World Health Organization

HEARING SCREENING

CONSIDERATIONS FOR IMPLEMENTATION

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ABBREVIATIONS

AABR	automated auditory brainstem response
ABR	auditory brainstem response
ASSR	auditory steady-state response
dB	decibel
dBA	A-weighted decibel
dBHL	decibels hearing level
EHC	ear and hearing care
ENT	ear, nose and throat
FM	frequency modulation
HHIE	hearing handicap inventory for the elderly
ICOPE	integrated care for older people
IPC-EHC	integrated people-centred ear and hearing care
JCIH	Joint Committee on Infant Hearing
kHz	kilohertz
MPANL	maximum permissible level
NICU	neonatal intensive care unit
OAE	otoacoustic emission
PPV	positive predictive value
PTA	pure-tone audiometry
SCN	special care nursery
TWG	technical working group
UNHS	universal newborn hearing screening
USA	United States of America
WHO	World Health Organization

INTRODUCTION

In the *World report on hearing*, the World Health Organization (WHO) estimates that by 2050 nearly 2.5 billion people will be living with some degree of hearing loss, at least 700 million of whom will require rehabilitation services. Currently, this number is 430 million, which includes people with moderate or higher grades of hearing loss who are most likely to benefit from hearing rehabilitation services. The vast majority of these people live in low- and middle-income countries, where access to ear and hearing care (EHC) is often limited. The sizeable gap in the need for, and access to, EHC services is indicated by the fact that only 17% of those who could benefit from a hearing aid, actually access or use one.

Unaddressed hearing loss is costly in terms both of the health and well-being of the people affected, and the financial losses arising from their exclusion from communication, education and employment. Each year, nearly 1 trillion International dollars are lost due to unaddressed hearing loss.

The *World report on hearing* outlines innovative, cost–effective technological and clinical solutions that can improve the lives of most individuals with hearing loss. Millions are already benefitting from these developments. Combining the power of technology with sound public health strategies, can ensure that these benefits reach all populations, thereby advancing the global vision of universal health coverage.

Towards this end, the *World report on hearing* recommends integrated people-centred ear and hearing care (IPC-EHC) within national health systems, and outlines a set of H.E.A.R.I.N.G. interventions (Box 1), that ensure that people with hearing loss or ear diseases receive the care and rehabilitation services they need.

Box 1 H.E.A.R.I.N.G. set of interventions

- **H** Hearing screening across the life course
- **E** Ear disease prevention and management
- **A** Access to technologies
- **R** Rehabilitation services
- **I** Improved communication
- **N** Noise reduction
- **G** Greater community engagement

Early intervention is critical to successful rehabilitation outcomes in people with hearing loss, as delays have a negative impact on language development, communication, social well-being and cognition. Since hearing loss is invisible, it commonly remains undetected, both in children and adults. For this reason, it is important that special measures are put in place to screen for hearing loss at different stages across the life course (Figure 1). Those most likely at risk include:

- newborns and infants;
- children, especially in pre-school and school settings;
- older people; and
- those who are exposed to noise, ototoxic chemicals and ototoxic medicines and are thus at greater risk of hearing loss.

Figure 1 Identifying hearing loss across the life course

ACROSS THE LIFE COURSE: Screening for hearing loss › Symptomatic testing

NEWBORN:	CHILDREN:	ADULTS:	OLDER ADULTS:
Newborn hearing screening	Pre-school and school ear and hearing checks	Hearing screening in high risk occupations	Regular hearing screening

The rationale for systematic hearing screening, and the benefits and challenges of implementation are provided in the *World report on hearing*, along with detailed information on the costs and potential financial benefits of implementing such screening and early intervention services. The report shows that increasing hearing screening and early intervention coverage during the next 10 years requires an additional annual per capita investment of US$ 1.33. The resulting health gain during the 10-year period would avert nearly 130 million DALYs (disability adjusted life years), benefit 1.4 billion people and yield a return of nearly US$ 16 for each 1 dollar invested.

The *World report on hearing* recommends that WHO Member States take urgent and evidence-based policy action to prevent, identify and rehabilitate hearing loss. This handbook provides the technical guidance to support Member States in developing and implementing screening strategies for early identification and intervention to address hearing loss and related ear diseases in newborns and infants, children at pre-school facilities and at school, and older people.

PURPOSE OF THE HANDBOOK

This handbook, *HEARING screening: considerations for implementation* is intended for use by anyone planning to implement a national or subnational level hearing screening programme. This includes EHC coordinators or focal points within ministries of health; public health planners; and nongovernmental organizations or civil society entities providing ear and hearing care.

The handbook provides practical information for facilitating screening and early intervention for hearing loss and related ear diseases in newborns and infants, pre-school children and school students, and older people.

DEVELOPMENT OF THE HANDBOOK

Hearing screening: considerations for implementation has been developed through a consultative and evidence-based approach. It forms three sections: hearing screening in newborns and infants; school-based hearing screening; and hearing screening in older people. The process of developing each section involved:

- setting up three technical working groups (TWGs), one for each screening group;
- preparing a list of questions to be addressed with respect to each screening group;
- undertaking a scoping review of existing guidelines for each screening group;
- assessing the guidelines that fitted the predetermined inclusion criteria for their quality through application of the AGREE-II tool;[1]

1 See: https://www.agreetrust.org/resource-centre/agree-ii/agree-ii-instructions/.

- reviewing in detail the high quality guidelines and, in response to pre-identified questions, extracting the data from these;
- conducting a 2-stage Delphi survey (where considered relevant by the TWGs) to support the data extraction process;
- developing each section based on the evidence reviewed and expert inputs;
- a review of drafts (by the TWGs) and provision of feedback; and
- undertaking an internal review prior to finalization.

USE OF THE HANDBOOK

The handbook provides guidance on important factors to be considered when developing a hearing screening programme; examples include who should be screened, the aim of the programme, the frequency of screening, the tools to be used, etc. Each of the three sections considers these and other relevant questions that must be answered during the planning phase. In addition, the sections give evidence-based options and discuss the advantages and disadvantages of the different options, so that countries can implement those which best suit their local context.

Countries must set up a national or local stakeholder group and plan their programmes after due consideration of the recommendations outlined in this handbook, along with the epidemiology of hearing loss and ear diseases within the country/region, availability of the health workforce, referral pathways, equipment and financial resources.

Further technical assistance in adaptation and implementation of hearing screening can be sought from WHO.

1 HEARING SCREENING IN NEWBORNS AND INFANTS

1.1 NEED AND RATIONALE

Unaddressed hearing loss, including congenital hearing loss, constitutes a serious obstacle to a child's development, education, and social integration *(1, 2)*. The impact of unaddressed hearing loss extends beyond adverse speech and language outcomes, especially in low- and middle countries *(3).* A key mitigating factor is the age at which intervention (amplification or enrolment in educational programmes) is initiated *(4, 5)*. There is a significant body of research demonstrating that children whose hearing loss is identified at an early stage and who receive early intervention have better outcomes than those with later detection and treatment *(4, 6–11)* (see section 1.11). Literature shows that children who are born deaf or who acquire hearing loss very early in their life and who are identified and receive appropriate interventions within 6 months of age are on a par with their hearing peers in terms of language development by the time they are 5 years of age *(12–15)*.

Early identification and intervention in newborns is made possible through newborn hearing screening (NHS) *(1, 15)*. When followed by prompt and suitable rehabilitation, hearing screening of newborns brings significant advantages both in terms of reducing the age of diagnosis and intervention and of improved language and cognitive development *(4, 10, 16–19)*. These advantages translate into improved social and educational outcomes for infants who receive timely and suitable care *(2)*. Cost–effectiveness studies have further demonstrated the financial benefits of universal newborn hearing screening (UNHS) in high-income, lower-middle-income and middle-income countries *(2, 20)*.

1.2 CURRENT STATUS AND PRACTICES

Successful newborn hearing screening programmes have been implemented in several countries using a variety of screening methods, protocols, and linkages to existing health care, social and educational systems *(21)*. It is estimated that nearly one third of the world's population, living mainly in high-income regions, is fully or nearly fully covered by newborn hearing screening programmes *(22)*. The degree of implementation and coverage of such programmes varies substantially across the world. A recent publication shows that screening coverage is closely associated with average living standards and economic well-being *(22)*. The lack of relevant policies, human resources, equipment and financial resources for NHS are challenges very commonly faced in low- and middle-income countries. These challenges are further aggravated by a low awareness about hearing loss and its associated stigma. These factors and potential solutions are further elaborated in the *World report on hearing (2)*.

There is also variation in how NHS is currently implemented worldwide. However, most guidelines adopted are based on the underlying principles of the position statement of the Joint Committee on Infant Hearing (JCIH) *(1, 23)*, as outlined in section 1.3.

While each country must develop its screening protocol based on several factors, such as the nature and severity of the hearing loss to be identified, the screening tools available, legislative support, the availability of qualified personnel and competent audiology services, cultural diversity, resources available and cost value *(1, 16, 24–26)*, the principles underpinning the JCIH recommendations form a strong basis for UNHS *(1)*.

