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Schoolchildren wearing hearing aids. MADAGASCAR

PIET VAN HASSELT

Hearing aid systems in low-resource settings

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For many patients there is an effective medical treatment for their hearing difficulties. Often, however, no medical or surgical solution is possible. For this large group of patients the next step typically involves rehabilitation – and hearing aid fitting is usually a key part of the process. Modern hearing aids do more than amplify sound. They process sound in dozens of different ways to improve hearing. Many hearing aids help to filter out competing speakers and background noise. They boost soft speech sounds and reduce the intensity of unpleasant loud noise. With a well-fitted hearing aid, satisfaction can be high and the hearing aid leads to an improved quality of life for the wearer. For adults with hearing loss, a well-functioning hearing aid may mean the difference between paid work and unemployment. For children with hearing loss, a hearing aid may be the difference between academic success and school failure. Above all, hearing aids enable both adults and children to communicate better. Connecting with others is a basic human need that cannot be ignored, and this is where hearing aids have the biggest impact.

For these reasons, and many more, a recent World Health Assembly resolution urged member states to 'improve access to affordable, cost-effective, high quality, assistive hearing technologies and products, including hearing aids'.[1]

International Centre for Evidence in Disability

Access to hearing aids: a very unequal picture

Today, over 466 million people live with disabling hearing loss. It is predicted that by 2050 nearly one in 10 people will have a hearing loss. The distribution of these hearing losses is not uniform across the world and two-thirds of people with severe to profound hearing loss live in a low- or middle-income country (LMIC). The production of all hearing aids today only fulfills 10% of global need, and in developing countries this figure is less than 3%.[2]

In upper-income countries, there are very well-developed hearing aid purchase and fitting support systems. Yet in LMICs, where the need for hearing aids is the greatest, the situation can be very different, with a lack of access to hearing aids and their associated rehabilitation services. The World Health Organization (WHO) estimated in 2007 that 35 million hearing aids are needed each year in LMICs, but only one million hearing aids are fitted.[3]

There are a number of reasons for this unmet need, but the most obvious and immediate is the discrepancy between the cost of hearing aids and the purchasing power of potential users in LMICs. The hearing aid global market is dominated by five European/North American manufacturers. They focus on producing

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high-quality hearing aids with advanced features, which provide excellent rehabilitative support but are not appropriate for many patients in LMICs, simply because they are not affordable. There are other costs associated with hearing aid use that patients may not be able to afford either, such as maintenance expenses and the regular purchase of hearing aid batteries; in addition, those with more severe hearing loss need custom-made earmoulds.

Another effect of the dominance of hearing aid manufacturers based in high-income countries is that hearing aids may lack features that would make them more adapted to use in LMICs, such as resistance to dust and moisture. For this reason, WHO has produced a document recommending evidence-based design features that are considered essential for hearing aids to be used in LMICs.[4]

There has been some effort to overcome obstacles linked to hearing aid technology itself, such as the production in some regions of alternative hearing aid brands available at much lower cost (but of lower quality), the bulk purchase of hearing aids by government or non-government agencies at a substantially reduced price, the availability in some regions of funding options through basic private health insurance plans or from consumer loans, and the development of rechargeable hearing aid batteries.

Access to hearing aids is not enough

It is not enough to hand patients a hearing aid – successful fitting needs an appropriate fitting service and a strong support system. Who will assess the patients' hearing, fit the hearing aids and provide follow-up care? LMICs generally have a shortage of professionals to provide hearing assessments and rehabilitation services. Many health professionals migrate to upper-income countries in search of improved opportunities. Audiologists are often the key professionals in the hearing healthcare system – they have the most knowledge of hearing aids and hearing aid fitting. Yet they are among those likely to travel abroad for career advancement. For example, over 50% of Indian audiologists are estimated to have relocated to other nations.[5]

This lack of personnel is a major barrier to hearing healthcare and shows that it is important not to focus exclusively on hearing technology itself and consider all the other factors needed to meet the growing need for hearing aids in LMICs.

A comprehensive approach involving the community

Hearing aid fitting services are often neglected because it is thought by health service managers that there is a lack of demand for such a service. Will anyone use a hearing aid service? The answer to this most basic question seems obvious – of course patients with hearing loss will want treatment! – but this is not always correct, because community awareness is still lacking in many LMICs. Individuals need to know that hearing loss can be treated and that affordable hearing healthcare is available in their local area. Raising community awareness is essential. It may need to be done before starting a service, even if all other parts of the hearing aid fitting system are in place. World Hearing Day (3 March each year) is an appropriate time to schedule awareness-raising activities that spread information about hearing loss and ways to manage the disorder.

Participation of health personnel at community level is also crucial. Community healthcare workers frequently see both adults and children with hearing impairment and can play a role in raising awareness and in establishing comprehensive hearing aid services. It has also been shown in some settings that healthcare workers, nurses, special education teachers and others with a background in rehabilitation can successfully assess hearing, fit hearing aids and provide essential follow-up services. What is needed is a quality training programme, a stable workforce and ongoing guidance and support from those professionals who are available in the community.

This issue of *Community Ear & Hearing Health* gives readers a chance to consider the bigger picture: what hearing aids are and how they are fitted, what their impact is, practical considerations when starting a hearing aid service, and some of the barriers that must be overcome for successful hearing aid fitting.

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How hearing aids work and how to take care of them

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Behind-the-ear hearing aid. ETHIOPIA

ROBBERT ENSINK

There are currently about 466 million people globally with a disabling hearing loss. Fewer than 1 in 5 people who need hearing aids have one. Sadly, even when people have hearing aids there are still many that go unworn. We find that well-fitted hearing aids, with good follow-up, maintenance and ongoing support, can go a long way towards improving uptake and use.

This article aims to provide primary and secondary health personnel, as well as health planners, with information on hearing aids. This will enable them to better support hearing aid users and therefore encourage uptake of hearing aids, as well as play their part in the multistep process that leads to good hearing aid services.

What is a hearing aid?

A hearing aid is a device that amplifies and modifies sound such that a person with a hearing loss can communicate and participate more effectively in daily activities. This can significantly improve quality of life both for the user and for the people around them.

