Report WHO APW

Hearing aid service delivery approaches in low and middle-income (LMI) settings: A Feasibility study

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Introduction

It is well known that the prevalence of hearing loss has increased over the last few decades. The major reason being hearing loss not addressed in a timely manner and this adversely affects people in terms of employment, socio-emotional well-being, education and quality of life. Across the globe, over 1.5 billion people have hearing loss of varying degrees. However, the majority of people with hearing loss reside in low-and-middle income countries (LMICs), where access to care is limited, not well integrated into public health systems, and prohibitively expensive. However, one of the most common rehabilitative measures for people with permanent forms of hearing loss, is hearing aids. Traditional clinic-based services require specialist diagnosis and provision of care using expensive and stationary equipment. These factors limit access and affordability of hearing care for people in LMICs. Additionally, under provision of hearing aids is a major challenge to individuals in LMICs. As a result, estimates have indicated that less than 3% of people in LMICs who could benefit from hearing aids, get them.

Despite the growing need for hearing care, LMICs face significant systemic barriers that hinder effective service delivery. These include limited healthcare infrastructure, shortage of trained healthcare professionals, and the geographical dispersion of populations, often in remote areas. Moreover, cultural perceptions of hearing loss and the stigma associated with wearing hearing aids further complicate efforts to address this issue. These factors underscore the complexity of implementing traditional clinic-based hearing services in LMIC contexts.

Utilizing community health workers (CHWs) as front-line providers of care and education while leveraging advances in digital technologies like mobile health (mHealth) is a promising public health strategy to increase hearing services accessibility. The purpose of this study is to assess the

feasibility of an end-to-end protocol, developed by the WHO technical working group on rehabilitation services in LMIs. This protocol proposes to utilize community health workers (CHWs) to screen and assess hearing loss, refer cases requiring medical intervention, fit low-cost preset hearing aids to those that qualify, and ensure follow up care that is specifically tailored to LMIs.

Community Health Workers (CHWs) have been pivotal in bridging healthcare gaps in various public health initiatives across LMICs, demonstrating success in maternal and child health, infectious disease control, and chronic disease management. Their role in community-based education, early detection, and linkage to care presents a unique opportunity to address the hearing loss burden. Leveraging CHWs for hearing services capitalizes on their trust within communities, ability to navigate cultural nuances, and potential to reach underserved populations. This approach aligns with WHO's emphasis on task-shifting strategies to optimize healthcare resources in resource-limited settings.

Rationale of the study

We have dearth of data regarding the utilization of Community health workers in fitting of hearing aids. The purpose of this study is to assess if the model can be successfully implemented to achieve its intended purpose; in addition to identify potential barriers and facilitators with the implementation of the model. Despite the recognized potential of CHWs in various health domains, there is a dearth of literature specifically exploring their role in the delivery of hearing care, particularly in the fitting and follow-up of hearing aids. This gap highlights a critical area of inquiry, as understanding the feasibility, challenges, and facilitators of employing CHWs for hearing aid distribution could inform scalable solutions for LMICs. Our study aims to fill this gap, contributing valuable insights into an underexplored area of public health interventions.

This study seeks to answer the following research questions:

1. Can CHWs effectively screen and assess hearing loss, and fit low-cost hearing aids in a LMIC setting?
2. What are the potential barriers and facilitators to implementing a CHW-led model for hearing aid distribution in LMICs?

Novelty of the study

The study aims to utilize the community health workers in addressing the unmet need of hearing care challenges. This study introduces a groundbreaking approach by deploying Community Health Workers (CHWs) to address the critical gap in hearing care within low-and-middle-income settings. Unlike traditional clinic-based models, this strategy leverages the unique position of CHWs within their communities to provide accessible, cost-effective, and culturally sensitive hearing care solutions. This innovation not only aims to increase the reach of hearing services but also to integrate these services seamlessly into the existing public health infrastructure, presenting a scalable model for other regions facing similar challenges.

Steps in the conduct of study

1. **Conceptualization of the proposal and adopting it for Indian settings.**
2. **Conduct of a Brainstorming Meeting**.

   A meeting for development of protocol and questionnaire was held via virtual mode on 9th September, 2023 with the following participants: -

   a. Dr. Suneela Garg
   b. Dr. A.K. Agarwal
   c. Dr. (Md.) Asheel WHO India office

d. Dr. M. Meghachandra Singh

e. Dr. Ravi Meher

f. Dr. Nidhi Bhatnagar

g. Dr. Amod L. Borle

h. Dr. Ekta Arora

i. Dr. Samar Hossain

j. Ms. Janki Mehta

The main agenda of the meeting was to develop the protocol and the questionnaires to cover the areas of interest in the study and assess the knowledge of the training healthcare worker (HCW) staff. The training agenda was also finalized. Protocol was reviewed and the preparation and finalization of the protocol was carried out.

The aspects covered in the meeting included -

- ✓ Aims and objectives
- ✓ Survey population and area
- ✓ Data collection tools and tests, Questionnaires, Hearing test, ear examination, Survey team and training
- ✓ Pre-survey visit
- ✓ Follow up Plan
- ✓ Quality checks
- ✓ Timelines for carrying out the study

The brainstorming meeting was pivotal for aligning the study's vision with practical execution. By developing a standardized protocol and questionnaires, we ensure

consistency and reliability in data collection across different settings. This step is crucial for accurately assessing the effectiveness of the CHW model in delivering hearing care and identifying areas for improvement.

