CONNECTED TECHNOLOGIES FOR HEARING HEALTH AWARENESS, ACCESS AND AFFORDABILITY

Phonak eAudiology series

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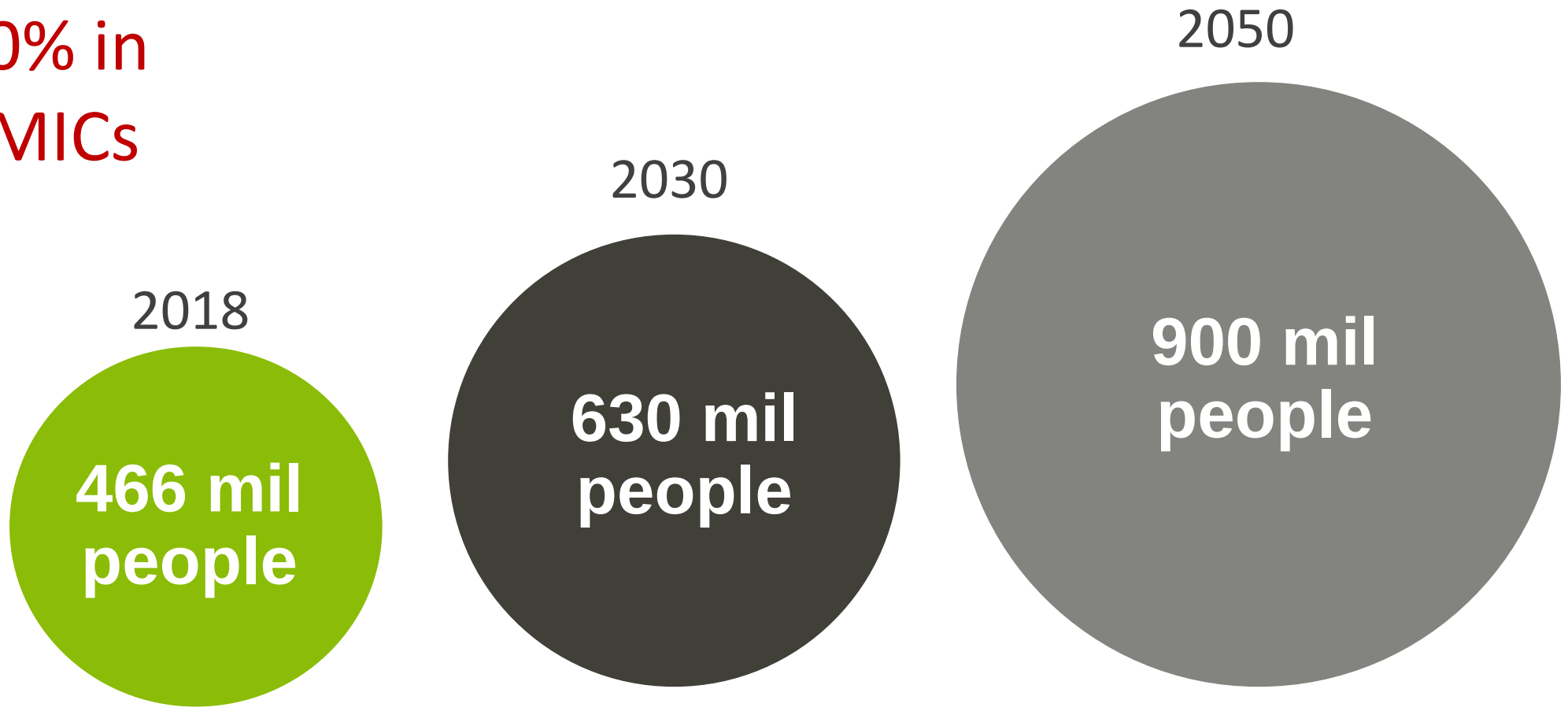
OUTLINE

- Hearing loss is a global epidemic
- Hearing care is inaccessible
- The promise of connected technologies
- Example 1: Community-based care
- Example 2: Consumer self-test & connect
- Conclusion

A GROWING GLOBAL EPIDEMIC

90% in LMICs



Adapted from World Health Organization (2018).

World Health Organization. (2018). *WHO global estimates on prevalence of hearing loss*. Retrieved from https://www.who.int/pbd/deafness/estimates/en/ on January 31st, 2019

A GROWING GLOBAL EPIDEMIC

Hearing loss – a growing global epidemic (millions)			
Region	**2018***	**2030***	**2050***
High-income countries	46	58	72
Latin America & Caribbean	40	56	87
Middle-East and North Africa	16	24	44
Sub-Saharan Africa	49	71	133
South Asia	131	176	267
Central / East Europe & Central Asia	34	40	46
East Asia	100	139	189
East Asia and Pacific	47	64	95

*estimated amount of people with hearing loss in different global areas until 2050

Adapted from World Health Organization (2018).

World Health Organization. (2018). *WHO global estimates on prevalence of hearing loss*. Retrieved from https://www.who.int/pbd/deafness/estimates/en/ on January 31st, 2019

A GROWING GLOBAL EPIDEMIC

- Major global contributor to the burden of disease
- In 2017 – 1.3 billion people affected (James et al. 2018)
- 5th leading cause of disability globally across all age YLDs

2017 rank – leading causes of disability

1. Low back pain
2. Headache disorders
3. Depressive disorders
4. Diabetes
5. Age-related hearing loss

Adapted from Findings from the Global Burden of Disease Study (2017)

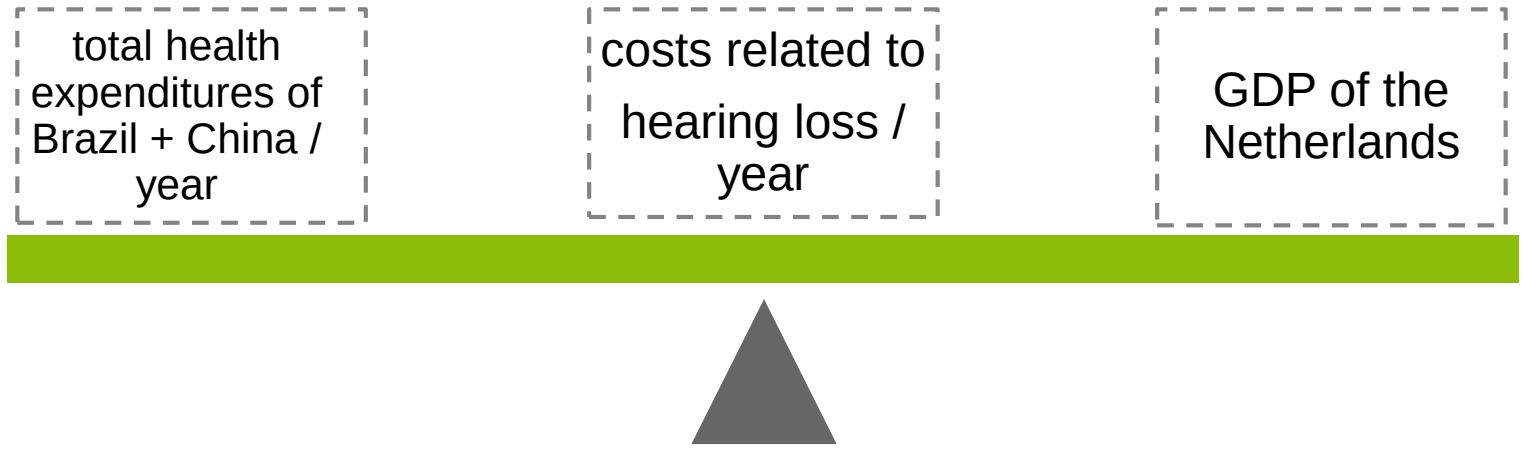
Institute for Health Metrics and Evaluation (IHME). (2018). Findings from the Global Burden of Disease Study 2017. Seattle, WA: IHME. Retrieved from http://www.healthdata.org/sites/default/files/files/policy_report/2019/GBD_2017_Booklet.pdf on January 31st, 2019

James, S. L., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., Abbasi, N., … Murray, C. J. L. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet, 392(*10159), 1789–1858. https://doi.org/10.1016/S0140-6736(18)32279-7

AN EXPENSIVE GLOBAL EPIDEMIC

Unaddressed hearing loss poses a high cost for the global economy

$ 750 billion per year



Adapted from World Health Organization (2018).

