Perspective

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Experience from Implementing Infant Hearing Screening Program at Immunization Centers in Kathmandu Valley, Nepal

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Abstract

In low-income countries, children with hearing loss are identified late due to the absence of universal newborn hearing screening. In addition to speech-related disabilities, hearing impairment is a common yet neglected disability in developing countries like Nepal. Early detection, reliable diagnosis and timely intervention are crucial, as they significantly increase the chances of infants with hearing loss developing skills equivalent to their peers. In Nepal, the rate of institutional delivery is comparatively lower than routine vaccination coverage. Infant hearing screening at immunization centers can be an alternative to universal newborn hearing screening in countries with lower institutional delivery rates. Hospital for Children, Eye, ENT, and Rehabilitation Services at Bhaktapur, Nepal, has accumulated four years of experience implementing infant hearing screening programs at immunization centers. Through this perspective, we aim to highlight insights and lessons learned that can inform future initiatives and improve similar infant hearing screening programs.

Keywords: Hearing-impaired, hearing screening, immunization centers, infants, Nepal

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Tweetable Abstract: Identifying barriers and facilitators and understanding the roles of duty bearers and right holders is crucial in implementing IHS programs.

Introduction

The burden of hearing impairment is increasing and is amongst the top 20 global burdens of diseases [1]. According to the World Health Organization (WHO), 466 million person in the world have disabling hearing loss (DHL), including 34 million (7%) children [2]. A significant majority of individuals with disabling hearing loss reside in low- and middle-income countries [2].

The National Population and Housing Census 2021 shows a significant proportion of hearing and speech-related disabilities in Nepal [3]. Studies have shown that at least one to six in 1000 newborns are affected by hearing impairment, with the burden higher in developing countries [4, 5]. Many developed countries have widely adopted universal newborn hearing screening (UNHS) for earlier identification of hearing loss, earlier amplification, and earlier enrollment into early intervention services, and they have significantly improved developmental outcomes in early childhood [6-10]. Early identification of hearing loss, followed by timely and appropriate interventions, minimizes developmental delays and promotes communication, education, and social development [11]. Hearing screening programs for infants and young children can identify hearing loss at a very young age [11, 12]. People with hearing loss benefit from early identification, use of hearing aids, cochlear implants, and other assistive devices, captioning and sign language, and other forms of educational and social support [13]. Hearing loss that cannot be managed medically or surgically, can benefit from the early use of hearing aids and speech therapy. It is well-recognized that hearing health in early life is essential to speech and language development, cognition, socio-emotional development, and learning [14-22].

Without hearing screening, it is hard to know the time of hearing changes in the first months and years of the baby's life. Hearing loss is usually detected in developing countries when babies are two years and older or enrolled in schools. This detection after two years is late and gives little time for intervention of hearing loss, which is necessary for optimal speech/language development because, by that time, hearing loss becomes permanent. The most critical period for learning language is during the first three years of life when brain is rapidly developing [23].

There is no government policy, strategy, or guidance for newborn or infant hearing screening (IHS) in Nepal. UNHS, if practiced, may miss a significant number of newborns, as 79% of newborns are delivered in health institutions [24]. Secondly, the logistics for similar screening at the tertiary level birthing center (Paropakar Maternity and Women's Hospital, Thapathali, Kathmandu) was formidable in a pilot by Hospital for Children Eye, ENT, and Rehabilitation Services (CHEERS) between 2015 – 2017. Our review of record registers of

newborn hearing screening during those times showed that nearly 8% of 146 newborns were in a high-risk group and were referred for further evaluation. During phone follow-ups, the primary reason mentioned was that the family did not live nearby to visit again. Additionally, when counseled for further follow-up, they noted the absence of a nearby screening or diagnostic center.

