

# Remote testing and treatment of hearing impairment: in and out of Africa

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Dave Moore

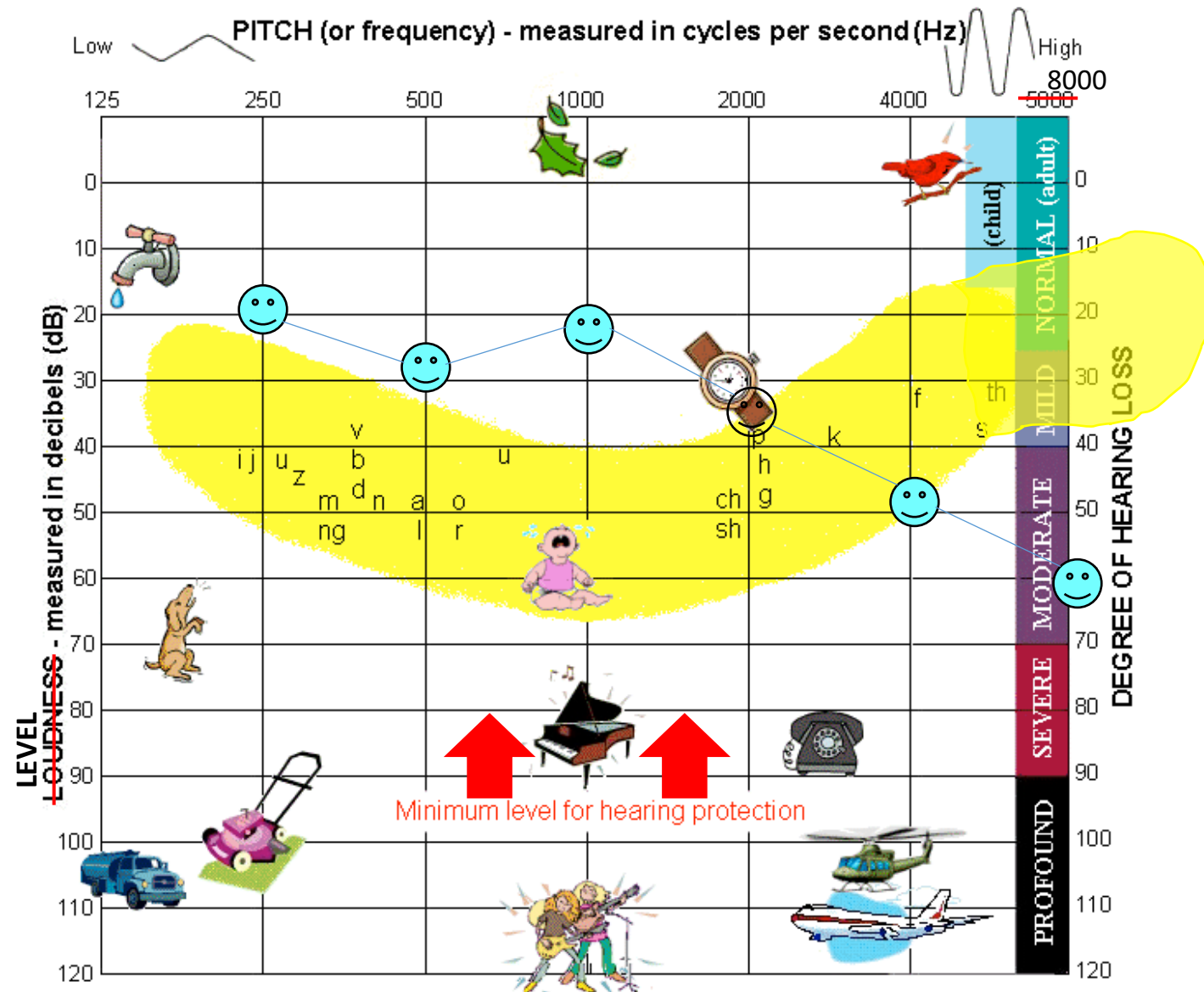
De Wet Swanepoel, Karina De Sousa, Herman Myberg (Pretoria, South Africa), Lina Motlagh-Zadeh, Lisa Hunter (CCHMC), Cas Smits (Amsterdam), Piers Dawes (Sydney), Kevin Munro (Manchester), Marcel Vlaming, Mark Edmondson-Jones (Nottingham)