A hearing aid creates more awareness of sounds for the user but it does not restore normal hearing. This is because a person with a sensorineural hearing loss experiences not just decreased audibility but other auditory deficits as well, e.g. increased loudness sensitivity and poorer speech discrimination. Hearing aids cannot overcome all these auditory deficits.

Unlike glasses, hearing aids are not a corrective device and they cannot be expected to work straight away. Many users will need time to adapt to the new hearing process and to understand the sound signal that is being put into their ears. Most people will need a significant amount of support in terms of aural rehabilitation and speech and language therapy. A hearing aid therefore has to be part of a whole solution offering comprehensive support services, particularly for children.

FIGURE 1 HOW AN ANALOGUE HEARING AID WORKS

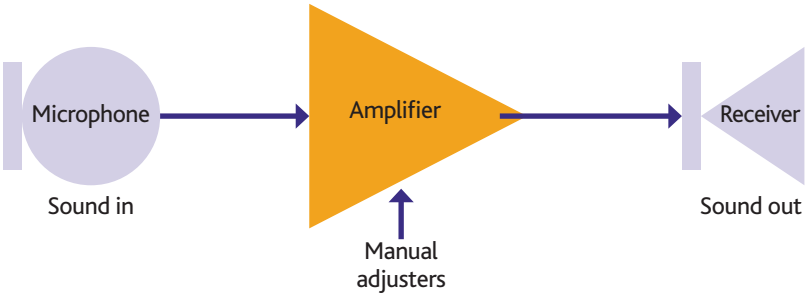
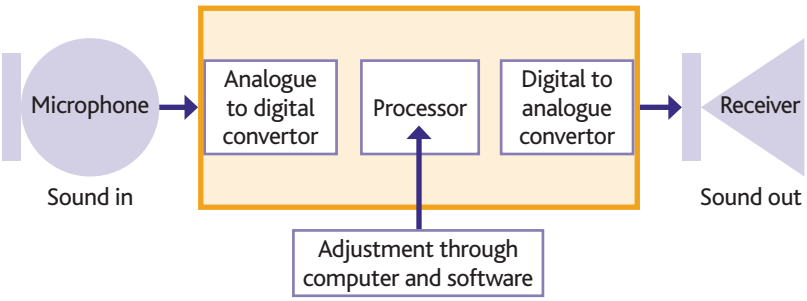


FIGURE 2 HOW A DIGITAL HEARING AID WORKS



How does a hearing aid work?

Digital and analogue hearing aids

Most hearing aids now use **digital** technology, which improves functionality. The price difference between digital and analogue hearing aids is now almost insignificant, so analogue hearing aids may become a thing of the past.

In analogue hearing aids (see Figure 1), sound is picked up by a **microphone**, amplified by an **amplifier** and then output into the ear by a **receiver** (or loudspeaker). Some basic sound quality changes can be effected manually, by adjusting trimmers on the hearing aid itself. Usually there will be a volume control that can be adjusted by the user.

In digital hearing aids, the basic amplifier is replaced by a digital chip (see Figure 2) and the hearing aid is set up using a software programme through a computer, which opens up possibilities for how the sound can be processed. Digital hearing aids have many sound processing features that do not exist in analogue hearing aids. This helps create a much more

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FIGURE 3
TAKING AN EAR IMPRESSION TO MAKE A CUSTOM EARMOULD: KEY STEPS


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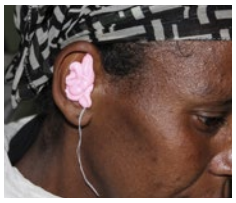
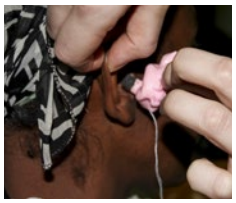
An 'otostop' is inserted before the impression material


ROBBERT ENSINK
Trained earmould technician correctly placing the otostop


ROBBERT ENSINK
Introducing the impression material


ROBBERT ENSINK
Waiting for it to dry


ROBBERT ENSINK
Carefully removing it


ROBBERT ENSINK
Checking the ear canal

accurate sound for the user's ears and individual hearing loss. Some of these features are:

- **Channels:** sound is separated into numerous frequency bands and each band is amplified by the amount required based on the person's audiogram.
- **Feedback cancellation:** this cancels out the whistling sound that hearing aids used to make.
- **Directionality and noise reduction:** sounds coming from in front of the wearer are more amplified than sounds coming from the sides and behind. This is a tremendous help when trying to follow a conversation in a noisy place.
- **Bluetooth connectivity to mobile phones and other media devices:** this provides a better sound quality for the user or connectivity for the audiologist.
- **FM systems**: particularly useful for children in a classroom setting, some hearing aids can pick up signals from a microphone that is located at some distance e.g around the teacher's neck.

Powering up hearing aids

Hearing aids are electronic instruments and need to be powered. The lack of batteries is often a major reason for discontinuing hearing aid use.

The most popular battery for digital hearing aids has traditionally been the disposable Zinc Air battery. There are also various rechargeable solutions on the market. Rechargeable hearing aid batteries can be recharged either via a mains power supply or through a solar-powered charger. Some models recharge the battery without removing it from the hearing aid, by placing it in a purpose-built slot on the charger.

Despite these more environmentally friendly developments, the availability, cost and duration of rechargeable hearing aid batteries is still an important issue to be taken into consideration when choosing the type of hearing aid and batteries.

Types of hearing aids

Hearing aids are often described by the way they look and where they are worn. The electronics inside could be either analogue or digital.

Body-worn hearing aids (BW)

These are now becoming rare as they are large, cumbersome and often not configurable separately for each ear. However, for some people they may be a practical solution due to easy availability of AA batteries and perhaps for some basic communication e.g. when a person is in a hospital bed. Most BW hearing aids are analogue.

Behind-the-ear hearing aids (BTE)

These are currently the most popular type of hearing aids worldwide. They consist of a small case which sits behind the ear and houses the microphone and receiver. Amplified sounds are then sent through a small plastic tube over the ear and into an earmould which is placed inside the ear canal (see note below on earmoulds). This earmould can be a universal dome or a custom-made earmould to fit the person's ear anatomy.