In addition, the possible amniotic fluid and debris accumulation in the outer and middle ears may affect newborn hearing screening in the early post-natal period, giving false-positive results. It is suggested that screening tests are postponed until fluids are resorbed, i.e., 48-96 hours after delivery [25]. In Nepal, most delivery cases are already discharged before this period, and newborn hearing screening may not be feasible after discharge because most live away from nearby centers or are unaware of its need. In addition, there is a lack of awareness and information about hearing screening among health workers in Nepal [26]. A study from rural USA also has revealed that the disparities in access to care among infants with parents from lower socioeconomic backgrounds and difficult geographical terrains increase the risk of delayed or missed follow-ups even after UNHS [27]. Routine hearing screening of infants attending immunization clinics by community health workers has been proven feasible and valuable for the early detection of hearing loss, as demonstrated in South Africa and Nigeria [28, 29].

In our experiences implementing IHS at five different immunization centers, from September 2020 to June 2024, we identified 101 babies needing further hearing evaluation from the first 5,070 infants. Over half (53%, n=53) have undergone the auditory brainstem response (ABR) evaluation process. Among 53 undergoing ABR evaluation, 2 of them have unilateral hearing loss, and 10 have bilateral hearing loss and are under habilitation. This is a morale boost for our community-focused Otolaryngology team compared to our earlier experience at the tertiary-level birthing center from 2015 to 2017. Though morale-boosting, there were some concerns during the implementation of the IHS program. However, despite these challenges, the initiative proved to be a significant step in promoting early detection of hearing issues among infants.

This perspective aims to provide key insights and lessons learned from our experience implementing the program, including the preparatory steps taken, the challenges encountered, and the strategies employed to address some of these obstacles. This viewpoint is intended to guide and enhance future efforts in developing or refining similar screening programs.

Infant Hearing Screening Program in Kathmandu Valley

The CHEERS hospital initiated and implemented the IHS program. The Department of Otolaryngology at CHEERS acted as the IHS program's referral hub and diagnostic center. The immunization centers at Changunarayan Municipality Hospital, Bode Maternal and Child Health Clinic, Siddhi Memorial Hospital, and CHEERS in Bhaktapur district, along with Bajrabarahi Chapagaun Hospital in Lalitpur, served as centers for hearing screening.

Immunization Centers for Infant Hearing Screening

IHS is a multistep process; an infant needs multiple follow-ups before being diagnosed as normal or with hearing loss. Our own experiences and studies have shown that loss to follow-up is one of the major challenges in hearing screening [28-30]. The infant with hearing loss may not be diagnosed and treated if not brought for follow-up screening.

In Nepal, immunization is a priority one program and a successful public health program, with more than 90% of children fully immunized [31]. Under the National Immunization Program, infants are brought at least five times to complete the vaccination. This immunization center approach could be an alternative, as hearing screening may need multiple visits, and the same is true with vaccination to complete the vaccination schedule [31], as shown in Table 1.

Table 1: Expanded program on immunization schedule of Nepal

Vaccine	Age of administration
BCG (Bacille Calmette-Guérin) Vaccine	At birth or first contact with immunization Center
Pentavalent Vaccine [DPT (Diphtheria Pertussis Tetanus) HepB (Hepatitis B), and HiB (Hemophilus Influenza Type B)]	6, 10, and 14 weeks
OPV (Oral Polio Vaccine)	6, 10, and 14 weeks
PCV (Pneumococcal Conjugate Vaccine)	6, 10 weeks and 9 months
Rotavirus Vaccine	6 and 10 weeks
IPV (Injectable Polio Vaccine)	14 weeks
MR (Measles-Rubella) Vaccine	9 and 15 months
JE (Japanese Encephalitis) Vaccine	12 months

Health Workers for Infant Hearing Screening

Given Nepal's dire shortage of audiology professionals, a pragmatic 'task shifting approach' by training primary healthcare workers was started in 2017 as Community Ear Health Workers (CEHWs). The CEHWs are trained for three months under the Council for Technical Education and Vocational Training (CTEVT) accredited short course. The CEHW training course builds the capacity of community medical assistants (auxiliary health workers) or equivalent passed health workers from CTEVT, who are registered in the Nepal Health

Professional Council. They are trained for the identification and treatment of common ear diseases. Besides, they also screen hearing loss using an audiometer, refer cases, promote ear and hearing health, and help rehabilitate people with hearing impairment. The same cadet of health workers was trained for initial hearing screening using Transient Evoked Otoacoustic Emission (TEOAE) (GSI, Corti™).

