



## **Summary: Hearing Screening**

### **Hungary**

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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.



	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 Hungary, hearing screening is organized nationally. Neonatal hearing screening is implemented across the entire country and is universally provided to all babies. A national guidance document was published in 2015. Neonatal hearing screening protocols are followed across all hospitals in Hungary, though data collection on a national level is still in progress since widespread implementation in 2015. Preschool hearing screening is also organized nationally and is a mandatory screening test for school admission.

The following report contains information with regards to hearing screening for the entire country of Hungary.

#### 3.1. General

The country of Hungary has a total area of 93 030 km<sup>2</sup> and a population of 9 753 000 as of 2017 (Hungarian Central Statistics Office, 2018). In Hungary, each birth is registered. The number of live births in Hungary was 91 577 in 2017 (Hungarian Central Statistics Office, 2018).

The World Bank income classification categorizes Hungary as a high-income country (The World Bank, 2018). The gross domestic product (GDP) was €12 673 per capita in 2017 (Hungarian Central Statistics, 2018)

From the World Health Organization (WHO) Global Health Expenditure Database, health expenditure in Hungary in 2015 was 888 USD or €782 per capita (World Health Organization, 2018).

Infant mortality rate in the country of Hungary was 3.9 per 1000 in 2015 (United Nations Statistics Division, 2016) and 3.6 per 1000 in 2017 (Hungarian Central Statistics, 2018)

#### 3.2. Neonatal hearing screening

In Hungary, neonatal hearing screening is conducted universally, with all babies in the country having access to hearing screening, though participation is obligatory for parents. Hearing screening for well and at-risk babies started in 1997. In 2015, it was fully implemented, and objective measures were mandated through a guidance document published by the State Secretariat for Health Care. Neonatal hearing screening is funded by health insurance but is not embedded into the Preventive Child Health Care screening system.

Neonatal hearing screening is organized by the hospitals or NICU departments, though hospitals should comply with the national guidance document and protocol (State Secretariat for Health Care, 2015). The same protocol is used for screening well and at-risk infants.

#### 3.3. Preschool hearing screening

In Hungary, preschool hearing screening is universally performed prior to school entry. Preschool hearing screening in Hungary was fully implemented across the country in 1997 and is funded by council. It is part of the Preventive Child Health Care Programme. Recommendations for screening at age 5 is also stipulated in the guidance document (State Secretariat for Health Care, 2015).

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

National guidelines for childhood hearing screening exist in Hungary, published by the Ministry of Human Resources - State Secretariat for Health Care, and decided on by a professional body of audiologists and neonatologists (State Secretariat for Health Care, 2015). The 2015 publication of guidelines for childhood hearing screening stipulate the widespread use of objective measures for universal neonatal hearing screening, specifically that aABR should be carried out.

Quality assurance of hearing screening programmes is not imposed by the federal government, though data collection has just recently started on a national level. Annually reports are not yet available.

There have not been any studies performed yet on the neonatal hearing screening programme in Hungary.



## 5. Process: Screening, Diagnosis, Intervention

### 5.1. Neonatal hearing screening

In Hungary, infants are screened in the hospital maternity ward, or in the NICU. In 2016, 0.61% of infants were born outside the hospital (either at home or on the way to the hospital). The average length of stay in the maternity hospital after birth is roughly estimated to be 3 days. Families are not invited to participate in screening, but screening is performed directly at the hospital or in the NICU by screening staff.

The target condition for screening both well- and at-risk infants is a bilateral or unilateral hearing loss of 35 dB HL. Screening should be completed by 1 month of age for both well and at-risk infants (State Secretariat for Health Care, 2015).

All infants (both well and at-risk) undergo the same screening protocol. There is no difference in screening protocol between groups of infants. However, the guidelines indicate that infants at-risk for hearing loss should be monitored, and a follow-up test should be performed at the age of 1 year and then annually up to 3 years of age (State Secretariat for Health Care, 2015). Data are unavailable on the childhood/infant prevalence of CMV infections or meningitis in Hungary.

