Alberta College of
Speech-Language Pathologists
and Audiologists

Guideline:

Hearing Screening Guideline and Protocol

Preschool to Adult

July 2023

Alberta College of Speech-Language Pathologists and Audiologists

Hearing Screening Guideline and Protocol

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Navigating this Guideline

This guideline specifically addresses the responsibilities of the registered speech-language pathologist (SLP) or audiologist for the provision of hearing screening services. This document utilizes the following icons:

The **Tools and Templates** icon provides the SLP or audiologist with checklists and documents that can be used to assist them with the provision of hearing screening services. Click on the bolded title of the document to view/print the tool and/template.

The **Magnifying Glass** is used to identify the first time that a key term is mentioned. The key term is italicized, bolded, and defined in the Glossary of Terms.

The **Link** icon references resources that the SLP or audiologist may want to review. These are typically external additional resources that may be helpful and can be accessed by clicking on the bolded title.

Acknowledgement

ACSLPA would like to thank the ACSLPA Hearing Guideline Review Ad-Hoc committee members for their time and participation on this committee, and the ACSLPA members who took time to share their expertise and provide thoughtful review and revisions to this guideline.

Introduction

This document outlines recommendations for standard procedures for developing a hearing screening program, and guides regulated members of ACSLPA in the procedure of screening to identify individuals who are at risk for peripheral hearing loss and require audiological follow-up. It is intended for use by regulated members and provides guidance to support personnel (SP) who work under the supervision of ACSLPA regulated members.

This document reflects current best practice methods, as described by the American Speech-Language-Hearing Association (ASHA) in 2021, the World Health Organization (WHO) World Report on Hearing (2021b), and the WHO Hearing Screening Considerations for Implementation (2021a). These guidelines are subject to periodic review and revisions over time.

Disclaimer:

While this document is intended for regulated members of ACSLPA and to guide support personnel (SP) who are supervised by regulated members, this protocol is available for use by other professions who conduct hearing screening. ACSLPA is not responsible for the misuse of this guideline or the actions of professionals belonging to another regulatory body (e.g., physicians, nurses, hearing aid practitioners, etc.).

Preamble

The Global Burden of Disease Study (2019) estimates that 1.57 billion people worldwide had some degree of hearing loss in 2019. Further, since more than 60% of people with hearing loss are over the age of 50 years, the prevalence of hearing loss is expected to increase as people age (Global Burden of Disease Study, 2019). WHO (2021b) estimates that by 2050, there will be 2.5 billion people with hearing loss.

Feder et al (2017) found that 7.7% of the Canadian children aged 6-19 years included in their study had previously undiagnosed hearing loss which they felt was an under representation of hearing loss in this population. This would suggest that even in the presence of an Early Hearing Detection and Intervention (EHDI) program, ongoing hearing screening is important to identify this condition in children.

Untreated hearing loss carries many negative consequences including sensorineural deprivation, delayed learning, cognitive and communication skills in children to loneliness, isolation, depression, and communication challenges in adults. Increased risk of dementia is associated with hearing loss in older adults (WHO, 2021a). Hearing loss, even when not severe, can have debilitating effects for school aged children (ASHA, 2021b) and can negatively impact speech and language development (WHO, 2021b). Bagatto (2020) notes that children with bilateral mild hearing loss can experience speech and language difficulties as well as social, emotional, and educational challenges. Mild hearing loss can cause difficulty understanding speech at normal conversational levels for adults when in the presence of background noise (WHO, 2021b).

Hearing loss can be expressed in one or both ears with a range of severities and types. Severity labels range from ‘mild’ to ‘profound’.

Hearing loss types include:

- Conductive - involving sound transmission through the external and middle-ear structures.
- Sensory - involving the analysis of sound waves and their conversion to a complex pattern of nerve impulses by the cochlea.
- Neural - involving the further analysis and transmission of nerve impulses to higher brain centres.

Hearing disorders may occur in any of these systems, alone or concurrently. Many conductive disorders are temporary and/or recurrent, but some may be chronic or permanent. Most sensory or neural disorders are almost always permanent, and some may be late in onset or become progressively worse over time.

Screening is an effective, low-cost intervention to identify and treat hearing loss and mitigate the negative consequences of this condition. The primary intent of hearing screening is to minimize the immediate and long-term consequences of hearing loss in people of all ages. WHO (2021a) recommends that hearing screening be implemented for those who are at risk across all stages of the life course from newborn infants to children to adults in high-risk occupations and older adults. Even when an Early Hearing Detection and Intervention (EHDI) program is in place it is important to have methods to identify hearing loss that develops at a later stage (WHO, 2021a).

Pediatric risk factors for hearing loss should be considered in hearing screening programs, however, a consistent, universal list of risk factors does not exist. For a list of childhood risk factors most frequently referenced in North America please refer to the Joint Committee of Infant Hearing's year 2019 position statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs, p. 19.

Alberta has a provincial EHDI program for newborns but does not have a province-wide mass screening program for children or adults at the time of this publication. Most individuals who receive hearing screening in Alberta are considered part of a targeted or high-risk population who possess a pre-existing illness or disorder (i.e., communication delays).

Hearing screening is an essential part of a communication assessment to establish if the client's hearing is sufficient to obtain reliable results on speech-language assessment and to optimize speech-language interventions, as applicable. Commencing speech-language therapy with an individual who has an undiagnosed hearing loss can lead to misdiagnoses, ineffective and inefficient service delivery, and delays in treating hearing loss. The SLP conducting a speech language assessment for a minor has a responsibility to support the parents or guardians to obtain a hearing screening for the child if the screening cannot occur at the time/place of the assessment. Every effort should be made to secure the hearing screening as soon as possible either before (preferred) or after the assessment.

Designing A Hearing Screening Program

Introduction

The goal of hearing screening is to identify individuals (children from age 3 years to adults) most likely to have peripheral hearing loss that may affect everyday communication, educational success, social, language, and cognitive development and/or integrity.