Procedure for Infant Hearing Screening

This hearing screening is non-invasive, which takes approximately five minutes, is conducted in a soundproof room when the infant is calm or asleep. All Children below one year (≤ 12 months) brought to selected immunization centers are enrolled in our IHS program. The infants are sent for hearing screening before immunization. Based on their caretakers' or parents' interviews, they are categorized as high-risk or non-high-risk infants [32]. All infants whose screening cannot be done due to the presence of wax, vernix, or debris in the external auditory canal are provided with free medicines and advised to follow up the following week. The external auditory canal is cleared up and screened during their follow-up visit.

For non-high-risk infants, TEOAE screening is done first in the immunization clinic. If the infant passes the hearing screening on the first attempt, parents or caretakers are advised to remain vigilant about any potential hearing or speech-related concerns and are advised to consult as soon as possible. They are also advised to re-screen their children every 6-9 months until they reach the age of 3 years. If the first screening test is referred, repeat screening is done on the next visit at the same immunization clinic. If the infant passes the repeat screening, the parents or caretakers are advised to be vigilant as above. Suppose it is referred again in the repeat screening, then the infant is referred to our hospital for detailed evaluation by otolaryngologists and further diagnostic tests by certified Audiologists. The diagnostic test includes evaluation using ABR and tympanometry.

When a baby is categorized as a high-risk infant, irrespective of the first screening result at the immunization center, the baby is referred to our hospital for detailed evaluation by otolaryngologists and further diagnostic tests by certified Audiologists.

Babies who do not pass detailed evaluation are advised further for surgical or non-surgical habilitation by the team of otolaryngolgists, audiologist, and speech-language pathologists.

The detailed steps are shown below in the flowchart in Figure 1.