Disclosure: David Moore is a paid scientific advisor to hearX Group

# Overview

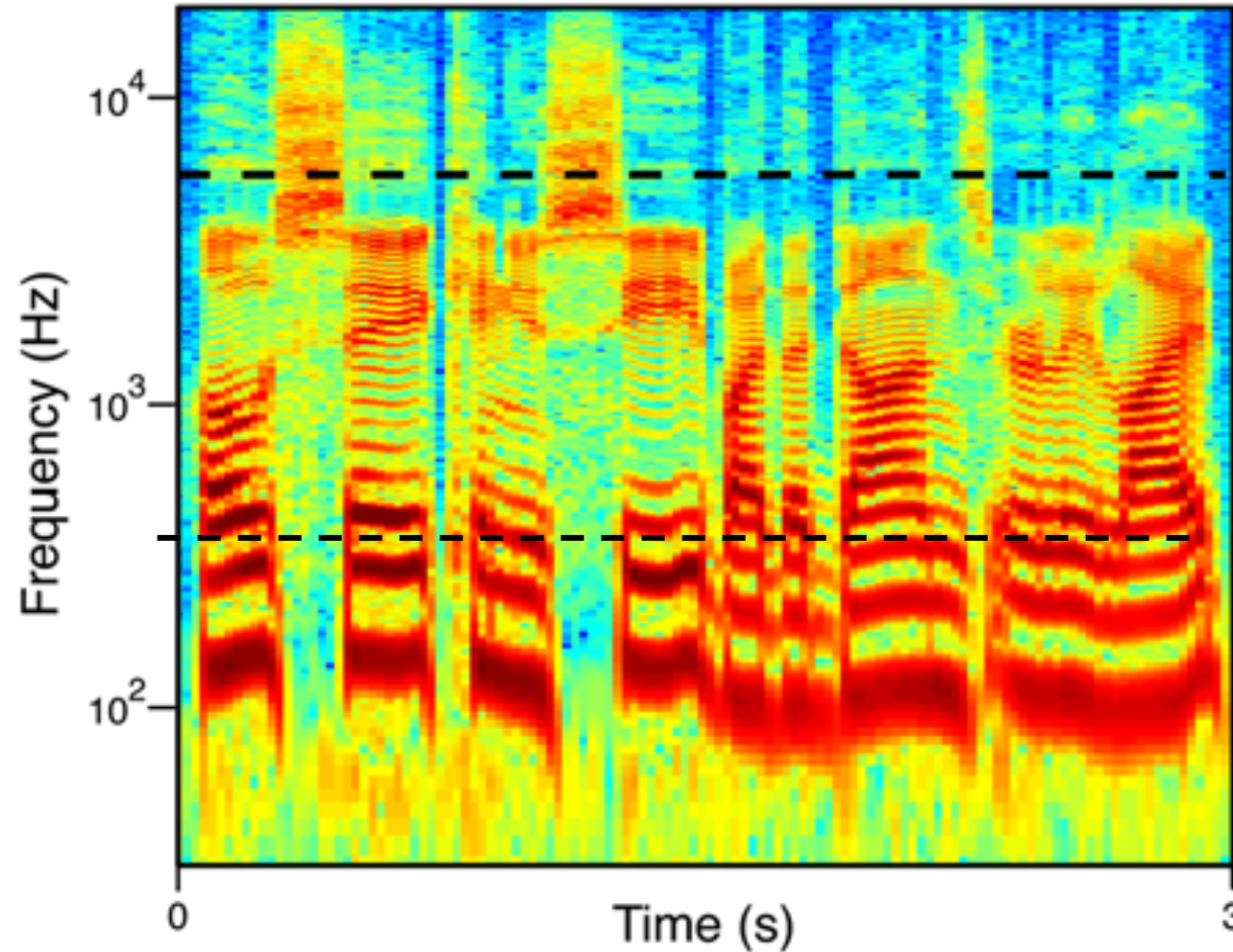
- Gold-standard audiogram hearing test needs to be extended
- Speech-in-noise testing needed for hearing evaluation
- Big-data research identifies links between diseases
- Smartphones can revolutionize (hearing) health care in low and middle income countries (LMICs)
- Remote fitting of hearing aids in Africa

# Audiometry



# Speech hearing

“Oh say can you see by the dawn’s early light”