Today, BTE hearing aids can be quite small and discreet. They can be used for a wide range of hearing loss severity. They are sturdy and often resistant to dust and moisture. They can be versatile and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Schoolboy wearing a body-worn hearing aid. MADAGASCAR

instantly fitted to the user, particularly if there are no custom parts to be made or if instant-made earmoulds technology is available.

In-the-ear (ITE) or in-the-canal (ITC) hearing aids

These hearing aids are custom made to fit either in the concha or inside the ear canal respectively. The size can vary from a shell that can be seen at the entrance of the ear canal (ear concha) to a tiny unit that sits deeper in the ear canal. They can be very cosmetically appealing or almost invisible. However, they do require much more maintenance as the electronics sit inside the ear canal which is prone to wax, moisture, etc. Most of them take tiny batteries which need regular replacement. They can be difficult to handle for someone with vision and/or dexterity impairments.

A note on earmoulds

Both BW and BTE hearing aids are fitted with earmoulds which secure the position of the hearing aid and channel the sound into the ear without leakage. These earmoulds can either be ready-made or custom-made.

Children will almost always need a custom-made earmould, as will persons with moderate or worse hearing losses. Persons with mild to moderate hearing losses can be fitted with a soft ready-made dome, if necessary. Custom-made earmoulds are always the preferred option both for children and adults, however, as they improve hearing aid performance.

To make a good custom earmould or shell, it is important to first take a good ear impression. This serves as a negative cast from which the earmould will be made. Figure 3 shows key steps in this process, which should be carried out by a trained technician.

As children's ears are still growing, their earmoulds need to be replaced regularly.

Most people also need to replace the tubes on their earmoulds at least on an annual basis.

How do we know that a hearing aid has been fitted as best as possible?

If hearing aids cannot restore hearing to normal, how do we know how much the hearing aid is really benefiting the user? During fitting, the audiologist will check that the hearing aid is set to the correct specifications for the person's hearing loss. Adjustments may need to be made over a period of time, which is why follow-up appointments are so important for an optimal user experience. The aim of hearing aids is for the person to communicate more efficiently and lead to a better quality of life.

What can primary health workers do to help users get the most out of their hearing aids?

Hearing aid users need support to get the most out of their hearing aids (which in turn will improve how often they use them). Primary health workers, with simple training, can do the following:

Check that the person knows how to use their hearing aids

Users should become familiar with their hearing aids and should know:

- How to easily insert and remove the hearing aids. Usually, right-ear hearing aids are marked in red and left-ear hearing aids are marked in blue.
- How to switch the aid on and off. Most hearing aids are switched off by opening the battery compartment door. Others might have an on/off button.
- Hearing aids should not be worn when sleeping or when bathing or swimming.
- How to manipulate any user controls (e.g. volume or programmes).
- When and how to change batteries or how to recharge them. Hearing aids usually give a beeping sound when the battery needs to be changed or charged.
- How to use the hearing aid when talking on the phone. It helps to turn on the phone loudspeaker or position the phone near the microphone of the hearing aid.
- Parents or carers can be trained to listen to the hearing aid to check that it is on and working properly.

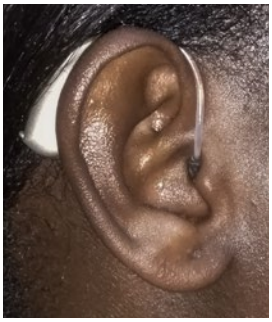
Check that users know how to look after their hearing aids

Cleaning, protecting and maintaining hearing aids is an important part of ensuring that the person is receiving sound effectively. Users can be given the following recommendations:

- Ensure that hearing aids are not exposed to water, sweat or other liquids.
- Use a soft cloth and brush to clean hearing aids so that the microphones and outputs do not get blocked with dust or dirt.
- Use a dehumidifying jar to store hearing aids when not in use. Rice grains or commonly seen silica gel sachets can be used as drying agents. Place some of these at the bottom of the jar, cover with tissue or foam and then place the hearing aids on top. Keep the jar tightly closed.
- Clean the hearing aid's plastic tubing to make sure it does not get blocked with earwax. A special brush or cleaning wire can be used ; do not use hairpins, paperclips or any sharp object to remove dirt from hearing aids or earmoulds.
- It is important to keep earmoulds clean and dry. Earmoulds or domes can be detached from the hearing aid and washed. You can use baking soda in water or warm soapy water. Do not use strong detergent or spirit. Ensure that the mould or dome is completely dry before re-attaching it to the hearing aid.
- Try not to drop the hearing aids, as they are delicate. Put them in a case when not in use to avoid mechanical damage.

SEEMA RUPANI SHAH

BTE hearing aid with custom-made earmould



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BTE hearing aid with universal dome

SEEMA RUPANI SHAH

ITE hearing aid in use

- Do not wear hearing aids if there is any ear discharge or infection.
- Do not try to repair the hearing aid yourself. If it breaks or does not function, return it to the place where it was fitted.

Check that hearing aids are comfortable and working well

- A well-adapted hearing aid should fit well; the user should be able to wear it all day without pain or discomfort.
- Ensure that the ears are free of wax, as wax could block the earmould.
- Check that there are no cracks in the plastic tubes or moulds that are going into the ear. The more severe the hearing loss, the better fitting the mould will need to be.
- There should be no whistling sound (called feedback) heard when the user has the hearing aid correctly inserted.
- No sounds should feel unpleasant when amplified. Soft speech should be audible, conversation should be comfortable and loud sounds should be tolerable. This can be checked by speaking to the user at different levels of loudness, beginning quietly then raising the voice in steps.

Encourage users to wear their hearing aids

When people put on their hearing aid, they can receive a lot of new sounds that they have not heard for a long time, or ever. This can take weeks or months to really adapt to. Health workers can encourage users to wear their hearing aids on a regular basis and reassure them that the process of adjusting takes time.

