Washington State EHDDI Learning Community Best Practices for Hearing Technology for Infants and Children who are Deaf or Hard of Hearing

2021

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Purpose of guidelines

The purpose of this document is to provide best practice guidelines to guide pediatric audiologists and other stakeholders in Washington State in supporting children who are deaf or hard of hearing who use hearing technology (HT). These guidelines were developed with a work group of WA state audiologists as well as input from a larger group of EHDDI stakeholders. This document serves as a compliment to guidelines from national organizations (AAA Amplification Guidelines, 2013) as well as textbooks (Pediatric Amplification: Enhancing Auditory Access, McCreery & Walker, 2018).

Principles of Care

- Providers: HT is provided by audiologists in Washington State and surrounding communities who have training, expertise, and appropriate equipment to accurately assess the hearing of infants and children, provide appropriate treatment options, maintain consistent practice in pediatric audiology, and provide family-centered care and access to appropriate referrals and resources.
- Families: Families are supported with services in audiology centers that are welcoming and designed to minimize barriers to care. Interpreters are provided for all communication with the family in the language chosen by the family, as needed.
- Evidence-based, careful, safe practice: Audiologists use evidence-based guidelines to guide their pediatric audiology practice and use techniques and device selections that have research evidence with infants and children. Equipment used for verification of HT is calibrated weekly and checked with a full calibration evaluation annually. All appointments are conducted in full compliance with infection control policies and standards with cleaning procedures for rooms, equipment and examiners that are in direct contact with the child.
- Goals for using HT: To support children who are using HT, the overall goal is to maximize the child's cumulative auditory experience and to maximize developmental outcome. Research supports that cumulative auditory experience is maximized by: the age of the child when HT use is started, daily use time of HT, the child's audibility with the HT, and the amount and richness of language environment the child is exposed to (Moeller et al, 2015).
- Appropriate technology: Children have access to HT that is appropriate for their hearing loss and age. HT is available from entry level devices, standard devices, and advanced devices and these options have a range of associated costs. HT options are not determined by the family's insurance coverage or the provider's biases about the family's ability to use technology; technology options are based on the child's candidacy factors that include age, degree, type and laterality of hearing loss, as well as consideration of additional disabilities or medical issues. Loaner HT is offered to maximize the child's early auditory access, if needed.
- Medical evaluation and clearance: Children need medical clearance from an otolaryngologist prior to HT fitting, in accordance with Washington state guidelines. Children and their families benefit from care coordination between audiologists and pediatric otolaryngologists in the community as well as high priority, expedited scheduling to ensure HT fitting is not delayed. If there is evidence or concern for a treatable audiologic issue, audiologists refer children immediately to an otolaryngologist for treatment and ensure timely follow-up with the audiologist. In addition to an expedited evaluation for medical clearance for HT, children should receive a comprehensive medical evaluation that includes diagnostic assessments to determine the etiology of the hearing loss including imaging, testing for congenital cytomegalovirus, and genetic testing as well as additional specialized medical evaluations, as indicated.
- Documentation: Audiologists document details of HT in clinical reports that are shared with families, and other EHDDI professionals.
- Rescission rights: Families are provided with documentation of devices at the time of purchase along with serial numbers and warranty timeline in accordance with WA state dispensary practices.
- Support services: Families and children who receive specialized support services along with HT have better outcomes. Refer to WA EHDDI Best Practices Guidelines for Audiologic Assessment (2020) for more details on support services and referrals.

Overview

Hearing technology definition: HT includes any device that provides improved auditory access and includes hearing aids (HA) and custom earmolds, bone conduction sound processors (BCSP), contralateral routing of signal hearing aid systems (CROS), cochlear implants (CI), and remote mic systems (RMS).

Assessment: The assessment process determines if a child is deaf or hard of hearing and how the child is impacted by their hearing loss. Providers help the family assess their goals for their child and determine if they are candidates for incorporating HT into their child's life.

Selection: The pediatric audiologist identifies appropriate HT options based on the child's type and degree of hearing loss and age, using evidence-based determination of candidacy. Families are involved in the decision-making process of selection.

Verification: Electroacoustic verification is an essential step in ensuring a child's audibility with hearing aids.

Orientation and Monitoring: During a HT orientation, a family is instructed in the care and use of the HT by the fitting audiologist. The family is supported with ongoing discussion of care and use with audiologists, birth to 3 providers, and educators.

Validation: Outcome measures are used to evaluate the child's benefit from HT using both audiological evaluations of the child's access to spoken language with the technology as well as outcome questionnaires.

Family Resources

Families benefit from learning about HT through discussion with providers, as well as resources in printed or electronic format, websites, and videos. Every family needs support to incorporate HT into their daily life. Some families have challenges in supporting their child's technology use and benefit from enhanced support services from audiologists, birth to 3 providers, family resource coordinators, and social workers. Families may benefit from support services that can be provided via telehealth to minimize travel challenges, as well as transportation support and financial assistance to offset costs associated with caring for a child who is deaf or hard of hearing. Families benefit from ongoing social and emotional support to help them advocate for their child's needs.

Families benefit from providers sharing resources to address a family's specific needs:

- Babyhearing.org: information about hearing technology for families
- Posters/brochures for families summarizing outcome research for children who are DHH
- Family Handout on hearing technology retention and use
- Hear to Learn website: family instructional videos and documents:
    - How to insert/remove earmolds
    - How to trim new earmold tubing
    - How to clean earmolds
    - How to check hearing aid batteries
    - How to replace hearing aid batteries
    - How to do a hearing aid listening check
    - Bone conduction sound processors: candidacy, care and use
    - Hearing aid and earmold care and troubleshooting
    - Importance of full-time hearing aid use
    - Supporting self-advocacy
    - Self-advocacy and device care timeline for families
    - Teaching other caregivers about hearing aids
- Hand out on remote mic systems for young children: info for families and daycare/preschool
- Hand out on how to use a remote mic system
- Video instructions for using the Phonak Roger Touchscreen transmitter
- Family handout on learning about cochlear implants
- Parent perspective on choosing cochlear implants for their child
- Enhancing communication with young children
- Music activities for young children

Assessment: Candidacy for Hearing Technology

1. **Determine if child has permanent hearing loss**
   - Accurate and timely assessment of hearing is the crucial first step in determining a child's candidacy for HT. Refer to for specific guidelines on assessment protocol:
     WA EHDDI Best Practices Guidelines for Audiologic Assessment (2020)
     In most cases, HT is appropriate for children with permanent hearing loss (HL), but may be considered for children for whom the permanency of the HL is not yet determined and can use HT during the ongoing diagnostic process. A minimum amount of information for determining HT candidacy is based on thresholds for both a low and a high frequency stimulus (e.g., 500 and 2000 Hz) and evidence that the hearing loss is permanent. Children with longstanding temporary HL may also be considered candidates for HT.

2. **Determine family's candidacy for hearing technology**

   - **Does HT support the family's communication goals for their child?**
     Ultimately, the family's candidacy for using HT with their child, is based on their communication goals for their child. With support and information, the family will determine their communication goals for their child. For families, whose goals include their child using listening and spoken language, HT are necessary tools for supporting their communication goals. Some families' communication goals include only listening and spoken language and other families' goals include both listening and spoken language as well as visual communication (American Sign Language, Signed Exact English, Cued Speech). For families using both visual and spoken language, their communication goals may be for their child to have basic sound awareness with HT, or they may have the goal of their child to have the ability to understand spoken language.

   - **Is the family ready to start HT with their child?**
     The decision for a family to choose HT for their child involves time commitment for appointments and for incorporating HT into their daily lives; the family needs to be ready to take on these responsibilities. Providers can help families understand the impact of hearing on early learning and communication and can illuminate the benefits of early auditory access on long-term development for children who use listening and spoken language. Providers honor that timelines vary across families and support them in the step-by-step process of gathering information and making decisions.

