Leveraging Boothless Audiometers to Implement Hearing Protection Device Fit-Testing at Military Hearing Conservation Clinics

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August 18, 2023

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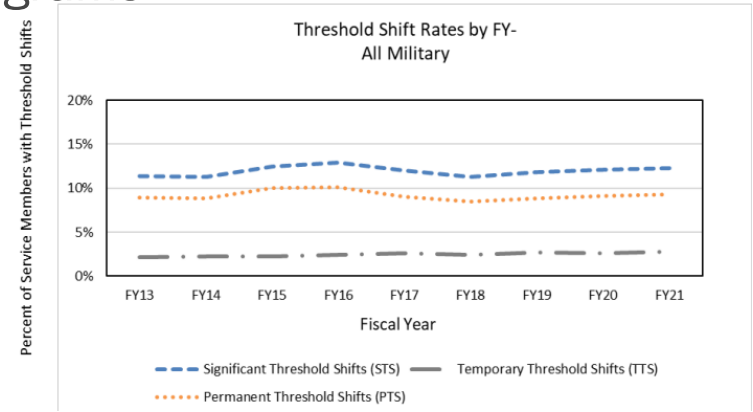
Outline

- Fit-testing & Military Relevance
- Project Background
- Methods
- Preliminary Data
- Next Steps

Fit-testing & Military Relevance

- Noise induced hearing loss (NIHL) is the #1 workplace health hazard to the Department of Defense (DoD) workforce
  - ~1.3 Million at-risk Active Duty, Guard, Reserve, and Civilian personnel receiving annual audiograms
  - Rates of threshold shift have plateaued (no significant improvement)

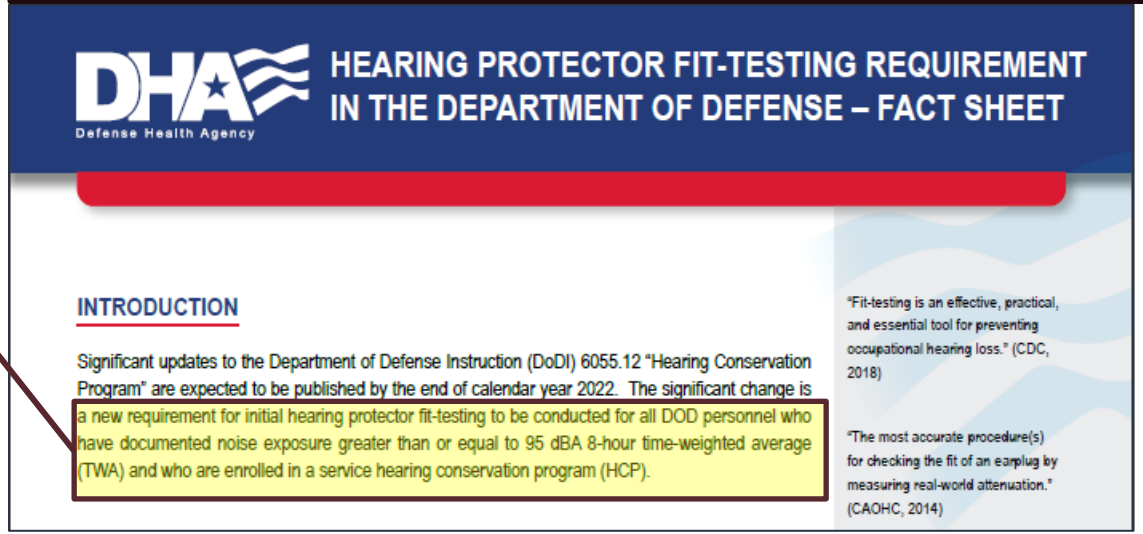
https://hearing.health.mil/Resources/News-and-Events/Hearing-Health-Review



Hearing Health Surveillance Data Review Military Hearing Conservation – Fiscal Year 2021

Fit-testing & Military Relevance

"A new requirement for initial hearing protector fit-testing to be conducted for all DoD personnel who have documented noise exposure ≥ 95 dBA 8-hr time-weighted average and who are enrolled in Hearing Conservation Program (HCP)"



DHA Defense Health Agency

HEARING PROTECTOR FIT-TESTING REQUIREMENT IN THE DEPARTMENT OF DEFENSE – FACT SHEET

INTRODUCTION

Significant updates to the Department of Defense Instruction (DoDI) 6055.12 "Hearing Conservation Program" are expected to be published by the end of calendar year 2022. The significant change is a new requirement for initial hearing protector fit-testing to be conducted for all DOD personnel who have documented noise exposure greater than or equal to 95 dBA 8-hour time-weighted average (TWA) and who are enrolled in a service hearing conservation program (HCP).

"Fit-testing is an effective, practical, and essential tool for preventing occupational hearing loss." (CDC, 2018)

"The most accurate procedure(s) for checking the fit of an earplug by measuring real-world attenuation." (CAOHC, 2014)

https://www.health.mil/Reference-Center/Fact-Sheets/2023/01/12/Hearing-Protector-Fit-Testing-Requirement-in-the-DOD

Additional fit-testing requirements:

- Significant threshold shift (STS) during periodic audiogram
- *"early warning" hearing loss. e.g., (15 ≥ dB loss @ 1-4 kHz)*
- Physical changes to ear canal
- Primary hearing protector no longer available

Fit-testing & Military Relevance

- Assumptions based on policy change:
  - A substantial proportion of the hearing damage that is currently occurring in the DoD is directly related to poorly fit hearing protection
  - Individual fit-testing could help solve this problem and produce a substantial reduction in service-related auditory injury in the military

- Much is still unknown regarding the implementation of hearing protection device (HPD) fit-testing across the DoD
  - Concerns of equipment/personnel/time
  - Variety of different clinical workflows
  - Minimum acceptable PAR
  - How to improve training to reduce/eliminate failure rate for those being tested?

