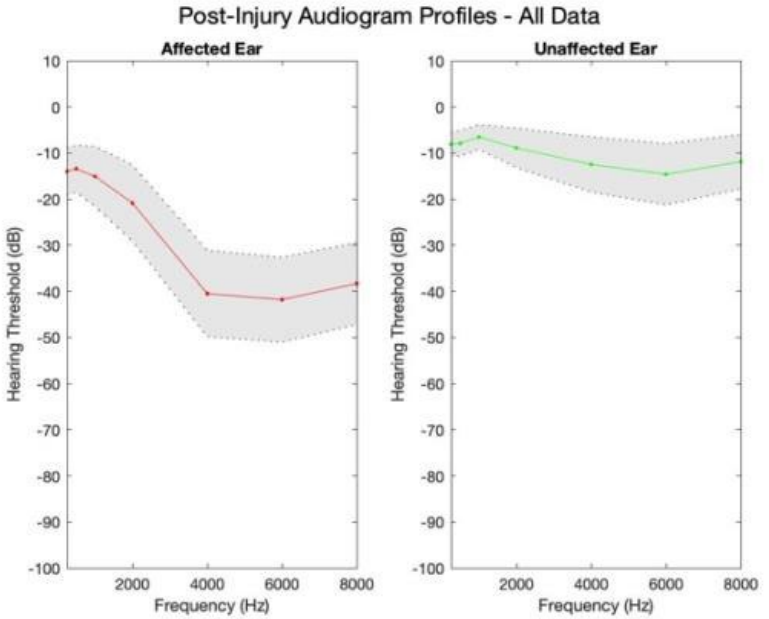

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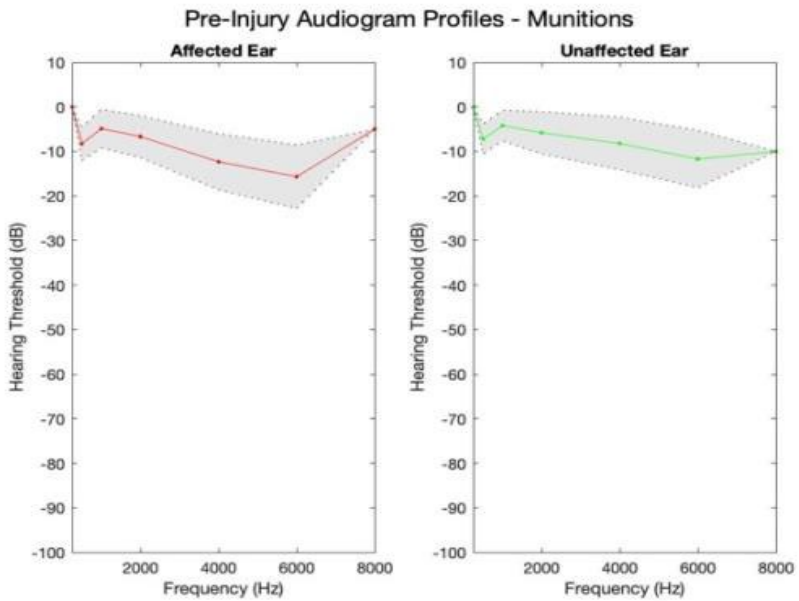
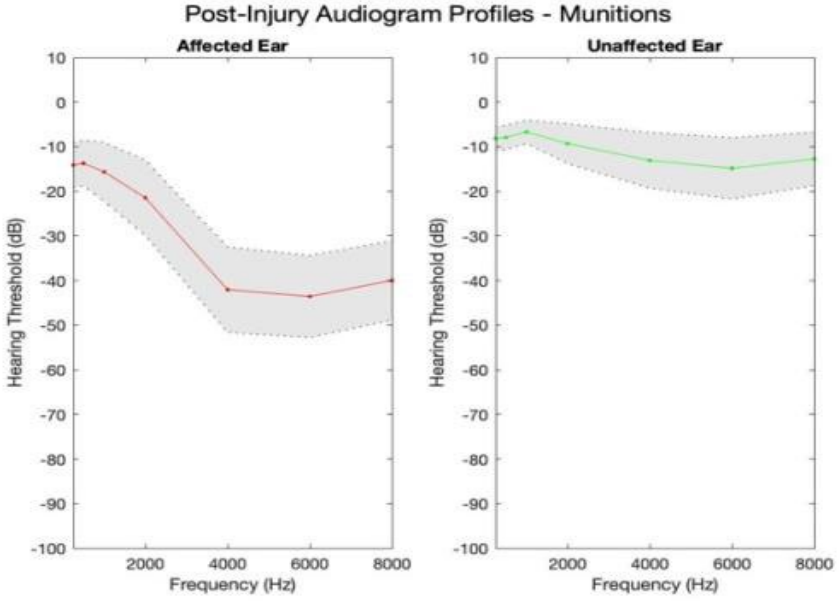
Acute Noise-Induced Hearing Loss





