

# Routine newborn hearing screening – an Indian experience

## Abstract

**Objective:** Newborn Hearing Screening to detect the hearing problems in neonates has become a standard of care in the USA, Australasia and UK after recent guidelines. We undertook this as a routine procedure in our hospital since Jan 2007.

**Setting:** Tertiary Maternity Hospitals in Bangalore, India.

**Participants:** All babies born above 35 weeks at the hospital and were with the mothers during the first few days - and not requiring NICU admission.

**Results:** Between Jan 2007 and Mar 2016 a total of 30,600 neonates were screened using Newborn Hearing Screening. 75 neonates who failed screening, a thorough clinical examination by the neonatologists revealed that 58 babies had a false positive result and passed the test after a week and 17 babies were investigated with an audiogram by a Paediatric Audiologist and 8 out of those fifteen infants had hearing difficulties requiring treatment by an ENT Surgeon.

**Conclusion:** These data confirm that Newborn Hearing screening of apparently well newborns should become a standard of care in India like many other developed countries and is very cost effective.

**Keywords:** newborn hearing screening (NHS), ent surgeon, newborn babies, audiology services, aabr, ent services

Volume 1 Issue 1 - 2016

R Kishore Kumar,<sup>1,2</sup> Prakash Kini,<sup>1</sup> Prashant Sardangouda,<sup>1</sup> Eshwar Reddy,<sup>1</sup> Muyeed Mohammed<sup>2</sup>

<sup>1</sup>Cloudnine Hospitals, India

<sup>2</sup>Notre Dame University, Australia

**Correspondence:** R Kishore Kumar, Consultant Neonatologist & Paediatrician, Cloudnine Hospital, 1533, 3rd Block Jayanagar, 9th Main, Bangalore - 560011, India, Tel +91 80 6673 2259, Fax +91 80 4020 2233, Email drkishore@cloudnynecare.com

**Received:** September 09, 2016 | **Published:** November 16, 2016

## Introduction

### What is already known on this topic

- Newborn Hearing screening has been shown to improve the prognosis of early-diagnosed hearing difficulties in newborn babies.
- Barriers to implementation include concerns about increased workload on audiology services.
- Screening programs are being implemented in most developed countries.

### What this paper adds

- Newborn Hearing screening does improve early diagnosis of hearing difficulties with minimal increase in cost and also the burden on audiology services.
- It is effective in improving early diagnosis of otherwise missed hearing difficulties.
- There is enough evidence to suggest a national recommendation for Newborn Hearing screening in India.

Congenital hearing impairment occurs in approximately 1 to 5 per 1000 live births and when permanent unilateral hearing loss is included, the incidence increases to 8 per 1000 live births.<sup>1-3</sup> Neonatal hearing loss has a prevalence that is more than twice that of other newborn disorders amenable to screening such as congenital hypothyroidism and phenylketonuria.<sup>4,5</sup> Studies done in India using different hearing screening protocols have estimated the prevalence of neonatal hearing loss to vary between 1 and 8 per 1000 babies screened. Early identification and intervention for hearing loss by

6 months of age provides better prognosis in language development, academic success, social integration and successful participation in the society.<sup>3</sup>

The need for universal hearing screening in neonates & its effectiveness and has previously been well proven.<sup>6,7</sup> Tests used for screening newborns for hearing loss include Oto-acoustic emissions (OAE) and automated Auditory Brainstem Response audiometry (AABR). While OAE is cheap, quick, simple and reliable with a sensitivity of 100% and specificity of 99%,<sup>8</sup> AABR has the additional advantage of identifying neonates with auditory neuropathy unlike testing for OAE. The other advantages of AABR include rapidity, easy-to-use and high sensitivity (0.99) and specificity (0.87).<sup>9</sup> The Maico MB11 BERAphone is an AABR system employing a special headphone.<sup>10</sup> It consists of a hand-held headphone unit which incorporates a set of three fixed reusable electrodes. It has been tested and found to have a sensitivity of 99.9% and specificity of 97.9% when used in a two-stage screening protocol which is comparable to that of OAE. The test is also seldom affected by ambient noise making it suitable for use in the postnatal ward.<sup>10</sup>

In 2007, a chain of tertiary maternity Hospitals reviewed the published evidence of benefit was thought to be sufficient enough to implement this practice into routine care. We present our cohort as our Indian experience.

