Hearing care by community health workers using digital technologies

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Introduction

Globally, the third-largest cause of the number of years lived with disability is unaddressed disabling hearing loss[1]. Hearing loss is expected to affect 2.5 billion individuals by 2050[1]. The cost associated with unaddressed hearing loss annually is estimated at $980 billion worldwide[1-3]. Although hearing loss affects individuals globally, low-and middle-income countries (LMICs) are home to nearly 80% of individuals living with hearing loss[1]. The reality is that persons with hearing loss in most LMICs do not have access to hearing care due to barriers including a severe shortage of hearing health professionals, centralised service-delivery models, expensive diagnostic equipment requiring highly trained persons to operate[1].

Innovative digital technologies are an important strategy proposed by the World Health Organisation to support hearing health service delivery, especially in LMICs[1]. With a smartphone penetration rate of 89% in LMICs[4], the

use of digital technologies is becoming especially relevant. Digital technologies have the potential to address many of the current barriers preventing effective hearing healthcare services in LMICs such as access and affordability[5]. The rise of the COVID-19 pandemic has further catapulted the need and use of digital technologies to provide safe hearing healthcare services as traditionally the test set-up, proximity and duration of appointments put both the audiologist and patient at a high risk of contracting COVID-19[6].

Innovative community-based hearing care

A new innovative model using a range of digital technologies operated by community healthcare workers (CHWs) to deliver end-to-end hearing healthcare services to adults in LMICs was recently piloted in the Western Cape, South Africa. The five-step model is illustrated in figure 1.

Screening for adult hearing loss

The first step in this model was to detect adult community members in need of hearing care through "self-report" and "community-referral" modes of detection. CHWs, recruited from the same community, were able to connect with community networks to create awareness and follow-up with interested individuals. Once community members were detected and identified, the next step was to diagnose hearing loss.

Home-based diagnostic hearing testing

The CHWs conducted home visits with the community members with suspected self-reported hearing loss to confirm if a hearing loss was present. Low-cost, commercially available smartphones and circumaural hearing protectors were used to facilitate the testing (figure 2). Clinically validated in-situ audiometry via a low-cost, high-quality hearing aid (16-channel WDRC, Bluetooth, adaptive directionality, and noise reduction) with circumaural hearing protectors

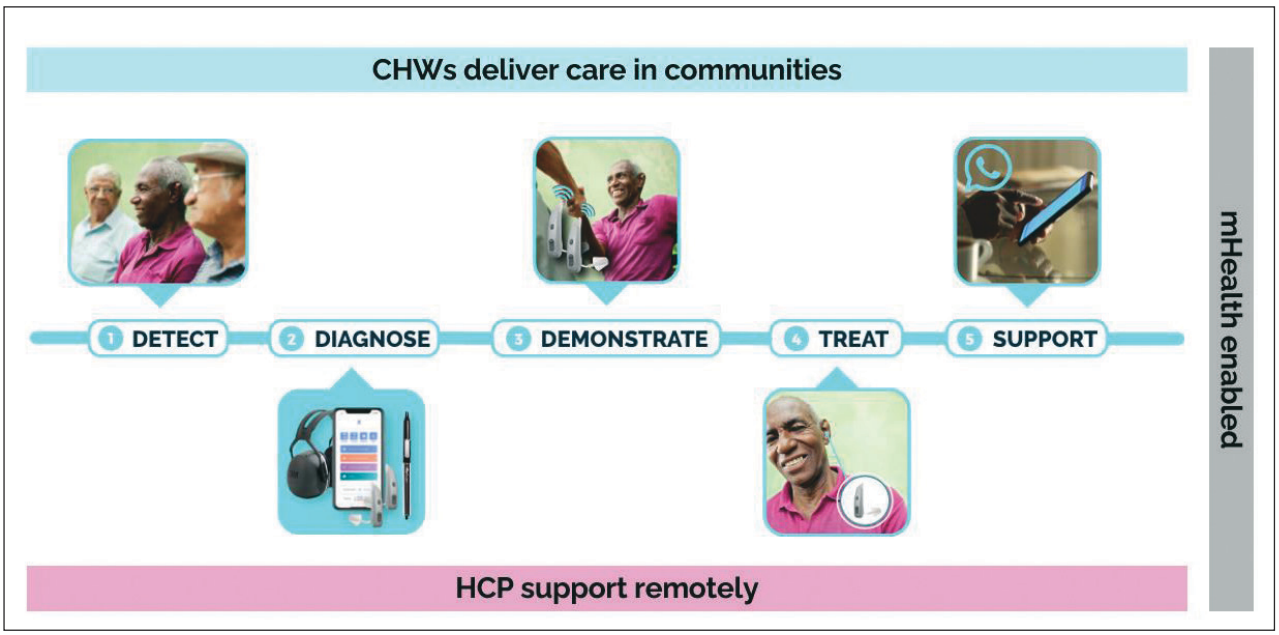

Figure 1: Work-flow process of the adult community hearing service delivery model

Figure 2: Community member having her hearing tested via in-situ audiometry

placed over the hearing aids (creates an environment comparable to a single-walled sound booth) was conducted to obtain an individuals' audiogram. Smartphone AI video-otoscopy via the hearScope (hearX group, Pretoria, South Africa) was conducted to evaluate patency of the ear canal to accommodate a hearing aid and identify ear disease (wax obstruction or possible middle-ear infection). Relevant referrals to clinics or ENTs were made if any abnormalities were detected. Lastly, the risk profile for potential asymmetric or conductive losses was determined through an algorithm using digits-in-noise (DIN) test results in combination with air conduction pure tone audiometry thresholds[7]. This recently validated technique has a reported 94% accuracy to differentiate sensorineural hearing loss from conductive or asymmetric hearing loss requiring medical follow-up. This approach negates the need for bone conduction testing in community-based settings by triaging patients at risk to more advanced diagnostic services. At the same time, it allows a decentralised model of care for the vast majority of persons with hearing loss who have a sensorineural cause and who can benefit from hearing aids.[7]

