

Prioritizing Hearing Aid Service Delivery Models for Low-Income Communities

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Millions of individuals worldwide are affected by hearing loss, with a global estimate of 2.5 billion projected by 2050.¹ Hearing loss has a profound effect on individuals' overall quality of life, including communication, social interactions, education, and employment.¹⁻⁴ However, hearing aid uptake is generally low. In Africa, less than 10% of individuals needing hearing aids acquire them, with some estimates as low as 3%.^{1,5} The global burden of hearing loss is exacerbated by the limited number of hearing health care services and the lack of trained professionals.^{1,6} The global shortage of hearing health care professionals, particularly in low- and middle-income settings, is a major challenge to existing service delivery models, which require specialist health care providers. Generally, low- and lower-middle-income regions have one or fewer ENT specialists or audiologists per million population.⁷ In Africa, 56% and 78% of countries have less than one ENT specialist or audiologist per million population, respectively.⁷



Figure 1: From left: An example of a CHW conducting a hearing assessment; a community member receiving hearing aids; and hearing aids placed in community members' ears. Hearing aid, service delivery models, low-income communities, telehealth, teleaudiology.

Considering the shortage of services and providers, the World Health Organization (WHO) has identified several key priorities to improve access to hearing health care services. These include community-based care facilitated by minimally trained community health care workers (CHWs) using innovative technologies.¹ Task-shifting from professionals to CHWs has been proposed to address the shortage and decentralize access to care.¹ This approach could enable CHWs to facilitate screening and assessment of hearing loss, referral of cases requiring medical intervention, fitting low-cost pre-set hearing aids for eligible individuals, and ensuring tailored follow-up care designed for low- and middle-income settings. The WHO has set up a technical working group developing guidelines for hearing aid provision service-delivery models in low-income settings.

INNOVATIVE COMMUNITY-BASED HEARING AID PROVISION

A recent review⁸ demonstrated that CHWs can be utilized across a range of hearing health care services and that these services are feasible for community-based hearing care. Services included infant hearing screening in rural areas⁹ and childhood and adult hearing screening in various decentralized settings.^{10,11}

Studies conducted in Bangladesh and India showcased the effectiveness of community-based hearing aid service provision models facilitated by CHWs.^{12,13} The Bangladesh study involved CHWs fitting pocket model hearing aids for children, comparing the community-based model to a traditional center-based approach. Both approaches yielded similar outcomes on most items of the International Outcome Inventory for Hearing Aids.¹² Similarly, in India, CHWs successfully fitted semi-digital hearing aids to an adult population during home visits and demonstrated significant self-reported benefit using the Abbreviated Profile of Hearing Aid Benefit.¹³ These findings are supported by a more recent randomized clinical trial which demonstrated positive outcomes of CHWs in providing personal sound amplification devices to older adults in community settings.¹⁴ CHWs can be enabled through innovative technologies incorporating digital strategies like automation, simple user interfaces, and remote data management and support.¹⁵

We recently conducted a study in the Western Cape, South Africa, delivering low-cost digital hearing aids to low-income communities facilitated by CHWs.¹⁵ Three CHWs fit 19 adult community members with hearing aids bilaterally using mHealth technology (Figure 1). The hearing aids allow for Bluetooth hearing aid fitting using the NAL/NL2 fitting algorithm from a smartphone application based on the thresholds tested.¹⁵ The pilot study demonstrated long-term success, with participants reporting very positive outcomes with their hearing aids; 14 of the 19 community members fitted were still using their hearing aids six months post hearing aid fitting. These community members also received an mHealth acclimatization and support program providing information on hearing aid use, maintenance, acclimatization and troubleshooting over a period of 45 days via WhatsApp or standard SMS. This mHealth program has demonstrated the potential for low-cost, scalable impact, with positive reports on applicability and accessibility from all community members.¹⁶ The use of CHWs facilitating teleaudiology has also been shown to be a feasible strategy for adults.¹⁷ Service-delivery models that utilize CHW allow scarce resources like trained professionals such as audiologists to support these programs through training, remote monitoring, and surveillance. Through the implementation of trained non-professionals, these programs have the potential to reach more people in need.

CONSIDERATIONS FOR COMMUNITY-BASED HEARING AID PROVISION

There are several important considerations for effective community-based hearing aid services in low-income settings, as outlined in Table 1. The CHWs facilitating the services are key in determining the successful roll-out and continued support. The recruiting and training of appropriate CHWs—ideally members of the target community—is essential, and the training these CHWs receive should be aligned with standardized guides and facilitated by hearing health care professionals. User-friendly, high-quality, low-cost assessment tools, intervention, and support must be provided to facilitate use in low- and middle-income settings.

