



## **Summary: Hearing Screening**

### **India**

### **Produced as part of Work Package 4**

**Date: 2019-06-20**

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**Disclaimer:** This is a summary report representing the responses from a screening expert working within hearing care services of the country or region reported. This report is the product of professional research conducted for the EUSCREEN study and does not represent conclusions made by the authors. It is not meant to represent the position or opinions of the EUSCREEN study or its Partners. Efforts were made to cross-check the information supplied; however, not all information supplied is fully verified by the authors.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 733352

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## 1. Glossary of Terms: Hearing Screening

|  |   |
|--|---|
| <b>Abnormal test result</b>                  | A test result where a normal “pass” response could not be detected under good conditions. The result on screening equipment may indicate “no response,” “fail,” or “refer.”   |
| <b>Attendance rate</b>                       | <p>The proportion of all those <u>invited for screening</u> that are <u>tested and receive a result</u>,</p> <ul style="list-style-type: none"> <li>• <u>Invited for screening</u> includes all those that are offered the screening test.</li> <li>• <u>Tested and receive a result</u> could be a “pass” or “fail”.</li> </ul> <p>Attendance rate provides information on the willingness of families to participate in screening.</p>  |
| <b>Attendance rate in first year of life</b> | <p>See definition of <b>Attendance rate</b>.</p> <p>The calculation cut-off is after <u>one year of life</u>.</p>   |
| <b>Compliance with referral (percentage)</b> | <p>The percentage of those who are <u>referred from screening</u> to a diagnostic assessment that actually <u>attend</u> the first diagnostic assessment.</p> <p>Percentage of compliance provides information on the willingness of families to attend the diagnostic assessment after referral from screening.</p>  |
| <b>Coverage</b>                              | <p>The proportion of those <u>eligible for screening</u> that are <u>tested and receive a result</u> within a <u>specific time</u>.</p> <ul style="list-style-type: none"> <li>• <u>Eligible for screening</u> includes those within the population that are covered under the screening or health care program.</li> <li>• <u>Tested and receive a result</u> could be a “pass” or “refer to diagnostic assessment”.</li> <li>• <u>Specific time</u> can be defined, such as 1 month after birth, 3 months after birth, etc.</li> </ul> <p>Coverage provides information on the overall effectiveness and timeliness of a complete screening programme.</p> <p>Factors such as being offered screening, willingness to participate, missed screening, ability to complete the screen, and ability to document the screening results will influence the coverage.</p> |
| <b>Coverage in first year of life</b>        | <p>See definition of <b>Coverage</b>.</p> <p>The <u>specific time</u> is pre-defined as within the first year of life.</p> <p>In other words, the coverage is the proportion of those eligible for screening that complete the screening sequence to a final result within the first year of life.</p>  |
| <b>False negatives</b>                       | The percentage of <u>infants/children with a hearing loss</u> (defined by the target condition) that <u>receive a result of “pass”</u> during screening.  |



|   |  |
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|   | Example: If 100 infants with hearing loss are screened, and 1 infant passes the screening, the percentage of false negatives is 1%.  |
| <b>False positives</b>                    | <p>The percentage of <u>infants/children with normal hearing</u> that <u>receive a result of “fail”</u> from the final screening test.</p> <p>Example: If 100 infants with normal hearing are screened, and 3 infants fail the screening and are referred for diagnostic assessment, the percentage of false positives is 3%.</p>  |
| <b>Guidelines</b>                         | Recommendations or instructions provided by an authoritative body on the practice of screening in the country or region.   |
| <b>Hearing screening professional</b>     | A person qualified to perform hearing screening, according to the practice in your country or region.  |
| <b>Inconclusive test result</b>           | A test result where a normal “pass” response could not be detected due to poor test conditions.  |
| <b>Invited for screening</b>              | Offered screening.   |
| <b>Outcome of hearing screening</b>       | An indication of the effectiveness or performance of screening, such as a measurement of coverage rate, referral rate, number of infants detected, etc.  |
| <b>Permanent hearing loss</b>             | <p>A hearing impairment that is <i>not</i> due to a temporary or transient condition such as middle ear fluid.</p> <p>Permanent hearing loss can be either sensorineural or permanent conductive.</p>  |
| <b>Positive predictive value</b>          | <p>The percentage of infants/children referred from screening who have a confirmed <u>hearing loss</u>, as described by your protocol or guideline and indicated in the <b>Target Condition</b> (see definition).</p> <p>For example, if 100 babies are referred from screening for diagnostic assessment and 90 have normal hearing while 10 have a confirmed hearing loss, the positive predictive value would be 10%.</p> |
| <b>Preschool or (pre)school children</b>  | All children between 3-6 years of age.   |
| <b>Preschool or (pre)school screening</b> | <p>Screening that takes place during the time children are between 3-6 years of age.</p> <p>This refers to <i>any</i> hearing screening during this age. The location of the screening is irrelevant to the definition.</p>  |