DCPH-A Public Health Project

"Incorporating Hearing Protection Device Fit-Testing into DoD Hearing Conservation Programs"

Walter Reed National Military Medical Center

DCPH–A
Defense Centers for Public Health – Aberdeen
(formerly U.S. Army Public Health Center)

- Purpose:
  - Evaluate the logistical, technical, and procedural requirements for implementing wide-scale HPD fit-testing into the DoD
- Primary Deliverables:
  - Evaluate the feasibly of incorporating fit-test systems in a variety of clinical workflows
  - Describe Personal Attenuation Rating (PAR) outcomes (across populations, HPDs, hearing status, noise exposure, etc)
  - Subjective feedback from participants and clinicians regarding benefits of test system(s)
  - Modeling PAR results using DOEHRS thresholds in place of open-ear fit-testing

Public Health Guiding Questions

Public Health Question(s)	Method	Data Collection Tool
1. How do service members (SM) and noise-exposed DoD personnel enrolled in a HCP perform on an initial HPD fit-test?	Behavioral hearing data	WAHTS + TabSINT
2. How does fit-testing performance vary with: (1) use and style of hearing protection (foam vs flange); (2) audiogram; demographic information (age, years of service, gender); (3) self-report of temporary changes in hearing; or (4) subjective hearing complaints and tinnitus?	Questionnaire + behavioral hearing data	WAHTS + TabSINT
3. Can thresholds obtained from the annual audiogram substitute for the unoccluded threshold in the PAR calculation to save time?	Behavioral hearing data	WAHTS + TabSINT
4. What are the logistical considerations for each potential use case of implementing HPD in DoD HCPs?	Survey	AHP Clinician Survey
5. What opportunities/challenges do DoD Audiologists encounter when providing HPD fit-testing services?	Survey	AHP Clinician Survey
6. What opportunities and challenges do SM and noise-exposed DoD personnel enrolled in a HCP encounter when included in a personal fit-testing program?	Questionnaire	WAHTS + TabSINT
7. What opportunities and challenges do commanders and supervisors of SM and DoD noise-exposed employees encounter when implementing personal fit-testing in the DoD?	Survey	Supervisor/Commander Survey

Equipment

Hardware

WAHTS™

OSHA- and ANSI-compliant calibrated headset with a built-in wireless audiometer.

Software

audhere

Occupational hearing testing and hearing protector application

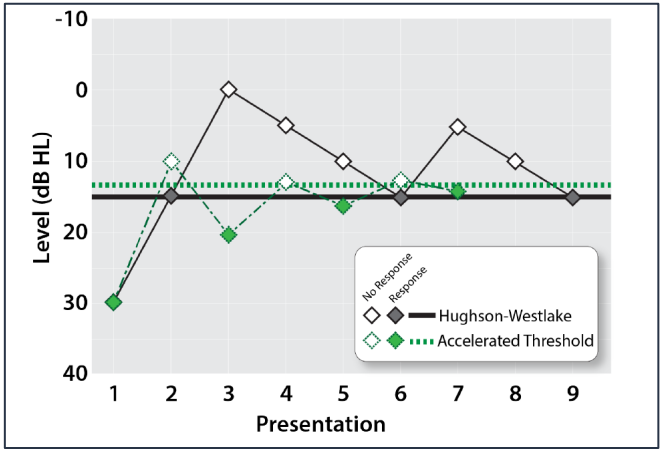
TABSINT

Open source platform for administering tablet based hearing-related exams, as well as general-purpose questionnaires.

Performance Criteria

- Psychophysical Real Ear Attenuation at Threshold (REAT) under headphones
- Binaural 1/3 octave narrow band noise (NBN) centered @ 0.5, 1, & 2 kHz
- Hughson Westlake with machine learning algorithm to achieve rapid convergence
  - Additional constraints developed (e.g., step-size, inconsistent responses)
- Output: PAR_{50} - measurement uncertainty
  - 3 dB roll-down foam, 4 dB flange

https://wahtshearing.com/fit-testing/



Procedures

- Target a network of Army Hearing Program clinics with access to the WAHTS purchased using FY20 CARES Act funds.
  - *>12,000 audiograms conducted with WAHTS to supplement backlog of hearing encounters due to COVID 19.*
    - *Sheffield et al., (2023). Increasing Hearing Readiness and Reducing Referrals Using Boothless Audiometry. Military Medicine.*
- All Service members (SMs) and noise-exposed DoD civilians personnel reporting to clinic are eligible for testing
- HPD fit-test is administered after audiogram

Clinician Survey

Hearing Protection Device Fit-Testing Pre-Project Survey

1. What is your site location? _____

2. Have you ever used a fit-testing system in the past? ◉ Yes ○ No

   a. If yes, which fit-test system have you used? (check all that apply)

   ☐ FitCheck Solo ☐ 3M E-A-Rfit ☐ Veripro ☐ Other (please specify): _____

3. Does your site have a fit-test system? ○ Yes ◉ No

   a. If yes, what system(s) do you have at your site? (check all that apply)

   ☐ FitCheck Solo ☐ 3M E-A-Rfit ☐ Veripro ☐ Other (please specify): _____

   b. If yes, how many units do you have?

   ___ FitCheck Solo ___ 3M E-A-Rfit ___ Veripro ___ Other (please specify): _____

   c. If you have a fit-test system, how often do you use it?

   ◉ Never ○ Rarely ○ Sometimes ○ Often

   d. If you answered never, rarely, or sometimes, why isn't it used more frequently?