Many persons will adjust better and quicker if they begin wearing the hearing aids gradually, starting in a quiet place, and perhaps at a lower volume level. Being committed early on in the process will help them get used to all the sounds around them and then be able to focus on what they are really trying to listen to. Their own voice may sound different at first because it is also being amplified by the hearing aids. Over time, they will also overcome this.

Follow-up and referral

Encourage the person to return for follow-up appointments and asks for consumable spare parts such as batteries and earmould plastic tubings.

You should also tell the user to make an appointment with specialist staff if he/she feels pain and/or discomfort when wearing the hearing aid or if they do not report improved communication after an appropriate use of the hearing instrument.

PHONAK

Illustration of a behind-the-ear hearing aid

PHONAK

Illustration of an in-the-ear hearing aid

SEEMA RUPANI SHAH

An earmould full of wax will not let sound into the ear

The impact of hearing aid use in low- and middle-income countries

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Hearing aids are considered the most effective and cost-effective way of making a major difference to the quality of life of hearing-impaired people and may contribute to the economic independence of affected individuals.[1]

There is a large body of evidence for the impact of hearing loss and the effectiveness of hearing aids for adults living in high-income settings, but there is very little data from low- and middle-income countries (LMICs), particularly in children, although the majority of people affected with disabling hearing loss live in those regions.[2] Insufficient data may contribute to a lack of awareness, which plays a part in the lack of access to hearing aids in LMICs.

SEEMA RUPANI SHAH

Girl wearing a hearing aid with instant earmould. ZANZIBAR

Impact of hearing loss

Studies in high-income countries have shown that hearing loss is associated with:

- difficulties with communication
- poorer mental health and wellbeing
- difficulties with daily living activities
- lower levels of employment and higher levels of poverty.

Data collected in LMICs shows a similar pattern. One study conducted in Yemen showed that self-reported quality of life was significantly lower among people with hearing loss. This was attributed to feelings of isolation, lower productivity, lower self-esteem and decreased social activity participation.[3] A study in Nigeria reported that hearing loss in elderly patients had a negative effect on their daily life, especially within the emotional domain.[4]

A 2016 study conducted in Guatemala[5] (see Box) showed that adults with moderate to profound hearing loss were significantly poorer and significantly more likely to have a lower income than people with no disabling hearing loss; they were also more likely to report depressive symptoms and significantly more likely to experience poor quality of life. In addition, the majority of participants described the emotional and social impact of hearing loss as disabling.

Impact of hearing aids

Studies conducted in high-income countries have shown that in the short-to-mid term, hearing aids contribute to:

- improved communication and social participation
- better quality of life
- better mental health
- greater educational and employment opportunities.

In the long term, evidence from high-income settings has demonstrated that hearing aids contribute to:

- better access to jobs
- improved performance at work
- greater educational opportunities
- improvement in socio-economic status.[6,7,8]

Existing data from LMICs clearly indicates a positive impact as well. Evidence from a hearing aid fitting programme in India found that after hearing aid use, people with disabling hearing loss reported improvements in their ability to hear and communicate.[9] Similarly, a study in Nigeria reported that hearing aid users had an improved quality of life following hearing aid fitting.[1]

The Guatemala study[5] found an improvement in quality of life and a reduction in symptoms of depression after an average of seven months of hearing aid use (see Box).

The need for more data

Collecting data from LMICs on the impact of hearing loss and of hearing aid fitting is essential. It helps to:

- raise awareness among local decision-makers, who may argue that their context is different from that of high-income countries
- advocate for more intervention
- draw attention to programmes and attract funding
- track progress and motivate teams
- identify local problems and pilot solutions.

A QUANTITATIVE IMPACT STUDY IN GUATEMALA[5]

Adults with a moderate to profound hearing impairment*, living within urban and rural areas in and around Guatemala City, were identified by the Sonrisas que Escuchan Foundation. For each case, a matched age and gender control was selected and screened to confirm that they did not have disabling hearing loss.

All 180 cases and 143 controls were interviewed using a structured questionnaire. Cases with hearing loss were then provided with hearing aids, and re-interviewed after a period of 6–9 months.

Results

Six to nine months after receiving hearing aids:

- 82% were satisfied with their hearing aids
- 71% of people used them daily, of which 93% used them for up to four hours per day.

The use of hearing aids significantly improved mental health and wellbeing, notably:

- There was a reduction in moderate to severe symptoms of depression
- 86% of participants reported that hearing aids increased their self-confidence
- 88% of participants reported that hearing aids had positively changed their enjoyment of life
- 23% felt safer wearing their hearing aids
- 56% reported that the most significant benefit of wearing hearing aids had been the ability to communicate with family and friends.

*Based on the WHO definition of disabling hearing loss

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Barriers to the use of hearing aid systems in low- and middle-income countries

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Hearing aids help millions of people throughout the world to hear better and consequently take a more active part in society, learn more easily, get better jobs, and improve their economic status. They are one of the most important public health interventions to decrease the burden of hearing loss throughout the world. They are similar to the use of glasses or spectacles by people with visual loss.

As the numbers of people with hearing loss and the burden of hearing loss continue to rise globally, and particularly in low- and middle-income countries (LMICs),[1] the need for hearing aids becomes ever greater. However, in contrast to glasses, they are less effective, more difficult to use, may stigmatise users and are far more expensive. This article examines the barriers to **availability**, **access** and **use** of hearing aids. It focuses on LMICs, where over 80% of people with hearing loss are found.

Barriers to availability of hearing aids in LMICs

Approximately 70 million hearing aids would be needed per year in LMICs if everyone who needs amplification were to get one hearing aid each.[2] In 2005, approximately 1 in 35 (less than 3%) of the hearing aids needed in LMICs were getting there. The situation has not improved much since then. There are a number of reasons for this lack of availability, including:

Poor supply of hearing aids by manufacturers
The total production of hearing aids in the world is less than 5% of global need,[3] and the majority go to high-income countries.[4] The major hearing aid companies do not yet see a significant market for their products in LMICs, despite the population increasing and ageing much faster there. By 2050, the global number of people aged 65 or older is likely to nearly triple to about 1.5 billion, with the vast majority living in less developed countries.[5]

Mother helping her daughter insert her hearing aid.
ETHIOPIA

ROBBERT ENSINK

There is also insufficient availability of hearing aid batteries and earmoulds, both of which are indispensable for the working of hearing aids.

