ISSN: 2083-389X
eISSN: 2084-3127

J Hear Sci, 2023; 13(1): 35–42
DOI: 10.17430/jhs/162293

AN EXPLORATORY STUDY OF NURSES' KNOWLEDGE, SKILL, AND TRAINING REQUIREMENTS FOR NEWBORN HEARING SCREENING IN A PUBLIC-SECTOR PROGRAM IN SOUTH INDIA

Santhana Keerthi S[1BCEF], Vidya Ramkumar[1AC-F], Shuba Kumar[2AC-E], Sheeba Anand[3B]

[1] Faculty of Audiology and Speech Language Pathology, Sri Ramachandra Institute of Higher Education and Research, Chennai, India
[2] Samarth NGO, New Delhi, India
[3] District Differently Abled Welfare Office, State Resource Cum Training Centre, Chennai, India

Corresponding author: Vidya Ramkumar, Faculty of Audiology and Speech Language Pathology, Sri Ramachandra Institute of Higher Education and Research, Porur 600116, Chennai, India; email: vidya.ramkumar@sriramachandra.edu.in

Contributions:
A Study design/planning
B Data collection/entry
C Data analysis/statistics
D Data interpretation
E Preparation of manuscript
F Literature analysis/search
G Funds collection

Abstract

Background: A pilot newborn hearing screening (NHS) program was established at 11 Corporation Maternity Hospitals in Chennai, a city in South India, to aid in the early detection of hearing loss. Nurses were trained how to screen newborns using both otoacoustic emissions (OAEs) and automated auditory brainstem responses (AABRs). The purpose of this qualitative study was to explore nurses' perceptions of the NHS program and the challenges they faced in implementing it.

Material and methods: Semi-structured interviews were conducted with 11 nurses, one from each hospital, who performed NHS in Corporation Maternity Hospitals. Interviews were conducted using guides and probes developed and validated by experts.

Results: Four general themes that covered the nurses' responses were identified: their understanding of NHS and skills in its execution; gaps in their understanding of the NHS program, constraints faced in implementing the screening program, and additional needs for support.

Conclusions: Addressing gaps in training needs, providing full documentation, and overcoming poor adherence to NHS protocols would help the program grow. The lessons learnt are also transferable to programs conducted in similar low–middle income countries.

Key words: qualitative research • newborn hearing screening • high risk • nurses • public sector

WSTĘPNE BADANIE JAKOŚCIOWE WIEDZY, UMIEJĘTNOŚCI I WYMAGAŃ SZKOLENIOWYCH PIELĘGNIAREK NA POTRZEBY PROGRAMU BADAŃ PRZESIEWOWYCH SŁUCHU NOWORODKÓW W SEKTORZE PUBLICZNYM SŁUŻBY ZDROWIA W POŁUDNIOWYCH INDIACH

Streszczenie

Wprowadzenie: Pilotażowy program badań przesiewowych noworodków (NHS) był prowadzony w szpitalach położniczych Corporation Maternity Hospitals (CMH) w mieście w południowych Indiach celem wczesnego wykrywania niedosłuchów. Pielęgniarki zostały przeszkolone w zakresie wykonywania badań przesiewowych z wykorzystaniem emisji otoakustycznych (OAE) i automatycznej detekcji słuchowych potencjałów wywołanych pnia mózgu (ABR). Celem tego badania jakościowego było zrozumienie, jak pielęgniarki postrzegają program NHS i z jakimi wyzwaniami muszą się zmierzyć podczas jego wdrażania.

Materiał i metody: Przeprowadzono częściowo ustrukturyzowane wywiady z 11 pielęgniarkami, które prowadziły badania NHS w szpitalach CMH. Wywiady przeprowadzono z wykorzystaniem opracowanych na potrzeby badania dyspozycji, pytań naprowadzających i tematów zwalidowanych przez ekspertów.

Wyniki: Zidentyfikowano trzy zagadnienia najlepiej wyjaśniające zebrane dane: wiedza i umiejętności pielęgniarek w zakresie wdrażania programu NHS; braki w ich wiedzy na temat programu NHS i ograniczenia napotkane podczas wdrażania programu badań przesiewowych.