4. What fit-test system would you like to have at your site? (check all that apply)

   ☐ FitCheck Solo ☐ 3M E-A-Rfit ☐ Veripro ☐ Other (please specify): _____

5. How would you use the fit-test system at your site?

6. Do you have a CEEP request in for a fit-test system? ○ Yes ◉ No

   a. If yes, what system(s) are you requesting? (check all that apply)

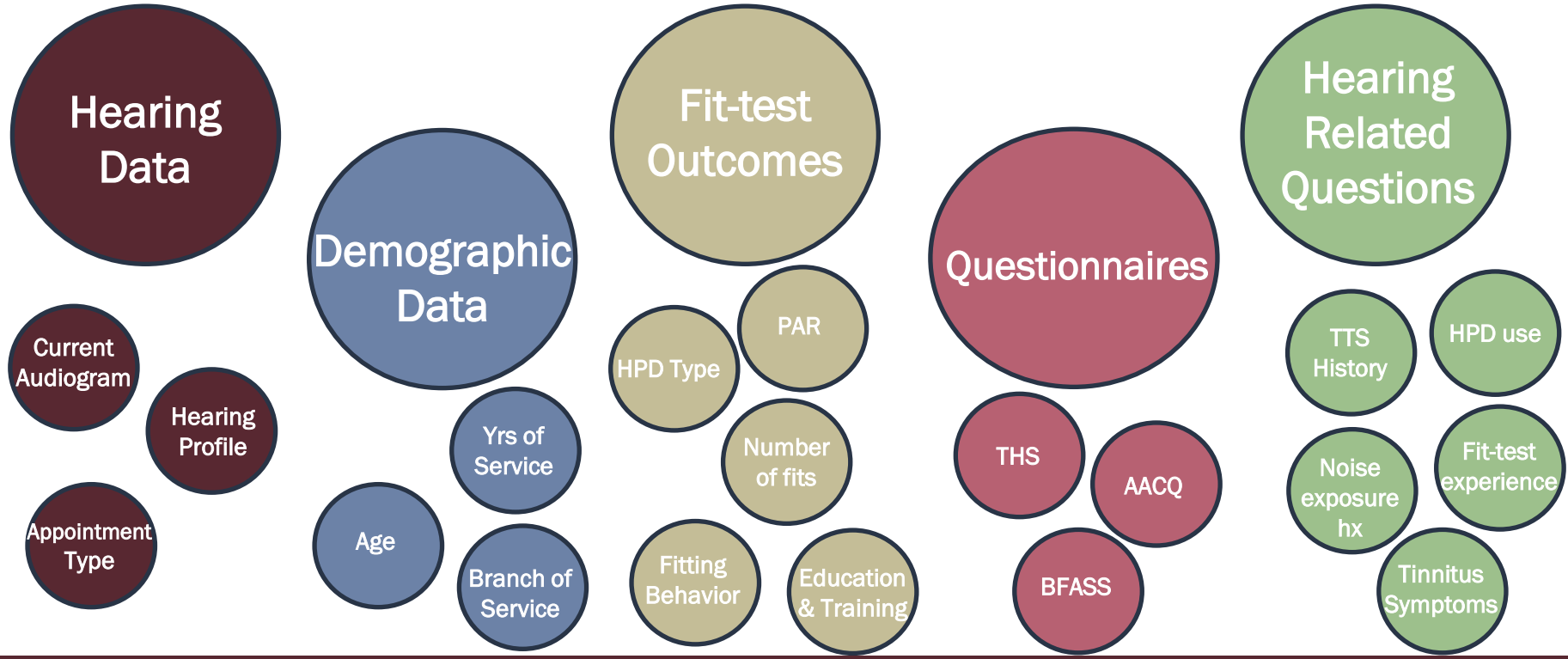
   ☐ FitCheck Solo ☐ 3M E-A-Rfit ☐ Veripro ☐ Other (please specify): _____

   b. If yes, how many units are you requesting?