The selection of any screening test depends, in part, on the test's performance in separating those with the **target condition** from those without the target condition. Whatever the screening test, a single cut-off value (the test criterion) must be chosen. The outcome of the screening is one of two possibilities: 'pass' or 'refer' (ASHA, 2021a).

A hearing screening program is designed to maintain the following integrated activities:

- selection of the target population,
- selection of screening personnel,
- training and supervision of screening personnel,
- implementation of defined protocols,
- data management, and
- a process for referral and follow-up for those who meet set criteria (pass vs. refer).

Audiologists are responsible for developing, implementing, managing, and overseeing hearing screening programs. They are accountable for hearing screening programs and are a resource for hearing screening procedural issues. Audiologists are also responsible for identifying risk factors that may impact the effectiveness of hearing screening programs such as infection prevention and control (IPC) measures, invalid screening results resulting from equipment malfunction or errors in calibration, loss to follow-up, etc., and for developing procedures to minimize or eliminate those factors (ASHA, 2021a).

Speech-language pathologists may be involved with developing a hearing screening program in collaboration with an audiologist (ASHA, 2021b). The role of SLPs is to collaborate with audiologists regarding the administration of a hearing screening program, to complete hearing screenings (and to supervise SP who complete hearing screenings) including communicating results and making referrals when appropriate.

SLPs must consult with audiologists when involved in developing a hearing screening program. An SLP who implements a hearing screening program and/or conducts hearing screening as part of a speech-language assessment should have an audiologist available for consultation as required. For example, SLPs can consider establishing a relationship with an audiologist who works in the same facility or with a community-based audiologist and booking an annual meeting to review hearing screening procedures and/or questions and concerns regarding hearing screening.

Program evaluation may involve the development of mechanisms to determine pass/refer rates, **false positive rates**, **false negative rates**, and to assure the effectiveness of follow-up protocols for patients who require rescreening or audiological follow-up. The types of data suggested to determine a program's effectiveness (e.g., **Positive Predictive Value (PPV)** and **sensitivity/specificity)** include:

- number of clients screened,
- percentage of clients who did not pass the screening procedure (initial and rescreen),
- percentage of clients referred for audiological follow-up, and
- number of clients diagnosed with permanent hearing loss (PHL).

Evaluation of a hearing screening program should be on-going in order to correct factors that negatively impact program performance and patient outcomes and experience.

Privacy and Confidentiality

Regulated members of ACSLPA must respect and ensure the confidentiality of client information. Requirements for privacy and confidentiality of client information are stated in the ACSLPA Standards of Practice, 2.2, Privacy/Confidentiality.

Informed Consent

Informed consent for hearing screening (as opposed to hearing assessment) must be obtained prior to conducting hearing screening, including follow up referral to other professionals. Please refer to ACSLPA's Standard of Practice 2.3, Informed Consent. ACSLPA's *Informed Consent for Service Guideline* provides detailed information regarding considerations related to consent.

Physician/Audiology Referral

Based on the case history and visual inspection of the ear, a person experiencing one or more of the following contraindications should be excluded from hearing screening and should, instead, be referred to the appropriate professional:

Physician Referral

- sudden hearing loss (**NOTE**: Urgent Referral Required)
- current, chronic, or recurrent ear infections
- otorrhea (drainage) and/or blood discharge from the ear canal
- otalgia (ear pain)
- foreign object in the ear canal
- inflammation of the ear

Audiology Referral

- sudden hearing loss (**NOTE**: Urgent Referral Required)
- pinna, ear canal, eardrum, head and neck abnormalities
- head injury (requiring recent hospitalization)
- programmable VP shunt

If a client is under the care of an otolaryngologist/ENT specialist or audiologist, then an audiological assessment is indicated rather than hearing screening.

Screening Personnel

Personnel involved in administering hearing screening must be trained and supervised by a registered audiologist and/or SLP who has training and experience related to the test procedures. Screening procedures may be performed by SP, and by audiologist or SLP students, under the supervision of regulated ACSLPA members (SLPs and/or audiologists). Please refer to the ACSLPA Standard of Practice on Clinical Supervision.

Preparation Visual/Otoscopic Inspection

Inspect the external ear visually prior to hearing screening to determine if contraindications such as signs of drainage or structural abnormalities exist. Otoscopic inspection is necessary for visualization of the ear canal when using insert earphones to look for any signs of drainage, impacted cerumen, the presence of a foreign body or structural abnormalities. The otoscope tip must not be inserted beyond the cartilaginous portion of the ear canal when otoscopic inspection is carried out as part of a hearing screening. Positioning the tip into the bony portion of the ear canal is a restricted practice and should only be performed by authorized individuals (*Speech-Language Pathologists and Audiologists Profession Regulation,* Alta Reg 124/2002). Training of SP to complete and report on visual or otoscopic inspection is the responsibility of an audiologist.

Selection of Stimuli

The speech-frequency related tones of 1000, 2000 and 4000 Hz are generally used as stimuli in hearing screening protocols for children and adults (WHO, 2021a) (ASHA, 2021b). In view of trends regarding the higher incidence of noise induced hearing loss in the adult and teen (13-18 years) population, it is recommended that the frequency 6000 Hz be included in the screening protocol for both teens and adults to identify permanent high frequency hearing loss (Sekhar et al., 2016).

The rationale for including 500 Hz in the screening protocol includes testing the frequency range that is essential for understanding speech (Minnesota Department of Health, 2022), recognizing the prevalence of chronic middle ear disease in children associated with fluctuating hearing loss (AAA, 2011), and recognizing that some hereditary sensorineural hearing losses present as late onset, progressive hearing losses at and below 2000 Hz (Pennings et al., 2003). However, the risk of over-referral when including 500 Hz in the screening frequencies for children is significant, especially when testing is performed outside of a sound booth. For that reason, the current protocol continues to recommend that 500 Hz be included only when testing in a sound booth and/or when using insert earphones.

