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Coordinator’s Column

Tamala S. Bradham

That was then. This is now. What about tomorrow? Memory lane tells us where we have come from; whereas some memories bring smiles, others may bring tears. We learn from those around us and the mistakes we have made. We celebrate our accomplishments, relish our achievements, and nod in approval of things’ going well.

Due to our past, today we have a variety of tools at our side that we can pull out in any second to help us with our patient, student, client, and/or family member. We have learned from those before us. They have helped us to be successful. For just a moment, think about what we know and have “today.”

• We know so much more about anatomy and physiology . . .
• We have a vast array of technologies at our fingertips to aid those with communication disorders . . .
• We have federal and state support that help children and their family’s access services . . .
• We have multiple organizations that support not only professionals providing services, but also clients’ families . . .

We are truly fortunate to have so many sources of knowledge and support that help us serve our clients today.

What about tomorrow? Looking into my crystal ball, I foresee the following:

1. Better evidence to support our practices, which will lead to more standardization in our practices and less confusion for the population we serve
2. Better access to highly qualified care through technological advances
3. Higher involvement of patients/students/clients/families in overall care
4. Better acceptance and integration of communication disorders in our communities and our nation

In some respects, the advances of “tomorrow” are already under way. If you have not been to www.asha.org/research/, you are missing out on some great information. I encourage SIG affiliates to spend some time with the evidence-based practice section. The compendium and the evidence maps are the first of their kind in our profession and will help us to shape our practices to become more effective and efficient!

There is a need to reach families in urban, suburban, and rural settings. It can take hours for patients to travel 200 miles or even 10 miles (in Los Angeles or New York, for example). This travel forces patients to spend time away from work and home and adds to the cost of gas and auto maintenance. The telephone unlocked the door, but telepractice has opened it. We just need to walk through it.

Instead of rescuing our patients, we are now involving them. With the Individuals with Disabilities Education Act (IDEA), families have to participate in goal-writing. States have multiple family support agencies and organizations. The medical home concept means that the families and patients need to be involved. Multiple therapy intervention approaches, like
auditory-verbal therapy, require family involvement. We are moving away from having the parent drop the child off at the clinician’s door and wave goodbye. Parents are in the treatment room or in the observation room taking notes (because they know they will be quizzed at the end of the session).

I envision a day when wearing a hearing aid is “cool” and augmentative communication devices allow users to communicate as effectively and naturally as anyone else. I see a day when it is just who we are and it is okay. I dream that the technology works the way it is supposed to and people don’t shy away from or pick on those who use them.

Our articles for this Perspectives capture the essence of where we have been and where we are going. From our past, we continue to move forward and learn new and innovative ways to use what we already have at our fingertips. James W. Hall III and Anuradha R. Bantwal take us down memory lane on objective testing techniques. Their article, titled “Objective Assessment of Hearing in Children: Update on Procedures and Protocols,” reminds us that there are always new ways of looking at old things. Jane R. Madell’s article, “Testing Babies: You Can Do It! Behavioral Observation Audiometry (BOA),” reminds us that we also need to obtain functional data, along with the objective data described by Hall and Bantwal. She provides some guidelines to follow to standardize how to obtain BOA responses.

When evaluating the “present,” we realize that we are in a state of transition from the past to the future. What can we take from the past and make better or easier? In “Moving to Mainstream Preschool,” Becky Clem does a wonderful job describing the process families go through in transition of services from an outpatient facility to a school setting. With advancements in technologies, early intervention, and proactive families, children with cochlear implants have more options when transitioning to their school of choice. The article includes parents’ comments and words of wisdom.

Looking ahead, K. Todd Houston shows us the future of health-care practices. His article, titled “TeleIntervention: Improving Service Delivery to Young Children With Hearing Loss and Their Families Through Telepractice,” describes a model for delivery therapy services to rural areas.

Thank you to our authors for making this a phenomenal issue of Perspectives. Much appreciation is extended to our Editor Extraordinaire Jace Wolfe and our Exemplary Associate Editor Aneesha Pretto. The future is looking bright!
Moving to Mainstream Preschool

Becky Clem
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Children with hearing loss have a world of opportunities available to them because of marvelous advances in hearing technology, including super-powered digital hearing aids, cochlear implants, wireless FM systems, infrared classroom technology for sound field, and the bone-anchored hearing aid (BAHA). These advances, along with the ability to identify children with hearing loss soon after birth and fit them quickly with hearing technology, have changed the face of intervention and education. It is important for clinicians to start listening and spoken language (LSL) intervention very early, because babies’ brains’ neural pathways have increased sensitivity to sound before age 3 years. When children with hearing loss learn to speak through listening, they may stay on a normal path to speech and language development (Cole & Flexer, 2007). Now, children with hearing loss who learn to listen and speak typically develop regional accents, clear speech production, the ability to grasp idioms and jokes, and competent conversational skills. The purpose of this article is to describe the processes that are typical as a child with hearing loss transitions from services provided by professionals at an outpatient cochlear implant center to services provided in school settings.

Introduction

Mainstream education for children with hearing loss or deafness in a spoken language approach is often verbalized by their parents as a high-priority goal. Auditory-verbal therapy (AVT) and auditory-verbal education—intervention practices aimed at the development of listening and spoken language (LSL) in children with hearing loss/deafness—are centered on evidence-based principles. One of the founding principles is to “Promote education in regular schools with peers who have typical hearing and with appropriate services from early childhood onwards” (AVT) and to “Promote education in regular classrooms with peers who have typical hearing, as early as possible, when the child has the skills to do so successfully” (Principles of LSLS, 2007).

For many children who have hearing loss and receive LSL intervention with maximum amplification, the development of speech and language occurs in synchrony with their overall development. Such a progression enhances a child’s readiness for school. Longitudinal evidence from Dornan, Hickson, Murdoch, and Houston (2007) and Dornan, Hickson, Murdoch, Houston, and Constantinescu (2010) shows that children in an AVT program (age 2 months to 6 years at the start of the study) made progress in auditory comprehension, oral expression, total language, and consonant articulation at the same statistical rate as their typical hearing peers. As part of that program, most participants were in mainstream educational settings on schedule with other children of the same age.

Children learn a tremendous amount of language through incidental listening and learning opportunities (Cole & Flexer, 2007). Young children’s quantitative vocabulary is directly affected by the number of words they hear; the more words children hear, the larger
their vocabularies (Hart & Risley, 1995). When parents we serve in our program at Cook Children’s Medical Center in Fort Worth, TX, start looking for mainstream preschool placements, we encourage them to look for programs that are rich in language, music, literature, and play opportunities. The premise for language-rich preschool settings for children with hearing loss is to foster opportunities to have incidental listening opportunities and peers as good language models. Because of support provided by professionals within our program, transition from early intervention services (i.e., private therapy, home-based early childhood intervention, center-based individual therapy) to a preschool environment is one parents view with optimism, rather than just apprehension.

There are several educational options for children with hearing loss, each with benefits depending on the needs of the child and the goals of the family. These include Preschool Program for Children with Disabilities (PPCD), preschool private setting, typical preschool public school setting, auditory-oral preschool, home school settings, Montessori, Parents Day Out (PD), day care with school, and faith-based preschool settings. In addition to a language-rich environment, other factors that can influence parents’ selection of an early childhood education include the needs of the child (which may differ over the course of 1–3 years before kindergarten), cost, proximity to home, hours of operation, daycare option, curriculum, family involvement, experience of professional staff, available services, and social aspects.

With the transition from early intervention (home-based or center-based) to preschool education, the focus moves from “family-centered” to “child-centered.” If a child has been receiving comprehensive early intervention services from a state or local agency and moves to a public preschool setting, then families and professionals from early intervention should work with school professionals to make a smooth transition of services for the child. The daunting paperwork required by most school systems and the number professionals involved can create apprehension and uncertainty for parents. Early intervention service providers should assist the family in overcoming the cumbersome logistics often associated with transitioning to a school-based program.

It is important for clinicians to coordinate services from state early intervention services to school-based intervention and deaf education in order to facilitate continued listening and language development and provide parents with a sense of security in sending their child to school. Every child whose family participates in state services should have an individualized educational program (IEP) in place to guide the transition to preschool, so that all professionals involved can work toward common goals for the child. The IEP is a plan that professionals and administrators from the school, along with the parents, develop in order for the child to succeed in school. The IEP has the child’s goals, special services or therapies, amount of time the child participates in different classes or therapies, and any special equipment needed at school to achieve those goals (U.S. Department of Education, 2008).

Services provided by public school district programs are available to children regardless of the preschool setting (public or private). The Individuals with Disabilities Education Act (IDEA) mandates that service continuums be discussed when a child transitions from Part C (birth to 3 years) to Part B (preschool). The principle behind IDEA is that local education agencies (LEA) are to ensure that, to the maximum extent possible, children with disabilities, including those in public or private programs, are to be educated with children who do not have disabilities. For some children with hearing loss who have been participating in Part C early intervention services, transition may occur to Part B preschool services. Some children with hearing loss will not be eligible for Part B preschool services because they may not show an educational need. For those children, a transition plan from Part C is to include other appropriate options. These could include, for example, private therapies, collaboration between private preschool and public preschool services, other community-based programs, or home-based therapy. Public school program-related services (such as speech-language therapy) are available if the child qualifies for them. Therapies offered from public schools are educationally based; the public school programs allow clinicians to offer related services that will help the
child do well in school. Qualifications for related services under Part B of IDEA are different than for Part C. Readers are encouraged to read about their states’ specific options and laws, as well as the references for IDEA laws (“Preparing to Transition,” 2010; Texas Education Agency, 2004; U.S. Department of Education, 2008).