|                                     |   |
|-------------------------------------|---|
| <b>Prevalence</b>                   | The number or percentage of individuals with a specific disease or condition. Prevalence can either be expressed as a percentage, proportion, or as the value per 1000 individuals within the same demographic.   |
| <b>Programme</b>                    | An organized system for screening, which could be based nationally, regionally or locally.  |
| <b>Protocol</b>                     | Documented procedure or sequence for screening, which could include which tests are performed, when tests are performed, procedures for passing and referring, and so forth.  |
| <b>Quality assurance</b>            | A method for checking and ensuring that screening is functioning adequately and meeting set goals and benchmarks.   |
| <b>Referral criteria</b>            | <p>A pre-determined cut-off boundary for when an infant/child should be re-tested or seen for a diagnostic assessment.</p> <p>For example, referral criteria may be “no response” at 35 dB nHL.</p>   |
| <b>Risk babies / Babies at-risk</b> | <p>All infants that are considered to be at-risk or have risk-factors for hearing loss according to the screening programme.</p> <p>Two common risk factors are admission to the neonatal-intensive care unit (NICU) or born prematurely. However, other risk factors for hearing loss may also be indicated in the screening programme.</p>  |
| <b>Sensitivity</b>                  | <p>The percentage of infants/children with hearing loss that are identified via the screening program.</p> <p>For example, if 100 babies with hearing loss are tested, and 98 of these babies are referred for diagnostic assessment while 2 pass the screening, the sensitivity is 98%.</p>  |
| <b>Specificity</b>                  | <p>The percentage of infants/children with normal hearing that pass the screening.</p> <p>For example, if 100 babies with normal hearing are tested, and 10 of these babies are referred for diagnostic assessment and 90 pass the screening, the specificity is 90%.</p>   |
| <b>Target condition</b>             | <p>The hearing loss condition you are aiming to detect via your screening programme. This includes:</p> <ul style="list-style-type: none"> <li>• The <u>laterality of the condition</u>, whether the program aims to detect both unilateral and bilateral hearing loss or just bilateral hearing loss.</li> <li>• The <u>severity of the condition</u>, whether the program aims to detect hearing loss <math>\geq 30</math> dB HL, <math>\geq 35</math> dB HL, <math>\geq 40</math> dB HL or <math>\geq 45</math> dB HL</li> </ul> |
| <b>Well, healthy babies</b>         | <p>Infants who are <i>not</i> admitted into the NICU or born prematurely.</p> <p>Well, healthy babies may or may not have additional risk factors for hearing loss, according to the procedures indicated in the specific screening programme.</p>  |



## **2. Abbreviations**

ABR – auditory brainstem response

aABR – automatic auditory brainstem response

ANSD – auditory neuropathy spectrum disorder

ASSR – auditory steady-state response

CI – cochlear implant

CMV – cytomegalovirus

dB HL – decibel hearing level

dB nHL – decibel normalized hearing level

dB SNR – decibel signal-to-noise ratio

DPOAE – distortion product otoacoustic emissions

HA – hearing aid

NICU – neonatal intensive care unit

OAE – otoacoustic emissions

TEOAE – transient-evoked otoacoustic emissions



### 3. Background

In India, hearing screening is performed regionally, but according to the national guideline. The following report contains information with regards to childhood hearing screening across [India](#).

#### 3.1. General

India has a total area of 3 287 469 km<sup>2</sup> with an estimated population of 1 298 041 000 in 2018.

In India, all births are registered to the National Portal of India Birth Registry. The number of live births in India is 27 million births per year.

The World Bank income classification categorizes India as a lower middle-income country (The World Bank, 2018). The gross domestic product (GDP) in 2018 was an estimated €1 800 per capita in India.