Pulsed or warble tones may be used instead of pure tones (ASHA 2021b). There is evidence that pulsed and warble tones are considered less difficult to hear than steady state tones (Lentz et al, 2017).

Manufacturers may include speech stimuli (in addition to pure tone stimuli) as part of screening audiometers. Speech stimuli are not frequency specific and may miss the presence of a partial hearing loss (i.e., high or low frequency) and are not recommended for hearing screening purposes (AAA, 2011).

Tympanometry

WHO recommends that tympanometry be performed whenever possible as part of the hearing screening protocol (WHO, 2021a). ASHA (2021b) supports the use of tympanometry for younger children (2021). The results of tympanometry give an impression of the middle ear status and can indicate conditions that require a medical referral (ANSI 2021b). The Global Burden of Disease Study (2019) indicated that most hearing loss for children under the age of 5 years was linked to the presence of otitis media, hence tympanometry is a useful/important part of the screening process.

In Alberta tympanometry and otoscopy are **restricted activities** that require a specific professional competence to be performed safely. Tympanometry and otoscopy should not be included as part of a hearing screening program unless the screener involved has the clinical competency to perform this activity safely. Audiologists who wish to include tympanometry into their hearing screening program may consult ASHA guidelines (2021b).

Equipment

An audiologist can be consulted regarding the selection and use of equipment required for hearing screening.

Audiometer / Audiometric Software

Pure-tone audiometer: The audiometer is an electronic instrument or software designed to measure the sensitivity of a person's hearing. It is calibrated to produce pure tones at various frequencies to measure hearing loss in decibels (dB HL). For hearing screening, consider a lightweight, portable screening audiometer with two earphones (i.e., TDH style and insert style), that produces a minimum of octave frequencies between 250 and 6000 Hz, at levels ranging from 0 to at least 90 dB HL. Ideally, stimuli should include a pulsatile presentation option.

Software: Audiometer software is widely available. The use of American National Standards Institute (ANSI) standard software on desktops, laptops, and tablets eliminates the need for traditional portable hearing screening equipment.

Audiometers and computers are delicate electronic instruments and should be treated with care. The following recommendations will assure safe, reliable, and consistent operation of the equipment.

- Audiometers/computers used for hearing screening may be diagnostic or portable in nature and must meet federal/provincial/agency specifications for electrical safety.
- Audiometers must be calibrated regularly, at least once every year, following the initial determination that the audiometer meets American National Standards Institute (ANSI) standards S3.6-2018 or current version.
- Audiometric software for hearing screening must comply with ANSI standards. S3.6-2018 and be kept calibrated and updated regularly according to manufacturer specifications.
- Equipment service records must be maintained for 10 years from the date of the last entry. (ACSLPA *Guideline: Clinical Documentation and Record Keeping*)

Transducers

Transducers: Standard over the ear (either **circumaural**, **supra-aural**, or **noise cancelling**) headphones and insert earphones are acceptable for use in hearing screening. When using insert earphones, include an otoscopic inspection together with a visual inspection, and use caution when inserting the otoscopic tip as well as the insert earphone.

Note: The use of insert earphones, circumaural, or noise cancelling headphones may reduce the impact of background noise. Noise cancelling headphones have been found to minimize false positive outcomes when testing at 500 Hz (Lo, 2013).

All headphones must be calibrated to the specific audiometer or audiometric software used. **DO NOT** substitute another set of headphones for the set that is regularly used with the audiometer or audiometric software without recalibrating the headphones to the audiometer or audiometric software.

Headphones are delicate devices that require special care in handling. Damage to headphones can be irreparable. Avoid:

- dropping the headphones,
- snapping the headphone cushions together,
- pressing the headphones down on a flat surface,
- poking sharp objects into the diaphragm of the headphones, and/or
- getting the headphones wet causing water damage.

Regularly inspect headphones. Damaged or cracked ear cushions need to be replaced to ensure optimum fit and ambient noise reduction. Headphone bands that have lost their 'spring' become difficult to resize and need to be replaced to ensure an optimal fit.

To avoid damaging the equipment during storage and transport keep the following in mind:

- Do not leave the equipment switched on with the cover in place as this may cause overheating and damage to internal components.
- When transporting the equipment in a car, ensure that it is protected from vibration. Avoid/protect from sudden stops, drops, jolts or bumps.
- Keep the headphones inside the audiometer case when not in use.
- Check the manufacturer instructions provided with your equipment. Most manufacturers provide information on appropriate temperature ranges for storage, transport, and normal operation. If in doubt, contact the manufacturer or supplier.

Certain environmental conditions may be detrimental to the performance of the equipment. Be sure to keep the following in mind:

- Extreme heat can cause severe damage to electronic equipment.
    - Never leave the equipment resting on a radiator or near any other sources of extreme heat.
    - **DO NOT** leave the equipment inside a vehicle where it would be exposed to direct sunlight in hot weather.
- Extreme cold: Resistance to electrical current flow decreases as temperature decreases. The acoustic output of the audiometer will be affected if it has been sitting in a cold vehicle. Delicate crystals in the microprocessor-based equipment can be damaged if the equipment is used when it is extremely cold.
    - Always allow time for the equipment to warm up to room temperature before turning on the audiometer.
- High humidity can damage the internal components of the equipment.
    - Do not expose the equipment to high moisture levels.

- Exposure to magnetic fields.
    - There is potential for an adverse event to occur when screening, assessing, and treating clients with programmable, implanted medical devices, such as cardiac pacemakers/defibrillators and **ventriculoperitoneal** (VP) **shunt** valves.

Screening Environment

Hearing screening is to be conducted in a clinical or natural environment conducive to obtaining reliable results. Pure tones, especially the frequency of 500 Hz, are difficult to hear in noisy environments. Ambient noise decreases the sensitivity and specificity of the screening test and can lead to **over-referral** to audiology. To prevent or minimize over-referral, use of a room that is as quiet as possible with ambient noise levels below 40 dBA (WHO, 2021a) is required.