3. **Capacity building of the Community Health Workers**

A training was held on 19th October, 2023 for the health workers. The pre – posttest questionnaire was filled by the attendees and the training was conducted as per below schedule:

	Topic	**Time**	**Speaker**
1.	Introduction & Objectives of the study	9.30AM–9.45AM	Dr. M.M Singh
2.	Orientation to the study	9.45AM–10AM	Dr. Arun Agarwal
3.	Community perspective of the study	10AM-10.15 AM	Dr. Suneela Garg
4.	Screening of the community- Basic hearing profile	10.30AM-11.15 AM	Dr. Ravi Meher
5.	Screening Ear morbidities - Identification of red flags	11.15AM-11.45 AM	Dr. Ravi Meher
6.	Hearing Aid fitting • Identification of parts of Ear • Fitting of Aid • Problems/Challenges in fitting	12.30 AM-2 PM	Consultant ALPS Mr. Akash Narang Mr. Ankur Pal
7.	Communication and Ethics	2 PM-2.30 PM	Dr. Nidhi Bhatnagar
8.	Ensure compliance after fitting the aid and Follow ups	2.30 PM – 3PM	Dr. Amod Borle
9.	Community Screening Questionnaire (Annexure I)	3.15PM-3.40PM	Dr. Ekta Arora
10.	Challenge Addressal & Hear WHO app	3.40 PM- 4PM	Dr. Samar Hossain

The team was oriented with the study protocol and with the basic steps to be followed during the conduct of the study. Capacity building of the team was done for the following-

- Screening of the eligible subjects
- Identify the red flags
- Fitting of the hearing aid
- Problems/Challenges in fitting the hearing aid

4. **Local Area Survey**

After contacting the local contact persons, a survey of the area was done to connect with the community. Households were screened and sociodemographic details were collected for the areas under study. At the same time, awareness was generated as to how to deal with common ear problems and when to consult an ENT specialist.

Posters were also displayed in the areas to generate awareness amongst the community regarding hearing problems and hearing care.

Objectives

Primary Objectives:

1. To determine the feasibility of establishing and delivering hearing aid services in Low and Middle-income settings in Delhi.

2. To study the user's adherence to the hearing aid usage and follow-up services.

Determining the feasibility of establishing and delivering hearing aid services in Delhi's low and middle-income settings goes beyond operational capability; it encompasses evaluating the financial viability, community acceptance, and the adaptability of the healthcare

system to integrate new service models. Success in these areas would mark a significant milestone in making hearing care universally accessible**.**

Secondary Objectives:

1. To identify the barriers and challenges that might hinder the successful implementation of hearing aid services

2. To formulate actionable strategies for overcoming identified barriers and challenges, ensuring sustainable and inclusive hearing aid service delivery to low and middle-income settings.

By identifying barriers and formulating strategies to overcome them, we aim not only to ensure the success of this initiative but also to lay down a roadmap for future endeavors to tackle healthcare challenges in underserved areas. This proactive approach is expected to catalyze a shift towards more inclusive and sustainable health service delivery models.

Materials & Methods

- **Study design-** Prospective cohort study– A feasibility study. The choice of a prospective cohort study and a multisite approach was guided by the need to closely monitor the implementation process and outcomes of the CHW model in real-time, allowing for the collection of longitudinal data. This design facilitates a comprehensive analysis of the model's effectiveness over time and across varied community settings, providing robust evidence to inform policy and practice.
- **Study Participants-** 25 adults (> 18 years) with moderate to severe hearing loss ($PTA_{0.5,1,2,4}$ in the better ear between 35 to 80 dB HL), free from red-flag referrals
- **Study duration-** 4 months
- **Sample size-**25
- **Study Site**- Two sites were included in the study, in low- and middle-income settings. The sites include**:**
    1. Family adoption area of the department of Community Medicine, MAMC - Khwaja Mirdard area
    2. Delhi Gate Health Centre, New Delhi.

  The areas under study were surveyed and every household was visited to screen for the study participants eligible for hearing aid fitting.

Following is the demographic profile of Delhi gate area.

S. No	Demographic Variables	Delhi Gate, n (%)
1.	Total population	7745
2.	No. of households	1434
3.	Gender: - Male - Female	 4134 (53.4%) 3611 (46.6%)
4.	Range of Per Capita Income	Rs. 120-26700

A total of 140 households were screened at Delhi gate area and 247 households were surveyed in the Khwaja Mirdard area.

Ethical considerations

Special attention was given to ensuring informed consent, respecting participant confidentiality, and minimizing any potential harm.

Data Analysis

Data analysis was carried out employing a mix of quantitative and qualitative methods to evaluate the study's objectives comprehensively. Quantitative data will be analyzed using statistical software to assess the prevalence of hearing loss, the effectiveness of hearing aid fitting, and adherence rates, while qualitative interviews will explore the experiences of CHWs and participants, identifying barriers and facilitators to hearing care delivery.

Expected Challenges and Mitigations

Anticipated challenges include potential resistance to new healthcare delivery models, logistical issues in remote areas, and the need for ongoing CHW training. To mitigate these challenges, the study will engage community leaders to foster acceptance, utilize mobile technology to enhance logistics and communication, and provide continuous support and resources for CHW training.

Methodology

Preparatory phase- Initial 15 days period after the commencement of the project was the preparation phase that included training of Health care workers by the audiologist under supervision of ENT specialist. At the same time, this period was utilized for a rapid survey for identification of the participants and creating awareness among the community. Subjects screened with red flag signs were managed as per standard treatment Protocol. The preparatory phase was critical for ensuring the project's success, focusing on building the capacity of Healthcare Workers (HCWs) through specialized training conducted by experienced audiologists and supervised by ENT specialists. This training encompassed both theoretical knowledge and practical skills in screening, identifying, and managing hearing loss. Concurrently, a rapid community survey was launched to identify potential study participants and raise awareness about hearing health, aiming to lay a solid foundation for the study's community engagement efforts.