Lack of awareness
People (including politicians and decision-makers) are not aware of the effects of hearing loss on individuals and that something can be done about it. They are not aware either of the economic and societal costs of hearing loss and of the benefits of hearing aids if they are properly fitted and used correctly. The true number of people with hearing loss is not generally known, although the World Health Organization (WHO) is making efforts to improve this. This lack of awareness limits advocacy for change and creates a lack of political will to prioritise and tackle this problem, which leads to a lack of programmes and resources.

Barriers to accessing hearing aids in LMICs

When hearing aids are available in LMICs, potential users face several barriers in accessing them, including:

Cost
The cost of hearing aids is the most important barrier to access. After the launch of the first *WHO Guidelines for hearing aids and services in developing countries* in 2001, WHO called for the cost of good quality hearing aids to come down to US$20 per unit. The goal of access to good quality, affordable hearing aids has still not been reached. The majority of people who need hearing aids earn less than US$10 a day,[6] so a hearing aid costing US$50–100 or more is a significant and often impossible expenditure. There are some lower-cost hearing aids available, but their quality is not adequate and they may not have sufficient power for the more severe hearing losses.

To the cost of hearing aids, one must add the recurring cost of batteries and maintenance expenses. In many sub-Saharan countries, the average annual cost for hearing aid batteries may be greater than the annual income of a farming family.[7]

Lack of services
Hearing aids cannot be expected to just work straight away after prescription (unlike glasses). They need to be fitted and their settings adjusted by trained personnel, usually in a follow-up visit, in order to be fully useful to the wearer. In many LMICs, there are no, or not enough, hearing health diagnostic and fitting centres, trained audiologists or audiology technicians and hearing aid repair technicians. This in turn affects the drive to offer hearing aids to those who need them.

Lack of referral by medical and other health personnel
The medical profession can act as a barrier to access. A study in the United Kingdom found that general

Continues overleaf ➤

practitioners (GPs) often failed to refer about half of the patients who came to them for help with a hearing loss. There was a poor perception amongst GPs of what hearing aids can do, which was partly the result of a lack of training in otology and audiology in the medical curriculum.

Insufficient availability of hearing aid batteries and earmoulds
This may be a problem in some countries. Even when batteries and/or earmoulds are available, they may only be available in major urban centres, but not in rural areas.

Barriers to the use of hearing aids in LMICs

Even when a person has been provided with a hearing aid, it often ends up being left in the drawer. There can be several reasons for this:

Lack of information about hearing aids
Hearing aids are not difficult to use but people in all countries do need good training from when they start using them in order to take fullest advantage of them. In LMICs, where there is a lack of trained personnel, hearing aid users may not be given enough help or information, which can lead to them becoming discouraged or disappointed with their hearing aid.

Poor quality of hearing aids
Low-cost hearing aids, often available without prescription, may be of poor quality and not be suitable for the hearing loss of the user.

Improper fitting and poor follow-up
Where numbers and training of personnel are inadequate, hearing aids may be improperly fitted and there may be poor follow-up or none at all.

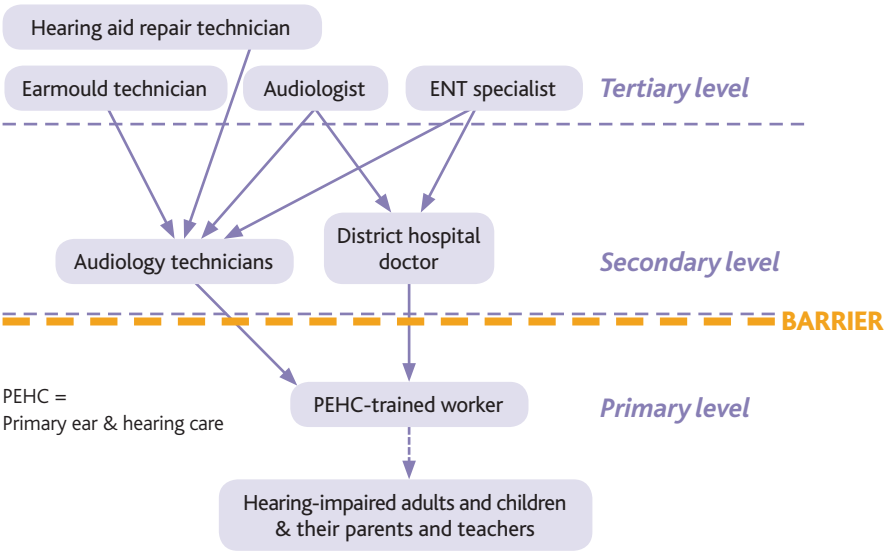
Stigma
People of all ages may feel that hearing aids make them look unintelligent and try to hide the fact that they are using them. Glasses, by contrast, are accepted as part of everyday life because they are much more common and perhaps because wearing glasses is seen as a sign that the wearer is learned or clever.

How can we improve the situation?

Providing hearing aids is a multistep process much more complex than prescribing glasses, and all the following aspects must be considered to overcome existing barriers:

Low-cost, quality hearings aids
Most hearing aid companies have adopted a high-cost and low-volume approach and focus their sales on high-income countries. From a public health perspective, this model needs to be turned around so that there is, in addition, a high-volume low-cost approach to cater for the majority of people in the world who need hearing aids. Innovative financing solutions may need to be put in place to enable poorer people to obtain them. In addition, these low-cost hearing aids need to be adapted to conditions in LMICs, such as humid environments. Effective supply chains also need to be put in place.

FIGURE 1 LEVELS OF HEARING HEALTH PERSONNEL IN LMICS*



*Extracted from: WHO Guidelines for hearing aids and services for developing countries (2nd edition). Geneva: WHO, 2004. Page 26.

Low-cost power supply
To address the high cost of batteries, attempts have been made to develop solar-powered rechargeable batteries and even rechargeable hearing aids. However, these have not yet been developed in a sufficient scale to make a difference. With greater numbers sold, the cost of batteries should also come down.

