

GUIDELINES FOR PEDIATRIC AMPLIFICATION

Section 3 of the Early Hearing Detection and Intervention (EHDI) Guidelines for Audiologists

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INTRODUCTION

This document provides recommended guidelines for early fitting of amplification (when chosen by the family) for infants or children identified with hearing loss. It is intended to promote a more standardized approach to ensure consistency in outcomes. This document describes optimal processes based on current evidence and combined clinical experience.

Expanded guidance is included on several main topic areas that research has shown can influence outcomes. Those factors, which parents can have an impact on, are detailed on pages 9-10.

Because of the importance of early identification of hearing loss, fitting of amplification (when chosen by the family) should be consistent with the national Early Hearing Detection and Intervention (EHDI) goal of providing amplification within one month of diagnosis of permanent hearing loss. Resources are available from the MDH–EHDI Program to assist with program support, implementation, and quality assurance.

BACKGROUND

Hearing loss is one of the most common congenital conditions with an estimated incidence of one to three per 1000 births. Nearly 95% of children who are congenitally Deaf/Hard of Hearing (DHH) are born to two typical hearing parents (National Institute on Deafness and Other Communication Disorders [NIDCD], 2016). Without early diagnosis



and intervention, children who are DHH are at risk for delays in a variety of developmental areas including social/emotional, language, vocabulary, articulation and intelligibility (McCreery & Walker, 2017, p. 2).

The goal of an EHDI program is to promote effective communication for all children through the early identification of hearing loss and the initiation of appropriate intervention services as early as possible. Birth to age 2 years is a critical period for brain development in the infant/young child, and all language input is essential. Multiple spoken and visual languages and their combinations are opportunities to be considered for each child and family. Early identification and intervention can substantially reduce or even eliminate developmental delays that often stem from a delayed diagnosis of hearing loss. For many children with hearing loss, early identification and intervention enables them to perform at the same level on language assessments as their peers with typical hearing and similar cognitive ability (Yoshinaga-Itano, Sedey, & Coulter, 1998).

The goal of amplification is to provide access to as much of the auditory environment as possible. Once the family has chosen to pursue amplification, the audiologist plays a critical role in guiding the family through appropriate device selection, verifying device function, and partnering with the family to promote successful communication and language acquisition outcomes.

CHILD & FAMILY CENTERED COMMUNICATION

In family centered care, families are recognized as the experts in determining what is best for their children and families. No one is able to better understand their child's needs more than the parents. Family centered care is a crucial component of best clinical practice (English et al., 2016; Gravel, 2002) and is beneficial to children and their families. Clinicians are encouraged to use a teach-back method to ensure parental understanding of test results and recommendations. When discussing communication options including amplification, an awareness of cultural differences is important (world heritage and religious cultures, as well as Deaf culture). Sharing resources and recommendations in an unbiased manner that recognizes each family's unique situation and background helps support parents to make the most informed choices for their child and family. Professionals should deliver information in a positive manner with sensitivity to the emotional needs of the parent.

FACILITY & PROFESSIONAL CONSIDERATIONS

A licensed audiologist is the only professional qualified to select and fit all forms of amplification for children including personal hearing aids, bone conduction or osseointegrated devices, cochlear implants, remote microphone systems, and other assistive devices. The audiologist must have experience with the assessment and management of infants and children with hearing loss, and must have the test equipment necessary for pediatric hearing aid selection, verification, and validation procedures. The process of ongoing follow-up and validation of amplification will require the audiologist to have close collaboration with the family and early intervention team to ensure that amplification provides appropriate auditory access and supports age appropriate language development. Facilities that lack the expertise or necessary equipment should establish cooperative arrangements with professionals and facilities that provide pediatric hearing services.





of Hearing Services Division.⁵ Parents can also reach DHS at 800-657-3663 with additional questions.

LOANER DEVICES

Fitting of amplification should not be delayed for financial reasons. Appropriate loaner amplification devices may be available through a variety of local, state, and national sources to allow families time to secure funds for amplification devices or await medical interventions. One source, the University of Minnesota Lions Infant Hearing Device Loaner Program,⁶ provides short-term loaner devices, typically for a time frame of 6 months. Inventory includes traditional hearing aids, bone conduction devices, remote microphone options, and more. This program is supported through partnerships with device manufacturers and grant support from the Minnesota Department of Health.