To evaluate room noise levels using a listening check, close the door and listen for the following constant or intermittent sounds: hum from overhead lights, fan/heating/air conditioning noise, intrusion of outdoor noise, indoor noise from nearby halls and rooms, etc. Consider all potential nearby noise sources such as plumbing, heating/cooling systems, traffic, office machines, appliances, as well as music or talking in adjoining rooms or hallways (Tennessee School Health Screening Guidelines, 2022).

Sound level meters or sound level meter apps can be used to determine the level of ambient noise in the screening environment. Screening environment noise levels should not be assumed to be static, therefore, noise levels of the screening environment need to be considered and re-measured as appropriate based on the conditions present at the time of screening.

Frequency specific noise levels can be measured using a sound level meter with 1/3 octave band measurement capability or with a validated sound level smartphone app. ASHA (2021a) recommends following ANSI specifications for maximum permissible ambient noise levels: 19.5 dBA at 500 Hz; 26.5 dBA at 1 kHz; 28 dBA at 2 kHz; and 34.5 dBA at 4 kHz (ANSI, 2003). Of note, Kardous and Shaw (2016) found the accuracy of noise measurements using a smartphone app was significantly improved when used with a calibrated external microphone.

Some environments may exceed the ANSI standard for pure tone screening but will still allow for accuracy when the screening tones are audible to normal hearing screening personnel or someone who is known to have normal hearing thresholds.

Infection Prevention and Control (IPC)

1. Hand hygiene between clients is critical. Please refer to Alberta Government Infection prevention and control strategy: Update 2015.
2. Single-use devices such as sponge tips and otoscope specula are to be disposed after one use.
3. It is recommended that headphone cushions be covered with acoustically transparent disposable headphone covers. The Council for Accreditation in Occupational Hearing Conservation (CAOHC) (2022) recommends using disposable, anti-viral earphone covers whenever possible.

   CAOHC (2022) suggests removing the cushions from the headband if using a liquid cleaner or using disinfectant wipes (alcohol or non-alcohol based). CAOHC (2022) acknowledges that the use of disinfecting cleansers degrades the earphone cushions over time. As well, CAOHC (2022) indicates that using a liquid to clean the headphones may cause damage to the transducer.

Care must be take using a cleaning liquid and earphone cushions must be replaced when cracks are observed.

Check manufacturers' recommendations for cleaning headphones.

4. Surface decontamination of surface materials and reusable devices (i.e., tabletops, toys, etc.) should occur when visibly soiled and in between clients to prevent cross-contamination. Refer to Alberta Government, Reusable & Single-Use Medical Devices Standards.

Referral Rates

Over referral reduces the effectiveness of hearing screening and places a burden on those who have normal hearing and do not require a referral to audiology (e.g., concern about hearing when there is no reason to be concerned, travel time, time away from work, the need to find childcare). As well, over referral places an unnecessary burden on audiology and healthcare resources. **Under referral** is also problematic resulting in delays in diagnosis and timely intervention.

To reduce unnecessary referrals to audiology, rescreen hearing if a refer result was obtained for the initial screen. After repositioning the headphones and reinstructing the client, carry out a second hearing screening within the same session. This has been shown to reduce referrals by at least 25% (AAA, 2011).

Repositioning the headphones and re-instructing follows the assumption that incorrect earphone placement and/or not understanding the task interfered with the ability to get an accurate screening result. If after a second screening the individual passes it is assumed one of these two factors led to the initial refer result.

Follow-Up

According to the 10 principles of screening for a disease or condition, one assumes there will be access to facilities for diagnosis and treatment (Wilson and Jungner, 1968). WHO Hearing Screening Considerations for Implementation (WHO, 2021a) recommends having protocols in place for follow up of referrals as a prerequisite for establishing hearing screening for school aged children. The offer and provision of hearing screening, whether in the context of a hearing screening program or at an individual client level, requires there to be a referral process in place to refer to an audiology service.

Data Management

Please refer to the Standard of Practice, Section 4.3, Documentation and Information Management. Detailed information regarding transmission, retention, storage, and disposal of records are addressed in the ACSLPA Guideline: *Clinical Documentation and Record Keeping* (2021).

Screening For Hearing Loss

An ACSLPA Guideline provides guidance to regulated members to support them in the clinical application of Standards of Practice.

Expected Outcomes

To identify individuals (preschool to adult) most likely to have peripheral hearing loss and who require audiological follow-up.

Target Population

Any person, from preschoolers to adults may be screened as outlined in this guideline. Any person who is determined to be 'unable to test' is to be referred to audiology services. Any individual who is routinely followed by an audiologist need not participate in hearing screening.

Clinical Indications

Hearing screening is to occur as part of a speech language assessment, or when a mandated hearing screening program is in place, or as requested when there are concerns of risk for hearing loss (ASHA 2021b). Any person who demonstrates contraindications as evidenced through visual or otoscopic inspection or case history should automatically be referred to an audiologist and/or physician (see Appendix A).

Hearing Screening Guideline

Environment and Equipment

Prior to testing, screening personnel will carry out a listening check of the equipment, headphones or earphones, and the environment. An individual with normal hearing can use a listening check to determine if the screening level of the pure tone stimulus can be heard in the screening environment.

Follow the steps below:

1. Close the door to the test room. Plug in the audiometer and turn on or open software. Ensure that the headphone or earphone jacks are properly plugged into the right (red) and left (blue) sockets.
2. Position the earphones in the ears or the headphones on the head over the ears and sweep through the test frequencies. Listen to each earphone or headphone at a 10 dB HL intensity level, for each frequency being tested: 1000, 2000, and 4000 Hz (500 Hz and/or 6000 Hz if included).
3. If the examiner or other individual can hear the tone at 10 dB HL at all frequencies, then the environment is quiet enough for the client with normal hearing to detect the tones at the appropriate screening level (i.e., 20 dB HL).
4. If the acoustic environment is not appropriate, an alternate location should be chosen.