3. **Determine child's candidacy for hearing technology**

   - **Is there evidence that the child is impacted by the hearing loss?**
     For an individual child, impact of the HL can be determined with both estimates of audibility and functional measures including speech audiometry and questionnaires. The age of the child will limit the extent that functional measures can be completed. Refer to the Outcome Measures Appendices 5 and 6 for age-appropriate measures. The speech intelligibility index (SII) is an estimate of the audibility of speech; the unaided SII estimates the proportion of average speech that is audible in quiet without HT. The unaided SII can be calculated by entering the child's hearing/BAER thresholds into electroacoustic verification equipment. Functional measures completed with speech audiometry in quiet and in noise give insight into the challenges this child may experience accessing conversational speech. Outcome questionnaires for the child, the family, and the teacher tap into the child's "real world" functioning. The challenge with outcome measures is that the developmental level of the child limits which

measures can be completed to evaluate the impact of the HL: for infants and young children, these measures are not possible or are quite limited in scope.

- **Is there evidence that children with similar hearing loss are impacted?**
  Research on the outcome of children who are DHH is very helpful in guiding understanding of the impact of HL. When research supports that children with similar hearing loss show impact on communication and learning, there is evidence to intervene with HT to minimize the impact for families whose goals include improved auditory access.
- **Are there medical/surgical contraindications for HT?**
  For children being considered for implantable devices, medical and/or surgical issues are crucial in determining candidacy.

4. Provide early access to hearing technology

- For families wishing to pursue hearing technology, audiologists strive to maximize early auditory access, with a goal of fitting HT within one month of identifying the child as deaf or hard of hearing, as supported by national guidelines (JCIH, 2019).
- Audiologists may utilize loaner HT during an interim period; loaner HT can benefit children in situations in which the audiologist and family are: 1) pursuing funding for HT; 2) dealing with middle ear issues in addition to permanent HL; 3) in the process of determining the details of the child's hearing levels.
- Barriers to early fitting include the following: 1) availability of appointments; 2) the family's readiness to start HT; 3) the audiologist's uncertainty of the child's candidacy for HT. Solutions to these barriers to timely fitting include the following: 1) scheduling strategies to maximize efficiency of appointments for medical clearance and fitting; 2) reducing uncertainty about candidacy for HT for audiologists; 3) providing loaner HT during the diagnostic process. Audiologists are encouraged to stay updated on new research and expanding candidacies for HT options.

Selection of Hearing Technology

Audiologists and families work together to select HT that is appropriate based on the child's degree and type of HL, age and developmental level, as well the family's goals, needs, and priorities. Since most HT will be used for an extended time period, consideration should be made to select HT that can serve the child's current needs as well as additional needs in the coming years.

Technology Features

For children to use HT for communication and learning, HT should provide:

- a range of audible speech levels with access to soft, average, and loud speech
- a broad bandwidth of audibility
- audibility in settings where noise and distance affect listening
- access to audio technology
- durable devices with tamper resistance
- accessories to improve retention and deter loss and removal
- coupling to earpieces that are comfortable with good retention and include appropriate ear acoustics
- user schedules that provide full-time access
- visible lights that help families monitor the function of the HT
- comfort for loud sounds and wind noise reduction may be an important feature for some children
- extended warranty

See *Appendix 1: Selection table* for an example of how an audiologist can identify important features in HT for an individual child as well as case examples.

Hearing Technology Options

1. **Hearing Aid**

- Behind-the-ear (BTE) hearing aids (HA) coupled to custom earmolds (EM) are the primary type of hearing aid fit on infants and children. BTE/EM fittings offer the most stable retention and are sturdier than other options. More gain is available in a BTE, providing reserve gain if needed for changes in hearing. Lastly, a BTE/EM device is the only HA option where incorporating real ear acoustics is possible using a real-ear-to-coupler difference (RECD) measure along with adjustments in a test box, whereas all the other options require on-ear verification with the child sitting quietly without moving for an extended period.
- Infants and young children need a HA that has safety features to ensure that small parts and batteries are not accessible to curious hands. The HA should have either a tamper-resistant battery door or a rechargeable battery system that does not use a removable battery pill. The HA ear hooks for young children should be a pediatric size with shorter length and tighter curvature and should include a pin that can be locked so that the earhook cannot be removed. Buttons and switches on HT can be active to be adjusted by the user or parent or can be deactivated. To avoid the settings being changed inadvertently, HT for young children typically has all buttons and switches disabled.
- Feedback from the HA can interfere with a child's auditory access; the goal is to use feedback suppression in the HA to reduce feedback without reducing gain. The earhook should include a filter that smooths out the peaks of the hearing aid response, reducing the chance of feedback. The impact of feedback suppression on the gain and output characteristics of the HA should be evaluated using electroacoustic verification after the feedback manager has been implemented.

- Digital signal processing of HA technology includes digital noise reduction, wide dynamic range compression, frequency lowering, directional microphone technology; signal processing features should be selected if research in children supports use.
  - Digital noise reduction has been shown to improve comfort without compromising audibility in children (Pittman, 2011a, b).
  - Wide dynamic range compression provides audibility across a range of speech levels and improved comfort for children (McCreery et al, 2012a).
  - Access to a broad frequency bandwidth is crucial for individuals who are DHH who use HT, and children who are DHH need a broader high frequency bandwidth than DHH adults (Pittman, 2008; Stelmachowicz et al, 2000, 2001). High frequency audibility can be maximized with either extended bandwidth HA or frequency lowering HA technology. Current HAs provide a wider bandwidth than older HAs and recent research shows that on average, current HAs can achieve an audible bandwidth of 8000 Hz (Van Eeckhoutte et al, 2020). Children who use HAs with frequency lowering technology show improvements in audibility, speech reception, and speech and language outcome (Bentler et al, 2014; Ching et al, 2013). For children whose high frequency audibility cannot be achieved with HAs, cochlear implants can provide a broader audible bandwidth.
  - Directional microphone technology uses multiple microphones on the HA to determine the spatial location of the speaker, typically focusing in front of the listener and reducing input located behind and to the side of the listener. Infants and young children do not always face the speaker and, therefore, directional microphone technology has the potential to limit audibility and limit incidental learning; directional microphone technology is best utilized by older school-age children (McCreery & Walker, 2017).
- Receiver-In-Canal (RIC) devices are often selected for teens and adults due to the slimmer profile and the open ear fitting. A RIC device is coupled to the ear with a wire and either a dome or a custom earpiece. The disadvantages of using a RIC with a younger child include: 1) fragility of the wire and receiver; 2) ear canal too small for receiver; 3) limited gain of the RIC; 4) retention challenges; 5) on-ear verification is required for adjusting the RIC and, therefore, the child must be old enough to sit quietly without moving during lengthy on-ear verification measures.
- Other HT that may be considered for older children include CROS and custom hearing aids. CROS (contralateral routing of signal) hearing systems use a transmitter hearing aid with a microphone that picks up sound on the ear with hearing loss and wirelessly transmits the signal to the receiver hearing aid worn on the other hearing ear. CROS systems are not recommended for young children due to the challenges with retention of the devices as well as the challenge of not occluding the normal hearing ear with the receiver dome/earpiece. Custom HAs worn completely in the ear canal or outer ear are not appropriate for children due to the need to remake the device with ear growth as well as the lack of compatibility with remote microphone systems and the need to complete on-ear verification.
- HT is available across a range of levels of technology from entry-level HT to premium HT and the cost increases as the number of features increase. Research to support advanced features is limited and typically only from adults using HT. Audiologists strive to provide affordable HT to families with the features that the child needs and have been supported by research to impact outcome.
- Earmold impressions are obtained for the initial fitting and new impressions are made as needed as the ear grows and the fit of the earmolds is insufficient. The frequency of a child's need for new earmolds depends on the age of the child and the severity of the hearing loss; typically, earmolds need to be replaced every 3 months in the first year of life, every 6 to 12 months from 1 to 5 years of life, and every 12 months or so for school age children and teens. Children with more severe hearing losses need a tighter fitting earmold and more frequent earmold remakes compared to children with mild/moderate hearing losses as feedback is