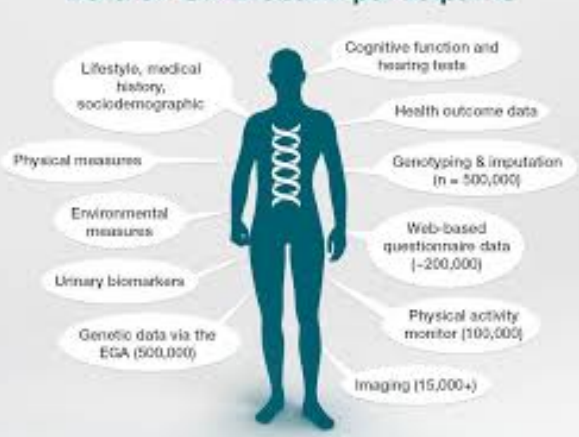
# UK Biobank

A research resource for the whole world

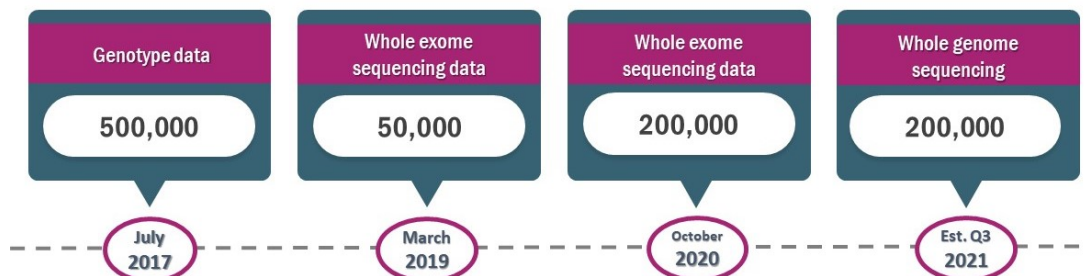


- Largest medical experiment: >500,000 people aged 40-70. <https://www.ukbiobank.ac.uk/>  
Initial data from 23 test centres (2006-10). Hearing questions and digits-in-noise (DIN) test
- DIN (N=185k) and questions (N=170 – 561k) were repeated on ‘smaller’ samples at ~6, 8 and 10 years after baseline assessment. Cognitive testing has followed a similar timetable
- Genetic analyses and MRI (structural, visual evoked and resting state fMRI) are available on sub-samples. MRI (N=50k) is followed up at ~2 years, coinciding with repeat hearing tests