Case History and Visual/Otoscopic Inspection

Obtain informed consent at the outset of the appointment. Following this a case history will be completed prior to screening. The case history may include the completion of a questionnaire by the client or caregiver.

Visually inspect the area around and behind the pinna. If a visual inspection indicates any contraindications to proceeding with hearing screening according to the list on page 6-7, medical and/or audiology referral is warranted.

Otoscopic inspection for hearing screening is only required if using insert earphones. It is important to use careful bracing and shallow insertion of the otoscope tip (or specula) to prevent entering the bony part of the ear canal during otoscopy.

Screening Pure Tones

1. Test frequencies are 1000, 2000, and 4000 Hz. Include 500 Hz when using a sound booth and/or insert earphones. Include 6000 Hz when screening teens and adults. Screening level intensity is 20 dB HL for children (Dodd-Murphy et al., 2014) (ASHA, 2021) and 25 dB HL for adults (ASHA, 2021a).
2. Discuss with the client how they can respond and/or train the client to respond in a specified manner each time a tone is heard. Any consistent type of response (i.e., hand-raising, verbal response, etc.) from the person being tested is acceptable. With younger children, a conditioned play audiometry technique may be used (see Appendix B – Hearing Screening Protocol-Conditioned Play Audiometry on page 22).
3. Position conventional headphones over the ears or insert earphones in the ears and present a conditioning level pure tone such as 40 dB HL at the frequency 1000 Hz. Consider using warble or pulsed pure tones instead of steady pure tones for ease of recognition.
4. Adjust the attenuator to the designated screening sound level (20 dB HL for children and 25 dB HL for adults) and present pure tones for frequencies in the following order: 1000 Hz, 2000 Hz, 4000 Hz, 6000 Hz (for teens and adults), then 500 Hz (when using a sound booth and/or insert earphones). Keep the screening sound level constant while testing all frequencies.
5. Present the tone at each frequency no less than 2 times and no more than 4 times to limit false positive responses (AAA, 2011).
6. A ‘pass’ is indicated by two positive responses out of three presentations. Failure to respond to at least 50% of the presentations (2 out of 3), at any frequency, at the screening level in either ear constitutes a ‘retest’ or ‘refer’ result. If responses are not obtained at one or several frequencies, during the initial testing, follow rescreen procedures. Note: Attempt one full screening before attempting rescreening at one or more frequencies.
7. Record results on a form that contains the date of screening, demographic information, and ear-specific and frequency specific responses. Different agencies may use different forms; however, all forms must include the above information.
8. When a client does not pass the screening the first time, an immediate rescreen is indicated (i.e., before the client leaves the appointment). To rescreen, remove the headphones, reinstruct the client, reposition the headphones and repeat the screening procedure for the missed frequencies. Rescreening occurs prior to communicating the results of the screening to the client or family, and prior to referring to an audiologist.
9. Rescreening should not be carried out more than once as multiple rescreening negatively impacts sensitivity. If after a second screening the result is still a 'refer' it is not acceptable to attempt any further adjustments and rescreen.
10. Following rescreening, refer the client to an audiologist if they fail any frequencies or if they are unable to complete rescreening. Screening personnel need to be familiar with resources

available to the client and refer them to the appropriate audiology service for follow-up. (Note: There is no need to refer to an audiologist when rescreening results in a 'Pass.').

Recording Results (PASS/REFER Criteria)

1. The results of the pure tone hearing screening must be recorded in the client file. The use of a chart to record the hearing screening results is recommended.
2. The design of screening forms may vary depending on employer requirements. Below is one example.
3. Record responses using a symbol for a positive response (✓) or for no response (x) under the appropriate box for each frequency for the right and left ears respectively as per the example below. Remember that an individual must respond to at least 50% (two out of three or four) of the presentations at each frequency to receive a 'pass' result for each ear.

Example Chart for Hearing Screening (rescreening indicated)															
Initial Screen	**500 Hz (inserts)**			**1000 Hz**			**2000 Hz**			**4000 Hz**			**6000 Hz**		
Right Ear	✓	✓		✓	✓		✓	✓		✓	x	x	✓	✓	
Left Ear	✓	✓		✓	✓		✓	✓		x	✓	x	✓	✓	

Example Chart for Hearing Rescreening (pass indicated)															
Rescreen	**500 Hz (inserts)**			**1000 Hz**			**2000 Hz**			**4000 Hz**			**6000 Hz**		
Right Ear										✓	✓				
Left Ear										✓	✓				

Referral Process (See Appendix A)

Refer the client to an audiologist if:

- the client obtains a 'refer' result for the rescreening,
- the client obtains a 'refer' result for screening and is unable to be rescreened,
- the client could not be conditioned to the task (i.e., using play during the rescreen), and/or
- the client is deemed 'unable to test'.

Documentation

Follow the ACSLPA Standard of Practice Section 4.3, *Documentation and Information Management,* related to the minimum data sets required in clinical documentation.

For hearing screening in particular:

- Document any instance where hearing screening was not able to be successfully completed and the reason why in the 'comments' section of the form.
- Recommendation for discharge ('pass') or audiological assessment ('refer') or when the client declines referral for further testing against recommendation must be documented in the client's chart/file.
- SP to document any questions that need to be directed to the supervising therapist (regardless of pass/refer results). For example, if a parent or caregiver has questions about the child's language development or if there are ongoing questions/concerns regarding the hearing screening process/results. The supervisor will then be able to follow up as necessary.

Please refer to the ACSLPA Standard of Practice, Section 4.3, *Documentation and Information Management* and the *Clinical Documentation and Record Keeping Guideline* (2021) for more detailed information.

Follow-up

1. Participation of a client in a screening procedure involves discussion regarding the results of the screen with the client or caregiver/family. Note: A 'refer' result (on the rescreen) is indicative of the need for further assessment and is not necessarily indicative of PHL.

