Innovations to Test and Protect Hearing
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“Medically Ready Force...Ready Medical Force”
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Stephanie Karch, Ph.D., Au.D. is a research audiologist at the Naval Submarine Medical Research Laboratory (NSMRL) and works as a principal investigator on the Regional Hearing Conservation Program of Record. In this role, she investigates the prevention of auditory injury (e.g., hearing loss, tinnitus) among service members. Specifically, she studies the effect of training and verification of hearing protection in the field, clinic, and laboratory; and the effect of hearing protection on auditory function (e.g., situational awareness, speech intelligibility, and localization).

A graduate in audiology from Gallaudet University, Dr. Karch has over seven years of doctoral level experience in military medical research, having served in Navy and Army medical research laboratories. Previous to her work at NSMRL, she characterized the vestibular function of military aviators, and investigated the comorbidity of auditory injuries and mild traumatic brain injuries. Dr. Karch also holds the American Speech Language Hearing Association’s Certificate of Clinical Competence in Audiology (C.C.C.-A.).
Devon Kulinski, Au.D. has supported Department of Defense (DoD) auditory research for the last seven years as a post-graduate research assistant at the Naval Submarine Medical Research Laboratory (NSMRL) and as a doctoral student at National Center for Rehabilitative Auditory Research (NCRAR). He is currently providing contract support as a research audiologist affiliated with Walter Reed National Military Medical Center (WRNMMC). His primary areas of support include the development of tablet-based fit-test systems for hearing protection devices, assessment of military hearing health education programs, and the measurement of acute auditory effects of blast exposure on active duty military personnel.
Disclosures

- Dr. Kulinski has no relevant financial or non-financial relationships to disclose relating to the content of this activity.
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Disclosures

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- This work presents results from numerous studies.
  - The study protocol NSMRL.2018.0004 was approved by the Naval Submarine Medical Research Laboratory Institutional Review Board in compliance with all applicable federal regulations governing the protection of human subjects.
  - All other reported study protocols were reviewed by the Naval Submarine Medical Research Laboratory Institutional Review Board in compliance with all applicable Federal regulations governing the protection of human subjects and was determined to not be human subject research.
- This work described herein is/was supported by the U.S. Navy Bureau of Medicine and Surgery funding work unit F1016.
- Approved for public release: distribution unlimited.
Innovations to Test and Protect Hearing: Hearing Protection Device Fit-Testing

Stephanie J. Karch, Au.D., Ph.D., C.C.C.-A.
Learning Objectives

At the conclusion of this activity, participants will be able to:

1. Define Hearing Protection Device (HPD) fit-testing.
2. Describe the different HPD fit-test methods, along with the pros/cons of each.
3. Explain the effect of the total number of frequencies used has on the time and accuracy of test results.
4. Discuss the utility of boothless audiometry in a hearing conservation clinic.
5. Identify how boothless audiometry can increase readiness and reduce referrals.
The Naval Submarine Medical Research Laboratory Team

- Dr. Jeremy Federman
  - Principal Investigator
- Mr. Derek Schwaller
  - Research Engineer
- Mr. Joshua Ginsberg
  - Research Associate
- Ms. Iram Qureshi
  - Biostatistican
Hearing Protection Device (HPD) Fit-testing, Defined

- HPD Fit-testing measures the individual attenuation achieved while wearing a given earplug or earmuff.
- The fit-test system calculates the personal attenuation rating (PAR), an individualized value of the total amount of attenuation achieved.
- Typically this is accomplished by taking two measures:
  - With the HPD donned (i.e., occluded)
  - Without the HPD donned or doffed (i.e., unoccluded)
- PARs are not static!
  - They can vary over time (including the same day) with different types of HPDs, and after training

Like photographs, PARs capture a moment in time.
But why?

- HP Checks can be used to:
  - Train the user
  - Train the trainer
  - Validate HPD fit
  - Document achievable attenuation with issued HPDs
  - Aid in the selection of appropriate and adequate HPDs
  - Identify persons who require an alternate size or design
Commercial off the shelf HPD fit-test systems will use one of three test methods:

- **Real Ear Attenuation at Threshold (REAT) – like**
  - Békésy tracking method
  - Earplugs only

- **Alternating Binaural Loudness Balance (ABLB)**
  - Don one earplug at a time, adjust the loudness until noise is perceived to be the same across ears
  - Earplugs only

- **Microphone-in-Real-Ear (MIRE)**
  - Earplugs or Earmuffs
  - Uses surrogate earplugs and probe microphones
One, Three, or More: The Effect of Total Number of Tested Frequencies (freq) on PAR¹

<table>
<thead>
<tr>
<th></th>
<th>0.25</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>8</th>
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<tbody>
<tr>
<td>1-freq</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>3-freq</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-freq</td>
<td>X X</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-freq</td>
<td>X X</td>
<td>X X</td>
<td>X X</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Frequencies are displayed in kilohertz (kHz).

