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Abstract

Service providers face a number of challenges in evaluating the needs of hard of hearing students who rely on auditory/oral and/or print means of communication. While documentation for some students clearly justifies specific accommodations, for others it does not. Many service providers are faced with the difficult task of justifying to administrators why the services are necessary. This session provided participants an understanding of the functional limitations created by hearing loss and the access options available, arming them with knowledge and confidence to advocate for students’ access needs. Participants had the opportunity to talk with an audiologist who is himself a cochlear implant user to have their hearing loss and documentation questions answered. Hearing assistance technologies also was available to explore.

The impetus for having this all-day workshop was the awareness and concern that there was a poor transfer of information between service providers and audiologists for students with hearing loss in the post-secondary education setting. When clear information is not adequately transferred, it may be difficult to develop and justify reasonable and appropriate recommendations for students. Whatever information is gathered significantly impacts documentation that can either benefit or harm a student’s educational access and process. The reasons for any poor transfer of information may be related to the assumptions of knowledge that both audiologists and service providers have about each other. For example, audiologists may assume that services providers who work with students with hearing loss know precisely what the student needs. Meanwhile, service providers may assume that audiologists will provide complete, detailed evaluations and recommendations that will work with the school’s available technology and resources, and ultimately meet the needs of the student. Alternatively, it may be that both parties are unclear about what questions need to be answered, and what information to provide.

Our approach to resolving some of these concerns is to educate service providers about certain audiology-related topics in order that they may be empowered to ask of audiologists specific information or documentation they need to best serve their students. Additionally, having a solid understanding of various issues involving assistive listening devices (ALDs) is considered of great importance. Due to the constraints of space, we will highlight some of the major points from our presentation. More detailed information and relevant references can be obtained in other
publications, both of which are free and accessible on-line (Davis, Atcherson, & Johnson, 2007; Atcherson, Davis, & Johnson, 2007).

Overview of Anatomy and Physiology of Hearing
Basic understanding of the anatomy and physiology of the hearing is essential for understanding how hearing loss leads to various functional difficulties (below), which will then help us develop appropriate expectations of what hearing assistance technology can and cannot do for students. Minimally, the peripheral auditory system involves the pinna, ear canal, ear drum, middle ear space (and structures), cochlea, and the hearing nerve. The purpose of the pinna and ear canal are to naturally provide a boost of high frequency information, particularly those of speech sounds. The middle ear begins with the ear drum whose physical movement via the ossicles (three tiny bones) becomes pressure waves in the fluid-filled cochlea. Within the cochlea, the pressure waves vibrate resonating membranes that neurally activate the sensory hair cells within the cochlea. There are two different types of hair cells that have fundamentally important roles. Outer hair cells are motile, whereby they contract to help amplify soft sounds entering the auditory system. However, it is the inner hair cell that actually relays sound information to the brain. When sounds are sufficiently loud, the inner hair cells are automatically activated. However, the processing of sound does not stop here. Sound processing enters the central nervous system where it is processed by the brainstem and auditory cortex (bottom-up processing) and is mediated by higher-level factors such as attention, cognition, and previous experience with sound (top-down processing). Thus, the auditory brainstem and brain are highly influenced by maturation, the environment, and any alterations anywhere along the auditory pathway (from the hearing loss in the cochlea to brain injuries). Specifically, the auditory brain is “plastic” and any change in the brain can either be beneficial or harmful thus having important implications for people with hearing loss. A final important consideration about the auditory system is that it is a binaural system and it works optimally when there is a clear, unaltered signal in both ears!