2. Inform the client/caregiver of the screening result. SP may communicate with the client or legal guardians the results of the hearing screening in terms of 'no follow up required' or 'requires follow up with an audiologist'. If medical referral is required, the SP will connect with their supervising audiologist or speech language pathologist to have a referral sent to the designated audiology test site affiliated with their local hearing screening program.

3. If a client has obtained a 'Refer' result for the rescreen or could not be tested, indicate to the client/caregiver that, with their consent, a referral to an audiology service for follow-up will be made. If there are no audiology services available in the client's local region, screening personnel will recommend that the client/family seek audiology services in another region. Inform the client/caregiver of their options (i.e., public and private practice audiology) and support them to select an audiology service of their choice.

4. After obtaining and documenting client consent, forward the results to the audiology facility to which the client is being referred. It is important to send the completed form as soon as possible so that follow-up can be arranged promptly. Results of a failed screening are to be forwarded to the consulting audiologist directly by the screener/referral source (including the screening form that provides client demographics, contact information, and results of the screening procedure for all frequencies and both ears).

5. Provision of additional information is recommended, especially if the client was unresponsive, was difficult to test, did not understand instructions, was not in good health, or had developmental delays.

Things to Avoid When Hearing Screening

1. Using uncalibrated equipment or acoustic signals such as the whisper test, finger rub test, analogue watch test, telephone hearing screening, hand-bell ringing, etc.

2. Using non-frequency specific (i.e., speech) stimuli/signals (except in the case of digits in noise (DIN) apps for adult hearing screening).

3. Screening in a noisy environment. If the acoustic environment is not appropriate and any of the screening frequencies are not audible to the screener, then screening should be moved to an alternate location.

4. Adjusting the level of the attenuator to 'find' threshold information or a response from the client if the client does not respond to the screening stimulus.

5. Waiting to rescreen at a later appointment. If a 'refer' result is obtained on the initial screen, rescreen immediately (same appointment). If a rescreen cannot be completed when indicated, refer based on the initial hearing screening results.

6. Describing the results of a hearing screening as anything other than: 'no follow-up required' or 'requires follow-up with an audiologist'.
7. Performing otoscopic inspection in isolation and independent of pure tone screening to determine hearing status.

Additional Information For Screening Adults For Hearing Loss

Common Causes of Hearing Loss in Adults

Acquired hearing loss in the adult population can have many etiologies with the possibility of more than one risk factor for an individual to sustain a hearing loss over time. Ototoxic medications, illness, aging, and exposure to loud noise and/or chemicals are only a few common causes. For more information on potential causes for hearing loss in the adult population please refer to the WHO World Report on Hearing (2021b, p 17-22).

Rationale

Hearing loss amongst adults in Canada is estimated at 35% of the population (Ramage-Morin et.al. 2019). Unaddressed and untreated hearing loss in adults has been linked to loss of productivity (early retirement), social isolation, anxiety, loneliness, depression and increased risk of falling (Brewster et al. 2021). WHO (2021a) recommends that older people with hearing loss receive intervention as early as possible. Hearing screening, referral, and treatment can have positive outcomes for increased quality of life.

Frequency of Hearing Screening

WHO (2021a) recommends starting hearing screening at age 50 years and every 5 years after until the age of 64 years. After the age of 65 years, the frequency of hearing screening is recommended to be every 1-3 years.

ASHA (2021a) recommends incorporating three components when screening the hearing of adults:

- use of a brief case history,
- screening for hearing loss using pure tones, and
- screening for hearing disability using standardized self-assessment questionnaires.

This three-pronged approach optimally informs recommendations and counselling regarding appropriate follow-up.

Standard Screening Protocols

Standard pure tone screening measures, including case history and otoscopy may be used with the adult population (see Appendix A *Hearing Screening Protocol,* page 20). Given the probability of hearing loss in the higher frequencies due to presbycusis and noise exposure, ACSLPA recommends always including the frequencies of 6000 Hz to the screening frequencies in the screening protocol.

Technology-based Screening Tools

Technology based hearing screening tools such as the digits-in-noise (DIN) hearWHO and hearWHOpro apps allow easy and accessible options for hearing screening of adults. Some DIN apps are free, validated, and easy to use by individuals screening their own hearing or for health care workers to provide (Potgieter, J.M., Swanepoel, W., & Smits C., 2018). Smartphone based apps can offer accurate and effective hearing screening although there is wide variability at the present time (Chen, et al., 2021). It is recommended that users review the accuracy of an app prior to use.

It is of note that these apps may use different 'pass' or 'refer' values than the cut off values used when screening using pure tones. It is important to use tools that have a strong evidence base and have validated their tools via comparison to pure tone gold standard audiometry.

Checklists as Hearing Screening Tools

Use of self-assessment tools can be used as part of the overall hearing screening or alone when other screening tools are not available. There are numerous self-assessment questionnaires available (ASHA, 2021a).

Some well-known validated tools include the Hearing Handicap Inventory for the Elderly (HHIE; Chou, Dana, Bougatsos, Fleming & Beil, 2011), the Self-Assessment of Communication (Schow & Nerbonne, 1982) and the recently published, Revised Hearing Handicap Inventory Screening Tool (Cassarly et al, 2020). Each of these tools have a proposed cut off value indicating when a referral for further hearing assessment is warranted.

Referral

Inform the client of the screening result in terms of 'no follow up required' or 'requires follow up with an audiologist or other hearing health care professional'. No further test result information is to be given to the client by SP.

If the client has obtained a ‘refer’ result for the rescreen or could not be tested, indicate to the client that it is recommended they follow up with an audiology facility or hearing clinic for a complete hearing assessment. The client may choose private (i.e., fee-for-service) or publicly funded services in Alberta.

APPENDIX A - Hearing Screening Protocol

Consistent with Competency Profiles for the professions, a protocol outlines the specific clinical criteria, activities, and procedures that should be adhered to by regulated members in the provision of specific professional services. Protocols are evidence informed.