Suitable earmoulds
Innovative ways to provide earmoulds (such as open fittings) and the use of other more readily available materials (such as dental materials) should be considered in areas where the lack of earmoulds is a barrier.

Personnel for hearing aid fitting and repairs
In LMICs, there is a particular barrier between the primary and secondary levels of healthcare which makes it more difficult for persons with hearing loss to progress from the primary level to the secondary level, where most fitting is currently done (see Figure 1). Greater access to hearing aids would occur if most fitting could be done at the primary level. Only the complex or severe cases would then need referral to the secondary or tertiary level. Selected primary health and community level workers could be trained to fit some types of hearing aid. This could be built into their advanced training or provided by follow-up courses for designated personnel.

Audiometry and otoscopy on smartphones and teleaudiology for remote diagnosis and fitting advice are upcoming solutions which would be helpful in some areas.

Systems for repairing hearing aids also need to be put in place – such as training hearing aid repair technicians for local repair, or offering people a refurbished hearing aid while their non-functioning new one is sent for repair.

Campaigns for better awareness
Finally, awareness of the effectiveness of hearing aids must be raised amongst decision-makers and in the community, to overcome the stigma of wearing hearing aids and to encourage support for programmes.

References

[1] World Health Organization (WHO). Addressing the rising prevalence of hearing loss. Geneva: WHO, 2018. http://apps.who.int/iris/handle/10665/260336

[2] WHO's 2018 estimate of the global number of people with disabling (moderate or worse) hearing loss = 466 million [see previous reference]. Subtract 26 million with profound loss = 440 million, of which 80% live in LMICs = 352 million. Assume life of a hearing aid is 5 years. 352/5 = 70.4 million. This would only provide 1 hearing aid per person, and includes all age groups.

[3] This assumes that the global production of hearing aids is approximately 20 million annually. 20/440 = 4.5%.

[4] World Health Organization (WHO). Preferred profile for hearing-aid technology suitable for low- and middle-income countries. Geneva: WHO, 2017. http://apps.who.int/iris/handle/10665/258721

[5] World Health Organization (WHO). WHO Global Health and Aging Report. Geneva: WHO, 2011. www.who.int/ageing/publications/global_health/en/

[6] Pew Research Centre, 2015. How Many Live on How Much, and Where. http://www.pewglobal.org/interactives/global-population-by-income/

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Beyond devices: what to consider when providing hearing aids in LMICs

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Although the number of potential hearing aid users is largest in low- or middle-income countries (LMICs), hearing aid availability and accessibility is still limited in most of these countries and mainly facilitated by nongovernment organisations (NGOs) and private businesses.

The very high cost of hearing aids is one of the main barriers to access in LMICs, and it seems natural to focus on cost when looking for solutions – whether by offering free or donated devices, or by trying to produce cheaper hearing aids.

However, improving access to hearing aids is not just about finding a cheaper or better device. Providing hearing aids is not a one-step procedure. It requires the dedication of a local team that is either self-sufficient or receives supporting visits in the region on a regular basis.

When a hearing aid is not delivered with the correct team or skills:

- It may be of no benefit to the user because it has not been adequately selected, adjusted or programmed.
- It may be uncomfortable because of an ill-fitting or low-quality earmould.
- If users are not correctly informed and trained about their hearing aid, they may end up disappointed.
- The hearing aid may not be repaired if it breaks down or the earmould is damaged.
- The lack of user satisfaction may discourage other people from seeking out audiology and hearing aid services and will not motivate governments to implement or support such services.

This article aims to provide a starting point for thinking about how to provide hearing aids in LMICs in a comprehensive way that ensures services have a positive impact and increase user satisfaction.

A local workshop providing earmoulds is an important element for sustainability.
SRI LANKA

ANDREW SMITH

Basic team and equipment

Hearing aids should **only** be supplied when personnel are available with the necessary skills and when there is access to the correct equipment, instruments and accessories.[1] CBM has found that the establishment of successful hearing aid services in LMICs is more strongly associated with the quality of training of their personnel and their diagnostic equipment, than with the type of hearing aid provided.[2]

Basic team

– One health promoter who will:
- raise awareness in the community about the importance of ear and hearing care (EHC)[3,4]
- coordinate hearing screenings
- establish means and routes for referral to and from audiology/ hearing aid services.

– A clinical audiologist who will:
- make an adequate hearing assessment
- deliver a diagnosis
- provide recommendations for action and follow-up.

– An audiometry technician who will:
- support the role of the health promoter in screening and referral activities
- perform tests and tasks appropriate to his/her level of training, under the guidance of the clinical audiologist.

– A hearing aid repair and mould technician who will receive referrals from the clinical audiologist or audiometry technician and will:
- obtain ear impressions
- produce earmoulds
- carry out adaptations, repairs and maintenance of hearing devices and/or earmoulds.

Connections should also be established with other professionals if available:
- ENT/Otologists
- Tertiary audiology centres (national referral centres where available)
- Speech and language therapists
- Paediatricians
- Teachers of the deaf
- Community leaders.

Basic equipment

- Audiometer with noise-occluding headsets
- Sound-level meter to measure background noise
- Tuning fork (at least 512 Hz and 1024 Hz) to test hearing and confirm audiometric findings
- Tympanometer (if possible)
- Otoacoustic emission tester (if possible)
- Equipment and materials for making earmoulds
- Hearing aid batteries and accessories (spare parts, tubing, etc.).

It is also important to have a suitably quiet environment for obtaining the most accurate hearing test on which to base the hearing aid fitting.

Scaling up

If the initial project is successful and you want to scale up to meet the needs of the local population, CBM has produced a guiding document giving 'essential' and 'recommended' numbers of personnel needed to provide services to a population of one million.[5]

Situation analysis

At the pre-planning stage, make sure that you have obtained concrete knowledge (preferably evidence-based data), concerning the local situation, specific needs and the feasible and realistic solutions that you can contribute to.

