CONNECTED TECHNOLOGIES FOR HEARING HEALTH AWARENESS, ACCESS AND AFFORDABILITY

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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

2018
466 mil people

2030
630 mil people

2050
900 mil people

Adapted from World Health Organization (2018).

### A GROWING GLOBAL EPIDEMIC

<table>
<thead>
<tr>
<th>Region</th>
<th>2018*</th>
<th>2030*</th>
<th>2050*</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-income countries</td>
<td>46</td>
<td>58</td>
<td>72</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>40</td>
<td>56</td>
<td>87</td>
</tr>
<tr>
<td>Middle-East and North Africa</td>
<td>16</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>49</td>
<td>71</td>
<td>133</td>
</tr>
<tr>
<td>South Asia</td>
<td>131</td>
<td>176</td>
<td>267</td>
</tr>
<tr>
<td>Central / East Europe &amp; Central Asia</td>
<td>34</td>
<td>40</td>
<td>46</td>
</tr>
<tr>
<td>East Asia</td>
<td>100</td>
<td>139</td>
<td>189</td>
</tr>
<tr>
<td>East Asia and Pacific</td>
<td>47</td>
<td>64</td>
<td>95</td>
</tr>
</tbody>
</table>

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

Adapted from World Health Organization (2018).

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)


Unaddressed hearing loss poses a high cost for the global economy

$750 billion per year

HEARING HEALTH IS INACCESSIBLE

AWARENESS CHALLENGE

FUNDEES

HEALTH PROFESSIONALS

PUBLIC AWARENESS

GLOBAL HEALTH

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

Adapted from Fagan & Jacobs (2018)


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
BARRIERS:

- Equipment expense
- Expertise required
- Efficiency challenges
- Centralized services
- Delayed access
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,
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
Greater access to mobile technology is associated with improvements in quality of life

Mobile connectivity can drive hearing health penetration in LMICS

GSMA, 2018
EXPONENTIAL TECHNOLOGY

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

Moore's Law: Transistors per microprocessor

Number of transistors which fit into a microprocessor. This relationship was famously related to Moore's Law, which was the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.

Source: Karl Rupp. 40 Years of Microprocessor Trend Data.

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

De Wet Swanepoel (Project lead)
Herman Myburgh (UP project co-lead)
Cas Smits (Co-investigator, Netherlands)
David Moore (Co-investigator, USA)
Claude Laurent (Co-investigator, Sweden)
Robert Eikelboom (Co-investigator, Australia)
Faheema Mahomed (Research associate)
Jenni-Mari Potgieter (PhD student)
Christine Louw (PhD student)
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
### CLINICALLY VALIDATED

<table>
<thead>
<tr>
<th>Feature</th>
<th>Status</th>
</tr>
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<tbody>
<tr>
<td>Accurate</td>
<td>✔️</td>
</tr>
<tr>
<td>Time efficient</td>
<td>✔️</td>
</tr>
<tr>
<td>Cost-effective</td>
<td>✔️</td>
</tr>
<tr>
<td>Quality control</td>
<td>✔️</td>
</tr>
<tr>
<td>Laypersons</td>
<td>✔️</td>
</tr>
</tbody>
</table>

(Swanepoel et al., 2014; Mahomed et al., 2016; Yousuf-Hussein et al., 2016; Van Tonder et al., 2018)
6818 screened at ECD
503 rescreened at PHC
180 confirmed with a HL
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

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)
Vision and Health for Everyone
EXAMPLE 2: CONSUMER TEST & CONNECT

hearZA
NATIONAL HEARING TEST OF SOUTH AFRICA

Research & validation, University of Pretoria
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)
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. 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


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


**Sens/Spec = 95% / 87%**
1. ACCURATE TESTING

No signf effect (p=0.84)

2. PUBLIC AWARENESS TOOL

HOW GOOD IS YOUR HEARING?
FIND OUT NOW!
How it works?
3. HEARING HEALTH TRACKING

- Personalized hearing score
- Annual in-app reminders
- Hearing scoreboard
PARTNERSHIP WITH ASSOCIATIONS
National initiative

REFERRAL DATABASE
In-app referral to closest provider
Secure cloud-based referral system

±400 practices
5. DECISION-SUPPORT

Ida Telecare tools
Adapted for hearZA

Decision support

Why Improve My Hearing?

Seniors with hearing loss are significantly more likely to develop dementia than those who retain their hearing*. This tool can help you think about it is for you to improve your hearing. You can print out a copy of it to your first appointment. You can also email it to your audiologist.

Many people find out that they have a hearing loss because they have difficulties in one or more of the situations shown below. Take the quiz.

Have you had hearing difficulties in any of these situations? (Circle yes if applicable)

*Adapted from: Hearing Loss and Dementia, National Institute on Aging, National Institutes of Health, 2019.

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

Phasic DIN

Anti-phasic DIN

Type of HL
- Normal
- Unilateral
- Bilateral
- Conductive

De Sousa et al, Unpublished
Could you be missing out?

Check your hearing!

An app to check your hearing.

World Hearing Day 2019
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