Wnioski: Zlikwidowanie braków w zakresie potrzeb szkoleniowych i w dokumentacji, a także przeciwdziałanie nieodpowiedniemu przestrzeganiu protokołów NHS mogłoby pomóc w zwiększeniu skali programu. Wnioski z tego badania mogą także zostać wykorzystane w programach prowadzonych w krajach rozwijających się o podobnym przychodzie (LMIC).

Słowa kluczowe: badania jakościowe • badania przesiewowe słuchu noworodków • wysokie ryzyko • pielęgniarki • sektor publiczny

List of abbreviations

AABR	Automated Auditory Brainstem Response
CMH	Corporation Maternity Hospitals
COREQ	Consolidated Criteria for Reporting Qualitative Research
NHS	New-born Hearing Screening
NPPCD	National Program for Prevention and Control of Deafness
OAE	Otoacoustic emissions
RBSK	Rashtriya Bal Swasthya Karyakram (Child Health Screening and Early Intervention Services) program
SSI	Semi-Structured Interview

Introduction

According to the results of several hospital hearing screening programs conducted in India over the last decade, an estimated 4/1000 newborn children have congenital hearing loss [1]. Because of the pervasiveness of childhood hearing impairment, newborn hearing screening (NHS) is recommended as a secondary prevention measure [2–4]. In 2006, the Government of India launched the National Program for Prevention and Control of Deafness (NPPCD) for the early detection and intervention of hearing loss. The Ministry of Health and Family Welfare implemented this program in 25 districts across 11 states, and it was later expanded to 228 districts across 27 states (2006–12). The National Health Mission launched the Rashtriya Bal Swasthya Karyakram (RBSK, Child Health Screening and Early Intervention Services) program in 2013 to identify deficiencies, diseases, and developmental delays (including hearing loss) in children from birth to age 18 years. As a result, state governments began to make efforts toward early detection. In 2016, the Kerala government launched a centralised NHS program to provide barrier-free access and empower people with disabilities. Furthermore, a 1-3-6-18 and 42-month follow-up timeline interventional approach for infants with hearing loss was targeted.

A pilot NHS program was launched in two districts of the Indian state of Tamil Nadu in 2018 through the Office of the State Commissioner for the Welfare of the Differently Abled (SCWDA). This is an important initiative that, if successful, has the potential to spread to other districts throughout the state. NHS is performed in this program by nurses from Corporation Maternity Hospitals (CMHs). Under the direction of the SCWDA, the State Resource Training Centre (SRTC) collaborated with audiologists in a private institution (Public–Private Partnership) to provide training to nurses prior to the implementation of NHS. In July 2018, nurses from CMHs received initial training from audiologists. In July 2018, two audiologists from a tertiary care university hospital trained the nurses to perform NHS in their respective CMHs. This training workshop primarily focused on the basic anatomy and physiology of hearing, the importance of early detection, intervention, and the NHS program. Also provided was orientation about screening methods, knowledge and skill in otoacoustic emission (OAE) and automated auditory brainstem response (AABR) screening and their procedures. They were also trained in the do's and don'ts of screening, counselling parents regarding test results, and follow-ups for re-screening and diagnostic assessment.

In order to ensure quality and consistency of the program in its processes and goals, periodic evaluation and monitoring was necessary. If problems are identified as and when they occur, appropriate corrective measures can be implemented in a timely manner [5]. Understanding the clinical effectiveness, knowledge, and practices of those personnel who perform screening is therefore useful – to not only implement strategies to improve the program, but also provide additional training if required.

Qualitative methods are a useful way of obtaining in-depth insights into implementation barriers and facilitators when implementing standardized practices across different levels of health care programs [6,7]. Qualitative interviews have been used to identify barriers in NHS programs in the USA [8] and South Africa [9].

The present exploratory, qualitative study was undertaken one year after the pilot NHS was implemented. Nurses participating in the NHS program in the Chennai district were interviewed to better understand their perceptions and knowledge of the program, the adequacy of the skill sets acquired from training, the quality and consistency of program implementation, and the challenges encountered during implementation.

Material and methods

The Institutional Ethics Committee of the tertiary care university hospital where the first and corresponding author work (CSP/19/MAR/76/123) approved this study.