1.3 GUIDING PRINCIPLES FOR NEWBORN HEARING SCREENING

- Newborn hearing screening, where practicable, should be based on the "1–3–6" principle *(23, 27)* (Box 1.1).
  - All infants should undergo hearing screening within the first month of life.
  - All infants whose initial screening and subsequent re-screening warrant diagnostic testing, should have appropriate audiologic evaluation by no later than 3 months of age to confirm the infant's hearing status.
  - Once hearing loss has been diagnosed, the infant and family should have immediate access to early intervention service. This should begin as soon as possible after diagnosis, and no later than 6 months of age.

Box 1.1 The 1–3–6 principle

SCREEN BY
1 MONTH OF AGE

DIAGNOSE BY
3 MONTHS OF AGE

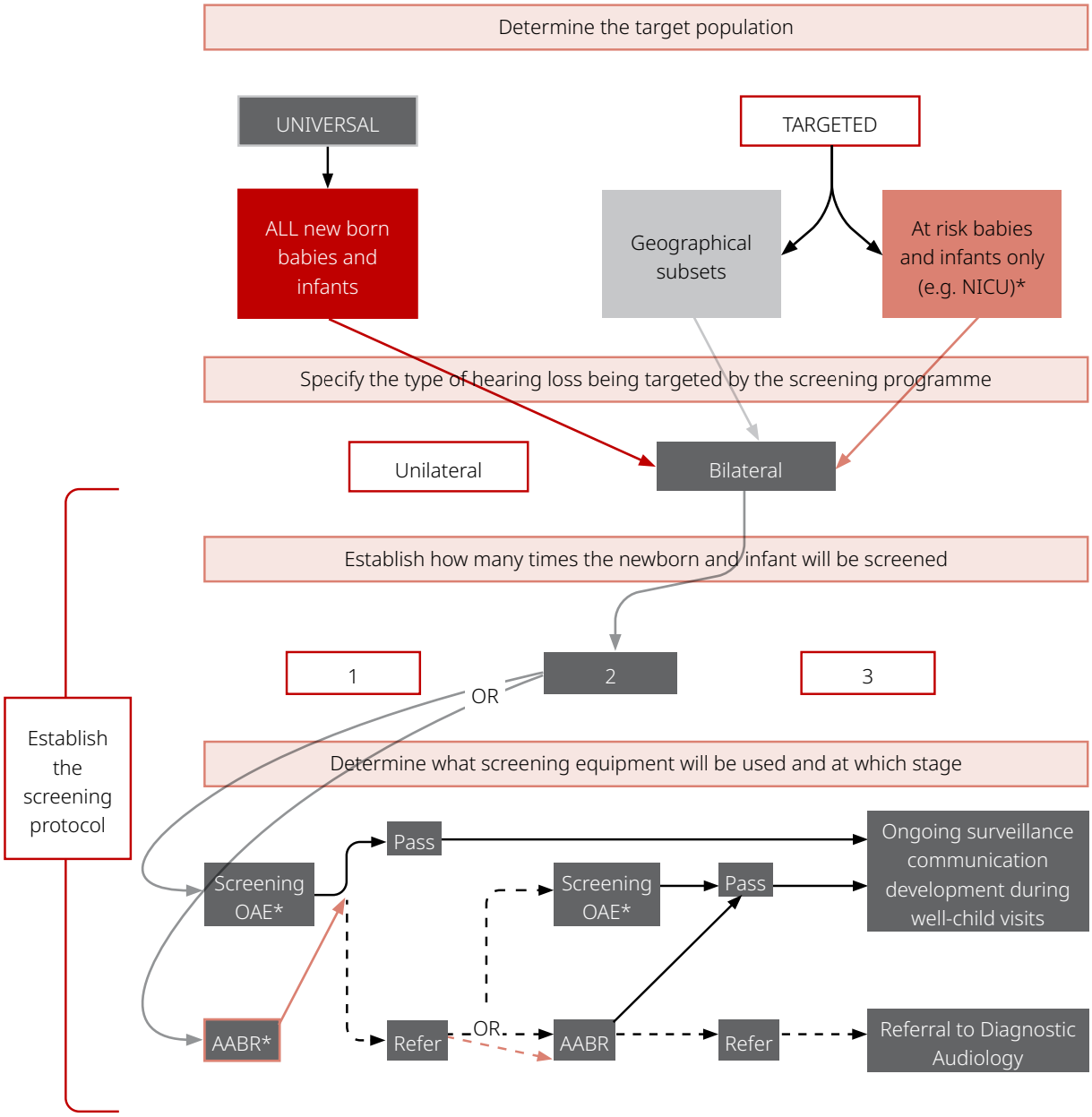
INTERVENE BY
6 MONTHS OF AGE

- In places where infants are predominantly born outside of hospital settings or where access to health care is limited and where it is not feasible to achieve the 1–3–6 timeline, the NHS programmes should strive to remedy this over time.
- Wherever feasible, the NHS programme should be integrated with, or linked to, existing health-care, educational or social systems, and the procedures and outcomes documented and reported *(28).*
- The programme should adopt a family-centred approach, with infant and family rights and privacy guaranteed through informed and shared decision-making, and family consent in accordance with state and national guidelines *(29).*
- Interventions, including provision of hearing technology and rehabilitation services, must reflect the family's preferences and goals for their child.
- Regardless of the outcome of their newborn hearing screening, all infants and children should be routinely monitored with respect to: hearing, cognitive development, communication, attainment of educational milestones, general health and well-being.

1.4 TARGET GROUP AND AIMS

Newborn hearing screening should be universal, and all infants (in the area or facility where screening is implemented) should be covered and assessed to identify hearing loss. However, in countries where the number of annual births is large and where resource limitations do not allow for universal screening, countries may choose to start a screening programme using selective (or targeted) screening only *(3)*, for example by including only infants considered "at-risk"; geographical subsets; or infants in a special care nursery (SCN) or neonatal intensive care unit (NICU) (see Figure 1.1). Countries should, however, plan to expand selective screening to universal screening over time. Testing only infants considered "at risk" is likely to miss approximately 50% who have no apparent cause for hearing loss *(2, 24, 30)*.

Figure 1.1 Setting up a newborn hearing screening programme



*AABR: automated auditory brainstem response; NICU: neonatal intensive care unit; OAE: otoacoustic emission.

The aim of any hearing screening programme is to diagnose hearing loss in infants at the earliest possible stage and to enrol them in timely intervention. Countries should decide the level and nature of hearing loss on which to focus, based on the capacity of their health system. The ear and hearing programmes of many countries focus on early intervention of infants with moderate or higher grade of hearing loss (i.e. above 35 dBHL) in the better hearing ear *(1)*. However, where resources permit, mild hearing loss and unilateral hearing loss should also be addressed due to the impact these have on language development and education *(31,32)*.

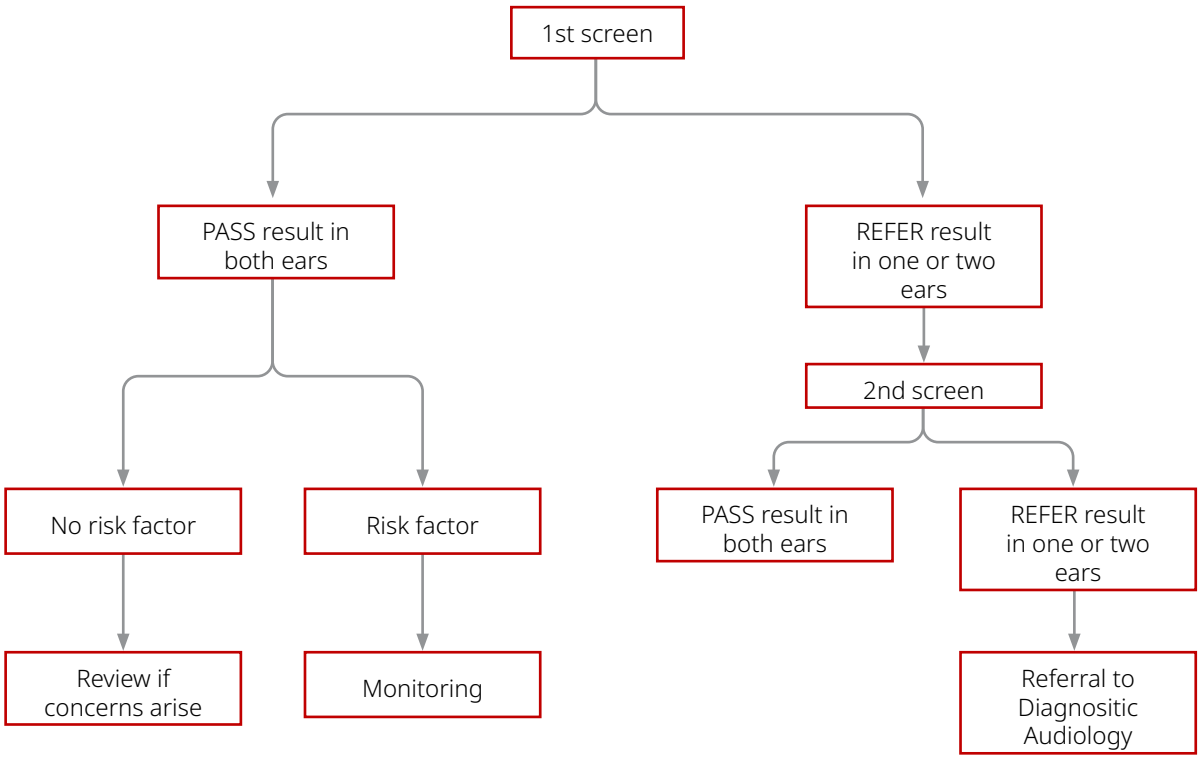
1.5 SCREENING PROTOCOL

A two-stage screening protocol is important to ensure a lower rate of false positives or higher specificity of the screening programmes (see Figure 1.2). This involves:

- First-stage screening, which is best performed soon after birth.
- Second-stage screening for all infants who fail the first stage screening.
- Referral for diagnostic audiology for infants who fail both the first and second stages of screening.