### 5.2. Neonatal diagnostic assessment

The diagnostic assessment after neonatal hearing screening referral should be completed by 3 months of age for both well, healthy infants and at-risk infants when possible (depending on the health of the infant). Tests performed for confirmation of hearing loss include a clinical-ABR and ASSR as well as tympanometry and an ENT exam (State Secretariat for Health Care, 2015).

### 5.3. Preschool hearing screening

In Hungary, preschool screening takes place in the kindergartens or in a district consultation room by a paediatric district nurse. Children are invited to participate in screening directly in person in the kindergartens.

The target condition for preschool hearing screening is a unilateral or bilateral hearing loss of 30 dB HL.

### 5.4. Intervention approach

In Hungary, treatment options available include grommets, hearing aids, bone conductive devices, and cochlear implants. Children are fitted with hearing aids from < 6 months of age and with cochlear implants from 1-2 years of age.

Fitting criteria for hearing aids in Hungary is a bilateral hearing loss of at least 25 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)

The process for neonatal hearing screening for well babies in Hungary is summarized in Table 1, whereby a 1-step aABR protocol is in effect. The aABR is performed in the maternity hospital after birth and up to 72 hours (i.e., before discharge). In some cases, screening may be performed later, but should be performed before 1-month of age. Only one aABR is required for referral to a diagnostic assessment; however, the guidelines recommend rescreening when possible in order to reduce false positives. Therefore, the aABR may be performed once if the baby is quiet/sleeping, or it may be performed a second time if possible (State Secretariat for Health Care, 2015).

**Table 1:** Process for neonatal hearing screening of all babies in Hungary.

Test	Age	Referral criteria	Device	Unilateral Referrals?	Location
aABR*	<72 hours	35 dB nHL		Yes	Maternity ward

\*The aABR may be performed one or more times before referral.

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

There is no difference in screening protocol for well or at-risk infants. See section 4.1 and Table 1 for details.

### 6.3. Preschool hearing screening

In Hungary, hearing screening is performed in kindergartens at 5 years of age. Pure-tone audiometry screening (with headphones) is performed (State Secretariat for Health Care, 2015). If one or more thresholds are worse than 25 dB HL a referral is made to an ENT for a diagnostic assessment.

**Table 2:** Process for preschool hearing screening in Hungary

Test	Age	Referral criteria	Unilateral Referrals?	Location
Pure-tone screening	5	25 dB HL	Yes	Kindergarten schools / District office



## **7. Professionals**

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

Screening for well-babies is performed by nurses.

There is a specific training programme for nurses to learn aABR screening, which consists of 1 day of certified training. Monitoring of screening staff and training updates are performed in Hungary.

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

Screening for at-risk infants is performed by NICU nurses. See 7.1 for details.

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

Preschool screening is performed by paediatric district nurses.



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

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

Data are unavailable regarding the coverage/attendance rates in Hungary. Data collection has recently started, and rates may be provided later. The goal is to reach 100% coverage.

### **8.2. Referral rates**

Data are currently unavailable regarding the pass or referral rates in Hungary.

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

Data are currently unavailable regarding the compliance or attendance rates for diagnostic assessment in Hungary.

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

Data on the prevalence rates of childhood hearing loss in Hungary are not available.

Data are unavailable regarding the prevalence of auditory neuropathy in Hungary.

### **8.5. Treatment success**

Data are unavailable on the percentage of children fitted with hearing aids in Hungary. Approximately 80-90 children are fitted with cochlear implants each year in Hungary.

### **8.6. Screening evaluation**

Data are unavailable on the sensitivity or specificity of neonatal hearing screening in Hungary; however, since 2015, only two children have been identified with permanent hearing loss in the ENT Department at Semmelweis University who had previously passed newborn hearing screening 2 years earlier; however, these hearing losses were likely caused by viral infections.



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

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

Data are unavailable regarding the coverage/attendance rates of preschool hearing screening in Hungary. The goal is to reach 100% coverage.