Table 1. Semi-structured interview guide (original in Tamil)

Can you tell me a little bit about your work in this hospital?
Training
How did you learn to perform the hearing screening? What is your opinion about the training you received? Name all those who are currently involved in the newborn hearing screening
Knowledge
Can you elaborate on which babies undergo hearing screening and when? What are the screening tests available here at your hospital to screen?
Skill
Can you explain about your preparation before the child comes for screening? What about child's cooperation for the screen? Can you describe any situation when you couldn't do the screening? What about equipment maintenance? On average, how long does the screening process take per child?
Results of screening
How are the results obtained for hearing screening? With whom (all) do you share these results? What about the parents' responses or feedback on the results of hearing screening?
Documentation
Where are all the screening results recorded?
Follow up
What happens if a child does not pass the screening? Can you share details on possible referrals for diagnosis and follow-up?

Research team

Investigator SK underwent a workshop on qualitative research since they had no prior experience with it. The interviewers had no prior relationship with the participants.

Theoretical framework and development of interview guides

We used our theoretical knowledge on NHS implementation as the basis for developing guides. To help with the interview process, a semi-structured interview guide (**Table 1**) was developed. The guide sought to elicit information about the nurses' work details, training received to conduct NHS programs, knowledge of NHS procedures and protocols, and their sense of competency in screening, counselling, and reporting results. Any difficulties they encountered in implementing the NHS in accordance with the training provided, as well as any additional support/training they required, were also elicited. The guide was reviewed by the 2nd author, an audiologist who was involved in the nurses' training; the 3rd author, an audiologist from the district differently abled welfare office; and the 4th author, a social scientist. Based on their feedback on the content, structure, and comprehensiveness of the questions (and follow-up questions), the interview guide was finalised.

Participant selection

The investigator contacted all nurses performing NHS in the 11 CMHs in the Chennai district operating since 2018. Each hospital has a minimum of two and a maximum of four nurses engaged in NHS-related activities. While we would have liked to have interviewed all nurses, some were unwilling to participate and others were constrained by work responsibilities and could not be relieved of their clinical duties. Consequently, we had access to just 11 nurses, at least one from each CMH. According to Guest and colleagues [10], 12 interviews are sufficient to achieve saturation if the objectives are fairly narrow and the sample is not too diverse. Given our specific focus, we thought 11 interviews were sufficient to achieve saturation. All nurses who took part in the study provided written informed consent.

Setting

The interviews took place in a quiet room at the respective CMH at a time convenient for the nurse, so that their routine hospital duties were not disrupted.

Data collection

SK conducted the one-on-one interviews. Each interviewee was informed of the purpose of the interview. The interviews lasted from 20 to 40 minutes. The interviews were audio recorded for analysis. Appropriate probe questions were used to clarify and elaborate on the interviewee's response.

Analysis

The interviewer transcribed all of the interviews verbatim and translated them from Tamil to English for analysis.

Table 2. Sample quotes from the interviews

Nurse's understanding of NHS and skills in its execution
Before, we weren't aware of it (NHS). But during the training, they (audiologist) taught us about the screening, which is very useful for us now – *nurse 4, 43 years; 1 year experience in NHS program*
It is very good to do screening early. Because if there is any problem, we can detect it at the earliest. We do echo screening for heart along with it now, we also do OAE screening. And we prefer to do this OAE screening, because we can give a clarified comprehensive report to parents about their baby. So that, they go home with satisfaction that their child is healthy – *nurse 1, 49 years; 1 year experience in NHS program*
Before screening, we will charge the machine (OAE equipment), then will clean the probe and then will switch on the AC. After that, we will allow only one attender (usually mother) along with the baby for screening. We will ask the mother to feed and wait till the baby is asleep. Then we comfort the baby and then will clean its ear with clean cloth – *nurse 3, 25 years; 6 months experience in NHS program*
Gaps in their understanding of the NHS program
We do the OAE screening, only with green colour tip. They [trained nurses] informed us to use only green tip – *nurse 7, 28 years; 1 year experience in NHS program*
We will do the screening again after feeding or will do it on second or third day before discharge. Or we will do it after 15 days when they [parents] come back for the vaccination of the baby – *nurse 4, 43 years; 1 year experience in NHS program*
We will only mention the low birth weight babies in high risk column, in OAE note – *nurse 3, 25 years; 6 months experience in NHS program*
Constraints faced in implementing the screening program
Usually we will utilise the afternoon timings after 3 pm to do the test because we will be busy in the morning and the babies will be awake too. And we also have to attend other babies who generally come for vaccination or any follow ups. So, afternoon is more convenient for us. But, sometimes we do in morning for some babies but it will be bit difficult because we have more OP's [out-patients] in the morning – *nurse 2, 29 years; 1 year experience in NHS program*
It's not like we won't do the screening for these babies [babies with high risk factors]. But we can't do the screening, because we refer these babies to ICH when the baby has RDS [respiratory distress syndrome] etc. – *nurse 8, 24 years; 8 months experience in NHS program*
We don't deliver any high-risk cases here [CMH], we have orders from higher officials not to perform deliveries as we have very limited facilities here. Yes, because of that I haven't seen any risk cases here – *nurse 6, 22 years; 2 months experience in NHS program*
Some parents tell that they are not feeling well and others tell that they are at their home town so they are unable to come, are the common reasons given by the parents for not coming – *nurse 6, 22 years; 2 months experience in NHS program*
Yes, but we will do it [AABR screening] after using it one more time. It would be better if we could get another session – *nurse 5, 30 years; 1 year experience in NHS program*
But if we can have two sisters [nurses] in duty, then one of us can take care of testing [OAE] and other will take care of routine work – *nurse 2, 29 years; 1 year experience in NHS program*
Once, we couldn't do the test as memory was full. The doctor called the maintenance person and they deleted the files and taught us how to delete the files. But now I would like to ask you [interviewer] how to delete the files if the memory is full again – *nurse 8, 24 years; 8 months experience in NHS program*