Note: Some screening programmes add an additional screening stage to reduce the number of false-positive test results requiring diagnostic audiology *(24, 33)*. While multiple stage screening is more costly and may cause delay in establishing a diagnosis and starting intervention, it yields higher specificity and thus reduces the number of false referrals for specialized and costly diagnostic audiology.

Figure 1.2 Two-stage screening protocol



1.6 AGE AND TIME FRAME FOR SCREENING

- F*irst-stage screening*: ideally this should take place within 1 month of age and should be conducted before the infant is discharged. First-stage screening can be performed as close to hospital discharge as possible, but there should be the possibility for a potential second-stage screening prior to discharge, if needed. When birth takes place outside of a hospital setting or where the screening programme is, for example, linked with immunization visits or well-baby clinic visits, it may not be possible to screen during the recommended 1 month period. In this case, first-stage screening should take place no later than 6 weeks of age.
- S*econd-stage screening*: infants who fail the first-stage screening, should undergo a second-stage screening. This can occur either while still in hospital, and following a gap of at least several hours from the first screening to decrease the false-positive test result due to transient newborn conditions; or as soon as possible after being discharged.
- Alternative arrangements must be made for completing the hearing screening of infants for whom it is not medically advisable or practical to do so in a timely manner, for example infants in an NICU, or on ventilators, or with severe life-threatening conditions. If screening is delayed, the procedure should be ensured once the infant is medically stable.

Note: Where a large number of infants are born outside of the hospital setting or formal health-care system, screening at the time of first vaccination is a possible strategy to increase coverage *(34).* An example of this is outlined in the newborn hearing screening guidelines of South Africa *(35)*.

1.7 SCREENING TESTS

As far as possible, physiological screening measures should be applied in preference to behavioural screening. Sensitive screening tests are commonly used and include automated auditory brainstem response (AABR) or otoacoustic emission (OAE) screening. There is no clear advantage of one technology over the other. For the well-infant population, first and second screening can be performed using either AABR or OAE technologies. With certain screening programmes, and where costs permit, AABR may be preferred; for infants in an NICU, AABR screening is recommended. These and other considerations for selecting the screening testing method are outlined in Box 1.2.

Box 1.2 Considerations in selection of screening test

- Screening with OAE alone will not detect infants with auditory neuropathy, which constitutes approximately 10% of congenital hearing loss.
- The incidence of auditory neuropathy, detected by AABR, is significantly higher among infants admitted to an NICU.
- When using OAE, transient-evoked OAE (TEOAE) has greater sensitivity, as it can detect hearing levels as low as 30dBHL.
- Both OAE and AABR screening demonstrates high sensitivity and specificity, although specificity may be marginally higher with AABR.
- AABR may be more costly than OAE. However, it is to be noted that while the initial investment is higher for AABR, the follow-up costs may be greater for OAE due to higher "refer" diagnoses and false-positive rates.
- AABR is likely to take slightly longer to record than OAE.
- OAE is more sensitive to background noise levels than AABR.
- A combined OAE and AABR screening protocol has been reported as providing the best positive predictive value (PPV). However, the cost of purchasing both types of screening equipment may be prohibitive for many countries.

Note: While the most effective approach is universal physiological screening using OAE testing or AABR, in cases where such programmes are not possible because of financial considerations or because appropriate equipment and personnel are unavailable (or because of a need to start in a more limited way and work towards universal physiological screening), other approaches that integrate behavioural tests can be used as interim measures *(21)*. Further details are provided in section 1.13.

1.8 HUMAN RESOURCES

Inpatient and outpatient screening can be conducted by paediatric audiologists, audiometrists, audiological or other technicians, primary care physicians, nurses, or nursing assistants. The decision regarding the screening personnel may vary depending on human resources available at each screening location.

Where screening is performed outside the hospital setting, health workers and other cadres providing childcare services at primary health-care level can be engaged.

Note: All screening personnel should undergo training irrespective of any prior qualifications. Training should focus on screening equipment to be used and the standard operating procedures of the programme including documentation of results, data collection and management (see Annex 1 for training requirements). Regular supervision of personnel in training is important for quality control and troubleshooting.

1.9 FOLLOW-UP

"Refer" result: All infants who have a "refer" result after first screening should be followed up to ensure that they have a second screening. Infants who fail both first and second screenings should be referred for diagnostic testing and be followed up.

Follow-up must be carried out systematically by a designated person to ensure that the required screening or diagnostic testing is completed. The steps in the follow-up pathway should be mapped out and a system established to facilitate family attendance at follow-up to ensure maximum compliance.

"Pass" result: Parents/caregivers should be provided with information about the usual hearing and language milestones *(30)* anticipated in the course of a child's development. In situations where these milestones are not met, or where hearing loss is suspected, the child should undergo a hearing screening test, irrespective of previous test outcomes. This is important because hearing loss can develop at any time after birth, or be progressive in nature, which becomes apparent as the child grows.

1.10 DIAGNOSTIC ASSESSMENT

All infants failing both stages of screening should undergo diagnostic audiology to confirm their hearing status by 3 months of age. Tests should include:

- **Objective assessment** of brainstem responses to sound stimulus for diagnosis of hearing loss through:
  - *Auditory brainstem response (ABR) testing* – the standard measure used to make a diagnosis of the nature and degree of hearing loss in each ear to ensure appropriate management (e.g. amplification, signing).
  - *Auditory steady-state response (ASSR)* – this can be used in addition to ABR in order to gain frequency specific threshold estimates.
- **Tympanometry** to assess the middle ear function.
- **Acoustic reflex** to test middle ear function and integrity of auditory brainstem pathways.
- **Otoacoustic emissions** – when combined with an ABR test, this provides critical information for the differential diagnosis of auditory neuropathy spectrum disorder and sensorineural hearing loss.
- **Medical evaluation** to determine the aetiology of hearing loss.

Diagnostic testing should be undertaken by a professional who has knowledge and experience of testing infants; who follows evidence-based protocols; and who has the necessary equipment for timely and comprehensive diagnosis.

1.11 INTERVENTION

In line with the principles outlined in section 1.3, intervention should ideally be initiated by the time an infant with hearing loss reaches 6 months of age. All countries should strive to achieve this. However, where this is not realistic immediately, countries can start with a more flexible goal to start management by 1 year of age. Decisions regarding management should be made through a consultative family-based approach.

Options for interventions include rehabilitative therapy to support the development of language skills, along with:

- **hearing technology use** (hearing aids or cochlear implantation);
- **sign language** learning; or
- a **combination** of the above.

In addition, parents should be directed to enrol their child in a suitable early education programme.

1.12 RED FLAGS FOR REFERRAL

Infants identified with any concurrent illness should be referred for the required treatment, in accordance with the best available standard of care. The following conditions, if identified, should lead to immediate referral for diagnostic audiology:

- Congenital cytomegalovirus
- Meningitis
- Congenital abnormalities of head and neck (e.g. unilateral or bilateral malformations of the ear, face or head)
- Significant head injury
- Syndromes associated with hearing loss
- Neonatal jaundice requiring exchange transfusion.

1.13 ALTERNATIVE SCREENING PATHWAYS

In community settings where newborn screening is planned and where physiological assessment is not feasible – either because of limitations in resources (financial, workforce or infrastructure), or because a large number of infants are born outside of health facilities and are thus not available for this approach – behavioural assessment can be used as an alternative first step in the screening process *(36).* However, this must be undertaken with the understanding that the specificity and sensitivity of behavioural observation is not well-established and that the proportion of false-negatives and false-positives may be higher using this approach.

The processes for behavioural assessment involve:

- **First screening**
  - *Time frame*: At first contact with the health system, for example a first visit to a health centre for vaccination *(34).*
  - *Method*: Behavioural screening using validated measures for behavioural screening (see Annex 2).
  - *Workforce*: Health workers trained to undertake behavioural observation.
  - *Referral*: Infants who show an equivocal response should be referred for a second screening at a health facility where hearing tests are available.

