Case Studies in Pediatric Amplification: Challenges and Considerations for Clinicians

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“There is a current trend to develop test protocols that are “evidence based.” . . . But, before we develop any new fitting guidelines, maybe we should first try to understand why there is so little adherence to the ones we already have” (p.26).

Survey of Best Practices: Pediatric Hearing Aid Fitting

Objective: Gather information on:

1. The clinical measures that are currently being implemented in pediatric audiology practices in North America;

2. The barriers to implementing protocols and/or guidelines in pediatric audiology practice; and

3. What might facilitate implementation of protocols/guidelines in pediatric audiology practice.
E-Survey:

1. Protocol for assessment/amplification in your practice;
2. Hearing Assessment Protocols;
3. Hearing Aid Selection and Fitting Protocols;
4. Verification Protocols;
5. Evaluation / Outcome Measurement Protocols
Respondents:

- We asked the hearing aid manufacturers, provincial and state associations and national audiology organizations to distribute the survey.

- Of the 491 respondents, 432 identified themselves as “pediatric audiologists” based on our provided definition.

- Most states/provinces in North America were represented in the survey.
Survey Responses – Challenges for Clinicians

- Verification Measurements (RECD)
- Outcome Measures
- Special Populations
Real Ear to Coupler Difference (RECD)

“As an experienced audiologist, working alone in a clinic, I feel anxious about measuring an RECD.” “I always use predicted measurements as I don’t want to seem unprofessional in front of parents.”
Why is Real Ear to Coupler Difference (RECD) Important for Children?

- The acoustics of an baby or child’s ear canal are very different from adults.
- Their acoustics change, as they grow.
- The child’s individual RECD is used in assessment process and in the hearing aid fitting process, to create the right hearing settings for gain and output.
Why is Real Ear to Coupler Difference (RECD) Important for Children?

- The RECD data is entered into the hearing aid software and into the verification system to generate fitting targets.

- Fitting hearing aids to targets for gain and output is a good starting point to best provide good speech information.

- RECD should be completed every time a child gets a new ear mold.
Measurement Guidelines
(Bagatto, 2014)

- **Coupler verification** is a better choice when:
  - The RECD has been measured – important for correct conversion of assessment data from HL to SPL.
  - The ear/earmold is very small
  - Patient compliance for “real real ear” is low
Measurement Guidelines
(Bagatto, 2014)

- **Real ear verification** is more accurate when:
  - The RECD has been measured (!!)
  - Venting plays a large role in the fitting (e.g., open fits)
  - Patient compliance for “real real ear” is high and room noise is low
Strategies to Overcome RECD Measurement Challenges

- Training and practice opportunities for new and experienced clinicians.

- Insertion tips (surgical tape or plastic wrap)

- Peer review, manufacturer measurement tools as an alternative option to verification equipment.
Strategies
Training and Practice

- Verification company or other support personnel can assist clinicians with skill development of using the RECD.

- This can be done in a group learning environment or individual, more personal and private session – you choose whichever will meet your learning style!

- Practice increases confidence and knowledge!
Strategies for Probe Tube Insertion

Premeasured probe tube attached with surgical tape is a fantastic way to keep probe tube straight, and to prevent it from moving!
Strategies for Probe Tube Insertion

What about inserting probe tube through vent?  
A few challenges:

• Need an ear size and ear mold that will support a vent.

• Vent is parallel so probe tube will be pointing into canal
Strategies

Peer Reviewed Manufacturer Measurement Tools

- Hearing aid manufacturers have began to utilize their hearing technology to help assist in the measurement of the RECD.

- Some of these technologies have been tested internally, but have not been evaluated by external researchers or on patients of different ages.

- Those, based on peer reviewed clinical evidence are best!
Outcome Measures

- At what age would you start assessing aided speech understanding in noise for children with hearing loss?
Aided Speech testing in noise

Benefits:

- Can give you a snapshot about “real world” performance of the child in complex listening environments with their hearing aids.

- May also provide evidence to justify the need for advanced features (i.e. noise reduction and directionality) and for PFM.

- Speech in noise tests have utility in assessing benefit or outcomes of hearing technology intervention.
Speech testing in noise

Considerations for the Audiologist

- Developmental age of child
- Sound booth set up
- Selecting Test Materials
### Table 1. Summary of Speech-Perception Tests in Noise for Children