The data was analysed using a thematic analytical approach [11]. This began with data familiarization through repeated readings of the interview transcripts. Two transcripts were independently coded by two coders (authors SKS and VR) from which a code book was developed. Coding refers to the process of data reduction whereby a word or a phrase is assigned to a segment of text as a means of summarising key elements reported in that piece of text. These codes were used to code the remaining transcripts, and new codes were added as needed. Any coding differences were discussed and resolved. We then clustered the codes based on similarity and regularity, which aided in the development of categories. We went over these categories and looked for themes, which meant identifying "coherent and meaningful patterns in the data" that were relevant to our research questions. These tentative themes were carefully reviewed and discussed to see if they related well to our data, after which we defined each theme, describing in detail what it meant in the context of our study. Finally, we sifted through the data, sorted and selected quotes, and organised them by theme.

The COREQ (Consolidated criteria for reporting qualitative research) checklist was used to report the findings [12].

Results

The semi-structured interviews included 11 nurses (all female), one from each CMH in the Chennai district. All the nurses were between the ages of 22 and 46 and had been in their current positions for a minimum of 2 months and a maximum of 1 year. NHS-related work was an added responsibility for all these nurses; none of them performed NHS as their sole responsibility. There were nurses who said they had received training as well as those who said they had not. The latter carried out their NHS duties under the supervision of previously trained nurses.

Table 3. Broad themes and codes

What the nurses knew well	What the nurses did not know well	Constraints in implementing the NHS program	Additional training and support needed
• Importance of doing NHS • Usefulness of training program • To include all the well born babies there for screening • Attitude of nurse for performing the screening • Idea about the various hearing screeners • Reason for selection of screener for testing based on risk • Confidence in performing the screening • Interpretation of the results • Preparations are done for the child and test environment before the screening • Ear tip selection for testing based on weight and ear size • Time taken for testing: quick screening done • Counselling the caregivers with refer results • Convincing parents for follow-ups • Cleaning the instrument • Maintenance of records for instrument • Separate documentation for high-risk babies • Follow-up done by phone calls • Follow-up given for rescreening • 2nd screening and referrals are counselled for detailed follow-up testing at higher centers	• Selection of screener for testing • Using only OAE to screen • Standard green ear tip used for testing • Test not done for out-patients • Over screening done • Repeated screening done at follow-ups • Repeated number of screenings done in 1st screening • Various types of documentation followed at various hospitals • Referral given to different hospitals • No cases encountered for detailed testing	• Lack of training: some nurses started doing screening without any training (self-learnt) • Predominately using OAE screener for testing babies with high risk due to lack of knowledge and confidence to use AABR screener • Screening done 3 times a week mostly at preferred times, likely on afternoons, due to work load and environment	• Need an extra person to do screening as the nurse has full work load • Support required to do AABR screening • More training needed for AABR screening • Support required for terms of higher-level training

A sample of verbatim responses from the nurses is listed in **Table 2**. Four broad themes emerged from the transcript analysis, and these are set out as four columns in **Table 3**. The themes were: nurses' understanding of NHS and skills in its execution (column 1); gaps in their understanding of the NHS program (column 2); constraints encountered in implementing the screening program (column 3); and additional training and support needed (column 4).