Clinicians should be aware of another important consideration in transitioning to a preschool program: helping and educating the preschool teachers and staff about the child with hearing loss. Topics to address might include:

- Acoustical environment
- Increased noise situations (lunch time, chapel time, school programs)
- Use of FM
- Non-use of amplification during nap time
- What to do if there are equipment problems
- How to change batteries
- Emergency procedures (fire drills, tornado alerts)
- Strategies to use in the classroom if extra help is needed
- Alerting staff to any difficulties child may have
- Positioning the child for maximum auditory input in activities such as circle time, story time, music, and hallway
- Strategies for facilitating listening and speaking throughout the day
- Strategies for getting the child’s attention through listening, instead of gestures and touching
- Strategies for problem listening situations, such as getting closer to the child rather than getting louder and repeating questions or responses from other children

The following case studies illustrate the process involved with transitioning a child with hearing loss from a center-based service delivery model to a preschool-based setting. First, the detailed case study describes the transitional process for a boy (Boy C) who lives in a rural community 100 miles from his cochlear implant center and therapy services. This child’s journey through preschool education in his local school is a strong example of requisite collaboration between rural school district personnel and speech-language pathologists (SLPs) and audiologists from outpatient rehabilitation and cochlear implant programs. Furthermore, in preparation for this article, three families were interviewed about their child’s transition into preschool settings; information about these children can be found in Table 1. Their responses are provided, following Boy C’s case study.
Table 1. Demographics for four children described in this article

<table>
<thead>
<tr>
<th>Current Age</th>
<th>Girl A</th>
<th>Boy A</th>
<th>Boy B</th>
<th>Boy C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28m</td>
<td>33m</td>
<td>38m</td>
<td>86m</td>
</tr>
</tbody>
</table>

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<tr>
<th>Hearing Loss Identification Confirmation</th>
<th>3wk</th>
<th>6wk</th>
<th>7m; fluctuating loss, inconsistent results</th>
<th>Birth</th>
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<table>
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<tr>
<th>Hearing Loss Cause/Type/Severity</th>
<th>Unknown/ bilateral/ profound SNHL</th>
<th>Anoxia/ SNHL/ moderate to severe right; profound left</th>
<th>Bilateral LVA/ SNHL/ left moderate, right profound</th>
<th>Unknown/ SNHL/ Bilateral profound</th>
</tr>
</thead>
</table>

<table>
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<tr>
<th>Amplification and Cochlear Implant (CI) Activation</th>
<th>Bilateral CI; right 12m, left 16m</th>
<th>Bimodal; left CI 15m</th>
<th>Bimodal; right CI 20m</th>
<th>Bilateral CI; right 14m, left 33m; right side internal failure at 5y, replaced 5y1m</th>
</tr>
</thead>
</table>

<table>
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<tr>
<th>Early Childhood Services and Age Started</th>
<th>State program–based ST 3m; AVT 9m</th>
<th>AVT 3m</th>
<th>ECI ST and Regional Day School TOD 6m; AVT 27m</th>
</tr>
</thead>
</table>

<table>
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<tr>
<th>Preschool Program Type and Age Started</th>
<th>Preschool 2y1m</th>
<th>Nursery school 18m; preschool 30m</th>
<th>Auditory-oral option school 20m; Preschool 3y</th>
<th>Parents day out 2y; PPCD 3y; reverse main preschool 3.5y</th>
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<tr>
<th>Communication</th>
<th>Spoken language</th>
<th>Spoken language</th>
<th>Spoken language</th>
<th>Spoken language</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Services</th>
<th>Home-based ST until 9m, then AVT; parent-infant advisor deaf education</th>
<th>AVT</th>
<th>AVT; OT</th>
<th>AVT; school-based ST</th>
</tr>
</thead>
</table>


**Transitioning in a Rural Community**

Boy C was identified at birth and confirmed at 5 months of age with a bilateral profound sensorineural hearing loss. His family faced the challenge of living 100 miles from the nearest services for pediatric hearing loss. The family did not have any relatives with hearing loss. During the parents’ high school years, they had known some students with hearing losses who had significant social and academic struggles and poor access to resources from their rural community of 4,500 people. They were concerned about the long-term welfare and education of their son, but wanted to maintain strong family and community ties in the rural community. Their pediatrician’s referral to a metropolitan cochlear implant center raised their awareness about potential outcomes for their son. Because their family and entire community of friends used spoken English, they chose LSL and cochlear implantation for their son. His first cochlear implant (CI) surgery was at 13 months of age with activation at 14 months. The second implant was at 32 months with activation at 33 months. At age 5 years, the right CI had an internal failure and was subsequently replaced within a month. The following is a timeline of his transition into his community preschool program and a description of services and outcomes over 4 years.

**First Year of School**

Boy C was the first child in the school district with a CI. He started the preschool program 2 months after the school year started because of his birthday. Before the school year started, his family met with the principal, who requested the SLP-AVT provide an in-service about children with CIs and how to work with their son. The in-service included the principal,
special education resource teacher, typical preschool teacher, PPCD teacher, school-based SLP, school nurse, inclusion teacher, and Boy C’s mother. It covered the basics of cochlear implantation and specifics related to the child. His mother provided hands-on training on his device, including how to change the batteries, check the coil, and perform an informal behavioral assessment of his ability to identify speech with his CI (e.g., the Ling six-sound test). The family and school administrators discussed the size (25 students) and location (portable building) of the typical preschool class. The PPCD class enrollment had two children who were good language models, and the class size was six students. The consensus was for Boy C to attend the PPCD class for half of the day and continue with AVT services in the Dallas-Fort Worth metropolitan area. Inclusion with the typical preschool class occurred several times during the morning for story time, music, and playground. One-on-one speech therapy services were scheduled on a two-session per week basis. Sound field FM systems were purchased for his classroom, his typical preschool, and for use in the gym and cafeteria.

The principal requested consultative services from the SLP-AVT monthly during school to provide training to all staff about working with children with CIs and specific training in the classroom for his teachers and for therapy sessions with his SLP. Specific training included how to use AVT strategies during therapy sessions; the importance of preferential seating during story time to maximize position for auditory input, especially during activities combined with larger classes; and how to use “motherese” and dramatic inflection during reading aloud time.

Over the course of the next year, collaborative activities among the CI center’s SLP/AVT, the school, and the CI audiologist at another CI center included training in various areas. The specialists worked with the preschool teacher on strategies to build auditory skill development and with the school-based SLP on auditory-verbal strategies to use during therapy sessions, goal-setting based on his listening abilities, and the development of spoken language through audition. They trained school staff in methods to monitor the use of the FM and sound field system and assisted in modification of classroom arrangement to maximize auditory input and decrease ambient noise (such as that from a portable air conditioner near the story time area). They discussed ways to facilitate communication and interactions between Boy C and typical hearing preschool class peers during inclusion activities and consulted on Boy C’s participation in noisy, large group activities, such as physical education. Finally, the specialists worked with the resource teacher on pre-teaching vocabulary and concepts.

Second Year

The PPCD class was no longer an appropriate placement for Boy C because of inadequate language models in that classroom and his excellent progress in spoken language. Typical preschool enrollment was attempted and proved to be overwhelming and unsuccessful for him after 1 month of school. His parents, preschool teacher, inclusion teacher, and SLP met to discuss appropriate placement for him.

School professionals combined the enrollment of the typical preschool and PPCD class and formed two reverse mainstream classes. The reverse mainstreaming concept grew from the mainstreaming education concept—that is, students with special needs spend some or all of the day in a typical education classroom with supports as necessary. For reverse mainstreaming, typical students spend some or part of the day in a special education setting. The students in special education benefit from social interaction with students with typical learning. In the case of children with hearing loss or deafness, the reverse mainstream student offers typical listening and speaking models. The regular education students benefit by socializing and learning about different special needs. Preschool and kindergarten classrooms are frequent sites of reverse mainstreaming.

The reverse mainstreaming arrangement benefitted both children with special needs and those who had typical hearing and learned abilities. The children with special needs emulated the language and social skills of the students from regular education classes. In this small community, some of these relationships started forming outside of school. The school-
based interactions offered the children with special needs the opportunity to socialize at school and interact in structured settings that offered typical language models. The students in regular education learned about helping others and sharing with children who had disabilities and specialized equipment (i.e., wheelchairs, special chairs, sound field system). Reverse mainstream classes resulted in a smaller, quieter environment and increased peer interactions among all students. It also allowed more typical hearing peers to serve as language models for Boy C and other children with speech and language deficits.

The personal FM system was used with the sound field system, and one-on-one speech therapy services were scheduled on a two-session-per-week basis. Consultation services from the SLP/AVT continued less frequently on an every-other-month schedule as school personnel became more confident and skilled in their work with Boy C. Private AVT services were discontinued as a result of continued improvement in working with his school-based SLP.

**Third Year**

Boy C was scheduled to attend the same reverse mainstream class. Poor progress occurred during the summer before this school year; in August, it was confirmed that an internal device failure had occurred on the right side. In November, he received a replacement of the right-side cochlear implant. He had high absenteeism secondary to cochlear implant replacement surgery and audiology appointments 100 miles from home. SLP-AVT consultation services were provided every other month. The resource teacher provided 30 minutes of one-on-one teaching services, and one-on-one speech therapy services were scheduled on a two-session per week basis.

There were several technical problems with the personal FM and sound field FM system. The school engaged in contractual services with the audiology department at a university in the region to troubleshoot the personal FM system in conjunction with the four sound field FM systems in the school.

**Fourth Year**

Boy C continued in reverse mainstream classroom. There was only one reverse mainstream classroom in the school at this time. He attended scheduled one-on-one teaching with his PPCD teacher for 1 hour a day and restarted private AVT services in the Dallas-Fort Worth metropolitan area subsequent to replacement of the right implant (once weekly). There was a continuation of the educational audiology consultation for the use of the FM systems and increased opportunities to participate in activities with the typical hearing preschool class.

Kindergarten readiness preparation took place at home, and he attended private AVT therapy activities that incorporated curriculum vocabulary and concepts. Boy C’s future kindergarten and 1st grade teachers, along with the SLP and reading and resource teachers, attended a 2-day training session on reading and literacy development for children with hearing loss who use spoken language.

