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# Perspectives of newborn hearing screening in resource constrained settings

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## ABSTRACT

Newborn hearing screening is an effective strategy for early identification of hearing loss in the newborn which result in early intervention and best outcome. However implementing universal screening strategy is a challenge in many resource constrained settings. There are various limitations towards successful implementation of hearing screening program in the developing countries. The cost effectiveness of the screening program also needs to be considered in a resource constrained settings. We attempt to provide a viewpoint that can be potentially helpful for the successful implementation of hearing screening in a resource constrained settings of the developing countries.

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## 1. Introduction

Hearing impairment in the newborn is common and often diagnosed late. The incidence of newborn hearing impairment averages around 0.5 to 5 per 1000 births (World Health Organisation, 2010). Hearing is critical for the normal development of language and communication skills and has an important role in the personality and intellectual development of the individual. However, hearing impairment has been neglected for long as it is not considered a life threatening condition. In 1978 Marion Downs advocated the importance of hearing screening in infants with high risk of congenital hearing loss (Kerchner, 2004). In the past hearing assessment in the newborn depended upon the behavioral response of the child to sound. Such methods were subjective and failed to provide an accurate assessment of the hearing status of the newborn. With technological advancement, objective and accurate assessment of the hearing status of the newborn has now become possible. As per the recommendations of the Joint Committee on Infant Hearing (JCIH), hearing screening in the newborn is performed within 1 month of birth to diagnose hearing loss before 3 months so that necessary intervention can be initiated by 6 months

of life (Joint Committee on Infant Hearing, 2019; Russ et al., 2010). This strategy is used to utilize the golden period of neural plasticity which is critical for the acquisition of language. Various screening strategies have been advocated like the universal newborn hearing screening and the high risk targeted hearing screening. Hearing screening can be done with either Otoacoustic emission (OAE) or the Auditory Brainstem Response (ABR). Some newborn hearing screening programs use a “two-stage protocol” consisting of OAE for the initial screening followed by ABR for rescreening (Joint Committee on Infant Hearing, 2019).

## 2. The scenario of newborn screening in India and other developing nations

Approximately 32 million children suffer from disabling hearing loss across the globe. According to the World Health Organization (WHO) estimate, the majority of them are in developing regions of South Asia, Asia Pacific and Sub Saharan Africa (World Health Organization, 2018). The implementation of universal newborn hearing screening (UNHS) has been encouraging in the developed countries. A retrospective analysis of screening records for nine years in England revealed coverage of 98.9% screening by 3 months of age (Wood et al., 2015). In the United States, approximately 98% of newborn babies underwent hearing screening (Centre for Disease Control and Prevention, 2019). The success behind such high screening rates is attributed to various family friendly initiatives, screening facilities at home and free of cost screening strategy (Wood et al., 2015). Newborn hearing screening strategy has also

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**List of abbreviations**

OAE	Otoacoustic emission
ABR	Auditory Brainstem Response
WHO	World Health Organisation
UNHS	Universal newborn hearing screening
JCIH	Joint Committee on Infant Hearing
NPPCD	National Program for Prevention and Control of Deafness
RBSK	Rashtriya Bal Swasthya Karyakram
NFHS	National Family Health Survey

been adopted in India. However, at present most of the health care facilities do not carry out mandatory screening at birth. The screening facility is mostly hospital based and limited to only a few secondary and tertiary care centers. The majority of hospitals do not have either universal or targeted high risk screening strategy (Paul, 2011). Approximately only 120 out of 350 government hospitals in India have facilities for the newborn hearing screening (Ramkumar, 2017). A study by Kumar et al. (Kumar and Mohapatro, 2011) revealed that only 38% of the medical colleges in India have a newborn screening program in place. There is also a dearth of trained audiology technicians to carry out an effective and outreach screening program. At present, the ratio of audiologists to the general population is about 1: 500000 (Ramkumar, 2017). The National Program for Prevention and Control of Deafness (NPPCD) was launched in India in 2006 with high risk hearing screening as one of the strategies for the early identification of hearing loss. The Rashtriya Bal Swasthya Karyakram (RBSK), a national program was implemented in India in 2013 for early detection and intervention of development anomalies, birth defects, childhood diseases and developmental delays. The program aims for congenital deafness screening in newborn babies at the district early intervention center. This program has been a significant step towards newborn screening. However, the implementation of the hearing screening program is not uniform across the country (Galhotra and Sahu, 2019). A centralized screening program has been established in the Southern states of Tamil Nadu and Kerala and two such programs have also been reported from the western region. The centralized screening program of Cochin and Ernakulum districts of Kerala in India cater to the newborn hearing screening from the majority of the maternity hospitals in the region (Paul, 2011, 2016). However, the total coverage is not known, especially in the rural areas. The implementation of newborn hearing screening programs in countries of the Southeast Asian Region is not impressive and many of the countries like Bhutan, Maldives, Indonesia, Myanmar, Nepal, Sri Lanka and Thailand lack national policy for the same (World Health Organisation, 2010). Western Asian country like Iran has demonstrated a very effective newborn screening program with high coverage, low referral rate and good follow up (Saki et al., 2017). On the other hand, Oman implemented a newborn hearing screening program in 2002 but the coverage of the program has been inconsistent across different regions in the country. Some of the regions in the country with a high birth rate had a very low coverage of newborn hearing screening (Khandekar et al., 2006). Presently there are no mandatory screening strategies in African countries and the reported coverage of hearing screening is only 24% (Theunissen and Swanepoel, 2008). Though there are reports of some form of hearing screening in many of the developing countries, yet there has not been a uniform coverage of screening strategy across the nation or regions.