Hearing Loss is More Than Just Loss of Audibility
Most people seem to appreciate that people with hearing loss need sound to be louder. If damage to the cochlea is restricted to the outer hair cells or if something is blocking sounds from reaching the cochlea, then most hearing aids are perfectly sufficient to restore loudness. However, hearing is much more complex than we realize which can lead to a number of other functional difficulties. When the inner hair cells are damaged, in addition to outer hair cell damage, hearing difficulties are compounded. When inner hair cells are damaged, the neural signals to the hearing nerve and to the brain become progressively distorted as the severity of hearing loss gets worse. Specifically, people with inner hair cell damage experience a loss of clarity (or crispness) of speech sounds. Behaviorally, they may complain that sounds are muffled. They may miss subtle differences between similar words, they may not hear consonants, they may be unable to separate speech from background noise, they may unable to tell where a sound is coming, and so forth. These difficulties are often related to poorer frequency discrimination, poorer temporal (time) discrimination, and the loss of any binaural advantages (i.e., input to both ears). The most obvious benefits to hearing with both ears is 1) two ears produces a perceptual “doubling” of loudness compared to one ear, 2) the brain relies on input from both ears to localize sounds, and 3) hearing in noise is much better with two ears due to spatial separation cues (since the speaker and background noise are often in different locations). Secondary to hearing loss caused by a damaged auditory system are the issues of increased likelihood of listening fatigue, possible tinnitus (ringing in the ears), and balance issues (another inner ear structure). These secondary issues may also need to be taken into account when planning recommendations for students with hearing loss.
Understanding the Audiogram (and its Limitations)

Terms such as sensorineural hearing loss, conductive hearing loss, and mild and profound hearing losses are often familiar to service providers who work with students with hearing loss. Less familiar to service providers are how to adequately interpret an audiogram and how to use associated information such as speech recognition thresholds (SRT), word recognition (WR) scores, tympanometry, and acoustic reflexes (AR). Information that could be gleaned only from an audiogram is explained here in this section, but other tests and their results will be discussed in section “Familiarization with Audiology Services”.

The audiogram is a graph used to plot the softest level of sounds across a range of pitches (Figure 1). The stimuli used are typically pure tones or modulating tones produced by an audiometer. From the top of the graph to the bottom, intensity levels (loudness) increase from about -10 dB HL to about 110 dB HL. From the left of the graph to the right, frequencies (or pitch) increases from 125 Hz to 8000 Hz, more or less representative of the range of sounds associated with speech. For adults, normal hearing is defined as any threshold that is 25 dB HL or softer at all tested frequencies on the audiogram. Young adults with normal hearing are expected have on average a threshold of 0 dB HL across frequencies. When thresholds exceed 25 dB HL (i.e., indication of hearing loss), it is common practice to take the air-conduction pure tone average (PTA) of the thresholds at 500, 1000, and 2000 Hz to determine the degree (or severity) of hearing loss. The ranges for different degrees of hearing loss are as follows: Mild for PTAs between 26 and 40 dB HL; moderate between 41 and 55 dB HL; moderately-severe between 56 and 70 dB HL; severe between 71 and 90 dB HL; and profound 91 dB HL and greater. Additionally, it is also helpful to note the shape (or configuration) of the thresholds for more telling information. In particular, you might see that hearing is better in the lower frequencies compared to the higher frequencies (a common configuration of hearing loss).

![Figure 1. Threshold audiogram with speech sounds (shaded area showing average conversational speech range)](image-url)
Right and left ear air-conduction thresholds are plotted as “O” and “X”, respectively. Air-conduction testing occurs through the use of headphones or earphones. Right and left bone-conduction thresholds are plotted using “<” and “>” or “[” and “]”, respectively. Bone-conduction testing occurs through a bone vibrator placed on the skull behind the ear, and the vibration bypasses the ear canal and middle ear and directly stimulates the cochlea. In cases where there are large air-conduction threshold differences between ears, you will see the “[” and “]” symbols used to denote that a masking noise was put into the “better ear” while testing the “poorer ear”. Based on this information, a sensorineural hearing loss (SNHL) is determined when both air- and bone-conduction thresholds overlap each other on the audiogram; a conductive hearing loss (CHL) is when air-conduction thresholds are greater than 25 dB HL at any frequency while the corresponding bone-conduction threshold is at least 10 dB better (called an air-bone gap) and within the normal range; and finally, a mixed hearing loss is one when both a SNHL and CHL occurs, the thresholds of which both are greater than 25 dB HL. The configuration of thresholds for a right ear, high-frequency SNHL is shown in Figure 1.

When interpreting the results of an audiogram, it is often helpful to visualize what parts of speech or everyday sounds are too soft or inaudible (see Figure 1 for example). When using audiograms, the reader should be aware of at least three things: 1) speech sounds actually vary quite widely in intensity and have energy at more than just the one frequency depicted; 2) audiograms do not indicate which hearing functions are likely to be affected; and 3) audiograms should be used only as one aspect in the interpretation of what a student with hearing loss may need. It is at this juncture that we alert the reader that there is more to be gathered than just the audiogram alone!