This paper describes a post-implementation review of the first 9 years of newborn hearing screening of well newborns at these hospitals. The aim was to describe the implementation of the screening programme and review whether the outcomes were consistent with those described in the literature in our setting.

## Methods

The study population included all babies born at the four maternity tertiary care hospitals between January 2007 and Mar 2016. A group of tertiary maternity hospitals - four of which are located in Bangalore (one each in Old Airport Road, Malleshwaram and two in Jayanagar). Delivering over 5000 babies a year. It provides a maternal fetal medicine service, which screens for high-risk births including newborn hearing screening.

Two nurses in each centre were trained for the study, and their knowledge, ability to obtain informed consent, counsel parents and perform the screening test was assessed formally at the end of the training period. The BERAPHone consists of a handheld headphone unit which is positioned on the babies head after application of electrode gel at the points of contact with the electrodes (vertex and mastoid). An optimized chirp stimulus is used at 35dB and the system automatically detects the presence of an auditory brainstem response based on an implemented statistical test algorithm. If response is detected the test produces a 'Pass' result while failure to detect a response within 120 seconds produces a 'Refer' result.

All newborn babies delivered in our hospital were screened by the trained nurses using BERAPHone between 24 hours and 48 hours after birth. Newborns admitted in the neonatal intensive care unit (NICU) were screened prior to discharge from the NICU (once their general condition was stable). Mothers of all babies born in the hospitals were counseled regarding the benefits of hearing screening using a standard leaflet which had been prepared using the available evidence for the same. The procedure of the screening test, need for follow-up and further tests if the baby failed the screening test, and the interventions available if hearing loss was explained by all Neonatologists. The first screening test was done in the postnatal wards or NICU after obtaining informed verbal consent from one of the parents. Parents of babies who failed ('refer') the screening test were counseled and asked to return after 1 week for second screening. These babies underwent a second testing in a quiet room. Those who passed on the second screening were discharged from the study while those who failed a second time were referred for further evaluation to the audiologists at the same centre, the babies were examined by an ENT Surgeon, parents were counseled and diagnostic testing using Auditory Steady State Response Audiometry (ASSR) was done.

## Data collection and analysis

The results of each neonate's screening were entered into HIS (Hospital Information System) database and stored. For this study we derived descriptive statistics for the number of babies screened, their demographics, the results of the screening, and the associated variables.

## Ethics and IRB approval

The parents or guardians of each child were informed about the screening using a printed brochure prior to the screening. Ethical committee approval for retrospectively analyzing the stored screening data was obtained. This screening was done between 24 and 48 hours of life. For babies going home on early discharge (discharge before 24 hours), the hearing screening was performed prior to discharge.

The hospital electronic, clinical database was searched for all newborn hearing screenings performed since commencement of the screening programme. Medical records were searched if further

information was needed. Information was collected on hearing screening, follow up details and after care for those who failed the test. We calculated the sensitivity, specificity, positive and negative predictive values, and a false positive rate.

## Results

There were a total of 30,600 babies born after 35 weeks in the study period. Of these, 28,779 babies had newborn hearing screening performed. Of the 21 babies not screened, 17 declined consent & 2 didn't get screened when our equipment needed to be re-calibrated – despite our repeated efforts they didn't return for the screening. Screening was missed in further 2 babies (performed but not recorded). Of the 28,77 babies screened, 75 neonates failed screening - a thorough clinical examination by the neonatologists revealed that 58 babies had a false positive result and passed the test after a week and 17 babies were investigated with an audiogram by a Paediatric Audiologist and 8 out of those fifteen infants had hearing difficulties requiring treatment by an ENT Surgeon.