**3. Universal versus high risk screening strategy**

The beneficial effects of the screening program across the population are beyond any doubt (Kolski et al., 2007). There has been a significant reduction in the age at diagnosis of hearing loss in the newborn which has resulted in early intervention and a better outcome (Wroblewska-Seniuk et al., 2017). However there have been proponents and opponents of both UNHS and high risk screening (Kerchner, 2004). High risk targeted screening is a feasible and practical approach in resource constrained settings. But high risk targeted newborn screening has been found to miss out 50% of the cases of deafness (Rai and Thakur, 2013). On the contrary universal screening detects most of the cases of newborn deafness early which allows timely intervention. About 75% of babies with hearing loss were identified by three months of age in hospitals having newborn hearing screening program compared to 30 months needed to detect the same percentage of babies with hearing loss in centers without screening program in place (Yoshinaga-Itano, 2003). However, it fails to detect mild hearing loss and delayed onset deafness and may give a false sense of security (Olusanya et al., 2004). Implementing universal newborn screening in a vast country like India is a challenging task because of a high birth rate, diverse socio-economic and cultural background with limited resources. Newborn hearing screening is done mostly in the hospital setting before the discharge of the baby. In a country like India, many deliveries are still conducted at the primary health center level. It is also necessary to take into account the number of non-institutional deliveries that take place. According to National Family Health Survey-4 (NFHS 4), 2015-16, nearly 21% of the deliveries in rural India take place in the home setting and approximately 16% do not undergo any antenatal check-ups (International Institute for Population Sciences and Mumbai, 2017).

**4. Limitations towards successful implementation of newborn hearing screening**

There has been inadequate dissemination of information regarding newborn screening programs among the various stakeholders. Even in countries with widely implemented screening strategies, it was seen that there was inadequate communication regarding the screening among the parents (Arnold et al., 2006; Ravi et al., 2016a). Around 21% of the mothers were aware of the newborn screening and about 70% came to know about the program only after hospitalization (Vohr et al., 2001). In another study published from an African country, 60% of mothers were unaware of the screening program and only 27% came to know about it from their antenatal visits (Jatto et al., 2018). This is important as maternal ignorance regarding hearing screen can also result in inadequate follow up of high risk babies (Ravi et al., 2016b). This was seen in a study by Sharma et al. in India where unwillingness towards testing was the most common reason for failure to follow up after initial failed screening (Sharma et al., 2018). Maternal education levels, socioeconomic status are other indicators that can predict follow up and are associated with earlier diagnosis of hearing loss and intervention (Ballantyne et al., 2014; Holte et al., 2012). There are significant loopholes in the knowledge about newborn screening among the midwives (Goedert et al., 2011). The role of midwives in community health in developing nations is of immense significance as they can counsel, educate and motivate expectant mothers to carry out newborn hearing screening. They can be a potential medium for the successful implementation of the screening program in such countries (Biernath et al., 2009). A systematic review found a significant deficiency in the knowledge among the health care professionals on various aspects of the newborn hearing screening program (Ravi et al., 2018). A study

conducted among the pediatricians in India pointed towards the need for continuing updates on the hearing screening (Ravi et al., 2017). A pediatrician can motivate parents to undergo hearing screening. It has been seen that many times parents refused to screen and defaulted in follow up after failed screening because the screening was not advised by the pediatrician (Scheepers et al., 2014). It is also noteworthy that there is a lack of information on risk factors of hearing loss among the obstetrician and gynecologists (Muniz et al., 2010). This assumes significance as the mother remains under the care of the obstetrician during the antenatal period during which she can be sensitized to the risk factors of hearing loss and motivated to undergo screening.