World Health Organization. (2018). *Deafness and hearing loss*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss on February 18th, 2019

HEARING HEALTH IS INACCESSIBLE

AWARENESS CHALLENGE

FUNDERS

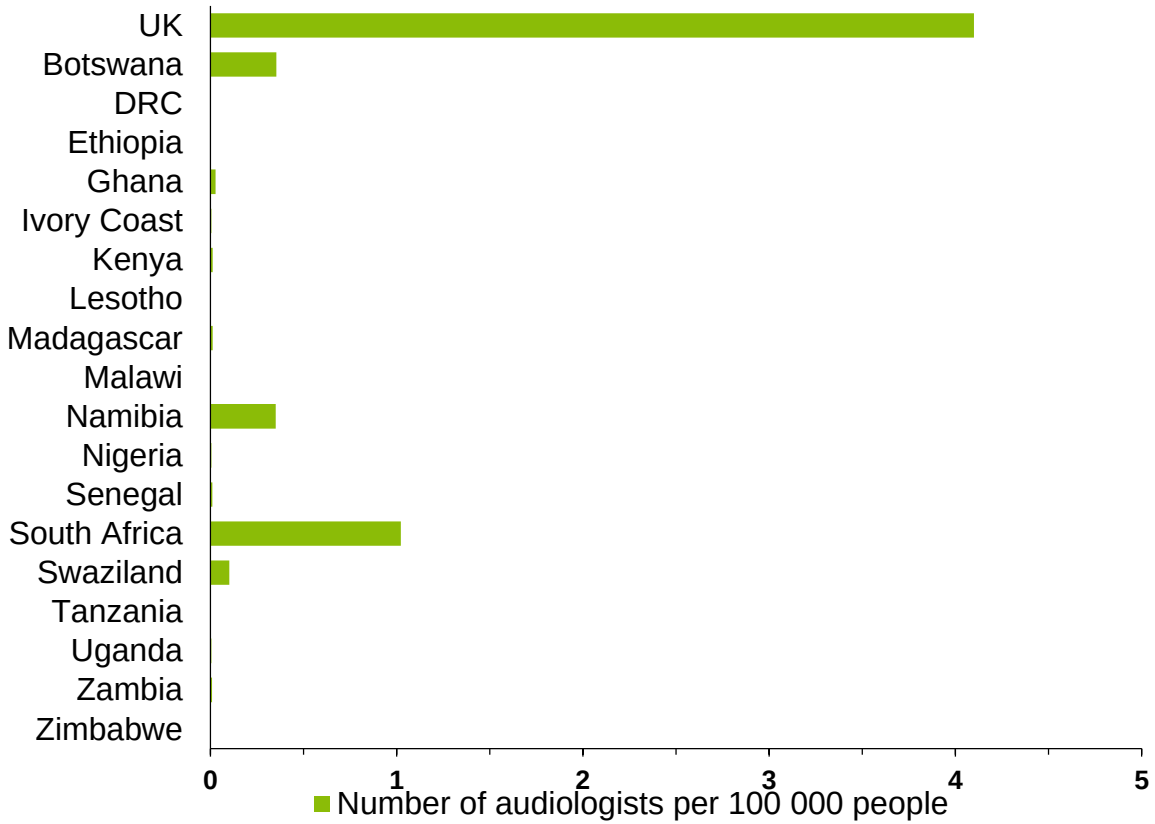
HEALTH PROFESSIONALS

PUBLIC AWARENESS

NGO's

GLOBAL HEALTH

ACCESS - HCP CHALLENGE



Adapted from Fagan & Jacobs (2018)

In sub-Saharan Africa: audiologist to people ratio = 1:1000000

Fagan, J. J., & Jacobs, M. (2009). Survey of ENT services in Africa: need for a comprehensive intervention. *Global Health Action,* 1–7. https://doi.org/10.3402/gha.v2i0.1932

Mulwafu, W., Ensink, R., Kuper, H., & Fagan, J. (2017). Survey of ENT services in sub-Saharan Africa: little progress between 2009 and 2015. *Global Health Action, 10*, 1–7. https://doi.org/10.1080/16549716.2017.1289736

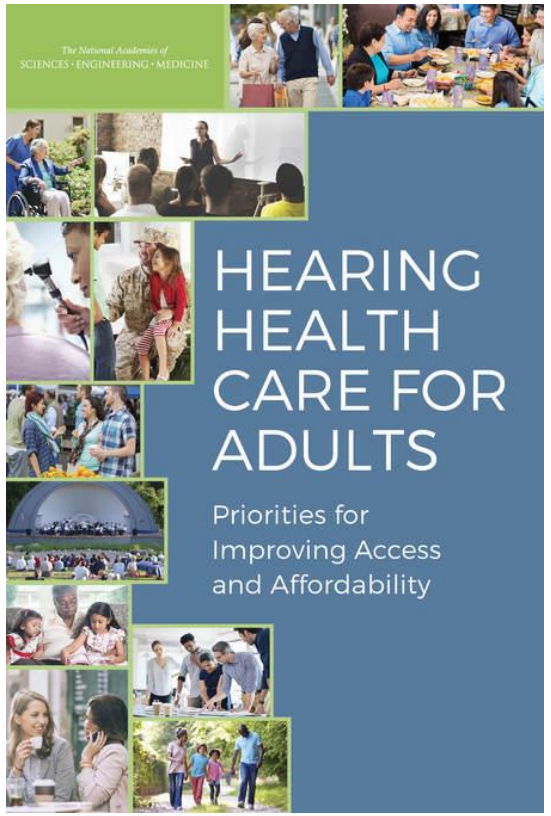
ACCESS - HCP CHALLENGE

Projected demand for audiology services over next 30 years (US)

Audiologists to serve the required need:

2015 – 80%

2030 – 64%



Key message:

Improve access to hearing health care for underserved and vulnerable populations

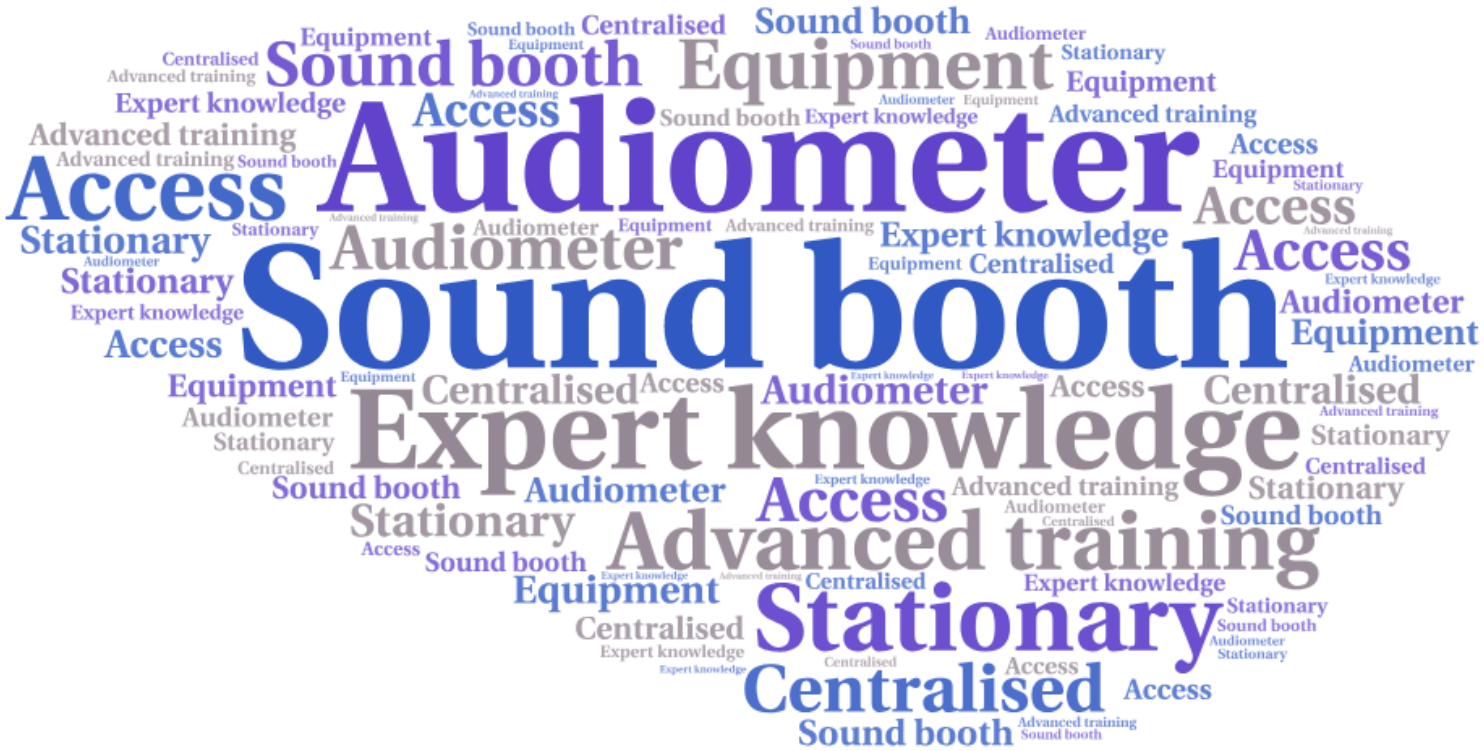
Windmill, I., and B. Freeman. 2013. Demand for audiological services: 30-yr projections and impact on academic programs. Journal of American Academy of Audiology 24, no. 5: 407-416.