   ___ FitCheck Solo ___ 3M E-A-Rfit ___ Veripro ___ Other (please specify): _____

7. What obstacles do you see in regards to implementing fit-testing at your site?

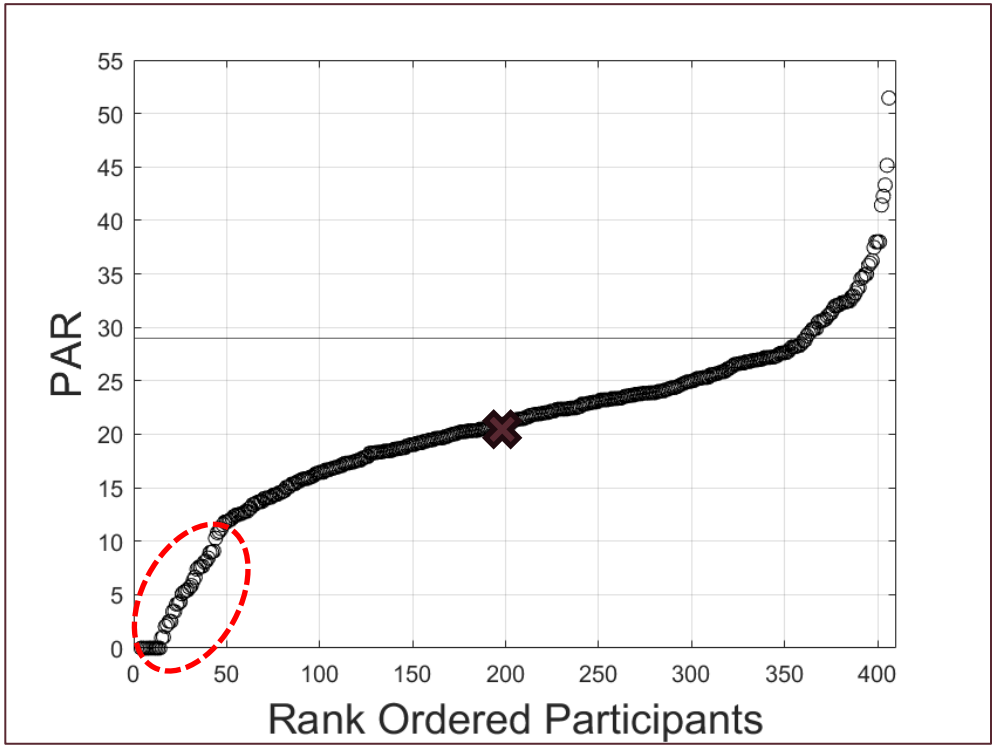
Overview of Data Collected



Progress to Date

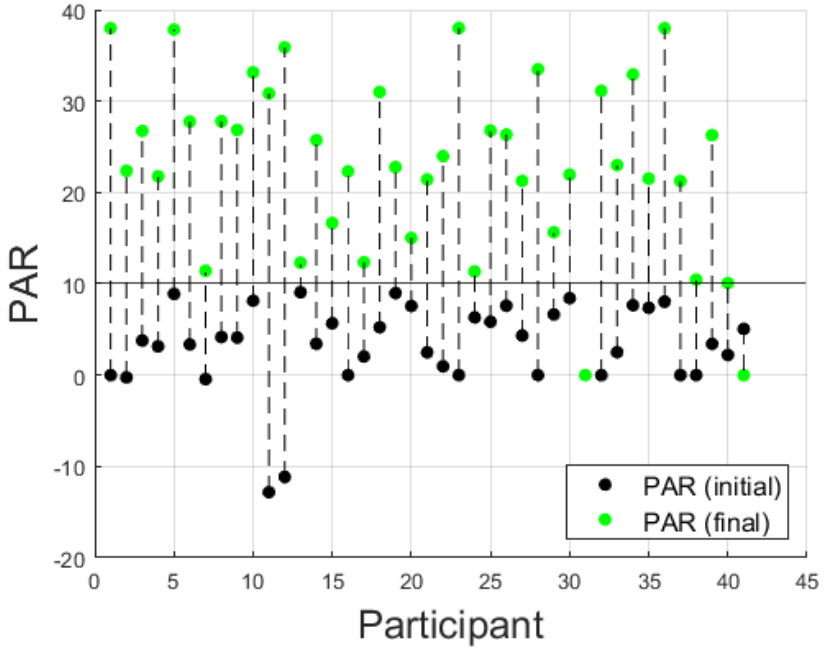
- Current Dataset represents outcomes from WRNMMC Hearing Conservation Clinic
- Data collection initiated April 2023
- Current up to 12 July 2023
- N = 407

Overall PAR Outcomes



- Initial data used 3M Classic foam plug (NRR = 29 dB)
- Mean PAR = 20.4 dB
- ~9% of participants recorded PAR $\leq$ 10 dB

PAR Improvement After Education

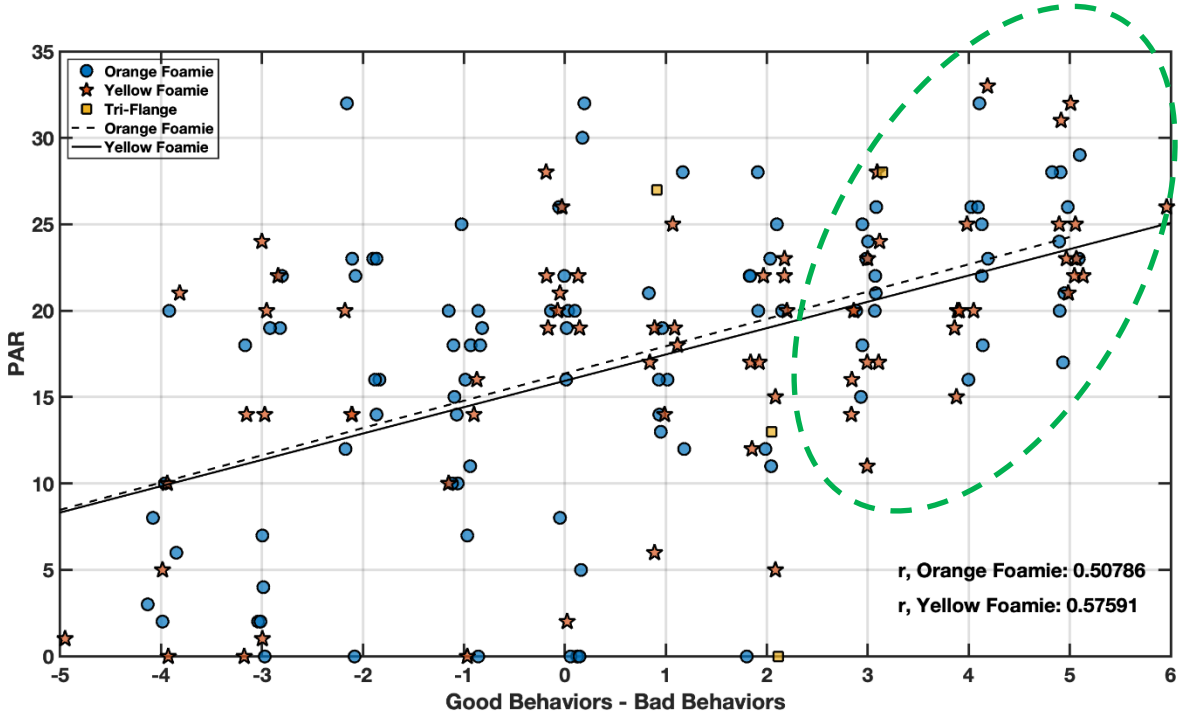


- No specific instruction given to site(s) on how to perform intervention
  - WR HCON provides demonstration on proper fitting techniques
- PAR improvement in 39 of 41 participants