- **Second screening**
  - *Time frame*: As soon as possible after the first screening
  - *Method*: Use of OAE or AABR (see section 1.7)
  - *Workforce*: See Human resources (section 1.8)

- *Referral*: Infants who fail the physiological test should be referred for diagnostic testing, followed by early intervention if diagnosis of hearing loss is confirmed.

- **Diagnosis and intervention:**
  - Options for diagnosis and intervention are described in sections 1.10 and 1.11.

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2 SCHOOL-BASED EAR AND HEARING SCREENING

2.1 NEED AND RATIONALE

The implementation of universal newborn hearing screening in many places has improved the ability to identify and address congenital hearing loss shortly after birth. However, globally, most newborns are not screened for hearing loss, and even when they are, those with hearing loss that is progressive or develops later in childhood often remain unidentified and therefore untreated *(1)*. In addition, ear diseases such as otitis media are a common cause of health-care visits and morbidity among children *(1)*. When unaddressed, these ear diseases can lead to hearing loss, and in some cases to life threatening complications. Hearing loss in a child's formative years can have substantial consequences on speech and language development and education. Early identification of ear and hearing problems in children, and connecting them to care, is critical to avoid long-term impact on language learning, cognition, educational attainment and social development *(2, 3)*.

Given that, worldwide, the vast majority of children attend school, school (and pre-school) screening presents a unique opportunity to conduct universal hearing screening among children. When followed by prompt diagnosis and appropriate interventions, school (and pre-school) ear and hearing screening programmes serve as a useful tool for mitigating the effect of unaddressed hearing loss and ear diseases. They also provide an opportunity to educate children and teachers about healthy hearing and safe listening practices *(1)*.

School hearing screening, (including screening in pre-schools, primary and secondary schools, or at school-entry) is mandated only in some parts of the world and there is a paucity of published data on current school hearing regulations, policies and guidelines. Even in places where school hearing screening is implemented, there are differences

in the protocols, tests used, and thresholds applied for making referrals for treatment *(4–12)*. A recently published review highlighted the urgent need for globally standardized school hearing screening protocols which would improve the robustness and potential impact of this intervention *(4)*).

2.2 GUIDING PRINCIPLES OF SCHOOL-BASED HEARING SCREENING

School-based hearing screening programmes should consider the following points:

- Diagnostic audiology and otology services must be developed prior to, or in parallel with, screening programmes and should be available to those who have been referred after participating in hearing screening programmes.
- The care pathway and follow-up mechanisms should be outlined at the time of intervention planning so that children identified with hearing loss or ear diseases can receive the care they need.
- Interventions, including medical and surgical services, hearing technology and rehabilitation, must be made available and recommended based on a person-centred approach, which addresses the clinical needs of the individual, respects their preferences and adapts to the cultural context and available resources.
- Wherever feasible, school (and pre-school) ear and hearing screening should be part of routine school health checks or combined with other health interventions such as general physical check-up, eye screening, dental care etc.
- The components of professional accountability, risk management, quality assurance, data management and programme evaluation must be developed prior to implementation of any screening programme. An advisory board may be set up to oversee the planning, implementation and evaluation.

2.3 TARGET GROUP AND AIMS

Children in pre-school or school should be screened with the aim to identify the following at the earliest possible time:

- **Hearing loss** in one or both ears (this includes both conductive or sensorineural, or a mixed type of losses).[2] Ideally all hearing thresholds higher than 20 dBHL should be identified *(5–11)*. Where environmental limitations or health system capacity for referrals poses a challenge for identification of 20 dBHL hearing levels, countries can, for example, start with a target hearing threshold of 30 dBHL or 35 dBHL cutoff in

2 Hearing screening typically includes air conduction testing only. The differentiation of the type of hearing loss (conductive, sensorineural or mixed type) is possible only on a diagnostic audiometry, which should be made available to all children who are referred at the initial hearing screening.

either ear *(9)*. Once this is well established, countries should aim to identify children with hearing thresholds higher than 20 dBHL (see Box 2.1).

- **Ear disease** that is likely to cause hearing loss, for example:
  - chronic otitis media
  - acute otitis media
  - otitis media with effusion
  - impacted wax
  - malformations of the ear
  - foreign bodies in the ear.

Box 2.1 Considerations for deciding the target hearing threshold

- Ideally children with hearing loss of any grade (i.e. 20 dBHL or higher) should be identified, as even mild hearing loss is known to affect educational attainment *(13, 14)*. This should be the aim, especially in places where testing environmental noise levels can be kept under a strict control (e.g. below 40 dBA); and health systems have sufficient capacity to manage the demand this will create.
- With programmes that are being set up, it may be prudent initially to target higher thresholds such as 30 dBHL or 35 dBHL. This is because lower thresholds such as 20 dBHL or 25 dBHL:
  - are difficult to assess in the presence of background noise (greater than 40 dBA);
  - will lead to a greater number of referrals for diagnostic evaluation and hence may pose a challenge for health systems; or
  - may lead to a high proportion of false-positive referrals, leading to an overburdening of health systems thereby creating distrust in the screening process.

2.4 AGE FOR SCREENING AND FREQUENCY

At a minimum, all children should be screened for hearing loss and ear diseases at school entry. In countries where health system capacity permits, school ear and hearing checks should be undertaken regularly *(6)*:

- upon initial entry to school;
- in kindergarten; and
- in school year grades 1, 2, 3, 7 and 11.

The school year grades noted above are indicative and based on existing guidelines. The actual time-points for conducting pre-school or school screening will need to be decided

by each country based on the epidemiology of ear diseases and hearing loss and available resources. For example, a country could start with ear and hearing screening at school entry and at grades 1, 3 and 7 *(9)* only, and then, based on the development of the health system capacity, gradually increase the frequency.

In addition to the above, where teachers or parents/caregivers have expressed a concern regarding the hearing status of a child, the child should be referred to a health service for an ear and hearing check-up.

2.5 SITE OF SCREENING

For ease of access to students, screening is best undertaken in the school environment *(5–12)*. A quiet location should be identified within the school premises and noise levels checked beforehand. It is important to ensure that noise levels during hearing screening do not exceed the maximum permissible levels (MPANLs) prescribed for the selected headphones and screening level. Moreover, screening should be paused when there are transient increases in ambient noise. Noise levels can be checked using a sound level meter if available, or with use of validated phone apps for noise level measurement.[3] In situations where sound meters are unavailable, screeners can test the suitability of the site by checking the levels to be used for screening against their own ability to hear the signals at their known hearing threshold levels, in the test environment.

2.6 SCREENING TESTS

When assessing hearing in children/students, the following testing methods should be included (Type of test, tools, and methods used are described in Table 2.1):

- **Pure tone air conduction hearing screening** to identify if the child is able to hear the target threshold (20 dBHL/25 dBHL/30 dBHL/35 dBHL) across test frequencies (see section 2.3 on target groups and aims and Box 2.1).
- **Ear examination including otoscopy** to detect the target ear conditions (see section 3.3). Otoscopy should be undertaken only where trained staff and decision support for examination and diagnosis of ear diseases is available (either on the spot or remotely). In situations where such staff or support is unavailable, otoscopy and tympanometry may be excluded.
- **Tympanometry** (wherever feasible), should be undertaken as part of the ear and hearing testing protocol.

3 Examples of validated apps that can be downloaded for use: NIOSH Sound Level Meter, Sound Meter Pro, or Sound Meter and Noise Detector.

Table 2.1 Tests for school ear and hearing screening *(5–12)*

	Type of test	Tools used	Testing method	Criteria for referral
Hearing testing	Sweep audiometry	Conventional (non-automated) screening audiometer.	Both ears tested separately at three frequencies (1 kHz, 2 kHz, and 4 kHz), at a fixed dB level of 20 dBHL /25 dBHL/30 dBHL /35 dBHL. A differential approach can be adopted that raises the dB level at 1 kHz to avoid a false-positive result due to background noise. For example, if the target hearing threshold is 25 dBHL, the screening will be conducted at 25 dBHL for 2 kHz and 4 kHz, but will be conducted at 30 dBHL for 1 kHz *(15, 16)*.	Child does not respond: • at the criterion threshold level; • at one or more frequencies; • at least two out of three times. Failure to respond in either ear should be an indication for referral.
		Automated digital screeners *(13, 14)*.		
	Digits-in-noise test or speech-in-noise tests.	Digit triplet-in-noise test, such as the WHO hearWHO app could be used in children aged more than 9 years of age *(18)*.	Both ears tested together. The smartphone app should be calibrated to refer subjects with speech-in-noise ratio corresponding to the target threshold level of 20 dBHL/25 dBHL/ 30 dBHL/35 dBHL.	Speech recognition thresholds specified for specific age groups *(17)* corresponding to target hearing threshold of 20 dBHL/25 dBHL/ 30 dBHL/35 dB.
Ear examination	Naked eye examination of the external ear for obvious anomalies; and otoscopic examination.	Otoscope (validated low cost options are available and can be used).*	Both ears examined separately.	• Ear discharge is observed. • Visual identification of previously undetected. structural defect(s) • Impacted cerumen or foreign objects. • Perforations or other abnormalities of the tympanic membrane are apparent.
Middle ear pressure assessment (where feasible)	Tympanometry.	Tympanometer or hand-held tympanometer.	Each ear assessed separately.	Flat (type B) or type C tympanogram.