more of an issue with higher gain HAs. Earmolds can be ordered in a variety of colors; children and families may enjoy selecting color options. Silicone is the preferred material for pediatric earmolds due to its durability, comfort and reduced radiant feedback. Earmold characteristics that can improve fit for infants and young children include: a helix lock portion, a "double-dip" earmold in which the earmold lab adds additional coating of material to improve fit, and a coating on the earmold that helps the earmold glide into the ear. Most young children use a full shell style earmold, whereas school-age children with milder degrees of hearing loss may use a skeleton style earmold. Venting of the earmold should be parallel (not diagonal) so that the high frequency response is not impacted and retubing does not block the vent. Venting is considered carefully for young children; most small earmolds do not have adequate space for a vent in addition to the sound bore. As ears grow, venting may provide benefits of ventilation of the ear and reduction of the occlusion effect in children who have milder degrees of low frequency hearing loss. The decision regarding the length of the canal portion of the earmold is based on the child's ear canal anatomy and degree of hearing loss with more severe hearing losses benefiting from a longer earmold canal portion. A helix lock portion of the earmold is typically used for infants and young children to improve retention, whereas school-age children do not typically need this feature that may cause irritation.

- Obtaining an accurate impression of the ear is crucial for high quality custom earmolds. Audiologists place the impression dam adequately deep for an appropriate earmold canal length and fill the concha and helix region of the ear with impression material. Reducing the child's movement during the impression is crucial; both a test assistant and a parent can help with distracting the child with a toy and using passive restraint of the child's head during the impression procedure.

2. Bone Conduction Sound Processor

A bone conduction sound processor (BCSP) transforms sounds picked up by the microphone into vibrations of the processor through either transcutaneous vibration of the temporal bone with a softband retention band or adhesive or via percutaneous stimulation and an implanted osseointegrated device. Candidates for a BCSP are: 1) children with conductive hearing loss or mixed hearing loss who are not candidates for a HA due to external ear anatomy or chronic drainage; 2) children with single-sided deafness. Infants and children of all ages are candidates for the transcutaneous BCSP, whereas children over the age of 5 years are candidates for the osseointegrated BCSP.

For infants and children using a transcutaneous device, the BCSP processor should be positioned on the mastoid, the best location for picking up sound on the specified side of the child's head and provides the most effective processor gain in young children. In situations where a processor on the mastoid is in contact with a car seat or caregiver, the processor can be moved to a forehead placement without impacting processor gain in infants (Mackey et al, 2016). The softband should be tight enough to stay in place and provide adequate force for efficient transduction; a good rule of thumb is to tighten the band such that one finger can fit under the softband but not two fingers stacked.

3. Cochlear Implant

A cochlear implant provides tonotopic electrical stimulation to the auditory nerve and is a HT device for children who do not receive adequate auditory access with hearing aids. Candidacy for cochlear implantation involves a series of evaluations that include measures of auditory function, imaging, and a psychosocial evaluation. Some children use cochlear implants on both ears and some children use a traditional ear-level HA in one ear and a cochlear implant in the other (bimodal). A hybrid device is a combination of a HA and a cochlear implant and provides acoustic amplification to the low frequencies and electrical stimulation to the higher frequencies; children with sloping HL are considered for hybrid devices.

Children with bilateral severe to profound hearing loss may receive CI implantation as young as 9 months of age, based on FDA guidelines. Children with SSD or profound sensorineural hearing loss in one ear and mild to moderately severe sensorineural hearing loss in the other ear are candidates for CI as young as 5 years of age, based on FDA guidelines. The candidacy for CI is expanding and include children with moderately severe HL who use HAs but have limited auditory progress and children with asymmetric HL with one ear in the severe to profound range and the other ear with hearing ranging from the normal range to the moderately severe range. In considering if and when to have a child transition from HAs to CI, other considerations of the child's auditory development, language development and family goals will provide a more comprehensive candidacy evaluation.

4. Remote microphone technology (RMT)

Children are impacted by the listening challenges of noise, reverberation and distance and young children are more impacted compared to older children and adults (Neuman et al, 2010). Young children spend time in noisy settings with negative signal to noise ratios (SNR) of -3 to -10 dB in the car, bus, stroller, shopping cart, and in wind outdoors (Mulla & McCraken, 2014). Research shows that when parents use RMT in the home environment, significantly greater amount of child-directed spoken language is accessible to the child (Benitez-Barerra et al, 2018). Children spend time in daycare, preschool, and school settings and studies show that noise levels are the highest in classrooms with the youngest children (Cruckley et al, 2011). RMT provides the most significant improved auditory access when noise, reverberation and distance create listening challenges, with improved SNR of approximately 15 dB (Lewis et al, 2004). Older technologies used FM (frequency modulation), whereas newer technologies use DM (digital modulation) to send the signal from the microphone transmitter to the receiver. Current RMT DM systems (Phonak Roger) use directional microphones as well as adaptive technology that adjusts the level from the transmitter mic based on the room noise, effectively maintaining a positive SNR. Digital RMT with adaptive-gain receivers provide better speech recognition in high level noise than RMT with fixed-gain receivers (Thibodeau, 2014). Lastly, Bluetooth digital remote mic accessories (Phonak Partner Mic, Oticon Connect Clip, Cochlear Mini Mic 2+) provide improved access in noisy settings with affordable clip-on microphones; these RMT systems show improved auditory access in low noise settings for both HA and CI users but are less effective compared to adaptive RMT in high noise settings (Wolf et al, 2015a, b). RMT can be used with parents and family members, daycare providers and teachers. Users should have access to ease of muting the microphone when not needed. RMT DM receivers can either be attached to the base of the HT or can be internal in the primary HT device.

5. Streaming Technology

HT can connect to audio technology (smartphone, tablet, computer, etc.) either directly through Bluetooth technology or through a streaming accessory (Phonak ComPilot, Oticon Streamer) or using a DM transmitter/receiver system. Though older children are more likely to enjoy the streaming capabilities of technology, families may find that young children benefit from the improved acoustic features of streaming instead of listening to the technology through a speaker. It should be noted that if the family wants to share the listening experience with the child, using a speaker is preferable as a direct streaming signal to the HT will be audible only to the child and not to the parent; however, an audio splitter can be used to provide both the parent and the child with auditory access to the streaming. Children may find streaming technology provides improved sound quality when listening to audio technology in a noisy setting.

Considerations for Specific Populations

1. **Bilateral mild to severe**

   There is a large body of evidence to support that the benefits of HT for children with bilateral HL. The earlier that children with bilateral HL receive and use HT, the better long-term speech/language and communication outcomes for these children (Sininger et al, 2010). Children with bilateral HL are typically fit with binaural HAs, however, for children with significant asymmetry across ears, the benefit in each ear should be monitored closely with monaural aided testing.

   Children who have limited audibility with HAs are at higher risk for less than optimal outcome. Research by Stiles (2012) indicates that children with aided SII of less than 65 are at risk for the impact of limited audibility on their language development and learning and should be considered for CI candidacy. Children with steeply sloping hearing loss may be candidates for hybrid CI technology that use electroacoustic stimulation and/or preservation of low frequency acoustic hearing with shallow electrode insertion. There is evidence that children who have limited audibility with hearing aids show improvement in speech perception with CI and for those using bimodal devices (Carlson et al, 2015).