Hearing Health Care for Adults: Priorities for Improving Access and Affordability (2016). National Academies Press

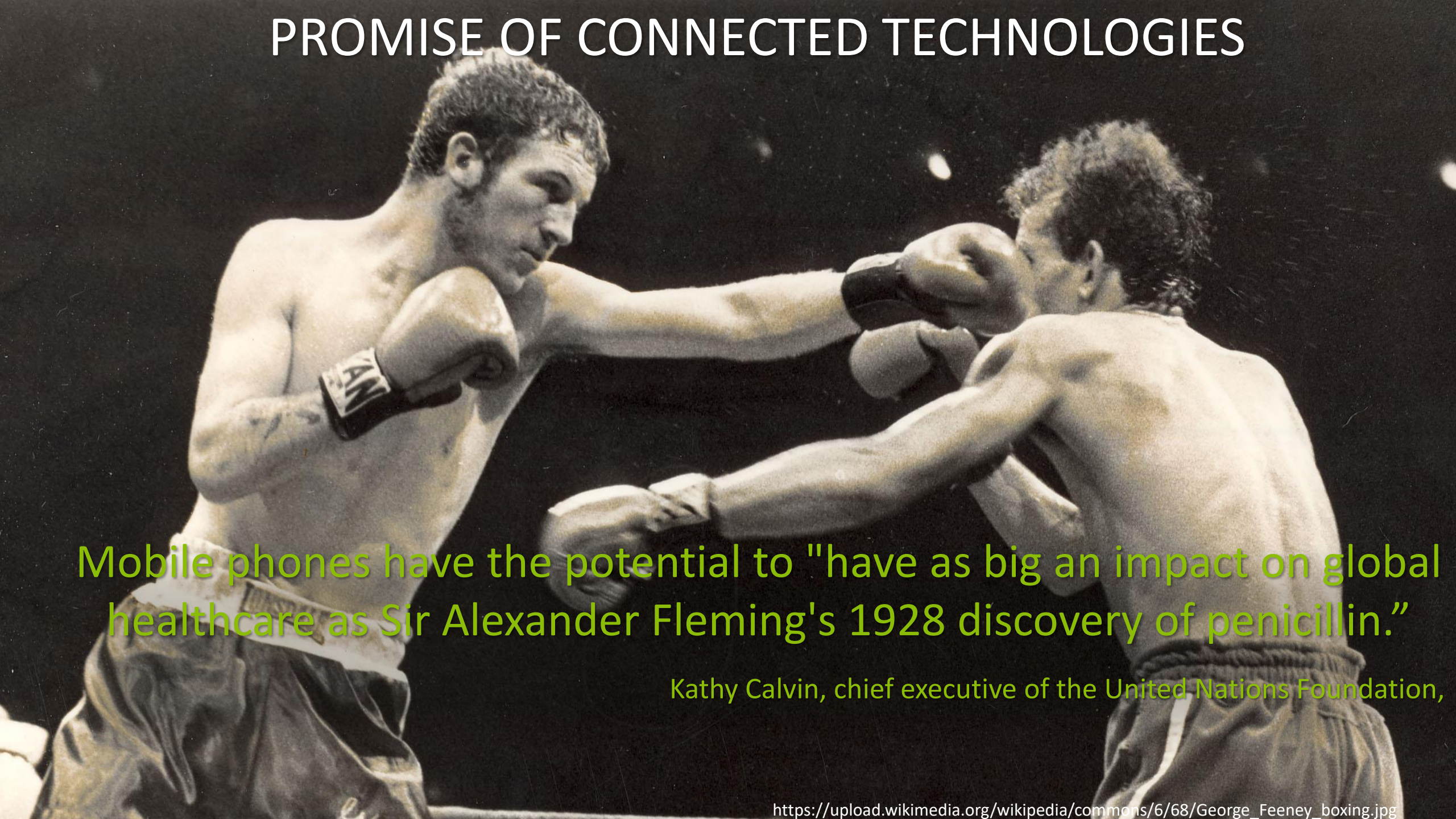
ACCESS - SERVICE CHALLENGE

BARRIERS:

- Equipment expense
- Expertise required
- Efficiency challenges
- Centralized services
- Delayed access



PROMISE OF CONNECTED TECHNOLOGIES



Mobile phones have the potential to "have as big an impact on global healthcare as Sir Alexander Fleming's 1928 discovery of penicillin."

Kathy Calvin, chief executive of the United Nations Foundation,

https://upload.wikimedia.org/wikipedia/commons/6/68/George_Feeney_boxing.jpg

CONNECTIVITY

Mobile subscriptions now exceed the global population (>8 billion)

From <0.5 billion in 2000 to >8 billion in 2015

More than 90% of the world's population have access to a mobile signal

2012 Information and Communications for Development : Maximizing Mobile. http://hdl.handle.net/10986/11958

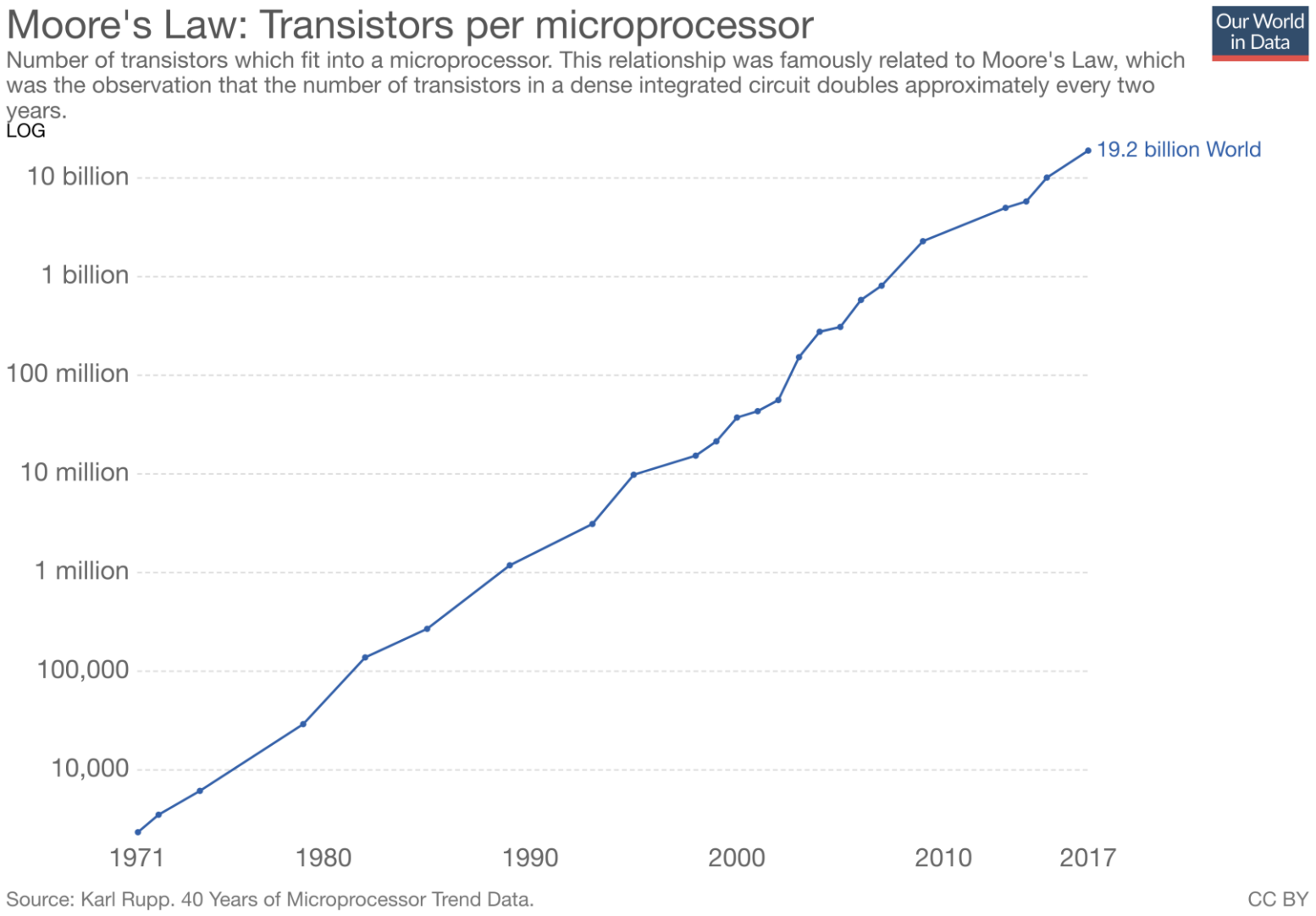
"Greater access to mobile technology is associated with improvements in quality of life"

GSMA, 2018

Mobile connectivity can drive hearing health penetration in LMICS

EXPONENTIAL TECHNOLOGY

Technologies where the power and/or speed are doubling, and/or the cost is halved every year



https://www.karlrupp.net/2015/06/40-years-of-microprocessor-trend-data/

Today half the adult population has a smartphone in 2020 80% will have a *”supercomputer in their pocket”*

(The Economist, 2015)

CONNECTED TECHNOLOGIES

1. Power of integrated mHealth
2. Scale of affordable decentralised access
3. Inclusion of simplicity & quality control
4. Advantage of smart data-driven solutions

TEAM

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Herman Myburgh (UP project co-lead)
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Claude Laurent (Co-investigator, Sweden)
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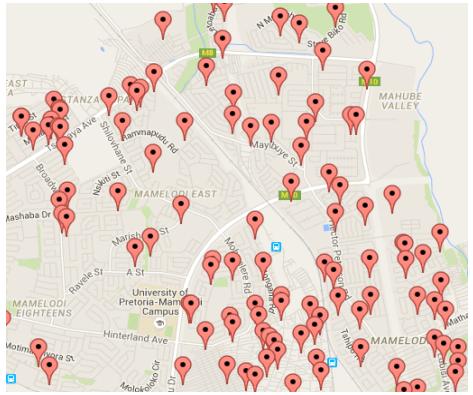
Shouneez Yousuf (PhD student)
Josefin Sandstrom (PhD student)
Karina Swanepoel (PhD student)

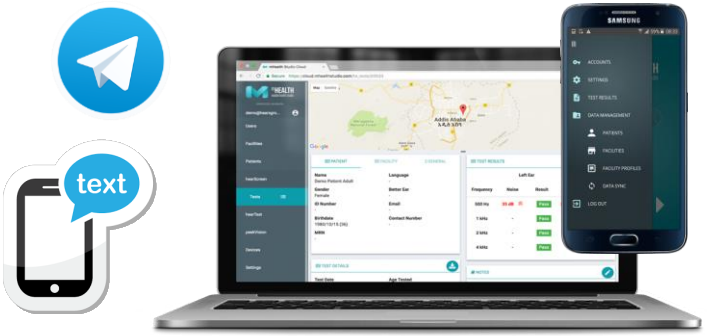
Disclosure: Co-founder and advisor of hearX Group