Study phase- Pre-designed questionnaire and client information sheet were used to collect the information from the participants. The study phase involved meticulous data collection through a pre-designed questionnaire and client information sheets, ensuring comprehensive information capture about the participants' hearing health status and their socio-demographic characteristics. This phase was instrumental in gathering detailed insights into the hearing loss prevalence and the

potential impact of hearing aid intervention in the community.

Sampling Strategy

Our sampling strategy was designed to inclusively and effectively identify individuals with hearing loss. The consecutive sampling for the initial screening, combined with the camp approach for community engagement, ensured wide coverage and awareness. This strategic blend aimed to maximize the identification of eligible participants while fostering a supportive community environment conducive to hearing care advocacy.

First appointment-25 adults (>18 years) in the sampled area were screened by consecutive sampling for any hearing loss. Household survey was done to screen the subjects who were eligible for hearing aid fitting. Camp approach was also used to create awareness among the community for hearing aid screening. Those identified with any red flag indicators were not included in the study.

Following are the red flags indicators:

→ Ear trauma

→ History of acute pain, active drainage, or bleeding from an ear.

→ Recurrent or chronic otitis media

→ Sudden onset or rapidly progressive hearing loss.

→ Unilateral or asymmetric hearing loss

→ Pulsatile tinnitus

→ Malformation of the ear canal

Audiometry (air conduction): The degree of hearing loss was determined with Audiometry and

individuals with moderate to severe hearing loss were taken up for hearing aid fitting. The mild hearing loss patients were recommended for annual screening and profound hearing loss were referred to local health system. Audiometry played a pivotal role in accurately assessing the degree of hearing loss among participants, facilitating the appropriate categorization and intervention. The decision to focus on individuals with moderate to severe hearing loss for hearing aid fitting was based on the potential for significant improvement in their quality of life. Meanwhile, guidance was provided for those with mild or profound hearing loss, ensuring they received necessary advice or referral for further care.

Inclusion Criteria:

1. Young Adults > 18 years of age
2. Residents of the low-income area

Exclusion Criteria:

1. Subjects with severe cognitive impairments

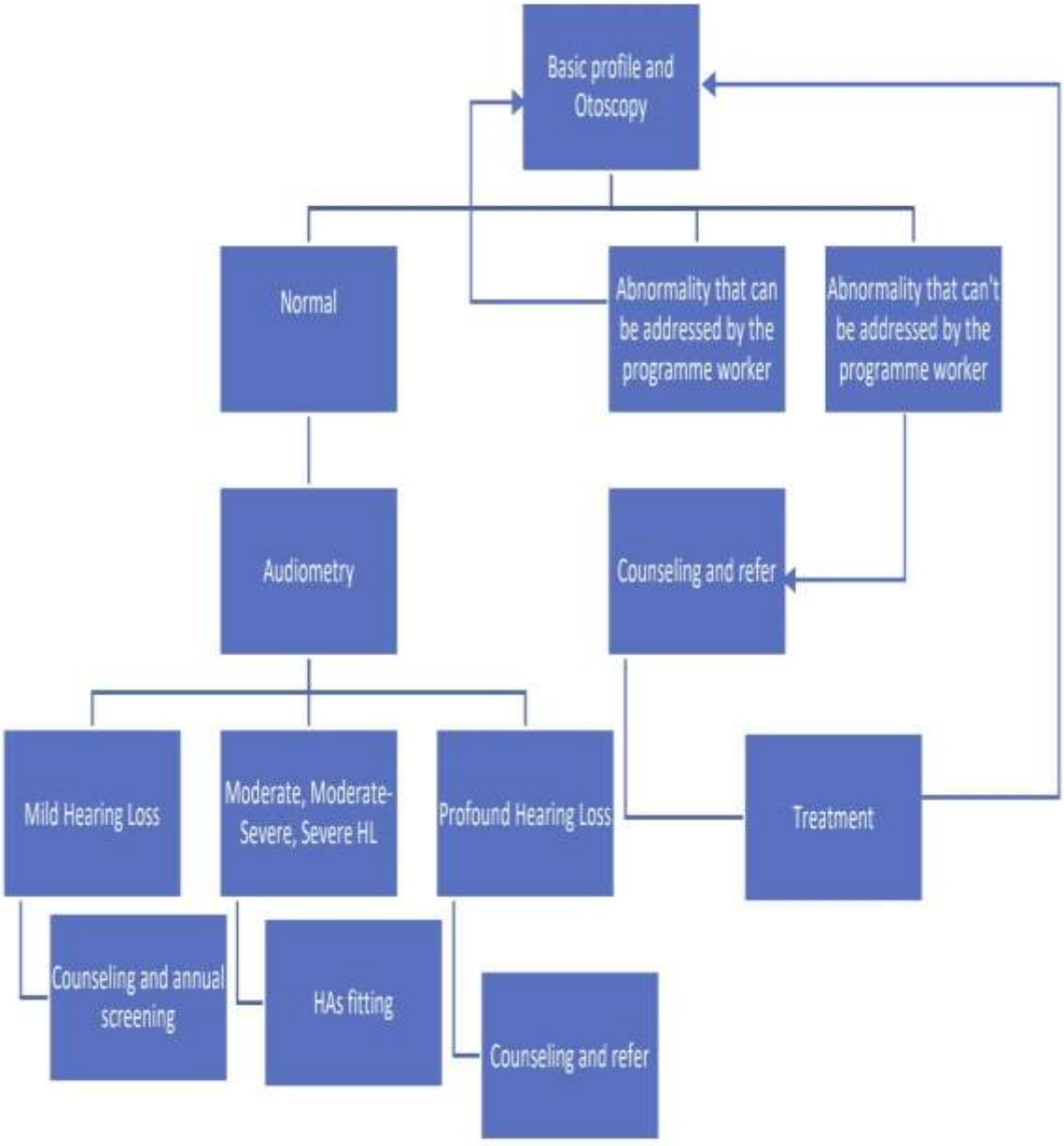


Figure 1. Overview of procedure and referral/inclusion process at the first appointment for adults

Follow ups – Follow ups were done at 2 weeks, 30 days, 45 days & 60 days to assess the benefits and challenges faced by the beneficiaries with the help of predesigned Questionnaire. Follow-up assessments were strategically scheduled to evaluate the long-term benefits and any challenges encountered by the hearing aid users. These intervals were chosen to capture the initial adjustment period and any subsequent changes in the users' experiences, providing valuable feedback for optimizing hearing aid service delivery in similar settings.