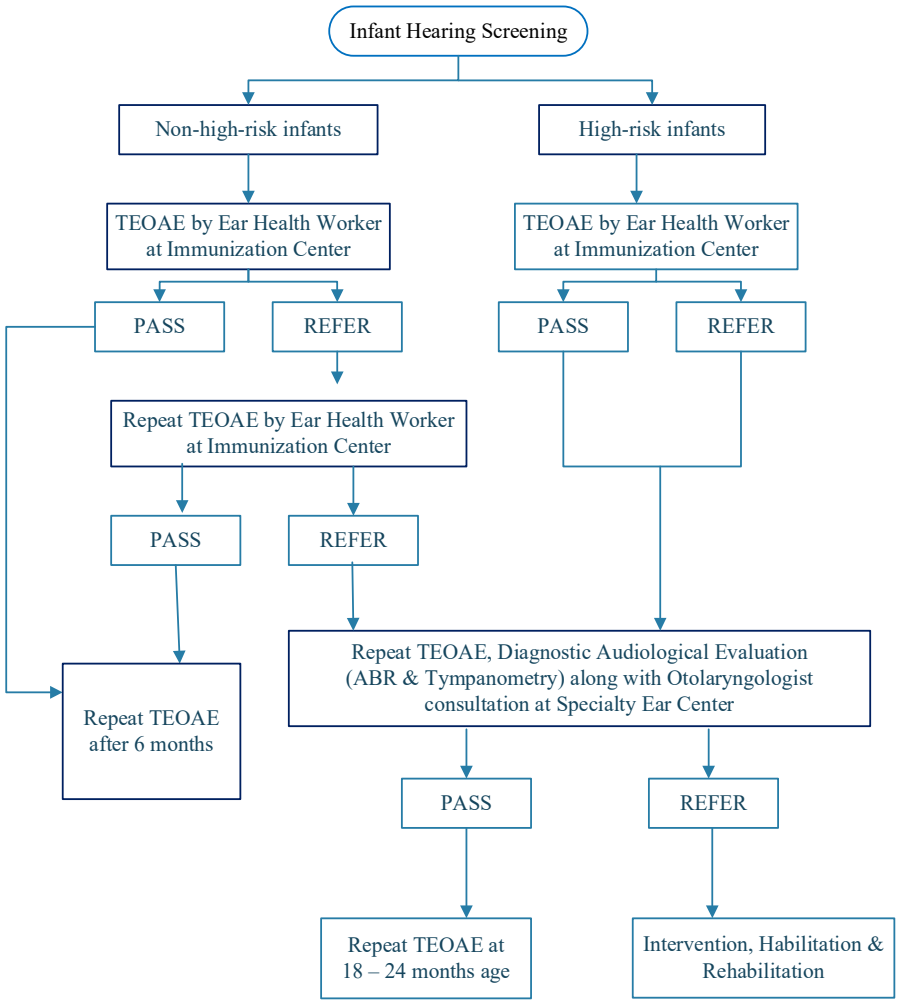

Figure 1: Flowchart for Infant Hearing Screening at Immunization Clinic

Implementation Challenges

Steps taken in advance to enhance infant hearing screening experiences

Since this hearing screening initiative is the first of its kind at the immunization center, we anticipated some challenges. We tried the following approaches to enhance IHS experiences for infants, parents, and caretakers.

1) Hearing screening before immunization

Although the parents and caretakers brought their children for regular immunization, the vaccinators were trained to counsel parents and caretakers on the importance of hearing screening and required follow-up. The infants were first screened for hearing loss and immunized later, so their restlessness or cries after immunization did not hamper the hearing screening process.

2) Free services

All infants brought for the immunization received free hearing screening services. They were also provided free medications or procedures following ear check-ups during the screening process. Most infants required dewaxing medicine, followed by wax removal. Further, all the infants screened under our IHS program continue to get free ear and hearing services until they reach three years of age.

3) Reduced steps for IHS users

The parents coming for their child's immunization did not have to register for hearing screening. They just had to wait for their turns upon arrival at the immunization center for hearing screening. A separate soundproof room was designated for IHS. Infants requiring wax removal were also given priority during their follow-up visits. The infants requiring a second OAE screening or diagnostic ABR and tympanometry test also had their OPD Card ready by CEHWs after their first hearing screening so they could come directly for a second screening or diagnostic evaluation without needing to go through the registration counter or process.

4) Orientation to the stakeholders

As this program is new to most service providers, especially the immunization center staff, they need to be made aware of the importance of IHS and the impact of hearing loss. The parents' first contact persons are the immunization center staff. CEHW, Audiology and Speech-Language Pathologists, public health experts, and the ENT surgeon visited and oriented the vaccinators and the management team as duty bearers of all immunization centers before starting the screening program.

5) Contact details of parents and caretakers for follow-up

In UNHS, the core goal is "1-3-6," i.e., screened at 1-month, audiological evaluation completed by three months, and intervention at six months of age [32]. Similarly, IHS is also a multistep process needing multiple follow-ups before diagnosing the infant as either normal or with hearing loss. Whether in UNHS or IHS, literature has shown that one of the barriers to achieving the aim of hearing screening is the loss of follow-up [28-30, 33, 34]. In order to contact them for follow-up, we kept records of all available phone numbers (residential and different mobile numbers from different service providers) of the parents and caretakers during the initial ear check-up and counseling. Mobile telephone numbers helped track some defaulters in Nigeria [35].

6) Dedicated room, equipment, and staff for hearing screening

We also built a separate soundproof room at five selected immunization clinics with support from the Embassy of Japan in Nepal under the Grant Assistance for Grassroots Human Security Projects fund [36]. The same fund also supported different screening and diagnostic equipment for hearing screening. These rooms and equipment were used exclusively for the IHS process. Similarly, we had four CEHWs for screening purposes, so there was no issue with human resources for screening purposes. Even though we only had one Audiology and Speech Language Pathologist, she always gave due preference to infants brought for hearing screening.

7) Health education to parents and caretakers of infants

The crucial part of IHS is to educate the right bearers, the parents and caretakers, about the importance of early hearing screening for their child. The vaccinators and CEHWs were trained and oriented to educate and counsel parents on the importance of vaccination and the need for follow-up visits.

Challenges faced during the screening processes

Despite the early preparation to conduct IHS at immunization centers, we encountered barriers during the implementation of the program.