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Treatment Outcomes

All Data	500 Hertz (Hz)	1K Hz	2K Hz	4K Hz	6K Hz	Pure Tone Average (PTA)	P (Significance between 2 groups)
Steroid	5.6(4.1)	8.5(5.7)	10.2(6.6)	12.2(6)	13.1(6.4)	9.1(1.4)	<.0.01
No Steroid	1.0(2.7)	1.7(2.6)	2.6(3.4)	5.5(4.1)	3.5(4.1)	2.7(1.0)	

- Mean and standard error decibel (dB)
- Wilcoxon singed rank test
- Early treatment within 14 days of injury

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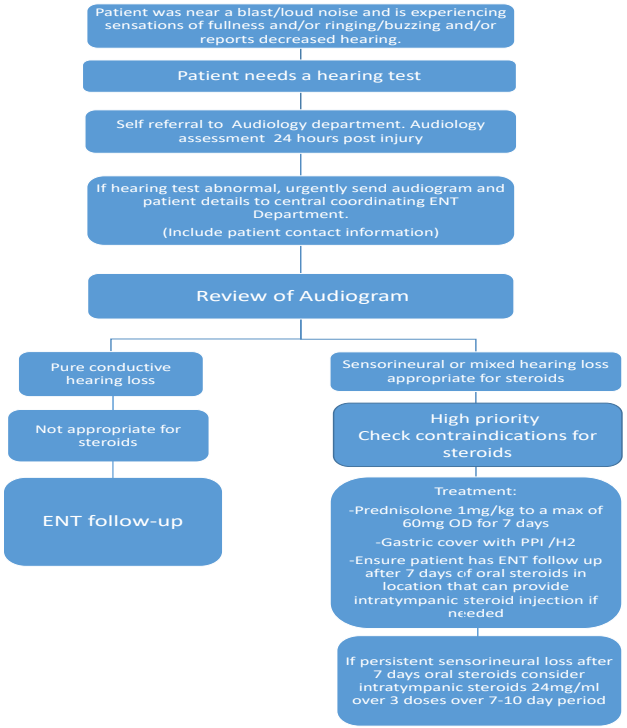
Acoustic Trauma Protocol



Knowledge Translation

- The HCE will conduct knowledge translation activities aimed at educating DOD providers on the accurate use of the aNIHL code and implementation of best practices related to aNIHL treatment, to include use of recommended outcomes measures.
- These activities will focus on implementation of the recommended practices in the DOD primary care, audiology, otolaryngology, and hearing conservation communities.

CPG Implementation and Adoption

- Identify the target audience
- Define the primary public health message succinctly and in lay terms
- Identify changes in practice or health outcomes the guideline might produce
- Identify barriers to implementation
- Identify gaps in care
- Create and execute a strategy to raise awareness and/or train providers
- Create and execute metrics for adoption

Key Takeaways

- 3-D ear models can be used to communicate with patients and educate providers.
- Sudden Sensorineural Hearing Loss (SSNHL) considered to be a true otologic emergency, given the observation that there is less recovery of hearing when there is delay in treatment.
- Acute Noise-Induced Hearing Loss (aNIHL) is defined as injury to the inner ear caused by impulse noise (140dB or greater), rising sharp peak, rapidly fading, and with short duration where symptoms of hearing loss, tinnitus, and ear fullness can result.

Questions?

Questions?

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