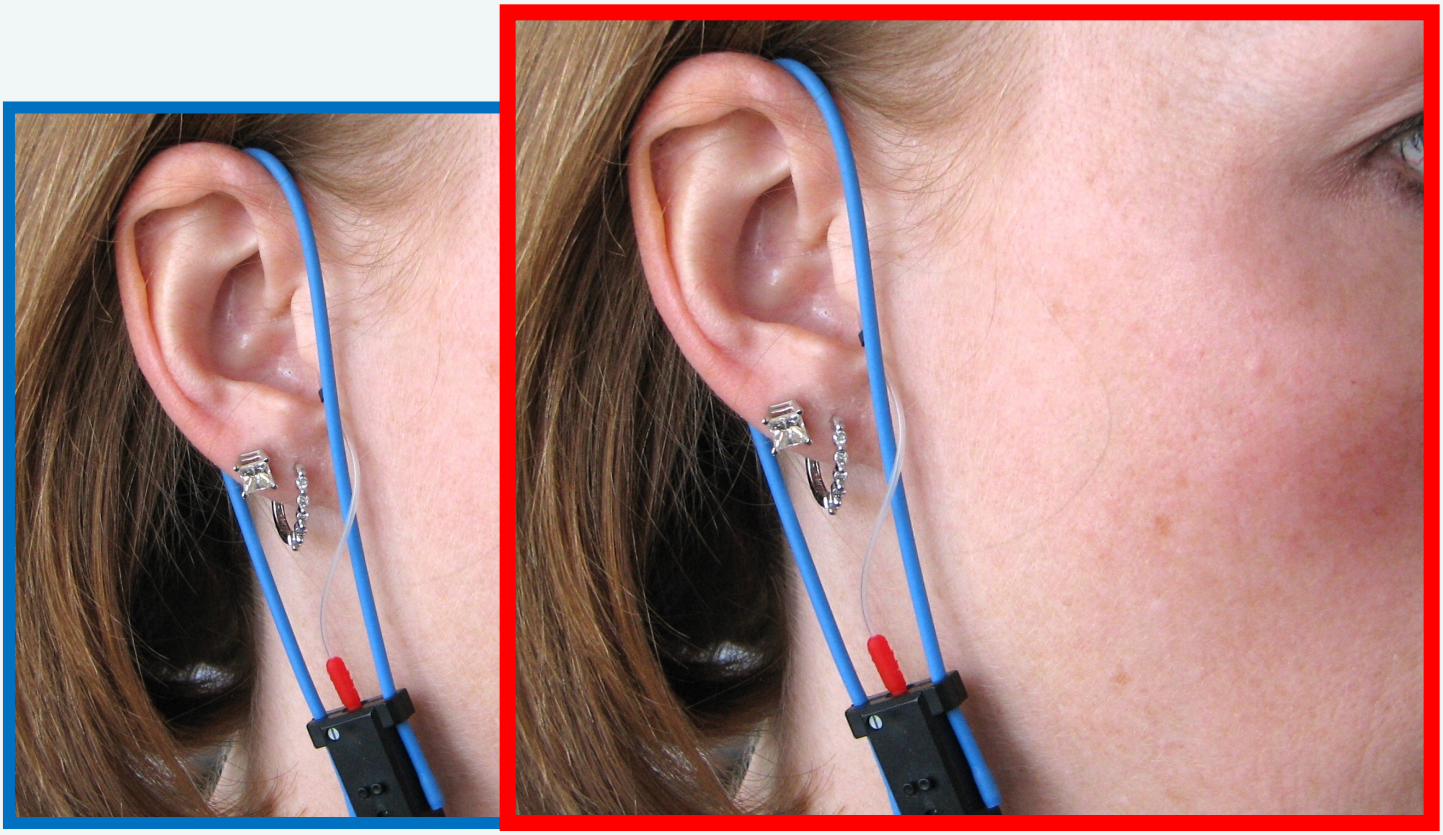
Hearing Aid Help

3rd edition

FOR SOON-TO-BE, NEW, OR EXPERIENCED HEARING AID WEARERS AND THEIR FAMILIES.