AMPLIFICATION CANDIDACY CRITERIA

Consider amplification for any type or degree of hearing loss that could possibly interfere with normal developmental processes (American Academy of Audiology [AAA], 2013). According to the Joint Committee on Infant Hearing (JCIH, 2007), if families choose to pursue amplification for their child with hearing loss, the fitting should take place within one month of diagnosis. In accordance with Food and Drug Administration (FDA) regulations, medical clearance must be obtained prior to fitting hearing aids on children (FDA, 2019). Following medical clearance, ongoing treatment of middle ear effusion should not delay fitting of amplification when there is also permanent hearing loss (Centers for Disease Control and Prevention [CDC]: National Center on Birth Defects and Developmental Disabilities, 2014).

The decision for amplification should be based on the child's audiological data, family preferences, and the existence of other medical conditions or special needs.

Binaural amplification (when chosen) should always be provided to young children with bilateral hearing loss

EQUIPMENT

Facilities must have equipment for real-ear measurement and related hearing aid verification and validation procedures to optimize audibility with amplification. Equipment must be calibrated annually in accordance with current American National Standards Institute (ANSI) Specifications or other applicable standards.

INSURANCE / MEDICAID COVERAGE

Minnesota Statute 62Q.675¹ (Revisor of Statutes, State of Minnesota, 2018) requires that health plans must cover hearing aids for children age 18 years or younger for hearing loss that is not correctable by other covered procedures. Coverage varies depending on the health plan. Parents may wish to contact their insurance provider to investigate their specific coverage. In some cases plans will award this benefit through a hearing aid appeals² process.

Children may also be eligible for coverage under the Minnesota Medicaid program. Eligibility criteria and information about how to apply for coverage can be found on the Department of Human Services website.³

When full coverage is not available through private or state health plans, additional financial support may be available through various foundations or community based civic organizations. A list of Hearing aid financial resources⁴ is provided by the Minnesota Department of Human Services (DHS) Deaf and Hard

unless there is a medical contraindication (AAA, 2013).

Infants with hearing loss who experience an extended hospital stay should be offered fitting with appropriate amplification as soon as medically feasible, after appropriate clearance for amplification is received from the treating physician. This timeframe should be adjusted as appropriate given other medical priorities and family situations.

Frequency specific thresholds obtained via auditory brainstem response testing must be converted to estimated hearing level (dB eHL) to appropriately fit amplification. At least two frequencies in each ear and an estimate of any conductive component are minimally necessary to begin the fitting process. Given this, fitting should proceed while efforts to fully define the audiogram are ongoing (Grimes, 2007).



Unilateral candidacy

Children with unilateral hearing loss are at risk for academic difficulties and speech and language delays. Amplification for unilateral hearing loss should be considered when measurable hearing is confirmed in the affected ear (AAA, 2013). When chosen by the family, a closely monitored trial with amplification is suggested.

When the ear with unilateral hearing loss is judged to be unaidable by air conduction, all available alternative amplification strategies should be explored. These strategies (bone conduction, remote microphones, and CROS devices) are discussed in later sections on *Style of Device* and *Device Features*. Cochlear implants are an emerging treatment for

single-sided deafness or asymmetrical hearing loss and may be considered on a case-by-case basis (Greaver, Eskridge, & Teagle, 2017).

Auditory Neuropathy Spectrum Disorder (ANSD)

Auditory Neuropathy Spectrum Disorder (ANSD) is “a hearing disorder in which the inner ear successfully detects sound, but has a problem with sending sound from the ear to the brain” (NIDCD, 2018). Accurate threshold information cannot be obtained for children with ANSD via ABR testing. Therefore, additional behavioral information is needed to determine management options. When behavioral audiological information has established that hearing sensitivity will not allow conversational level speech to be sufficiently audible, a closely monitored trial with amplification is recommended (AAA, 2013; Roush, Frymark, Venediktov, & Wang, 2011; Walker, McCreery, Spratford, & Roush, 2016). Benefit from air conduction amplification for children with this condition is not clearly predictable. If expected progress is not demonstrated, alternative strategies for effective access to language should be explored. One of these strategies may include cochlear implants.