Test Group

Mean PAR (dB)

1-freq | 21.2
3-freq | 28.5
5-freq | 28.0
7-freq | 26.8

* p < 0.03

1-freq 3-freq 5-freq 7-freq

80 80 80 80
Pass rate refers to the total number of individuals who achieved the minimum target PAR.

In this data set, the minimum target PAR was 25 dB attenuation.
One, Three, or More: The Effect of Total Number of Tested Freq on time

<table>
<thead>
<tr>
<th>Test Group</th>
<th>Mean Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-freq</td>
<td>4.1</td>
</tr>
<tr>
<td>3-freq</td>
<td>5.5</td>
</tr>
<tr>
<td>5-freq</td>
<td>7.4</td>
</tr>
<tr>
<td>7-freq</td>
<td>9.2</td>
</tr>
</tbody>
</table>

* p < 0.01
One Ear or Two... what to do?

- Varies by test system and intent of the tester (e.g., clinician/safety officer, industrial hygienist)

- The gold standard method to test HPD attenuation (i.e., REAT testing) is to test both ears simultaneously.

- Why consider single ear testing?
  - Calculated PAR for the right and left ears independently
  - Identify which ear(s) requires an alternate size earplug or HPD design
  - Asymmetric hearing thresholds at one or more test frequencies

- Single ear testing will take longer than testing both ears simultaneously.
Does the test system influence the PAR?²

While statistically different, the mean PAR across test methods is approx. 3 dB, and therefore not clinically/operationally significant.

Note.

- **REAT**: Real Ear Attenuation at Threshold
- **FCS**: FitCheck Solo™
- **CCF-200**: Computer Controlled Fit-tester
- **PT**: pure tone
- **NBN**: narrow band noise

 Mean PAR (dB)  

<table>
<thead>
<tr>
<th>HPD Fit-Test System</th>
<th>REAT</th>
<th>FCS</th>
<th>CCF-200 PT</th>
<th>CCF-200 NBN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28.2</td>
<td>30.7</td>
<td>30.3</td>
<td>31.3</td>
</tr>
</tbody>
</table>

* p < 0.0001
Experiential HPD (eHPD) Fit-Training Method (n = 151). ³

Note: The HPD tested is a cylindrical foam earplug with a NRR of 29 dB.
Note: The HPD tested is a tapered foam earplug with a NRR of 33 dB.
Calculating Effective Exposure: De-rating vs. PAR

<table>
<thead>
<tr>
<th>HPD (NRR)</th>
<th>De-rating 50%(^5)</th>
<th>Pre-Training PAR of 16.0</th>
<th>Post-eHPD Fit-Training PAR of 29.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foam Earplug (33 dB)</td>
<td>87.6</td>
<td>84.6</td>
<td>71.0</td>
</tr>
<tr>
<td>Foam Earplug (33 dB) + Earmuff (30 dB)</td>
<td>73.3</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Note. The 8-hr TWA is 100.6 dBA.

To calculate the effective exposure, the following formulas were used:

- Single HPD:
  - De-rating = TWA dBA – [(NRR – 7) * 0.5];
  - PAR = TWA dBA – PAR

- Double HPD:
  - De-rating = TWA dBA – [((NRR – 7) + 5) * 0.5]

Verifying earplug fit via HPD fit-testing results in the identification that the earplug alone provides sufficient protection for the employee’s work environment.
Innovations to Test and Protect Hearing: Using Boothless Audiometry in the Clinic (and out) to Enhance Hearing Readiness

Devon Kulinski, Au.D.
Learning Objectives

At the conclusion of this activity, participants will be able to:

1. Describe the utility of boothless audiometry in a hearing conservation clinic

2. Discuss how boothless audiometry can increase readiness

3. Explain how boothless audiometry can reduce referrals
Hearing Conservation Programs (HCPs)

“Policy is written in order to protect all military personnel and noise-exposed civilian personnel from hearing loss resulting from hazardous occupational and operational noise.”