## Data on UK Biobank participants



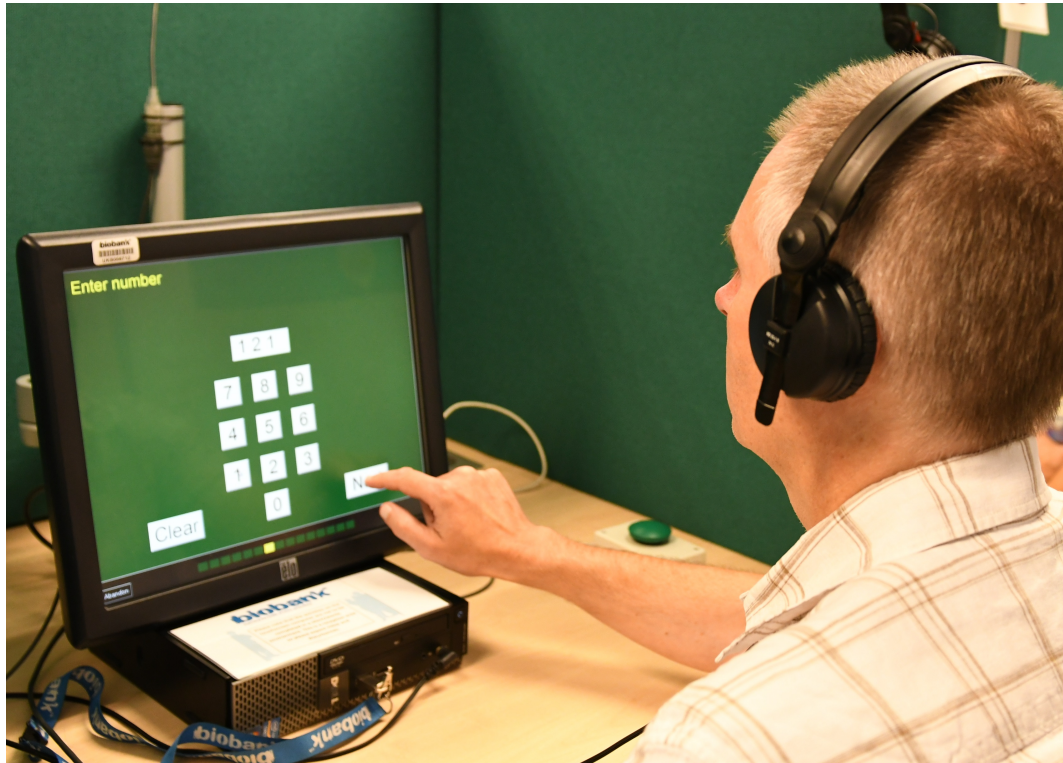
## Genetic data release timeline





# Digits-in-noise (DIN)

A remotely deliverable test for speech-in-noise hearing

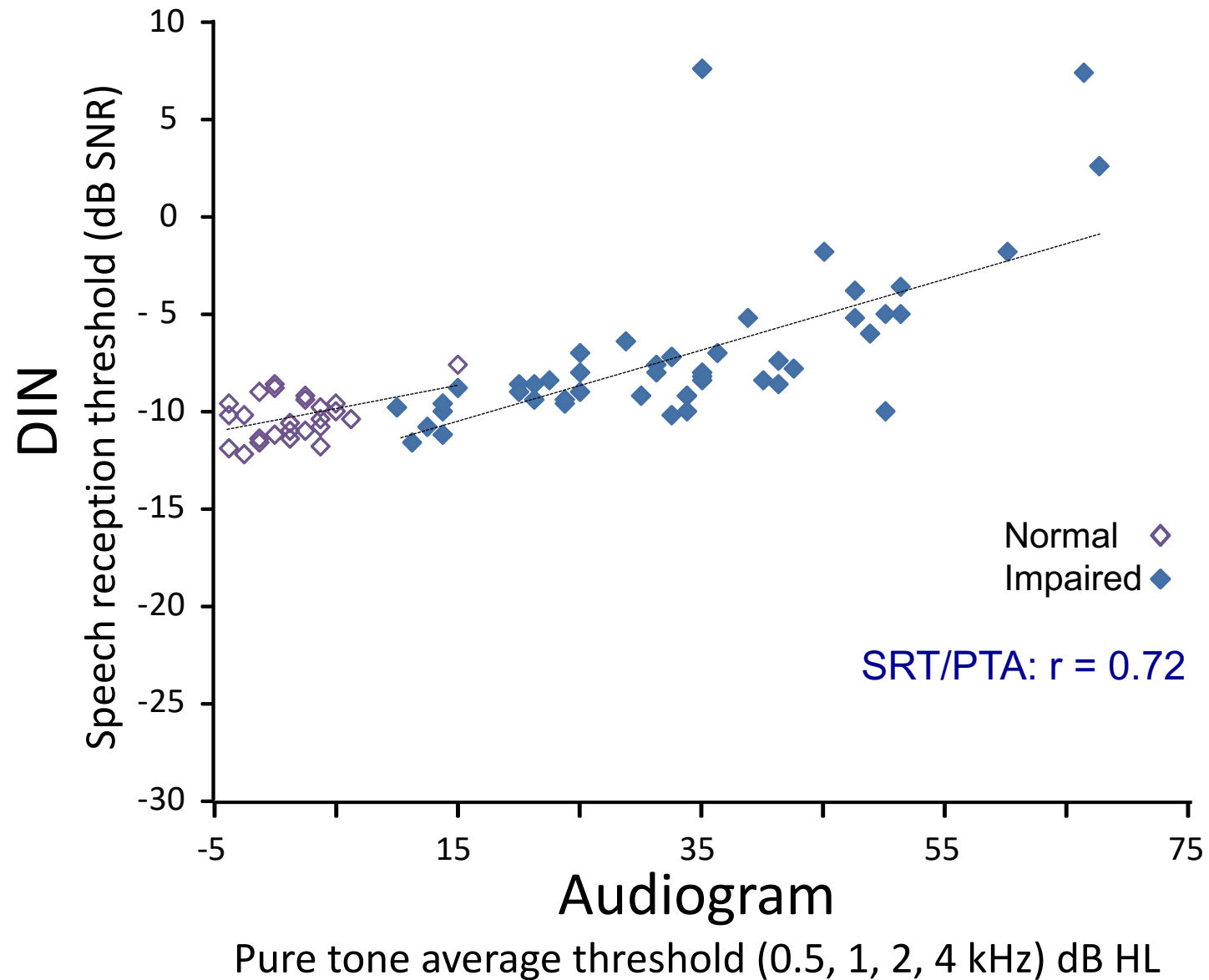


- Three spoken digits in steady, digit-shaped noise
- Adaptive staircase, 25 trials; About 3 min/ear
- Internet deliverable. Sound booth not needed
- Usable for young children ( $\geq 4$ -6 y.o.) and older adults
- Try it at