*An example of a low-cost option is the Arclight scope. See: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7041821/

2.7 HUMAN RESOURCES

Ear and hearing checks in schoolchildren can be performed by the following cadres:

- **Ear and hearing care clinicians** (e.g. ear, nose and throat (ENT) specialists, audiologists, speech and language pathologists).
- **Non-hearing care clinicians** (e.g. school doctor, general physician, paediatrician).
- **Trained health workers and nurses** (e.g. clinical officers, nurses, medical assistants, technicians) *(13, 14)*.
- **Trained lay health workers** (e.g. community health workers) *(13, 14)*.
- **Trained teachers** *(19)*.

In situations where ear and hearing checks are to be performed by non-clinicians, training must be provided, followed by supervised practice and ongoing quality control and support. Following training, regular checks should be made to ensure good practice and compliance to standards and guidelines. The training requirements for non-clinicians are summarized in Box 2.2.

Box 2.2 Content of training for school ear and hearing screening

Clinicians, nurses and health workers who are not trained in ear and hearing care should receive training in the following:

- the importance of hearing – especially for education;
- the purpose and protocol of screening;
- basic anatomy of the ear;
- causes of hearing loss;
- the basic operation of the screening programme and the process for reporting;
- the role of the screener;
- screening and referral methods;
- screening room set-up and calibration of equipment;
- equipment, including maintenance and troubleshooting if not working;
- background noise measurements;
- otoscopy and tympanometry (where available); and
- identification of the target ear and hearing conditions.

Hearing care clinicians should be sensitized to the purpose and protocol for the screening programme.

2.8 REFERRAL CRITERIA

As outlined in the principles (section 2.2), a school screening programme must be linked with ear and hearing services so that children identified with ear diseases or hearing loss can access the care they require. Actions to be taken for different test results are as follows:

- "Pass" result: Children with a "pass" result following ear and hearing screening, and who are not identified as having "refer" criteria, should be advised to care for their ears and be provided with information on ear and hearing care.[4]
- "Refer" result: Children with a "refer" result following screening should undergo an ear and hearing check-up for diagnosis and management. Ideally this should be undertaken by a clinician with competence in ear and hearing care.
- Red flags: Children who receive a "red flag" alert following ear and hearing screening should be referred for further assessment, irrespective of the screening outcome. Red flag alerts include:
  - parent/caregiver or teacher concern regarding a child's hearing, speech and language development, inattention, learning difficulties or any ear problems (irrespective of test outcomes) *(8)*;
  - ear discharge; if ear discharge is foul smelling, this should be a cause for immediate and urgent referral;
  - redness and painful swelling behind the ear (mastoid); and
  - acute pain in or around the ear.

Referrals can be made to a primary care physician, trained nurse or to an ear and hearing care clinician. The decision of who should receive the referrals must be based on the local context, availability of ear and hearing clinicians and other trained health workforce. A triaged referral approach can be followed. For example, medical concerns such as ear discharge, swelling etc., can be treated by a primary care physician or trained nurse; hearing loss concerns should be referred directly to an ear and hearing care clinician.

4 Flyer on ear care (English): https://who.canto.global/s/Q2CPO

2.9 DIAGNOSTIC ASSESSMENT

Diagnostic services for assessing hearing loss that are available at the referral centre should include *(5–12)*:

- diagnostic pure tone audiometry (wherever possible, this should include bone conduction testing);
- otoscopic or microscopic examination; and
- tympanometry or other measures of middle-ear status.

The type of diagnostic test conducted should be decided by the ear and hearing care clinician following an examination. Specialized neurological or radiological tests may be required.

2.10 INTERVENTION

All children identified with hearing loss or ear diseases should have rapid access to interventions. The need for such services should be based on advice by clinicians through a person-centred approach, taking into account: *(1)*

- the nature and severity of the hearing loss;
- ear diseases and possible complications;
- comorbidity/ies;
- family preferences for type of intervention;
- available resources; and
- cultural considerations.

The range of services for intervention include: *(1)*

- the medical management of ear diseases;
- middle-ear surgery;
- the use of hearing technologies, such as hearing aids, or other implantable devices, such as middle-ear or cochlear implants;
- the use of hearing assistive technologies, such as hearing induction loops; hardwired, FM, or infrared systems; or remote microphone systems (direct auditory input devices);
- rehabilitative therapy;
- sign language and other means of sensory substitution, as appropriate (for example speech reading and finger spelling); or
- captioning services.

It is important that parents/caregivers whose children are diagnosed with ear disease or hearing loss receive proper guidance and support, for example through parent-to-parent support groups. In addition, teachers must be informed (through parents/caregivers), of the child's needs so that in situations where certain adaptations are needed (for example, seating the child at the front of the classroom, reducing background noise levels, using loop systems etc.) these can be made.

2.11 HEARING HEALTH PROMOTION

A school screening programme that addresses ear and hearing problems provides an opportunity to promote ear and hearing health. Children, their families/caregivers, teachers and school staff should be provided with information on the importance of:

- hearing health;
- ear care, including the "do-s and don't-s" for healthy hearing;[5] and
- safe listening, including use of hearing protection, safe listening practices and available tools such as safe listening apps.

2.12 DATA MANAGEMENT

The principles of data management should be outlined clearly in the implementation guidelines as a requirement, and a reporting mechanism and quality control process defined.

Data management protocol should consider:

- The notification of test results to parents and teachers.
- Confidentiality of results.
- The recording of results and maintaining a database that includes:
  - screening data with date/s (e.g. screening outcome for each frequency, noise levels of the screening environment);
  - recommendations made;
  - personnel conducting follow-up; and
  - monitoring of outcomes in children referred under the programme.
- Regular reporting to address questions such as:
  - What percentage of the target population was screened?
  - Of those screened, what percentage was referred for further ear and hearing assessment?

5 Flyer on ear care (English): https://who.canto.global/s/Q2CPO

  - Of those referred, what percentage received a professional ear and hearing assessment?
  - What percentage of those screened was found to have an ear disease or hearing problem?
  - What types of ear diseases or hearing problems were identified?

- Data analysis and reporting:
  - to monitor trends over time;
  - to showcase the need for ear and hearing screening in schools;
  - for quality control; and
  - for training and feedback to testers and educators.

2.13 PREREQUISITES FOR ESTABLISHING SCHOOL-BASED EAR AND HEARING SCREENING

When planning ear and hearing programmes in schools, the following factors must be considered:

- Ear and hearing care services must be available for referred children, or be developed concurrently.
- Noise levels at the screening site must be controlled.
- Screening must be calibrated regularly (preferably at least once annually), using reliable equipment.
- Consent or assent must be given by the parent/caregiver and child (active or passive, in line with local policies).
- Normal asepsis measures must be established for infection control.
- Management and accountability of the programme must be ensured.
- Procedures must be in place for follow-up of referrals.

2.14 USE OF TELEMEDICINE FOR SCHOOL-BASED SCREENING *(20)*

In areas that have human resource limitations, ear and hearing screening can be undertaken through the application of telemedicine services whereby trained health workers conduct examinations on-site connecting with clinicians in a remote location. By reviewing images and test results, clinicians can guide health workers through potential diagnosis and referral for care. The remote connection can either take place in real-time; or the examination and images can be stored for later review by the clinician and feedback provided in a time-bound manner to facilitate early intervention.

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3 HEARING SCREENING IN OLDER PEOPLE

3.1 NEED AND RATIONALE

Global Burden of Disease estimates suggest that over 65% of the global population aged over 60 years experiences some degree of hearing loss *(1)*. Given the global demographic trends *(2)*, the need for hearing care among older people is likely to continue rising in the coming decades *(3)*.

The consequences of unaddressed adult-onset hearing loss include social withdrawal and isolation, emotional dysfunction, threats to personal relationships, loss of productivity and wages, early retirement, and mental and physical decline including poor balance and falls *(4–10)*. Hearing loss in older people is significantly associated with increased risk of dementia and cognitive decline. Given the high prevalence of hearing loss in older people and the degree of its association with dementia, addressing hearing loss may contribute to reducing the risk of dementia by 8% at the population level *(11)*. Indeed, at the population level, hearing loss is the most common potentially modifiable factor for dementia among older people.

Early detection of hearing loss and appropriate interventions can mitigate many of the associated adverse effects in older people *(12–14)*. However, the onset of hearing loss is often subtle and can go unrecognized *(15)*. Notably, people aged in their 60s with unacknowledged or unaddressed hearing loss are at increased risk of social isolation and cognitive decline *(16)*. Despite the functional limitations associated with hearing loss *(17)*, people typically wait as long as 10 years before seeking any hearing care *(18, 19)*. Hence, it is important to implement systematic hearing screening in older people followed by prompt rehabilitation (such as hearing aid fitting) *(4, 17, 20)*.