HCP Procedures
- Noise measurement and analysis
- Noise abatement
- Personal hearing protectors
- Hearing Health Education
- Audiometric monitoring
  - Reference and annual testing
  - Defense Occupational and Environmental Health Readiness System – Hearing Conservation (DOEHRS-HC)
- Others: Written plan, implementation, recordkeeping, program evaluation
Defense Occupational and Environmental Health Readiness System – Hearing Conservation (DOEHRS-HC)

- All SMs enrolled in Hearing Conservation Program require annual hearing tests
- DOEHRS-HC: Collects, maintains, compares and reports hearing conservation, hearing readiness and deployment data for Department of Defense personnel
- Typically performed in multi-person booths (up to 8 SMs) with automated test

COVID-19 had a significant impact on the ability for hearing conservation clinics to maintain hearing readiness
- Army Hearing Program (AHP) best practice guidelines (TA 538-0520) to reduce community transmission
- Resulting in significant backlog of personnel needing annual hearing exam
<table>
<thead>
<tr>
<th>Hearing Readiness Classification</th>
<th>Information Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing Readiness Class 1</td>
<td>Soldier's unaided hearing is within H-1 standards for both ears (IAW AR 40-501). Annual audiogram (DD Form 2216 or DD Form 2215) within 12 months.</td>
</tr>
<tr>
<td>Hearing Readiness Class 2</td>
<td>Soldier has DD Form 2215 or 2216 within 12 months. Soldier’s unaided hearing is within H-2 or H-3 standards (IAW AR 40-501). H-2 and H-3 Soldiers must have a documented permanent hearing profile entered in e-Profile (DA Form 3349) and MEDPROS Web Data Entry (MWDE). H-2 Soldiers must have a complete audiological evaluation on record. H-3 Soldiers must have a complete audiological evaluation and Speech Recognition in Noise Test (SPRINT) on record. H-3 Soldiers must have completed a MAR2. If required, Soldier has prescribed hearing aid(s) and 6 month supply of batteries on hand.</td>
</tr>
<tr>
<td>Hearing Readiness Class 3</td>
<td>Soldier has DD Form 2215 or 2216 within 12 months and unaided hearing is within H-2 or H-3 standards.</td>
</tr>
<tr>
<td></td>
<td>- HRC 3A – Complete audiological evaluation has not been completed</td>
</tr>
<tr>
<td></td>
<td>- HRC 3B – e-Profile (DA Form 3349) and MWDE not complete</td>
</tr>
<tr>
<td></td>
<td>- HRC 3C – MAR2 not complete</td>
</tr>
<tr>
<td></td>
<td>- HRC 3D – Does not meet standards with hearing aid</td>
</tr>
<tr>
<td></td>
<td>- HRC 3E – Soldier meets HRC 2 standards, but does not have required hearing aid(s) and 6 month supply of batteries on hand</td>
</tr>
<tr>
<td>Hearing Readiness Class 4</td>
<td>Soldier has not received a DOEHRSHC audiogram within 12 months, or received DOEHRSHC audiogram but requires a follow-up test.</td>
</tr>
<tr>
<td></td>
<td>- HRC 4A – Soldier’s most recent audiogram is more than 12 months old</td>
</tr>
<tr>
<td></td>
<td>- HRC 4B - Audiogram within 12 months, however, STS identified and follow-up hearing test is required</td>
</tr>
<tr>
<td></td>
<td>- HRC 4C – Soldier demonstrated a STS and did not complete follow-up testing within 90 days of the periodic hearing test</td>
</tr>
</tbody>
</table>

https://phc.amedd.army.mil/PHC%20Resource%20Library/TIP_No_51-075-0517_DOEHRSHCandMEDPROSHearingReadinessClassificationDiscrepancies.pdf#search=hearing%20readiness%20classification
Hearing Readiness during COVID-19

Peak HRC-4 of 14.6% in July 2020
- target is <6%
- pre-pandemic was ~5%

“Medically Ready Force...Ready Medical Force”
## The Coronavirus Aid, Relief, and Economic Security (CARES) Act Funding

