



Summary: Hearing Screening

Republic of Moldova

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1. Glossary of Terms: Hearing Screening

Abnormal test result	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.”
Attendance rate	<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"> • <u>Invited for screening</u> includes all those that are offered the screening test. • <u>Tested and receive a result</u> could be a “pass” or “fail”. <p>Attendance rate provides information on the willingness of families to participate in screening.</p>
Attendance rate in first year of life	<p>See definition of Attendance rate.</p> <p>The calculation cut-off is after <u>one year of life</u>.</p>
Compliance with referral (percentage)	<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>
Coverage	<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"> • <u>Eligible for screening</u> includes those within the population that are covered under the screening or health care program. • <u>Tested and receive a result</u> could be a “pass” or “refer to diagnostic assessment”. • <u>Specific time</u> can be defined, such as 1 month after birth, 3 months after birth, etc. <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>
Coverage in first year of life	<p>See definition of Coverage.</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>
False negatives	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%.
False positives	<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>
Guidelines	Recommendations or instructions provided by an authoritative body on the practice of screening in the country or region.
Hearing screening professional	A person qualified to perform hearing screening, according to the practice in your country or region.
Inconclusive test result	A test result where a normal “pass” response could not be detected due to poor test conditions.
Invited for screening	Offered screening.
Outcome of hearing screening	An indication of the effectiveness or performance of screening, such as a measurement of coverage rate, referral rate, number of infants detected, etc.
Permanent hearing loss	<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>
Positive predictive value	<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 Target Condition (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>
Preschool or (pre)school children	All children between 3-6 years of age.
Preschool or (pre)school screening	<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>



Prevalence	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.
Programme	An organized system for screening, which could be based nationally, regionally or locally.
Protocol	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.
Quality assurance	A method for checking and ensuring that screening is functioning adequately and meeting set goals and benchmarks.
Referral criteria	<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>
Risk babies / Babies at-risk	<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>
Sensitivity	<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>
Specificity	<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>
Target condition	<p>The hearing loss condition you are aiming to detect via your screening programme. This includes:</p> <ul style="list-style-type: none"> • The <u>laterality of the condition</u>, whether the program aims to detect both unilateral and bilateral hearing loss or just bilateral hearing loss. • The <u>severity of the condition</u>, whether the program aims to detect hearing loss ≥ 30 dB HL, ≥ 35 dB HL, ≥ 40 dB HL or ≥ 45 dB HL
Well, healthy babies	<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 the Republic of Moldova, hereafter Moldova, hearing screening is organized and implemented locally.

The following report contains information with regards to hearing screening in the entire country of Moldova.

3.1. General

The country of Moldova has a total area of 33 851 km² or 29 683 excluding Transnistria. The population of the Republic of Moldova is 3 550 852 as of January 2017 (National Bureau of Statistics of the Republic of Moldova, 2019). In Moldova, each birth is registered with the Office of the Civil Status. The number of live births in Moldova was 37 394 in 2016 (National Bureau of Statistics of the Republic of Moldova, 2019).

The World Bank income classification categorizes Moldova as a lower-middle-income country (The World Bank, 2018). The gross domestic product (GDP) is €2 176 per capita in 2017 (National Bureau of Statistics of the Republic of Moldova, 2019).

From the World Health Organization (WHO) Global Health Expenditure Database, health expenditure in Moldova in 2015 was 171 USD or €150 per capita (World Health Organization, 2018).

Data acquired from the 2016 United Nations Demographic Yearbook indicate an infant mortality rate of 9.4 per 1000 for the country of Moldova in 2014 (United Nations Statistics Division, 2016). Infant mortality rate remained similar for the years 2015 and 2016 at 9.7 and 9.4, respectively (National Bureau of Statistics of the Republic of Moldova, 2019).

3.2. Neonatal hearing screening

Only some hospitals in Moldova have implemented universal neonatal hearing screening. Universal hearing screening is not carried out across the entire country. Neonatal hearing screening is also not carried out on all at-risk or NICU infants.

Screening for well and at-risk babies was first implemented in 2017. As indicated, it is not yet implemented across the entire country. Neonatal hearing screening is not embedded in the Preventive Child Health Care screening system. Well-baby screening is funded through health insurance and at-risk-baby screening is funded by the hospitals.

Hospitals across Moldova performing neonatal hearing screening use the same protocols for screening.