2. **Bilateral severe to profound**

   Children with severe to profound bilateral HL show benefit from both HAs and CIs (Davidson, 2015). Children who show no response at the limit of audiological (ABR, audiometer) equipment are considered candidates for HT as the child may residual hearing that is not captured by the assessment. There is evidence that age of receiving CI is a significant factor in outcome; outcome is maximized in children who receive CI in infancy (Ching et al, 2018). For families with children with severe or profound HL who wish to use HT, the discussion of both HA and CI technologies should start early, so that families know about immediate options as well as future options for their child. A trial with HAs is a necessary step in CI candidacy and there is evidence that children who have experienced early auditory access prior to cochlear implantation have better outcome (Eisenberg et al, 2004). When families are referred to a CI team for more information and evaluation of CI candidacy by 3 to 6 months of age, the candidacy process can be started so that children with bilateral severe to profound HL can receive CI as early as the FDA-approved age of 9 months. An important first step in the candidacy process is imaging (CT, MRI) of the auditory system to determine if implantation is contraindicated based on structures of the cochlear and auditory nerve.

3. **Bilateral mild or bilateral isolated hearing loss**

   Research supports that children with mild HL are more vulnerable to the impact of their HL because their hearing loss is not always addressed with intervention and HT. These children are more vulnerable due to uncertainty about candidacy for HT, delayed fitting of HT, as well as limited use of HT (Walker et al, 2015). In making decisions regarding candidacy, audiologists typically rely on the audiogram, however, recent research (McCreery et al, 2019) supports that using the unaided SII is a better indicator of the impact on audibility and determining candidacy for children with minimal/mild HL; children with an unaided SII for conversational speech of less than 80 should be considered candidates for HT to minimize the language delays. More details about calculating and interpreting the SII is found in the Outcome Measures section.

4. Unilateral hearing loss: mild to moderately-severe

Children with unilateral hearing loss (UHL) show impaired ability to rely on binaural hearing and, therefore, have difficulty hearing speech in noise and localizing to find the source of sound. Research shows that children with UHL show poorer outcomes in language development, learning and academics compared to children with typical hearing (Lieu et al, 2010). As of 2020, the evidence for benefit from HT in children with UHL is quite limited with only a few published studies that have looked at the outcome for children with UHL who use a HA (Briggs et al, 2011). Despite the limited evidence for benefit, current guidelines (Bagatto et al, 2019) support that for children with UHL, the first-line treatment is a monaural HA and, for children with unilateral atresia, fitting with a BCSP should be considered. Increasingly, children with UHL are being fit with UHL: in 2010, 27% of children with UHL were fit with HT, and in 2017, 73% of children in their study were fit with HT (Fitzpatrick et al, 2010, 2017).

5. Unilateral hearing loss: severe to profound

Children with single-sided deafness (SSD) have difficulty hearing speech in noise and localizing to find the source of sound and show impacts on their language development and academics (Lieu et al, 2010), similar to other children with UHL. Children with SSD are not typically considered candidates for a monaural HA due to the limited audibility in the ear with HL as well as the potential for crossover of the amplified signal and interference with their other hearing ear. Individuals with SSD are candidates for HT that picks up sound on the side of the head with hearing loss and transmits it the other side either by bone conduction (BCSP) or by digital transmission (CROS); these HT options alleviate the head shadow effect but do not provide the individual with the benefits of binaural hearing. There is some evidence of benefit for both BCSP and CROS in older children/teens and adults with SSD, but no evidence in young children (Liu et al, 2017; Lin et al, 2006). Cochlear implantation for individuals with SSD is a recently developing option with FDA approval in 2019. There is emerging evidence that children with SSD who receive a CI show improved ability to hear speech in noise, to localize to sound, and have improved language development with benefit maximized by early implantation (Sangen et al, 2019). An additional consideration for children with SSD is determining the child's anatomy as cochlear nerve dysplasia can be present in approximately 50% of children with SSD and in these cases, CI would not be feasible (Arndt et al, 2015). Lastly, children with SSD can be considered candidates for RMT as their primary HT.

6. Auditory Neuropathy Spectrum Disorder (ANSD)

All children with ANSD are impacted by their hearing disorder; because it is a spectrum disorder, there is large variability across children, both in hearing thresholds as well as ability to understand speech (Rance & Barker, 2008). In the early stages of learning about ANSD, families benefit from understanding that their child will be impacted by ANSD and the magnitude of the impact will be learned over time. Children are identified with ANSD based on physiological responses with ABR and OAE, but candidacy for HT is based on behavioral hearing thresholds which can be measured once the child is at a developmental level of 6 months. Research shows that children with ANSD show significant benefit from hearing aids for those with aidable hearing levels and studies that have compared outcome in children with ANSD to children with sensorineural hearing loss, show that the two groups show similar benefits from HT (Walker et al, 2016).

Children with ANSD whose behavioral hearing thresholds are in the severe to profound hearing loss range or those with very poor word recognition in the ear with ANSD may be candidates for CI.

7. Permanent conductive hearing loss

Children with permanent conductive hearing loss are fit with air conduction HA technology if the child has external ear anatomy to support the coupling of an earmold and retention of the HA. Children with permanent conductive hearing loss due to atresia and microtia or children with chronically draining ears are candidates for (BCSP. For young children, the BCSP is worn as a transcutaneous device, retained with a softband or adhesive that creates pressure to conduct the vibratory signal. A BCSP can be implanted into an osseointegrated device in children over the age of 5. Children with CHL from atresia who use BCSP technology show improved outcome in auditory and speech and language skills (Attaway et al, 2014)

Verification

- Verification is the important process of measuring the gain and frequency response characteristics of a hearing aid and ensuring that the child has adequate aided audibility of speech. Verification is an ongoing process to ensure that over time the child is receiving adequate auditory access.
- Pediatric prescriptive targets, normative data, and fitting methods that take into account the unique developmental and auditory needs of children are used for pediatric hearing aid verification instead of manufacturer's proprietary prescriptions. Both the Desired Sensation Level (DSL) prescription and the National Acoustics Laboratory prescription (NAL) prescription are supported by research; in north America, audiologists typically use DSL.
- Verification is completed with speech stimuli at a variety of levels (45 to 80 dB SPL) as well as frequency-specific stimuli for measuring maximum power output at 90 dBSPL. When completing verification, the hearing aid is set to omnidirectional with frequency lowering and directional microphone settings deactivated. The audiologist modifies the hearing aid gain characteristics to meet targets across the frequency range.
- Electroacoustic verification is completed either using the REAR or the S-REAR measure
  - Real ear aided response (REAR): verification is completed with the hearing aid and earmold/earpiece on the child's ear and the child seated in front of the equipment speaker. The probe mic is placed on the floor of the child's ear canal at an adequate depth, and then the HA and earmold/ear piece are inserted into the ear, with the audiologist securing the probe tube so it does not move with the insertion.
  - Simulated real ear aided response (S-REAR)/simulated real ear measure (S-REM): verification is completed by measuring the child's real ear to couple difference (RECD) and then verification is completed with the hearing aid on the coupler in the test box. For young children who have challenges sitting quietly without moving for an extended period, the RECD/S-REM is preferable to the REAR measure. Obtaining an accurate RECD measure may not be possible at every attempt; in these situations, an age matched average RECD can be used. Though average RECD values are valid to use in these situations, individual RECD measures are crucial due to the high variability of RECD values across individuals (McCreery et al, 2015). The transducer coupling (foam tip or earmold) used for the RECD should be the same transducer coupling used for measuring the child's hearing thresholds, as this results in the "cleanest conversion". For measuring the RECD with the personal earmold, the probe tube is placed on the floor of ear canal and the RECD transducer from the verification equipment is attached to the earmold tubing. The probe tube is not threaded through the earmold vent as this practice changes the acoustic properties of the venting. For measuring the RECD with a foam earphone tip, having foam tips pre-threaded with a probe tube mic provides a quick and stable measurement. For either transducer coupling, the measurement is quickly completed when the child is quiet, and the audiologist has determined that the measurement is valid. The audiologist then completes verification of the HA in the test box coupler. The probe tube should be inserted at adequate depth in the canal and approximately 4 mm beyond the end of the earmold/earpiece for a valid measure; when measured from the inter-tragal notch the probe tube should be inserted 20 to 25 mm for young children and 28 mm for older children. If the probe tube is occluded or against the canal, the measures will be unusually low, and the probe must be cleared or replaced and reinserted.
    See *Appendix 2 for illustration of the RECD measure.*
- Interpretation of HA verification
  - Is the instrument achieving target gain? A hearing aid output meets targets if the verification is within +/- 5 dB of targets across the frequency range (McCreery et al, 2013).
  - Is the instrument appropriately limiting the output? MPO should not exceed targets.