### RHC-Atlantic

<table>
<thead>
<tr>
<th>Region</th>
<th>Location</th>
<th>Total Positions</th>
<th>Onboard</th>
<th>In Progress</th>
<th>Candidate Needed</th>
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</thead>
<tbody>
<tr>
<td>RHC-A</td>
<td>Aberdeen Proving Ground</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
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<tr>
<td>RHC-A</td>
<td>Aberdeen Proving Ground - Edgewood</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
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<tr>
<td>RHC-A</td>
<td>Carlisle Barracks</td>
<td>1</td>
<td>1</td>
<td>-</td>
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<td>3</td>
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<td>Fort Detrick</td>
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<td>1</td>
<td>-</td>
<td>-</td>
</tr>
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<td>2</td>
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<td>-</td>
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<tr>
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<td>Fort Knox</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
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<tr>
<td>RHC-A</td>
<td>Fort McNair</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>RHC-A</td>
<td>Fort Meade</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
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<tr>
<td>RHC-A</td>
<td>Fort Myer</td>
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<td>1</td>
<td>-</td>
<td>-</td>
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<tr>
<td>RHC-A</td>
<td>Fort Stewart</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
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<tr>
<td>RHC-A</td>
<td>Letterkenny AD</td>
<td>1</td>
<td>-</td>
<td>1</td>
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<tr>
<td>RHC-A</td>
<td>New Cumberland</td>
<td>1</td>
<td>1</td>
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<td>-</td>
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<tr>
<td>TOTAL</td>
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<td>20</td>
<td>17 (85%)</td>
<td>2 (10%)</td>
<td>2 (10%)</td>
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### RHC-Central

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<th>In Progress</th>
<th>Candidate Needed</th>
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<tbody>
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<td>Fort Bliss</td>
<td>3</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RHC-C</td>
<td>Fort Hood</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RHC-C</td>
<td>Fort Huachuca</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>Fort Irwin</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RHC-C</td>
<td>Fort Leonard Wood</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>RHC-C</td>
<td>Fort Polk</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>RHC-C</td>
<td>Fort Sam Houston</td>
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<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
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<td>11</td>
<td>8 (73%)</td>
<td>3 (27%)</td>
<td>0 (0%)</td>
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</table>

### RHC-Pacific

<table>
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<tr>
<th>Region</th>
<th>Location</th>
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<th>Onboard</th>
<th>In Progress</th>
<th>Candidate Needed</th>
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<tbody>
<tr>
<td>RHC-P</td>
<td>TAMC</td>
<td>1</td>
<td>-</td>
<td>1 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>1</td>
<td>0 (0%)</td>
<td>1 (100%)</td>
<td>0 (0%)</td>
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</table>

### RHC-Europe

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<th>Region</th>
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<th>Total Positions</th>
<th>Onboard</th>
<th>In Progress</th>
<th>Candidate Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHC-E</td>
<td>USAG Baumholder</td>
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<td>1</td>
<td>-</td>
<td>-</td>
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<tr>
<td>RHC-E</td>
<td>USAG Grafenwoehr</td>
<td>1</td>
<td>1</td>
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<td>-</td>
</tr>
<tr>
<td>RHC-E</td>
<td>USAG Hohenfels</td>
<td>1</td>
<td>1</td>
<td>-</td>
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<tr>
<td>RHC-E</td>
<td>USAG Kleber</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RHC-E</td>
<td>USAG Wiesbaden</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RHC-E</td>
<td>USAG Vicenza</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>6 (100%)</td>
<td>6 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

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“Medically Ready Force...Ready Medical Force”

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TOTAL: 38 tech positions across 28 locations
Boothless audiometry benefits

In the context of a pandemic, boothless audiometry enables testing to be completed at accelerated rates in many ways improved from the standard booth:

(1) permitting social distancing practices during testing (i.e., 6+ feet of separation)

(2) keeping personnel out of confined spaces where air exchange rates may be limited

(3) increasing the number of personnel who can be tested simultaneously by a single hearing technician

(4) eliminating the need for SMs to travel to a centralized location in order to complete annual hearing test requirements.
“WAHTS SOP” Development (Wireless Automated Hearing Test System)

Scope of Practice needed for a DOEHRS-HC equivalent test to augment Army Hearing Readiness during COVID-19 response and recovery

1. Development of custom protocol
   - reflect Benson-CCA (Computer Controlled Audiometer) 200 specs

2. Guidance on test environment
   - Maximum Permissible Ambient Noise Levels (MPANL), Calibrations

3. Test administration and advanced features
   - Test Battery, automated masking, additional HCON features

APPENDIX A: Maximum Permissible Ambient Noise Levels (MPANL) for testing using the Wireless Automated Hearing Testing System

Unanles otherwise specified, all measurements reflect dBZ – SPL (Unweighted)

