

Alberta Health Services Pediatric Amplification Reference Paper

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Purpose

This document provides a reference for fitting children in the province of Alberta (birth to 17 years of age) with personal amplification. Information regarding the pre-selection, verification, validation, equipment orientation and training, and follow-up and referral processes is also outlined.

Background

Evidence-based clinical practice documents are increasingly used to improve quality and standardization of care. Audiologists from public health, secondary, tertiary, urban, rural, and private practice settings created this resource in collaboration with Alberta Health Services, Health Professions Strategy and Practice – Interprofessional Practice. A list of the working group membership and their qualifications is provided in Appendix A.

This Clinical Reference Paper (CRP) was created through discussion among audiologists about leading practices and review of available literature. The document has some characteristics of a Clinical Practice Guideline (CPG) but cannot be identified as such as it lacks some requirements of a CPG. A number of existing guidelines and protocols related to pediatric amplification (AAA, Pediatric Amplification Protocol, 2003, Bagatto, Scollie, Hyde & Seewald, 2010) were reviewed using the AGREE II protocol (Brouwers, et al, 2010). The documents that scored well on appraisals were chosen as models and amalgamated to create the current document.

A Pediatric Amplification Flow-map (Appendix B) and a Pediatric Amplification Checklist (Appendix C) are provided to support clinical implementation of the recommendations within this CRP. This CRP will be reviewed and updated every three years or as required based on substantial changes in accepted pediatric amplification practices.

1. Basic Requirements for Pre-selection of Amplification

- Fitting of hearing aid(s) may begin before all required data is obtained (AAA, Pediatric Amplification Protocol, October 2003).
- Modification of routine assessment procedures may be necessary when evaluating a child who is difficult to test.
- Amplification is a process that needs to be revisited on an ongoing basis.
- View the child as an individual within their everyday environment; consider the child's health, cognitive status, interests, functional needs and abilities.

Required Data:

- Thorough case history, including medical and/or developmental history.
- Demonstration of a permanent hearing loss. This includes all bilateral hearing losses from minimal to profound and can also include unilateral hearing loss or auditory neuropathy.
- Type, magnitude, and general configuration of the hearing loss.
- Ear-specific thresholds, or best estimates, for air and bone stimuli - via behavioural testing or electrophysiological assessment.
- Speech audiometry results (appropriate to age of client).
- Otoscopy.
- Acoustic immittance measures.
- Otoacoustic emissions.
- Documentation of the consent process (in which parents or guardians consent to have their child fit with amplification).
- Consultation by an otolaryngologist to confirm the absence of contra-indications to non-medical intervention.

2. Amplification & Hearing Assistance Technology Considerations

Amplification with a personal FM system is provided to young children, unless there are clear contraindications. Considerations for choosing the best available technology to meet an individual child's needs are outlined below.

Routing of Signal

- Air conduction amplification
- Bone conduction amplification when appropriate
- CROS (contra-lateral routing of signal) fittings may be considered for a unilateral unaidable hearing loss with normal hearing in the better ear. This option is only considered for children who can accurately report sound quality.
- BiCROS (hearing aid and CROS) fittings for a unilateral unaidable ear in conjunction with hearing loss in the better ear
- Ear-level personal FM may be considered for:
 - auditory processing disorder (APD)
 - fluctuating hearing loss due to unmanageable otitis media
 - some cases of auditory neuropathy spectrum disorder (ANSO)
 - minimal hearing loss
 - unilateral hearing loss

Style

- Behind-the-ear (BTE) hearing aids are the style of choice for most children
- Providing the best possible amplified speech signal is not compromised for cosmetic purposes, particularly in the early years of life when auditory skills development and speech-language learning is occurring at a rapid pace.