Screening Procedure

- ☐ Prepare equipment and room (see *Hearing Screening Guideline, Environment and Equipment*, page 14).
- ☐ Position the audiometer or laptop with the control panel/screen facing the examiner. The client should be seated, facing away from the tester, in such a way that the client cannot see display panel/screen or the tester's hands.
- ☐ Ensure there are no previously indicated contraindications prior to proceeding with screening (refer to previous section, *Physician/Audiology Referral,* page 8).
- ☐ If performing otoscopy, insert the tip of the specula into the ear canal while adequately bracing against the head. When performing this task, do not insert the tip of the otoscope beyond the cartilaginous portion of the ear canal.
- ☐ Before placing the headphones or insert earphones on the client, explain the listening task to the client asking them to respond right away even if the beep is very faint or sounds far away. Ask the client to raise their hand (or whatever type of response the client can give) for as long as the sound is heard and put it down when the sound disappears.
- ☐ Conditioned play audiometry can be used for a child who is not yet able to raise their hand when the beep is heard. (See Appendix B, *Hearing Screening Protocol - Conditioned Play Audiometry,* page 22)**.**
- ☐ When using TDH or circumaural headphones, ask the client to remove their eyeglasses (if worn) to prevent inadequate acoustic seal or discomfort. Have the client brush any hair behind their ears. Position the headphones so that the small round diaphragm in the middle of the headphone is directly opposite and over the ear canal.
- ☐ If using insert earphones, select the appropriate size of tip (pediatric or adult). Pinch the foam tip to collapse the sponge prior to inserting into the client's external ear canal. Insert the sponge tip into the canal (no further than the cartilaginous portion of the ear canal) leaving the sponge visible and flush with the opening of the canal. This will maximize sound retention and reduce the effects of ambient noise. If the entire foam tip is capable of being inserted further than flush with the opening of the canal, use a larger size.

Presentation of the Stimulus

1. Place the headphones on the client.
2. Set the frequency dial to 1000 Hz and the intensity to condition the client at 40–50 dB.
3. Beginning with the right ear, press the stimulus presentation button and hold for three seconds, observing the response.
4. If the client responds, then reduce the intensity to the screening level of 20- or 25-dB HL (as appropriate for a child or adult client) and present the tone again. Note: after conditioning, keep the intensity level constant for the entire test.
5. Pause between presentations for at least three seconds. Keep the interval time between tones irregular (short and long) to avoid any false positive responses resulting from the client anticipating a rhythm and guessing when the tone will be presented.
6. Present each tone at least 2 times and not more than 4 times at the same intensity. At least two positive responses out of three (and not more than 4) presentations constitute a 'pass' response at that frequency. Remember that the client must respond at each test frequency in each ear to obtain a 'pass' for the overall screening.
7. Next, turn the frequency dial to 2000 Hz and follow the same procedure.
8. Turn the frequency dial to 4000 Hz and repeat the procedure.
9. Turn the frequency dial to 6000 Hz (for teens and adults) and repeat the procedure.
10. Turn the frequency dial to 500 Hz (if using insert earphones and/or a sound booth) and repeat the procedure.
11. Select and press the stimulus presentation button for the left ear and repeat the procedure starting at step 6.
12. Reposition the headphones and carefully reinstruct the client before rescreening, if required, to reduce the number of referrals to audiology for follow-up.

APPENDIX B - Hearing Screening Protocol-Conditioned Play Audiometry

3 years to 5 years chronological age or for children not able to respond to standard hearing testing requirements

Consistent with Competency Profiles for the professions, a protocol outlines the specific clinical criteria, activities, and procedures that should be adhered to by regulated members in the provision of specific professional services. Protocols are evidence informed.

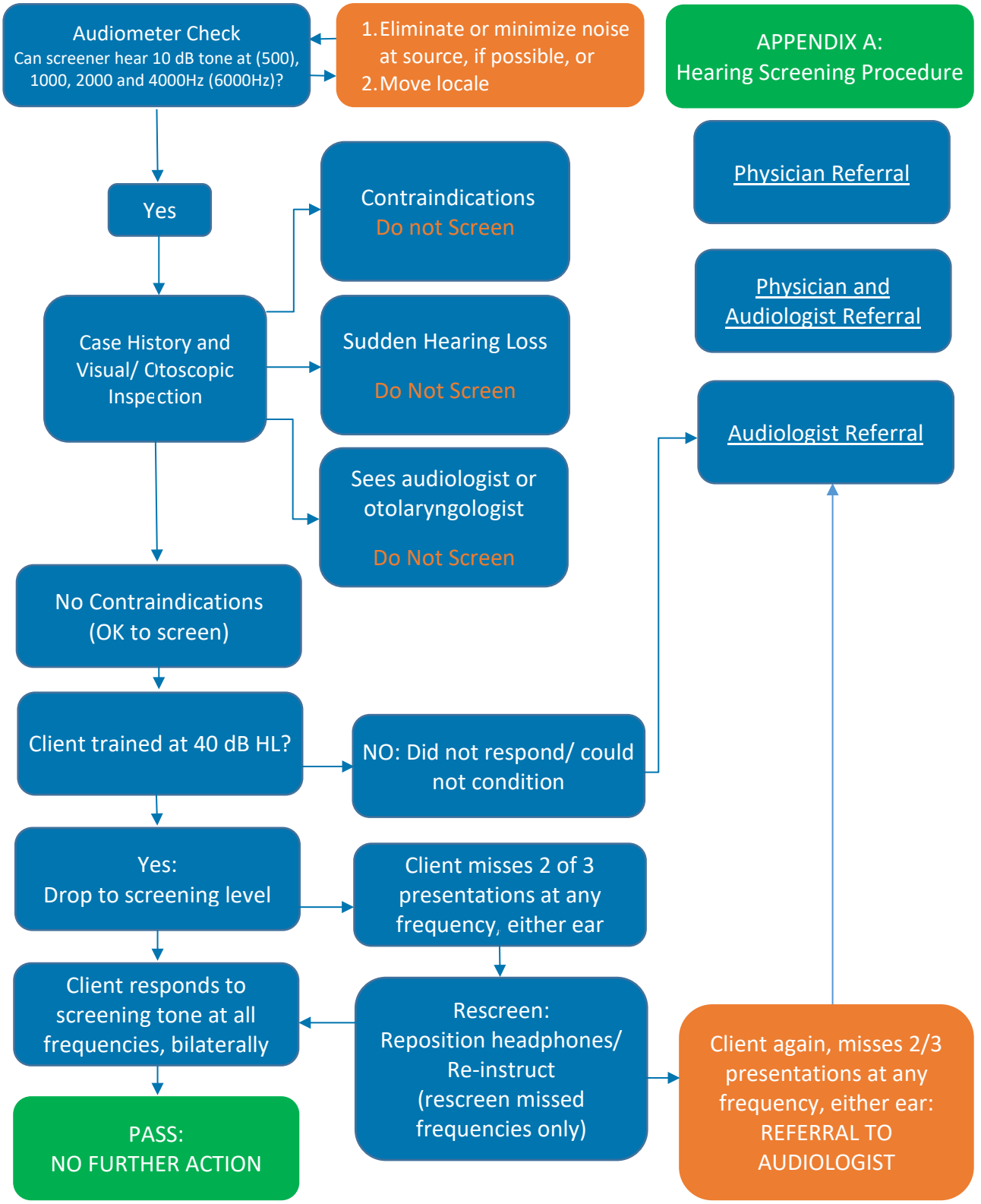
Conditioned play activities for hearing screening can help develop rapport and be a listening game that can 'break the ice' with many young children. Any number of play activities can be used in conditioned play audiometry such as putting a block or small toy in a bucket or large container, placing a piece of puzzle in a puzzle board, or placing pegs in a pegboard. Switching to a different task/game can be helpful to retain the child's interest. The activity should be appropriate to the client's dexterity, age, and developmental level. If the client is unable to perform conditioned play audiometry, the client must be referred to an audiologist for audiological assessment (with client/caregiver informed consent).