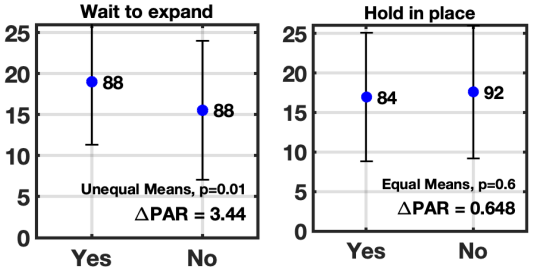
Fitting Behaviors

- Admin observes fitting behaviors upon initial fit and records techniques used to fit device
- No instruction or intervention given until re-fit
- Checklist based off 3M fitting instructions
  https://www.3m.com/3M/en_US/worker-health-safety-us/personal-protective-equipment/foam-earplugs/
  - e.g., roll plug, pulling ear outward/upward, wait for foam to expand

Fitting Behaviors

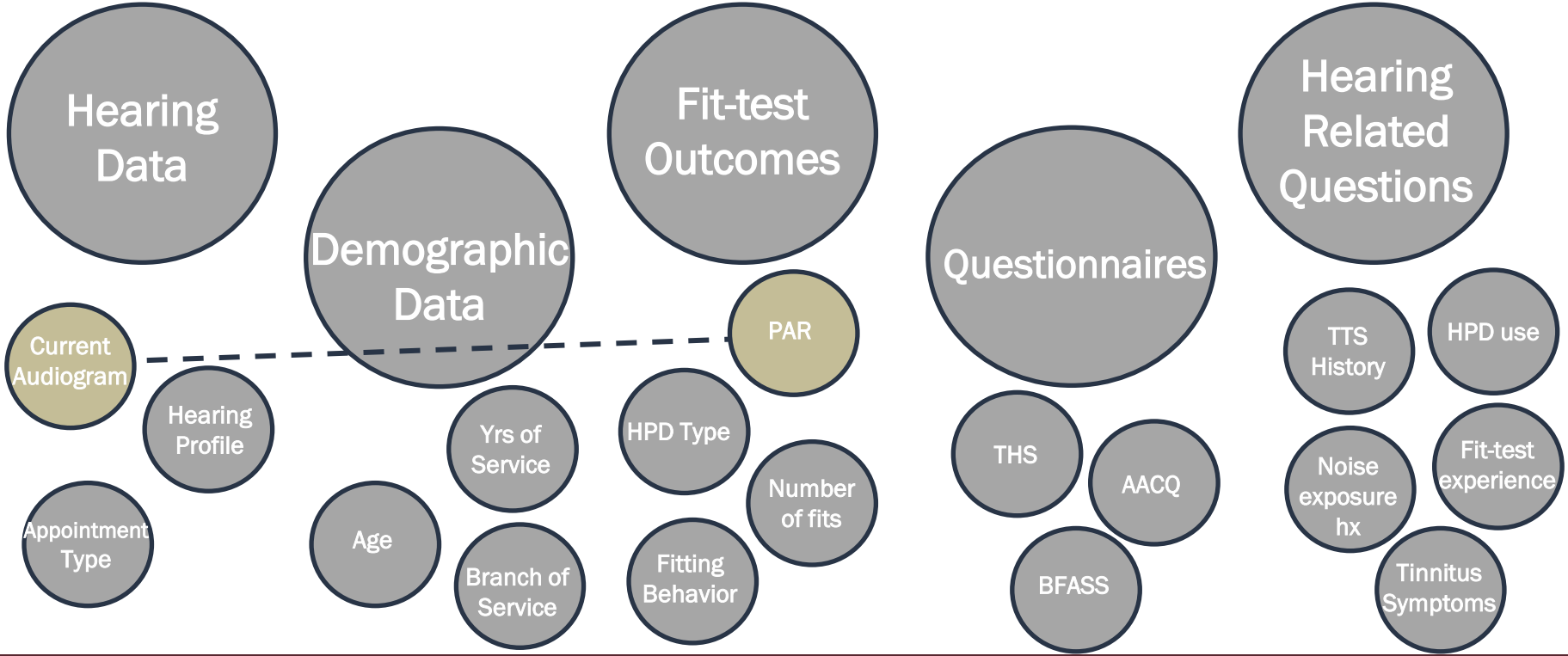


- Composite of “good” behaviors minus “bad” behaviors plotted based on PAR/HPD
- Moderate correlation between fitting behaviors and resulting PAR



