Hospital-Based Newborn Hearing Screening Across the Globe: A Systematic Review and Preliminary Report on Guatemala's Program

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Abstract

3 out of every 1000 children is born with a hearing loss. Both hearing screening and intervention services have a significant positive impact on these children. The current study focuses on newborn hearing screening (NHS) services. Hospital staff typically use otoacoustic emissions (OAEs) or automated Auditory Brainstem Response (AABR) for screening. If referred after screening, the child will go through a diagnostic ABR, which requires interpretation by an audiologist or equivalent professional. The specific screening protocol prior to this last step differs across programs. There are two objectives to this study.

1. Systematic Review: To identify and examine the reported outcomes of hospital-based newborn hearing screening (NHS) programs. Factors and outcomes included:
   - Coverage rates
   - Referral rates
   - Loss to follow up (LTF) rates
   - Birth Screening Performance Index (BSPI)
   - Screening protocol (OAE-only, AABR-only, two-tier, or two technology)
2. Guatemala NHS Program: To examine outcomes relative to the systematic review results.

Systematic Review

Eligible studies published in English up to February 2019 were identified through searches of PubMed (NCBI), the Cochrane Library, ASHA Wire and relevant article reference lists. The data were screened using pre-defined inclusion and exclusion criteria to generate a list of eligible articles. Data extracted included screening protocol, coverage rate, referral rate, LTF rate, and number of newborns identified with permanent congenital hearing loss (PCHL).

45 articles were included for data extraction and analysis. Screening protocol and type of equipment in general play a role in referral rates and the Birth Screening Performance Index. Many factors affect coverage rates and lost to follow up rates (see below). ABR was found to be a more expensive method compared to OAEs but some studies also found ABR was a more sensitive measure when used within the first 24 hours of life.

Two studies used an OAEs-only protocol and were located in the Region of the Americas, similar to the Guatemala NHS program. Below are their specific results along with the average from all studies in the systematic review.

Location	Number of Screening Stages	BSPI (%)	Coverage Rate (%)	Referral Rate (%)	LTF Rate (%)	Prevalence of PCHL (%)
Brazil	2	92.28	90.52	3.33	19.75	0.09
Colombia	2	98.45	99.88	0.29	49.68	0.09
Average	2	91.99	95.53	2.80	13.97	0.39

Methods and Materials

Data from Guatemala were collected from January 2018 to March 2019 from five sites across the country. The program employed two different hearing screening protocols based on whether a newborn was classified as "No Risk" or "High Risk" for hearing loss (see below for risk factors). High Risk newborns received an immediate referral for a diagnostic ABR after one failed screening. No Risk newborns received two screenings before a diagnostic ABR. Both protocols used OAEs for screening, though the ABR machine was shared amongst the sites and used for automated ABR (AABR) screening instead of OAEs whenever possible. Data from the program are included in Figure 1.

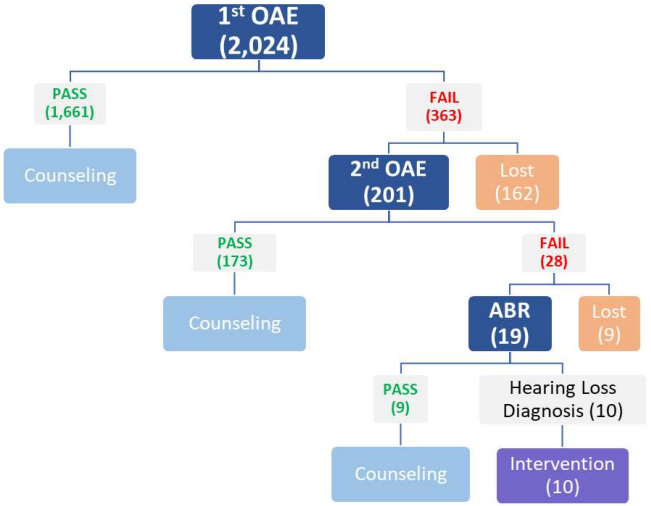
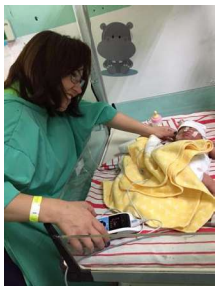
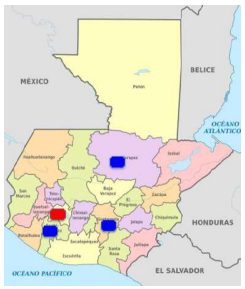