<table>
<thead>
<tr>
<th>Category</th>
<th>500 Hz</th>
<th>1000 Hz</th>
<th>2000 Hz</th>
<th>4000 Hz</th>
<th>8000 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN</td>
<td>79.9</td>
<td>85.2</td>
<td>87.4</td>
<td>87.0</td>
<td>87.0</td>
</tr>
<tr>
<td>AMBER</td>
<td>87.7 – 87.8</td>
<td>81.3 – 81.4</td>
<td>73.1 – 73.2</td>
<td>71.1 – 71.2</td>
<td>71.1 – 71.2</td>
</tr>
<tr>
<td>RED</td>
<td>≥79.5</td>
<td>≥79.9</td>
<td>≥79.7</td>
<td>≥79.1</td>
<td>≥79.1</td>
</tr>
</tbody>
</table>

MPANL for testing using the WAHTS System (measured with Type II SLM with no octave band analysis capability):

- ≤3 dB SPL
- 3 – 72 dB SPL
- > 72 dB SPL

If using a sound level meter without octave band analysis capability:

- ≤3 dB SPL
- ≥3 – 82 dB
- > 82 dB

1. Development of custom protocol
Wireless Automated Hearing Test System (WAHTS)

Meinke (2017)

Shapiro (2019)
https://tabsint.org/

Shapiro (2019)
https://svantek.com/products/sv-104-personal-noise-dosimeter/

Background Noise Results
Standard: ANSI S3.1-R2008
Headset: WAHTS
- Below Limit
- Within 3 dB SPL of Limit
- Above Limit
- Limit
- Dosimeter Noise Floor
2. Guidance on test environment
Maximum Permissible Ambient Noise Levels (MPANLs)

Unless otherwise specified, all measurements reflect dBZ – SPL (Unweighted)

<table>
<thead>
<tr>
<th>Category</th>
<th>500 Hz</th>
<th>1000 Hz</th>
<th>2000 Hz</th>
<th>4000 Hz</th>
<th>8000 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN</td>
<td>≤59.6</td>
<td>≤63.2</td>
<td>≤63.4</td>
<td>≤70</td>
<td>≤73.3</td>
</tr>
<tr>
<td>AMBER</td>
<td>59.7 – 67.4</td>
<td>63.3 – 71.8</td>
<td>63.5 – 71.6</td>
<td>70.1 – 78</td>
<td>73.4 – 80.5</td>
</tr>
<tr>
<td>RED</td>
<td>≥67.5</td>
<td>≥71.9</td>
<td>≥71.7</td>
<td>≥78.1</td>
<td>≥80.6</td>
</tr>
</tbody>
</table>

If using a sound level meter without octave band analysis capability:
MPANL will not exceed:

<table>
<thead>
<tr>
<th>dBZ SPL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>≤53 dB SPL</td>
<td>27 dBA</td>
</tr>
<tr>
<td>≥54 – 72 dB SPL</td>
<td>≥28 – 32 dBA</td>
</tr>
<tr>
<td>&gt; 73 dB SPL</td>
<td>&gt; 33 dBA</td>
</tr>
</tbody>
</table>

Guidance for Type I/II SLMs with octave band analysis
Guidance for Type II SLMs without octave band analysis

Technician will measure ambient noise and record on template

Sound levels are: GREEN AMBER RED
2. Guidance on test environment

Daily Calibration

Calibration Results Table

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left (dB)</td>
<td>-3</td>
<td>0</td>
<td>-2</td>
<td>-3</td>
<td>0</td>
<td>-1</td>
<td>-3</td>
</tr>
<tr>
<td>Right (dB)</td>
<td>-4</td>
<td>2</td>
<td>-6</td>
<td>-2</td>
<td>-3</td>
<td>-1</td>
<td>0</td>
</tr>
</tbody>
</table>
3. Test Administration & Advanced Features

WAHTS SOP Clinic

Select test:

1) WAHTS Full Battery (Tinnitus + HHE)
2) DOEHS-HC Test Only
3) Tinnitus Questions Only
4) HHE&T Only
5) Calibration Test Fixture
6) MPANL
7) Manual Calibration Check

WAHTS SOP Results

Result Table

<table>
<thead>
<tr>
<th></th>
<th>Left (dB HL)</th>
<th></th>
<th>Right (dB HL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500 Hz</td>
<td>1000 Hz</td>
<td>2000 Hz</td>
</tr>
<tr>
<td>FREQ H</td>
<td>5</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