PRE-SELECTION OF DEVICE CHARACTERISTICS

Style of Device

The goal of amplification is to provide the best possible amplified access to the speech signal. Behind-the-ear (BTE) hearing aids are the optimal style for young infants and most children. In-the-ear (ITE) and completely in the canal (CIC) hearing aids are not recommended for use with infants and young children due to the small size and rapid growth of the outer ear.

A bone conduction aid may be appropriate for single sided deafness (complete absence of hearing in one ear) or if the loss is conductive and BTEs cannot be used due to medical or physical contraindications (such as atresia). A bone anchored (surgically implanted) hearing aid may be appropriate for some

older children on a case by case basis once they reach the FDA approved age of 5 years.

CROS/BICROS hearing aids may be considered for children with unilateral hearing loss when they are able to control their environment. It is important to note that in noisy classroom situations, remote microphone solutions may be preferable over CROS devices (AAA, 2013).

A cochlear implant may be considered for children who gain limited benefit from amplification. Any family considering cochlear implantation should consult with their audiologist and a cochlear implant center to determine candidacy, per current FDA guidelines.

Device Features

Flexibility in setting electroacoustic parameters is critical when selecting appropriate amplification for infants and children. Advancements in technologies should be considered on a regular basis to assess for developments that may help improve outcomes and meet specific audiological needs. A summary of evidence supporting the consideration to use many of the currently available signal processing options can be found in the AAA Clinical Practice Guidelines for Pediatric Amplification (AAA, 2013). Capability to access direct audio input (DAI), telecoil, and remote microphones should be considered. Wireless connectivity will become valuable as the child becomes more mobile and needs to listen to speech at greater distances, to improve signal-to-noise ratio, or when increased signal strength is desired to improve audibility of speech (i.e. in cases of severe or profound hearing loss). Remote microphones and comparable technologies are the systems of choice to reduce the negative effects of background noise, distance from the talker and high reverberation levels.

Full-time use of directional processing is not recommended for infants or children, because for some listening situations directional processing would be undesirable (AAA, 2013). Ease of listening in noise may be improved by considering directional microphone or noise reduction strategies on a case-by-case basis, especially for children that are able to orient their head toward the talker. According

to McCreery & Walker (2017) “ease of listening in noisy situations can promote the consistent use of hearing aids” (p. 72). Frequency lowering strategies may also be considered for hearing losses where audibility in the high frequencies cannot be achieved through regular hearing aid processing. Fitting of any type of signal processing algorithm should always be accompanied with verification and behavioral validation (AAA, 2013).



Safety features and warranty

Safety features should include a tamper resistant battery compartment, deactivated buttons and controls for younger children, tamper proof ear hooks, and possibly a retention clip/cord as appropriate for each child’s age. A hearing aid maintenance kit should also be provided to parents that includes basic items such as a battery tester, dry aid kit, device manual, listening stethoscope, extra case, batteries, and clinic contact information. Coverage of the device for loss and damage or extended warranties may ease financial burdens for families if devices are lost or damaged.

Physical fit/earmolds

The physical fit of the hearing aids and earmolds is important for comfort, retention, and acoustic response. Earmolds should be made of a soft material for safety and comfort. They should be replaced whenever feedback is excessive at optimal settings or when retention or comfort issues occur. Retention devices may help increase parents’ confidence in venturing out into more challenging listening

environments with their children without fear of losing their devices. This can increase hearing aid use time during outdoor play. Audiologists should help parents explore the wide range of retention options, being careful not to limit discussion to only the audiologist's preferred solutions. Retention devices may include elastic sleeve covers, security loops, clips with cords, two-sided tape, headbands, bonnets, and caps. Many options are available online (McCreery & Walker, 2017, p. 117).



VERIFICATION OF ELECTROACOUSTIC CHARACTERISTICS

The following section focuses on verification of acoustic hearing aids. Fitting and verification of other device types (bone conduction, cochlear implants, and remote microphone technology) is beyond the scope of this document.

