Early Identification of Sensorineural Hearing Loss in a Neonate via Universal Screening : A Case Report as a Catalyst for State-Level Programmatic Change

Dr. Abraham .K. Paul[1]
Indira Gandhi Co-operative Hospital Kochi – 682020 , and
Convenor, Newborn hearing screening programme, IAP Kerala.

Address for correspondence
Dr. Abraham .K. Paul Senior Consultant Pediatrician & HOD Indira Gandhi Co-operative Hospital Kochi – 682020, and Convenor, Newborn hearing screening programme, IAP Kerala.
email : abrahamkpaul@gmail.com

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Abstract

Introduction:

Hearing impairment is one of the most common congenital conditions, yet early identification remains a challenge in low-resource settings.

Case summary:

We present a case from January 2003, during an early institutional attempt at newborn hearing screening, in which a neonate with moderate-to-severe bilateral sensorineural hearing loss was successfully diagnosed by Otoocoustic emission(OAE) screening and subsequently confirmed by Auditory Brainstem response (ABR) and rehabilitated by 6 months of age. The outcome—age-appropriate speech development and successful mainstream schooling—provided compelling momentum for scaling up district-wide screening initiatives.

Conclusion:

This report highlights the utility of OAE and ABR-based protocols in influencing health system planning and emphasizes the need for robust public health strategies to implement universal newborn screening in resource-constrained contexts. It documents how that clinical milestone inspired the Indian Academy of Pediatrics (IAP) Cochin Branch to spearhead a scalable model that evolved into a state-wide initiative by 2020. The Kerala experience offers a replicable pathway for other regions aiming to implement UNHS aligned with SDG 3.2.

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Keywords:

- Newborn Hearing Screening
- Public Health Implementation
- Kerala Model
- Universal Screening
- Pediatric Audiology

Background :

At the time of this case, newborn hearing screening was virtually non-existent in many Indian healthcare settings, with limited awareness among professionals and policy makers. There was minimal published evidence locally, and structured protocols for early detection and intervention were not in place.

Case Presentation:

Between January and March 2003, during a pilot phase of institutional newborn hearing screening in a tertiary care setting with low baseline awareness and no prior implementation protocol, 504 neonates were screened using universal otoacoustic emission (OAE).

Out of the screened cohort, one neonate failed the initial OAE test in both ears. This child also presented with significant neonatal hyperbilirubinemia, a known risk factor for auditory dysfunction.

Investigations:

The infant underwent initial otoacoustic emission (OAE) screening, which failed in both ears, prompting further evaluation. Auditory Brainstem Response (ABR) testing subsequently confirmed the presence of bilateral sensorineural hearing loss. Comprehensive assessments were conducted, including consultations with ENT specialists and pediatric neurology. A CT scan of the brain yielded normal results. However, genetic testing was not available at the time and could not be performed.

Treatment

- Early amplification with bilateral hearing aids
- Enrolment in a structured auditory-verbal therapy program
- Family counselling and speech-language follow-up

Differential Diagnosis

The following differentials were considered:

- Auditory Neuropathy Spectrum Disorder (ANSD) Given the association with hyperbilirubinemia, ANSD was a plausible consideration. However, consistent ABR findings and good response to amplification reduced its likelihood.
- Syndromic Hearing Loss Syndromes such as Jervell-Lange-Nielsen or Usher syndrome were considered, but there were no dysmorphic features or systemic abnormalities identified.
- Hyperbilirubinemia-Induced Auditory Toxicity Direct bilirubin toxicity affecting the auditory nerve or brainstem was considered the most probable etiology in the context of elevated bilirubin levels and absence of other systemic involvement.
- Genetic Non-Syndromic Sensorineural Hearing Loss Could not be ruled out due to the lack of genetic testing; however, the timing and severity aligned more closely with the clinical picture of bilirubin-induced damage.

Outcome and Follow-Up

The infant demonstrated:

- Age-appropriate auditory and speech-language development within expected milestones
- Effective use of hearing aids with regular audiological follow-up
- Normal cognitive and social development, leading to integration in mainstream schooling
- No signs of regression or additional disability through early childhood and school entry
- Parental support and early intervention services were pivotal in ensuring optimal rehabilitation and long-term functional outcomes.

This experience set the foundation to ponder implementation enablers—like responsive leadership, clinical vigilance, and the power of single-case advocacy—to build systemic newborn screening programs.