Figure 1. Guatemala Newborn Hearing Screening Program Outcomes

Guatemala Results

- 2,024 newborns in total were screened.
- The overall referral rate of 1.50%, which is near the average from the systematic review.
- 170 newborns (8.40%) were lost to follow-up. This is below the average for all programs in the systematic review (13. 97%) and significantly below the rates for all included countries in the same region of the world (18.89%).
- Ten newborns were identified with permanent congenital hearing loss (prevalence of 4.9:1000).
- Three had a severe hearing loss and six had profound hearing loss. These nine were fitted bilaterally with hearing aids. One newborn was identified with bilateral microtia and was fit with a bone conduction sound processor.





Discussion

Multiple barriers and challenges occurred during the implementation of the Guatemala NHS program. These factors affected all outcomes. The challenges generally fit into three categories;

1. The institutions where screenings are performed
2. Family factors
3. The screening process

For example, some hospitals were interested in screening High Risk babies only. Some newborns left the hospital less than 24 hours after birth. In cases where a second screen was required, the logistics for reaching families in distant regions was difficult. Particularly in small villages and indigenous communities, most families do not have a mailing address. There was also a learning curve for technicians to use the screening equipment proficiently. When the technicians mastered the technique, the first screening referral rate significantly decreased from 24.47% to 17.93%.

In the future, the program in Guatemala is looking to provide hearing screening in new locations across the country. Training has started for two audiology technicians for the Petén region in the north and two for Izabal in the far east. To implement the program in Izabal, they are in the process of purchasing another OAE device, which should arrive within May 2019.

Conclusions

The systematic review identified coverage rates, referral rates, LTF rates and the BSPI in hospital-based universal NHS programs.

The NHS program in Guatemala is new and quickly expanding across the country. The rate of PCHL requiring amplification in the group of newborns screened is 10/2024 (0.49%). Coverage, referral and loss to follow rates show that a universal NHS program in Guatemala is feasible, and the preliminary results are in line with other programs across the globe. Measures to expand the program should continue.

List of Hearing Loss Risk Factors In Guatemala Protocol

- Low birth weight (14%)
- Prematurity (11%)
- Any exposure to ototoxic medications (5%)
- Use of mechanical ventilation (5%)
- Jaundice (3%)
- Asphyxia (1%)
- Time in an incubator (1%)
- Other factors - family history of hearing loss, syndromes, head/neck abnormalities (0.3%)

Factors that Affected NHS Outcomes

1. Educational disparities and lack of knowledge among parents
2. Distance
3. Work constraints
4. Unfavorable attitudes
5. Less priority given to hearing compared to other medical conditions by parents
6. Rescreened at some other center
7. Inaccurate contact details
8. Change of address
9. Superstitious and cultural beliefs
10. Barriers to adequate healthcare
11. Financial constraints
12. Lack of health insurance
13. Forgot to keep an appointment
14. Lack of schedule a follow-up appointment
15. Lack of understanding of results
16. Parental refusal
17. Lack of service provider's knowledge
18. Overburdened nursing staff used as a screener
19. Lack of family support
20. Lack of service system capacity
21. Communication failure, socio-economic barriers, lack of parental reminders
22. Incomplete test reports
23. Short time to implement NHS
24. Early discharge
25. Screening staff on leave
26. Reduced maternal education
27. Anxiety

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References

See paper for full list of references