A. Family level challenges

a. Working parents

Some of the infants belonged to nuclear families, with both parents working and responding to phone calls that they could not bring their child for hearing screening follow-up. This could be due to only 60 days of fully paid 98 days of maternity leave as enshrined in the Labour Act 2017, which they can avail of before or after childbirth [37]. Still, most private employers do not provide maternity leave to

their employees, and women hesitate to ask [38]. They leave their infant to a caretaker who is not responsible for taking the infant to the health facility, which leads to the infant failing to show up for follow-up.

b. Change in immunization centers
Some of the parents were daily laborers. They are temporary settlers who have moved from place to place, failing to appear in one of our five immunization centers with IHS services in Kathmandu Valley.

c. Lack of awareness among parents and caretakers
Nepal's child health program focuses mostly on survival, vaccine-preventable diseases, nutrition, growth, and development [31]. The parents and caretakers perceive and prioritize the same and have minimal or no concern for hearing health.

B. Community-level challenges
Few families have associated hearing loss with stigma or negative beliefs, leading to a reluctance to seek screening or treatment. This has further delayed identification and intervention in at-risk children.

C. Management level challenges
a. Change in vaccinators at immunization centers
The transfer of vaccinators to other centers and the lack of handover of responsibilities from transferred personnel to new ones responsible for vaccination also induced a loss of follow-up of infants needing further screening. The culture of not handing over one's task during the transfer hindered our hearing screening services for various reasons.

b. Added responsibilities of vaccinators without any incentives
IHS is a new concept that has yet to be endorsed by the government; personnel still need to be designated for this task. As we chose vaccinators to volunteer for this task, they sometimes complained about it as an added burden to their already overloaded work without any incentive. This might have led to a few infants missing their initial screening or follow-up.

c. Shelf life of vaccines in routine immunization
The Japanese Encephalitis vaccine is given at the age of one. It should be used entirely within one hour after the vial is opened and reconstituted. In such cases, the vaccinators choose to vaccinate the children first rather than send them for hearing screening as they do not want the vaccines wasted. This leads to an infant not cooperating with hearing screening after vaccination, eventually losing the opportunity to follow up after that period.

d. IHS schedule
This program is solely dependent on CHEERS for its implementation. CHEERS provides the CEHW and required equipment every week, which misses the infants coming for immunization on the non-IHS day in an immunization center with multiple immunization days.

D. COVID-19 pandemic
Our immunization center-focused hearing screening activity started during the COVID-19 pandemic. The COVID-19 pandemic significantly impacted the health systems' capacity to continue delivering essential health services, including routine immunization programs for children in Nepal [39]. The lockdown and restrictions deepened the economic crisis among working-class families, and some families reported to have migrated to their permanent homes from their temporary addresses in Kathmandu Valley. In due course, infants needing follow-up services could not get them as the program was limited to immunization centers in Kathmandu Valley. In addition, the fear of contracting COVID-19, uncertainty about opening immunization centers during the pandemic, and lack of public transport decreased the childhood vaccination uptake in Nepal. Some parents reported shifting to another immunization center as it was nearer and safer to travel during COVID-19. Besides, the annual report of the Department of Health Services of Nepal also showed poorer immunization coverage during the pandemic [31]. Moreover, the parents and caretakers of infants needing follow-up visits following initial screening were adamant that they would visit after the COVID-19 pandemic. However, our record shows otherwise.

Continued Efforts to Overcome Challenges

1) Refresher and experience-sharing session
A refresher and experience-sharing session were held at the beginning of 2023 to ensure that they were well-informed and equipped to provide the best counseling to parents of infants coming to the immunization. The experience-sharing session was fruitful for new vaccinators joining the health centers as they got oriented on IHS. The session helped vaccinators learn from each other's challenges. The vaccinators shared the social stigma related to hearing loss during the session.

2) Development of IEC materials
Based on learnings from the implementation of the IHS program and experiences shared by CEHWS and vaccinators, IEC materials

have been developed to be displayed at immunization rooms about the importance of early infant hearing screening, receiving definitive diagnostic testing, and subsequent intervention.