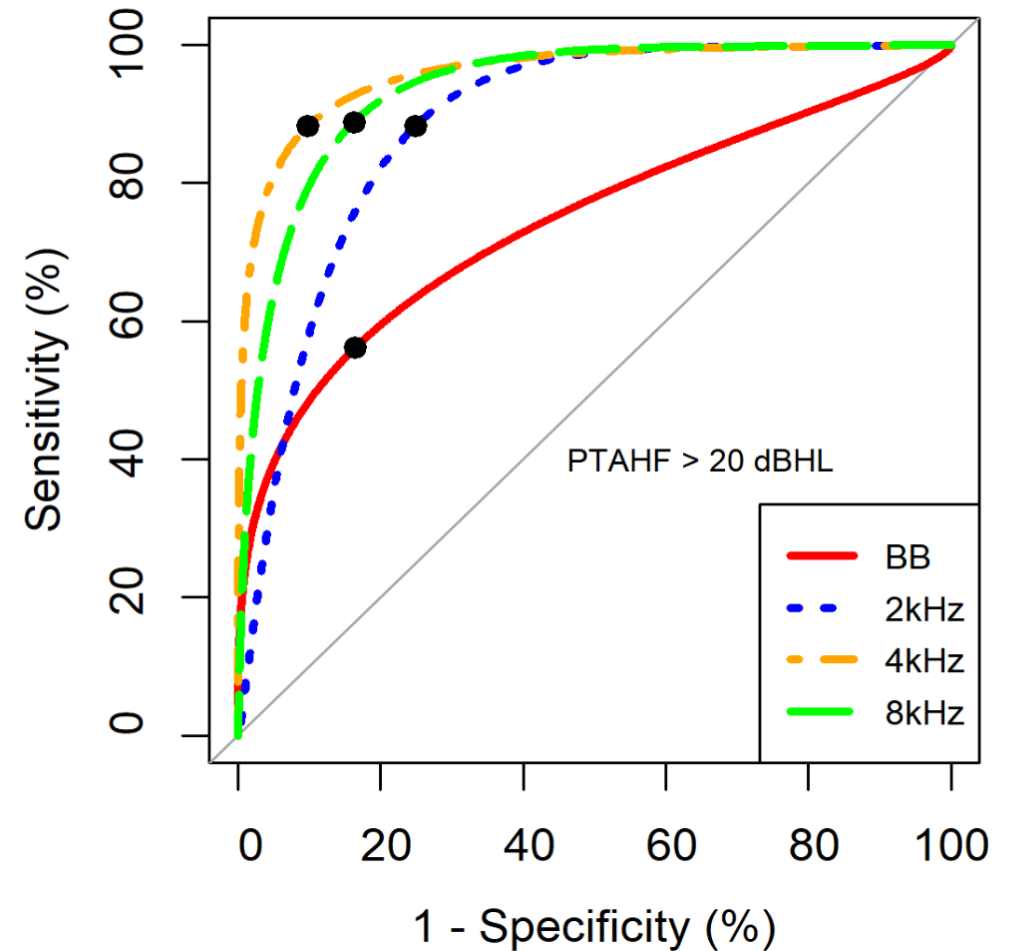
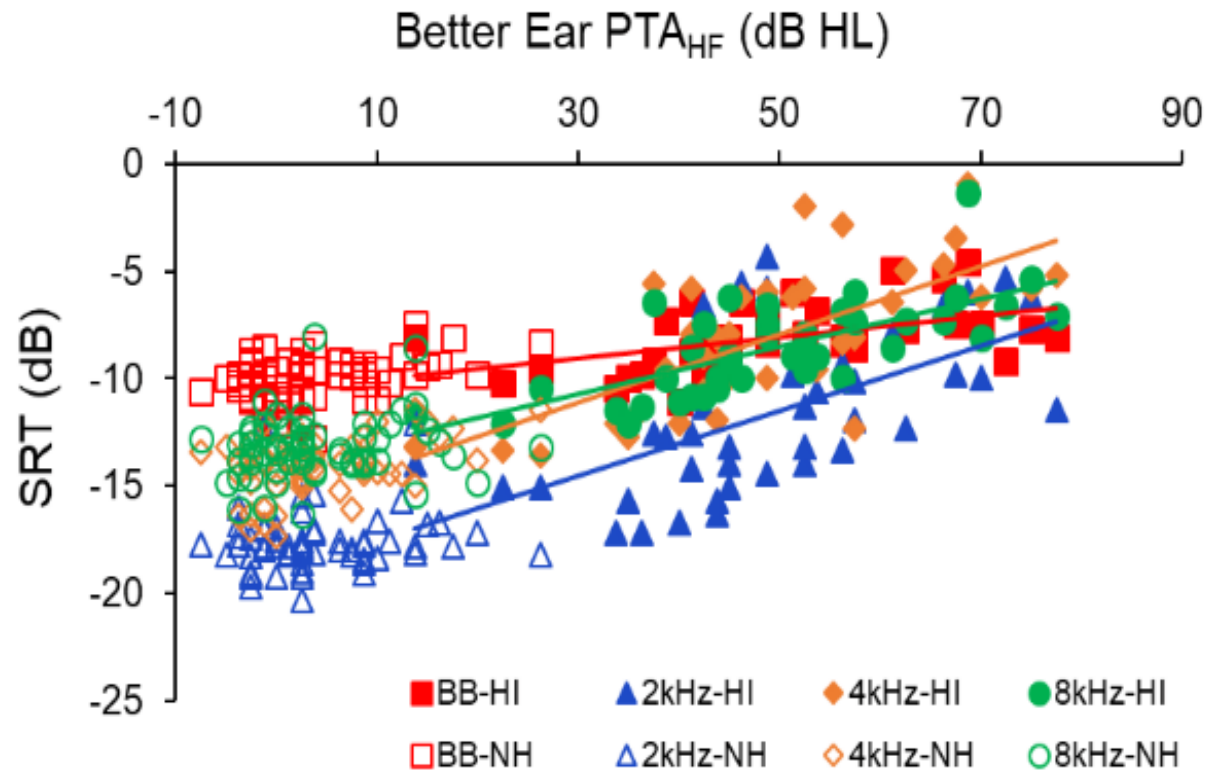
<https://computationalaudiology.com/din-demo/>