Many tools are available for this, from a simple SWOT analysis (Strengths, Weaknesses, Opportunities and Threats)

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to the World Health Organization's comprehensive Ear and Hearing Care Situation Analysis Tool.[6]

You can ask yourself the following questions:

1. How is existing healthcare organised at primary, secondary and tertiary level and what is the total number of specialists in hearing care? Does the country recognise the profession of certified audiologist, or are hearing care technicians trained?
2. Has research been done in the country?
3. Who is the main hearing aid dispenser? Do local suppliers, if there are any, guarantee a replacement policy for defective hearing aids?
4. Is it possible to create the multi-disciplinary teams needed for the provision of hearing aids using local personnel?
5. Once hearing aids are fitted, how is follow-up organised, or how can it be arranged in the future?
6. Can low or no tax rates and import duties be applied to hearing instruments and hearing aid batteries?
7. Is there health insurance in the country, what EHC services does it cover, and how does it work?
8. Would teleaudiology with smartphones be possible?
9. Is the Ministry of Health involved in prevention programmes for hearing loss?
10. Is hearing screening (neonatal or other) currently available? Is there a screening programme for schoolchildren?
11. Are there any awareness campaigns for hearing impairment?

Hearing aids and accessories

Many NGOs today still bring their 'own' hearing aids with them to LMICs (sometimes a collection of randomly donated new or refurbished hearing aids). In many cases, these donated hearing aids lack the amplification power necessary for most of the hearing losses encountered by visiting EHC or audiological rehabilitation teams. It is therefore important to carefully consider which hearing aids should be provided, rather than just accept any batch of donated hearing aids. Our recommendation is that only new hearing aids from reputable manufacturers are considered.

1 Opt for a small range of digital models

Select a small range of makes and models (which can cover all levels of hearing loss) to facilitate prescription, fitting and repair.

The type and model of hearing aid supplied should also reflect local circumstances regarding availability, affordability and accessibility. WHO has produced a document detailing the hearing aid features that would most benefit users in LMICs.[1] Digital hearing aids are preferable when possible, as they provide better sound quality and improved patient usage. They are also easier to maintain and repair, and their amplification range is larger (which means fewer models will need to be kept in stock).

The amplification power of the hearing aids provided should match the needs of the population (see also Table 1 for helpful estimates).

2 Plan for access to earmoulds and batteries

These essential elements often act as a barrier, therefore must be considered from the start.

Establish a way of supplying high-quality earmoulds and fast repair services locally. Where possible, promote the role of earmould/repair technician, e.g. as a vocational training opportunity for persons who are deaf or hard of hearing.

Locally available, rechargeable, including solar-charged, hearing aid batteries might be the most ideal situation, but their cost and availability may be too challenging. Therefore, the choice of batteries needs to be evaluated on a one-to-one basis.

TABLE 1 ROUGH ESTIMATION OF THE NUMBER OF DEVICES AND AMPLIFICATION POWER NEEDED WHEN PROVIDING HEARING AIDS IN A LMIC[5]

		Essential	Recommended
Number of devices required (based on one hearing aid per person)		1% of total population of influence	3% of total population of influence
Proportion of each type of hearing aid	Low-power hearing aids (for mild hearing loss: 26–40 dB)	5% of total number of hearing aids	10% of total number of hearing aids
	Medium-power hearing aids (for moderate hearing loss: 41–60 dB)	35% of total	45% of total
	High-power hearing aids (for severe hearing loss: 61–80 dB)	45% of total	35% of total
	Super-power hearing aids (for profound hearing loss: over 80 dB)	15% of total	10% of total

3 Second-hand hearing aids are not recommended

The issuing of second-hand and reconditioned hearing aids is to be strongly discouraged due to difficulties in prescribing them (they are often old, unspecified models) and the need for frequent repairs (with spare parts being very expensive and inaccessible). However, reconditioned hearing aids could be recommended when a proper repair laboratory, battery supply and follow-up services are in place, and hygiene measures have been taken to sanitise the hearing aids and avoid any risk of spreading diseases from one user to another.

4 Consider your target population

The target population for hearing aids should be those with moderate and severe hearing loss, particularly children (in this case, mild loss should also be included). The effectiveness and positive impact of hearing aids is greater for this range of hearing loss and age group. This is because the technical specifications of the devices will be simpler and these users will more easily achieve the level of hearing needed to understand spoken language and to develop speech. This in turn will increase hearing aid use and user satisfaction.

Planning for sustainability

The current 'top-down' approach will not be enough to meet the need for hearing aids in low-resource settings. Hearing aid fittings are multistage procedures that show no similarities with eye or mobility programmes, for example, and require a new and different approach: setting up good sustainable local hearing aid services, by building upon existing systems and services, and providing regular capacity building.

References

[1] World Health Organization. Preferred profile for hearing aid technology suitable for low- and middle-income countries. Geneva: WHO, 2017.

[2] Extracted from: CBM Audiology Guidelines (formerly named: 'Audiology Position Paper'). CBM International, Bensheim, Germany, 2015.*

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[4] WHO. Primary Ear and Hearing Care training resources: four manuals which can be downloaded from: www.who.int/deafness/activities/hearing_care/en/

[5] CBM. Strategic Plan for CBM's work in Ear and Hearing Care 2011–2015; Annex 4: Input-output framework for an estimated population of one million. (updated 2016). CBM International, Bensheim, Germany.*

[6] World Health Organization. Ear and Hearing Care: Situation Analysis Tool. Geneva: sWHO, 2015. http://apps.who.int/iris/handle/10665/206141

*For access to the original CBM documents please contact Dr Diego Santana at diego.santana@cbm.org

Improving access to hearing care and hearing rehabilitation in the Philippines

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Disabling hearing loss affects 8.8% of the population in the Philippines.[1] Among a total population of 106 million Filipinos (according to a 2018 estimate), at least 9 million have a hearing loss which requires medical attention or rehabilitation through hearing aids. Although hearing disability is a perennial public health concern, the Philippines has one of the smallest ear and hearing specialist population in Southeast Asia. There is currently a limited number of hearing health professionals: there are only 862 ENT physicians, 84 audiologists and 462 speech and language pathologists. In addition, this personnel tends to remain in key cities. Access to ear and hearing healthcare is therefore a challenge, especially in geographically isolated and disadvantaged areas.