Coupling for assistive technology

- FM-compatible hearing aids and telecoil for accessing the various forms of current assistive device technology
- Consider hearing aids with blue tooth compatibility for older children

Fine tuning

Instrument program features (multiple compression channels, frequency compression, etc.) that allow flexibility in fine tuning electroacoustic programs/parameters are critical. Hearing aid residual gain is needed to address fluctuating or progressive hearing loss. Also consider features that may be useful as the child gets older (e.g., noise reduction, directional microphones or multiple programs).

Safety and tamper-resistant features and retention devices

- Volume control deactivation capability or volume control covers
- Tamper-resistant battery door
- Huggies, otoclip, double-sided tape, etc.

Sound Channel

- Ear hooks
 - pediatric
 - standard
- Earmolds
 - Material and style appropriate for age and degree of hearing loss
 - Venting option appropriate for ear canal size, degree and configuration of hearing loss)
- Tubing
 - Standard (dry tube preferable if space allows)
 - Slim tubing
- Receiver-in-the-ear (RITE) or receiver-in-the-canal will be considered for older children who would otherwise reject traditional amplification.
- Softband vs. Headband (Bone Conduction Hearing Aids)

Sample Alerting Devices

- Vibrating alarm clock
- Strobe light fire alarm
- Amplified phone
- Doorbell signaler

3. Verification

The electro-acoustic performance of the chosen hearing aid(s) needs to be verified to ensure optimal audibility for soft sounds and optimal maximum output. The targets for hearing aid gain, frequency response and maximum output power are obtained using the most recent version of the Desired Sensation Level prescription procedure and verified by using real-ear measurements (REMs) or the 2cc coupler-based approach (simulated REMs) using individually measured Real-Ear-to-Coupler Differences (RECDs).

Equipment required for hearing aid verification:

- A real ear/hearing aid analyzer: Verifit or Audioscan RM 500SL

Considerations for Simulated Real-Ear Measurements (sREMs):

- Simulated Real-Ear Measurements is the preferred method of hearing aid verification for infants and young children.
- Individual RECDs for each ear are measured and used to predict ear-canal thresholds in dB SPL and to derive targets for hearing aid gain and MPO.
- When the RECD measurement is not possible (non-compliance) or practical (time constraints), age-appropriate predicted RECDs available in the DSL software may be used (Bagatto, Scollie, Seewald, Moodie, Hoover, 2002).
- Predicted RECDs were derived from data obtained from infants and children with normal middle ear function. Therefore, any acoustic changes due to middle ear effusion or a perforated tympanic membrane will not be reflected in the average RECDs (Bagatto, Scollie, Hyde, Seewald, 2010). As a result, individual RECDs are measured whenever possible.
- RECDs from one ear can be used to obtain gain targets for both ears if there are no physical or anatomical differences between ears such as a mastoid cavity, an atretic ear canal, or a tympanic membrane perforation (Tharpe, Sladen, Huta, McKinley Rothpletz, 2001). If there are physical differences between the ears, individual RECD measures are recommended for each ear.
- Input levels representing soft (55dB SPL), average (65dB SPL), loud speech (75dB SPL) and MPO are used to determine the output of the hearing aid and ensure that soft sounds are audible and loud sounds are not uncomfortable.
- The RECDs need to be measured any time a new earmold is fitted. The RECDs are then used to re-verify and re-set the hearing aids.

NOTE: Real-Ear Measurements (in-situ) are the preferred verification method for older children who are able to cooperate during these measurements.

Aided Soundfield Verification/Functional Gain Measurement is not recommended as a verification procedure for amplification for the following reasons:

- Infants less than 6 months cannot perform conditioned tasks for behavioural testing.
- Aided soundfield testing provides information at only a few frequencies and the test-retest reliability is poor (Stuart, Durieux-Smith, Stenstrom, 1990).
- The stimuli (narrow-band noise, warble tones) used for aided testing are not speech stimuli.
- Aided soundfield testing does not provide information about MPO.
- Aided soundfield thresholds have poor validity especially for severe to profound hearing losses and when non-linear signal processing is used (Bagatto et al, 2010).