The use of a systematic approach when selecting electroacoustic characteristics of hearing aids for children is considered of utmost importance to ensure optimal amplification. Two prescriptive methods validated for children are Desired Sensation Level (DSLm [i/o])[®] method (Child Amplification Lab, National Centre for Audiology, Western University)

and National Acoustics Laboratory-Nonlinear formula Version 2 (NAL-NL2) (Keidser, Dillon, Flax, Ching, & Brewer, 2011). Though the underlying design goals of the prescriptive methods differ, both are expected to provide sufficient amplification (McCreery & Walker, 2017, p. 83). Electroacoustic gain and maximum output targets for these methods are usually available in hearing instrument electroacoustic analysis systems. Gain and output targets should incorporate ABR thresholds appropriately converted to estimated hearing level (dB eHL) or behavioral thresholds.

Electroacoustic verification systems (coupler and probe microphone) optimally utilize speech-like stimuli or calibrated recordings of speech to verify audibility for soft, average, and loud speech. Pure tones are most ideal to verify maximum power output (MPO). With infants and small children, simulated real-ear verification should be done by measuring the real-ear-to-coupler difference (RECD) and applying it to hearing thresholds and 2cc coupler measurements of hearing aid output to simulate sound pressure level (SPL) in the ear canal. If current measured RECD's cannot be obtained, published age-norms for average RECD can be used (Bagatto, Scollie, Seewald, Moodie, & Hoover, 2002). Real-ear (in situ) measures should be attempted as soon as a child has sufficient head control and can cooperate (McCreery & Walker, 2017, p. 78), and may often be possible with a sleeping infant. In situ measures may be preferable to simulated measures in older children with larger earmolds or large vents (Bagatto et al., 2005).

Prior to direct evaluation of the hearing aid on the child (in situ), the hearing aid may be preset in a hearing aid test box or real-ear simulator to verify that specified targets are met using the child's RECD. At a minimum, new in situ real-ear measures or RECD and simulated measures should be completed when new earmolds are fit. Children under 1 year old need frequent verification (every three months) and children age 1-3 years should be seen every six months or more frequently if there are risk factors for progressive hearing loss. Older children can be seen annually for verification if their hearing is stable. (McCreery & Walker, 2017, p. 93) Along with routine verification, it is important to have current audiological information when utilizing real-ear

measures. This is addressed in the [Follow-up and Monitoring](#) section.

The Speech Intelligibility Index (SII) may be useful in measuring aided audibility. Degree of hearing loss can limit the amount of audibility that can be achieved. The University of Western Ontario published Pediatric Amplification Protocol (PedAmp) (Bagatto et al., 2011) shows normative SII range by degree of hearing loss. If SII values are below the normative range for a child's hearing loss, the clinician should make further attempts to adjust amplification.

Determine and verify maximum power output (MPO) or real ear saturation response (RESR) levels by using prescriptive output targets (i.e. DSLm [i/o] ®), temporarily disabling some features like feedback suppression if needed, and applying probe microphone measures to verify output in the child's real ear. This can be done using RECD and 2cc coupler measures, or MPO measures can be performed in situ with the probe in the child's ear if the signal is not alarming to the child (McCreery & Walker, 2017, p. 88).

The Situational Hearing Aid Response Profile (SHARP)² is an online tool that shows audibility for speech in different listening environments. Audiologists can use this to assess audibility when the speaker is farther away than 1 meter, or use it as a counseling tool for parents to understand how audibility can change across listening situations.

Verification of other activated hearing device features (i.e. directional microphones, feedback suppression, frequency lowering, noise reduction) is important to ensure they are working appropriately and do not interfere with audibility of speech (McCreery & Walker, 2017, p. 94). Procedures for advanced feature verification are beyond the scope of this document. Audiologists may wish to check with the manufacturer's user manuals for the specific feature verification options available on their equipment.

Continued observation, re-assessment of the child's hearing levels, and modification of prescriptive amplification settings should be completed at regular intervals as new information becomes available about the child's hearing, new technology, or prescriptive methods. See [Follow-up and Monitoring](#) section.