**Hearing Instruments: Not Just Hearing Aids**

**Analog and Digital Hearing Aids**

There has been a boom of hearing instrument technology in just the last decade. Not only are we dealing with hearing aids and cochlear implants, but there are also lesser known technologies that remain on the market for specific types of hearing loss. One of the biggest changes in hearing instrument technology has been the shift from analog hearing aids with turn-screws for changing the gain and tone to highly sophisticated digital hearing aids that are programmed by computer with various “listening” programs that are mathematically manipulated by the hearing aid’s internal computer chip. Some of the features worth mentioning in digital hearing aids include directional microphones, noise reduction, and feedback management. Directional microphones involve the use of two microphones (one in the front and the other in the back) and anything that is “common” between the two is cancelled out (though never entirely). Anything that is not “common” is amplified. This may be especially helpful when listening to an instructor at the front of a room in a noisy classroom. Noise reduction is a strategy of the hearing aid to reduce background noise (which tends to be lower in frequency) while amplifying speech sounds (particularly higher frequency sounds). Although research does not show an improvement in speech understanding with noise reduction, it does improve listening comfort. Finally, feedback management involves suppressing any “squealing” or “hearing aid feedback” coming from the hearing aid. In the past, when a hearing aid was squealing, we would turn the volume control down. However, this reduces the audibility of sounds and makes it more difficult to understand. With digital feedback management, the hearing aid suppresses the feedback on its own while minimally adjusting the volume. Another big change is that older hearing aids (analog or digitally-programmable analog) had manual switches (Off, Microphone, or Telephone) and now we may see hearing aids with buttons to change between listening programs, including the use of a telephone. Despite all of these innovative developments, no hearing aid is perfect because of some technological constraints, and because the digitally-amplified and manipulated signal still has to travel through a damaged cochlea (recalls outer and inner hair cells).
Frequency Transposition and Bone-Conduction Hearing Aids

Two less common, but beneficial hearing aids worth discussing are frequency transposition hearing aids and bone-conduction hearing aids. Frequency transposition hearing aids were designed for people with residual low frequency hearing and unaidable mid to high frequency hearing (due to dead hair cell regions). These hearing losses tend to be called “rapidly-sloping” or “precipitous” due to their steep audiogram configurations. Functionally, these people may be unable to detect high frequency sounds even with regular hearing aids (see Figure 2A). A frequency transposition hearing aid not only amplifies sounds, but it also “transposes” high frequency sounds to a lower frequency region where the better hearing is. The result is that any high frequency sound that is transposed will have the quality that it is lower in frequency, but is now detected! One participant used a terrific analogy by saying, “Robin’s chirp now sounds like Raven’s caw”). Although the transposed sound will be, in some cases, unnatural, wearers of this technology remark at how they can now hear high frequency speech sounds and birds chirping; however, research does not currently indicate that it provides significant speech understanding improvement. Bone-conduction hearing aids, as the name suggests, are for people who have chronic, medically-unresolved conductive hearing losses. Either of these two lesser-known hearing aids can be used with assistive listening devices as would be expected for most other hearing aids.

Figure 2. A. Precipitous hearing loss showing the amplified (arrows) conversational speech range (compare to Figure 1). Notice that high frequency sounds are completely missed even when speech is amplified. B. The conversational speech range is not only amplified (arrow), but also transposed (arrows) where the person’s residual hearing is.