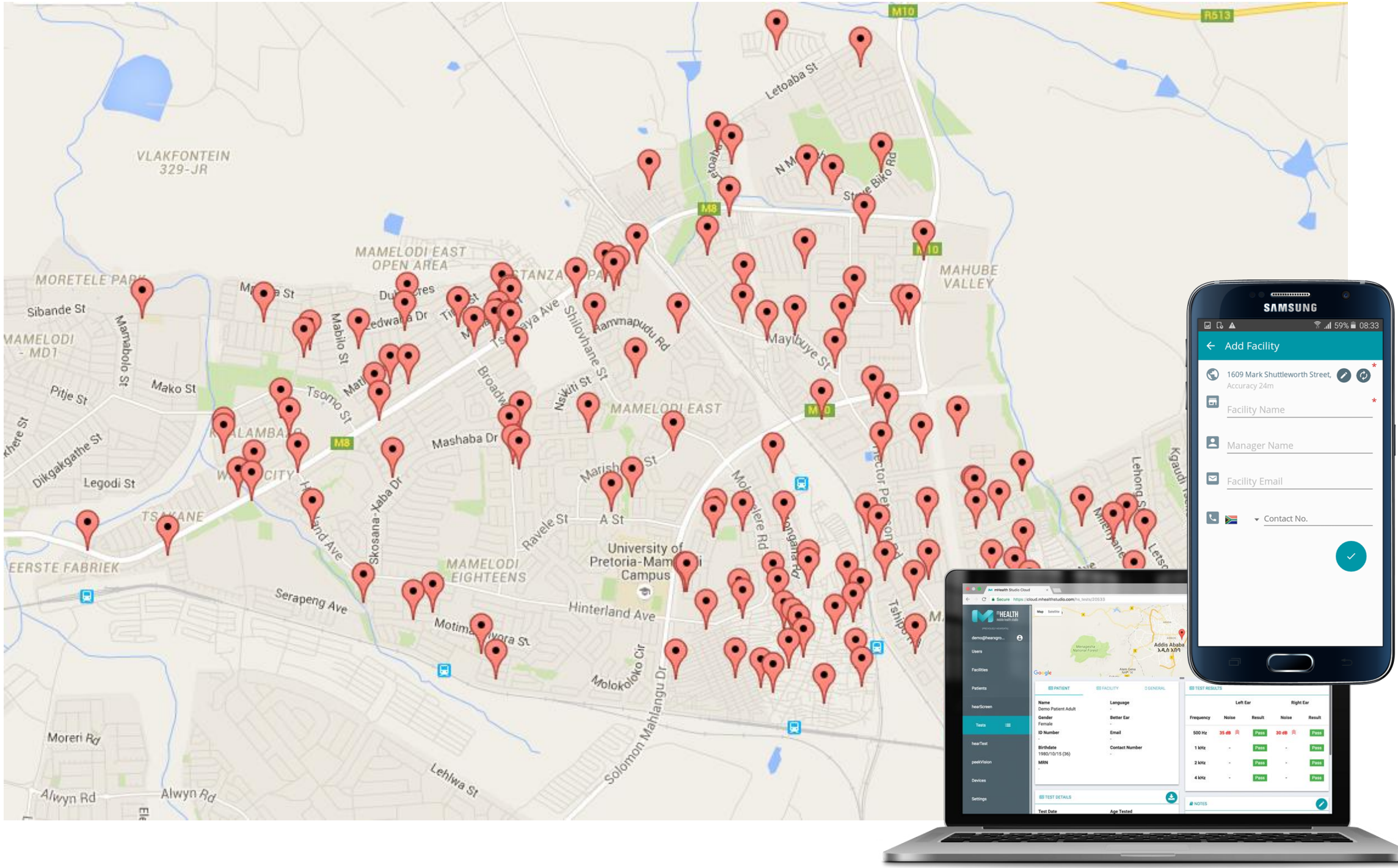
EXAMPLE 1: COMMUNITY-BASED CARE

ECD mapping → Community screening → PHC triage & diagnose → PHC fitting

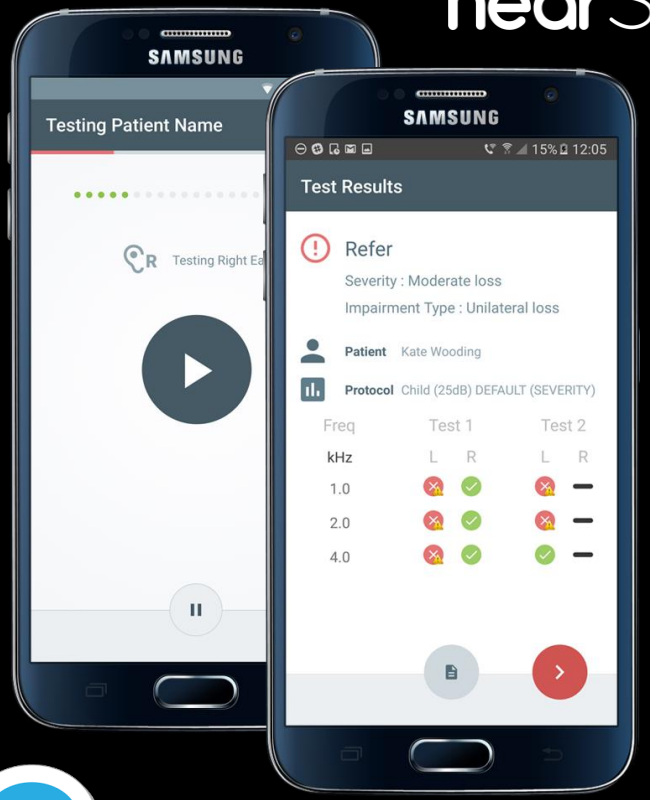


Data capturing, monitoring, surveillance, referral, reporting, directing care, tracking

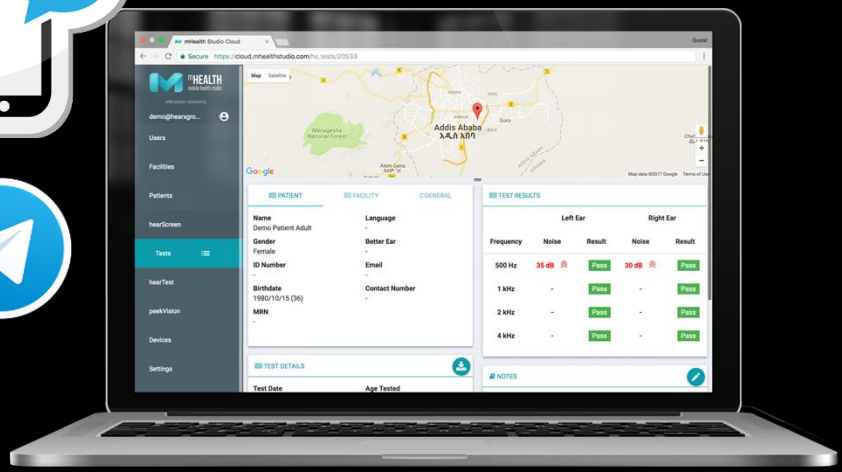



VLAKFONTEIN
329-JR
MAMELODI EAST
OPEN AREA
MAHUBE
VALLEY
MAMELODI EAST
MAMELODI
EIGHTEENS
TSAKANE
EERSTE FABRIEK
University of
Pretoria-Mam
Campus
Letoaba St
Steve Biko Rd
Sibande St
Mako St
Pitje St
Legodi St
Tsomo St
Mashaba Dr
Ravele St
A St
Hinterland Ave
Serapeng Ave
Skosana-Xaba Dr
Mabilo St
Shilovhane St
Hammapudu Rd
Maybuye St
Molokoloko Cir
Solomon Mahlangu Dr
Moreri Rd
Alwyn Rd
Lehlwa St
M10
M8
R513
SAMSUNG
Add Facility
1609 Mark Shuttleworth Street,
Accuracy 24m
Facility Name
Manager Name
Facility Email
Contact No.

hearScreen®


SAMSUNG
Testing Patient Name
Testing Right Ear
SAMSUNG
15% 12:05
Test Results
Refer
Severity : Moderate loss
Impairment Type : Unilateral loss
Patient Kate Wooding
Protocol Child (25dB) DEFAULT (SEVERITY)
Freq
Test 1
Test 2
kHz
L R L R
1.0
2.0
4.0


text


mHealth Studio Cloud
mHEALTH
Users
Facilities
Patients
hearScreen
Tests
hearTest
peekVision
Devices
Settings
Addis Ababa
PATIENT
FACILITY
GENERAL
TEST RESULTS
Name
Demo Patient Adult
Gender
Female
ID Number
Birthdate
1980/10/15 (36)
MRN
Language
Better Ear
Email
Contact Number
Left Ear
Right Ear
Frequency
Noise
Result
500 Hz
1 kHz
2 kHz
4 kHz
Pass
TEST DETAILS
Test Date
Age Tested
NOTES

CLINICALLY VALIDATED

	hearScreen/Test
Accurate	✓
Time efficient	✓
Cost-effective	✓
Quality control	✓
Laypersons	✓

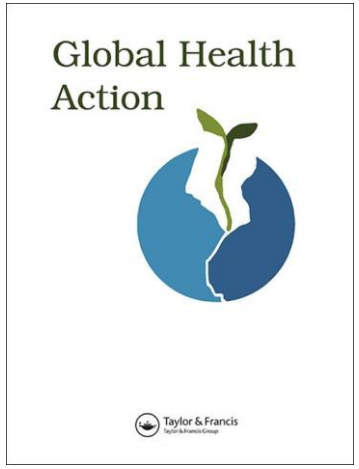
(Swanepoel et al, 2014; Mahomed et al.. 2016; Yousuf-Hussein et al. 2016; Van Tonder et al. 2018)

hearTest™ audiometry app

6818 screened at ECD

503 rescreened at PHC

180 confirmed with a HL



Hussein, S. Y., Swanepoel, D. W., Mahomed, F., & de Jager, L. B. (2018). Community-based hearing screening for young children using an mHealth service-delivery model, *Global Health Action, 11(*1), 1–8. https://doi.org/10.1080/16549716.2018.1467077.