Boy C’s transition over the 4 years in preschool was possible because of the flexibility of his school’s administration. Their investment in consultative services and advanced training on reading and literacy development exemplifies the commitment needed for this child’s success in the mainstream.

**Families’ Experiences**

Three families from our program shared their recent experiences in transitioning their young children to nursery and preschool settings. They expressed their thoughts, feelings, and ideas about challenges they faced in sending their child to a typical preschool, how they planned ahead with school professionals, and what they found to be the best aspects of mainstream preschool. They also provided a wish list for professionals working with their children in early childhood education settings. All of these children received early intervention services (as shown above in Table 1) before beginning a preschool-type program.

Following are questions asked of parents and some of the responses provided.
What were the teachers’ questions, and what did you share with them about your child? What have been your fears about having your child in school?

Girl A’s mother: The teachers didn’t really have any specific questions for me, but I met with them before school started and provided them the basics about cochlear implants. I also provided them with a fact sheet [see supplemental materials, Addendum A] specifically about her. I think that I told them what they needed to know but at the time I just wasn’t sure if I was missing something.

Boy A’s mother: The teachers didn’t have any burning questions other than what to do when his hearing aid “rings.” The first year he attended at 18 months of age, he didn’t know how to put his speech processor or coil back on when it came off. I showed the teachers how to do it, and it wasn’t a problem. This year he knows how to put his coil back on. If he has trouble, he asks for help. My fears were and still are sometimes that teachers don’t realize how hard he has to work to hear when there is a lot of ambient noise. Even though I’ve explained it to them, they really don’t understand. I believe part of that is that he does so well and doesn’t act like children with a hearing loss. He acts like every other kid in the class. It will be interesting to see how he does as he gets older and can tell us what he needs. I just want to be sure he learns to read and doesn’t struggle. So far, he seems to fit right in, without inhibitions, and the teachers are doing great with him.

Boy B’s mother: I met separately with the teacher and the assistant in his class to talk with them about his specific issues. I shared with them his specific sensory integration issues and what to do when he is struggling. We also discussed his technology. They asked about how to help him keep the processors on his ears, how to put his “magic ears” back on in the event that he takes them off, how to add more tape in case the tape fails, etc. We spent a considerable amount of time reviewing the FM system and its functions. More than anything, they asked questions about how to ensure that he is included in the class. What is his hearing range? Does he read lips? Does he sign? What does he find most helpful to understand instruction?

I would have to say acceptance was our biggest fear. Being in a mainstream class means that our son doesn’t have peers with “magic ears.” So, he was going along this path without “someone else just like him.” I worried that he would be made fun of, not accepted by the other children, and would not want to return to class. My second most fear was that he would be lost in a sea of hearing peers. I didn’t want him off in a corner playing by himself while others played and learned together, and not interacting with everyone else because he couldn’t hear clearly or felt out of place. Lastly, I had a fear that his technology would be lost or flushed down the toilet (by him, not a classmate). I have a friend whose child was so frustrated by all the noise at school that her child flushed his technology down the toilet. I didn’t want him to go through that kind of pain and sadness.

What is the most challenging aspect of having your child with a hearing loss in mainstream education?

Girl A’s mother: The only challenge we have experienced so far was recently. The teachers took off her cochlear implants for nap time and she cried and said she needed to listen. They put them back on and told her to just sit quietly on her mat and read while the other kids napped. They said she seemed scared that she couldn’t hear. I love that she wants to listen but do think she gets scared in situations where she isn’t familiar if she can’t hear. The next time she went to school, we asked the teachers to leave one processor on during nap so that she can lay her head down but still hear and be comfortable with the situation. This plan worked well.

Boy A’s mother: We aren’t to the point of mainstream challenges yet. I’m hoping to learn what other children have encountered and how they and their families have handled things.
Boy B’s mother: The most challenging aspect, for me, was letting go. When he is at home or in an auditory-oral school, I know that he is reaching the goals set out by our cert AVT/SLP. When I wasn’t with him or more in control of his environment, I felt that I couldn’t help him when he struggled or needed help. Now that he is in a mainstream preschool, he learns what every other child learns, at a faster pace. I was worried that the learning process would be too fast, that he would be left behind by his hearing peers. I soon realized that his days for going to preschool are our reading days. He is too tired for “home AVT” and that we need to chill out more, read a ton of books, and enjoy being together. I realized that “following his lead” was more important that reaching every single goal that I have for him on a daily basis.

Boy B’s father: My biggest concerns were over his acceptance by both the students and the teachers. That has turned out to not be an issue at all. He absolutely adores his preschool teacher and loves going to school—he has also turned into a chatterbox around the house and also loves reading books—it’s gone from being a chore for him to sit and read books to something he seeks to do. Much of this was already naturally occurring in his development, but it seems as if being around “normal” kids his age in preschool has really helped catalyze his progress.

What would be on your wish list as parents of a child with a hearing loss as he/she entered any phase of school?

Girl A’s mother: The one item I would like is something from my daughter’s cochlear implant company about what I should share with the teachers before she starts school. I checked their website and there wasn’t something simple to provide them.

Boy A’s mother: Ideally, it would be very helpful for all the teachers and administrators in the school to have some education about children with hearing loss who use hearing aids and cochlear implants. It’s important for them to be equipped with knowledge and comfortable working with our son. He will do his part; I just want them to do theirs.

Boy B’s mother: My wish list would be:

• That his teachers love, accept, and embrace a child with a hearing loss.
• That the teachers would understand our goals, embrace those goals, and help [my child] reach them.
• That the teachers would be good “AVT role models” and use voice to communicate with him through pitch and drama, rather than touch or movement.
• We want him to make friends and feel accepted even though he is a little different.
• We want him to learn what every other preschool child learns—colors, shapes, numbers, letters, social skills, etc. That way he is prepared for mainstream kindergarten.
• We want him to love to learn! Preschool sets the stage for his later years.

What would you consider to be the best thing about mainstreaming your child in preschool?

Girl A’s mother: The best thing about mainstreaming her is knowing that she is just as capable as the other kids. She feels “normal” because she is treated just like the other kids.

Boy A’s mother: He has the same opportunities as “normal” kids and that he isn’t “special” or different from everyone else other than the fact that he uses “ear power” to hear. I believe he will do whatever he puts his mind to, and he will be very successful. I hope that the confidence and lively personality he displays so far is never impeded by his hearing loss.

Boy B’s parents: Hands down the best thing about mainstreaming a hearing impaired child is the verbal role models. I have seen our son’s social and conversational language improve by leaps and bounds since he started mainstream preschool in September. He is more communicative in everyday life, more engaged, more included. He loves to talk
to us now and his inhibitions are gone. While the mother in me wants him to learn all
the typical preschool things, I have to say the one thing that brings me to tears is our
son wants to talk more. That is priceless . . . it makes all the difference for our family.

Summary

Moving to the mainstream for preschool is an exciting milestone in the lives of families
of children with hearing loss. By planning ahead, enlisting the help of professionals, sharing
specifics about the child, and being flexible, these families can help ensure that the result will
be a happy and successful experience for all.

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Objective Assessment of Hearing in Children: Update on Procedures and Protocols

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Early identification and diagnosis of hearing loss in infants and young children is the first step toward appropriate and effective intervention and is critical for optimal communicative and psychosocial development. Limitations of behavioral assessment techniques in pediatric populations necessitate the use of an objective test battery to enable complete and accurate assessment of auditory function. Since the introduction of the cross-check principle 35 years ago, the pediatric diagnostic test battery has expanded to include, in addition to behavioral audiometry, acoustic immittance measures, otoacoustic emissions, and multiple auditory evoked responses (auditory brainstem response, auditory steady state response, and electrocochleography). We offer a concise description of a modern evidence-based audiological test battery that permits early and accurate diagnosis of auditory dysfunction.

Introduction

Objective measures of auditory function directly assess activity or function of the ear or the brain, independent of any behavioral response from the patient. The outcome of behavioral measurement is immediately graphed and/or quantified numerically and then compared to appropriate normative expectations or data. Age and gender effects on objective measures are quite predictable, and clinicians regularly account for these in data analysis. With the introduction of new objective measures, researchers invariably raise concerns about an apparent clinical limitation that characterizes behavioral audiometry—that is, “subjective” analysis and interpretation of findings. Clinical experience and research evidence do not support this objection to objective auditory measures. Analysis of objective test findings leaves little room for subjective distortion of data. With adequate education and training, audiologists are remarkably accurate and consistent in their analysis and interpretation of objective test findings. Furthermore, algorithms for automated analyses and statistical confirmation of test data exist for all current objective measures of auditory function, thus eliminating any chance for the negative impact of human fallibility or bias.

Initial efforts to objectively assess hearing in children date back more than 60 years. In the 1950s, electrocochleography (ECochG) was applied by select teams of otolaryngologists and
audiologists in estimation of auditory thresholds in difficult-to-test children who were generally delayed in speech and language and strongly suspected of having hearing loss (see Hall, 2007, for review). The technique, however, was far from the standard of care. ECochG recording in children required a surgeon to place an electrode close to the cochlea and anesthesia to ensure the child would cooperate with the procedure.

Soon after, in the 1960s, other groups of research-oriented audiologists and neurologists reported the application of the auditory late cortical evoked response in estimation of auditory thresholds in children who were unable to be assessed with behavioral audiometry (Hall, 2007). The good news was anesthesia and surgical support were not needed for clinical measurement of cortical evoked responses, but the strategy relied heavily on patient cooperation and was very age-dependent. Children undergoing auditory late response measurement needed to be very quiet and almost motionless, yet awake. Unfortunately, cortical auditory evoked response measurement required almost as much cooperation as behavioral audiometry. Until at least the mid-1970s, objective assessment of hearing in children, with both ECochG and cortical auditory evoked responses, was available in relatively few major medical centers throughout the world.