Nurses' knowledge of NHS and their ability to carry it out

Nurses understood that the goal of performing hearing screening at birth was to detect congenital hearing loss as soon as possible and to support early intervention. Those who had participated in the training programs, in particular, felt that the training was beneficial in providing them with the knowledge and skills needed to perform newborn hearing screening tests. Whether or not they attended the training, they were aware of the two objective screening tools, OAE and AABR, because all CMHs had both. Regarding the screening program's implementation, the nurses reported that all healthy babies were screened before being discharged, usually within 3 days after birth in the case of normal deliveries and within 5 days in the case of C-section deliveries. The nurses only used the OAE screener, but they were aware that AABR screening was required for newborns who were at high risk of hearing loss. A few nurses found OAE screening to be very simple and felt confident in their ability to carry it out correctly and interpret the test results.

The majority of nurses stated that they first calmed or put the baby to sleep before screening. They also prepared the testing environment by lowering noise levels in the surrounding areas. They also said that they cleaned the ear tips and probe after each screening test. The majority of nurses said they finished OAE screening within 5 to 10 minutes. All nurses stated that they explained the results to the parents or caregivers and informed them of any necessary follow-up visits. They described using a register to record all screening results and follow-up visits, which

was reviewed on a regular basis by the administrator in charge. The majority of nurses reported routinely calling families to remind them of their scheduled follow-up and screening appointments.

Gaps in their knowledge of the NHS program

There were gaps in adhering to the protocols and procedures governing the screening program. Regardless of whether there were high-risk factors for hearing loss, the nurses preferred to perform OAE screening only. Although some nurses were trained to perform AABR screening, they did not feel confident in using the equipment because they did not feel fully trained in its use. They thought the AABR screening procedure was more difficult than the OAE screening procedure. Several nurses chose a standard green ear tip to perform OAE screening rather than selecting ear tips after inspecting the baby's ear canal. To obtain pass results, nurses repeated the first screening multiple times on the same day or on subsequent days before discharge. These subsequent screenings were also counted as part of the initial screening result.

Despite the fact that all CMHs recorded NHS-related data, nurses from each hospital described different formats for documenting it. Most hospitals reported that nurses recorded information about high risk factors, but further investigation revealed that the risk factors were not specific to hearing loss. Furthermore, many of the nurses mentioned keeping a separate monthly census register and saving the data in a computer system. Some of them used a social media encrypted chat app to update the monthly census. There was no clear distinction between the first and second screenings, and no follow-up appointment details were documented. The majority of the nurses were unsure about the referral centre for hearing loss diagnostic confirmation. They were not aware of the designated diagnostic referral centre, the SRTC.

Constraints encountered in implementing the screening program

Due to their other duties at the hospital, many nurses found it difficult to conduct the hearing screening in the mornings and thus preferred to perform the screening in the afternoons, or thrice a week, depending on their work load. Nurses were employed at the CMH on a temporary contract or as permanent employees. The permanent staff nurses had attended the audiologists' training programs, but they did not always perform screening. The screening tests were mostly carried out by nurses who were employed on a temporary or contract basis. As previously stated, these nurses had received no formal training aside from that provided by the permanent nurses who had attended the training program. Although a few contract nurses reported attending the training programs, in many cases they resigned soon after, or their tasks were changed, or they were transferred to another hospital. The frequent changes in the deployment of nurses were considered as contributing to a lack of continuity and efficiency in the screening tests.

Because these babies were usually transferred to a tertiary care hospital immediately after birth, nurses at the CMH had few opportunities to screen them. The nurses performed the OAE screening on these newborns only when they returned to the CMH for immunisation. The nurses expressed concern about the loss of follow-up, which occurred despite all of their efforts to send reminders and counsel parents about the importance of re-screening follow-up. They attributed this loss to follow-up to the mother's move to their maternal residence post childbirth and incorrect mobile phone numbers provided. In terms of the reasons for not performing the AABR screener, a few nurses stated that the equipment was not yet installed in their hospital and thus the screener was not available. According to one nurse, the NHS program at her site was halted for 2 months due to OAE instrument repairs.