Demonstrate hearing aid benefit

The digital technologies used to diagnose hearing loss were all integrated with a mobile platform, had a user-friendly design, and made use of automated test protocols, which enabled CHWs to facilitate the testing. Program managers could also do remote surveillance through the cloud-based platform for quality control and support. When a hearing loss was confirmed, a demonstration to experience the benefit of the hearing aids was done immediately (figure 3). The autofit option programs the hearing aids from the smartphone based on the test results (NAL-NL2 fitting formula)

Figure 3: Community member receiving demonstration of hearing aid benefit

through Bluetooth. This experience supports an informed decision to take up hearing aids as an intervention.

Home-based hearing aid fitting and support

After the demonstration, if the community member wished to continue, they were fitted bilaterally by the CHWs with the in-situ hearing aids. The low-cost high-feature digital hearing aids (hearX Lumen) are suitable for mild to moderate-severe hearing loss and includes wide dynamic range compression, 16-channels, and directionality. CHWs orientated the community members on the hearing aid user-operated controls and device maintenance. Finally, persons fitted with hearing aids were provided with a mHealth support and acclimatisation program (figure 4). This program includes the provision of information on device management and use, troubleshooting and general acclimatisation tips provided via text message or WhatsApp messaging service over a 45-day period. CHWs also provided batteries and disposables as well as conducted follow-up visits.

Outcomes

The pilot study has been an overwhelming success, with participants reporting very positive outcomes with their hearing aids. Some examples of participant testimonials include: *"It is as if I am able to see. Everything is clear"; "Having hearing aids changed my life. It gives me confidence around other people. I can hear and do not have to ask for repetition."* Another community member reported that, *"People respond positively to the fact that I wear hearing aids. They notice that I respond more and quicker than before. They previously thought that I was unfriendly, they did not realise that I could not hear."* Additional comments include, *"Now I can engage with my family again - I love my hearing aids"; "I recommend a hearing aid to anyone with a hearing problem because this hearing aid helps so much, it changed my life."*

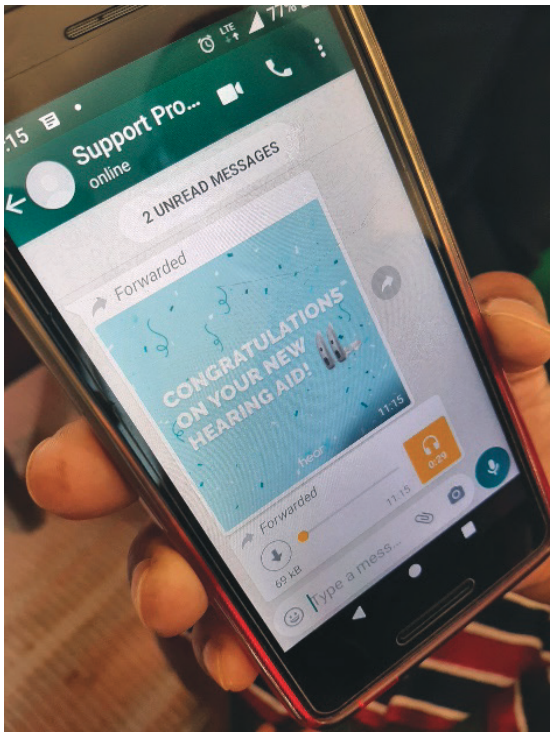

Figure 4: Community member receiving the first message from the mHealth support and acclimatisation program

Looking forward

Future goals for this innovative service delivery model include the implementation of a scaled-up launch in Kenya. The project in Kenya is being funded by the Assistive Technology Impact Fund (ATIF) Fund. The ATIF was launched out of the UK Aid-funded AT2030 programme, led by the Global Disability Innovation Hub (GDI Hub) and offers support to get Assistive Technology solutions for low- and middle-income

populations on a path to scale. hearX Group and Foundation together with partner Ilara Health (a Kenya-based healthtech start-up bringing affordable and accessible diagnostics to primary care facilities) will implement the pilot to bring hearing care to communities whilst also testing monthly payment plans to increase affordability. More info available https://www.hearxgroup.com/blog/HEARX%C2%AE-BECOMES-THE-FIRST-TO-RECEIVE-FUNDING-FROM-THE-ASSISTIVE-TECHNOLOGY-IMPACT-FUND.html.

References:

1 World Health Organisation. (2021). World report on hearing.

2 United Nations. (2015). Transforming our world: the 2030 Agenda for Sustainable Development. *United Nations: New York, NY, USA*.

3 World Health Organisation. (2017). *Global costs of unaddressed hearing loss and cost-effectiveness of interventions: a WHO report, 2017*. World Health Organization.

4 Wigginton, C. (2021). Global mobile consumer trends.

5 Swanepoel, D.W. (2020). eHealth technologies enable more accessible hearing care. *Seminars in Hearing*, *41*(02), 133-140.

6 Swanepoel, D. W., & Hall, J. W. (2020). Making Audiology Work During COVID-19 and Beyond. *The Hearing Journal*, *73*(6), 20-24. https://doi.org/10.1097/01.HJ.0000669852.90548.75

7 De Sousa, K. C., Smits, C., Moore, D. R., Myburgh, H. C., & Swanepoel, D. W. (2020). Pure-tone audiometry without bone-conduction thresholds: using the digits-in-noise test to detect conductive hearing loss. *International Journal of Audiology*, *59*(10), 801–808.