The year 1976 accurately demarcates the beginning of the modern, objective hearing test battery. Compelling evidence from large-scale studies in varied patient populations, as reported in a series of publications by James Jerger (reviewed in Hall & Swanepoel, 2010), convinced audiologists everywhere that impedance (immittance) measures—tympanometry and acoustic reflexes—were valuable clinical tools. Robert Galambos clearly demonstrated the unprecedented value of the auditory brainstem response (ABR; then referred to by many terms and acronyms, but not ABR) in newborn hearing screening and diagnosis of hearing loss in infants and young children (see Hall, 2007, for review). Jerger and then clinic supervisor/PhD student Deborah Hayes first articulated the enduring “cross-check principle.” In their classic, “The Cross-Check Principle in Pediatric Audiometry,” Jerger and Hayes (1976) summarized the limitations and pitfalls associated with exclusive reliance on behavioral test results. They then made a strong case for the use of aural immittance (then impedance) measures and/or auditory brainstem response (then brainstem-evoked response) to verify or “cross-check” the behavioral test results. After presenting a small series of case reports to illustrate the oftentimes disastrous diagnostic and management outcomes that can result from stubborn reliance on behavioral test alone, the authors confidently concluded,

In summary, we believe that the unique limitations of conventional behavioral audiometry dictate the need for a “test battery” approach. The key concept governing our assessment strategy is the cross-check principle. The basic operation of this principle is that no result be accepted until it is confirmed by an independent measure. (Jerger & Hayes, 1976, p. 620)

The objective test battery did not expand further until approximately 20 years later, when otoacoustic emissions (OAEs) technology became available as a routine clinical procedure, as documented by the introduction of a number of FDA-approved devices and the approval of two new Current Procedural Terminology (CPT) codes. Within the next decade, the Joint Committee on Infant Hearing (2000) recommended strongly the routine application of frequency specific (i.e., tone burst) and bone conduction evoked ABR measurement as the strategy of choice for auditory assessment of infants, as well as young children and children who are difficult to test. Soon after, audiologists could also turn to the auditory steady state response (ASSR) for objective estimation of auditory thresholds, especially in children with severe to profound hearing impairment. We now have, readily available for use in patients of all ages, an assortment of objective techniques for early and accurate identification and diagnosis of every type and site auditory dysfunction, from middle ear disorders to auditory neuropathy spectrum disorder (ANSD) to central auditory processing disorders.
Rationale

Early diagnosis and intervention for hearing loss in infants are critical for optimal communicative and psychosocial development. Indeed, one would be hard-pressed to identify more important, or challenging, clinical responsibilities for audiologists. The diagnostic process, as outlined in this brief article, requires knowledge of auditory system anatomy, physiology, and development. This knowledge must be combined with the technical ability to accurately, yet very quickly, administer a variety of objective test procedures. Analysis and interpretation of diagnostic test results must be done “on the fly”—as the data are collected—to ensure that all vital information for intervention and habilitation is acquired as soon as possible to meet the definition of “early intervention” (by 6 months after birth). The audiologist then must prescribe amplification for an infant with constantly changing auditory system maturity who cannot immediately confirm satisfaction with the hearing aid fitting. A successful hearing aid fitting is verified mainly by normal auditory behavior, a rich repertoire of phonemes, intelligible speech, and normal language development. The stakes in this clinical drama are incredibly high. Quality control in the diagnostic and intervention process—the outcome of the audiologist’s efforts—will be evidenced by the child’s ability to communicate effectively. Diagnostic and habilitation failure is not an option. The child’s future is on the line.

Limitations of Behavioral Audiometry

Clinical limitations of behavioral audiometry form the rationale for objective assessment of auditory function in all patients, but particularly in infants and young children. Behavioral audiometry simply does not provide valid and reliable information on auditory function, which is necessary for timely diagnosis and intervention. The list of “listener variables” that can influence, and sometimes invalidate, behavioral audiometry includes, but is not limited to,

- Age and development
- Neurological immaturity (sensory and motor)
- Cognitive factors
- Language
- Attention and state of arousal
- Motivation

Clinical Applications

There are multiple clinical applications of objective auditory measures. We have already touched upon newborn hearing screening and diagnosis of hearing loss in infants and young children. Although these applications are indeed crucial, others also play an important role in children and adults. Diagnosis of ANSD is possible only with a combination of objective techniques. Objective measures, such as OAEs and tympanometry, offer the most efficient and accurate means of screening for hearing loss in pre-school and school-age children. Objective auditory procedures permit prompt and unequivocal identification and diagnosis of pseudohypacusis (i.e., non-organic, false, or exaggerated hearing loss) and, therefore, timely and appropriate management. Finally, objective measures supplement behavioral diagnostic audiometry procedures in the assessment of auditory processing disorder (APD), particularly when behavioral findings are confounded by the already mentioned listener variables or the effects on behavior of other co-existing disorders (e.g., cognition and language in most children or adults with traumatic brain injury). In short, objective test procedures are essential in audiology today.

A Modern Test Battery

Below, we describe the clinical applications of various objective test procedures used in a modern test battery, including

- Acoustic immittance measures
OAEs
Auditory evoked responses
ECochG
ABR

**Acoustic Immittance Measures**

Without question, immittance measures remain the most sensitive and clinically feasible technique for evaluating middle ear function (see Hall & Swanepoel, 2010, for a recent review). Measurement of the acoustic reflex quickly provides clinically useful information on a substantial portion of the auditory system, as well as a non-auditory structure (the 7th cranial nerve). Considering the many and varied advantages of immittance measurement, we assert that no other widely accessible procedure in audiology provides as much diagnostic information with such a modest investment of time and effort. It is surprising that, even though instrumentation for immittance measurements is widely accessible and found in virtually all audiology clinics and private practices, the majority of audiologists do not routinely perform either tympanometry or acoustic reflex measurements during audiologic assessments.

An April 2010 Page Ten article in *The Hearing Journal* (Hall, 2010, p. 10) on the topic of acoustic immittance measures begins with this exchange between the mysterious interviewer and the author:

**Question 1:** I’m not too sure I can come up with 20 questions on this topic [acoustic immittance measures]. These measures have been around for so many years, there’s not really much new to talk about, is there?

**Response:** Not so fast my friend. There’s plenty of new information on immittance measures, from valuable new clinical applications of tympanometry to uses of the acoustic reflexes to new CPT codes!

How can a clinician use instrumentation that was probably purchased years ago to exploit— that is, make the most of—acoustic immittance measurements in his/her clinical practice? We’ll cite selected new applications of old immittance technology, or old applications of new and improved immittance technology.

- Immittance measurements are valuable clinically because they are quick, technically simple, have relatively high sensitivity and specificity, and can be recorded in persons of all ages without regard to developmental or cognitive status. So, acoustic immittance measurements will contribute to diagnostic audiological assessment of every patient who walks through the clinic door.
- A high probe tone frequency (e.g., 1000 Hz) is required (e.g., Joint Committee on Infant Hearing, 2007) when recording tympanograms in infants (at least up to the age of 4 months). With more conventional lower frequency probe tones (e.g., 226 Hz), it is possible to record a normal tympanogram from an infant with abnormal middle ear function (a false-negative error).
- Toynbee and Valsalva techniques are long-standing but under-used measures of Eustachian tube dysfunction. The Valsalva maneuver is useful to ascertain whether the Eustachian tube can be forced open and negative middle ear pressure minimized when positive pressure is developed within the mouth and naso-pharynx.
- Wide band reflectance, an alternative to conventional acoustic immittance measurement, quickly (< 1 minute) provides information on middle ear function for many frequencies from 100 to 8000 Hz or higher. And, recordings are made at atmospheric pressure without the need for an air-tight (hermetic) seal.
- Acoustic reflexes contribute importantly to the diagnosis of ANSD.
- Acoustic reflex findings also contribute to the diagnosis of superior canal dehiscence syndrome.
Measurement of the acoustic reflex threshold for broadband noise (BBN) offers a quick, clinically feasible, readily available, and objective technique for differentiating between normal and abnormal cochlear function in persons of all ages, even infants.

New CPT codes went into effect in January 2010. Additional CPT codes are now available for combinations of measures. Code 92550 is used for the combination of tympanometry and acoustic reflex threshold measurements.

The reader who is interested in making the most of acoustic immittance measurements in his/her clinic is encouraged to read this article (Hall, 2010) and to apply the information.

OAEs

OAEs contribute importantly and in a truly unique way to the diagnosis of auditory dysfunction, even though they have essentially no value in defining the degree of hearing loss. Some of the many clinical applications of OAEs are listed below. Indeed, in terms of anatomic site sensitivity and specificity—that is, detection and verification of outer hair cell dysfunction—OAEs have no rival in the audiological test battery. A full description of generation and mechanisms of OAEs, OAE measurement and analysis, and the many evidence-based clinical applications of OAEs in children and adults is far beyond the scope of this brief review. Everything you might want to know about OAEs is available in a new book devoted entirely to the topic (Dhar & Hall, 2011).