Table 1. Important Considerations for Community-Based Hearing Aid Provision Service-Delivery Models

Topics	Considerations
Recruitment of CHWs	<p>Community members:</p> <ul style="list-style-type: none"> • CHWs that are members of the community can understand the language and culture. • They are also familiar with community social networks, NGOs and community leaders to spread awareness about services.
CHWs Training	<p>Hearing health care professional training:</p> <ul style="list-style-type: none"> • Trained professionals preferable to ensure competency. • WHO Primary Ear and Hearing Care Training Manual. • Standardized training for CHWs. <p>Training should include theory, practical experience and assessment:</p> <ul style="list-style-type: none"> • Theoretical training is essential. Pre-and post-training surveys may be of value to ensure CHWs' knowledge. • Practical experience is important. Include demonstrations on actual patients and practice under supervision. CHWs must feel confident before providing services. • Evaluation to maintain quality, confirm competence, and further inform training and experience.
Community Networks	<p>Identify community networks:</p> <ul style="list-style-type: none"> • Identify and partner with local NGOs, community groups and leaders. • Identify a referral network. • Good referral networks established to ensure follow up is supported.
Tools	<p>Innovative technologies:</p> <ul style="list-style-type: none"> • Innovative technologies to conduct hearing assessments with user-friendly designs and automated test protocols support to make task-shifting. • Innovative mobile technologies (e.g., mHealth), with cloud-based data management for remote surveillance, quality control, and CHW support.
Intervention	<p>Hearing aids:</p> <ul style="list-style-type: none"> • High-quality, low-cost hearing aids to ensure affordability. • Autofit in-situ or pre-programmed over-the-counter devices that are simple to program and fit. <p>Cerumen management:</p> <ul style="list-style-type: none"> • Cerumen is an important consideration and requires basic treatment (e.g., sweet oil, manual or irrigation removal). <p>Otitis media:</p> <ul style="list-style-type: none"> • Suitable referral structures to assist community members presenting with possible otitis media.
Support	<p>Support program:</p> <ul style="list-style-type: none"> • Community members should be provided with information on device management and troubleshooting. • A mHealth support program could aid in providing this information. <p>Support should be available in the home language of the community member:</p> <ul style="list-style-type: none"> • Information in the community members' home language is essential to ensure understanding. <p>Support should be easy to read and understand:</p> <ul style="list-style-type: none"> • Readability of the support should be evaluated to ensure understanding and does not exceed a US grade 5 level.

CONSIDERATIONS FOR PEDIATRIC POPULATIONS

While some studies have been conducted on community-based hearing aid provision, it is important to recognize that there is a significant knowledge gap, particularly concerning special populations, such as children. Additional feasibility studies involving children are essential to explore the potential of implementing a service-delivery model for special populations. Children have unique hearing characteristics compared with adults, and their hearing development, anatomical differences and communication needs add more complexity to locally driven service provision. Early detection is a major contributor to successful intervention. Subsequently, prompt intervention efforts can profoundly impact the child's outcomes and future development.¹

CHWs could play a pivotal role in this process by conducting hearing screenings, referring children who fail for further diagnostic testing, or facilitating diagnostic testing with specialist oversight using teleaudiology-enabled equipment and services. Specialized electrophysiological tests, like auditory brainstem response (ABR) or otoacoustic emissions

(OAE), could potentially be conducted and interpreted by an expert using telehealth, while the physical setup can be facilitated by the CHW. Diagnostic tools that are user-friendly, automated and have a straightforward setup could enhance teleaudiology-facilitated testing.

CHWs would require more specific training to facilitate screening and hearing assessments in children, including the support of teleaudiology-assisted ABR and OAE tests. With regards to intervention, CHWs can play a significant role in initial interactions, pre-hearing aid fitting, support post-fitting, and troubleshooting and orientation. Fitting hearing aids with support from remote specialists could be potential options but will require specific upskill training.

Phased but accelerated approaches to providing hearing health care to children are recommended. Care aimed at older children is more easily started. Once established, however, expanding services for younger children can and should be prioritized due to the urgent need to provide early intervention to children with hearing loss.

CONCLUSION

The major disparity between the number of individuals in need of hearing aids and those who actually receive them is of great concern, particularly in low- and middle-income settings. To address the issues contributing to limited hearing health care services, a WHO technical working group on hearing aid service-delivery in low-income settings has developed a draft protocol for adults and children. This proposed model is -currently being evaluated in a multicenter feasibility study, including diverse sites in South Africa and low-income settings in the US. This multicenter study will allow for a comprehensive evaluation of this protocol's effectiveness and will inform a finalized guideline to be released in 2024. Innovative, community-based service-delivery models that can offer services outside traditional settings, in underserved communities, and in a scalable manner have the potential to significantly improve hearing health care services in global, resource-limited settings.