Discussion

This case underscores how one early success in newborn hearing screening within a resource-limited setting can serve as a policy lever. It served as a compelling "proof of concept," prompting clinicians and policymakers to ask: What if we could extend this benefit to every child born in Kerala?

a) **Building the Statewide NBHSP**

Phased Implementation

Phase	Timeframe	Coverage	Highlights
I: City Pilot	2003–2014	31 → 91 hospitals in Ernakulam	Coordinated by IAP Cochin Branch
II: State Rollout	2014–2020	516 hospitals (84 govt, 432 private)	Kerala declared "Hearing Friendly"

Screening Protocol

1. **OAE Screening**: For all newborns before discharge
2. **ABR Audiometry**: For NICU babies and those failing OAE twice (4-week interval)

b) **Stakeholder Engagement and Resource Optimization**

- *Partners:* IAP district branches, private audiology firms, hospital administrators
- *Strategies:*
  - Sharing portable OAE devices among facilities
  - Audiology services outsourced or pooled through regional hubs

- IAP-led procurement and training

- *Incentive:* Districts declared "Hearing Friendly" upon full compliance

c) **Outcomes**

Expansion timeline

- 2014: Ernakulam became first "Hearing Friendly" district
- 2020: All 14 districts onboarded; Wayanad was the final district to comply
- 516 facilities: Implemented screening before newborn discharge
- Universal ABR for NICU neonates: Enhanced detection of auditory neuropathy

Impact Snapshot:

Table 2: Screening coverage

Indicator	Outcome
Coverage	100% facility-level implementation statewide
Detection	High-risk infants diagnosed before 3 months
Intervention	Hearing aids fitted within therapeutic window
Systemic change	Proof-of-concept case → Full-state policy shift

d) **Key Insights**

The implementation of Kerala's statewide newborn hearing screening program was notably influenced by a single sentinel case that demonstrated the transformative impact of early identification and intervention. This case served as a powerful catalyst for broader systems change, illustrating how targeted clinical evidence can drive policy decisions when strategically leveraged.

Centralized coordination emerged as a vital enabler, allowing efficient resource allocation, streamlined training, and scalable implementation across public and private health facilities. By minimizing redundancy and maximizing cost-sharing, this approach ensured sustainability and uniform service delivery.

Collaboration between government entities, professional associations like the Indian Academy of Pediatrics, and private audiology providers proved essential. These partnerships extended service reach, particularly in underserved and resource-constrained areas, reinforcing the equity goals of the program.

Furthermore, the adoption of district-wise milestones created a sense of accountability and momentum. Declaring districts as "Hearing Friendly" only after achieving full implementation galvanized local health systems and encouraged structured, phased adoption throughout the state.

Comparison to Global Practices

Region	UNHS Implementation	Kerala's Approach
High-Income Countries	Since 1999	Tech-intensive, insurance-funded
Kerala	Since 2003 (full by 2020)	Cost-shared, centrally coordinated, policy-integrated

e) **Policy Implications and Future Directions**

- National Scaling Potential: Through IAP regional chapters and RBSK integration
- SDG 3.2 Alignment: Advances early diagnosis, inclusive education, and equity in child health
- Replicability Framework:
  - Case-based advocacy → Clinical piloting
  - Multi-stakeholder platform → District accountability
  - Monitoring & IEC → Community ownership

Conclusion

Kerala's newborn hearing screening journey—from a single success story in 2003 to a statewide movement by 2020—demonstrates how clinical data can be transformed into public health action. With clear stakeholder coordination, context-sensitive design, and policy anchoring, universal newborn hearing screening is not only feasible but scalable—even in resource-limited settings

Key points:

Proof of concept: Identification of hearing loss before 2 months of age, with intervention by 6 months, mirrored outcomes seen in high-income settings—normal communication and learning outcomes.

Role of hyperbilirubinemia: Reinforces its

significance as a red flag for auditory follow-up, aligning with global Joint Committee on Infant Hearing (JCIH) guidelines.

Low yield but high impact: Despite identifying only one case in 504, the life-changing impact on that child served as a powerful advocacy example.

Programmatic momentum: This case was pivotal in initiating advocacy for district-level adoption of Universal Newborn Hearing Screening (UNHS), supported by Health system stakeholders, Pediatric and audiology communities, and Community sensitization efforts

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Conflict of interest statement

"None declared."

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