Clinical applications in the pediatric population include
- Neonatal hearing screening
- Hearing screening of pre-school children
- Hearing screening of school-age children
- Diagnostic auditory assessment of sensory hearing loss
- Identification and diagnosis of ANSD
- Identification and diagnosis of pseudohypacusis (false and exaggerated hearing loss)
- Diagnosis of auditory processing disorders
- Monitoring for drug-induced (ototoxic) auditory dysfunction
- Early detection of noise- or music-induced auditory dysfunction in adolescents and teenagers

Clinical applications in the adult population include
- Occupational and military hearing screening
- Diagnostic auditory assessment of sensory hearing loss
- Identification and diagnosis of ANSD
- Identification and diagnosis of pseudohypacusis (false and exaggerated hearing loss)
- Diagnosis of auditory processing disorders
- Diagnosis and management of tinnitus and hyperacusis
- Monitoring for drug-induced (ototoxic) auditory dysfunction
- Early detection of noise- or music-induced auditory dysfunction in at-risk patients
- Early detection of auditory dysfunction in systemic diseases, for example,
  - Autoimmune disease
  - Diabetes
  - Arthritis
- Diagnosis of Meniere’s disease
- Differentiation of cochlear versus retrocochlear auditory dysfunction
- Monitoring response to medical therapy in patients with idiopathic sudden sensorineural hearing loss
We’ll highlight here three relatively recent advances in OAE technology and clinical applications. One new and welcome attempt is the development of clinical instrumentation combining OAE and acoustic admittance and/or reflectance technology. The middle ear, of course, plays a critical role in OAE measurement, influencing both activation of the cochlea by the stimulus presented to the ear and also the outward propagation of OAE-related energy from the cochlea to the external ear canal. OAEs are highly dependent on the status of the middle ear and markedly affected by middle ear dysfunction. Devices that combine the capability for recording transient evoked otoacoustic emissions (TEOAEs) and distortion product otoacoustic emissions (DPOAEs), along with acoustic immittance measurement, are perfectly suited for efficient hearing screening of neonates, pre-school, and school-age children. Confirmation of middle ear status before or immediately after OAEs are recorded permits the clinician to quickly and confidently differentiate middle ear from cochlear (outer hair cell) dysfunction as the reason for abnormal OAE outcome. New devices, such as the Maico Ero-Scan Plus, include desired features, such as high frequency probe tone tympanometry and the option for programming the sequence of test procedures (e.g., tympanometry + TEOAE and/or DPOAE or vice versa).

Another exciting advance is remote measurement of OAEs via telehealth techniques. Investigation of newborn hearing screening with DPOAEs showed no difference in findings for on-site face-to-face hearing screening versus hearing screening remotely with telemedicine technology. In other words, researchers validated hearing screening with DPOAEs (and also ABR) conducted remotely against the conventional approach for hearing screening with these technologies (Krumm, Huffman, Dick, & Klich, 2008).

Finally, we’ll comment on OAEs as a tool for hearing screening of pre-school children. There are hundreds of publications describing newborn hearing screening with OAEs, but relatively little mention of their test performance or value in screening pre-school children, like those enrolled in Head Start programs. Detection of hearing loss in children in the age range of 3 months–5 years is just as critical as it is for newborn infants. There are four compelling reasons why screening for hearing loss after the neonatal period is important:

- Hearing loss in young children can have a major negative impact on speech/language acquisition, social development, emotional and psychosocial status, and pre-academic skills, such as reading readiness.
- Pre-school hearing screening permits detection of young children with hearing loss who did not undergo hearing screening in the nursery before hospital discharge.
- Screening during pre-school years will detect progressive or delayed-onset cochlear hearing loss, a major contributor to the increased prevalence of hearing loss at school age.
- Ongoing screening efforts detect conductive hearing loss secondary to middle ear disease.

The limitations of pure tone hearing screening in the pre-school years are well appreciated, especially by audiologists and others who have attempted this challenging task. Drawbacks to pre-school hearing screening include poor reliability, the adverse effect of a variety of test actors (e.g., cognitive status of the child, noise in the test setting, and skill and experience of the tester), a sizable proportion of children who cannot be validly tested, and considerable test time.

In contrast, OAEs take little time, are technically simple to administer, and, perhaps most important, are not influenced by the troublesome listener variables. Research indicates that OAEs stand up well to the traditional pure tone hearing screening standard (Driscoll, Kei, & McPherson, 2001; Lyons, Kei, & Driscoll, 2004; Nozza, 2001), when certain assumptions are met. Reliance on a simple signal to noise ratio (SNR) criterion for a pass or refer outcome is not sufficient. An OAE (i.e., DPOAE) hearing screening test is enhanced by more rigorous criteria for a pass outcome, that is, a SNR of > 6 dB plus an absolute distortion product (DP) amplitude...
of > 0 dB SPL. This point is illustrated by the distributions for normal hearing versus hearing impaired persons as a function of DPOAE amplitude, shown in Figure 1. DPOAE amplitude is shown on the X-axis. Distributions of pass and refer outcomes are shown in relation to the criterion for a pass outcome. Two criteria must be met for a pass outcome: (a) a SNR of > 6 dB (confirming the presence of a DP) and (b) minimal DP amplitude of 0 dB (approximately the lower limit of normal DP amplitude). The use of these combined criteria for concluding a refer result will detect almost 100% of ears with pure tone hearing thresholds of > 20 dB HL.

Figure 1. Distribution of pass versus refer outcomes for DPOAE screening of pre-school and school-age children. A criterion of > 0 dB SPL for DPOAE amplitude effectively differentiates children with the likelihood of normal hearing sensitivity versus hearing loss.

Auditory Evoked Responses

Published literature on the multiple and varied applications of auditory evoked responses in clinical audiology is vast. There is also remarkable accumulated clinical experience with electrophysiological responses elicited from the cochlea, auditory brainstem, and auditory cerebral cortex. Over the years, millions of children and adults worldwide have undergone hearing screening or formal diagnostic assessment with auditory evoked responses. Of course, a topic that broad and well-researched cannot be properly addressed in this brief update. What follows, therefore, is a concise synopsis of one clinically valuable application for several auditory evoked responses. The reader is advised to seek more detailed information from books and peer-reviewed articles that report original research on other auditory evoked response topics of interest, such as speech evoked ABR, ASSR, cortical evoked responses (e.g., auditory middle latency response, auditory late response, P300 response, and mismatch negativity [MMN] response).

ECochG

ECochG might be described aptly as “the auditory test with 9 lives” (or at least 5, at last count). As noted above, in earliest reports of ECochG, researchers described its role in the objective hearing assessment of difficult-to-test children. With the discovery of ABR, ECochG fell out of favor as an objective technique for auditory assessment. Before long, however, ECochG re-emerged as a test for the diagnosis of Meniere’s disease. And, several years later, ECochG techniques were applied in intra-operative neurophysiological monitoring during surgeries that put the auditory system function at risk. During the same time period, ECochG principles and components (e.g., electrode designs) were used to enhance ABR wave I for more precise neuro-diagnosis of retrocochlear auditory dysfunction. Most recently, we have witnessed a resurgence of interest in ECochG as a critical test in the accurate diagnosis of ANSD.

ECochG is useful in the identification and essential for the diagnosis of ANSD (see Hall, 2007, or Hall & Swanepoel, 2010, for review). With direct measurement of the ECochG, or
relatively simple modifications of the ABR test protocol, the clinician can more precisely define the site of auditory dysfunction. Application of ECochG in ANSD is dependent on an appreciation of the anatomic generators of, or contributors to, the three main components: cochlear microphonic (CM) = outer hair cells; summating potential (SP) = inner hair cells; and action potential (AP) = distal 8th cranial nerve fibers. If OAEs and/or the ECochG CM are recorded, yet the ABR is entirely absent, then ANSD must be suspected.

Clinicians must answer a key question for the audiological management of patients with ANSD: Is the site of auditory dysfunction pre-synaptic (i.e., inner hair cells) or post-synaptic (i.e., auditory nerve fibers)? Patients with the pre-synaptic form of ANSD, with inner hair cell abnormality but intact auditory nerve function, would be considered better candidates for cochlear implantation (e.g., McMahon, Patuzzi, Gibson, & Sanli, 2008). Neuro-radiologic studies would be needed to verify anatomic integrity of the 8th cranial nerve. On the other hand, the post-synaptic ECochG pattern, which implies auditory nerve dysfunction, would not be compatible with cochlear implant success. Auditory nerve function is necessary for effective cochlear implant stimulation.

ANSD diagnosis and management is dependent on more than ECochG findings. Final diagnosis of ANSD takes into account information from behavioral audiometry (including speech audiometry), acoustic immittance measures, other auditory tests, thorough medical history, and perhaps diagnostic findings from a host of medical specialists (e.g., otolaryngology, ophthalmology, neurology, genetics, etc.).

**ABR**

Diagnosis of auditory dysfunction in infants, including accurate estimation of auditory thresholds, is an essential first step in early intervention for hearing impairment. The one and only technique recommended by the Joint Committee on Infant Hearing (2007) to achieve this goal is frequency specific ABR measurement—that is, recording ABRs elicited by tone burst stimulation. Two factors required for successful and accurate estimation of auditory thresholds with tone burst ABR recordings are an evidenced-based clinically feasible test protocol and a very quiet (preferably sleeping) patient. Almost 40 years of clinical experience and research have contributed to a frequency-specific ABR protocol (see Table 1 in this article’s supplemental materials).

With modern ABR system software, any audiologist can quickly and easily enter these stimulus and acquisition parameters into multiple protocols (e.g., for air conduction click stimuli, bone conduction click stimuli, and air conduction tone burst stimuli) for immediate clinical use. Options for encouraging a child to rest quietly or sleep include the time-tested sleep deprivation technique and/or administration of the over-the-counter natural substance melatonin. There are also now FDA-approved devices specially designed for recording ABRs from un-sedated children (e.g., the Vivosonic Integrity system). Finally, some children’s sleep must be facilitated with either a conscious sedative (e.g., chloral hydrate) or light anesthesia (e.g., propofol). These and other techniques and strategies for ensuring adequate patient state for ABR measurement are reviewed in detail in the literature and in books (e.g., Hall, 2007) and described on websites (American Academy of Pediatrics, n.d.).