ORIENTATION AND COUNSELING

The initial orientation will likely include information counseling that focuses on insertion and removal as well as how to operate the device controls, how to clean and maintain devices, warranty information, battery size, and safety. Parents/caregivers should practice these skills during the visit following demonstration (Tharpe, Ryan, & Gustafson, 2017). In addition to helping parents feel confident in their skills, it is also important to help them understand their vital role and enlist them as partners in improving the quality and quantity of their child's auditory experience (McCreery & Walker, 2017; Tharpe, Ryan, & Gustafson, 2017).

Partnering with parents to shape outcomes

Over the course of the continued clinical relationship, counseling should include explanations of the main malleable (or changeable) factors that shape outcomes (Moeller, Tomblin, & OCHL Collaboration, 2015; McCreery & Walker, 2017):



Ensuring Audibility for speech

Audiologists need current data to ensure the quality of the hearing aid fitting and appropriate aided audibility. Parents may need help understanding the importance of returning to the clinic on a planned schedule to ensure that hearing thresholds used to set devices are current, and that earmolds are fitting

appropriately. It is helpful for them to know that the recommended frequency of visits may change with age or risk factors, and that the clinic may have a system to remind families to follow-up.

Consistency and duration of hearing aid use

Help parents understand that more consistent hearing aid users have better outcomes.

- Help them find appropriate retention options for the devices so they are more likely to keep devices on during family outings and outdoor play.
- Explain data logging and how it can be beneficial to parents, especially when used collaboratively to problem-solve (i.e. if there is a discrepancy between the log and parent's report of hearing aid use) (Munoz, Preston, & Hicken, 2014).
- Recognize the challenges parents face when working toward having the child use amplification during "all waking hours" and be their supportive partner. As they work toward increasing device use time, focus efforts to wear devices during highly communicative periods of time to increase the child's exposure to spoken language (McCreery & Walker, 2017).
- Provide support to increase parent's self-confidence. Parents who are more confident in their ability to manage their child's devices are often able to get their children to wear devices more often. Check in with them about how they are feeling. Help them learn to troubleshoot and teach other caregivers how to manage devices. Connect them to parent-to-parent support (McCreery & Walker, 2017). For more information on referrals, see the [MDH Guidelines for Audiologist Referral to Early Intervention, Medical Specialties, and Connection to Parent-to-Parent and Family Support](#).

Quality and Quantity of Linguistic Input

Parents provide a great deal of linguistic input for their child. In addition to ensuring parents are connected to early intervention, an audiologist's counseling may include ideas for parents to improve the quality of their child's linguistic environment (Ambrose, Walker, Unflat-Berry, Olesen & Moeller, 2015). This might include regular reading with their child, using expansive conversation style (more open-ended questions and less directives/commands), and

making conversational turn-taking easier by reducing other distractions (like background television) (McCreery & Walker, 2017).



VALIDATION OF AIDED AUDITORY PROGRESS

The child's own speech and that of others should be audible, comfortable, and clear. Validation is ongoing and accomplished through use of the following:

- Speech, language, and communication assessments obtained during the habilitation process. Parents, audiologists, and early intervention providers should be in regular communication with one another about the child's progress and any need for amplification fine-tuning.
- Direct measurements of the child's performance in clinical and natural environments may include aided speech perception measures. These could include Ling sounds spoken from various distances, NU-CHIPS, WIPI, PB-K words, or Pediatric Minimum Speech Test Battery[®] (Uhler, Warner-Czyz, Gifford & PMSTB Working Group, 2017) as child becomes older.
- Parent report questionnaires, i.e., for birth to age 2: LittleARS Auditory Questionnaire (Coninx et al., 2009); for birth to age 3: Infant Toddler Meaningful Auditory Integration Scale (IT-MAIS) (Zimmerman-Phillips & Osberger, 1997); for age 2-7 years: PEACH: Parents' Evaluation of Aural/Oral performance of Children (Ching & Hill, 2007).

Validation should also include other assistive listening devices used in the child's habilitation (e.g. remote microphone systems).

FOLLOW-UP AND MONITORING

In addition to more frequent verification, as noted in the Verification of Electroacoustic Characteristics section, periodic audiological re-evaluations are essential. Hearing should be re-evaluated 1 month following initial fitting, at 2-3 month intervals thereafter for the first year of amplification, every 4-6 months until age 5, and yearly thereafter. The frequency of follow-up may need to be increased if fluctuation or progression of the hearing loss is noted and/or if progress is not as expected. A similar schedule is important for older children with a new diagnosis since progressive loss is a possibility.