3) Orientation to Female Community Health Volunteers

In Nepal, Female Community Health Volunteers are integral to many community-based health programs focused on maternal and child health services [31]. Their roles are instrumental in linking mothers, families, and communities to periphery-level health facilities. We also have oriented these household roaming volunteers to improve IHS uptake and follow-up care.

4) Periodic visits of Consultant Audiologist and Speech-Language Pathologists and Otolaryngologists to Immunization Centers

In an effort to enhance the IHS program, consultant Audiologists, Speech-Language Pathologists, and Otolaryngologists frequently visited hearing screening activities at immunization centers. In addition to supervising and monitoring these activities, these professionals can positively impact vaccinators, health workers, parents, and caretakers involved in the program.

Their presence at these centers can influence vaccinators and health workers to maintain their commitment to the IHS program. Furthermore, they can be crucial in encouraging parents and caretakers to adhere to the screening and follow-up processes. In Nepali communities, these professionals hold high social and clinical status due to their extensive medical education and role in diagnosing and treating conditions. This status enables them to effectively communicate the importance of hearing health and the benefits of early detection and intervention.

Recommendation

Hearing screening is a fundamental right for all infants and should be accessible at every immunization center. Training and equipping these centers to conduct OAE examinations can ensure universal access to IHS, even for infants who visit on non-IHS days. Additionally, providing incentives can motivate vaccinators, who already have many responsibilities.

Literature also recommends involving health workers such as physicians, pediatricians, other medical professionals, and public health personnel to strengthen hearing screening and improve follow-up care [40-45]. Moreover, there is a critical need for enhanced health education and awareness campaigns to increase understanding of hearing health among parents and caretakers. This will help them internalize its significance in the context of quality of life. An implementation study to formulate the best way to universalize the IHS would provide a tangible way to overcome the barriers of IHS.

Conclusion

Our initial experiences highlight the need for further studies to identify barriers and facilitators in implementing IHS programs. Additionally, understanding the roles of duty bearers and right holders is crucial for the program's success. Parents and caretakers share equal responsibility for the hearing health of their children alongside other stakeholders. In resource-limited settings like Nepal, immunization centers can play a vital role in the early identification of children with hearing problems.

Active participation from health facility management committees and vaccinators could enhance the screening program, which requires extended follow-ups and multiple visits. Government mandates, coordination, or integration of the IHS and immunization programs and incentives for vaccinators involved in screening can streamline screening and follow-up activities. A multidisciplinary approach involving healthcare experts, public policy decision-makers, health educators, and community engagement is imperative for successfully implementing an IHS program.

Author Contributions

Arun, Bijay, and Madan conceptualized and drafted the manuscript. Arun, Bijay, Luna, Prasanta, Ganesh, Preeti, Sanjib, Rajan, Madan, and Kumud edited, revised, and finalized it. All authors have read and approved it.