**Concluding Remarks**

The objective auditory procedures reviewed in this brief paper and others are indispensable for provision of audiology services that are consistent with current standard of care in pediatric and adult patient populations. FDA-approved equipment for measurement of objective auditory tests is readily available to audiologists. Clinical application of objective auditory procedures is supported by substantial evidence published in the peer-reviewed literature and easily justified, because objective measures are invariably tests that add value to auditory diagnosis and improve patient outcome. CPT codes permit legitimate billing when objective diagnostic auditory tests are performed in a clinical setting.
References


Testing Babies: You Can Do It! Behavioral Observation Audiometry (BOA)

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Behavioral observation audiometry (BOA) is the only test protocol that provides a direct measure of hearing. This valuable technique can be used to monitor hearing and hearing aid benefit in infants who are not yet able to participate in visual reinforcement audiometry (VRA). In this article, I present a carefully developed protocol that uses changes in sucking, resulting in a reliable threshold measures. Key points include

1. Auditory brainstem response (ABR) testing, auditory steady state response (ASSR) testing, and otoacoustic emissions (OAEs) testing provide critical information about the status of the auditory pathways but are not direct measures of hearing.
2. Only behavioral testing provides a direct measure of hearing.
3. Behavioral testing can be used to monitor hearing and performance with hearing technology.
4. When carefully performed, using appropriate criteria including using changes in sucking as an indication of a response, behavioral observation audiometry can be used by clinicians to accurately measure thresholds in infants cognitively less than 6 months of age.

Introduction

The goal of audiological evaluation of babies is to determine how they are hearing, to fit technology, and to monitor technology to ensure they are receiving sufficient auditory access to enable them use hearing to develop speech and language. For us to be successful as clinicians, we need to know how children hear. Auditory brainstem response (ABR) testing, auditory steady state response (ASSR) testing, and otoacoustic emissions (OAEs) are frequently used to assist in estimating peripheral hearing in infants (American Speech-Language-Hearing Association [ASHA], 2007). Though these tests are an important part of the audiology practice and provide important information, they are, in fact, not tests of hearing. In an extreme example, in a case of auditory neuropathy spectrum disorder (ANSD), the information provided by these tests is not useful for determining technology needs. The only true test of hearing is behavioral assessment. ABR, ASSR, and OAE measures provide information about the integrity of specific sites within the auditory system (Delaroche, Thiebaut, & Dauman, 2004; Gravel, 2000; Hicks, Tharpe, & Ashmead, 2000; Sininger, 1993). Only behavioral testing truly tests hearing, because it measures the response of the entire auditory system from the outer ear through the cerebral cortex. Behavioral tests permit measurement of what an infant actually perceives; they are measures of functional hearing abilities. Numerous authors have posited the necessity for cross-checking physiological results with behavioral data by using a battery of tests to determine hearing sensitivity (Bess & Humes, 2003; Gravel, 2000; Hicks et al., 2000; Jerger & Hayes, 1976; Madell, 1998, 2008; Northern & Downs, 2002). With older children, we
expect to use behavioral tests (visual reinforcement audiometry [VRA], conditioned play 
audiometry [CPA]) to monitor performance, and most audiologists are comfortable doing this. 
Behavioral evaluation of infants younger than 6 months is more difficult to achieve and less 
well documented.

Behavioral Testing in the Past

Noisemakers were the most common sound source employed for early hearing tests on 
infants. They were selected for testing because they were readily available, simple, inexpensive, 
and could be used in any setting (a sound room was not required). The difficulty with 
noisemakers is that they usually have very broad frequency responses and their intensity is not 
easy to control. In addition, a wide variety of behaviors from the infants were accepted as 
responses to sound, including limb movement, eye blink, startle, and changes in respiration. 
We now know that those behaviors, while responses to sound, are not threshold responses, but 
rather responses to supra-threshold stimuli. As a result, thresholds obtained to noisemakers 
were not in agreement with thresholds obtained to other behavioral tests as infants got older, 
and behavioral tests on infants were not considered reliable.

The Need for Behavioral Testing of Infants

As hearing screening becomes universal, audiologists are being asked to assess hearing 
in very young infants who have failed newborn screening and to manage hearing loss when it is 
identified. One of the first steps in hearing loss management is the selection and fitting of 
appropriate amplification. Hearing aid fitting requires an accurate assessment of the degree 
and type of hearing loss, with both ear and frequency specific information obtained by air and 
bone conduction.

Many audiologists feel comfortable testing hearing in infants over 6 months of age using 
VRA, but do not feel comfortable testing younger infants, infants with delays in development, or 
critically ill infants. Early detection and intervention (EDHI) guidelines recommend that an 
infant who is referred after hearing screening at birth should be fit with hearing aids by 3–6 
months of age (Centers for Disease Control and Preventions, 2004). Yoshinaga-Itano, Coulter, 
and Thomson (2001) and others have demonstrated that infants who are fit with appropriate 
technology prior to 6 months of age can develop speech and language skills commensurate 
with their normal hearing peers, and infants fit with technology later than 6 months of age do 
not catch up to those fit earlier. Sharma, Dorman, and Spahr (2002) have demonstrated that 
infants who receive auditory stimulation at a sufficiently early age have evoked potential 
latencies similar to typically hearing peers, but infants who do not have sufficiently early 
access do not. Moeller (2010) demonstrated that 40% of children are not receiving sufficient 
gain from their hearing aids, as measured in a variety of ways. If audiologists are not 
comfortable assessing aided benefit in infants, this will contribute to children being 
inappropriately fit with amplification.

A major benefit of behavioral testing is that it allows parents to participate in testing by 
allowing them to assist in determining when the infant is responding to a sound. When 
clinicians provide parents with information about what to observe, they can actively participate 
in testing and better understand and accept their child’s hearing loss (Gravel & McCaughey, 
2004). Electrophysiologic testing, on the other hand, provides little for a family to observe, 
making it difficult for them to understand and accept test results. Real-ear measures provide 
important information about how much sound is reaching the eardrum, but this information is 
difficult to interpret without good information about the status of the infant’s unaided hearing. 
Tonal ABR and ASSR measures provide some of this information, but thresholds obtained may 
vary by 15+ dB resulting in under- or overestimating hearing levels. Behavioral observation 
audiometry (BOA) techniques can assist in obtaining ear and frequency specific information 
and can provide confirmation of information obtained from electrophysiological tests. In 
addition, BOA can be used to monitor performance with technology, which cannot be 
accomplished with ABR.
Diagnostic Evaluation of Neonates

Diagnostic evaluation of hearing in infants includes immittance testing to assess middle ear status and one or more test protocols that will provide frequency and ear specific information, ideally for both air and bone conduction. ABR testing, auditory steady state evoked potentials (ASSEP), and/or OAE testing are frequently included in the test battery. BOA is used less often.

**BOA: The Basics**

Historically, many different “behaviors” have been used to assess hearing in infants (arousal, limb movement, respiration changes, eye blink), but these have not proven to be sufficiently repeatable and, more important, have not been good indicators of threshold. The behavior most likely to provide threshold responses is a change in sucking (Delaroche et al., 2004; Madell, 1988, 1995a, 1998, 2008; Widen & Keener, 2003). Arousal responses, limb movements, and eye blinks frequently reveal supra-threshold level responses, but rarely threshold level responses, because these behaviors typically are elicited to louder stimuli. Sucking responses, however, though present at supra-threshold levels, are frequently observed at or close to threshold. Both initiation and cessation of sucking are acceptable responses. Some infants will start sucking when a sound is presented, others will cease sucking, and some will do both.

**Observation of the Sucking Response**

Sucking can be observed with a bottle, nursing at the breast, or with a pacifier. I ask the family to bring the infant to the evaluation session hungry, so that the baby will be ready to suck. The infant needs to be as comfortable as possible during testing. If the infant usually drinks from a bottle, the family should bring one. If the infant usually nurses, it would be best if the infant is nursed during testing. If the infant uses a pacifier, the family should bring one along. After the infant is finished eating, testing can frequently continue by observing sucking with a pacifier. If an infant is very hungry, it is best to allow the infant a little time to eat to enable him/her to get over that initial extreme hunger prior to beginning testing.

As soon as the baby settles down, testing can begin. The best way to observe the sucking response is to be able to see the infant’s mouth close-up. This can be accomplished by using in the test room a video camera with a zoom lens that can be adjusted from the control room. If a camera is not available, the audiologist needs to be certain that he/she can clearly see changes in sucking in order to use this technique.

**Sucking as a Response**

As with all other test responses, timing is the key factor. With any test protocol, (behavioral or electrophysiological) responses can be accepted only if they fall within a reasonable time window after presentation of the stimulus. Infants are fairly consistent, internally. Some respond to the “on” of the stimulus and others respond to the “off.” The timing of the response is also usually consistent. Infants respond at about the same number of seconds after presentation of the stimulus each time, with the response time slightly shorter for louder stimuli (Madell, 1998, 2008; Northern & Downs, 2002; Thompson & Weber, 1974; Widen & Keener, 2003).

**Positioning the Infant**

The necessity of appropriately positioning the infant cannot be overstated. To obtain reliable test results, the infant needs to be resting in a comfortable position with full support of the head and torso and must be visible to the testers. If the child is nursing, the mother will be holding the child in her arms. If the child is using a bottle or pacifier, the child may be held in a parent’s arms or placed in an infant seat. The advantage of an infant seat is that the infant will not be receiving any “signals” from the parent. Involuntary movements by the mother or other parent in response to sound, such as stiffening or movement of the breast or bottle, can be transmitted to the infant; therefore, changes in sucking may occur that are not related to
the auditory stimuli. If the infant is being held, the clinician must very carefully instruct the parent to remain silent and still throughout testing to eliminate noise or movement that could interfere with test results. It is sometimes useful to have the parent wear earphones to prevent her/his hearing and being influenced by the sound. However, there is an advantage to having a parent hear the sounds: It enables him/her to hear what the baby is hearing, to better understand the test results. A test assistant can be very helpful in monitoring the baby’s status and adjusting positioning when necessary, reminding the parent holding the infant not to respond to test stimuli, and being a second pair of eyes to observe responses.