Observations

The comprehensive household survey underscored the prevalence of hearing loss within the community, highlighting the critical need for accessible hearing care services. The successful fitting of hearing aids in a majority of eligible participants at the Delhi Gate site demonstrates the feasibility and potential impact of this intervention in improving auditory health in LMI settings.

Total 387 houses were visited and subjects were screened from each household in both Delhi Gate and Khwaja Mirdard area. 140 participants were screened for hearing problems at Delhi Gate LMI settings and 247 participants were screened at Khwaja Mirdard low- and middle-income (LMI) area.

Fitting of Hearing Aids

In Delhi Gate, 15 subjects were screened for the eligibility for hearing aid. Out of them, 13 were fitted with a hearing aid and 2 subjects refused to be a part of the study.

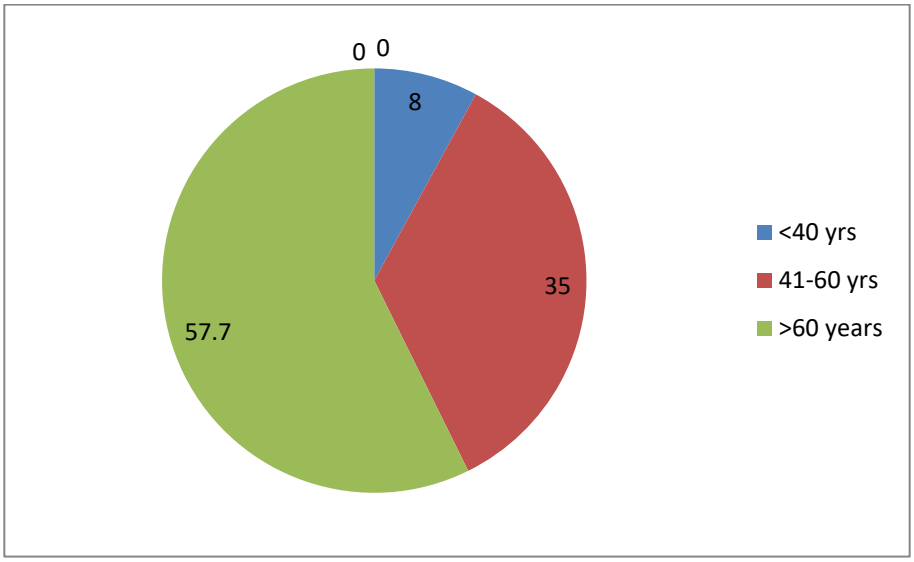
Similarly, in Khwaja Mirdard area, 18 patients were screened with hearing loss problems with eligibility for hearing aid. 13 subjects got the fitting done for the hearing aid.

Table 1. Distribution of subjects screened at the study sites

	Delhi Gate	Khwaja Mirdard	Total	Percentage (n= 387)
No. of subjects screened	140	247	387	----
Eligible for hearing aid	15	18	33	8.5
Subjects identified with Red Flag (Referred)	29	116	145	37.5
				n=33
Subjects fitted with hearing aid	13	13	26	78
Refusals	1	3	4	12.1
Unavailability of the subject	1	2	3	9.1

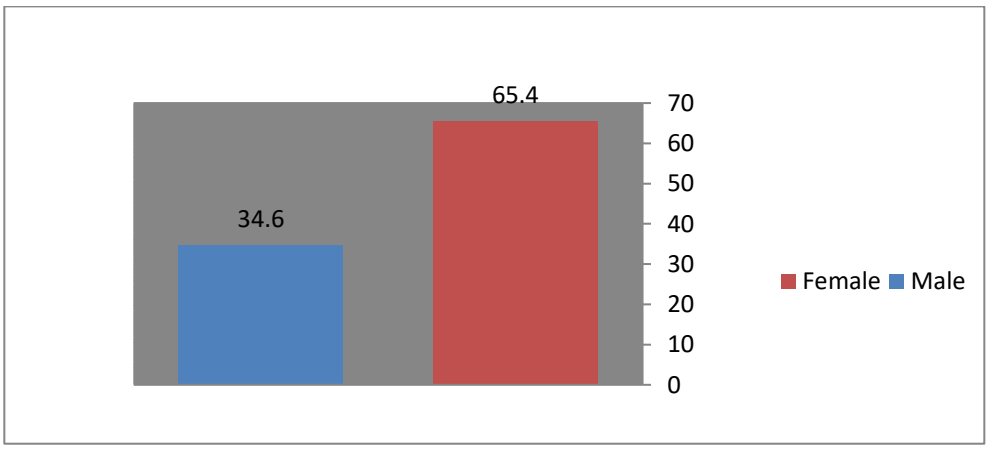
Thus, out of the total screened population, 8.5 % were found to be eligible for hearing aid fitting. Red flags were found in 37.5% subjects. Amongst the eligible ones, 78% were fitted with hearing aids, whereas 12 % subjects refused to get the hearing aid and 9 % subjects were unavailable to get the hearing aid fitting done.

Fig. 2 Distribution of study subjects according to the age groups



Out of the 26 subjects who got the hearing aids, 57.7% subjects were more than 60 years of age whereas 8% subjects were from younger age group of less than 40 years and 35% subjects were of the age group between 41 to 60 years.