- Is the instrument providing good aided audibility?
    - Are Aided SII values within the expected range for the degree of HL?
      See *Appendix 3* for published norms from Bagatto et al, 2010
    - Are Aided SII values showing a high proportion of audible speech for soft and average speech?
    - Is high frequency audibility maximized?
        - After the hearing aid has been adjusted to meet prescriptive targets, the audiologist determines the maximum audible output frequency (MAOF) range, defined as the frequency range where the average and peak lines of the aided speech spectrum intersect the child's audiogram. If the MAOF shows a limited bandwidth of audibility, the audiologist completes verification with filtered high frequency stimuli (Verifit Speech 6300 Hz /s/ and 4000 Hz /sh/ stimuli) and adjusts the frequency lowering in the fitting software to provide audibility of the high frequency stimulus. The goal is to provide the least amount of frequency lowering that results in the filtered 6300 Hz stimulus being audible to the child, with energy above the audiogram on the verification equipment. In addition, the /s/ and /sh/ stimuli should be distinguishable in both the verification and in the listener's perception.
          See *Appendix 4* for an illustration of verification of high frequency audibility.

- If there are concerns about audibility based on verification as well as outcome measures, the audiologist considers options to improve audibility:
    - Reduce feedback management
    - Change earmold acoustics
    - Use frequency lowering for improving high frequency audibility
    - Change HA to more powerful device
    - If using RIC technology, change to BTE
    - Consider CI candidacy

- Verification of BCSP
  BCSP devices should be adjusted by tightening the softband to the proper tightness or adjusting the magnet strength. In-situ threshold measurements using the programming software and the BCSP on the child provide a validation of appropriate settings in children who can participate. Lastly, the output of the osseointegrated BCSP can be verified with HT verification equipment and a skull simulator; protocols and in development to transcutaneous BCSP technology.

- Programming/mapping of CI
  Mapping of CI technology involves a series of adjustments at the initial activation and in follow-up assessments. The audiologist selects the coding strategy for the processor and the coil strength. Adjustments to the C and T levels are determined based on the child's behavioral responses to sound; the T level is the minimum electrical stimulation detected and the C level is the upper stimulation level.

Orientation and Monitoring

When audiologists teach families about using and caring for HT, families benefit from receiving clear, concise information in verbal, written and electronic formats tailored to the unique needs of each family. Families also benefit from information being reviewed at follow-up visits as well as addressing additional issues over time.

At the initial fitting, for children using a HA and earmold, the audiologist trims the earmold tubing to the appropriate length for the child and runs the feedback suppression software with the HA and earmold on the child's ear. Families benefit from having the opportunity to communicate with their child in the first few minutes of wearing the HT; the audiologist helps the family look for age-appropriate responses to sound in their child. The audiologist demonstrates putting on and taking off the HT and has the family practice; families benefit from the audiologist using a "teach back" approach to allow families to show or express what they've learned. An initial HT orientation can focus on providing information that address the following questions:

- How do we turn HT on/off?
- How do we put HT on and keep it on?
- How can we tell if HT is working?
- When do we take HT off?
- How do we take care of HT?
- How can we connect to other audio and hearing assistance technology?

Care kit: Families are provided with a kit that includes the tools they need to care for their child's HT. Families are provided with a listening tube and instructions for completing a listening check. For devices with disposable batteries, the family receive a battery tester and for devices with rechargeable batteries they receive a charging unit and instructions for charging. Families need to understand the indicator lights on the device and the meaning of a change in the lights. Children who use custom earmolds need tools for cleaning the earmolds including wax loops and blowers. Dry kits are provided with instructions for nightly storage for removing any moisture from the HT. Lubricants may be provided for children who use custom earmolds; a water-based lubricant (e.g., Otoease) applied to the earmold can help the earmold glide into the child's ear and an oil-based lubricant (e.g., Otoferm) can serve as both a lubricant as well as to fill in gaps when a child's earmold is not fitting tightly. Double-sided tape may help prevent HT from falling off the ear. Hats/caps with under the chin ties/Velcro made from material that does not block sound are the most effective strategies for keeping HT on and deterring child removal. HT clips that attach to the device and clip on the child's clothing can be used to prevent loss.

In the ongoing support of families using and caring for HT, discussions can reinforce topics addressed previously as well as broaden to additional topics:

- How often should my child wear HT?
- How can we keep the HT on full time?
- How can we troubleshoot the HT?
- How can we tell the HT is helping our child?
- How should we communicate with our child?
- How can we advocate for our child?

For children being fit with streaming technology, the audiologist provides instructions on how to connect with audio technology (phone, tablet, etc.). For remote mic technology, the audiologist provides instructions on the transmitter microphone use and muting as well as how to synch the transmitter and RMT receiver. Lastly, the audiologist provides instructions on how to complete a listening check with RMT. For accessories that utilize a charging unit, the audiologist provides instructions on how to appropriately charge the accessory.

Monitoring hearing technology

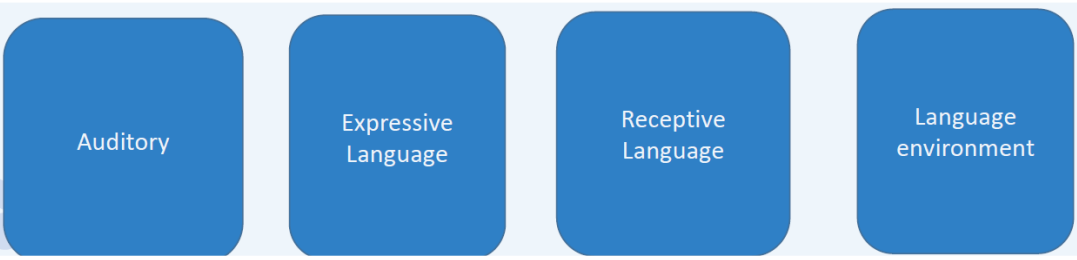
Children with HT are closely monitored both for both hearing levels and fine tuning of HT during which audiologists provide ongoing education and support to the family. After an initial fitting, a child should return for follow-up within 1 month to ensure that the technology is fitting well, and the family is making progress with use and care. Children receive follow-up every 3 months during the first year after the fitting and then every 6 months until age 5, and then every 12 months thereafter. Children who demonstrate hearing change or families who need enhanced support are seen more frequently. On-going audiologic evaluation and adjustment of amplification are necessary to ensure consistent audibility over time. Hearing aid fittings for infants and young children are often based on limited electrophysiological or behavioral data and as additional audiometric information is obtained, the HT can be adjusted more precisely. Children are more likely than adults to experience fluctuation or progression of hearing loss over time.