CONCLUSION:

- CWs can detect children affected by hearing loss using mHealth technologies
- Asynchronous eHealth with connected technologies allow:

  i) Active noise monitoring, ii) quality indices of test operators and iii) cloud-based data management and iv) referral features

Growing impact in communities > 30 000 kids

EARS & EYES FOR EDUCATIO

Hearing screenings	5901
Referral rate	5.5% (n=325)
1st line f-up rate	90% (n=292)
Diagn referrals	34.2% (n=100)
Attend diagn apptmnt	73% (n=59)
Confirmed HL	71% (n=42)

hearX group

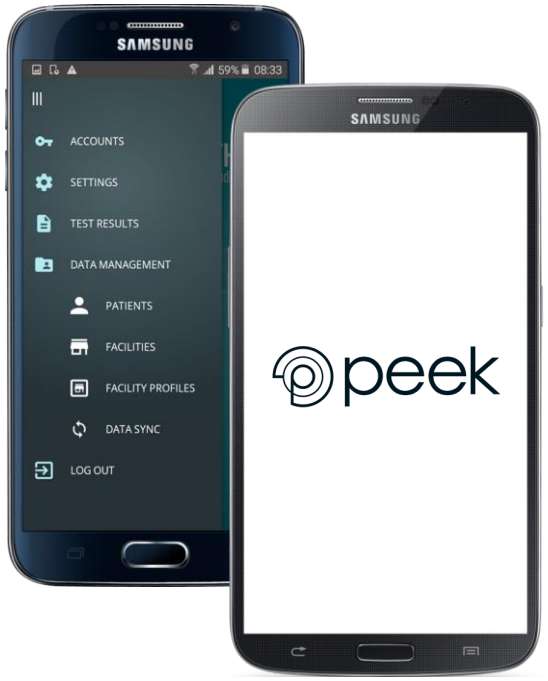
Carel du Toit

HEAR THE WORLD FOUNDATION
a Sonova Group initiative

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

peek

Vision and Health for Everyone



EXAMPLE 2: CONSUMER TEST & CONNECT

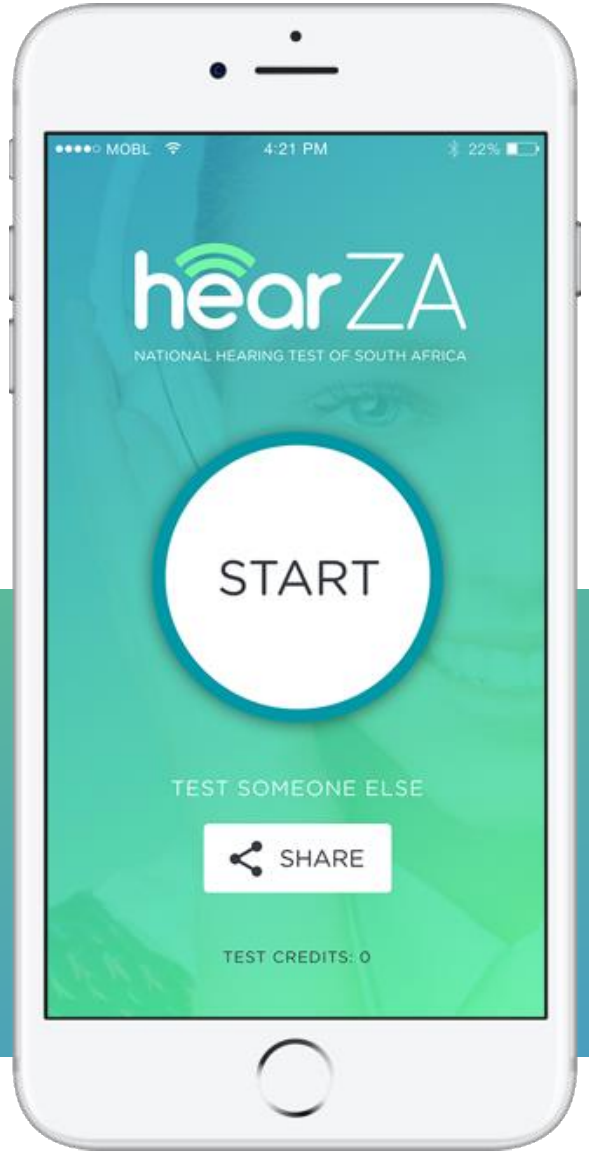
hearZA

NATIONAL HEARING TEST OF SOUTH AFRICA

Research & validation, University of Pretoria

ANDROID APP ON Google play

Available on the App Store



EXAMPLE 2: CONSUMER TEST & CONNECT

- Digits-in-noise SRT test on a smartphone
- Unlike an audiogram, this test does not require calibration
- Highly correlated with pure tone audiometry with sensitivity and specificity up to 90%
- Can be completed in 3 minutes
- More ecologically valid test than audiogram

(Potgieter et al. 2016; 2018; De Sousa et al. 2018)

AIMS

1. Accurate detection of hearing loss
2. Strategic public awareness tool
3. Personalized hearing health tracking
4. Linking to hearing health providers
5. In-app decision support (Ida telecare)

1. ACCURATE TESTING

Sens/Spec =
95% / 87%

DEVELOPMENT

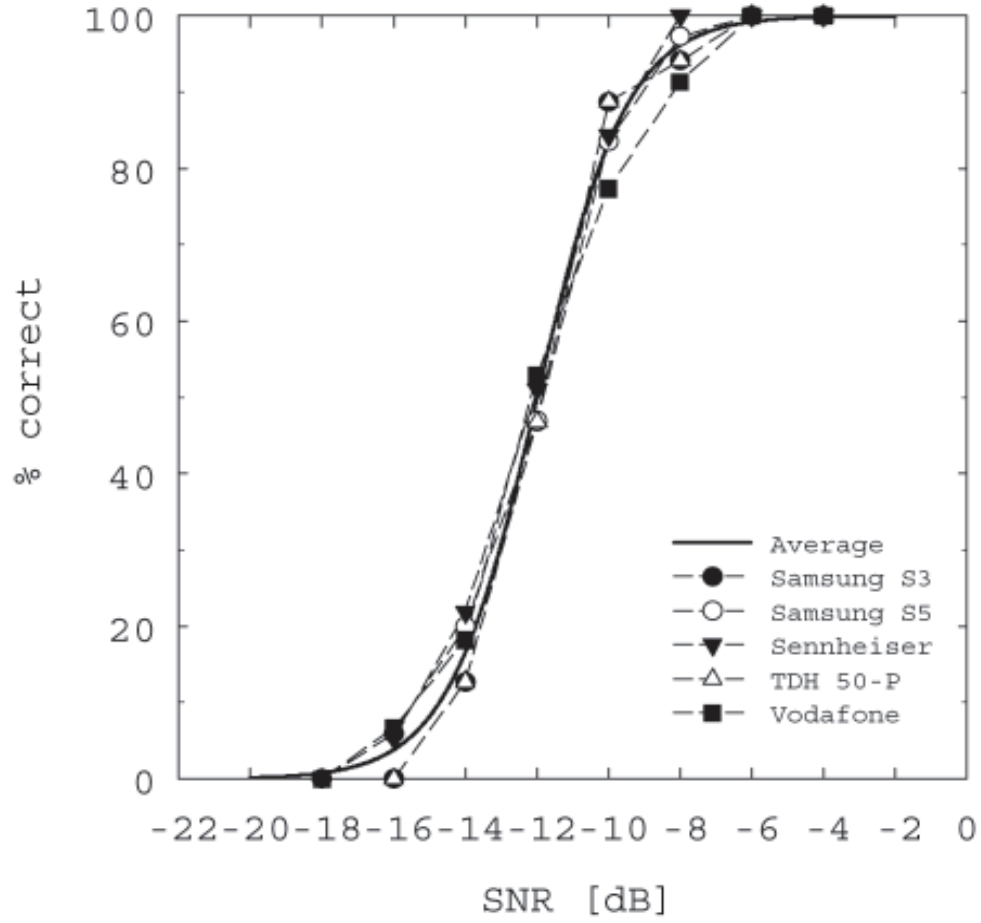
1. Phase I: Recording and equalization of the digits
2. Phase II: Development of the smartphone application and test procedures
3. Phase III: Smartphone digits-in-noise test headphone type effect and norms

Potgieter, J., Swanepoel, D. W., Myburgh, H. C., Hopper, T. C., & Smits, C. (2016). Development and validation of a smartphone-based speech-in-noise hearing test in South African English. *International Journal of Audiology,* 55(7), 405-411.