- Some behaviors more indicative of performance than others

Overview of Data Collected



Overview of Data Collected

Hearing Data

Fit-test Outcomes

Demographic Data

Current Audiogram

PAR

Hearing Profile

Yrs of MOS Service

HPD Type

Number of fits

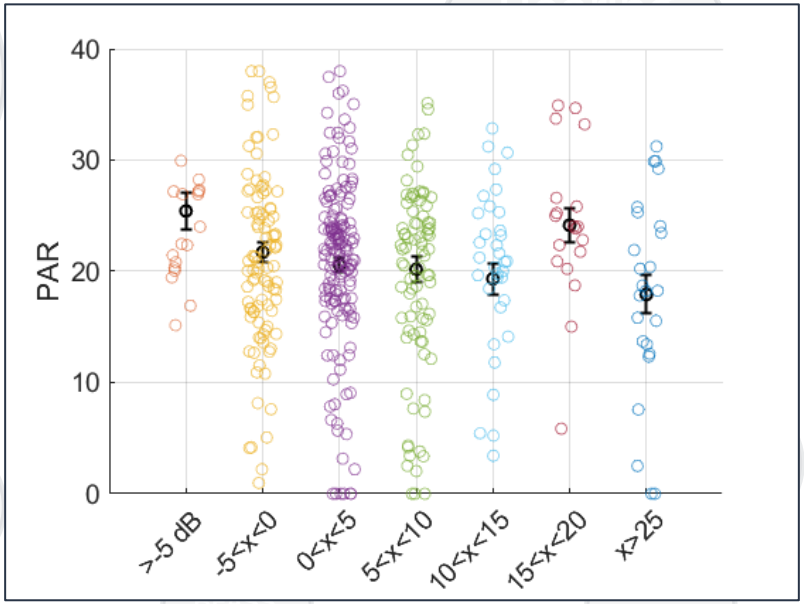
Appointment Type

Age

Gender

Fitting Behavior

Symptoms



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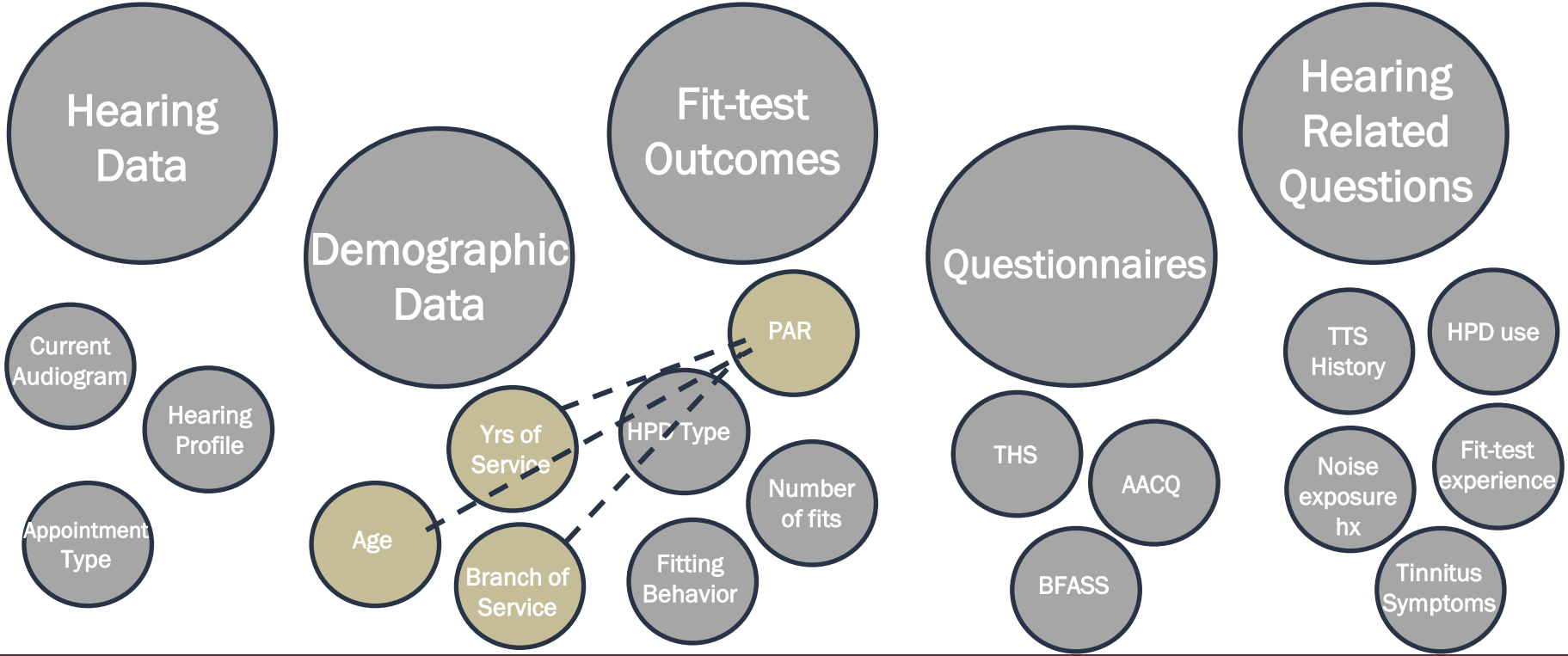

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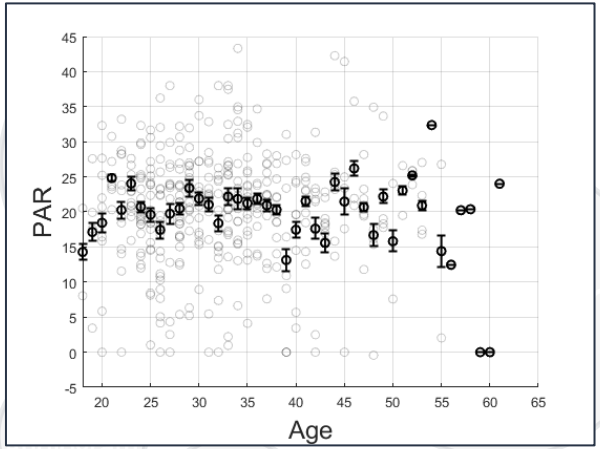