Validation: Outcome Measures

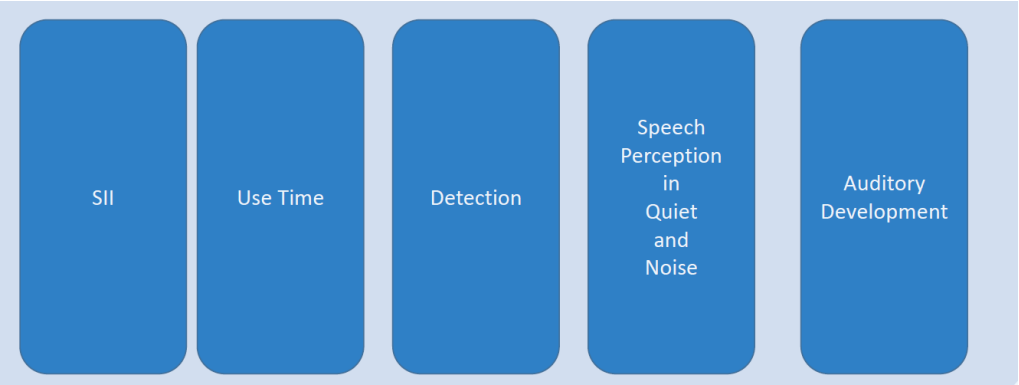
For children who use HT, there is a large range of developmental outcomes with many factors interacting in each child. Malleable factors are those that can be modified include: 1) age of fitting of HT; 2) duration and consistency of HT use; 3) audibility of speech with HT; 4) richness of the child's language environment (McCreery & Walker, 2017). Nonmalleable factors are related to the child and the environment that cannot typically be changed and include: 1) socioeconomic status; 2) additional disabilities.

All children who are DHH should have their developmental progress monitored; JCIH guidelines (2019) support that children should receive developmental evaluations every 6 months from birth to age 36 months. Outcomes assessment is an integral part of evidence-based practice.

Communication Outcome Measures



Auditory Outcome Measures



Auditory outcome measures are used for children who are DHH and whose family has identified improved auditory access as a communication goal. Both qualitative and quantitative measures are effective in documenting the use of and benefit from HT.

1. **Auditory Outcome measure: Audibility**

   The Speech Intelligibility Index (SII) is a standardized measure for estimating the audibility of speech. The SII is measured with electroacoustic verification equipment with soft and average speech stimuli and shows the proportion of the speech signal that is audible to the child in quiet. Aided SII values should be in the expected range for the degree of hearing loss; see *Appendix 3: Aided SII norms*. When aided SII values are monitored closely in each child along with other outcome measures, children with limited audibility can be identified and interventions can be adjusted to improve the child's access to language.

2. **Outcome measure: Use time**

- Use time is a measure of how often the child is using the HT and can be estimated both by asking the family about typical use time and by datalog measures in the HT that calculates average daily use time since the child's last visit. Research supports that children who have more hours of HT use have better outcomes; children who have early access to HT and used the HT at least 10 hours per day achieved language outcomes on par with same-aged children with typical hearing, whereas children with part-time use have poorer language outcomes (Tomblin et al, 2015). There is a large variability in use time across children and across age. Research shows infants and toddlers have the lowest use time of HAs, compared to older children (Walker et al, 2013). Children with milder HL use HAs less than children with moderate to severe HL (Walker et al, 2015). There is also large variability in the daily use time for children with CI technology (Bush et al, 2017). Family factors that limit HT use include: invisibility of the impact of HL, family acceptance of HL and need for HT, family understanding of early learning, family feeling of shame and fear, and multiple caregivers involved in the child's care. Factors that support HT use include: families with strong parenting skills and self-efficacy as well as those that receive support from EHDDI stakeholders. Providers partner with families to support their use of HT with their child by listening and validating family's challenges. When providers "police" HT use, we lose the opportunity to look at the challenges together and find solutions. Audiologists find opportunities to build on the successes families are having with HT use. Lastly, families benefit from understanding how HT benefits their child, the connection between auditory access and brain development, and how to recognize subtle benefit changes and time for benefit to be evident and, lastly, to recognize the listening effort exerted by the child to "get by" without HT.
- Families benefit from looking at their child's daily activities and identifying quality listening settings during which HT use can be maximized (e.g., shared reading, mealtime). Families can also identify settings where HT use is not currently reasonable (e.g., the car). When a child consistently removes their HT, parents may misinterpret the behavior as indicative that the technology does not fit or is uncomfortable or is too loud or not set appropriately. For infants and toddlers, removal of HT is typically related to age-appropriate curiosity. Strategies that work to deter child removal of HT include: use of a cap/hat that ties under the chin, distraction and engagement in a fun activity, persistent parent replacement and, lastly, knowing when to take a short break from HT. Providers' ongoing challenge in working with families it to balance the benefits of full auditory access with HT use with use that is reasonable for the family at the stage they are at. Families who are concerned about losing HT will benefit from the use of retention clips which attach to the clothing and the HT. See handout on strategies for improving retention.

3. Outcome measure: Detection

- For children who use BCSP or CI technology, the aided audiogram is a crucial measure in determining that the technology is set appropriately for the child. Children's aided detection thresholds are measured in the soundfield with frequency-specific stimuli across the frequency range. For children who wear HAs, electroacoustic verification as well as aided speech detection and recognition are more valid measures for setting the hearing aid and for evaluating benefit.
- For young children who are not able to participate in word and sentence recognition, aided detection of the Ling 6 phonemes provides an evaluation of the child's access to a range of speech sounds. Typically, recorded phonemes are presented at both a conversational level (50 dBHL) and a soft speech level (35 dBHL) and the child's performance is described at each level (e.g., 6/6 @ 50 dBHL, 4/6 at 35 dBHL).

4. Outcome measure: speech audiometry measures

- Speech audiometry measures are used to assess the child's ability to recognize words, phrases, and sentences at typical levels of conversational speech in quiet and noise while wearing HT. Age-appropriate word lists are selected based on the child's developmental level of speech and language skills in English. Typically, a 25-word list is used for each condition, preferably using recorded speech stimuli.
  Children's aided ability to identify speech (words, phrases, sentences) is typically measured in the soundfield at a conversational level of 50 dBHL and a soft speech level of 35 dBHL in quiet. Speech recognition in noise is evaluated speech stimuli from one speaker and recorded babble from the opposite speaker, resulting in a variety of SNRs (-5, 0, +5 dB SPL). Multi-talker and 2-talker babble are used as appropriate noise stimuli. For test rooms with a 2-speaker setup, babble is presented from one side and the speech stimuli from the opposite side, whereas a booth with a 3-speaker arrangement provides the option of speech from a front speaker and noise from a side speaker. For children with binaural HT, aided measures are typically conducted binaurally, but monaural testing may be beneficial for children with asymmetrical hearing or for bimodal users. For children with asymmetrical hearing or UHL, it may be beneficial to measure performance with speech stimuli from both the left and right speakers with noise from the opposite speaker and compare performance across measures. Speech recognition measures are interpreted both by the percentage correct as well as a descriptive term: 90-100% = excellent, 80-90% = good, 70-80% = fair, 50-70% = poor, <50% = very poor. When using 25 words lists, performance across conditions is considered significant if there is at least a 20% difference.
- SNR loss measures (e.g., BKB-SIN, HINT-C) utilize a number of sentences presented with varying SNRs, used to calculate the SNR loss. For the BKB-SIN, sentence and word stimuli can be presented from the same speaker or from 2 different speakers for children with asymmetrical hearing, Findings are interpreted using age-matched corrections based on test guidelines. The SNR loss is interpreted using the following criteria: 0-3 dB=Normal/near normal performance in noise; 3-7 dB =Mild SNR loss with mild difficulties in noise; 7-15 dB=Moderate SNR loss with significant difficulties in noise; >15 dB =Severe SNR loss with severe difficulties in noise.
  See *Appendix 5: Speech Audiometry Tables*

5. Outcome Measures: Questionnaires

- Outcome questionnaires are used as a structured method for evaluating the child's listening and communication. Family members as well as older children/teens can complete questionnaires. The *Outcome Measures Table* lists questionnaires that are appropriate across ages of children. Some measures chart communication/auditory development in comparison to age-appropriate expected scores (e.g.,

LittlEARs, PEACH) whereas most questionnaires have a rating scale, but no norms. Questionnaires like the LIFE-R, the SIFTER, and the TEACH can be completed by teachers for input on how the child is listening and communicating in a school setting. Findings from questionnaires are interpreted along with other outcome measures to address the child's benefit from and auditory access with HT.