### **9.2. Referral rates**

Data are unavailable regarding the referral rates of preschool hearing screening in Hungary.

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

Data are not available.

### **9.4. Screening evaluation**

Data are not available. In rare cases, children who pass screening have a hearing loss. The percentage of false positives depends on the screening situation (background noise, etc).



## 10. Costs: Neonatal Hearing Screening

There has not been a cost effectiveness analysis completed in Hungary. Screening is free of charge for parents. There is no financial reward when parents attend hearing screening, nor is there a penalty for those who do not attend hearing screening.

### 10.1. Screening costs

The costs for neonatal hearing screening in Hungary are 2043 HUF (approximately €6) per child.

### 10.2. Equipment costs

*(Information extracted to protect commercially sensitive data)*

The costs for disposables, including electrodes and ear tips, are 300 HUF (€1) per child. The cost for maintenance is not indicated.

### 10.3. Staff costs

Data on the number of screening staff in Hungary is unknown. The monthly salary for a nurse in Hungary is the 150 000 HUF or €464 per month.

### 10.4. Diagnostic costs

Diagnostic costs are not indicated.

### 10.5. Amplification costs

In Hungary, children with deaf parents who refuse cochlear implant for their children would not be treated.

The cost for bilateral hearing aid intervention is approximately 500 000 HUF or €1 546. This cost is covered by the national insurance company. The cost for cochlear implant fitting in Hungary is 7.0 million HUF or €21 654, which is also covered by the national insurance company. These costs do not include ongoing intervention after initial fitting and implantation, consultations and hearing aid adjustments, ear molds, speech therapy, etc. These are additional costs, covered by another budget; however, these costs are not indicated.

### 10.6. Social costs

There are 7 specialized schools across Hungary for deaf and hard-of-hearing students, including kindergarten. Approximately 160-180 children attend one of these 7 specialized schools. In mainstreams schools, there is special support. Specifically, a special teacher works with children with hearing loss twice a week.

Data on costs are unavailable.



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

### **11.1. Screening costs**

Data are not available on costs of preschool hearing screening; however, the cost would be the salary of the kindergarten or local nurse. The instrument for screening is provided by council.



## 12. References

- Hungarian Central Statistics. (2018). *3.1.3. Per capita gross domestic product (GDP) (1995–)*. Retrieved from STADAT: [http://www.ksh.hu/docs/eng/xstadat/xstadat\\_annual/i\\_qpt016.html](http://www.ksh.hu/docs/eng/xstadat/xstadat_annual/i_qpt016.html)
- Hungarian Central Statistics. (2018). *undefined*. Retrieved from STADAT: <http://www.ksh.hu/>
- Hungarian Central Statistics Office. (2018). *6.1.2. live births*. Retrieved from STADAT: [http://www.ksh.hu/docs/hun/xstadat/xstadat\\_evkozi/e\\_wns001.html](http://www.ksh.hu/docs/hun/xstadat/xstadat_evkozi/e_wns001.html)
- Hungarian Central Statistics Office. (2018). *Population, People's Movement (1900–)*. Retrieved from STADAT: [http://www.ksh.hu/docs/hun/xstadat/xstadat\\_hosszu/h\\_wdsd001a.html?579](http://www.ksh.hu/docs/hun/xstadat/xstadat_hosszu/h_wdsd001a.html?579)
- State Secretariat for Health Care. (2015). *Health Professional Guidelines - Full-time, age-related hearing screenings for children 0-18 years old and the care and rehabilitation of filtered children*. Budapest: Ministry of Human Resources.
- The World Bank. (2018). *World Bank GNI per capita Operational Guidelines & Analytical Classifications*. The World Bank.
- United Nations Statistics Division. (2016). *Demographic Yearbook – 2016*. Department of Economic and Social Affairs. New York: United Nations.
- World Health Organization. (2018). *Global Health Expenditure Database*. (W. H. Organization, Producer) Retrieved 08 01, 2018, from NHA Indicators: <http://apps.who.int/nha/database/DataExplorerRegime.aspx>