Additional training and support

The nurses felt that they needed more hands-on experience with AABR screening. They felt that the time allotted to them during their training program for learning about the AABR screening was inadequate. A few nurses suggested that NHS work be done at a specific time of day so that they could allocate time for other duties during the rest of the day. Another felt it would be preferable to have dedicated personnel, such as a doctor, perform screening for all babies rather than nurses who rotate duty frequently. In contrast, others felt it was critical that they be taught about the care and maintenance of these instruments.

Discussion

Qualitative assessments of the feasibility and challenges of NHS programs among key stakeholders are extremely limited, particularly in the context of government-implemented programs. The feasibility assessment of a pilot NHS in South Africa provided useful insights to guide large-scale program implementation [13]. One such attempt was made in Orissa, India, by assessing parents' and audiologists' perspectives on NHS [14], but the present work is the first known attempt in an Indian context to study nurses' perspectives using qualitative methods that provide deeper insights.

Nurses recognised the importance of screening all babies at birth and before discharge from CMHs and were successful in meeting the benchmark coverage rate for well babies. Several studies have recommended screening babies at birthing hospitals before discharge as a successful way to achieve a higher coverage rate [15–18]. Our findings also indicate that the information provided during initial training was beneficial to the nurses in performing OAE screening. They took the necessary steps to reduce noise interference, increasing screening efficiency. They were comfortable using the OAE screener because of its ease of use and simplicity of operation. When compared to AABR screening, OAE screening is known to be easier and faster [19].

While the pilot NHS program was somewhat successful, this exploratory study identified challenges that must be addressed before scaling up the implementation. To begin with, nurses were aware of the importance of AABR screening and the criteria for performing it, but they lacked confidence in using the AABR equipment. As a result, even

high-risk newborns were screened using OAE screening, potentially leading to false negative results. The equipment used in this program was an AABR screener with a screening protocol for single intensity screening. The screening protocol calls for the preparation of the newborn's skin and the placement of electrodes, just as is required for detailed diagnostic testing. The nurses must also operate the equipment using software installed on a laptop computer, necessitating specific technology training which may have created a barrier for nurses to use AABR for follow up. Furthermore, extensive patient preparation is required, and the procedures are both complex and time-consuming, which serve as a deterrent to its use. Therefore, because of its simplicity and ease of use [20], equipment designed for automated ABR screening is recommended. Given the scarcity of trained audiologists, the availability of simple automated hearing screening equipment that non-audiologists can use is extremely valuable. NHS programs in the public sector should carefully consider the cost–benefit ratio of using automated hearing screening technologies. Such information would be useful when scaling up implementation.

During OAE screening, nurses used one size ear tips on all infants. Even though most newborns can accept a standard neonatal size ear tip, it is important to inspect the ear canal for debris/wax as this will affect the quality of the screening results. However, testers can only learn to select appropriate ear tips and achieve the proper fit with practice and experience [21]. This highlights the importance of having dedicated personnel involved in NHS, which was not possible in this NHS program. NHS was also performed by nurses with and without training. Permanent staff nurses were delegated to attend the NHS training; in contrast, the nurses involved in newborn care who performed the hearing screening were not directly trained by the audiologist. Instead, these nurses had learned their screening techniques from those who had received training. As a result, there were bound to be gaps in their knowledge and skills. Furthermore, the nurses who performed the screening were temporary employees who were frequently transferred, which contributed to the program's lack of continuity and efficiency. Frequent changes in screening personnel have been shown to increase referral rates [22], reducing program specificity.

Only paper-based documentation was used in this program, resulting in a significant lack of uniformity. Data management is critical for effective newborn tracking and follow-up [23] as well as developing an information management system (IMS) for larger government programs. Data management software for newborn hearing screening programs is available from screening device manufacturers; however, for public-sector programs, uniform electronic records would be preferable because they promote integrated health-care data management.

The screening protocol used by the nurses also differed and did not adhere to the recommended two-stage screening. To obtain 'pass' results, multiple first screenings were attempted on the same day or before the babies were discharged. While the desire to obtain a 'pass' result demonstrates the nurses' motivation, repeated screening without an adequate time gap is likely to increase false-positive results and decrease the test reliability [24,25]. Furthermore, because newborns with any high-risk conditions were transferred to tertiary care centres immediately after birth, several high-risk babies were missed for screening before discharge. The nurses were only able to screen these newborns if they returned to the CMHs for immunisation follow-up. Missing high-risk babies defeats the purpose of 'at birth' screening for hearing loss, so all health care providers in CMHs must be involved, and a suitable protocol to screen such high-risk babies must be developed.