Fig. 3: Distribution of study subjects according to the gender



Out of the 26 subjects who got the hearing aids, 65.4% subjects were females.

Table 2. Distribution of the subjects according to the red flag signs detected

S. No.	Red Flag Signs	Khwaja Mirdard	Delhi Gate	Total n=145	Percentage
1.	Ear Wax	29	14	43	29.6
2.	Ear Itching	27	6	33	22.7
3.	Ear pain	18	2	20	13.8
4.	Ear Discharge	29	7	36	24.8
5.	Ear perforation	4	0	4	2.75
6.	Tinnitus	6	0	6	4.13
7.	Otitis Media	1	0	1	0.68
8.	CSOM	1	0	1	0.68
9.	Ear Trauma	1	0	1	0.68
		116	29	145	

Among the 145 subjects identified with red flags, 29.6 % were identified with wax followed by ear discharge i.e 24.8 %. Very few subjects were identified with other red flags like CSOM or ear trauma.

Management of subjects with red flags

Those subjects who were identified with red flags were counselled and were referred to ENT OPD MAMC for further management. They were managed as per the standard treatment protocol.

Table 3. Screening details of the subjects who received the hearing aids

Question	Yes	No	Percentage (n=26)
No. of participants with whom the conversation needs to be repeated before getting the hearing aid?	25	1	96.1
No. of participants who increase the volume of TV as compared to other members before getting the hearing aid?	25	1	96.1
No. of participants who have consulted any health care provider for hearing impairment?	11	15	42.3
No. of participants in whom the hearing improved (subjectively) post treatment?	15	8	57.7
No. of participants who were aware of the hearing aids for hearing loss?	15	8	57.7
No. of participants who were ever been suggested using a hearing aid?	7	8	26.9

Out of the 26 participants who received the hearing aids, 96% of them had problems like need of repeat conversations and increasing the volume of TV as compared to other members whereas only 42% have consulted any health care provider for hearing impairment. Also, 57.7% participants were aware of the hearing aids for hearing loss.

Follow ups

For the 26 patients who were fitted with the hearing aids, follow ups have been done as per the specified timelines. Alternate day telephonic calls were also made to the subjects post the fitting of the aid to ensure compliance and to resolve any immediate challenge being faced.

The total number of 26 individuals were fitted Hearing Aid and followed up regularly for 2 months.

Table 4. Follow up of individuals with hearing aid

Follow up Questions	**No. of subjects n=26 (%)**	**No. of subjects n=26 (%)**	**No. of subjects n=26 (%)**	**No. of subjects n=26 (%)**	**Action Taken**
	15 days	30 days	45 days	60 days	
Subjects who were comfortable to use Hearing Aid	22(84.6)	24 (92.3)	25(96.1)	25(96.1)	Counselling
Subjects having discomfort in using Hearing Aid	4(15.4)	2(7.7)	1(3.8)	1(3.8)	Counselling & Training
Subjects who were able to maintain the aid easily	21(80.8)	25(96.1)	25(96.1)	25(96.1)	Counselling & problem addressal
Unable to maintain without assistance	5(19.2)	1(3.8)	1(3.8)	1(3.8)	Training & assistance
Subjects who didn't face difficulty in finding a technician	26(100)	26(100)	26(100)	26(100)	Counselling & problem addressal
Easy availability of Hearing Aid Batteries	26(100)	26(100)	26(100)	26(100)	Counselling & problem addressal

Subjects who experienced subjective improvement in hearing	26(100)	26(100)	26(100)	26(100)	Counselling & problem addressal
Subjects who have never experienced any social challenges like Stigma	25(96.1)	25(96.1)	25(96.1)	26(100)	Counselling & problem addressal
Subjects who have experienced any social challenges like Stigma	1(3.8)	1(3.8)	1(3.8)	0	Counselling & problem addressal
Subjects who had financial issues in purchasing a Hearing aid or continuing the use	26(100)	26(100)	26(100)	26(100)	Counselling & problem addressal
Subjects who returned the aid	-	-	-	1(3.8)	

Out of the 26 subjects, who got the hearing aid fitting done, all subjects used the hearing aid regularly for 60 days. Follow up was done for all the subjects and 85% subjects were comfortable with the use of hearing aid initially. After counselling, training and assistance by the team, 96.1 % became comfortable with the use of hearing aid.

Almost all the subjects found it easy to get the batteries for the hearing aid and none of them had a difficulty in finding a technician if required. Only 1 subject i.e 3.8% returned the hearing aid because of discomfort being experienced.

CASE REPORTS

1. CASE REPORT OF MR RAM KUMAR AFTER 30 DAYS OF FIRST FITTING

Ram Kumar, a 58-year-old male residing in Delhi Gate, Central Delhi District, was grappling with a unique and formidable set of challenges. He lacks a permanent home, seeking shelter wherever possible, particularly during harsh winter months when he sleeps on the ground floor of a building adjacent to the health center in Delhi Gate. Hampered not only by a lack of stable housing but also by impaired vision in one eye and the absence of hearing in one ear, he faces considerable difficulties. His inability to hear exacerbates the complexities of his daily life, impacting communication and making simple interactions, such as understanding directions or engaging with others, immensely challenging. In addition to these hurdles, he has resorted to begging for sustenance.

Alone in the world without family or friends, Ram Kumar's daily life was profoundly impacted by both hearing loss and impaired vision. However, after receiving a hearing aid fitting, he noticed a significant improvement in his ability to hear. Despite his transient living situation, Ram Kumar has incorporated the hearing aid into his daily life, removing it at night when he sleeps. This interview was conducted after 30 days of the initial fitting, revealing a positive impact on his ability to navigate and engage with the world around him. In a poignant contrast to his otherwise challenging circumstances, the hearing aid fitting has become a source of solace and improved quality of life for Ram Kumar.