Enhanced Screening Score

1/Y1/48.4/9/3/0
Interfacing with DOEHERS-HC Data Repository

- Audiometric results are manually transposed from the tablet Results Table into the medical encounter in DOEHERS-HC Data Repository

- The DOEHERS-HC software automatically calculates against reference audiogram of record (DD2215) to determine:
  - Significant Threshold Shifts (STS) *most common*
    - ≥ 10 dB difference @ 2, 3, 4 kHz
  - Other reasons for referral (contralateral masking, tinnitus, other medical referral)

- WAHTS never used to re-establish baseline
  - SMs will need to return for testing with standard DOERHS-HC testing or manual audiometry performed by audiologist to confirm any change in hearing reported by WAHTS

“Medically Ready Force...Ready Medical Force”
SMs identified with Positive STS (via WAHTS) referred for follow-up testing with standard DOEHRS-HC procedure (CCA-200)
### Positive STS Comparison

#### WAHTS (annual) vs CCA (f/u1)

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference (dB HL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean difference (dB HL)</td>
<td>-0.40</td>
<td>1.90</td>
<td>2.80</td>
<td>-2.60</td>
<td>-1.90</td>
<td>-2.40</td>
<td>-0.43</td>
</tr>
<tr>
<td>Standard deviation (dB HL)</td>
<td>5.33</td>
<td>5.97</td>
<td>6.78</td>
<td>6.64</td>
<td>9.09</td>
<td>8.76</td>
<td>7.10</td>
</tr>
<tr>
<td>Absolute differences (dB HL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean absolute difference</td>
<td>3.80</td>
<td>4.50</td>
<td>5.80</td>
<td>5.20</td>
<td>6.30</td>
<td>7.20</td>
<td>5.47</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>3.72</td>
<td>4.32</td>
<td>4.45</td>
<td>4.84</td>
<td>6.76</td>
<td>5.46</td>
<td>4.92</td>
</tr>
</tbody>
</table>

Table 1: Differences between WAHTS (annual test) and CCA-200 (follow-up) threshold estimates

#### CCA (annual) vs CCA (f/u1)

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference (dB HL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean difference (dB HL)</td>
<td>-0.19</td>
<td>1.11</td>
<td>1.57</td>
<td>1.02</td>
<td>1.20</td>
<td>-0.83</td>
<td>0.66</td>
</tr>
<tr>
<td>Standard deviation (dB HL)</td>
<td>7.07</td>
<td>4.73</td>
<td>8.74</td>
<td>9.59</td>
<td>9.41</td>
<td>9.85</td>
<td>8.23</td>
</tr>
<tr>
<td>Absolute differences (dB HL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean absolute difference</td>
<td>4.81</td>
<td>2.78</td>
<td>6.11</td>
<td>6.39</td>
<td>6.94</td>
<td>6.94</td>
<td>5.66</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>5.13</td>
<td>3.97</td>
<td>6.42</td>
<td>7.17</td>
<td>6.40</td>
<td>6.97</td>
<td>6.01</td>
</tr>
</tbody>
</table>