**Testing Protocol**

**Soundfield vs. Earphone Testing**

Below, I outline the steps involved in BOA testing. The goal of the initial audiologic evaluation of an infant is usually to be certain that the infant has sufficient hearing to develop speech and language. It may not be necessary to obtain ear specific information at the first visit. Soundfield testing using noise bands or warble tones at one low and one high frequency is a good way to start. Soundfield is less stressful for the infant and has the secondary benefit of allowing parents to hear the test stimuli. If the infant is still attending after obtaining two or three soundfield thresholds, clinicians can make a decision on how to proceed. If a hearing loss is present, the clinician may decide that it is important to do bone conduction (BC) testing next or to use insert earphones and obtain thresholds for each ear. If the child is no longer sucking, clinicians should schedule a return appointment to obtain ear specific information to complete testing. Clinicians should not release any infant from audiologic follow-up until ear-specific information is obtained.

The Behavioral Observation Test Protocol includes these steps:

1. Bring the infant into the test room in a hungry state.
2. Seat the infant so his/her torso is supported and not fidgety and so tester(s) can easily see the infant’s mouth.
3. Monitor the infant’s state during testing and stop if the infant becomes fidgety.
4. Instruct the parent not to respond to test stimuli or responses from the child.
5. The test assistant will keep the infant centered, observe responses, and monitor the parent’s behavior.
7. Begin testing with a stimulus that is slightly above estimated threshold.
8. Test one low (500 Hz) and one high (2000 Hz) frequency initially, and select additional frequencies to test depending on the infant’s initial responses.
9. Reduce thresholds in 10 dB steps and increase in 5–10 dB steps to bracket the threshold. Record a response after 3 reversals.
10. Take breaks as needed to calm the infant and increase usable test time.
11. If soundfield testing indicates a hearing loss, test bone conduction.
12. If the infant is still responding, or at the next test session, test with insert earphones.
13. Test with technology as needed.


**Test Stimuli**

When planning the test session, the clinician should keep in mind that infants will provide only a limited number of responses; each stimulus presentation must be considered
carefully. The goal of the testing is to obtain frequency-specific test results. Warble tones or narrow bands of noise will provide this information. Broadband stimuli, such as music, conversational speech, or white noise, will not. Narrow bands of noise are frequently easier for an infant to respond to (Gravel, 2000; Madell, 1998, 2008) and may provide thresholds that are 5–10 dB softer than those obtained with warble tones.

Speech awareness thresholds to low (“ba”), mid-high (“sh”), and high (“s”) frequency speech stimuli can be used to confirm warble tone/noise band thresholds. The threshold for “ba” should be close to the threshold obtained at 500 Hz, “sh” should be close to the threshold obtained at 2000 Hz, and “s” should be close to the threshold obtained at 3000–4000 Hz (Ling, 2002; Madell, 1995b, 1998, 2008).

Other Influencing Factors

The audiologist must know something about the infant to obtain reliable test results. Spending a little time with the infant prior to beginning testing will increase the likelihood of obtaining reliable test results. It is important for the audiologist to have a good estimate of the infant’s developmental, neurological, and behavioral status. Can the infant do whatever is required for testing? If the audiologist is looking for sucking changes, he/she needs to know that the infant sucks steadily. Some infants take a few sucks, stop, and then start again. When an infant has an irregular sucking pattern, it becomes very difficult to use sucking to assess hearing. Some infants, because of serious medical conditions, will be fed with a gastrointestinal tube, so the infant will not be eating. If the infant uses a pacifier, it may still be possible to test hearing by measuring non-nutritive sucking responses. However, if the infant does not use a pacifier, it will not be possible to measure hearing using a sucking technique.

Comparison of BOA Thresholds to VRA and CPA

Figure 1 is typical of many multiple audiograms that demonstrate that thresholds can be obtained accurately by using BOA. The audiogram makes the best possible case for the reliability of the BOA sucking technique by comparing thresholds obtained with BOA, VRA, and CPA on the same child.
Figure 1. Comparison of BOA, VRA, and CPA


**Developing Comfort Using BOA**

As with most other skills, it takes experience to become a competent tester when using the BOA sucking paradigm. It requires the opportunity to practice and willingness to work on developing a new skill. The DVD that accompanies Madell and Flexer (2008) demonstrates the protocol in detail and may be of assistance to the audiologist in practicing.

**References**


TeleIntervention: Improving Service Delivery to Young Children With Hearing Loss and Their Families Through Telepractice

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As telecommunication technology continues to evolve, opportunities are emerging for telepractice to meet the communication needs of children with hearing loss. As well, documented shortages of well-trained speech-language pathologists and pediatric audiologists are leading some centers to augment their service delivery through telepractice as a means to meet a need for qualified providers. For families of young children with hearing loss, obtaining services that support auditory learning and spoken language can be a challenge in some communities. One form of telepractice, teleintervention, provides early intervention services to families of children with hearing loss using internet-based videoconferencing to model and coach parents in language facilitation techniques. Though it is a relatively new service delivery model, preliminary results are promising.

A Historical Perspective

In 1875, Dr. Alexander Graham Bell uttered those immortalized words, “Mr. Watson, come here, I want you!” into a rather crude transmitter. In the next room, Thomas A. Watson, a lab assistant, heard Dr. Bell’s voice clearly through the receiver. In that moment, a new form of mass communication was born: the telephone. While Bell ultimately understood the wider implications for his invention, his initial experiments focused on how to transmit speech across a wire. Bell, a noted elocutionist and teacher of the deaf, believed that children with even the most significant hearing loss could develop intelligible spoken language if given appropriate instruction. Thus, the telephone was a product of his work in deaf education. Bell knew that if he could transmit speech across a wire, he could make the speech louder and the children he taught would hear it better. In turn, they could learn to self-monitor their own voices and improve their speech intelligibility.

Although Bell lived to see the world transformed by the telephone (he died in 1922), it would have been difficult for him to imagine the evolution of telecommunication technology. In fact, landline telephones are becoming passé as more individuals and families prefer their cellular-based smart phones. Similarly, the impact of the Internet, especially over the past 30 years, ushered in the “information age,” allowing individuals immediate access to more information than at any point in history with only a few clicks of a computer’s mouse. And today, society is entering a new age of connectivity. Not only is access to various media (e.g., audio, streaming video) readily available through the Internet, this media can be viewed on a variety of devices, such as laptops, smart phones, and tablet computers. Connectivity also goes beyond constant access to the Internet to incorporate various forms of social media (e.g., Facebook, Google+, Twitter, etc.). Through this constant interactive connectivity, individuals...
are developing new personal relationships, establishing professional networks, and advocating countless social and political causes.

As this evolution continues, telecommunication is being transformed once again with applied Internet technology. That is, live point-to-point and multipoint audio and video transmission is now possible through the Internet. Today, services and related computer hardware and software, such as SKYPE, Oovoo, iChat, Facetime, and Google Talk—to name just a few—allow individuals to see and hear colleagues, friends, and family in real time. Until recently, these videoconferencing services were available only to corporations, government agencies, hospitals/medical centers, and universities; the general public had limited access. However, because many of these services are now web-based (e.g., SKYPE, Oovoo, etc.), a democratization of access to videoconferencing has occurred.

**The Booming Age of Telepractice**

As videoconferencing technology has become more widely available, the associated equipment costs have declined and these services have become more cost-efficient. As a result, web-based videoconferencing can be used to deliver health care through a variety of medical and allied health disciplines; this is typically referred to as telemedicine or telehealth services. The American Speech-Language-Hearing Association (ASHA) defined this service delivery model as telepractice for practitioners in audiology and speech-language pathology (ASHA, 2005a, 2005b, 2010). Evaluating telepractice in audiology, Swanepoel and Hall (2010) reviewed related peer-reviewed literature and found that these services were both reliable and effective across ages and patient populations. Likewise, Mashima and Doarn (2008) completed a similar review and described broad application of telepractice in speech-language pathology, including treatment of neurogenic communication disorders, fluency disorders, voice disorders, dysphagia, and childhood speech and language disorders.

Families and caregivers of young children with hearing loss often face challenges securing appropriate services from qualified providers. Evidence continues to mount that demonstrates the shortage of professionals with the necessary knowledge and skills to deliver evidenced-based medical, clinical, and early intervention services to this special population (Houston, Munoz, & Bradham, 2011; Joint Committee on Infant Hearing, 2007; Moeller, White, & Shisler, 2006; Shulman, Besculides, Saltzman, Ireys, & White, 2010; White, 2008). To provide greater access to services, some practitioners and their centers employ models of telepractice to address the developmental, communicative, and learning needs of young children with hearing loss and their families, often with favorable results (Behl, Houston, Guthrie, & Guthrie, 2010; McCarthy, Munoz, & White, 2010).

**A Model of TeleIntervention**

In fall of 2008, administrators at Sound Beginnings—an early intervention and preschool program for children with hearing loss housed on the campus of Utah State University—initiated a project designed to evaluate the overall effectiveness of services delivered through a telepractice model. Soon afterward, the faculty and staff team involved in the project coined the term teleintervention to describe the early intervention services provided virtually using distance communication technology (i.e., videoconference equipment). When the project was launched, two families volunteered to participate, which was adequate at the time to determine the general feasibility of such a model. That is, the project investigators sought to determine if teleintervention would be comparable to traditional home-based early intervention services and to see if the children improved their listening and spoken language skills. In addition, the parents and caregivers of the children were carefully monitored to determine if they successfully improved their own language facilitation techniques.

Since the project required high-resolution audio and video, top-of-the-line videoconferencing equipment was purchased and placed in the families’ homes. (Note: While
investigators decided this equipment was optimal for the project, practitioners can use less expensive equipment, such as a laptop with a web-based camera [webcam] and one of the online videoconferencing services such as SKYPE or Google Talk. However, practitioners must ensure that the quality of the transmission allows them to meet ASHA's requirement that the quality of services be equivalent to in-person service delivery [ASHA, 2005b]. The compact videoconferencing units contained a video camera, and a 24-inch video monitor was connected to the unit console. With these units, parents could see and hear the sessions provided by the project faculty member, who was a speech-language pathologist (SLP). At the university, the SLP used the same equipment, providing high-quality video and audio to observe and coach the parents through each session's activities. From the home, the videoconferencing equipment was connected to a broadband Internet connection. Fortunately, the university had high-speed Internet capacity, which allowed consistent connectivity with the unit in the parents’ home.