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Conflict of Interest

None

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References

1. Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 2020;396(10258):1204-22.
2. Haile LM, Kamenov K, Briant PS, Orji AU, Steinmetz JD, Abdoli A, et al. Hearing loss prevalence and years lived with disability, 1990–2019: findings from the Global Burden of Disease Study 2019. The Lancet. 2021;397(10278):996-1009.
3. National Statistics Office. National Population and Housing Census 2021 (National Report). Thapathali, Kathmandu, Nepal: National Statistics Office; 2023.
4. Smith RJH, Bale JF, White KR. Sensorineural hearing loss in children. The Lancet. 2005;365(9462):879-90.
5. Olusanya BO, Newton VE. Global burden of childhood hearing impairment and disease control priorities for developing countries. The Lancet. 2007;369(9569):1314-1317.
6. Nelson HD, Bougatsos C, Nygren P. Universal Newborn Hearing Screening: Systematic Review to Update the 2001 US Preventive Services Task Force Recommendation. Pediatrics. 2008;122(1):e266-e76.
7. Aurélio FS, Tochetto TM. Newborn hearing screening: experiences of different countries. Arquivos Internacionais de Otorrinolaringologia. 2010;14(03):355-63.
8. Wolff R, Hommerich J, Riemsma R, Antes G, Lange S, Kleijnen J. Hearing screening in newborns: systematic review of accuracy, effectiveness, and effects of interventions after screening. Archives of Disease in Childhood. 2010;95(2):130.
9. Patel H, Feldman M, Society CP, Committee CP. Universal newborn hearing screening. Paediatrics & Child Health. 2011;16(5):301-5.
10. Yoshinaga-Itano C, Manchaiah V, Hunnicutt C. Outcomes of Universal Newborn Screening Programs: Systematic Review. Journal of Clinical Medicine. 2021;10(13):2784.
11. World Health Organization. Childhood Hearing Loss: Strategies for prevention and care. Geneva, Switzerland: World Health Organization; 2016 2016. Report No.: 9241510323.
12. Okhakhu AL, Ibekwe TS, Sadoh AS, Ogisi FO. Neonatal hearing screening in Benin City. International Journal of Pediatric Otorhinolaryngology. 2010;74(11):1323-6.
13. World Health Organization. Deafness and hearing loss: World Health Organization; 2023 [updated 27 February 2023; cited 2024 10 January]. Available from: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss.
14. Grandori F. European Consensus Statement on Neonatal Hearing Screening Finalised at the European Consensus Development Conference on Neonatal Hearing Screening 15-16 May 1998, Milan, Italy. Scandinavian Audiology. 1998;27(4):259-60.
15. Erenberg A, Lemons J, Sia C, Trunkel D, Ziring P. Newborn and infant hearing loss: detection and intervention. American Academy of Pediatrics. Task Force on Newborn and Infant Hearing, 1998-1999. Pediatrics. 1999;103(2):527-30.
16. Yoshinaga-Itano C. Early intervention after universal neonatal hearing screening: Impact on outcomes. Mental Retardation and Developmental Disabilities Research Reviews. 2003;9(4):252-66.
17. Yoshinaga-Itano C. From Screening to Early Identification and Intervention: Discovering Predictors to Successful Outcomes for Children With Significant Hearing Loss. The Journal of Deaf Studies and Deaf Education. 2003;8(1):11-30.
18. Meinzen-Derr J, Wiley S, Choo DI. Impact of early intervention on expressive and receptive language development among young children with permanent hearing loss. American annals of the deaf. 2011;155(5):580-91.
19. Qi S, Mitchell RE. Large-Scale Academic Achievement Testing of Deaf and Hard-of-Hearing Students: Past, Present, and Future. The Journal of Deaf Studies and Deaf Education. 2011;17(1):1-18.
20. Vohr B, Jodoin-Krauzyk J, Tucker R, Topol D, Johnson MJ, Ahlgren M, et al. Expressive vocabulary of children with hearing loss in the first 2 years of life: impact of early intervention. Journal of Perinatology. 2011;31(4):274-80.
21. Tomblin JB, Harrison M, Ambrose SE, Walker EA, Oleson JJ, Moeller MP. Language Outcomes in Young Children with Mild to Severe Hearing Loss. Ear and Hearing. 2015;36:76S-91S.
22. Roland L, Fischer C, Tran K, Rachakonda T, Kallogjeri D, Lieu JEC. Quality of Life in Children with Hearing Impairment:Systematic Review and Meta-analysis. Otolaryngology–Head and Neck Surgery. 2016;155(2):208-19.
23. Nathan PE, Marschark M, Spencer PE. The Oxford handbook of deaf studies, language, and education: Oxford University Press; 2010.
24. Ministry of Health and Population [Nepal], New ERA, ICF. Nepal Demographic and Health Survey 2022. Ramshahpath, Kathmandu: Ministry of Health and Population [Nepal]; 2023.
25. Güven SG. The Effect of Mode of Delivery on Newborn Hearing Screening Results. Turk Arch Otorhinolaryngol. 2019;57(1):19-23.
26. Sharma A, Bhatarai P, Kunwar S, Prabhu P. Knowledge and attitude of nurses about newborn hearing screening in Nepal. Journal of Neonatal Nursing. 2021.
27. Bush ML, Hardin B, Rayle C, Lester C, Studts CR, Shinn JB. Rural Barriers to Early Diagnosis and Treatment of Infant Hearing Loss in Appalachia. Otology & Neurotology. 2015;36(1):93-8.
28. Swanepoel DW, Hugo R, Louw B. Infant hearing screening at immunization clinics in South Africa. International journal of pediatric otorhinolaryngology. 2006;70(7):1241-9.
29. Olusanya BO, Wirz SL, Luxon LM. Community-based infant hearing screening for early detection of permanent hearing loss in Lagos, Nigeria: a cross-sectional study. Bulletin of the World Health Organization. 2008;86:956-63.
30. Meyer ME, Swanepoel DW, le Roux T, van der Linde M. Early detection of infant hearing loss in the private health care sector of South Africa. International Journal of Pediatric Otorhinolaryngology. 2012;76(5):698-703.
31. Department of Health Services. Annual Report 2078/79 (2021/2022). Kathmandu, Nepal: Department of Health Services; 2023.
32. Joint Committee on Infant Hearing. Year 2019 position statement: principles and guidelines for early hearing detection and intervention programs. . The Journal of Early Hearing Detection and Intervention. 2019;4(2):1-44.
33. Therrell BL, Padilla CD. Barriers to implementing sustainable national newborn screening in developing health systems. International Journal of Pediatrics and