From the World Health Organization (WHO) Global Health Expenditure Database, health expenditure for India in 2015 was 59 USD or €53 per capita (World Health Organization (WHO), 2018).

An infant mortality rate of 37 per 1000 is reported for India in 2015 (United Nations Statistics Division, 2016).

#### 3.2. Neonatal hearing screening

In India, neonatal hearing screening is conducted locally and often selectively, with variation across the country in how screening is implemented. In some jurisdictions, screening is only performed on babies who show risk factors. In private healthcare sector, screening could be carried out universally. Participation is not obligatory for parents. Because of the diversity of programmes across the country, neonatal hearing screening may be funded by parents, charity, companies, health insurance, council, municipalities, employers, states/provinces, and the government of India.

A national programme for the prevention of deafness, including neonatal hearing screening, was launched in 2006 with a plan for scale-up; however, hearing screening it is not yet available across the entire country. The national programme to date is to build the infrastructure for future screening.

#### 3.3. Preschool hearing screening

Preschool hearing screening falls under the National Programme of Deafness in India; however, no routine screening is performed. As of December 2016, 335 screening camps have been performed in some states. During camps, all children (and adults) of any age are invited for routine testing, including hearing screening. In these camps, hearing screening is embedded in Preventive Child Health Care screening. When a child is suspected to have hearing loss, a referral is made to a hospital, and intervention, when warranted, is provided to children under 15 years of age under the National Programme.

In other areas, children are referred to ENT specialists if there are indications or a suspicion of hearing loss.

Because of the variability in care, preschool hearing screening may be funded by parents, charity, companies, health insurance, council, municipalities, employers, states/provinces, and the government of India.



#### **4. Guidelines & Quality Control**

There is a national guideline for the building infrastructure for hearing screening in India (Ministry of Health and Welfare, 2016). The guideline covers aspect such as training, procurement of equipment, recruitment of manpower, and provision of free hearing aids. A consensus document on newborn screening has also been published by experts in the field (Paul, et al., 2017); however, there is currently no universal protocol followed for performing neonatal hearing screening.

The content of the national guideline was decided on by the technical committee of the Government of India. It has not been revised since implementation, and no information is available on how revisions would take place or be funded.

Quality assurance is imposed by the government via audits of services when performed. There is no information as to whether annual reports are available.

Data are unavailable as to whether research has been performed on the national neonatal hearing screening programme. Some studies have been performed on local screening programmes, as reviewed by Ramkumar (2017). There have not been studies published on the effectiveness of hearing screening in India.



## **5. Screening – Diagnosis – Intervention process**

### **5.1. Neonatal hearing screening**

Well and at-risk babies may be screened in the hospital, child health clinic, private clinic, or school. At-risk infants may also be screened in the NICU. Data are not available regarding the percentage of infants born in maternity hospitals, nor the average length of stay in a maternity hospital after birth.

Hearing screening protocols are not identical across all of India. Data are not available regarding how the protocol varies across the country. Data are not available regarding the differences in well or risk babies. Data are not available regarding whether there are differences in protocols between groups of infants. Data are not available regarding the prevalence of CMV or meningitis among infants or children in India.

The goal is that hearing screening should be completed within 3 months after birth, for both well and at-risk infants.

### **5.2. Neonatal diagnostic assessment**

Currently, diagnostic assessment referral is typically completed around 2 years of age when a suspicion of hearing loss is noted, unless a syndrome or other factor indicates deafness earlier. However, the goal is to diagnose infants by 6 months of age.

### **5.3. Preschool hearing screening**

Data are not available regarding the protocol of preschool hearing screening or differences across regions. Data are not available regarding the target condition.

### **5.4. Intervention approach**

In India, treatment options available include grommets, hearing aids or cochlear implants. The goal of intervention is to fit hearing aids from 6-12 months of age or older and with cochlear implants from <6 months of age or older depending on the extent and severity of deafness. However, given the age at which most children are identified, the age of fitting/implantation is much older. The goal of the national programme is to initiate rehabilitation by 9 months of age.

Hearing aid fitting criteria is a hearing loss of greater than 40 dB HL.



## 6. Protocols

Hearing screening protocols are described for neonatal hearing screening (well and at-risk) as well as for preschool hearing screening when applicable.