Families enrolled in the project received weekly teleintervention sessions that lasted approximately 60–75 minutes each. Usually, families had already received a packet of materials (e.g., toys, books, etc.) that were selected to meet the child’s current goals in speech, language, and listening. These packets were mailed every 3 weeks or so and contained enough materials to last a month. Unless otherwise determined, parents would return the materials once those lessons had been completed.

Typically, each session began with a discussion of the speech, language, and listening goals targeted during the prior session and how previously demonstrated communication strategies had been integrated into the child’s daily routines. The SLP and parents/caregivers discussed any new communication behaviors that might be relevant to the child’s progress, such as new or emerging speech sounds, words, or listening behaviors that have been noticed. Once these updates were shared, the SLP introduced the goals for that day’s session, explaining the desired speech, language, listening, and interactive behaviors. Both the family and the SLP used similar toys and everyday materials to target these goals. After discussing which materials and activities would most engage the child, the SLP demonstrated the activity before asking the parent to engage the child. The parent repeated the activity while the SLP observed. At this point in the session, the SLP’s role shifted to that of a coach. The SLP provided positive reinforcement and constructive feedback to the parent based on how the activity was being implemented and how communication strategies that promote listening and spoken language were being applied.

This same scenario was repeated as one activity ended and a new activity was initiated. Throughout the session, the parent and the SLP closely monitored the child’s attention level. For example, if the child began to lose interest, the parent may have said, “Let’s do it one more time, and then we’ll get something else to play with!” By maintaining control of who (i.e., the parent) ended each activity, the parent could move through several activities that reinforce listening and spoken language without losing the child’s interest or seeing the session deteriorate into a power struggle.

As the session came to a close, the SLP summarized the goals and facilitation strategies that were modeled and practiced during the session. Based on the child’s performance and developmental level, new or additional communication goals were discussed that would be targeted in the home the following week. Before the session ended, the parent was given ample opportunity to discuss any concerns about the child’s progress, ask questions about short- or long-term communication goals, or seek input about troubleshooting the child’s hearing technology (e.g., digital hearing aids and/or cochlear implants, FM systems).

The teleintervention model has been shown to be a viable service delivery model for supporting children with hearing loss who are acquiring spoken language. Children obtained language outcomes consistent with or exceeding developmental norms. Additionally, the parents became more confident in their role as their child’s primary facilitator of language. (For a more complete description of the teleintervention project at Utah State University, see Behl et al., 2010.)
Parent Coaching

Too often, SLPs are reluctant to engage the parent as their child’s primary language facilitator. However, numerous studies have demonstrated that effective parental engagement leads to improved communication outcomes in children with hearing loss (DesJardin & Eisenberg, 2007; Moeller, 2000; Zaidman-Zait & Young, 2007). Unfortunately, SLPs and other practitioners often do not have the background and training to be effective coaches and may not be comfortable working with parents in such a manner (Fleming, Sawyer, & Campbell, 2011; Houston & Bradham, 2011). In regard to the teleintervention service delivery model, parent coaching is a central component, because the SLP is not in the room with the child and cannot take control of the session. Ultimately, the SLP must develop a partnership with the parent and, by so doing, allow the coaching relationship to emerge.

Through the coaching relationship, the SLP works to increase the parent’s confidence and skills in reinforcing appropriate listening and spoken language targets during play activities. As the parent’s confidence grows, he/she should incorporate the same speech, language, or listening strategies into the child’s daily routines. For example, the parent may learn how to appropriately model and expand language during a cookie-baking activity. By reinforcing listening and language targets during these regularly occurring activities within the home, the parent can make these skills more habitual and easily transfer them to other commonly occurring activities, such as bath time, getting dressed, or setting the table for dinner. This coaching paradigm requires a partnership that emphasizes the role of the parent as the one who best knows his or her child’s interests and temperament (Peterson, Luze, Eshbaugh, Jeon, & Kantz, 2007).

Family-Centered Practices

Although teleintervention is still a relatively new service delivery model for children with hearing loss and their families, definite advantages and very few disadvantages can be identified. Even families who live in a community where specialists are available may find that receiving services via teleintervention can be very beneficial. For example, some families may live a short distance from the center or program, but have other young children in the home who need supervision. The process of packing up all of the children as well as the child with hearing loss and then traveling to the center is no small undertaking. Teleintervention allows the family to stay at home with less disruption to the family routine.

For other families, the shortage of highly skilled early interventionists in their chosen form of communication may propel them toward telepractice. Through teleintervention, parents may have greater access to professionals who could meet the communication needs of their child. And, because the model incorporates a coaching partnership, the interaction is different from that of traditional home visits. As a result of active engagement during teleintervention sessions, parents are better equipped to integrate speech and language goals into the child’s typical routines.

Given the importance of intensive early intervention, teleintervention may prove to be a more efficient way to ensure consistency of services. With traditional home visits, a family may need to cancel a session if the child or someone else in the family has even a minor illness. However, with teleintervention, cancellations can be kept to a minimum. Even if the child or parent is not feeling well, the session can proceed without the danger of sharing unwanted germs. For children who are medically fragile and/or may have a compromised immune system, this is an added comfort for parents. As a result of fewer interruptions to their intervention schedule, children are more likely to reach their communication goals.

Provider’s Perspective

Once the equipment is in place and functioning, the sessions focus less and less on the operation of the technology and more on the intervention. Some practitioners may have greater
facility with technology, but most of the technology—from the more expensive videoconferencing equipment to the standard laptop and webcam—are relatively simple to use. Tutorials on how to set up and use this technology are available online and through many of the manufacturers or service providers (i.e., SKYPE, Oovoo, etc.). However, regardless of how efficient a provider may become with using the equipment, it is critical to have support from specialists who are experts in telecommunication systems. These professionals are able to keep providers informed about new trends and products that could potentially enhance the program’s telepractice, as well as help troubleshoot issues when problems do arise.

Though the technology is rather simple to use, the potential for problems do exist. For example, a family in a rural area may not have access to a high-speed Internet connection. The available bandwidth of the Internet connection is a critical component to manage. That is, a dial-up connection is slower than a high-speed broadband connection. Other factors may affect bandwidth, such as a high volume of users on the service being used at the time (e.g., SKYPE). Beyond the specific equipment employed, the available bandwidth established through the connection is the most important factor that will affect any teleintervention session.

In addition, some parents may not feel comfortable with teleintervention and may decide that they prefer a more traditional, in-home service delivery model. Those families may decline participating in teleintervention. However, they may be open to starting services at the center or in the home and slowly moving to a teleintervention model. Some professionals may recognize parenting or other behavior management issues that need to be addressed through a more traditional service delivery model before suggesting that the family consider teleintervention.

In a similar fashion, some professionals may be “techno-phobes” and may feel intimidated by the technology. Providers who are a bit reluctant to use technology in this manner for service delivery may find it helpful to observe other centers or practitioners who are currently providing teleintervention or engaged in telepractice. In the end, program or center administrators should carefully choose the providers on staff who will be delivering teleintervention services and the families who will receive them.

Professional Issues

ASHA (2010) continues to detail a range of professional issues that may potentially affect practitioners who are providing services through telepractice. Three of the most important issues concern privacy regulations, licensure, and reimbursement for services. In some settings, telepractice may not be allowed for fear of violating the Health Insurance Portability and Accountability Act of 1996 (HIPAA). HIPAA addresses a patient’s protected health information (PHI), and the act requires that telepractice sessions be protected from unauthorized access. However, HIPAA does not specify the method of protection. Some facilities have made reasonable accommodations by carefully selecting software and hardware that offer great protection from unwanted access. As well, the Internet connection between the provider and the parent can be made more secure by establishing virtual private networks (VPNs), using enhanced firewall software on the provider’s and parent’s computers, and using password protection to log into secure websites or videoconferencing services.

Licensure remains a challenge for telepractice providers in most states. According to ASHA (2010), only a small number of state licensure boards have addressed telepractice in the legislation or regulatory language. Thus, considerable variability exists among states in terminology and the specificity of existing regulations. Providing telepractice services across state lines requires that professionals secure and maintain licensure in both states.

Reimbursement for services continues to be a challenge for providers who are using telepractice models. Romanow and Brannon (2010) described some of these challenges and the fact that, as telepractice in health care continues to grow, Medicare and Medicaid either do not allow telepractice or greatly restrict reimbursement for audiological and speech-language services provided through this model. However, some states have modified their state
regulations regarding Medicaid or have passed legislation that defined how reimbursement can occur. Though these modifications may not be perfect, they still may be helpful; practitioners should investigate if and how these services have been addressed in their respective states.

**Conclusion and Next Steps**

For well over a century, telecommunication has continued to evolve. Today, modern technology allows constant connectivity from a range of devices and the ability to see and hear others in real time, whether they are just down the street or thousands of miles away. Inevitably, the widespread availability of this technology—used in combination with the Internet—has allowed professionals to provide a range of audiological, speech, and language services through telepractice. Although challenges remain in the areas of privacy regulations, licensure, and reimbursement, professional associations, practitioners, and other stakeholders will continue to seek solutions to these and other issues. For children with hearing loss and their families, new programs of telepractice, such as teleintervention, are proving to be effective service delivery models. In 1875, a simple desire to transmit speech across a wire led to a communication revolution. Through telepractice, we may be witnessing another evolutionary step in how services can be delivered to young children with hearing loss and their families. Dr. Bell would be proud!

**References**