In his own words, he quoted:

"Jab log mujhe meri madad ke liye bulaate to mujhe ye samajhane mein dikkat hoti ki ve kis disha se bula rahe hain."

Translation: When people called to help me, I had trouble understanding which direction they were calling from.

After receiving the hearing aid, he said:

"Yeh kaan ki machine mere liye varadaan hai, isse main madadagaar logon ki aavaaz sun pata hoon."

Translation: This hearing aid is a boon for me; it lets me hear the voices of helpful people.

Fig.4: Interview of Mr. Ram Kumar by Health Worker

2. CASE REPORT OF MRS RANI PRAVEEN

Trained health workers play a pivotal role in providing comprehensive services throughout the entire spectrum of ear andhearing care. This includes education on hearing health, conducting hearing screenings, performing assessments, fitting hearing aids, offering counseling, and ensuring follow-up services.

Rani Praveen's journey with hearing loss began abruptly while watching TV. She experienced a sudden buzzing sound, followed by a complete loss of hearing in left ear. Seeking medical help, she visited a local doctor who prescribed ear drops, but unfortunately, the treatment did not restore her hearing. Over the next three years, Rani Praveen struggled with the challenges of living with unaddressed hearing loss, leading to a sense of despair.

Intervention

Rani Praveen's hope was rekindled when she learned about a community-based hearing care camp in her locality. The camp offered hearing checks and provided hearing aids to those in needs. Eager to find a solution, Rani Praveen participated in the camp's activities and underwent relevant tests to assess her hearing loss. The examination revealed the need for a hearing aid in her left ear. Through the camp's outreach program, Rani Praveen received a fitted hearing aid. This intervention was made possible by trained health workers who conducted on-the-spot assessments, ensuring accessibility to hearing care services for individuals like Rani Praveen who might face challenges in accessing traditional healthcare facilities.

Outcome & Conclusion

The impact of the hearing aid on Rani Praveen's life was transformative. She regained the ability to hear in her left ear, bringing immense joy and relief to both her and her family. This

improvement in communication has strengthened family bonds andcontributed to a more fulfilling family life.

Rani Praveen's case exemplifies the positive outcomes achievable through community-based ear and hearing care initiatives. By leveraging trained health workers and accessible technologies, individuals with hearing loss, even in underserved areas, can receive timely interventions and regain a crucial aspect of their lives. The success of such programs not only improves the well-being of the individuals involved but also enhances the overall quality of life for their families and communities. In her words, she said:

"Mujhe kam sunayee dene ke karan bahut muskilon ka saamana karana padta tha."

Translation: Due to hearing loss, I was facing lots of problem in my daily life.

After hearing aid fitting, her response was:

"Meri kismat achchhi thi ki mujhe kaan ki machine mili jisse mere sunane ki shakti mein sudhaar hua aur jeevan ki muskil aasaan huyee."

Translation: I was fortunate to get a Hearing Aid that improved my hearing and made my life much easier.

Fig.5 : Interview of Mrs. Rani Praveen

Summary

This study responds to an urgent global health concern, addressing the escalating prevalence of hearing loss, particularly in LMICs where traditional hearing care services are often inaccessible or unaffordable. By pioneering the use of community health workers (CHWs) for the delivery of hearing care, we propose a scalable, community-centric solution aimed at drastically increasing the uptake of hearing aids among those in need. The prevalence of hearing loss has increased over the last few decades, with the major reason being hearing loss not addressed in a timely manner. Majority of people with hearing loss reside in low-and-middle income countries (LMICs), where access to care is limited. One of the most common rehabilitative measures for people with permanent forms of hearing loss, is hearing aids. It has been estimated that less than 3% of people in LMICs who could benefit from hearing aids, get them. This protocol thus, proposes to utilize community health workers (CHWs) to screen and assess hearing loss, fit low-cost preset hearing aids to those that qualify, and ensure follow up care that is specifically tailored to LMIs.

Through a meticulous feasibility study, we embarked on an innovative journey to transform hearing care delivery in LMIC settings. The preparation phase laid the groundwork for effective community engagement and the training of CHWs, ensuring a robust foundation for the project's success. The study's design—emphasizing inclusivity and accessibility—sought to overcome the traditional barriers to hearing care.

A meeting for development of protocol and questionnaire was held via virtual mode on 9th September, 2023. Thereafter, the team was oriented with the study protocol and with the basic steps to be followed during the conduct of the study. Capacity building of the team was done for the following-

- Screening of the eligible subjects
- Identify the red flags
- Fitting of the hearing aid
- Problems/Challenges in fitting the hearing aid

A Feasibility Prospective cohort study was conducted for a period of 4 months including 25 adults (> 18 years) with moderate to severe hearing loss ($PTA_{0.5,1,2,4}$ in the better ear between 35 to 80 dB HL), free from red-flag referrals. Two sites were included in the study, in low- and middle-income settings. The sites included were:

- Family adoption area of the department of Community Medicine, MAMC - Khwaja Mirdard area
- Delhi Gate Health Centre, New Delhi.

Initial 15 days period after the commencement of the study was the preparation phase that included training of Health care workers by the audiologist under supervision of ENT specialist. Subjects screened with red flag signs were managed as per standard treatment Protocol. During the Study phase, Pre-designed questionnaire and client information sheet were used to collect the information from the participants.

In the sampled area, 25 adults (>18 years) were screened by consecutive sampling for any hearing loss. Household survey was done to screen the subjects who were eligible for hearing aid fitting. Camp approach was also used to create awareness among the community for hearing aid screening. Mild hearing loss patients were recommended for annual screening and profound hearing loss were referred to local health system.