## Discussion

We have looked at our experience over the last 9 years and we strongly feel newborn hearing screening is a cost effective public preventive programme that should be implemented all across the world especially in India, since it alleviates lot of morbidity.<sup>11</sup> We have tried to analyse the cost benefit ratio by doing the following analysis:

### Staffing and equipment cost

This was implemented in our services with the need for one additional nursing staff. The equipment costs around 2.5 lakh rupees or 5.3 lakh rupees depending upon one would use OAE or BERA for screening programme. The total cost to be invested is around Rs. 3,00,000 per 2 years – and even if it is charged at Rs. 200 per baby (less than \$3 per baby) - the cost will be "recovered" with 1,600 deliveries! More deliveries the cost should/could be lower. If the same equipment is shared between 2 or 3 hospitals, along with the staff, it could be even more beneficial cost wise.

### False positive rates

The main concern is of 'false positive' tests which can have some undesired effects and anxiety among family members. The false positive rate can be decreased significantly if one uses BERA instead of OAE. In our study and in the rest of the literature, false positive was extremely low (0.2% i.e., 58/28,779).

### Lack of availability of expertise

If the testing and the clinical pointers are towards deafness or no other cause can be found, then a referral for ENT Surgeon who is experienced in investigating such babies will be requested. At our hospital, we have facilities for paediatric ENT services with less than 4 hours notice.

### Workload

This was a concern when we first implemented, and for this reason, we incorporated screening into the routine newborn examination and employed one dedicated paediatric nurse to do the test. But this nurse does BCG vaccination along with blood tests required for the babies at discharge. Once the benefits were seen, there was quick acceptance amongst the staff & obstetricians regarding the value of this test, and this played an important role in promotion of the test.

## Cross-infection risk

We adopted a pragmatic approach with re-useable probes and cleaning between patients. The cost is a fraction of what it would be to use disposable probes. There were no cross-infection issues that we were aware of during or since the period of this review.

## Discharge delay

This has not been a concern in our service because the screening was incorporated seamlessly into our baby checks & BCG vaccination after 24 hours. This will clearly vary between services depending on the availability of nursing staff and may be a barrier to newborn hearing screening. The optimal timing of screening remains a controversy. Earlier screening (<24h) results in more false positives, but many of these are important to avoid anxiety among parents and relatives. A late screening results in a lower false positive and may be more accurate for diagnosis of hearing problems.

## Conclusion

This post-implementation review shows that newborn hearing screening can be introduced into Indian practice with minimal cost and minimal extra burden to ENT services. Our findings mirror those in the rest of the literature with cases of major deafness that might have been missed, being diagnosed prior to discharge. The ‘false positive’ rate is extremely low, but the term ‘false positive’ is a misnomer in this context as over half of these babies had some other pathology. This screening practice should be seen as a test of neonatal well-being not just for hearing difficulties and should become a standard of care in India, there is no reason why this cannot be done?

Without Universal Newborn Hearing Screening (UNHS), infants with hearing loss are typically identified with an established language delay. The average age at the time of diagnosis in unscreened children is 24 months, whereas mild to moderate hearing deficits may be undiagnosed until school age.<sup>12</sup> In screened population the time of diagnosis is much earlier with an average of 3 months, and allowing intervention by the age of 6 months.<sup>12,13</sup>

In two systematic reviews,<sup>13,14</sup> there was sufficient evidence to conclude that infants who are screened are identified earlier and receive intervention earlier. Updated evidence from multiple studies<sup>13–17</sup> now indicate that infants who are diagnosed and receive intervention before six months of age score 20 to 40 percentile points higher on school-related measures (language, social adjustment and behaviour) compared with hearing-impaired children who receive intervention later on.<sup>13</sup>

## In fact, WHO in its report in 2010 said

There is lack of epidemiological data in most countries? The prevalence of the problem should be assessed in various age groups (neonates if appropriate audiological services available), in urban and rural communities, and in communities with special needs. Universal neonatal hearing screening is recommended and a policy of universal neonatal screening is adopted in all countries and communities with available rehabilitation services and that the policy be extended to other countries and communities as rehabilitation services are established<sup>11</sup> and it is high time all countries including India make it mandatory for this screening which is so cost effective.