Implantable Hearing Devices

Cochlear implants have clearly penetrated mainstream culture and it has been said that there are over 100,000 people worldwide with this amazing technology. Fundamentally, cochlear implants are used when people with hearing loss have little to no residual hearing remaining, and both speech understanding and/or environmental awareness is not satisfied with even the most powerful hearing aids. In contrast to hearing aids, cochlear implants do not amplify sounds, but rather provide direct electrical stimulation to the hearing nerve. Although cochlear implants have the ability to improve thresholds for many users, the functional outcomes between users varies significantly, which are due to history of hearing loss, age at onset, prior hearing aid use, prior communication abilities, and status of entire auditory system, to name a few. Therefore, we should avoid the assumption that all cochlear implant users will have the same benefit. While cochlear
implants have been around for several decades, there are some recent trends that have been developing that are worth discussing. More and more we are seeing people with two cochlear implants and several research studies have shown benefit of two over one. Hybrid cochlear implants—part cochlear implant for high frequencies and part hearing aid for low frequencies—are also being studied. Finally, there seems to be some benefit for cochlear implant users who take a bimodal approach by continuing to use their hearing aid in their non-implant ear. The bimodal approach may not be acceptable if the extent of the damage in the non-implant ear is so severe that there is simply too much distortion.

**Sound and Setting**

The above information helps to clarify how the hearing mechanism functions with or without technology, but it does not explain human behavior. There is a great deal of variability in how individuals respond to hearing loss. They may be able to communicate well in some situations but experience a great deal of difficulty in others. Lacking other information, service providers may hold a number of misconceptions or beliefs: (1) the label “hard of hearing” indicates the individual does not have a serious impairment, (2) people who can hear well enough to make a phone call would not qualify for an accommodation, (3) a classroom accommodation would not be necessary if one is not needed in the intake or application interview, (4) clear speech indicates that the person does not have a severe hearing loss, (5) people who speechread do not need additional assistance, and 6) hearing aids provide satisfactory access. Let’s look more closely at some of the other factors involved in successful communication.

First, what type of communication is taking place? Does it involve an informal conversation with a known individual, group participation, or lecture? In an intake interview, for example, the counselor is usually using his or her best listening skills and maintaining eye contact. This gives the listener full access to the speaker’s face. Facial expressions and body language greatly facilitate understanding. In a lecture in school or a training or meeting at work, there is usually much less give and take in the conversation. There is limited eye contact and minimal opportunity for response or feedback; it is less likely to occur in an optimal listening environment; and at the same time, the listener is held completely responsible for the information presented.

A major listening challenge for individuals with hearing loss, though, is group discussion. It is important to appraise the variety of information a person with normal hearing picks up auditorially to understand why this is a challenge. In a large group of people, we are able to locate the direction a sound is coming from, whether the speaker is male or female, and identify whether the speaker is a child or adult. We might even recognize the voice so we know who we are looking for. These differentiations will be blurred for the individual with a hearing loss. With normal hearing, we also glean other information that may help us socially. The person may have an accent that we could comment on, may speak passionately about the topic, or may come across as insecure or even condescending. We also hear grammatical information and cues about when to interrupt or ask a question. Without these cues we can easily make a social misstep which others might misattribute as rude or socially inept behavior.

With few exceptions, there is little argument that in academic, employment, and social settings, hearing and understanding speech is vital to our functioning. So how much speech does one need to hear in order to have access to the entire message or to succeed? Hearing 75 or 80% sounds like a lot…but is it enough?

As an example, hearing loss in the higher frequencies is the most common type of loss. In looking at a mapping of common speech sounds by frequency or pitch and decibel (dB) or loudness, it can be seen that even a mild high frequency loss means the individual loses the sounds s, f, t, h, p, k, th,
sh, ch. These are extremely common sounds and provide pluralization and tense information. When these key sounds are missing, the message becomes ambiguous.

In looking at a meaning of common sounds by frequency (dB) or loudness, it can be seen even a mild increase in frequency to mean the individual heard the sound.

The above sentence is the second sentence in the previous paragraph. Only the high frequency sounds listed above have been removed. Even though the reader is reading and not listening, it is easy to see that the individual is not missing a word here or there, but missing sounds in many words. Not counting the list of sounds at the end, 74% of the letters of the original sentence could be heard, but only 37% of the words are left intact. Being able to hear 75% of a message may seem adequate, but functionally it is devastating, especially in a classroom environment.

The final piece to understanding the bigger picture of the challenge of hearing is the issue of background noise. Both hearing aids and cochlear implants use a microphone to collect sound, and neither discriminates perfectly between speech and background noise. In research conducted by Blair (1990), students with normal hearing understood clearly as long as the speech was 6 dB louder than the background noise. Students with hearing loss, though, required speech to be 15-25 dB louder than the background noise. This concept is known as the signal-to-noise ratio.