Aided soundfield measurement may be useful for counseling purposes, in some cases.

4. Amplification orientation and training

Families have an active role in the care and use of hearing aids. The family is also provided with written and visual information, so that they can review it at a later date. Family literacy must be considered in all cases and an interpreter provided as needed. Within Alberta Health Services, you may complete an interpreter booking request to receive assistance: <http://insite.albertahealthservices.ca/frm-09967.pdf>

The following topics are discussed to support involvement (adapted from Table 1 of Elfenbein, 2000).

What to expect

- Amplification and the speech signal
- Impact of noise and distance

Care and Maintenance

- Equipment needed to care for hearing aids
- Techniques for cleaning earmolds and hearing aids
- Procedures for battery checks and insertion
- Procedures for listening checks

Use of the Hearing Aid

- Incorporating hearing aid care into the family routine
- Putting hearing aids on child and securing them (provide suggestions for retention)
- Suggestions to help parents when their child is resisting wearing the hearing aid
- Setting user controls
- Incorporating use of hearing aids into the child's routine
- Plans for documenting experiences with hearing aids

Potential use of data logging measures

- If these measures will be monitored, discuss this with the parents

Child Development

- Developmental milestones for children who have normal hearing (e.g., communication skill acquisition)
- Expectations for this child's acquisition of developmental milestones (e.g., response to sound)
- Activities to promote development of communication skills

- Referral options and potential reasons for referral. Services options include speech language pathology, early intervention, Alberta Education, social work and others as needed

Potential Problems

- Safety issues (e.g., battery ingestion)
- Coping with noise and distance (e.g., at home, in the car)
- Understanding and combating feedback
- Protecting hearing aids from potential hazards (e.g., pets, moisture)
- Troubleshooting techniques
- Plans for repair of malfunctioning hearing aids

Follow-up

- Plans for follow-up contact between the family and clinician. The frequency and type of contact will vary based on the needs of the individual child and family.
- Trial periods, warranty, and insurance information.
- Discuss other assistive listening options as they become appropriate (e.g., FM, telecoil, Bluetooth®).
- Potential alerting devices.
- Counseling the patient and family regarding:
 - Communicating with their child regarding the hearing loss.
 - Dealing with questions/reactions of friends, relatives and others.
 - Contact with other services (e.g., intervention teams).
 - Supports including parent groups, provincial/national/international organizations, web sites, social workers, mental health, and others as appropriate.

5. Validation

Validation is an ongoing process that ensures the infant or child is receiving optimal speech input via their hearing aids (AAA Pediatric Amplification Protocol, 2003). The benefit of amplification must be demonstrated and documented. This benefit is monitored regularly following identification of hearing loss and the fitting of amplification on the pediatric population. The clinician will:

- Obtain information to confirm consistent use of amplification at each visit.
- Obtain aided speech perception measures at regular intervals. This enables the audiologist to assess the child's ability to perceive and discriminate speech information as well as to monitor progress.
- Use Functional Assessment Tools (Questionnaires) at regular intervals to evaluate hearing aid function in real world settings.

Functional tools assess the child's ability to hear in a real world environment. The choice of assessment tools will depend on the age of the child with consideration given to auditory, speech and language, social and cognitive development. It is recognized that there are time limits within the clinic as well as limits regarding children's attention and ability. Full assessment is preferred, but not always possible.

Following are suggestions for use of aided speech perception measures and functional assessment questionnaires. This is not a comprehensive list, rather examples of tools that can be used to evaluate benefit of amplification and development of auditory skills.