## Acknowledgements

None.

## Conflict of interest

Author declares that there is no conflict of interest.

## References

- Mehra S, Eavey RD, Keamy DG. The epidemiology of hearing impairment in the United States: newborns, children, and adolescents. *Otolaryngol Head Neck Surg.* 2009;140(4):461–472.
- Stach BA, Ramachandran VS. Hearing disorders in children. In: Madell JR, Flexer C, editors. *Pediatric Audiology: Diagnosis, Technology, and Management.* New York: Thieme Medical Publishers Inc; 2008. p. 3–12.
- Mason JA, Herrmann KR. Universal infant hearing screening by automated auditory brainstem response measurement. *Pediatrics.* 1998;101(2):221–228.
- Fisher DA, Dussault JH, Foley TP, et al. Screening for congenital hypothyroidism: results of screening one million North American infants. *J Pediatr.* 1979;94(5):700–705.
- Bickel H, Bachmann C, Beckers R, et al. Neonatal mass screening for metabolic disorders: summary of recent sessions of the committee of experts to study inborn metabolic diseases. *European Journal of Pediatrics.* 1981;137:133–139.
- Sanders R, Durieux-Smith A, Hyde M, et al. Incidence of hearing loss in high risk and intensive care nursery infants. *J Otolaryngol Suppl.* 1985;14:28–33.
- Joint Committee on Infant Hearing. Joint Committee on Infant Hearing (JICH) 1994 Position Statement. *Pediatrics.* 1994;95:152–156.
- Maxon AB, White KR, Behrens TR, et al. Referral rates and cost efficiency in a universal newborn hearing screening program using transient evoked otoacoustic emissions. *J Am Acad Audiol.* 1995;6:271–277.
- Iwasaki S, Hayashi Y, Seki A, et al. A model of two-stage newborn hearing screening with automated auditory brainstem response. *Int J Pediatr Otorhinolaryngol.* 2003;67(10):1099–1104.
- Cebulla M, Shehata-Dieler W. ABR-based newborn hearing screening with MB11 BERAphone® using an optimized chirp for acoustical stimulation. *Int J Pediatr Otorhinolaryngol.* 2012;76(4):536–543.
- Newborn and infant hearing screening. Current issues and guiding principles for action. Geneva: World Health Organization. World Health Organization. Outcome of A Who Informal Consultation Held At Who Headquarters, Geneva, Switzerland; 2010:9–10.
- Durieux-Smith A, Fitzpatrick E, Whittingham J. Universal newborn hearing screening: A question of evidence. *Int J Audiol.* 2008;47(1):1–10.
- 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–e276.
- American Academy of Pediatrics, Joint Committee on Infant Hearing. Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. *Pediatrics.* 2007;120(4):898–921.
- Korver AM, Konings S, Dekker FW, et al. Newborn hearing screening vs. later hearing screening and developmental outcomes in children with permanent childhood hearing impairment. *JAMA.* 2010;304(15):1701–1708.
- McCann DC, Worsfold S, Law CM, et al. Reading and communication skills after universal newborn hearing screening for permanent childhood hearing loss. *Arch Dis Child.* 2009;94(4):293–297.
- Yoshinaga-Itano C, Coulter D, Thomson V. The Colorado Newborn Hearing Screening Project: Effects on speech and language development for children with hearing loss. *J Perinatol.* 2000;20(8 Pt 2):S132–S137.