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REFERENCES

World Health Organization 2021 World Report on Hearing. Retrieved from: <https://www.who.int/publications/i/item/world-report-on-hearing>

Helvik A-S, Krokstad S, Tambs K 2013 Hearing loss and risk of early retirement. The HUNT study The European Journal of Public Health 23 617 622 <https://doi.org/10.1093/eurpub/cks118>

Jung D, Bhattacharyya N 2012 Association of Hearing Loss with Decreased Employment and Income among Adults in the United States Annals of Otology, Rhinology & Laryngology 121 771 775 <https://doi.org/10.1177/000348941212101201>

Shukla A, Harper M, Pedersen E, et al. 2020 Hearing loss, loneliness, and social isolation: a systematic review *Otolaryngology--Head and Neck Surgery* 162 622 633 <https://doi.org/10.1177/0194599820910377>

Bisgaard N, Zimmer S, Laureyns M, Groth J 2021 A model for estimating hearing aid coverage world-wide using historical data on hearing aid sales *International Journal of Audiology* 1 9 <https://doi.org/10.1080/14992027.2021.1962551>

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 1289736 1289736 <https://doi.org/10.1281080/16549716.16542017.11289736>

Kamenov K, Martinez R, Kunjumen T, Chadha S 2021 Ear and hearing care workforce: current status and its implications *Ear and hearing* 42 249 257 <https://doi.org/10.1097/AUD.0000000000001007>

Eubank T N, Beukes E W, Swanepoel D W, Kemp, Kaley G, Manchaiah V 2022 Community-based assessment and rehabilitation of hearing loss: a scoping review *Health & Social Care in the Community* <https://doi.org/10.1111/hsc.13846>

Ramkumar V, John K R, Selvakumar K, Vanaja C S, Nagarajan R, Hall J W 2018 Cost and outcome of a community-based paediatric hearing screening programme in rural India with application of tele-audiology for follow-up diagnostic hearing assessment *International Journal of Audiology* 57 407 414 <https://doi.org/10.1080/14992027.2018.1442592>

Dawood N, Mahomed-Asmail F, Louw C, Swanepoel D 2021 mHealth hearing screening for children by non-specialist health workers in communities *International Journal of Audiology* 60 sup1 S23 S29 <https://doi.org/https://doi.org/10.1080/14992027.2020.1829719>

O'Donovan J, Nakku D, Nyanzi D, et al. 2021 Training, supervision and performance of Community Health Workers in the delivery of ear and hearing care to 321 community members in rural Uganda *Clinical Otolaryngology* 46 1193 1199 <https://doi.org/10.1111/coa.13815>

Borg J, Ekman B r O, Östergren P-O 2018 Is centre-based provision of hearing aids better than community-based provision? A cluster-randomized trial among adolescents in Bangladesh *Disability and Rehabilitation: Assistive Technology* 13 497 503 <https://doi.org/10.1080/17483107.2017.1332110>

Emerson L P, Job A, Abraham V 2013 Pilot study to evaluate hearing aid service delivery model and measure benefit using self-report outcome measures using community hearing workers in a developing country *ISRN otolaryngology* 973401 <https://doi.org/10.1155/2013/973401>

Nieman C L, Betz J, Garcia Morales E E, et al. 2022 Effect of a community health worker-delivered personal sound amplification device on self-perceived communication function in older adults with hearing loss *JAMA* 328 2324 2333 <https://doi.org/10.1001/jama.2022.21820>

Frisby C, Eikelboom R, Mahomed-Asmail F, et al. 2022 Community-based adult hearing care provided by community healthcare workers using mHealth technologies *Global Health Action* 15 1 <https://doi.org/https://doi.org/10.1080/16549716.2022.2095784>

Frisby C, Eikelboom R, Mahomed-Asmail F, et al. 2023 mHealth hearing aid acclimatization and support program in low-income communities: a feasibility study *JMIR Formative Research* *IN PRESS*

Coco L, Carvajal S, Navarro C, Piper R, Marrone N 2023 Community health workers as patient-site facilitators in adult hearing aid services via synchronous teleaudiology: feasibility results from the conexiones randomized controlled trial *Ear & Hearing* 44 28 42 <https://doi.org/10.1097/AUD.0000000000001281>