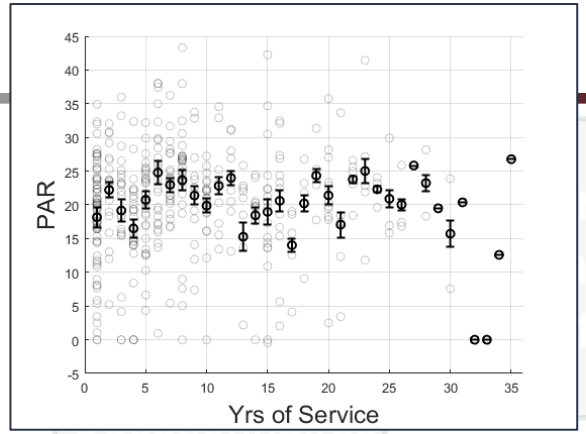

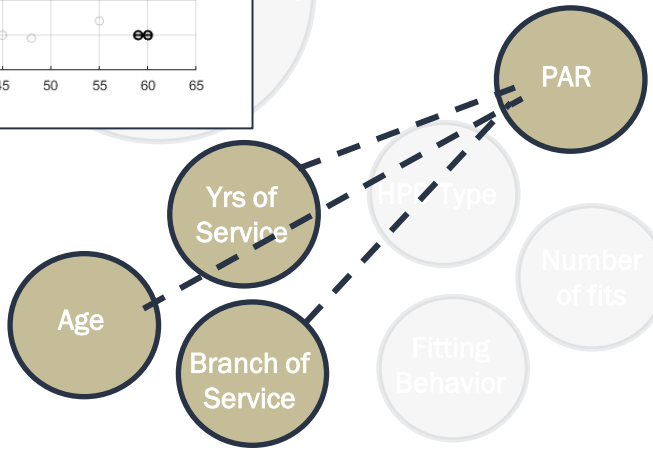

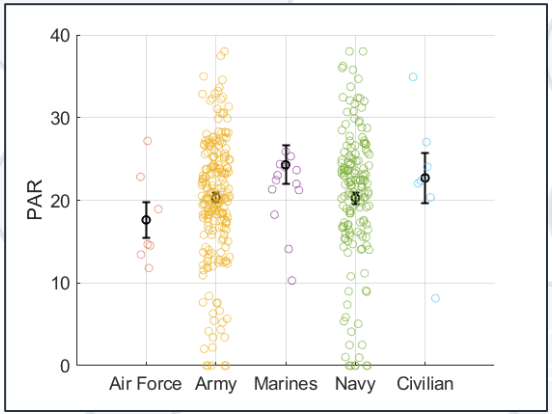

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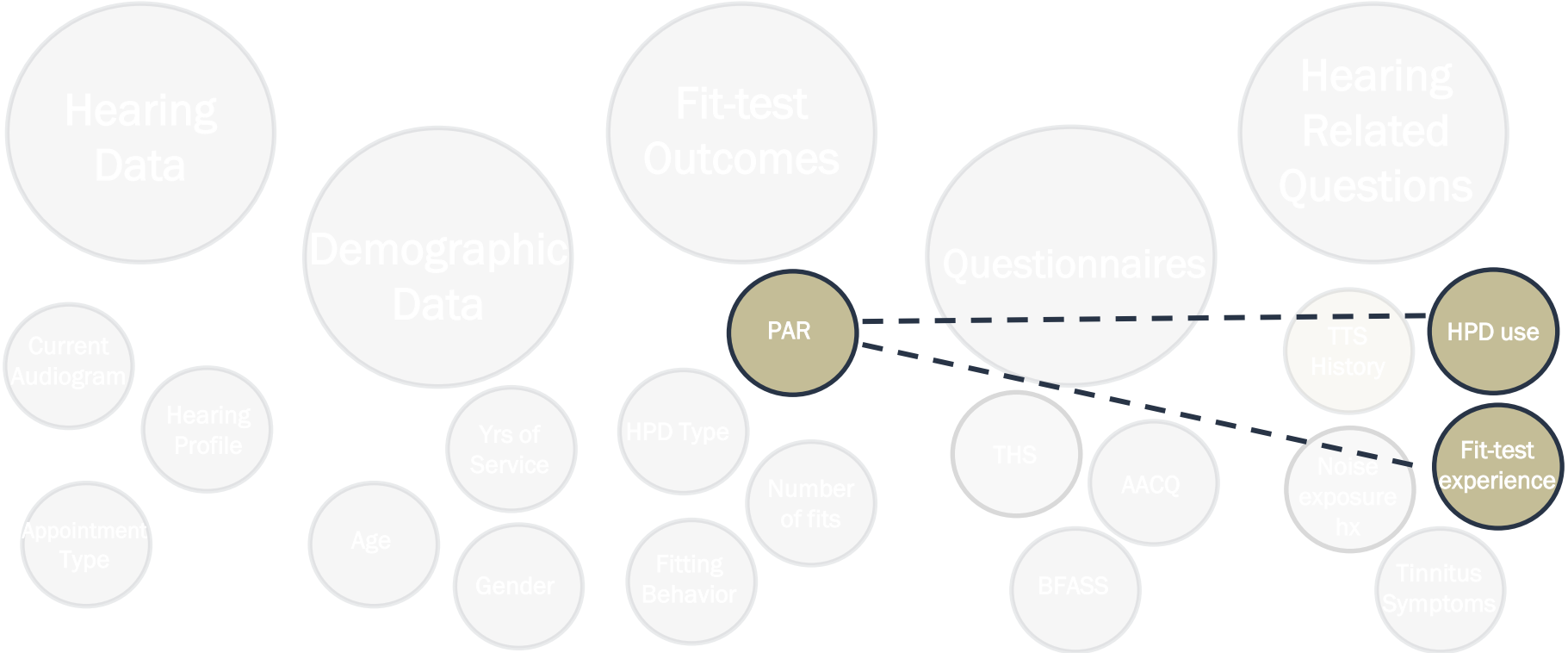