<table>
<thead>
<tr>
<th>Test (Acronym)</th>
<th>Ages</th>
<th>Test Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamford-Kowal-Bench Speech in Noise test (BKB-SIN)</td>
<td>5+ years</td>
<td>Modified-adaptive test; Measures SNR loss for sentences in multi-talker babble</td>
<td>High validity, reliability, &amp; sensitivity; may be used with any population; simple administration &amp; scoring; portable &amp; may be used in the classroom; inexpensive; on CD</td>
<td>May have ceiling/floor effects at standard SNRs; only appropriate for school-aged children</td>
</tr>
<tr>
<td>Hearing in Noise Test for Children (HINT-C)</td>
<td>6-12 years</td>
<td>Adaptive test; measures 50% correct threshold for sentences in speech-shaped noise</td>
<td>High validity, reliability, &amp; sensitivity; computerized; may be used with any population; multiple languages; simple administration, scoring &amp; interpretation</td>
<td>Expensive; only appropriate for school-aged children; speech-shaped noise may not be as challenging as other noises</td>
</tr>
<tr>
<td>Listening in Spatialized Noise-Sentences test (LiSN-S)</td>
<td>6-11 years</td>
<td>Adaptive test; measures sentence-in-noise thresholds for varying noise locations &amp; types of noise</td>
<td>High validity, reliability, &amp; sensitivity; computerized; simple administration, scoring, &amp; interpretation</td>
<td>Only designed for use with suspected APD; may only present under headphones; expensive</td>
</tr>
<tr>
<td>Pediatric Speech Intelligibility test (PSI)</td>
<td>3-6 years</td>
<td>Measures percent-correct performance for words and sentences in single-talker competing noise</td>
<td>High validity &amp; reliability, may be used with young children; simple scoring and interpretation; inexpensive; on CD</td>
<td>Complicated administration; may have ceiling/floor effects; single-talker noise may not be challenging; only for young children</td>
</tr>
</tbody>
</table>

Note: APD = auditory processing disorders; CD = compact disc; SNR = signal-to-noise ratio loss
BKB-SIN (Ng et al., 2011)

- Ng, Meston, Scollie & Seewald (2011) assessed it for use as an aided outcome measure.

- Present speech at conversational level and competing babble from speakers. Where you have a two speaker setup, 0 degree azimuth is recommended for spatial separation.
BKB-SIN (Ng et al., 2011)

- Adapted BKB-SIN test was reliable for all groups.
- It was sensitive to differences between participant groups.
- Sensitive to improved speech recognition abilities with the use of directional microphones.
- Uses child-appropriate and realistic materials, therefore it provides an option for the clinical evaluation of the efficacy of hearing aid technology in children.
Special Populations

- My eight year old patient with a severe hearing loss who wore BTEs just received a cochlear implant on his left ear.

- On his right ear, he some good residual hearing.
Should I consider having him continue to wear his BTE on his right ear?

How can I ensure the two technologies complement one another?
Terminology

**Bimodal** - Cochlear implant at one ear and hearing aid at the contra-lateral ear

**Electro-acoustic Stimulation/EAS** - Cochlear implant and hearing aid at the same ear
Combining Acoustic and Electric Hearing
(Lisa Davidson, Washington University)

- Hearing Aid
  - Voice pitch/voice quality
  - Music appreciation
  - Perception in noise

- Cochlear Implant
  - Speech recognition ~ consonant and vowel recognition
  - Speech intelligibility
Research Literature on Benefits of Bimodal Devices (Lisa Davidson, Washington University)

- In general, adult and pediatric studies have demonstrated benefits of using a hearing aid in the non-implanted ear.

- Benefits may include: speech perception in quiet and noise, localization, speech quality, music appreciation/recognition & ease of listening.

(See review from Ching et al. 2007; Sammeth et al. 2011; & Schafer et al., 2011)
Candidacy for Bimodal Fitting
(Lisa Davidson, Washington University)

- All children and adults with unilateral CIs should be considered as candidates for a trial with a hearing aid.

- Unilateral CI users with very limited residual hearing at the HA ear, may still benefit from bimodal stimulation (minimal aided thresholds and speech perception—note Kong et al., 2005; Zhang et al., 2010)

- Most cases demonstrating no measurable benefit appear to do no worse
Candidacy for Bimodal Fitting – Preparation for a Second Implant?
(Lisa Davidson, Washington University)

- Binaural stimulation of auditory pathways and the possibility that HA use may contribute to more successful CI use (Sammeth et al., 2011)

- Literature suggests that period of HA use may facilitate spoken language and literacy skills in children eventually receiving a 2nd CI (Nittrouer & Chapman, 2009; Nittrouer et al., 2012)
Fitting/Adjusting for Bimodal Fit (CI+HA)
(Lisa Davidson, Washington University)

- Balance comfort /loudness of input levels from soft to loud between the CI and hearing aid using:
  - Live voice presentation
  - Calibrated running speech
  - Environmental sounds at various levels
  - Starting point is with the hearing aid. Adjust output of hearing aid, evaluate compression characteristics etc.
Validating Fit of CI+HA
(Lisa Davidson, Washington University)

- Aided thresholds – as a test for minimal audibility levels.

- Aided speech testing (binaural and monaural)
Validating Fit of CI+HA
(Lisa Davidson, Washington University)

- Most important to determine that bimodal perception is not degraded compared to CI alone.

- Cochlear Implant and Hearing Aid Audiologist – same person? If not, how do we coordinate this fitting? Who is the most knowledgeable professional to make adjustments? How are professionals currently managing this scenario?
Summary

- Our survey, and clinician comments/questions clearly show that pediatric audiologists are attempting to follow audiology guidelines for the assessment of children’s hearing and for the provision of appropriate amplification to children with hearing loss. This is really great!

- There are still gaps that can be addressed by paying attention to implementation issues that arise at the level of the guideline; the individual practitioner; the context in which they work; and the broader healthcare system.

- Supportive professional networks and partnerships between clinicians, administrators and manufacturers is a good starting point to help address some of these challenges.