- The Test performed is the screening technique used
- The Age of the child is indicated in hours, days, months or years
- Referral criteria may be the lack of an OAE response at specified frequencies, a response-waveform repeatability constant, the absence of an aABR response at a specified intensity, or an absent behavioural response at a specified intensity. Referral criteria may be defined within a protocol or limited based on the device used.
- The Device is the screening device used.
- Unilateral Referrals indicates whether children are referred if only one ear fails screening.
- The Location is where the screening takes place

### 6.1. Neonatal hearing screening (well)

There is no single sequence of screening for neonates in India.

### 6.2. Neonatal hearing screening (at-risk)

There is no single sequence of screening for at-risk neonates in India.

### 6.3. Preschool hearing screening

There is no single sequence of screening for preschool-age children in India.



## **7. Professionals**

### **7.1. Neonatal hearing screening (well)**

Neonatal hearing screening when performed is done by ENT physicians or audiologists.

Training is part of the 3-year education for an ENT physician or audiologist.

### **7.2. Neonatal hearing screening (at-risk)**

Screening for at-risk (NICU) infants when performed is done by ENT physicians or audiologists. See 7.1 for details on training.

### **7.3. Preschool hearing screening**

Preschool hearing screening when performed is done by ENT physicians or audiologists.



## **8. Results: Neonatal Hearing Screening**

### **8.1. Coverage and attendance rates**

No data are available.

### **8.2. Referral rates**

No data are available.

### **8.3. Diagnostic assessment attendance**

No data are available.

### **8.4. Prevalence / Diagnosis**

It is indicated that the prevalence of deafness (all ages, all hearing loss) in Southeast Asia is 4.6 to 8.8%.

For school-age children, Sapra et al. (2015) found that 0.508% were identified with sensorineural hearing loss out of a population of 1500 children between 6 to 12 years of age screened for hearing loss.

Vignesh, Jaya, and Muraleedharan (2016) indicated that 8.26% of children referred for diagnostic assessment with suspicion of hearing impairment were diagnosed with a sensorineural hearing loss. Out of these infants with confirmed sensorineural hearing loss, 5.06% were diagnosed with bilateral or unilateral auditory neuropathy spectrum disorder.

No other data are available.

### **8.5. Treatment success**

No data are available. However, the Ministry of Health indicates that at least 6380 hearing aids were distributed by the Ministry of Health in 2016 to children and adolescents in India.

### **8.6. Screening evaluation**

No data are available.



## **9. Results: Preschool Hearing Screening**

### **9.1. Coverage and attendance rates**

Not applicable.

### **9.2. Referral rates**

Not applicable.

### **9.3. Diagnostic assessment attendance**

Not applicable.

### **9.4. Screening evaluation**

Not applicable.



## **10. Costs: Neonatal Hearing Screening**

It is the Government of India's initiative that screening will be free of charge for parents; however, currently screening is at a cost to parents in the private sector. There is no financial reward when parents attend hearing screening, nor is there a penalty for those who do not attend hearing screening.

There has not been a cost-effectiveness analysis performed on neonatal hearing screening in India.

### **10.1. Screening costs**

The total or per-child costs for the neonatal hearing screening program is unknown.

### **10.2. Equipment costs**

The cost of a portable OAE device is 3500 USD (€3097). The annual cost for calibration of equipment is not known, nor are the costs for disposables.

### **10.3. Staff costs**

Staff costs for training and subsequent employment are under the umbrella of the National Programme for Prevention and Control of Deafness to empower the human resource infrastructure required for implementation of a neonatal screening programme in the future.

### **10.4. Diagnostic costs**

The total cost of diagnostic confirmation is not indicated.

### **10.5. Amplification costs**

In India, not all children with hearing loss are offered invention. This is due to capacity problems, payment problems, and access. In other words, parents may not reach the proper facilities.

The cost for a hearing aid in the first year is approximately €128 after receiving subsidy from the government. The cost for each subsequent year is €64 after subsidies. For cochlear implant treatment, the cost for the first year and each subsequent year is approximately €6 379 and €2 552, respectively. These costs are after subsidization from the government.

### **10.6. Social costs**

Data are not available regarding special schools for the deaf and hard of hearing in India. Data are not available regarding extra support in mainstream schools.

All costs associated with schooling or special support are unknown.



## **11. Costs: Preschool Hearing Screening**

### **11.1. Screening costs**

Total costs are not available.

### **11.2. Equipment costs**

Data are not available.

### **11.3. Staff costs**

Data are not available.



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