Table 2: Differences between CCA-200 (annual test) and CCA-200 (follow-up) threshold estimates
Positive STS Rate (JUN – SEP 2019)
Ft. Meade MEDDAC

```
<table>
<thead>
<tr>
<th>Testing Inst. Name - Zip/PAS/UIC</th>
<th>Person DoD</th>
<th>N w/Periodic</th>
<th>N w/STS on Periodic</th>
<th>N TTS</th>
<th>N PTS</th>
<th>N Reestab DD 2215</th>
<th>N F/U 1 Test</th>
<th>N F/U 2 Test</th>
<th>N F/U 1 w/STS Resolved</th>
<th>N F/U 2 w/STS Resolved</th>
<th>N New Cases w/STS</th>
<th>% w/STS on Periodic</th>
<th>% TTS</th>
<th>% PTS</th>
<th>% Reestab DD 2215</th>
<th>% No Test on F/u1</th>
<th>% No Test on F/u2</th>
<th>% STS Resolved on F/u1</th>
<th>% STS Resolved on F/u2</th>
<th>% New Cases w/STS</th>
<th>% New Cases Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Military &amp; Civilian</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ft Meade - 20755</td>
<td></td>
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<td>3</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td></td>
<td>18.18%</td>
<td>5.45%</td>
<td>12.73%</td>
<td>166.67%</td>
<td>20.00%</td>
<td>33.33%</td>
<td>20.00%</td>
<td>16.67%</td>
<td>50.00%</td>
<td>9.09%</td>
</tr>
<tr>
<td>Army</td>
<td>1,601</td>
<td>94</td>
<td>54</td>
<td>40</td>
<td>14</td>
<td>25</td>
<td>0</td>
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<td>8</td>
<td>19</td>
<td></td>
<td>5.87%</td>
<td>3.37%</td>
<td>2.50%</td>
<td>93.33%</td>
<td>26.60%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>48.94%</td>
<td>34.78%</td>
</tr>
<tr>
<td>Marine Corps</td>
<td>147</td>
<td>6</td>
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<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
<td>4.08%</td>
<td>2.04%</td>
<td>2.04%</td>
<td>100.00%</td>
<td>16.67%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>50.00%</td>
<td>50.00%</td>
<td>2.04%</td>
</tr>
<tr>
<td>Navy</td>
<td>124</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td></td>
<td>8.06%</td>
<td>4.84%</td>
<td>3.23%</td>
<td>100.00%</td>
<td>30.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>60.00%</td>
<td>0.00%</td>
<td>10.00%</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Totals: Ft Meade - 20755</td>
<td>1,936</td>
<td>120</td>
<td>195</td>
<td>94</td>
<td>36</td>
<td>31</td>
<td>2</td>
<td>57</td>
<td>9</td>
<td>28</td>
<td></td>
<td>6.20%</td>
<td>3.41%</td>
<td>2.79%</td>
<td>104.76%</td>
<td>25.83%</td>
<td>6.25%</td>
<td>47.50%</td>
<td>28.12%</td>
<td>23.33%</td>
<td>1.45%</td>
</tr>
<tr>
<td>Grand Totals:</td>
<td>1,936</td>
<td>120</td>
<td>195</td>
<td>94</td>
<td>36</td>
<td>31</td>
<td>2</td>
<td>57</td>
<td>9</td>
<td>28</td>
<td></td>
<td>6.20%</td>
<td>3.41%</td>
<td>2.79%</td>
<td>104.76%</td>
<td>25.83%</td>
<td>6.25%</td>
<td>47.50%</td>
<td>28.12%</td>
<td>23.33%</td>
<td>1.45%</td>
</tr>
</tbody>
</table>
```

“Medically Ready Force...Ready Medical Force”
Positive STS Rate (JUN – SEP 2021)
Ft. Meade MEDDAC

<table>
<thead>
<tr>
<th>Selected ZIPPASUIC(s): 20755 - Ft Meade - Army</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Testing Inst. Name - Zip/PAS/UIC</strong></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Military &amp; Civilian</strong></td>
</tr>
<tr>
<td><strong>Air Force</strong></td>
</tr>
<tr>
<td><strong>Army</strong></td>
</tr>
<tr>
<td><strong>Marine Corps</strong></td>
</tr>
<tr>
<td><strong>Navy</strong></td>
</tr>
<tr>
<td><strong>Other</strong></td>
</tr>
<tr>
<td><strong>Totals: Ft Meade - 20755</strong></td>
</tr>
<tr>
<td><strong>Grand Totals:</strong></td>
</tr>
</tbody>
</table>

“Medically Ready Force...Ready Medical Force”
KACC Construction Brings Opportunity

Construction required Ft. Meade HCON to be shut down from June – October 2021

Boothless audiometry allowed for continued compliance/throughput

Additional portability to bring hearing testing “to the unit”

What if boothless audiometry was not an option?

Boothless Hearing Conservation Clinic held at Ft. Meade’s McGill Training Center
Photo: Victoria Bugtong, AuD
MEDDAC Hearing Readiness Improving Due to WAHTS & Dedicated HCON Technicians
Additional Capability:
Leveraging WAHTS to Reduce Referrals

- Advanced Medical Technology Initiative (AMTI) Grant
  - “Addressing Masking Referrals from DOEHRSHC with Boothless Audiometry Technology”

- The objectives of this project are to:
  - Evaluate the use of boothless audiometry to automatically measure masked thresholds at DoD Hearing Conservation sites and reduce clinical referrals for contralateral masking.
  - Determine the need for clinical referrals for tinnitus evaluation using an enhanced tinnitus screening protocol administered via tablet to SMs reporting they are bothered “a little” or “a lot” in response to the current DOEHRSHC tinnitus question.
Reducing Referrals

Automated Masking

- Development of automated masking feature with WAHTS
- **Phase 1:** each SM requiring masking will receive an automated masked audiogram using WAHTS and manual masked audiogram from DoD audiologist
- Phase 2: implement validated automated assessment and calculate return of investment (ROI).