To condition using play activities:

1. Place the headphones on the table (so they function like a loudspeaker) and hand the child a peg or block.
2. Set the frequency indicator to 1000 Hz and present a tone at 90 dB HL or greater for two to three seconds.
3. The tester will demonstrate an appropriate response the first few times the tone is presented to ensure the child understands the task.
4. Allow the child to practice several attempts and praise the child with each successful response. Use hand-over-hand assistance to train response, if required.
5. Once the child consistently responds appropriately, turn down the intensity of the stimulus to 40-50 dB HL. Introduce the headphones directly onto the child's head with the small round diaphragm of the headphone directly opposite and over the ear canal.
6. Note: If the tester is unable to perform conditioned audiometry, the child must automatically be referred to an audiologist for audiological assessment.

Follow the screening procedure and the presentation of stimulus instructions in Appendix A, *Hearing Screening Protocol*, page 20.

APPENDIX C - Hearing Screening Referral Protocol



APPENDIX D - Acronyms

AAA	American Academy of Audiology
AADL	Alberta Aids to Daily Living
ACSLPA	Alberta College of Speech-Language Pathologists and Audiologists
AHS	Alberta Health Services
ANSI	American National Standards Institute
ASHA	American Speech-Language Hearing Association
CAA	Canadian Academy of Audiology
CAOHC	Council for Accreditation in Occupational Hearing Conservation
CMV	Cytomegalovirus
dB	Decibels, a measure of sound intensity
EHDI	Early Hearing Detection and Intervention
ECMO	Extracorporeal Membranous Oxygenation
GBD	Global Burden of Disease
HHIE	Hearing Handicap Inventory for the Elderly
HRR	High Risk Registry
IPC	Infection Prevention and Control
HL	Hearing Level
Hz	Hertz, frequency measured in cycles per second
JCIH	Joint Committee on Infant Hearing
NICU	Neonatal Intensive Care Unit
OAE	Otoacoustic Emissions
OM	Otitis Media
OME	Otitis Media with Effusion
PCHL	Permanent Childhood Hearing Loss
PHL	Permanent Hearing Loss
PPE	Personal Protective Equipment
SAC	Speech-Language & Audiology Canada
SLP	Speech-Language Pathologist
SP	Support Personnel (with **SLP** or Audiologist)
SPL	Sound Pressure Level
TDH	Telephonics Dynamic Headphone
VP	Ventriculoperitoneal (shunt)
WHO	World Health Organization

APPENDIX E - Glossary

Circumaural headphones:	Headphones that cup and surround the ears, enclosing them.
False Negative Rates:	The proportion of positives which yield negative test outcomes with a test.
False Positive Rates:	The proportion of negative test results which yield positive test outcomes with a test.
Insert earphones:	Foam earplugs attached to a transducer via a small tube.
Noise cancelling:	Use of active noise control technology to reduce unwanted ambient sounds.
Over referral:	Unnecessary referral resulting from a false positive test.
Positive Predictive Value:	The ratio of patients truly diagnosed as positive to all those who had positive test results.
Restricted Activity	Refers to high risk activities performed as a part of providing a health service that require specific competencies to be carried out safely by authorized persons. The complete list of restricted activities is in part 0.1 of the Heath Professions Act.
Sensitivity:	The ability of a test to accurately identify an individual with a disease as positive.
Specificity:	The ability of a test to accurately identify an individual without a disease as negative.
Supra-aural:	Refers to headphones that rest on the ears, not enclosing the ears.
Target Condition:	The health condition of interest that a test is used to detect.
Target Population:	Mass or all asymptomatic individuals vs. at-risk populations.
Under referral:	Referrals missed due to false negative test results.
Ventriculoperitoneal shunt:	Thin plastic tube to drain extra cerebrospinal fluid from the brain.

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