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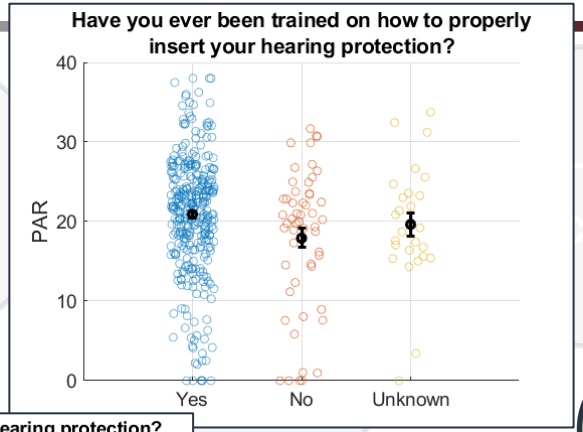
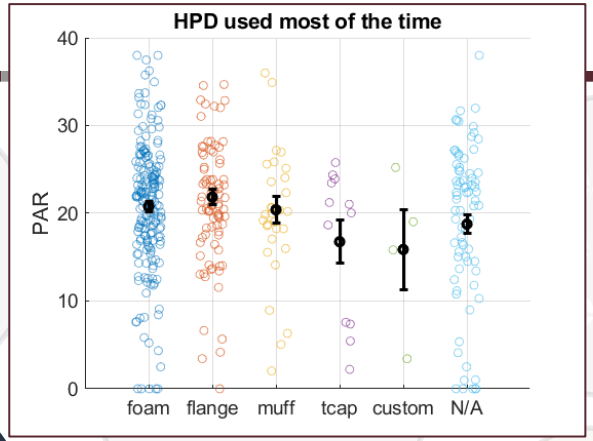
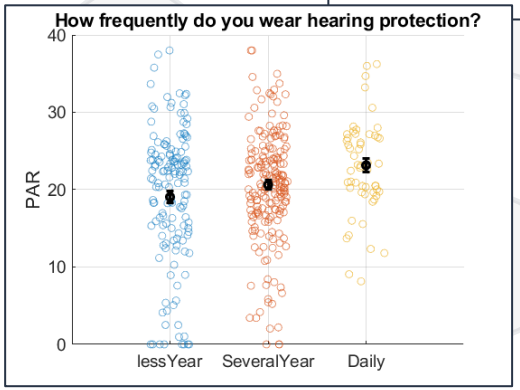
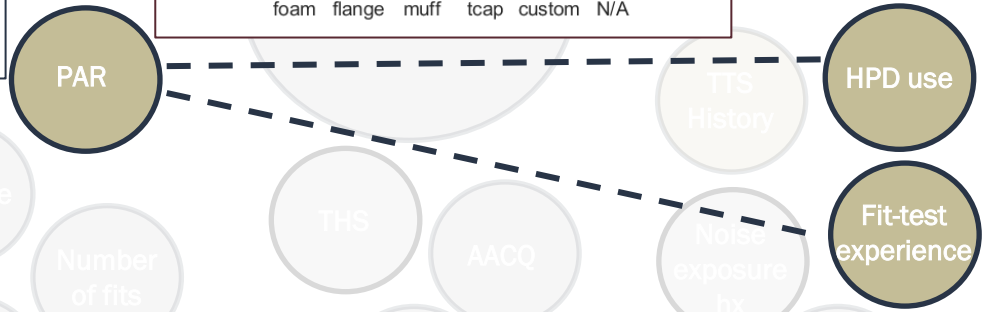
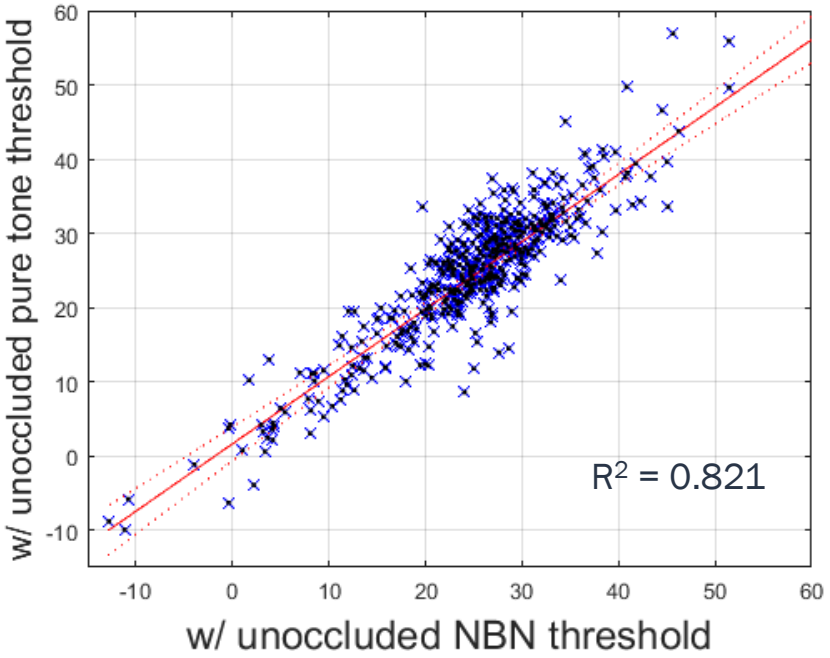








Use of Audiometric Thresholds



- Audhere PAR vs PAR extrapolated using DOEHRS-HC thresholds
  - **Better hearing threshold of L/R ears @ .5, 1, 2, kHz used to calculate unoccluded condition**
- Same occluded thresholds for both conditions
- Strong correlation between use of unoccluded NBN and pure tone threshold from audiogram

Next Steps

- Data collection
  - Expansion to Beta Site (Kimbrough Ambulatory Care Center, Ft. Meade, MD)
    - ✓ Multi-person boothless clinic (4-6 individuals tested simultaneously)
    - ✓ audhere used for annual testing + fit-testing
  - Onboarding of other AHP sites with WAHTS
  - Enroll sites using other HPD fit-test equipment

Conclusion

- Updates to DoD HCPs include a new requirement for HPD fit-testing
- This public health initiative is set to evaluate aspects associated with a service-wide rollout
- Ultimate goal is to provide actionable information that can be used to guide policy at the service level & to improve our understanding of the relationship between PAR and hearing health outcomes in the military.

Questions

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