Although the cost–effectiveness of hearing screening in older people has not been studied extensively, limited available literature describes how an increased use of hearing care *(21)* is associated with a positive improvement to the quality of life of older people, as well as economic gains to society *(18, 22)*.

3.2 SCREENING PRACTICES AROUND THE WORLD

Globally, guidelines for hearing screening in older people are limited. Where guidelines have been developed, they vary substantially in their recommendations *(23–26).* In some countries, hearing screening is implemented solely for those with clinical indications or concerns; in others, annual or 3-yearly screening is recommended. Age groups for screening also vary, as do methods of testing and follow-up *(23, 25, 26)*. In 2021, the United States Preventive Services Task Force *(27)* concluded that at present there is insufficient evidence for screening asymptomatic adults aged 50 years and older for hearing loss. Overall, there is a lack of universal guidelines for when and how older people should be screened.

The limitation in available evidence to support systematic screening for hearing loss among older people is a primary barrier to expanding hearing screening. The relative lack of evidence underlines the importance of research across diverse settings and countries. With an ageing global population, and increasing evidence of the negative ramifications of adult-onset hearing loss, action is needed. With the growing understanding of the importance of systematic hearing screening followed by intervention in older people *(17, 28),* the guidance outlined below provides a basis for countries to plan, implement and evaluate their own hearing screening programmes. The recommendations presented are based on current understanding and available evidence and are subject to future revision. The development of programmes for hearing screening of older people in coming years is likely to boost the available limited body of evidence, so that screening protocols can be refined and high-quality guidelines established.

3.3 GUIDING PRINCIPLES OF HEARING SCREENING IN OLDER PEOPLE

The principles underpinning hearing screening programmes for older people include the following:

- Diagnostic audiology services must be developed in parallel with screening programmes and should be available to those referred through screening programmes.
- Interventions, including hearing technology and rehabilitation services, must be made available and recommended based on a person-centred approach; they must support the individual's listening needs and preferences, and not be based solely on the audiological test results.

- The care pathways and follow-up mechanisms should be outlined at the time of intervention planning and integrated in the comprehensive care pathway. This is essential so that people identified with hearing loss can benefit from options for person-centred care following the screening *(1)*.
- Wherever feasible, hearing screening should be part of routine health checks or combined with other health interventions (e.g. general physical check-up, eye screening, dental care etc.). The WHO ICOPE handbook recommends to screen hearing capacity in conjunction with other domains of intrinsic capacity (malnutrition, cognition, mobility, mood, vision) as well as underlying diseases. It can also be included in evaluation of people with comorbidities such as those with diabetes and cognitive impairments.
- The components of professional accountability, risk management, quality assurance, and programme evaluation must be developed prior to implementation of any screening programme.

3.4 TARGET GROUP AND AIMS

All older people should be screened with the aim of identifying, at the earliest possible stage, those with hearing loss who would benefit from the use of hearing technology or from non-technological interventions such as education, counselling and communication training.

(The target group does not include those who are currently enrolled in workplace hearing conservation programmes for exposure to noise or chemicals. Those services are outside the scope of this document and should not be influenced or altered by age-based hearing screening.)

3.5 AGE FOR SCREENING AND FREQUENCY

All adults, from the age of 50 years should be screened regularly for hearing loss. Screening may be conducted at 5-yearly intervals until the age of 64 years. From 65 years of age, the frequency of screening should be increased to every 1–3 years *(23, 26)*. Wherever possible, hearing screening schedules should align with other health checks.

3.6 SITE OF SCREENING

Screening can take place in a variety of settings including:

- **clinical settings:** primary care centres, physician's clinics, hospitals, audiology clinics;
- **community settings:** public facilities such as recreation centres and libraries; or
- **home settings:** private homes or long-term care facilities for older people.

In each of the settings, tests can be administered in-person or online. The site selection should be based on local context, ease of access for older people, availability of human

resources and ability to ensure control of background noise levels during testing so that accurate test results can be obtained. Screening in home settings can be conducted during home care services visits.

3.7 SCREENING TESTS

There are two stages of testing for hearing loss in older people:

Step 1: All those undergoing screening should be asked about the status of their hearing and experience of hearing difficulties in day-to-day life using simple questions, examples of which are outlined in Box 3.1. As far as possible, validated questions with established psychometric properties should be used.

Box 3.1 Examples of questions for screening

A. Yes/No questions:

- Do you have a hearing problem now? *(29)*
- Do you have a diagnosed hearing loss?
- Do you use hearing aids?

B. Scaled questions:

- How would you characterize your hearing (using a hearing device if you use one)? *(30)*
  - Excellent
  - Very good
  - Good
  - Fair
  - Poor

C. Existing screening questionnaire

- The hearing handicap inventory for the elderly (HHIE) *(31)*.

A positive response to the question or questionnaire indicates a hearing problem, and the person should be referred for audiological assessment rather than be sent for screening. If the person already has a diagnosed hearing loss or uses a hearing aid, referral for audiological assessment may be unnecessary at times. However, it may still be required if there has been no recent follow up with an ear and hearing care professional. The person may be directed directly for such consultation without having to undergo Step 2.

With individuals whose response is negative (i.e. they do not report a hearing problem), a second screening test should be undertaken (Step 2).

Step 2: The following tests, described in Table 3.1, are used to check for hearing loss in older people:

- Detection of pure tones in both ears at a fixed decibel level.
- Digit triplet-in-noise test.
- Determination of air conduction thresholds through pure-tone threshold screening.
- Whispered voice test.

Table 3.1 Tests for screening in older people

Screening test	Setting	Testing method	Refer criteria
Detection of pure tones in both ears at a fixed dB level.	Most suitable when screening is undertaken in a community setting or in clinical settings other than an audiology clinic.	Both ears should be tested separately, at three frequencies (1 kHz, 2 kHz and 4 kHz), at a fixed dB level of 35 dBHL.	Failure to respond at 35 dBHL at one or more frequencies in either ear.*
Digit triplet-in-noise test.		Both ears tested together through digit triplet-in-noise test, such as the WHO hearWHO	A low score that corresponds to a dB cut-off of 35 dBHL e.g. A score below 50 on the hearWHO test.
Determination of air conduction thresholds through pure tone screening.	Audiology clinic.	Both ears tested separately for air conduction thresholds. Four frequencies (0.5 kHZ, 1 kHz, 2 kHz and 4 kHz) Hearing threshold calculated as an average of the four frequencies.	An average hearing threshold below 35 dBHL.
Whispered voice test	This should be the preferred option only when other tests are unavailable.	See Annex 3 (Whispered voice test).	See Annex 3 (Whispered voice test).

* Where the capacity of the health system permits, and it is considered more suitable, mild hearing loss can also be identified (i.e. a hearing level above 20 dB may be set as the criterium).

When undertaking any of the above-described tests, it is important to ensure that levels of background noise are below 40 dBA *(32).* This can be ensured by testing with a sound level meter or with use of a validated smartphone app.[6]

6 Some examples of validated apps that can be downloaded for use: NIOSH Sound Level Meter, Sound Meter Pro, or Sound Meter and Noise Detector.

3.8 FOLLOW-UP

a) "Pass" result: All those with a "pass" result in the screening should be advised to:

- care for their ears and be provided with relevant information about hearing, listening function in everyday life, and ear and hearing care;[7]
- undergo another screening at a specified future time point (at least after a period of 5 years or 2 years, depending on age);
- seek medical care in the event of any symptom such as increased hearing difficulty, tinnitus, ear discharge etc.

b) "Refer" result: All those who are referred through hearing screening should:

- be asked about the presence of any "red flag" alerts (see Box 3.2);
- have an ear examination to assess for wax impaction and its removal;
- have a repeat hearing screening following the removal of wax.
- in cases where, after wax removal and repeat screening, another "refer" result is given, undergo diagnostic testing, which, if possible, should be conducted during the same visit to minimize patient discomfort and maximize compliance.

c) Red flags: All those with a "red flag" alert following screening should be referred to an ear and hearing care clinician for further assessment, irrespective of the screening outcome.