Better Hearing Philippines (BHPI) was founded by a group of individuals from government and nongovernment agencies in support of the hearing-impaired community. It is a non-profit, nongovernment organisation that aims to support government efforts in promoting ear and hearing health.

Developing comprehensive services for access to hearing rehabilitation

In partnership with different local and international organisations, BHPI developed the Easy Access to Rehabilitation Services (EARS) Programme to address public health concerns about ear and hearing in the country. It was first implemented in the Metro Manila area.

The EARS programme has four components:

1 Research and policy advocacy

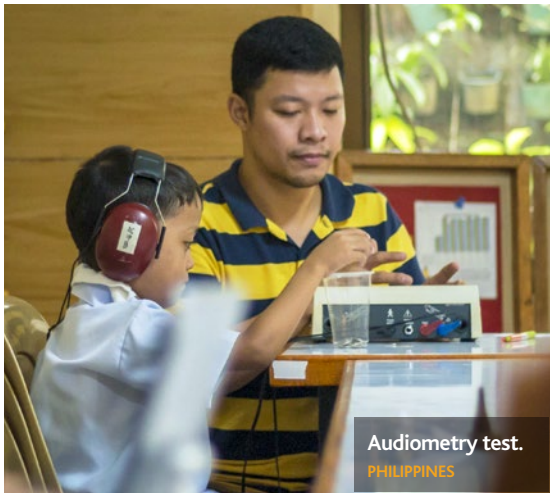
Research and information are essential tools to make governments aware of problems and to highlight what has been accomplished.

- BHPI provided information about ear and hearing health to national health programme planners.
- BHPI conducted a nationwide survey following the WHO Survey Protocol. This was used to advocate for landmark policies and laws, such as a Universal Newborn Hearing Screening Law and a Benefit Package for Children with Hearing Impairment.
- BHPI constantly monitors what is being accomplished by the EARS programme.

2 Capability building

The EARS programme works towards incorporating the prevention of deafness and hearing impairment into existing primary healthcare services and community-based rehabilitation programmes.

- Training packages were developed in partnership with local health partners. These incorporate all aspects of prevention and rehabilitation and are available to all levels of healthcare.
- Over 1,000 Community Health Workers, Primary Health Nurses and City/Municipal Health Physicians were trained to provide basic ear and hearing health services in their respective communities. They were also trained to refer local patients to specialised services.



BETTER HEARING PHILIPPINES, INC.

Audiometry test.
PHILIPPINES

3 Service delivery

- BHPI facilitated the establishment of two CBM-funded service delivery centres for Ear and Hearing in Visayas and Mindanao, to form the backbone for activities in the whole country. These centres provide diagnosis, hearing aid prescription, fitting, orientation and initial follow-up.
- BHPI also partnered with the University of Santo Tomas, which has a Masters Programme in Clinical Audiology. Volunteers from the University offer comprehensive audiological assessments and management services including the provision of hearing aids supported by Government Charity Programmes and nonprofit organisations.
- After the initial follow-up, patients are followed up by trained local health workers within their communities. For (re)habilitation follow-up, we established partnerships with local schools and academic institutions offering speech and language services.

4 Social mobilisation

- To increase awareness of prevention and early identification of hearing loss, BHPI worked with the University of Santo Tomas to develop information, education, and communication materials for use in local communities.
- Volunteers use specific dates to conduct awareness activities throughout the year: World Hearing Day (in March), National Disability Prevention and Rehabilitation Week (in July) and Deaf Awareness Week (in November).

Conclusion

This cycle of advocacy development, manpower development, and service delivery has since then been replicated in other key areas around the country. Partnerships, including with the government, are at the heart of the EARS programme. They allow us to work together towards the sustainability of services and, through regular meetings with stakeholders, to take steps to continually improve access to ear and hearing care and rehabilitation.

BETTER HEARING PHILIPPINES, INC.

Hairband advertising World Hearing Day.
PHILIPPINES

Reference

[1] Prevalence of ear disorders and hearing loss in the Philippines. Better Hearing Philippines, Inc., 2005. Retrieved from www.bhphil.org/downloads/prevalence_of_ear.pdf

Tips to take care of your hearing aids

PROTECT THEM

- Do not expose your hearing aids to water or other liquids
- Try not to drop hearing aids, as they are delicate. Put them away when not in use to avoid mechanical damage
- Do not wear hearing aids if you have an ear discharge or infection
- Store hearing aids in a dehumidifying jar when not in use. You can make one by placing rice grains at the bottom of a jar and covering them with tissue, before placing the hearing aids on top and tightly closing the lid

CBM

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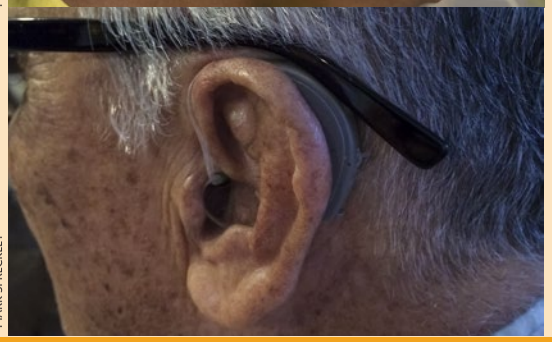

MARK SPRECKLEY

CLEAN THEM REGULARLY

- Use a soft cloth and brush to clean hearing aids so that they do not get blocked with dust or dirt
- Earwax can block hearing aids' plastic tubing. Make sure to clean it with a special brush or cleaning wire
- Earmoulds should be detached from the hearing aid and washed regularly. Use baking soda in water or warm soapy water (**not** strong detergent or spirit). Ensure that the mould is completely dry before re-attaching it
- Do **not** use hairpins, paperclips or any sharp object to remove dirt from hearing aids or earmoulds

MAKE SPECIALIST APPOINTMENTS TO ADJUST OR REPAIR THEM

- Contact the staff who fitted your hearing aid if you feel pain or discomfort when wearing it, or if it does not seem to improve your hearing
- Contact hearing aid repair services if your hearing aid stops working. Do **not** try to repair it yourself

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