4. Phase IV: Performance of EAL speakers on the smartphone digits-in-noise test compared to native English speakers.

Potgieter, J., Swanepoel, D. W., Myburgh, H. C., & Smits, C. (2018). Smartphone digits-in-noise hearing test: performance of English additional language speakers. *Ear and Hearing.*

1. ACCURATE TESTING



No signf effect (p=0.84)

Potgieter JM (2017). Doctoral thesis. https://repository.up.ac.za/handle/2263/63731

2. PUBLIC AWARENESS TOOL

3. HEARING HEALTH TRACKING

- Personalized hearing score
- Annual in-app reminders
- Hearing scoreboard

4. LINKAGES TO HEARING CARE

PARTNERSHIP WITH ASSOCIATIONS

National initiative

REFERRAL DATABASE

In-app referral to closest provider

Secure cloud-based referral system

±400 practices

SASLHA
South African Speech-Language-Hearing Association

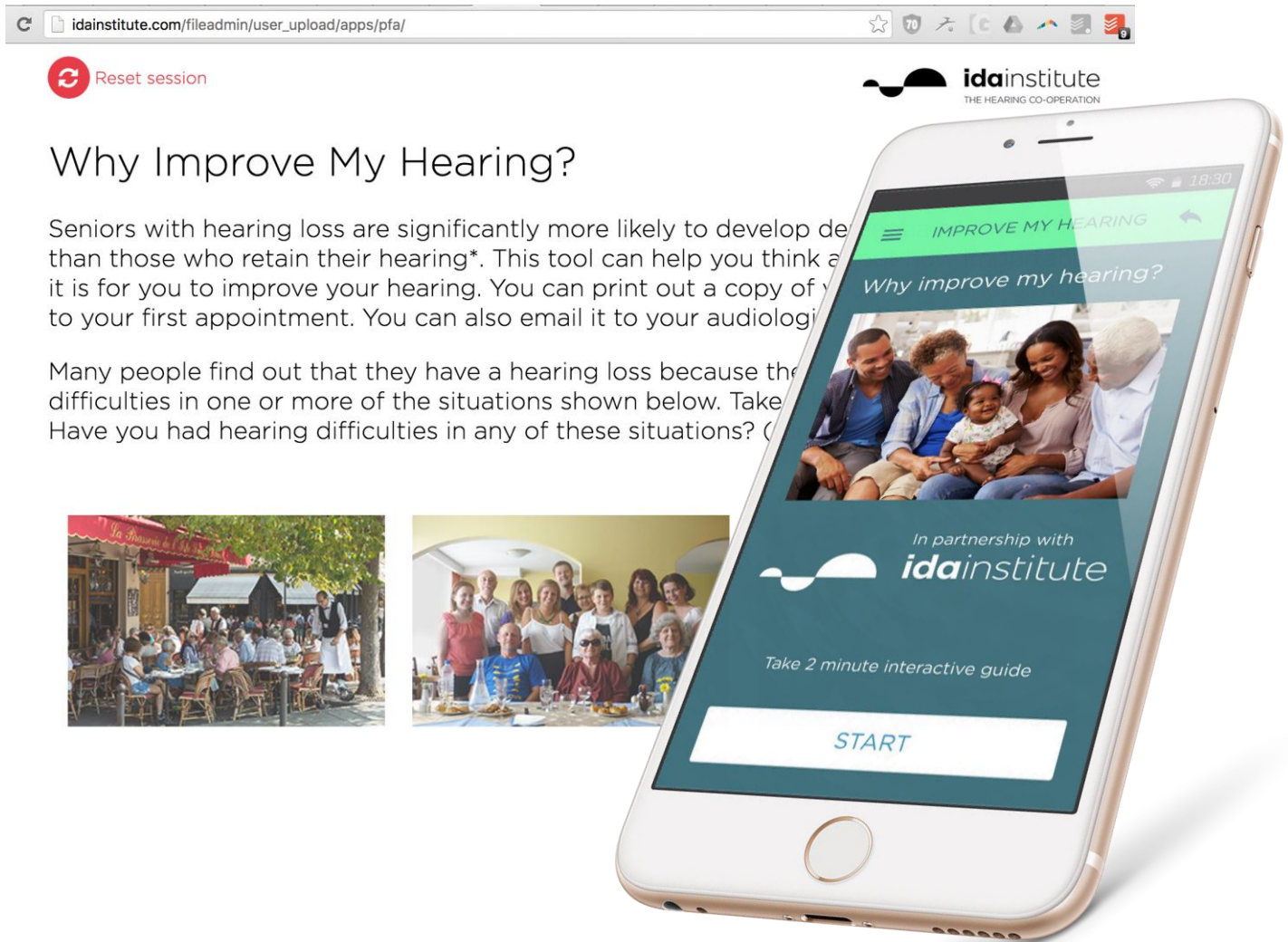
South African Association of Audiologists

5. DECISION-SUPPORT

Ida Telecare tools

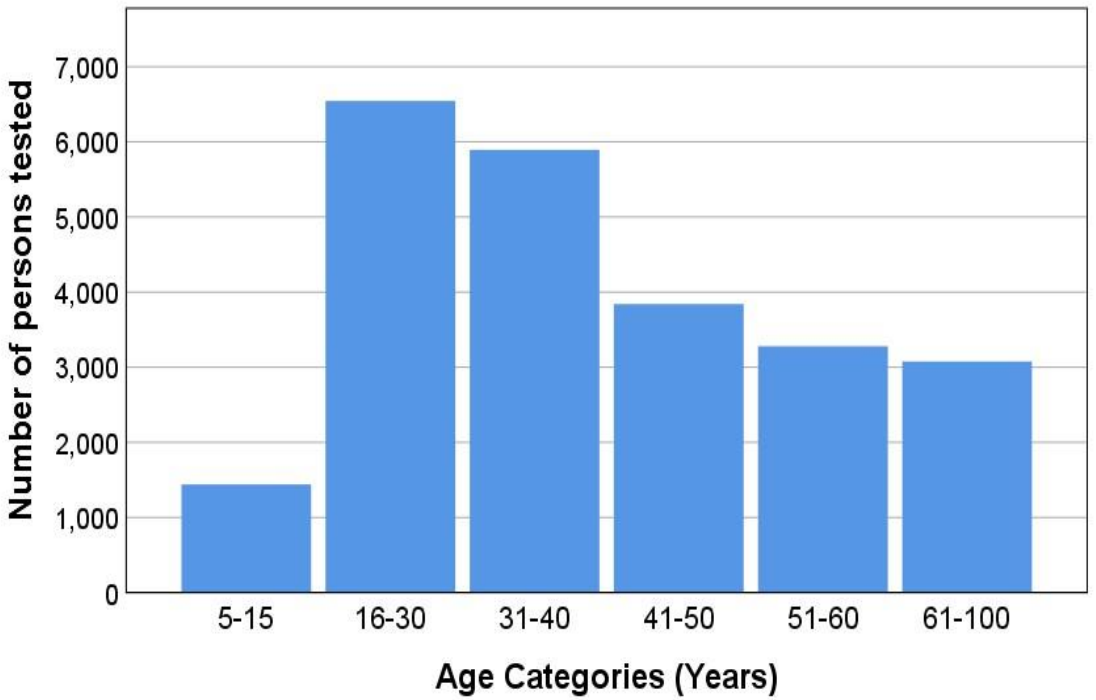
Adapted for hearZA

Decision support

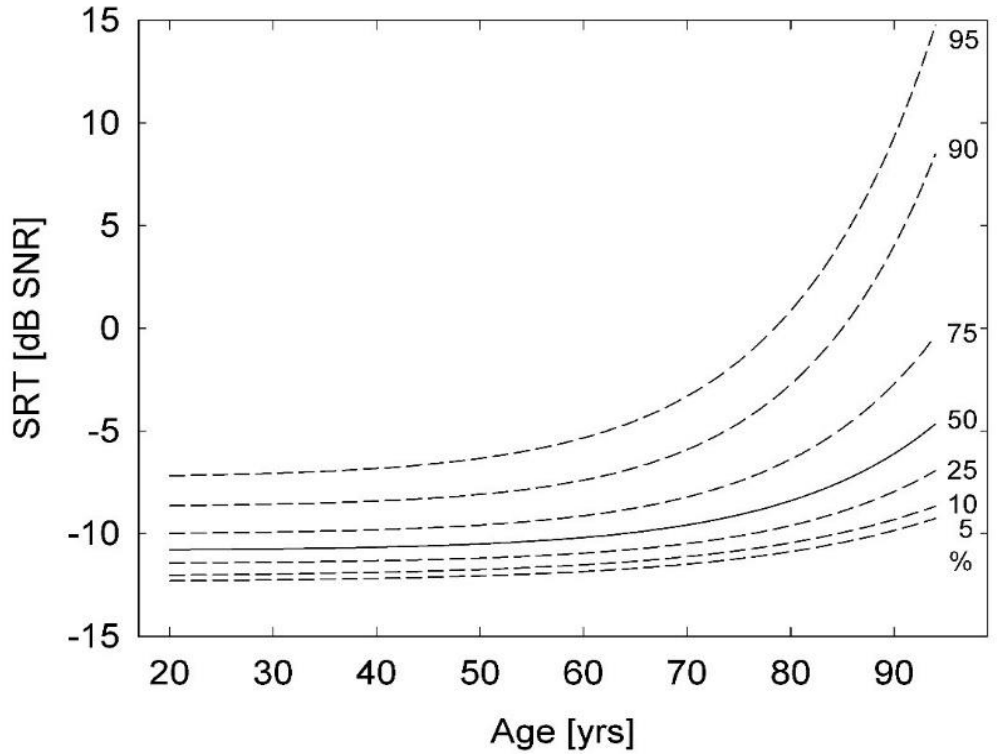


A Smartphone National Hearing Test: Performance and Characteristics of Users.

De Sousa, K. C., Swanepoel, D. W., Moore, D. R., & Smits, C. (2018). ***American Journal of Audiology***, 27(3S), 448-454.