The vast majority of nurses were unaware of the designated referral centres for additional diagnostic evaluation. As a result, they referred the babies to nearby government tertiary care hospitals, where there was no mechanism to track whether or not the babies were followed up on. The percentage of those who return for follow-up [18] can be used to assess a program's efficiency. The newborn hearing screening was an extra duty for the nurses. Despite their efforts to complete the screening prior to discharge, the nurses found it difficult to balance their time between various responsibilities. An increase in the workload of screening personnel reduces the number of patients they can see [18,26] and impairs the quality of services they can provide. Such administrative difficulties can only be overcome by working with administrators and providers to develop appropriate strategies. Other challenges included equipment repairs and technical snags, which resulted in a few of the CMHs of a lack of continuity in screening. The lack of alternate backup equipment when machines needed to be serviced contributed to disruptions in screening activities, which could have affected the program's overall coverage rate, as reported in other studies [8].

Conclusions

This study was undertaken to identify key issues in a public-sector pilot NHS implementation in India. The findings of this study provide clear insights into gaps to be addressed prior to scale-up both within India and other similar low–middle income countries. While the findings were based on semi-structured interviews among 11 nurses, the interpretation of the data using thematic analysis showed data saturation, which suggests that the sample size was adequate.

Trainers and program planners could use the identified gaps and suggestions for additional training in AABR screening and troubleshooting OAE to design refresher training programs. Further, following the pilot phase and scaling up of the program, program implementers should consider the value of appointing a dedicated nurse for hearing screening.

Data availability statement

On request, the corresponding author can provide data that back up the study's conclusions. Since the data contains information identifying participants it cannot be easily de-identified, and so the data is not publicly available. Nevertheless, particular data sets can be provided after identifiers have been erased.