3.3. Preschool hearing screening

In Moldova, preschool hearing screening is not conducted universally, nor is it embedded in the Preventive Child Health Care screening system. Preschool hearing screening, when conducted, is organized through international projects and through ENT or family doctors. Specifically, three projects have been carried out in Moldova by *Pediatres du Monde* from France, a Moldovan-Polish project, and a Swiss project since 2007. These projects were carried out within a limited timeframe on a limited number of infants.



4. Guidelines & Quality Control

National guidelines for hearing screening exist in Moldova and are used across hospitals.

The content of hearing screening programme was decided on by the Ministry of Health through a multidisciplinary team of experts, doctors, representatives from the Ministry with the help of experience of advanced countries. Guidelines have not been changed since its implementation.

The neonatal hearing screening programme is still in early stages in some hospitals, and therefore data are not yet collected for many indicators. Data collection is in progress and annual reports will be available.



5. Process: Screening, Diagnosis, Intervention

5.1. Neonatal hearing screening

Well-babies and at-risk babies are screened in the hospital, where the average length of stay is estimated to be 3 days. It is estimated that 97% of births take place at the maternity hospital, while 2% of births take place at home. Families of well and at-risk infants are invited to participate in neonatal screening directly in the maternity ward by ENT-audiologists.

It is not clear at what age screening should be completed according to guidelines; however, screening is completed in the maternity ward before discharge.

The target condition for screening well or at-risk babies is not specifically defined in guidelines.

In Moldova, at-risk infants are defined as infants born earlier than 34 weeks or with a weight of less than 1500 grams; however, there are no differences in protocol between well and at-risk infants. All infants are screened with the same protocol.

The prevalence of CMV infections and meningitis among neonates is not known.

5.2. Neonatal diagnostic assessment

The diagnostic assessment tests performed after neonatal hearing screening referral are OAE, impedance audiometry and ASSRs. Well infants should have their diagnostic assessment completed by 12 months of age and at-risk infants should have the process completed by 2 years of age.

5.3. Preschool hearing screening

When international projects are underway, preschool hearing screening is performed in kindergartens and schools. Children are invited to participate via their family doctors through administration within preschool institutions. Testing is performed by a ENT-audiologist or family physician.

When hearing screening was performed, the target condition for preschool hearing screening was a bilateral hearing loss of ≥ 25 dB HL.

5.4. Intervention approach

In Moldova, treatment options available include hearing aids. Infants are fitted with hearing aids from 1-2 years of age. Cochlear implants are only available in Moldova when European projects are in effect. In these instances, cochlear implants may be implanted as early as 6-12 months of age; however, they are typically implanted at 2-4 years of age. Other children that have citizenship in Romania may be fitted there.

Hearing aid fitting criteria in Moldova is a bilateral hearing loss of 60 dB HL or worse.



6. Protocols

Hearing screening protocols are described for neonatal hearing screening (well-baby 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)

For babies that are screened in Moldova, a 2-step OAE-OAE protocol is in effect whereby both OAEs are performed in the maternity ward before discharge. Infants that do not pass the OAEs are referred to the audiological centre for follow-up testing.

Table 1: Screening process for neonates in Moldova.

Test	Age	Referral Criteria	Device	Unilateral Referrals?	Location
OAE1	2-3 days	Not specified	Not specified	Yes	Maternity ward
OAE2	Before discharge	Not specified	Not specified	Yes	Maternity ward

6.2. Neonatal hearing screening (at-risk)

Infants considered at risk do not have a separate protocol. See section 6.1 for the protocol used for all babies that are screened in Moldova.

6.3. Preschool hearing screening

In Moldova, audiometry from 500 to 4000 Hz and tympanometry may be performed at the age of 6-8 years. The referral criteria are thresholds of 30 to 35 dB HL or worse.



7. Professionals

7.1. Neonatal hearing screening (well)

Screening for well babies is performed by ENT-audiologists and ENT resident doctors. In the future, neonatologists and nurses will also perform hearing screening. There is currently no specific training for hearing screeners in Moldova; however, a training programme is in progress.

7.2. Neonatal hearing screening (at-risk)

Screening for at-risk infants is also performed by ENT-audiologists and ENT resident doctors. In the future, neonatologists and nurses will also perform hearing screening.

7.3. Preschool hearing screening

ENT-audiologist and family doctors perform preschool hearing screening.



8. Results: Neonatal Hearing Screening

8.1. Coverage and attendance rates

The coverage rate of neonatal hearing screening in Moldova is approximately 30% by rough estimation. The attendance rates are unknown.