Box 3.2 "Red flag" alerts

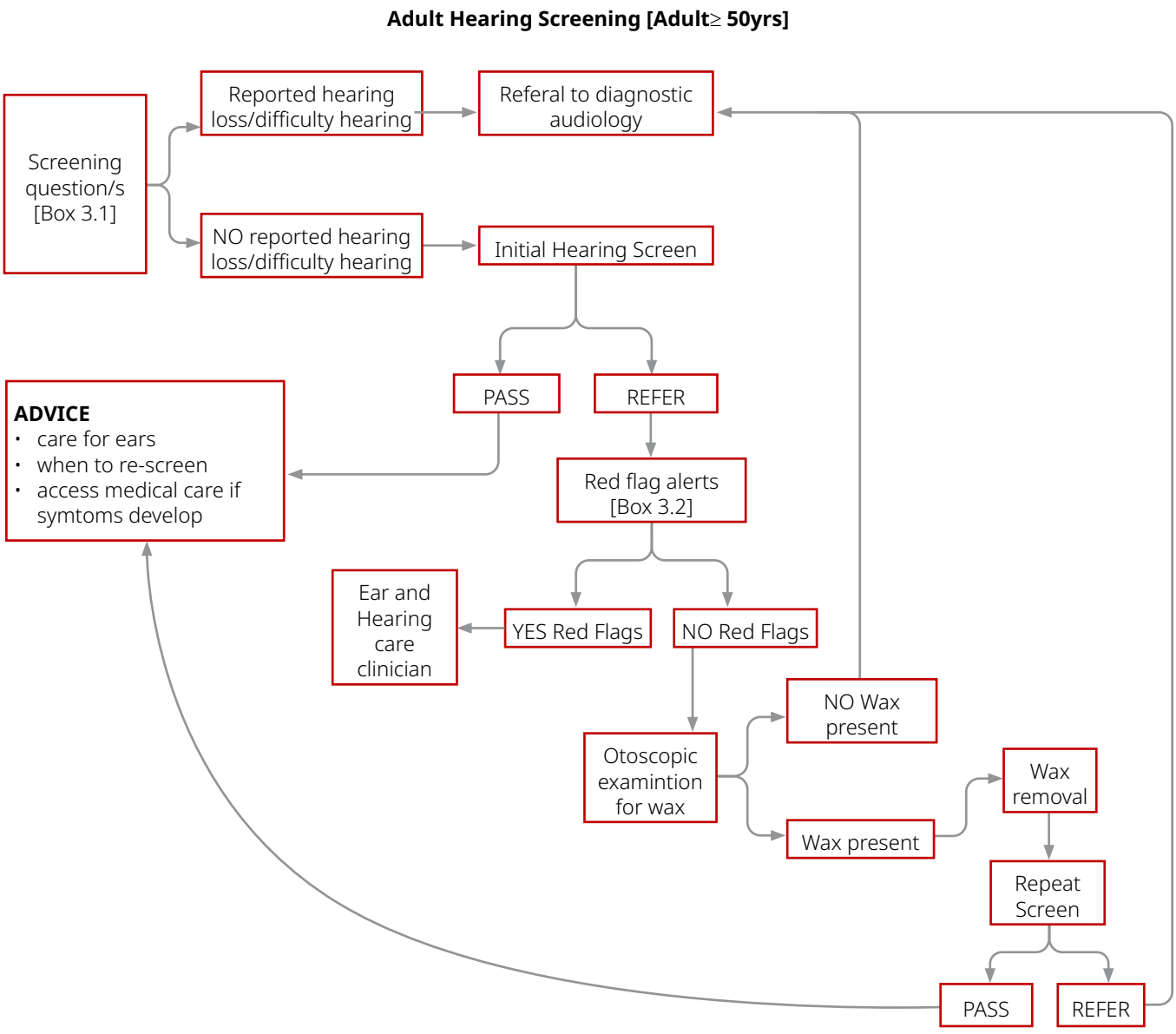
A "Red flag" alert following screening indicates the need for expert attention and can result from:

- a history of rapidly progressive hearing loss or unilateral hearing loss of unknown origin;
- exposure to noise (at work, home or in recreational activities) or ototoxic medicines/ chemicals;
- complaint of ear pain, ear discharge or dizziness; and
- a pre-existing diagnosis of ear disease, such as chronic otitis media.

All individuals who are referred for further assessment should be followed up to ensure that they are able to access the diagnostic services and care they need. The processes of screening, referral and follow-up are described in Figure 3.1.

7 Flyer on ear care (English): https://who.canto.global/s/Q2CPO

Figure 3.1 Steps in hearing screening and follow-up of older people* *(17)*



*Adapted from **the WHO Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care.** See: https://apps.who.int/iris/handle/10665/326843.

3.9 HUMAN RESOURCES

Hearing screening in older people can be performed by the following cadres:

- **Ear and hearing care clinicians** (e.g. ENT specialists, audiologists, speech and language pathologists).
- **Non-hearing care clinicians** (e.g. family doctor, physicians).
- **Trained health workers** (e.g. clinical officers, medical assistants, technicians, nurses, pharmacists or other allied health professionals).
- **Trained lay health workers** (e.g. community health workers).
- **Others** such as trained volunteers.

Where hearing screening is to be performed by health workers or other non-clinicians, training should be provided initially, followed by supervision and ongoing support, the level of which will depend on the test they are trained to administer.

3.10 DIAGNOSTIC ASSESSMENT

All those who obtain a "refer" result after wax removal (if this was indicated) should undergo a diagnostic hearing assessment to confirm hearing loss and establish degree and nature. This helps identify the need for rehabilitation and/or other interventions and should include at a minimum:

- **pure-tone audiometry** (PTA): air- and bone-conduction; and
- **tympanometry** for middle ear assessment.

Wherever it is feasible to do so, **speech audiometry** should be undertaken as this can offer valuable information regarding everyday functioning. Basic diagnostic assessments can be conducted by an ear and hearing care professional or other trained personnel.

3.11 INTERVENTION

Once a diagnosis of hearing loss has been made, the interventions must include option (a) and may include options (b) (c) or (d):

(a) Basic education and counselling on hearing loss for people with hearing loss, their caregivers and families, to facilitate psychological acceptance and adjustment. This should also include communication training and adaptations in social and physical environments and peer mentoring.

(b) The need for, and type of, hearing technology should be assessed and whichever technology is required (e.g. hearing aids, implant, hearing assistive technologies) should be provided and fitted by a trained professional who is authorized to do so (in line with local rules and regulations).

(c) Further or more advanced testing, where this has been indicated by the nature of hearing loss or associated symptoms.

(d) Repeat testing at a later date, as considered necessary.

Once hearing loss is identified, it is essential that it is addressed as early as possible and in an appropriate manner to mitigate any adverse impact. Intervention strategies must adopt a person-centred approach, taking into account the individual's communication needs and preferences, as well as available resources *(1)* (Figure 3.2). Intervention strategies should also address the individual's social and physical environments (Box 3.3), including guidance regarding hearing assistive technologies (such as FM systems and hearing induction loops), captioning, speech reading and communication strategy training. Some people (and their families/caregivers) may benefit from counselling to help them accept and adjust to the hearing loss, including learning to overcome the stigmatizing attitudes of others towards hearing loss. Others may also need care for related comorbidities, such as cognitive decline or dementia.

Figure 3.2 Person centred ear and hearing care

CLINICAL PROFILE – WHICH INCLUDES:

Otological status

Audiological profile: degree; type; age of onset

Other functional limitations such as visual impairment; developmental disabilities e.g. autism

COMMUNICATION NEEDS – WHICH INCLUDE:

Hearing difficulties experienced

Communication requirements

COMMUNICATION PREFERENCES – SUCH AS:

Oral–aural

Visual/tactile

AVAILABLE RESOURCES

What resources are possible given the environment, health infrastructure and clinical services available

Box 3.3 Assessing and managing social and physical environments*

- Provide support and help with managing emotional distress.
- Provide hearing assistive technologies around the house (e.g. vibrating or flashing telephones and doorbells).
- Provide the individual and their family/caregiver with strategies to stay connected and maintain social relationships.

*Adapted from **the WHO Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care.** See: https://apps.who.int/iris/handle/10665/326843.

3.12 HEARING HEALTH PROMOTION

Those who receive a "pass" result for their hearing screening test, should be provided with information regarding the prevention of hearing loss and care of ears, including:

- the importance of hearing health;
- ear care, including the "do-s and don't-s" for healthy hearing;[8]
- noise control in the environment; ear protection at home and in the workplace;
- safe listening including the importance of, and means for, safe listening practices; and
- the importance of communication for maintaining participation in activities of everyday life.

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ANNEX 1
COMPONENTS OF A TRAINING PROGRAMME FOR NEWBORN HEARING SCREENING

IDENTIFICATION OF TRAINERS

- It is recommended that training and assessment of competency be undertaken by professionals with experience in hearing screening techniques and practices (for example audiologists, otologists or experienced screening programme managers), in conjunction with training input from equipment manufacturers.
- Organizing a "train-the-trainer" educational programme would help increase the numbers of trainees for screening.

TRAINING PROGRAMME

- Course components of a training programme should include: screening procedures and equipment use; calibrating and maintaining equipment; optimizing the screening state of the infant; explaining test procedures and results; and documenting and reporting test results.
- Training should be delivered face-to-face and include practical learning experience.
- Attention should be paid to infection control procedures and infant handling skills.

REVISION TRAINING

- It is recommended that regular educational in-service training for screeners is conducted and that screening personnel demonstrate the required competency and skills to perform the hearing screen.