In addition to a strong signal-to-noise ratio, two other properties of sound impact the listener’s ability to receive sound—distance and reverberation. Distance from the sound source also has a dramatic impact on the ability to hear. Consider that the average speech is about 65dB at 3 feet. At about 4 feet (for example, the first row in a classroom), the intensity drops to about 53dB, and at 16 feet (about the fourth row), the intensity is only 41dB. With or without a hearing aid, it would be beneficial to sit closer to the sound source.

Reverberation is the third characteristic of sound that hearing aids and cochlear implants cannot overcome. Reverberation is the time required for the intensity of a sound to drop 60 dB once it has stopped being produced. The longer the time, the more of an echo, and the muddier sound becomes (see Figure 3). Assistive listening technology can help overcome these problems.

Assistive Listening Devices
Assistive listening devices (ALDs) consist of a microphone, a transmitter and receiver system, and a coupling device, such as headphones. The speaker talks into the microphone. The microphone is
attached to a transmitter, which sends the signal across a limited distance to the user’s receiver. The only sounds being transmitted are those coming through the microphone. The user’s receiver picks up the signal and sends it to the coupling device, such as headphones. There is a volume control on the receiver, so that the user can turn it up or down as needed.

The beauty of ALDs is that they improve the signal-to-noise ratio and eliminate or minimize the effects of distance and reverberation (see Figures 4 and 5).

There are three major transmission systems related to ALDs: FM, infrared, and induction. The personal FM transmitter is about the size of a pager, and has an on-off switch and a jack for a microphone. The instructor plugs in the microphone and clips it close to his or her mouth, turns the transmitter on, and begins speaking. The FM receiver looks very similar and, like other receivers, includes an on-off, volume control, and a jack for headphones or another coupling device. The user wears the receiver to intercept the signals and plugs in headphones or another coupling device to relay the sound from the receiver to the ear (see Figure 6). FM uses radio waves to transmit the signal across the distance, like tuning into a radio station.
Infrared (IR) systems use infrared light to transmit the signals, similar to remote controls for televisions. IR transmitters must be plugged into a power source. Most of them collect sound from an existing public announcement system, although there are home versions that are used with television sets.

The electromagnetic induction loop is the only system that is properly referred to as a “loop.” The system consists of a loop of wire that is powered by an amplifier and a microphone (see Figure 8). The amplifier must be plugged into a power source. The wire loop transmits electromagnetic waves that carry the signal. An area as small as a table or as large as a room can be looped.
If the consumer’s hearing aid has a built-in telecoil, no external receiver is needed. The user would enter the looped area and change his or her hearing aid setting to telecoil mode to pick up sound signals. Unfortunately, hearing aids sold in America are not always fitted with telecoils, and only recently have they been built in to cochlear implants. In order for those without hearing aids (or those without telecoils) to use the system, an induction receiver must be used. These receivers, actually a telecoil in a box, look like the FM receivers described above and headphones can be plugged into them to transmit the sound to the ear.

**Figure 9. Oval Window (left) and Univox (right) induction listening systems.**

**Coupling Devices**

Headphones and earbuds are the most commonly used devices to transmit sound from the receiver to the ear. If the individual does not have hearing aids or if the hearing aids do not have telecoils, the user is limited to acoustic methods such as headphones or earbuds. Some users remove their hearing aids to use headphones. This may be because of comfort or because of a problem with feedback (squealing) when covering the hearing aid microphone. This means the consumer loses the benefit of his or her hearing instrument.

If the hearing aids have telecoils, there are two other listening options (see Figure 10) that use induction. One is the neckloop (on the right): A neckloop is a loop of wire that plugs into the receiver in the headphone jack and is worn around the neck. The neckloop gives off a signal (a magnetic field) that is picked up by the telecoil. The neckloop can even be worn under clothing, depending on the strength of telecoil, the thickness of the neckloops, and the severity of the hearing loss. As with the induction loop system, using the neckloop requires that the hearing aid be set to the telecoil mode.