Total 387 houses were visited and subjects were screened from each household in both Delhi Gate and Khwaja Mirdard area. 140 participants were screened for hearing problems at Delhi Gate LMI settings and 247 participants were screened at Khwaja Mirdard low- and middle-income (LMI) area.

Thus, out of the total screened population, 8.5 % were found to be eligible for hearing aid fitting. Around 37.5 % subjects were found with red flags. Of the eligible ones, 78% were fitted with hearing aids, whereas 12 % subjects refused to get the hearing aid and 9 % subjects were unavailable to get the hearing aid fitting done.

Out of the 26 participants who received the hearing aids, 96% of them had problems like need of repeat conversations and increasing the volume of TV as compared to other members whereas only 42% have consulted any health care provider for hearing impairment. Also, 58% participants were aware of the hearing aids for hearing loss.

Out of the 26 subjects, who got the hearing aid fitting done, follow up was done for all the subjects and 85% subjects were comfortable with the use of hearing aid. After counselling, training and assistance by the team, 96.1 % became comfortable with the use of hearing aid.

Almost all the subjects found it easy to get the batteries for the hearing aid and none of them had a difficulty in finding a technician if required. Only 1 subject i.e 3.8% returned the hearing aid because of discomfort being experienced.

Our findings illuminate a path forward in hearing care, revealing that a significant proportion of the screened population could benefit from hearing aid fitting. The high acceptance and comfort levels post-intervention underscore the potential of CHWs to revolutionize hearing care delivery. Moreover, the study highlights the critical role of ongoing support and training in enhancing user comfort and addressing technical challenges.

This study has conceptualized the empowerment of health care workers by building their capacity to identify the hearing-related challenges and enhance their knowledge and skills.

Barriers & Challenges

Challenges faced by the subjects post the hearing aid fitting:

- Majority of the subjects experienced lack of voice clarity while using the aid. This was resolved by counselling them to keep the volume soft hearable instead of high volume.
- Many subjects had mild pain in the ear while or after using the aid. Thus, counselling was done to help them adapt to a new aid.
- Some of the subjects experienced battery related challenges. The teams changed the battery of hearing aid for those who required. Also, ordered a new battery set of 6 pieces to be provided to anyone who requires the same.

- To manage the functioning of the hearing aid, the teams guided the subjects as to how to increase and decrease the volume as per requirement and also told them to contact the team in case of any such issue in future.

Despite encountering challenges such as initial discomfort and technical issues with the hearing aids, the study team's responsive approach—through targeted counselling and support—demonstrated the feasibility of overcoming these barriers. This proactive problem-solving underscore the importance of flexibility and community engagement in the successful implementation of health interventions.

Conclusion and way forward

The hearing care workforce isn't able to adequately meet the rising global burden of unaddressed hearing loss. Task sharing and person-centred care in low-resource settings, can address the burden through a community health worker model (CHW). Many LMICs already have some type of CHW-provided care, which traditionally focused on identifying and managing infectious diseases, such as dengue fever, malaria, HIV/AIDS and now chronic diseases.

This study has conceptualized the empowerment of health care workers by building their capacity to identify the hearing-related challenges and enhance their knowledge and skills. This can lead to increase in their self-efficacy, participation, and thus paving the way in channelizing the hearing solutions under the national health care delivery system. Training the health care workers can facilitate the lives of hearing aid users and improve their quality of life in case of need, affordability issues, heavy load in tertiary settings and other physical limitations.

Our study not only confirms the viability of leveraging CHWs for hearing care in LMICs but also points to the transformative potential of integrating mobile health technologies into community health strategies. By empowering CHWs with the skills and knowledge to address hearing challenges, we pave the way for a more inclusive, effective, and sustainable model of hearing care—a model that can be adapted and scaled across different contexts to meet the growing global need.

The success of this model heralds a new era in hearing care, one where task sharing and technological innovation converge to create accessible solutions for all. As we look to the future, it is clear that the integration of such models into national healthcare systems can significantly contribute to the reduction of the burden of hearing loss, ultimately improving the quality of life for millions globally.

Some glimpses of the training session conducted for Health Care workers

Some glimpses of the Hearing aids being fitting in the field















The Team

Annexure I

Screening Questionnaire for Community

Section I

Sociodemographic details

Name of the informant: Age of the informant:

Gender of the informant: 1. Male 2. Female 3.Third Gender

House No: Area:

Name of the Head of Family:

Name of the study Subject:

Age of the subject:

Gender of the subject: 1. Male 2. Female 3. Third gender

Total family members:

Occupation (as per Modified Kuppuswamy scale):

Educational status (as per Modified Kuppuswamy scale):

Total family income per month:

Per capita income per month:

Socio Economic Status category (as per Modified Kuppuswamy scale):

Section II

Screening of Hearing Impairment (Directed towards the informant)

1. Is there anyone in the house with difficulty in hearing? 1. Yes 2. No
2. Does he/she complain of pain in the ear? 1. Yes 2. No
3. Does he/she have ear discharge? 1. Yes 2. No

4. Can he/she understand clearly what other members say? 1. Yes 2. No
5. Do you need to repeat during the conversation with him/her? 1. Yes 2. No

6. Does he/she increase the volume of TV as compared to other members?

1. Yes

2. No

Section III

Treatment History

If yes to any question from 1 to 6, the go to Q.7. If no, go to Section IV.

