



## **Summary: Hearing Screening**

**Malawi**

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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>	A pre-determined cut-off boundary for when an infant/child should be re-tested or seen for a diagnostic assessment.  For example, referral criteria may be “no response” at 35 dB nHL.
<b>Risk babies / Babies at-risk</b>	All infants that are considered to be at-risk or have risk-factors for hearing loss according to the screening programme.  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.
<b>Sensitivity</b>	The percentage of infants/children with hearing loss that are identified via the screening program.  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%.
<b>Specificity</b>	The percentage of infants/children with normal hearing that pass the screening.  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%.
<b>Target condition</b>	The hearing loss condition you are aiming to detect via your screening programme. This includes: <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>	Infants who are <i>not</i> admitted into the NICU or born prematurely.  Well, healthy babies may or may not have additional risk factors for hearing loss, according to the procedures indicated in the specific screening programme.



## **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 Malawi, hearing screening is organized locally in hospitals and schools. The following report contains information with regards to childhood hearing screening across Malawi.

#### **3.1. General**

The country of Malawi has an area of 118 484 km<sup>2</sup> and with an estimated population of 16 310 000 in 2015 and 19 196 246 as of 2017. (CountrySTAT Malawi, 2019).

In Malawi, it is estimated that all births are registered. The number of live births in Malawi is an estimated 663 000 per year (United Nations Population Fund, 2011).

The World Bank income classification categorizes Malawi as a low-income country (The World Bank, 2018). The gross domestic product (GDP) in 2015 was €195 per capita in 2008 (CountrySTAT Malawi, 2019).

From the World Health Organization (WHO) Global Health Expenditure Database, health expenditure for Malawi in 2015 was 34 USD or €30 per capita (World Health Organization (WHO), 2018).

An infant mortality rate of 69 per 1000 was reported in 2009 (WHO Regional Office for Africa., 2010) which has decreased to an estimated 38.5 per 1000 for 2017 (Statistica, 2019).

#### **3.2. Neonatal hearing screening**

In Malawi, neonatal hearing screening is not conducted universally, as only selected, targeted infants are offered hearing screening. It is also not offered in all hospitals in Malawi due to lack of resources, and participation is not obligatory.

Hearing screening that exists in Malawi started in 2015-2016.

#### **3.3. Preschool hearing screening**

There is no preschool hearing screening in Malawi.



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

There are no guidelines for hearing screening in Malawi, nor is there a dedicated protocol.

Audiologists and ENT specialists decide on how to perform neonatal hearing screening.

Quality assurance of the neonatal hearing screening programme is not imposed by the government, though data on screening outcome are collected in hospital files. Annual reporting is not performed.

Research has not been performed on neonatal hearing screening in Malawi, nor have there been studies published on the effectiveness of hearing screening in Malawi.



## **5. Process: Screening, Diagnosis, Intervention**

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

At-risk/NICU infants are screened in the hospital in the audiology clinic and invited to participate directly in person in the hospital. The percentage of infants are born in a hospital or at home is unknown. The average length of stay in a hospital after delivery is unknown.

It is not known by what age hearing screening should be completed; however, pre-mature infants may have their hearing screened after 36 weeks. Hearing screening occurs around 2-8 weeks of age.

Infants that are considered at risk are when the caregiver has concerns about hearing or development, there is a family history of permanent childhood hearing loss, a NICU stay exceeds 48 hours, or when one of the following criteria are met, regardless of length of stay: the use of assisted ventilation, presence of jaundice, exposure to ototoxic medications (gentamycin, streptomycin, quinine) or loop diuretics (furosemide/Lasix), the presence of in-utero infections (cytomegalovirus, herpes, rubella, syphilis, toxoplasmosis, HIV, malaria), presence of craniofacial abnormalities, presence of syndrome associated with hearing loss, presence of neurodegenerative disorders, postnatal infection including meningitis, head trauma, or chemotherapy. It is not known the percentage of infants that meet these risk factor criteria.

Data are not available regarding the prevalence of CMV or meningitis among infants or children in Malawi.

The target condition for screening for well and at-risk babies is not indicated.

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

The diagnostic assessment after neonatal hearing screening referral should be completed after 36 weeks gestation. It is not indicated by when the diagnostic assessment should be completed.

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

Not applicable.

### **5.4. Intervention approach**

In Malawi, treatment options available include grommets, hearing aids, or cochlear implants. Infants are fitted with hearing aids from 6 months of age or older and with cochlear implants from 5 years of age or older.

The hearing aid fitting recommendations are a unilateral or bilateral hearing loss of more than 25 dB HL and less than 110 dB HL.



## 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)

Not applicable.

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

The screening process for at-risk infants is described in Table 1. Specifically, otoscopy, tympanometry, and aABR/ASSR is performed in the audiology clinic.

Table 1: Process for neonatal hearing screening for at-risk infants in Malawi

Test	Age	Referral Criteria	Unilateral Referrals?	Location
Otoscopy + Tympanometry + aABR/ASSR*	2-8 weeks	25 dB nHL	Yes	Audiology clinic

\* Testing is performed twice before referral to full diagnostic assessment

### 6.3. Preschool hearing screening

Not applicable.



## **7. Professionals**

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

Not applicable.

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

Screening for at-risk infants is performed by audiologists and audiology officers. There is no specific training for these professionals to perform hearing screening.

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

Not applicable.



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

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

Information on coverage and attendance rates in Malawi are not known. All at-risk infants at the Queen Elizabeth Central Hospital (QECH) are offered screening.

### **8.2. Referral rates**

Information on pass or referral rates in Malawi are not known. It is roughly estimated that 40% of at-risk infants tested are referred for diagnostic evaluation after screening.

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

Data are not available on the compliance or attendance rate to the diagnostic assessment.

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

Data are unavailable regarding prevalence rates of childhood hearing loss in Malawi.

### **8.5. Treatment success**

Ten young children are fitted with hearing aids per year and no children are fitted with cochlear implants in Malawi.

### **8.6. Screening evaluation**

Actual data on the sensitivity or false negatives are not available.

The percentage of false negatives is roughly estimated to be less than 5% and the percentage of false positives is roughly estimated to be less than 15%.

The positive predictive value (PPV) of a refer result is roughly estimated to 50%.



## **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**

In Malawi, it is unknown if screening is free of charge for parents; however, 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 Malawi.

### **10.1. Screening costs**

The total screening costs for neonatal hearing screening is \$1000, or \$2 per infant screened.

### **10.2. Equipment costs**

The cost for an OAE screening device is \$2000, for an aABR device is \$12 000 and for ASSR is \$20 000. Maintenance costs for the equipment is \$500, and devices are replaced every 10 to 20 years. The total cost for disposables is roughly estimated to \$10 000. It is unclear for how many tests this disposable cost covers.

### **10.3. Staff costs**

There are 11 professionals that perform hearing screening in Malawi. The annual salary for an audiology officer is \$3600 and for an audiologist is \$9600.

The costs for training are unknown.

### **10.4. Diagnostic costs**

The total cost of diagnostic confirmation is not indicated.

### **10.5. Amplification costs**

In Malawi, not all children are provided intervention due to capacity problems. The costs for amplification are not known, as devices are donated.

### **10.6. Social costs**

There are 6 special primary schools in Malawi for children who are deaf or hard of hearing. It is unknown how many children attend one of these special schools

Special needs assistants are available for deaf children who attend mainstream schools.

All costs associated with schooling or special support are unknown.





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

### **11.1. Screening costs**

Not applicable.

### **11.2. Equipment costs**

Not applicable.

### **11.3. Staff costs**

Not applicable.



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