**Figure 10. Silhouette and neckloop coupling devices.**

Silhouettes look like flattened, behind-the-ear (BTE) hearing aids and they hook behind the ear just like a BTE hearing aid. They will work with either BTE or in-the-ear hearing aids that are fitted with telecoils. Because they are closer to the hearing aid than a neckloop, they provide a stronger signal for more severe losses. Using the telecoil further reduces room noise because the hearing aid microphone can be turned off when the hearing aid telecoil is activated. Now the only sound being
picked up is what is coming across the system’s microphone. With the hearing aid microphone off, it cannot receive room noise or anything that is not said into the ALD microphone.

Direct audio input (DAI) is an option on some models of behind-the-ear (BTE) hearing aids that allows an external audio source to be plugged directly into the aid (see Figure 11) via a patch cord. It is also how external microphones and assistive listening devices are coupled to both behind-the-ear cochlear implants and older models with body worn processors.

![Figure 11. Direct Audio Input components.](image)

This brief overview cannot include all of the options available. New options, such as Bluetooth compatible neckloops, have become available since this workshop was presented. For more detailed information, see the full publication *Demystifying Hearing Assistance Technology*.

**Familiarization with Audiology Services**

Audiologists are state-licensed professionals (most states require licensure) with Masters- or doctoral-level degrees. The scope of audiology practice is broad, which, in addition to testing all aspects of hearing and fitting hearing devices, also includes balance function assessment, counseling, tinnitus and hyperacusis testing and therapy, and intra-operative monitoring alongside surgeons. For the purposes of this discussion, we will focus on audiology services common to students in post-secondary settings.

**Comprehensive Hearing Evaluation**

The typical comprehensive hearing evaluation involves the taking of a case history, otoscopic inspection, pure tone threshold testing, speech recognition threshold testing, and word recognition testing. As needed, audiologists may conduct tympanometry, acoustic reflex testing, otoacoustic emission testing, or evoked potential testing. It is important that we understand that the tests that make up an audiologist’s test battery should be driven by complaints, inconsistencies, and any potential “red flags”. Audiologists, as well as third party payers, are discouraged from using a test battery approach that includes the same tests on every patient. Table 1 shows a description for each procedure or test included in a hearing evaluation.

Once the comprehensive hearing evaluation is completed, the audiologist will often summarize the case history, interpret the results of the evaluation, and make formal recommendations based on the reported hearing complaints. The recommendations may include, for example:

- A referral to see a physician for any medically suspicious findings for the cause of hearing loss, or any sudden, unexpected changes in hearing loss (possible follow-up hearing evaluation may be required)
- A return visit to talk about new or updated hearing devices (both of which may require multiple visits for selection, fitting, and fine-tuning adjustments)
- A referral to see another specialist for related issues (speech-language therapy, psychological adjustment counseling, balance function assessment, etc)
- Educationally- or vocationally-appropriate suggestions or resources to assist the student

Table 1.

<table>
<thead>
<tr>
<th>Procedure or Test</th>
<th>Description</th>
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<tbody>
<tr>
<td>case history</td>
<td>Detailed report of hearing complaints, past and current medical history, and familial history of hearing loss.</td>
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<tr>
<td>otoscopic inspection</td>
<td>Visual inspection of the outer ear and behind outer ear, and otoscopic inspection in the ear canal and ear drum.</td>
</tr>
<tr>
<td>pure tone threshold</td>
<td>Air- and bone-conduction testing seeking the softest sound that can be detected across a broad frequency range. Pure tone average (PTA) can be calculated from air-conduction results at 500, 1000, and 2000 Hz. The PTA should closely match the SRT. The lower the PTA, the better the hearing.</td>
</tr>
<tr>
<td>speech recognition threshold (SRT)</td>
<td>Bisyllable words are presented seeking the softest level at which words can still be understood. The SRT should closely match the PTA. The lower the SRT, the better the hearing.</td>
</tr>
<tr>
<td>word recognition (WR)</td>
<td>A fixed list of monosyllable words presented and the WR score is the total number correct in percent. The higher the WR score, the better the hearing.*</td>
</tr>
<tr>
<td>tympanometry</td>
<td>Assesses the function/health of the ear drum and middle ear through sound pressure. Helps to confirm conduction hearing losses. No behavioral response required from the patient.</td>
</tr>
<tr>
<td>acoustic reflexes</td>
<td>Assesses the function/health of the hearing nerve, lower brainstem, facial nerve, and the Stapedius muscle in the middle ear. Helps to rule out neurologic lesions. No behavioral response is required.</td>
</tr>
<tr>
<td>otoacoustic emissions (OAEs)</td>
<td>Assesses the function/health of the outer hair cells in the cochlea. Outer hair cells should naturally amplify sound sounds. Lack of OAEs suggests outer hair cell damage at least a moderate hearing loss or conductive hearing loss. No behavioral response is required.</td>
</tr>
<tr>
<td>evoked potentials</td>
<td>Assesses the neural function/health of the cochlea, hearing nerve, and most auditory brainstem structures non-invasively using electrodes placed on the skin. Helps to rule out auditory neuropathy/dys-synchrony and tumors on the hearing nerve or brainstem, or helps to confirm severer hearing losses. No behavioral response is required.</td>
</tr>
</tbody>
</table>