Tinnitus

- Additional tinnitus screening question according to Hearing Center of Excellence (HCE) “Tinnitus Question Response Guidance”
- Responses trigger administration of Tinnitus Functional Index (TFI) And Tinnitus and Hearing Survey (THS) on tablet
- Outcome metrics from questionnaire will determine correlations between tinnitus screening response and management recommendations.
Being exposed to hazardous noise when not using hearing protection devices ("earpro") can cause which of the following:

A. Permanent damage to the inner ear
B. A ruptured eardrum
C. Temporary or permanent changes in hearing and tinnitus
D. All of the above

D. All of the above

Noise exposure without hearing protection can result in permanent damage to the inner ear. Exposure to blast can result in a ruptured eardrum or damage to the bones in the middle ear. Exposure to hazardous noise also can cause ringing, buzzing, or roaring noise in the ears. Exposure to noise can temporarily change your hearing, and repeated exposure over time may cause permanent hearing damage.
Key Takeaways

- HPD fit-testing can be used to measure the amount of attenuation achieved with the tested HPD and fitting condition.
- HPD fit-testing should not replace HPD fit-training. If anything it should be used in conjunction.
- The PAR value provides an objective measure of HPD fit, which can inform if the HPD is appropriate for the employee’s work environment.
- Annual audiometric monitoring is a key element of maintaining a hearing ready force and helps to identify early changes in hearing.
- Utilization of boothless audiometry during this public health crisis has been successful to meet the mission in maintaining a medical ready force.
- Innovations as a direct result from this endeavor highlight several improvements in comparison to current standards of care that should be considered for permanent inclusion in DoD Hearing Conservation.
Acknowledgements

- **Army Public Health Center (APHC)**
  - LTC Andy Merkley (Army Hearing Program Manager)
  - Mr. Benjamin Sheffield (Auditory Research Engineer)
  - Dr. LaGuinn Sherlock (Research Audiologist)
  - Mr. John Bugay (Audiology Technician)
  - Ms. Stephanie Bullock (Audiology Technician)

- **Walter Reed National Military Medical Center (WRNMMC)**
  - Dr. Doug Brungart (Chief Scientist, Audiology and Speech Pathology Center)
  - LTC Deepa Hariprasad (Director, Audiology and Speech Pathology Center)
  - Dr. Devon Kulinski (Research Audiologist)
  - Dr. Jaclyn Schurman (Research Audiologist)
  - Ms. Rebecca Holtzman (Research Program Manager)
  - Ms. Anisa Swann (Research Assistant)

- **Ft. Meade (Kimbrough)**
  - Dr. Victoria Bugtong (Chief, Audiology and Hearing Conservation)
  - Dr. Michele Spencer (Audiologist)
  - LTC Christopher Caldwell (Chief of Vision and Hearing)
  - Ms. Laura Pomeroy (Audiology Technician)

- **Office of The Surgeon General / Defense Health Headquarters (OTSG)**
  - COL Amy Blank (Audiology Consultant, Deputy Chief of Staff for Public Health)

“Medically Ready Force...Ready Medical Force”
References


Questions?

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devon.m.kulinski.ctr@mail.mil
How to Obtain CE/CME Credits

To receive CE/CME credit, you must register by 0850 ET on 29 October 2021 to qualify for the receipt of CE/CME credit or certificate of attendance. You must complete the program posttest and evaluation before collecting your certificate. The posttest and evaluation will be available through 11 November 2021 at 2359 ET. Please complete the following steps to obtain CE/CME credit:

1. Go to URL: https://www.dhaj7-cepo.com/content/oct-2021-ccss-promising-practices-military-health-care
2. Search for your course using the Catalog, Calendar, or Find a course search tool.
3. Click on the REGISTER/TAKE COURSE tab.
   a. If you have previously used the CEPO CMS, click login.
   b. If you have not previously used the CEPO CMS click register to create a new account.
4. Follow the onscreen prompts to complete the post-activity assessments:
   a. Read the Accreditation Statement
   b. Complete the Evaluation
   c. Take the Posttest
5. After completing the posttest at 80% or above, your certificate will be available for print or download.
6. You can return to the site at any time in the future to print your certificate and transcripts at: https://www.dhaj7-cepo.com/
7. If you require further support, please contact us at: dha.ncr.j7.mbx.cepo-cms-support@mail.mil