See *Appendix 6: Outcome Questionnaires*.

Communicating with Families

When children who use HT and their families return for follow-up assessment and monitoring of HT, audiologists engage in conversations to discuss the child's and family's progress and questions and develop a plan for the appointment. The case history should address: HT use time, challenges with HT function and retention, access to RMT, and updates on intervention/education services.

After hearing assessments, verification and outcome measures have been completed, the audiologist and the family discuss the following:

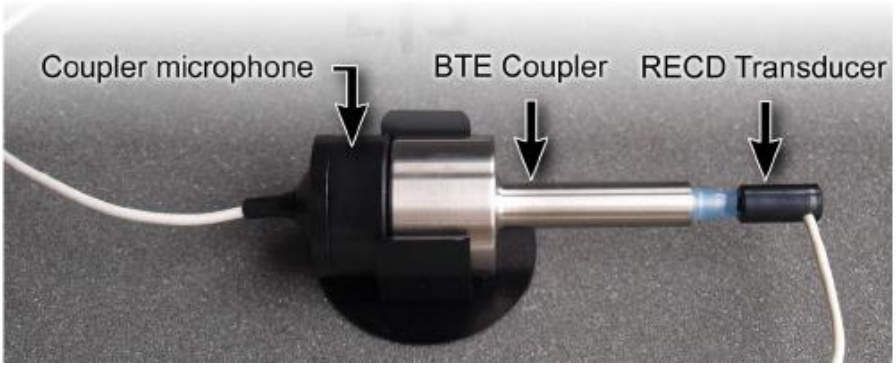
- How is the child hearing today?
- How is the HT functioning and how often HT being used by the child?
- How is the child benefiting from HT? What is the child's current auditory access?
- Are family communication goals being met?
- What is the timeline for follow-up assessment and referrals?

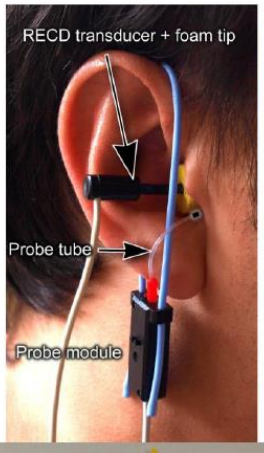
Appendices

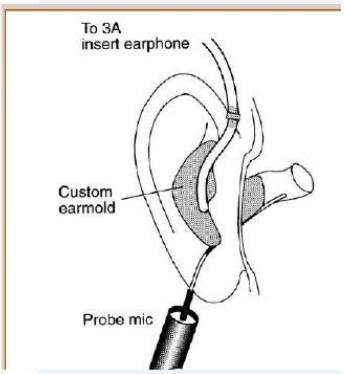
Appendix 1: Selection Table and Selection Examples

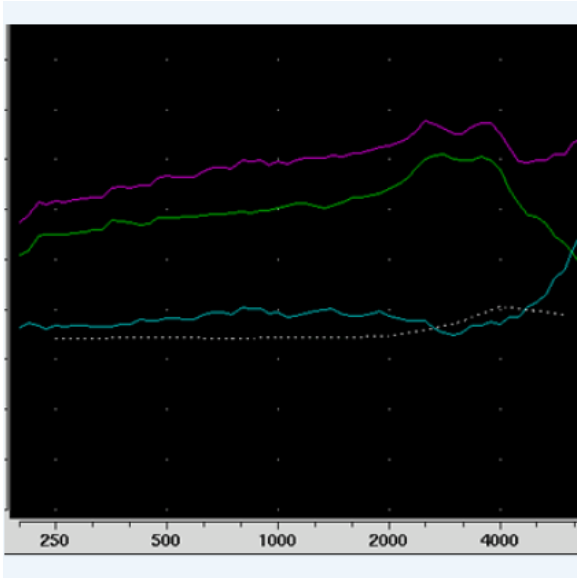
Hearing Aid Feature	**HA A**	**HA B**
Extended Warranty		
Broad bandwidth (extended BW, frequency lowering)		
Noise reduction basic		
Noise reduction advanced		
Extended channels		
Visual display light		
Extended program choices		
Wind block		
Softening of sudden loud sounds		
Batteries (disposable or rechargeable)		
Remote mic accessory		
Remote mic system compatibility		
Streaming (accessory or internal)		
Warranty		
Cost		

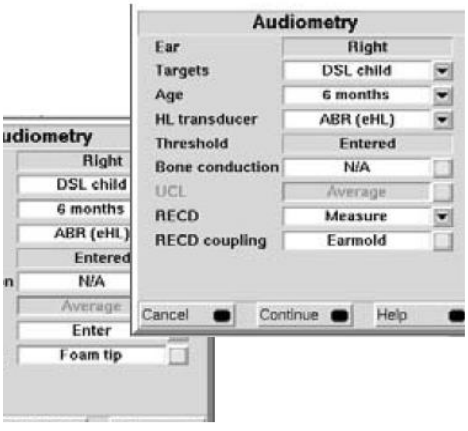
Appendix 2: RECD measure











Appendix 3: Verification: Aided SII Norms

Appendix

Aided Speech Intelligibility Index (SII) Normative Values v1.0, Revision 2

Child's Name:

_____

Test Date: _____

NOTES: _____

_____

_____

_____

_____

INSTRUCTIONS:

Step 1:

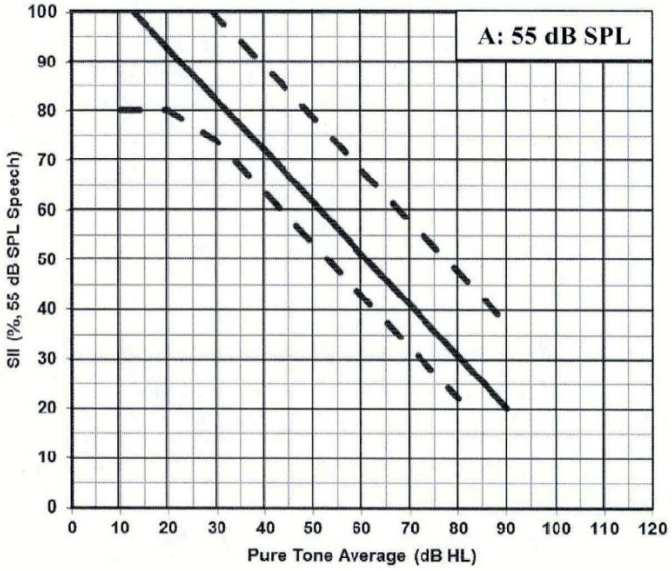
- Calculate the child's 3-frequency PTA for 500, 1000, & 2000 Hz.
- Fit the aid to DSL v5 Child Targets as close as possible, trying not to deviate more than ±5 dB.

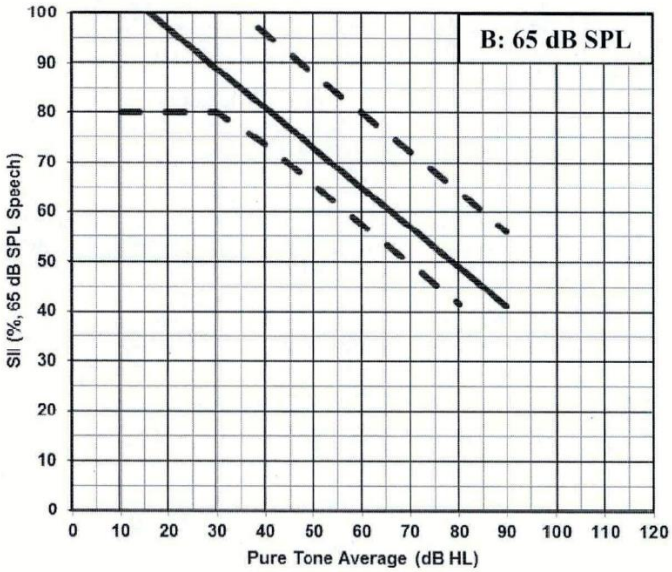
Step 2:

- Plot the aided SII value associated with the REAR measured with a 55 dB SPL speech input on panel A relative to the corresponding PTA on the X-axis.
- Plot the aided SII value associated with the REAR measured with a 65 dB speech input on panel B relative to the corresponding PTA on the X-axis.