Assessment or initial fitting:

- Obtain a baseline measure of auditory skills using a functional assessment questionnaire (choose tool appropriate for age).
 - LittleEars Auditory Questionnaire (Tsiakpini, Weichbold, Kuhn-Inacker, Coninx, D'Haese & Almadin, 2004): 0-24 months
 - Parents' Evaluation of Aural/Oral Performance of Children (PEACH) Scale (Ching & Hill, 2007): 1 month- school age

Within 3 months of hearing aid fitting:

- Complete follow up functional assessment questionnaire to monitor progress
 - LittleEars/PEACH
- Complete aided speech detection testing:
 - Aided SDT or SRT using VRA or play audiometry (age 6m+)
 - Aided Ling sound detection using VRA or play audiometry (age 6m+)

Within 3-6 months of hearing aid fitting:

- Complete follow up functional assessment questionnaire to monitor progress
- Complete aided speech perception testing: Aided speech perception test materials are presented at 50 dB HL in quiet (conversational level). The optimal test condition is open set recorded test materials. Younger children often need a closed set, monitored live voice presentation.

Choose the test most appropriate for the developmental level of the child:

Age	Test	Reference
2-3 years limited vocabulary and language skills	Low Verbal Early Speech Perception (ESP) Test (closed set)	(Moog & Geers, 1990)
children with limited vocabulary and language skills	Early Speech Perception Test Standard Version (closed set)	(Moog & Geers, 1990)
3-5 years	Northwestern University's Children's Perception of Speech Test (NU-CHIPS)	
5-10 years	Word Intelligibility by Picture Identification (WIPI) Test* (closed set)	(Ross & Lerman, 1970)
5-8 years	Phonetically Balanced Kindergarten (PBK) Words	(Haskins, 1949) (Madell, 2011)
5-12 years	Hearing In Noise Test – Children (HINT-C) Sentences	Advanced Bionics, Online source
6 years +	University of Western Ontario plural test – cited in research and under development	(Glista, Scollie, Bagatto, Seewald, Parsa & Johnson, 2009)

Annual reviews:

- Complete aided SDT or SRT
- Complete aided speech perception testing in quiet (50dB HL)
- Consider aided speech perception testing in noise (Suggested presentation level: +5 dB SNR: speech at 50 dB HL/ noise at 45 dB HL)
- Discussion of changes in the environment and participation in activities or other personal factors that may impact function.

6. Follow-up and Referral

After the initial fitting of amplification, a regular follow-up schedule is determined. This schedule is reassessed on an ongoing basis and modified to accommodate individual needs.

During the initial 30 days with amplification, at least 2 visits are scheduled to determine how the child and family are adapting to the hearing aids and to check earmold fit. During these visits, the audiologist listens to the family's stories and experiences. The audiologist addresses any family concerns regarding the child's hearing loss by providing support, resources and other contacts as needed.

Consultation with parents includes coaching regarding the use, care and maintenance of hearing aids, troubleshooting and satisfaction with the hearing aids. The audiologist provides information and resources on hearing loss, consistent use of amplification, child development, realistic expectations, and benefits of a personal FM system.

After the initial 30 days, follow-up visits are scheduled

- every 3 months during the first year after the initial hearing aid fitting
- every 6 months during the second year after the initial hearing aid fitting
- annually thereafter (Bagatto et al, 2010).

The schedule may vary depending on the child's age and individual child or family needs.

Assessment at follow-up visits may include, but is not limited to:

- Discussing successes in the child's development, care and use of the hearing aid.
- Problem solving regarding barriers to consistent use and any child or family concerns.
- Ear specific behavioural hearing thresholds
- Otoscopy and middle ear assessment
- A listening check of the hearing aids and FM system
- Electro-acoustic analysis of hearing aids
- Assessing earmold fit and determine if new molds are required
- Re-measuring RECDs and readjusting amplification whenever new molds are fitted or if there is a change in the middle ear status (Bagatto, et al 2010) or based on new audiological test results
- Re-instructing about use, care and troubleshooting of amplification if required
- Making appropriate interdisciplinary referrals when required (speech language pathologist, occupational therapist, otolaryngology, paediatrician, social worker, early intervention, etc).

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Appendix A: Working-Group Members

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