Smartphone delivery: hearX <https://www.youtube.com/watch?v=av-PdrzHn3I>  
hearX <https://www.youtube.com/watch?v=TlopgvZyNHQ>

# DIN correlates with audiogram



# Low-pass noise sensitizes DIN





# Hearing Aids



- Deregulation of hearing aids – President's Council of Advisors, 2015
- Remote fitting of hearing aids in Africa. NIH R21/R33 (pending), 2020

hearX hearing aid



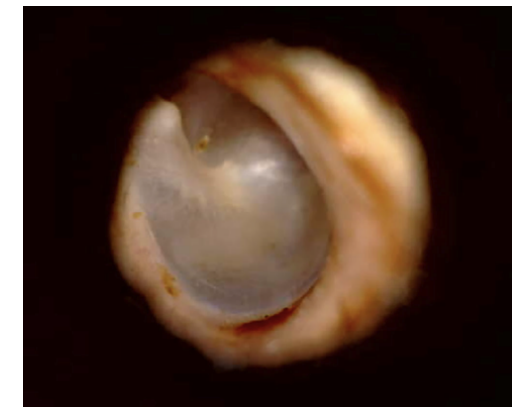
- Directional hearing
- Noise reduction
- Telecoil
- Autofit

# Hearing aids in LMICs

## Challenges and opportunities

80% of world hearing loss is in LMICs

- C: One audiologist per million people in subsaharan Africa  
O: Smartphone penetration + community (lay) health workers + autofit
- C: Affordability  
O: Smartphone 'brains' + falling price of hearing aids + social media economy
- C: Medical referral  
O: Smartphone checklist + onward referral + smartphone otoscope
- C: Scalability  
O: WHO + NIHR Global health networks



# Final thoughts

- Digital technology has enabled a step-change in hearing evaluation and intervention
- Big-data approaches are well-suited to many aspects of interdisciplinary RPS research
- There are an almost unimaginable number of ways in which smartphones can make a step change in global health
- A career in research can lead in many amazing directions!