References

1. Ramkumar V. A review of neonatal hearing screening practices in India. J Hear Sci, 2017; 7(1): 9–15. https://doi.org/10.17430/902592
2. Korver AMH, Konings S, Dekker FW, Beers M, Wever CC, Frijns JHM, et al. Newborn hearing screening vs later hearing screening and developmental outcomes in children with permanent childhood hearing impairment. JAMA, 2010; 304(15): 1701–8. https://doi.org/10.1001/jama.2010.1501
3. Olusanya BO, Newton VE. Global burden of childhood hearing impairment and disease control priorities for developing countries. Lancet, 2007; 369(9569): 1314–7. https://doi.org/10.1016/S0140-6736(07)60602-3
4. Yoshinaga-Itano C. Universal newborn hearing screening programs and developmental outcomes. Audiol Med, 2003; 1(3): 199–206. https://doi.org/10.1080/16513860310002031
5. Finitzo T, Grosse S. Quality monitoring for early hearing detection and intervention programs to optimize performance. Ment Retard Dev Disabil Res Rev, 2003; 9(2): 73–8. https://doi.org/10.1002/mrdd.10062
6. DiCicco-Bloom B, Crabtree BF. The qualitative research interview. Med Educ, 2006; 40(4): 314–21. https://doi.org/10.1111/j.1365-2929.2006.02418.x
7. Gill P, Stewart K, Treasure E, Chadwick B. Methods of data collection in qualitative research: interviews and focus groups. Br Dent J, 2008; 204: 291–95. https://doi.org/10.1038/bdj.2008.192
8. Shulman S, Besculides M, Saltzman A, Ireys H, White KR, Forsman I. Evaluation of the universal newborn hearing screening and intervention program. Pediatrics, 2010; 126 (Suppl 1): S19–S27. https://doi.org/10.1542/peds.2010-0354F
9. Khoza-Shangase K, Harbinson S. Evaluation of universal newborn hearing screening in South African primary care. Afr J Prim Health Care Fam Med, 2015; 7(1): 769. https://doi.org/10.4102/phcfm.v7i1.769
10. Guest G, Bunce A, Johnson L. How many interviews are enough? Field Methods, 2006; 18(1). https://doi.org/10.1177/1525822X05279903
11. Clarke V, Braun V. Successful Qualitative Research: A Practical Guide For Beginners. Thousand Oaks: Sage; 2013.
12. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care, 2007; 19(6): 349–57. https://doi.org/10.1093/intqhc/mzm042
13. Kanji A, Khoza-Shangase K, Moroe N. Newborn hearing screening protocols and their outcomes: a systematic review. Int J Pediatr Otorhinolaryngol, 2018; 115: 104–9. https://doi.org/10.1016/j.ijporl.2018.09.026
14. Sahoo KC, Dwivedi R, Athe R, Bhattacharya D, Rajsekhar K, Pati S. Stakeholders' perspective for improved Universal Newborn Hearing Screening Uptake in Odisha, India. J Trop Pediatr, 2021; 67(3): fmaao62. https://doi.org/10.1093/tropej/fmaa062
15. Paul AK. Centralized newborn hearing screening in Ernakulam, Kerala: experience over a decade. Indian Pediatr, 2016; 53(1): 15–7. https://doi.org/10.1007/s13312-016-0782-7
16. Gupta S, Sah S, Som T, Saksena M, Yadav CP, Sankar MJ, et al. Challenges of implementing universal newborn hearing screening at a tertiary care centre from India. Indian J Pediatr, 2015; 82(8): 688–93. https://doi.org/10.1007/s12098-015-1688-4
17. Vignesh SS, Jaya V, Sasireka BI, Sarathy K, Vanthana M. Prevalence and referral rates in neonatal hearing screening program using two step hearing screening protocol in Chennai: a prospective study. Int J Pediatr Otorhinolaryngol, 2015; 79: 1745–7. https://doi.org/10.1016/j.ijporl.2015.07.043
18. Cavalcanti HG, de Melo LPF, Buarque LFSFP, Guerra RO. Overview of newborn hearing screening programs in Brazilian maternity hospitals. Braz J Otorhinolaryngol, 2014; 80: 346–53. https://doi.org/10.1016/j.bjorl.2014.05.005
19. Meier S, Narabayashi O, Probst R, Schmuziger N. Comparison of currently available devices designed for newborn hearing screening using automated auditory brainstem and/or otoacoustic emission measurements. Int J Pediatr Otorhinolaryngol, 2004; 68: 927–34. https://doi.org/10.1016/j.ijporl.2004.02.008
20. Augustine AM, Jana AK, Kuruvilla KA, et al. Neonatal hearing screening: experience from a tertiary care hospital in Southern India. Indian Pediatr, 2014; 51: 179–83. https://doi.org/10.1007/s13312-014-0380-5
21. De Ceulaer G, Daemers K, Van Driessche K, et al. Neonatal hearing screening with transient evoked otoacoustic emissions: a learning curve. Audiology, 1999; 38: 296–302. https://doi.org/10.3109/00206099909073039
22. Mukari SZ, Tan KY, Abdullah A. A pilot project on hospital-based universal newborn hearing screening: lessons learned. Int J Pediatr Otorhinolaryngol, 2006; 70: 843–51. https://doi.org/10.1016/j.ijporl.2005.09.018
23. Schmeltz LR, Fritzler J. EHDI information management. In: A Resource Guide for Early Hearing Detection and Intervention (eBook, Chapter 31). National Center for Hearing Assessment and Management, Utah State University, 2011. https://www.infanthearing.org/ehdi-ebook/2015_ebook/31-Chapter31InfoManagement2015.pdf
24. Dimitriou A, Perisanidis C, Chalkiadakis V, Marangoudakis P, Tzagkaroulakis A, Nikolopoulos TP. The universal newborn hearing screening program in a public hospital: the importance of the day of examination. Int J Pediatr Otorhinolaryngol, 2016; 91: 90–3. https://doi.org/10.1016/j.ijporl.2016.10.015
25. Olusanya BO, Swanepoel DW, Chapchap MJ, et al. Progress towards early detection services for infants with hearing loss in developing countries. BMC Health Serv Res 7, 2007; 14. https://doi.org/10.1186/1472-6963-7-14
26. Sarpomaa KK, Isaac O, Alexei DJ, Karikari OV. Challenges of screening and early detection of hearing impairment among children in some selected hospitals in Kumasi Metropolis. Saudi J Med Pharm Sci, 2017; 3: 1330–4. https://doi.org/10.21276/sjmps.2017.3.12.11