There are various other hindrances towards the successful implementation of universal newborn hearing screening program among the developing nations. Caregivers bearing the expenses of the screening due to non-inclusion of the tests in the birthing package of the hospital and medical insurance have been shown to influence the refusal towards hearing screening and follow up (Scheepers et al., 2014). The same factors may well be the cause in other developing countries. The stigma associated with deafness prevents many from seeking rehabilitative measures. The social structure of rural India with financial dependency of the mother on senior family members is often a deterrent factor even though it has been seen that mothers have the early suspicion of hearing loss in her child. Besides these, the distance of centers offering testing facilities is a hindrance for the mother, particularly in the rural areas (Merugumala et al., 2017). Other major challenges towards successful implementation of the newborn hearing screening program include lack of trained staff and equipment along with a lack of awareness among the health care providers (World Health Organisation, 2010; Galhotra and Sahu, 2019; Theunissen and Swanepoel, 2008).

The economic viability of the newborn hearing screening is an important factor to be considered for the success of the program. A study conducted in a premier tertiary care institute in India did not find universal newborn hearing screening as a cost-effective strategy even though its benefits are manifold (Gupta et al., 2015). However, a study conducted in China on the cost-effectiveness of the hearing screening program came up with interesting findings. The study found universal hearing screening to be cost-effective in the long run in developed provinces with a higher program coverage, diagnosis and intervention rates. On the other hand in the developing regions of the country, a targeted high risk screening was more cost-effective than universal screening (Huang et al., 2012). Though similar studies are lacking in other countries, it offers a viable and practical alternative for successful implementation and outcome of the hearing screening program in various developing countries.

## 5. Universal hearing screening in the developing regions – our viewpoint

Universal hearing screening is an ideal scenario for any country. However, from a practical point of view, its feasibility needs to be assessed in a resource constrained setting. The implementation of universal screening should be done in a staged manner. A target of complete coverage for screening of all high risk babies must be achieved before we can roll over towards universal screening. This is where expectant mothers will have to play a greater role. A voluntary health seeking attitude of the mothers will go a long way in achieving the target of 100% screening of high risk babies. For this to happen, the mothers must be empowered with knowledge of risk factors of hearing loss in newborn babies and infancy. The ideal time to make such an impression is during the antenatal visits particularly in the second and early part of the third trimester which can be combined with other antenatal well-being sessions.

The American College of Obstetrician and Gynecologists recommends dissemination of educational resources on newborn screening to pregnant mothers (Committee Opinion No. 616, 2015). The educational resources about the newborn hearing loss and its risk factors as well as the development milestones need to be incorporated in the antenatal sessions. The obstetrician in hospital settings and the midwives and aganwadis in the community have the potential to play a greater role in the dissemination of information and motivating the mothers to undergo hearing screening of their newborn babies. Mothers can have a strong suspicion regarding the hearing status of her baby and can be trained during the antenatal period on the early signs and risk factors of the hearing loss. It was seen in a study from Nigeria that mothers had the suspicion of hearing loss in newborns in almost 80% of cases. Though most of the parental suspicion occurred between 12 and 24 months, a small number (about 12–15%) doubted the hearing status of their baby before six months of age (Olusanya et al., 2005; Störbeck and Young, 2016). The cause of delay in suspicion is probably due to the lack of awareness of the development milestones among the mothers. A study conducted in Hongkong revealed that only 22% of mothers were aware of the age at which the baby localizes sound while only 63% knew when the baby starts paying attention to familiar voices (Lam et al., 2018). We believe that it will be worthwhile to educate the mothers on the normal development milestones and encourage them to seek early medical attention if there is any deviation from such a timeline. Trained mothers can be a potential workforce for the dissemination of information regarding newborn screening especially in remote areas and socioeconomically backward regions of the developing countries. A strategy to train a group of mothers who have experienced and dealt with a deaf child in the family will have more impact on society in motivating people to undergo screening. It may be worthwhile to utilize the antenatal contact sessions for the dissemination of such information and at the same time prepare the mother for the well-being of her baby. At the same time, it is important to train the peripheral health workers on the protocol for hearing screening and further evaluation of failed screen. A community-based screening program with OAE by the midwives and the aganwadis might be an effective strategy in remote locations particularly for high risk cases. A policy of wait and watch in cases of failed screen and development delay should be condemned at all levels of health care delivery.

## 6. Conclusion

Successful implementation of universal newborn hearing screening should be the goal of every nation. The challenges in doing so in the developing and resource constrained countries are many. However, it is possible to achieve the goal. Universal hearing screening is not the sole responsibility of the audiologist or the otolaryngologists. It has to be a concerted team effort with equal involvement of the gynecologists, pediatricians, along with the nursing and the midwives. In this team, expectant mothers will have to play a greater role. Maternal education on the risk factors of hearing loss along with early identification and suspicion of hearing loss will go a long way in realization of the goal of universal newborn hearing screening.

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## Declaration of competing interest

Nil.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.joto.2020.05.001>.

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