TRAINEES MUST COMPLETE A MINIMUM INITIAL TRAINING AND DEMONSTRATE COMPETENCY AND SKILLS IN THE FOLLOWING AREAS:

- Benefits of hearing screening.
- Clinical screening procedures, ensuring:
  - a quiet screening space;
  - an ideal screening state (e.g. for infants, preferably sleeping or settled);
  - correct preparation and set-up;

  - correct probe positioning (i.e. verifying ear canal is open and patent).
- How to perform the screening; equipment uses and care:
  - Conducting the daily probe or headphone calibration and checking to minimize errors with, for example:
    - poor connections between probe and hardware; or
    - problems related to debris or wax blocking the speaker or microphone ports in the probe tip.
- Policies and procedures of the hospital or other health facility for hearing screening.
- Risks, including psychological stress of the parents.
- General care and handling of infants in hospital settings, especially NICU infants, in line with the hospital policies and procedures.
- Documentation in the medical file to include:
  - obtaining signed consent form;
  - recording results (e.g. Bilateral PASS; Unilateral REFER; Incomplete; Declined screen);
  - screening method used (e.g. Screening TEOAE, Screening DPOAE, Screening ABR,[9] whispered voice test, pure tone audiometry screening); and
  - making a referral – and the referral centre.
- Communication of results to parents/guardian and other health professionals, to include:
  - explaining the screening result – e.g. what the result means, the next steps (e.g. referral to diagnostic assessment for a "Refer" result or follow-up after 6 months of age in cases where the child has been identified with a risk factor for hearing loss).
  - ensuring the parents/guardian understand the importance of immediate follow-up.
- How best to respond if a parent/guardian declines a screening.
- Reporting and data collection, keeping in mind:
  - confidentiality of screening data; and
  - relevant regulations/laws.
- Required hospital and other health clinic mandatory training, such as:
  - infection control practices and hand hygiene;
  - security; and
  - fire safety training.
- Cultural sensitivity.

9 TEOAE: transitory evoked otoacoustic emission; DPOAE: distortion product otoacoustic emission; ABR: auditory brainstem response.

EXAMPLES OF TRAINING PROGRAMMES

- In the United Kingdom of Great Britain and Northern Ireland: https://www.gov.uk/government/publications/newborn-hearing-screening-programme-nhsp-operational-guidance/2-education-and-training.
- In Utah, USA: http://www.infanthearing.org/nhstc/.

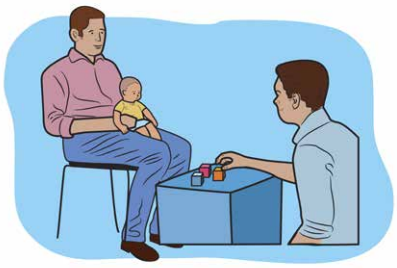
ANNEX 2
DISTRACTION TEST FOR IDENTIFYING HEARING LOSS IN CHILDREN

REQUIREMENTS:

- Two people to perform the test, one as the distractor and one as the tester.
- Colourful wooden blocks or similar toy (the toy should not make any noise).
- A towel or sheet.
- Rattle (if available).

PROCEDURE:

1. Make sure you are in a quiet room.
2. The infant should sit in the lap of the parent. The parent should be asked to stay still and silent.
3. The distractor should sit in front of the infant, with the wooden blocks (or other toy).



4. The tester should sit behind and to the side of the infant, holding the rattle. The tester should be about one metre away from the infant.

5. The distractor plays a game with the infant. For example, putting wooden blocks on top of each other.
6. The distractor stops playing and covers the blocks (or the toy) with a towel or sheet.
7. The tester gently shakes the rattle for five seconds. The infant should turn to the noise.
8. The tester moves to behind the other side of the infant. Steps 5 to 7 are repeated.
9. Repeat steps 5 and 6. Do not make any noise. The infant should not turn its head. This confirms that the infant is actually turning their head because of the sound.
10. If the infant does not turn, the test can be repeated with a louder sound. If there is no response the child should be sent to a specialist for further tests.

Additional notes: If a rattle is not available, the tester can use their voice. A low pitch "oooo" sound and a medium pitch "eeee" sound should be used on each side.

Its important to note that this method is not always reliable or validated. In case of any doubt, REFER!

ANNEX 3
WHISPERED VOICE TEST

A whispered voice test should be the preferred option only when other methods for testing are unavailable.

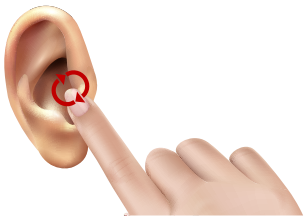
Conducting a whispered voice test:[10]

Figure A1 The University of California Whisper Test

The Whisper Test

1. With the patient sitting on an exam table or chair, stand an arm's length away (approximately 2 ft.) behind the patient.

2. Tell the patient: "During the hearing test, I will ask you to cover the ear that is not being tested as I say the letters and numbers out loud. You will cover your ear by putting your finger over your tragus."



3. Have the patient cover the ear that's NOT being tested with one finger over the tragus. Have the patient slowly move the finger in a circular motion.

4. Take a deep breath and exhale fully before whispering the number-letter combination.

5. Give a number-letter-number combination (for example, 4-K-2).

8-M-3 **2-J-7**
K-5-R **S-4-G**

6. Have the patient repeat what they hear.

7. If the patient successfully repeats, move on to testing the other ear. Ensure that the number-letter-number combination is different for each ear.

8. If the patient is unsuccessful, reattempt testing with a different number-letter combination. If a patient gets 3 total letters and/or numbers correct (out of 6 numbers or letters spoken for that ear) after a second attempt, it is considered a pass.

9. Remember to document the results.

10 Adapted from the University of California, San Francisco, United States of America (https://geriatrics.ucsf.edu/sites/geriatrics.ucsf.edu/files/2018-06/whispertest.pdf, accessed 18 May 2021).

ANNEX 4
MANAGEMENT OF CONFLICT OF INTEREST

All members of the technical working group (TWG) and peer reviewers completed and submitted a WHO Declaration of Interests form and signed confidentiality undertakings prior to attending any TWG meetings and review. The WHO department for Noncommunicable diseases reviewed and assessed the submitted declarations of interest and performed an internet search to identify any obvious public controversies or interests that may lead to compromising situations. If additional guidance on management of any declaration or conflicts of interest had been required, the department would have consulted with colleagues in Office of Compliance, Risk Management and Ethics. If deemed necessary, individuals found to have conflicts of interest, financial or non-financial, would have been excluded from participation on any topics where interests were conflicting. The management of conflicts of interest was reviewed throughout the process. TWG members were required to update their Declaration of Interest, if necessary, before each meeting. Declared interests of the TWG members and reviewers are summarized below. No conflict of interest was identified.

Name	Expertise	Disclosure of interest	Management of conflict of interest
Arun Agarwal	Community ENT	None declared	None identified
Susan Emmett	School ear and hearing screening, ENT	None declared	None identified
Catherine Mcmahon	Hearing screening in older adults	Employment at Macquarie University Research funds NIH/ NIDCD	None identified
James Saunders	ENT, school ear and hearing screening	None declared	None identified
Christine Yoshinaga-Itano	Newborn hearing screening	Research funds	None identified
Xingkuan Bu	ENT, hearing screening	None declared	None identified
Patricia Castellanos	Community audiology	None declared	None identified
Chitra Chander	Public health	Paid consultancy (WHO)	None identified
Ivy Chilingulo	Public health	Paid consultancy (WHO)	None identified

Name	Expertise	Disclosure of interest	Management of conflict of interest
Teresa Ching	Audiology, hearing screening	None declared	None identified
Jackie Clark	Audiology	None declared	None identified
Adrian Davis	Audiology, Public health	None declared	None identified
Kathleen Pichora-Fuller	Hearing screening in older adults	Research funds	None identified
Jean-Pierre Gagne	Adult audiology	None declared	None identified
Carmen Kung	Cognitive Neuroscience	Research funds	None identified
Arunda Malachi	Public health	Paid consultancy (WHO)	None identified
Vivienne Marnane	Speech Pathology	Research funds	None identified
Norberto Martinez	ENT and audiology	None declared	None identified
Serah Ndwega	Community audiology	None declared	None identified
Katrin Neumann	Audiology, newborn screening	None declared	None identified
Carrie Nieman	Hearing screening in in older adults, community ENT	Employment,- Johns Hopkins University School of Medicine, Research funds-National Institutes of Health, United States	None identified
Bolajako Olusanya	Pediatric audiology	Director, Phonics Hearing Centre, Lagos, Nigeria	None identified
Sowmya Rao	Audiology	Paid consultancy (WHO)	None identified
De Wet Swanepoel	Audiology, hearing screening technologies	Co-founder hearX digital hearing technologies	None identified
George Tavartkilaze	Audiology	None declared	None identified
Peter Thorne	Audiology	None declared	None identified
Kelly Tremblay	Adult audiology	Research funds, University of Washington	None identified
Katherine Wallis	Public health	Paid consultancy (WHO)	None identified
Angela Wong	Audiology	Research funds	None identified

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For more details refer to:
https://www.who.int/health-topics/hearing-loss

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