* It is not appropriate to subtract the WR score from 100% to estimate the amount of hearing loss (e.g., If the WR score is 74%, is not appropriate to say that one has a 26% hearing loss.)
Some Audiology Service Caveats
Most audiologists are involved in the practice of providing comprehensive hearing evaluations and providing hearing aid services, but they may not be routinely involved in the distribution of assistive technology, particularly assistive listening devices. There seems to be an assumption on the part of both audiologists and their patients that assistive technology may not be needed above and beyond a set of hearing aids, a loud television, or a loud telephone. While some assistive technology can be cumbersome and cost-prohibitive, the reality is that people with hearing loss are often unaware of such technology. For that reason alone, it is imperative that audiologists discuss these additional and often beneficial technologies. In keeping with this important role, audiologists also need to anticipate the circumstances in their patient’s educational, professional, or personal lives where hearing aids may simply not be enough. By not keeping assistive technology in mind, audiologists may fail to come up with creative solutions for attaching hearing aids to amplified stethoscopes, listening headsets offered at movie theaters or shows, or even personal music devices (CD and digital mp3 players).

Documentation Issues
It is common for audiologists to provide updated hearing evaluation reports that only include the results of most necessary tests, such as a otoscopy, air-conduction pure tone threshold check, and speech recognition threshold check. The reason for this is that some audiologists have had the luxury of working with the same patients over several years. When patients do not report any significant changes, fewer tests may be conducted than might otherwise be considered for a new patient. Echoing an earlier statement, we must be specific about what we need from the audiologist.

When the audiologist does not (or is not able to) provide some thoughts about functional impact of hearing loss with and/or without hearing technologies, there are some practical and informal ways to assess this using available scales of communication function. These include the Client Oriented Scale of Improvement (COSI; Dillion, James, & Ginis, 1997), and the Hearing Handicap Inventory for Adults (HHIA; Newman, Weinstein, Jacobson, & Hug, 1991).

The previous sections have hinted at the need for a greater level of understanding of the functional impact of hearing loss caused by various anatomical and/or physiologic pathologies of the auditory system, strengths and limitations of the audiogram (the graph only), the various benefits and caveats of hearing technology, considerations involved in assistive listening technology, and the role of audiologists. Simply put, this is a lot of information one has to have a good grasp of. Rather than burdening any one professional with the collective task of figuring out what a single student with hearing loss needs, perhaps we need to open the lines of communication by being more specific about what we need from each other. With appropriate signed release for information for example, if we ask for an “audiogram” from an audiologist to document hearing loss, it is possible that the audiologist may send or fax a single piece of paper that contains the name of the student, the name of the audiologist who conducted the test, the date of testing, and all the results of the comprehensive hearing evaluation with a bunch of symbols, letters, and numbers. Unfortunately, the service provider working with the student will then have to decipher the information from that one piece of paper in order to formulate some goals and needs. Rather than taking this approach, service providers could be more specific about what they need. We suggest that service providers ask not only for the results of the comprehensive hearing evaluation, but to also request a brief case summary, a lay interpretation of the hearing evaluation, some conclusions about the functional impact of hearing loss, and make formal recommendations. Even more important is the need for the audiologist to make some judgments about any technologies the student is currently using. This will help to determine if new or updated hearing technologies are in necessary, and it will help determine if current or future technologies are compatibility with a service provider’s existing resources.
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