Earmolds should be checked and remade as necessary, often every 2-3 months during periods of rapid growth.

Hearing aid re-checks should include regular coupler and real-ear measures of performance. When a hearing aid needs to be sent for repair, the child should have access to a loaner hearing aid.

Chronic or recurrent middle ear conditions can affect hearing thresholds and the effective use of hearing aids. Periodic immittance testing is recommended in all cases of pediatric amplification, using age-appropriate immittance protocols. Close monitoring of aided benefit is warranted. Infants with chronic middle ear conditions (e.g. otitis media with effusion (OME)) should be referred for medical treatment. Modifications to earmold configuration or transition from air conduction to a bone conduction device may also be considerations.

Audiologists and families should communicate at each visit to answer questions regarding care and use of amplification devices. Regular communication is also necessary at each visit to ensure that appropriate referrals continue to be made and that the family is receiving desired services.

Ongoing communication between the clinical audiologist, family, members of the early intervention team, educational audiologist, and the medical home is critical. A written care plan/action plan is recommended for optimal communication success.

Family support and counseling is ongoing. Families should be referred to MN Hands and Voices.

DOCUMENTATION AND REPORTING

Minnesota Statute 144.966 (Revisor of Statutes, State of Minnesota, 2019)⁹ outlines responsibilities for the Early Hearing Detection and Intervention Program for healthcare providers, the Minnesota Department of Health, and for the Newborn Hearing Screening Advisory Committee. One requirement includes evaluating program outcomes to increase effectiveness and efficiency. To do this, MDH-EHDI requests reporting of the amplification information related to child outcomes after diagnosis. The report form can be accessed at <http://www.improveehdi.org/mn/library/files/AudioReportingForm.pdf>.



QUALITY ASSURANCE / QUALITY IMPROVEMENT

The Minnesota Newborn Hearing Screening Advisory Committee sets benchmarks and indicators for Minnesota to ensure all infants and children with hearing loss will receive timely and appropriate early intervention services (medical, audiological, and developmental).

MDH tracks number and percent of infants with bilateral permanent confirmed hearing loss (PCHL) whose parent(s) chose personal amplification and who were fitted within 1 month of PCHL diagnosis.

Similar to tracking screening by 1 month, diagnosis by 3 months and early intervention by 6 months, MDH is charged with tracking this amplification indicator. Audiologists fitting Minnesota children with amplification are asked to report the initial fitting date to MDH so that stakeholders can assess the timeliness from diagnosis to amplification across clinics and geographic regions of Minnesota. Clinics can use this data to work on improving amplification timeliness within their clinic. Stakeholder groups (i.e. state agencies and others) can use this data to identify statewide issues that affect timeliness to amplification for children.

SELECTED LINKS

¹Minnesota Statute 62Q.675 Hearing Aids; Persons 18 or Younger. https://www.revisor.mn.gov/statutes/2018/cite/62Q.675?keyword_type=all&keyword=62Q.675

²Hearing aid appeals: Information for parents. <https://edocs.dhs.state.mn.us/lfserver/Public/DHS-7915-ENG>

³Minnesota Department of Human Services: Applying for Medical Assistance. <https://mn.gov/dhs/people-we-serve/people-with-disabilities/health-care/health-care-programs/programs-and-services/disabilities-apply.jsp>

⁴Hearing aid financial resources. <https://edocs.dhs.state.mn.us/lfserver/Public/DHS-7904-ENG>

⁵Minnesota Department of Human Services- Deaf and Hard Of Hearing Services Division. <https://mn.gov/deaf-hard-of-hearing/>

⁶Lions Infant Hearing Device Loaner Program. <https://hearbank.web.health.state.mn.us/home.xhtml>

⁷The Situational Response Hearing Aid Profile (SHARP). <http://www.audres.org/rc/sharp/>

⁸Pediatric Minimum Speech Test Battery. <https://aaa.publisher.ingentaconnect.com/contentone/aaa/jaaa/2017/00000028/00000003/art00007>

⁹Minnesota Statute 144.966. <https://www.revisor.mn.gov/statutes/cite/144.966/>



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