8.2. Referral rates

Estimations for referral rates are presented in Table 2.

Table 2: Estimated referral rates for neonatal hearing screening.

Test	Referral Rate
OAE1	35%
OAE2	

Referral rates assume 100% attendance rate.

It is estimated that 13% of well infants and 30% of at-risk infants are referred from neonatal hearing screening for an audiological assessment.

8.3. Diagnostic assessment attendance

It is estimated that 10% of well infants and 29% of at-risk infants complete a diagnostic examination. This would indicate that the loss to follow-up rate is roughly estimated to be from 4 to 23%.

8.4. Prevalence / Diagnosis

Data are not yet available regarding the prevalence rates of hearing loss in Moldova. The prevalence of permanent hearing loss among neonates in Moldova was roughly estimated, as follows:

Bilateral ≥ 40 dB HL: 1 per 1000	Unilateral ≥ 40 dB HL: 1 per 1000
Bilateral ≥ 80 dB HL: 2 per 1000	Unilateral ≥ 80 dB HL: 2 per 1000

While the prevalence of hearing loss of children diagnosed without being screened is not indicated, in Moldova, the number of cases of children with hearing loss is presented in Table 3.

Table 3: Number of cases of permanent hearing loss among children in Moldova

Number of cases	Bilateral		Unilateral	
	≥ 40 dB	≥ 80 dB	≥ 40 dB	≥ 80 dB
	1060	190	280	70

Data are unavailable regarding prevalence of bilateral auditory neuropathy in Moldova.

8.5. Treatment success

In Moldova, it is estimated that 150 to 170 children are fitted with hearing aids per year. Moldova does not yet have a cochlear implant programme, and children are only fitted with cochlear implants when international projects are in place or if the families travel to another country. To date, an estimated total of 70 children have cochlear implants in Moldova.

8.6. Screening evaluation

For neonatal hearing screening in Moldova, figures for screening evaluation are roughly estimated. The percentage of false negatives is roughly estimated to be 20% and the percentage of false positives is roughly estimated to be 40%. These figures include children with middle ear pathologies, and are also representative of the estimated false positive and false negative rates from the initial learning stage of the staff performing hearing screening. In other words, these rates are notably high due to the initial low acceptance of learning the proper screening procedure among neonatologists and nurses.



9. Results: Preschool Hearing Screening

9.1. Coverage and attendance rates

When projects are underway, it is estimated that approximately 20% of preschool age children are invited for hearing screening. The estimated coverage rate is around 10%.

9.2. Referral rates

From the results of the preschool hearing screening project, 37% of children screened were referred for further evaluation.

9.3. Diagnostic assessment attendance

From the results of the preschool hearing screening project, 25% of infants screened received a diagnostic evaluation; however, it is indicated that the compliance rate is unknown.

9.4. Prevalence / Diagnosis

From the results of projects, 6% of children screened were diagnosed with a bilateral hearing loss ≥ 25 dB HL and 2% of children screened were diagnosed with a unilateral hearing loss ≥ 25 dB HL. Data indicated that 1% of children screened were found to have a unilateral hearing loss ≥ 80 dB HL.



10. Costs: Neonatal Hearing Screening

Neonatal hearing screening in Moldova is free of charge for parents. There 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 completed in Moldova.

10.1. Screening costs

There are no data on costs for neonatal hearing screening.

10.2. Equipment costs

The cost of equipment is not known, as the devices were procured from international projects. Devices are expected to be replaced every 5 years.

10.3. Staff costs

The annual salary of professionals that perform hearing screening is roughly estimated to be anywhere from €3 600. Data are not available on the educational cost for hearing screening professionals.

10.4. Diagnostic costs

The cost for a diagnostic assessment is not indicated.

10.5. Amplification costs

In Moldova, all children are treated for hearing loss. The costs for intervention have been covered by international projects and insurance companies. There are no costs to the parents.

10.6. Social costs

In Moldova, it is estimated that there are 5 schools for deaf and hard of hearing with approximately 300 children from 6 to 18 years of age. Data on the cost per child for specialized school are unavailable. Children with hearing impairment that attend regular schools are provided amplification and auditory rehabilitation by speech therapists when needed.



11. Costs: Preschool Hearing Screening

11.1. Screening costs

Costs for preschool hearing screening when in effect are covered by charity / international projects.

11.2. Equipment costs

Not known / not applicable.

11.3. Staff costs

Not known.



12. References

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