7. Has he/she consulted any health care provider for hearing impairment?

1. Yes

2. No

If yes to Q.7, then go to Q.8
If no to Q.7, then go to Q. 13

8. When was the treatment initiated? _____

9. From where the treatment was taken? 1. Govt. hospital 2. Pvt. Hospital 3. Chemist 4. Any other

10. Do you have any available health records? 1. Yes 2. No

If no, go to Q.12

11. If yes, write the diagnosis and treatment mentioned from the available records.

_____

12. Has the hearing improved (subjectively) post treatment? 1. Yes 2. No

13. Reason for not seeking treatment? 1. 2. 3.

<u>Section IV</u> (Directed towards the subject only)

Hearing Aid related history

14. Are you aware of the hearing aids for hearing loss? 1. Yes 2. No
15. Have you ever been suggested using a hearing aid? 1. Yes 2. No
16. Have you ever used a hearing aid? 1. Yes 2. No
17. If yes, was hearing improved after using? 1. Yes 2. No
18. How often he has changed the hearing aid?
19. What were the challenges faced in using a hearing aid?
    A. Unable to maintain the aid due to lack of knowledge 1. Yes 2. No
    B. Non availability of technician nearby 1. Yes 2. No
    C. Battery not easily available 1. Yes 2. No
    D. Physical discomfort like pain/irritation etc. 1. Yes 2. No
    E. Aid doesn't fit properly 1. Yes 2. No
    F. Embarrassment or social stigma while wearing the aid 1. Yes 2. No
    G. Any health ailments interfering with the use of hearing aid 1. Yes 2. No
    H. Financial constraints limiting the continuation of hearing aid 1. Yes 2. No

Section V

20. Screening done for hearing impairment by WHO app? 1. Yes 2. No.

21. If done, outcome of screening. _____

Annexure II

Follow up Questionnaire

This questionnaire aims to comprehensively assess the post-fitting experiences and challenges related to the use of hearing aids in low and middle-income settings, providing valuable insights for further improvement and support.

SectionI

Name of the informant: Age of the informant:

Gender of the informant: 1. Male 2. Female 3.Third

House No: Area:

Name of the Head of Family:

Name of the study Subject:

Age of the subject:

Gender of the subject: 1.Male 2.Female 3.Thirdgender

Total family members:

Occupation (as per Modified Kuppuswamy scale):

Educational status (as per Modified Kuppuswamy

scale):

Total family income per month:

Per capita income per month:

Socio Economic Status category (asper Modified Kuppuswamy scale):

Section-II

1. Duration of Hearing Aid Usage:

- a) Less than 3 months
- b) 3-6 months

- c) 6-12 months
- d) More than 12 months

2. Comfort and Irritation:
- a) No discomfort or irritation
- b) Mild discomfort occasionally
- c) Moderate discomfort frequently
- d) Severe discomfort always

3. Maintenance of Hearing Aid:
- a) Able to maintain without issues
- b) Faces occasional difficulties
- c) Struggles frequently
- d) Unable to maintain properly

4. Challenges in Finding a Technician:
- a) No challenges
- b) Occasional challenges
- c) Frequent challenges
- d) Unable to find a technician

5. Availability of Hearing Aid Batteries:
- a) Easily available
- b) Available with occasional difficulties
- c) Often unavailable
- d) Never available

6. Improvement in Understanding Others:

- a) Significant improvement
- b) Slight improvement
- c) No noticeable change
- d) Worsened ability

7. Frequency of Hearing Aid Replacement:

- a) Never replaced
- b) Replaced once
- c) Replaced twice or more
- d) Regularly replaced

8. Health Issues Affecting Hearing Aid Use:

- a) No health issues affecting use
- b) Mild health issues occasionally
- c) Moderate health issues frequently
- d) Severe health issues always

9. Social Challenges or Stigma:

- a) No challenges or stigma
- b) Occasional challenges
- c) Frequent challenges
- d) Severe challenges or pervasive stigma

10. Financial Constraints:

- a) No financial constraints
- b) Occasional financial challenges
- c) Frequent financial challenges
- d) Unable to afford continued use

11. Use of WHO App for Post-Fitting Screening:
    - a) Yes
    - b) No
12. Outcome of Post-Fitting Screening with WHO App:
    - a) Improved settings for better hearing
    - b) No change observed
    - c) Technical issues encountered
    - d) Did not use the app

Annexure III

Pre test Questionnaire

Q 1. How will you identify a normal Tympanic Membrane?

a. Pearly grey in colour and translucent

b. Red and bulging

c. Convex and transparent membrane

d. Red and convex

Q 2. Which is one of the most important clinical symptoms of Conductive Hearing Loss?

a. Pain and discharge in the affected ear

b. Bleeding from the affected ear

c. Decreased hearing in noisy environment

d. Poor speech discrimination

Q.3 What is the differentiating feature of Sensorineural Hearing loss and Conductive Hearing Loss?

a. Hearing better in noisy environment in SNHL

b. Hearing better in noisy environment in Conductive HL

c. Noisy environment masks hearing in Conductive HL

d. Speech discrimination poor in Conductive HL

Q.4 Is hearing loss/impairment reversible?

a. Yes b. No

Q5. What are the major causes of hearing loss/impairment in SNHL?

a. Trauma

b. CSOM

c. Ageing

d. Congenital

Q6. What component of the ear does a hearing aid primarily assist?

a. External canal

b. Cochlea

c. Middle meatus

d. Ear ossicles

Q 7. What cultural factors should be taken care of when advising hearing aid?

a. Traditional preferences

b. Social media patterns

c. Language and customs

d. Latest trends

Q 8. Which of the following could be a significant barrier to the use of hearing aids in LMI areas?

a. Lack of technician for the maintenance of the hearing aid

b. Availability of different brands and colors

c. High internet speeds

d. Unaffordability and lack of awareness about the correct use of hearing aid

Q 9. What role can awareness campaigns play in improving hearing aid adoption rates?

a. Reducing battery prices

b. Dispelling myths and reducing stigma

c. Increasing device utility

d. Maintainence of the device

Q10. What measures will you take in case of any challenge faced by the subject after hearing aid fitting?

a. Refer to the audiologist
b. Counsel the subject to stop using the aid
c. Remove the aid
d. Wait and watch