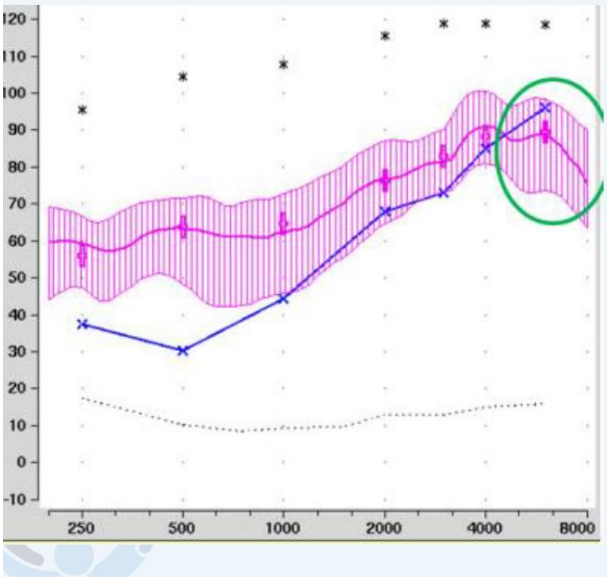
INTERPRETATION:

- The solid line in each panel indicates the average aided SII values for children aged birth to 6 years.
- The dashed lines indicate the confidence intervals around the mean (lower = 1 SD; upper = 2 SD).
- If the child's aided SII values fall within the dashed lines, then the child's hearing aid fitting is electroacoustically acceptable for his/her PTA.

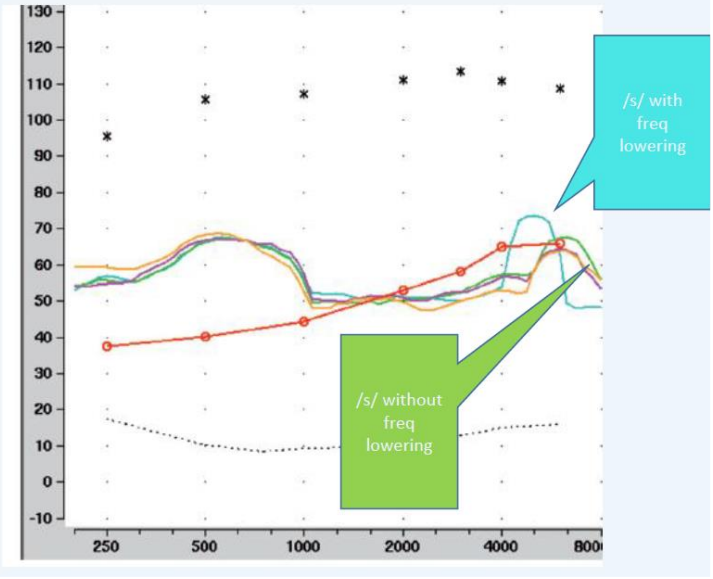




Appendix 4: Verification of High Frequency Audibility



MAOF (maximum audible output frequency) is defined as the frequency at which the average speech spectrum intersects the child's audiogram. For the figure on the left, the MAOF is approximately 4500 Hz.



To adjust frequency lowering settings to maximize audibility, filtered 6400 Hz speech stimuli to stimulate /s/ is used to maximize the amount of energy above the child's audiogram with the minimum amount of lowering of frequency. The green line represents the verification of the 6300 Hz /s/ stimulus without frequency lowering and the aqua line represents verification of 6300 Hz /s/ with frequency lowering activated on the HA.

Appendix 5: Speech Audiometry Table

Test	Language Age	Description
Ling 6 Sound Test	6 months-3 years	Detection of recorded phonemes /a/ /i/ /u/ /s/ /sh/ /m/
ESP Early Speech Perception Test	2 years +	Closed set: Spondees and words, Detection, pattern perception, word identification
O&C Open and Closed Test	2 years +	Closed and open set picture identification
NU-CHIPS Northwestern University Children's Perception of Speech	2.5-5 years	Closed set (4), picture identification
WIPI Word Intelligibility by Picture Identification	3.5-6 years	Closed set (6), picture identification
PSI Pediatric Speech Intelligibility Test	3-10 years	Closed set, verbal response, quiet and noise
MLNT/LNT (Multisyllabic) Lexical Neighborhood Test	3 years +	Open set: Multisyllabic and monosyllabic words. Lexically easy/difficult
UWO Plurals Test	4 years +	Closed set: picture response
PB-K Phonetically Balanced Word Lists-Kindergarten	5 years +	Open set: Monosyllabic words
Az Baby BIO Sentence Test	5 years +	Open set sentences
W-22 (Central Institute for the Deaf list W-22)	8 years +	Open set: monosyllabic words
NU-6 (Northwest University Auditory Test #6)	12 years +	Open set: monosyllabic words
Listening Comprehension Test	6-17 years	Open set
SNR LOSS MEASURES		
Phrases in Noise Test (PINT)	3 years +	Closed set sentences; varying SNRs with recorded classroom noise
BKB-SIN (Bamford-Kowal-Bench Speech in Noise)	5 years +	Open set sentences in varying SNRs with multi-talker babble both on Ch1
HINT-C Hearing in Noise Test-Children	5 years +	Open set sentences in varying SNR with speech-shaped noise
WIN Words in Noise Test	6 years +	Open set monosyllabic words in a range of SNRs with multi-talker babble
SPIN	Teen-adult	Sentences in noise
QUICK-SIN	Teen-adult	Sentences in multi-talker babble in varying SNRs
SPRINT	Teen-adult	Words in noise

Appendix 6: Outcome Questionnaires

FAMILY OUTCOME MEASURE	TARGET AGES	FORMAT
ELF Early Listening Function	5 mos-3 years	Observation of 12 activities
LittlEARS	1 mo-2 years	35 yes/no questions; age-specific norms chart
Auditory Skills Checklist	5mos-5 years	3-point scale
IT-MAIS and MAIS: (Infant/Toddler) Meaningful Auditory Integration Scale	5 mos-3 yrs-IT-MAIS; >3 yrs- MAIS	10 questions, 5-point scale,
CHILD Children's Home Inventory for Listening Difficulties	3-12 years	15 questions, 8-point scale, parent and child versions
PEACH Parent's Evaluation of Aural/oral performance of Children	3-7 years	13 items, 5-point scale; norms chart
SSQ Speech, Spatial and Quality of Hearing Questionnaire	4 years +	8 situations parent and child versions
P-APHAB Pediatric Abbreviated Profile of Hearing Aid Benefit	10-17 years	24 items, 7-point scale; parent and child versions
HEARQL Hearing environments and reflection on quality of life	8-12 years	35 items
SAC-A Self-Assessment of Communication-Adolescent	Teens	12 items, 5-point scale
SCHOOL-BASED OUTCOME MEASURE	**TARGET AGES**	**FORMAT**
SIFTER Screening Instrument for Targeting Educational Risk Preschool SIFTER, SIFTER and Secondary SIFTER	3-5 yrs-P-SIFTER 5-12 yrs-SIFTER 12-18 yrs-S-SIFTER	15 questions covering 5 content areas: teacher questionnaire
LIFE-R Listening Inventory for Education-Revised	8-18 years	15 items; teacher and student questionnaires
TEACH Teacher's evaluation of Aural/oral performance of children	3-7 years	11 items teacher questionnaire
CHAPS Children's Auditory Processing Performance Scale	7-16 years	35 items teacher questionnaire
CPQ Classroom Participation Questionnaire	9 years+	16 questions; student questionnaire

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