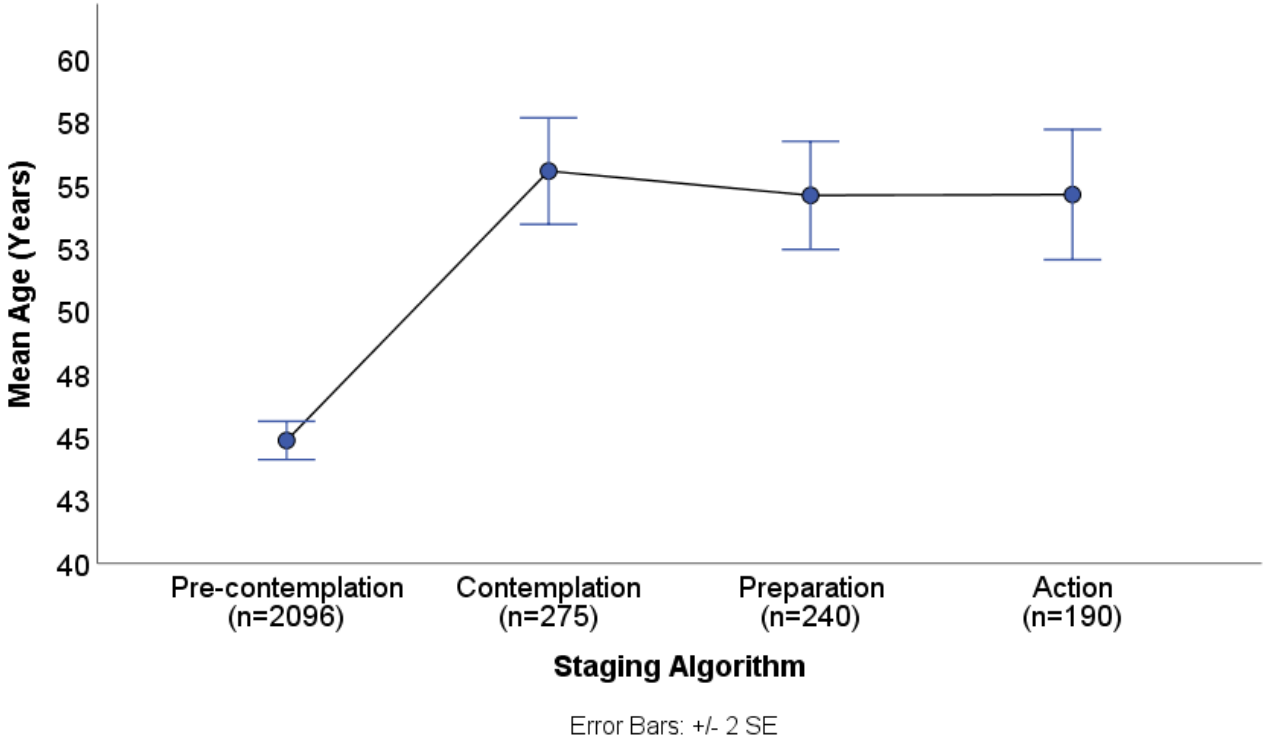


Age distribution of persons taking the hearZA™ test (*n*=24072)

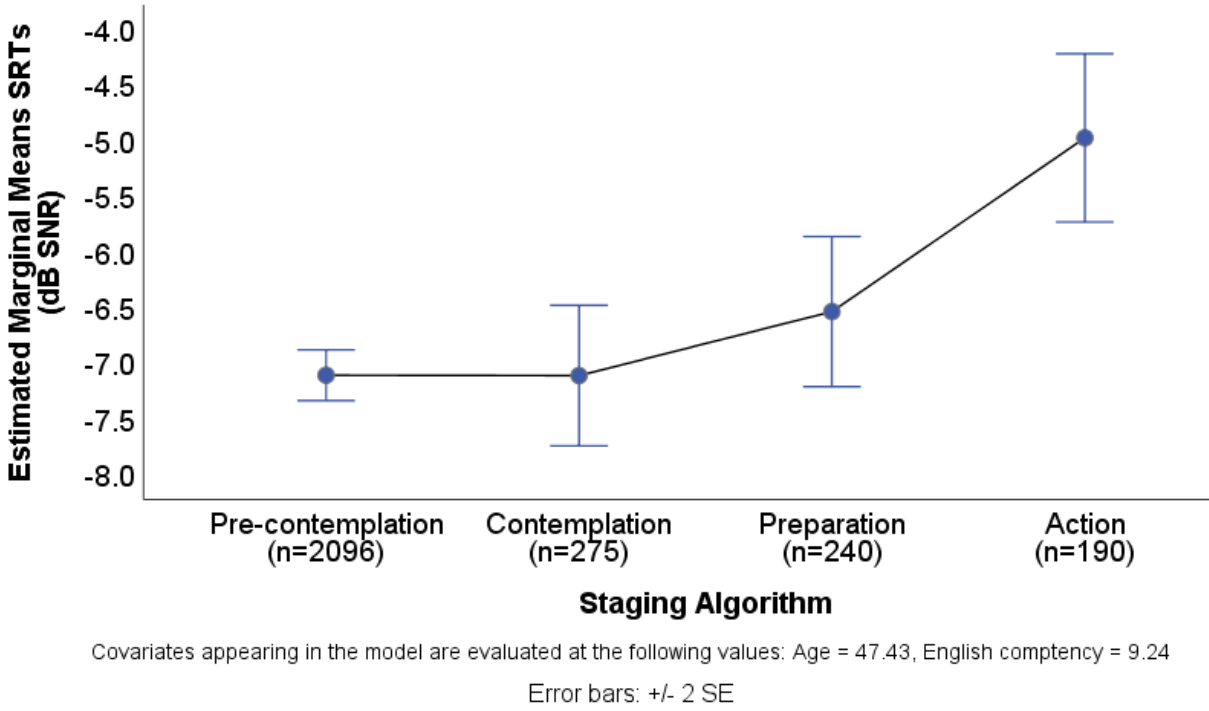


SRT against age group percentiles

READINESS TO TAKE UP INTERVENTION



Mean age for the corresponding stage of change



Mean SRT score with the corresponding stage of change adjusted for age and English language competence