Adolescent Medicine. 2014;1(2):49-60.
34. Mumtaz N, Babur MN, Saqulain G. Multi-level barriers & priorities accorded by policy makers for Neonatal Hearing Screening (NHS) in Pakistan: A thematic analysis: Neonatal Hearing Screening. Pakistan Journal of Medical Sciences. 2019;35(6).
35. Olusanya BO, Akinyemi OO. Community-based infant hearing screening in a developing country: parental uptake of follow-up services. BMC Public Health. 2009;9(1):66.
36. Republica. Japan hands over hearing screening equipment and soundproof rooms for infants in Bhaktapur and Lalitpur districts Kathmandu, Nepal: Nagarik Network; 2022 [updated 14 September 2022; cited 2024 11 January]. Available from: https://myrepublica.nagariknetwork.com/news/japan-hands-over-hearing-screening-equipment-and-soundproof-rooms-for-infants-in-bhaktapur-and-lalitpur-districts/.
37. The Labour Act, 2017 (2074), (2017).
38. Shrestha E. Despite robust legal provisions, pregnant women still find it difficult to get maternity leave Kathmandu Nepal: Kantipur Media Group; 2020 [updated 13 February 2020; cited 2024 12 January]. Available from: https://kathmandupost.com/2/2020/02/13/despite-robust-legal-provisions-pregnant-women-still-find-it-difficult-to-get-maternity-leave.
39. Kuikel BS, Shrestha A, Xu DR, Shahi BB, Bhandari B, Mishra RK, et al. A critical analysis of health system in Nepal: Perspectives based on COVID-19 response. Dialogues in Health. 2023;3:100142.
40. Finitzo T, Crumley WG. The Role of The Pediatrician in Hearing Loss: From Detection to Connection. Pediatric Clinics of North America. 1999;46(1):15-34.
41. Halloran DR, Wall TC, Evans HH, Hardin JM, Woolley AL. Hearing Screening at Well-Child Visits. Archives of Pediatrics & Adolescent Medicine. 2005;159(10):949-55.
42. Moeller MP, White KR, Shisler L. Primary Care Physicians' Knowledge, Attitudes, and Practices Related to Newborn Hearing Screening. Pediatrics. 2006;118(4):1357-70.
43. Harlor ADB, Jr, Bower C, Practice Co, Medicine A, Otolaryngology–Head tSo, Surgery N. Hearing Assessment in Infants and Children: Recommendations Beyond Neonatal Screening. Pediatrics. 2009;124(4):1252-63.
44. Deng X, Gaffney M, Grosse SD. Early Hearing Detection and Intervention in the United States: Achievements and Challenges in the 21(st) Century. China CDC Wkly. 2020;2(21):378-82.
45. Alqudah O, Alqudah S, Al-Bashaireh AM, Alharbi N, Alqudah AM. Knowledge, attitude and management of hearing screening in children among family physicians in the Kingdom of Saudi Arabia. PLOS ONE. 2021;16(8):e0256647.