IMPROVING TEST SENSITIVITY

Binaural stimulation

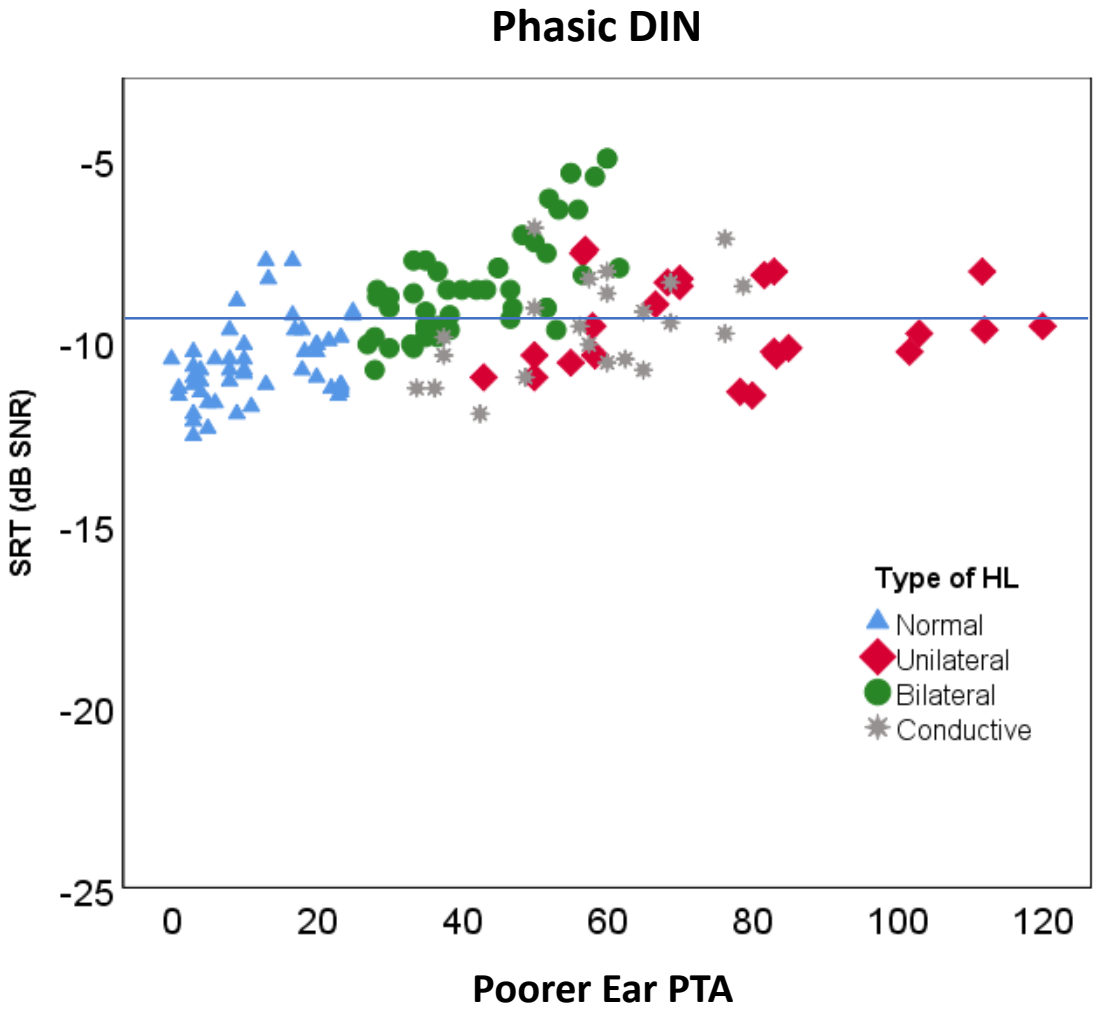
Phasic digits

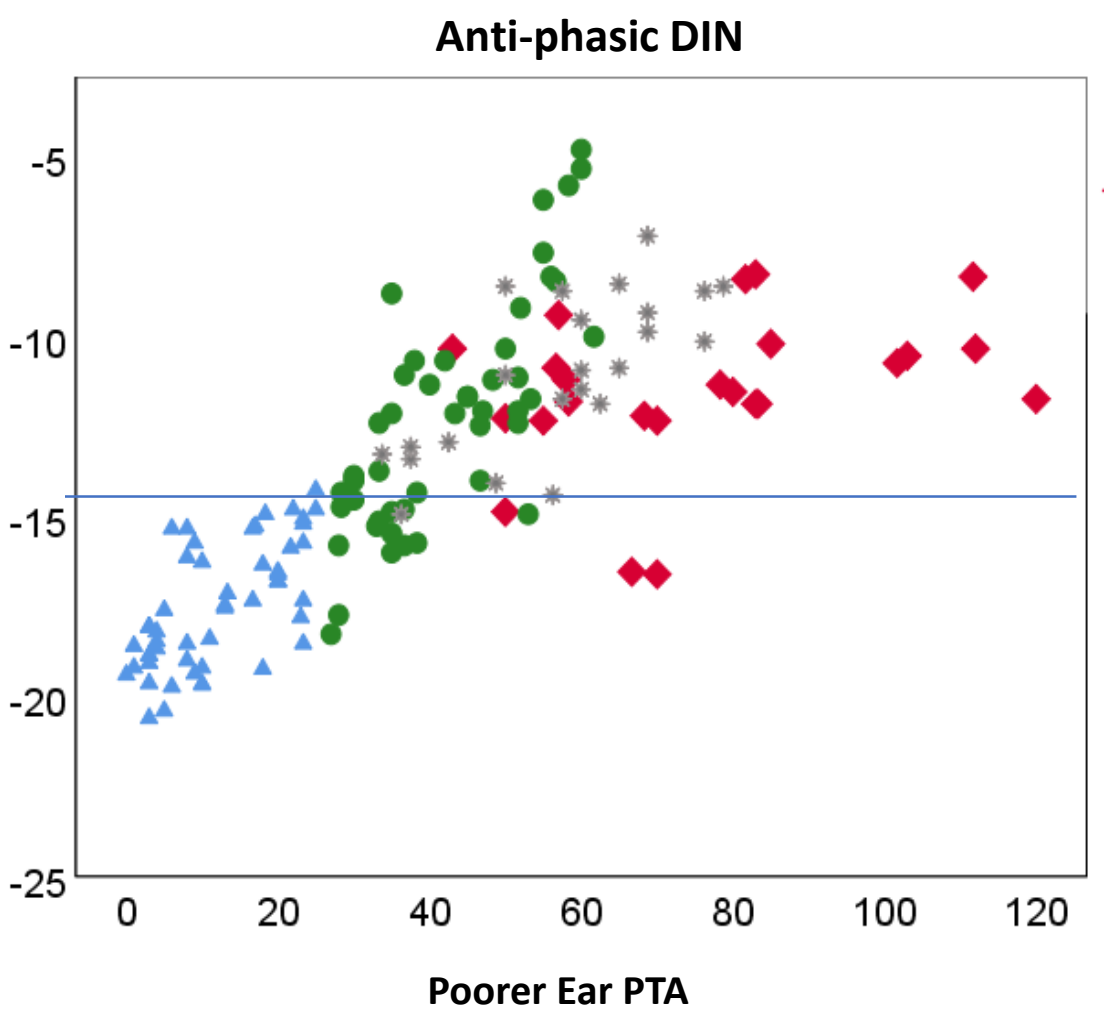
-10,8 dB SNR

Anti-phasic digits

-18,7 dB SNR

IMPROVING TEST SENSITIVITY



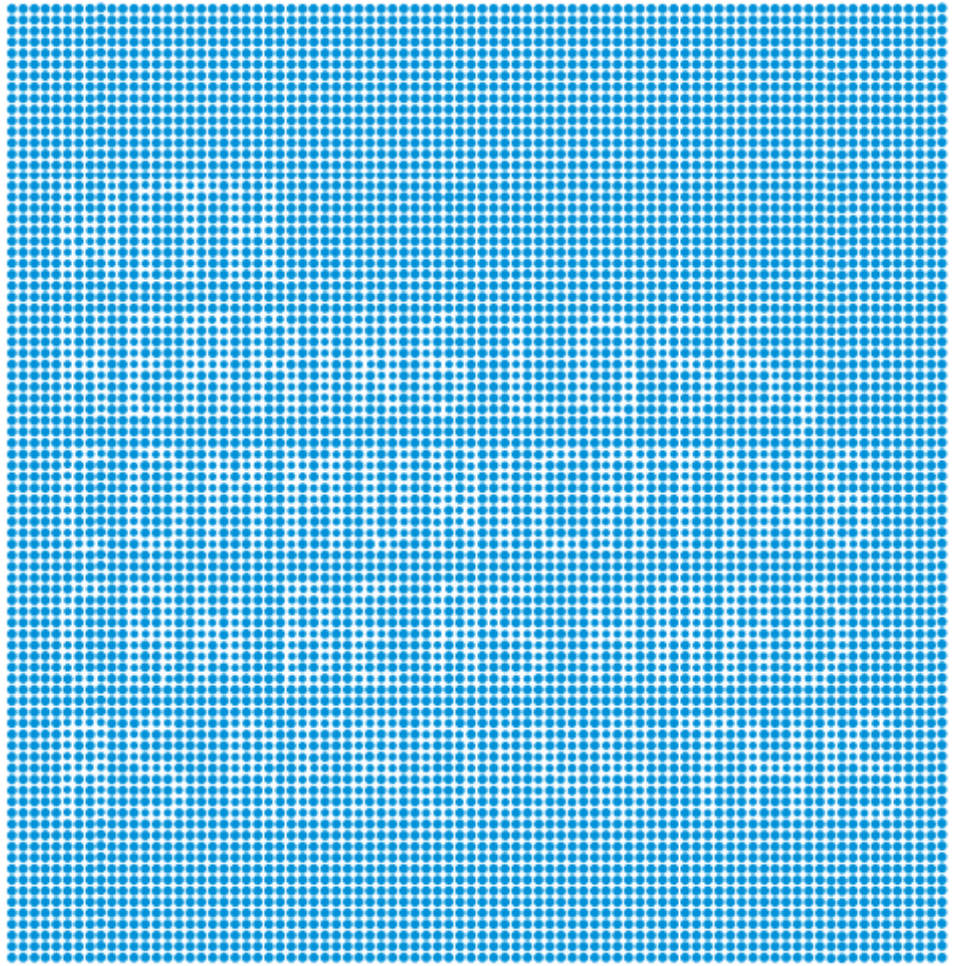


De Sousa et al, Unpublished

ANDROID APP ON Google play

Available on the App Store

AMERICAN ACADEMY OF AUDIOLOGY



Could you be missing out?

Check your hearing!

hearWHO

An app to check your hearing.

World Health Organization

World Hearing Day 2019

ANDROID APP ON Google play

Available on the App Store

CONCLUSION

- Hearing loss is a major global health problem and is largely inaccessible
- Connected technologies - powerful health enablers
- New models for access that improve 1) reach 2) efficiency & 3) impact
- Bridging the gap between pervasive need, limited and delayed access
- Optimize, personalize and manage hearing health pathway from detection through to intervention

References

The Economist 2015. Planet of the phones http://www.economist.com/news/leaders/21645180-smartphone-ubiquitous-addictive-and-transformative-planet-phones

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Mahomed-Asmail F, Swanepoel D, Eikelboom RH, Myburgh HC, Hall JW III (2016). Clinical validity of hearScreen™ smartphone hearing screening for school children. Ear & Hearing, 37:e11-17.

Sandström J, Swanepoel D, Myburgh HC, Laurent C (2016). Smartphone threshold audiometry in underserved primary health-care contexts. International Journal of Audiology, 55:232-238.

Potgieter JM, Swanepoel D, Myburgh HC, Hopper TC, Smits C (2016). Development and validation of a smartphone-based digits-in-noise hearing test in South African English. International Journal of Audiology, 55(7):405-411

5Yousuf Hussein S, Swanepoel D, Biagio de Jager L, Myburgh H, Eikelboom RH, Hugo J (2016). Smartphone hearing screening in mHealth assisted community-based primary care. Journal of Telemedicine and Telecare, 22(7):405-412.

Van Tonder J, Swanepoel D, Mahomed F, Myburgh HC, Eikelboom RH (2017). Automated smartphone threshold audiometry: Validity and time-efficiency. Journal of the American Academy of Audiology, 28(3):200-208.

Louw C, Swanepoel D, Eikelboom RH, Myburgh HC (2017). Smartphone-based hearing screening at primary health care clinics. Ear & Hearing, 38(2)e93–e100.

Potgieter, JM, Swanepoel D, Myburgh, HC, & Smits, C (2018). The South African English Smartphone Digits-in-Noise Hearing Test: Effect of Age, Hearing Loss, and Speaking Competence. Ear and Hearing, 39(4), 656-663.

Yousuf Hussein S, Swanepoel D, Mahomed-Asmail F, Biagio de Jager L (2018). Community-based hearing screening for young children using an mHealth service-delivery model. Global Health Action, 11(1):1467077