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Introduction

Our most important sense for communication

The purpose the first edition of this book was to help the hearing aid user, or soon-to-be hearing aid user, understand more about hearing aids. The simple idea being that the better you understand how hearing aids are fit, how they work, and how to keep them working, the better your chances of succeeding with hearing aids. That is also the purpose of this third edition.

Since the first edition of this book, a hearing aid has been manufactured that provides "better than normal hearing". We'll explain why this is both true and false.

There are approximately 35 million people in the United States (11.3% of the population) with impaired hearing. A staggering number but just as staggering is that only 28.5% of those 35 million hearing impaired people use hearing aids. Why don't more hearing impaired individuals use hearing aids? Some of the reasons probably include:

- They have been told by their doctor, perhaps 20 years ago, that hearing aids would not help.
- Their neighbor had a bad experience with hearing aids.
- They tried hearing aids but did not succeed.
- They think that they hear ok, or deny impaired hearing.
- The cost of hearing aids.

Lost in the above reasons is that most hearing aid fittings work, and work very well. The vast majority of folks who get a proper hearing test and properly done hearing aid fitting wear their hearing aids all day. We want you in that majority.

Most people getting hearing aids just want it simple: to put the aids in and go about their business with better hearing. That is our goal too, but hearing aids do not usually, even if fit perfectly, give perfect hearing. And fitting hearing aids is a multi-step process that can be poorly done.

Why do hearing aid fittings sometimes fail? The following should not happen but sometimes does:

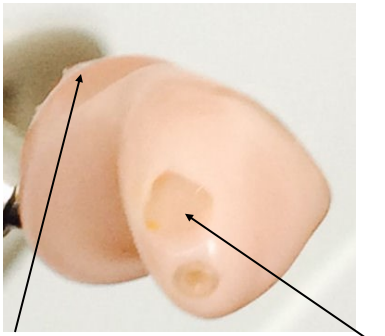
- The aid does not physically fit the ear comfortably.
- The venting of the aid is incorrect.
- The hearing aid characteristics are based on a faulty diagnosis or incorrect hearing evaluation.
- The hearing aid characteristics are incorrectly adjusted, even though the hearing evaluation is accurate.
- The wearer is not using the aid properly.
- The aid keeps breaking.
- The wearer does not want to hear differently or to be encumbered by a hearing aid.

A vent is an opening through the hearing aid. Typically it is a hole, or channel, running from the most inside portion of the aid to the outside of the hearing aid. In general, the better someone's hearing the larger the vent should be, and the worse someone's hearing the smaller the vent. Someone with a severe hearing loss, for example, may not have a vent at all.

This book is intended to steer you through the process of getting good results from hearing aids . We want you to succeed with hearing aids. So what goes into a successful hearing aid fitting?

- The hearing aid produces the correct sound at your eardrum for your hearing impairment.
- The hearing aid is comfortable to wear 18 hours a day.
- The wearer or wearer's helpers are able to insert the aid into the ear correctly and can tell when the battery needs changing.

Before we look at some of the details for achieving this, we will share with you a list of important points about hearing aids.



This hole connected to this hole.
A vent.

A List of Some Important Points

" Ah—Silence"
A severely hearing impaired person after removing an unwanted hearing aid

- Step #1 is to get a thorough evaluation of your hearing. This is not a screening test, not often a free test, and certainly not a test you take over the internet through your computer. Hearing test result accuracy is vital to how well you will hear with hearing aids. Just as important, you need a correct diagnosis. You may have the type of hearing impairment for which hearing aids are the only way to help, but you need professionally checked to be sure. Your ear should be checked for wax (cerumen), infection, tinnitus needs addressed, etc.

- Step #2 is to see someone who knows and fits hearing aids. The person you see in step #2 may be the same person you see for step #1, but it will not be your neighbor, family doctor, or someone who does not know hearing, hearing aids, and how to couple one to the other.

- If you are unsure if hearing aids are for you, the most important consideration is your desire and need to hear better.

Some hearing aids can be programmed to automatically increase the gain (volume) over a period of time. This allows the audiologist to set the initial hearing aid gain a little low so that the new wearer is not over-whelmed, and can get used to hearing in a new way, and even get used to hearing sounds they may not have heard for a while. After a month or so, the gain automatically increases to a more optimal setting for best hearing.

- Hearing aids can, and do, break.

- If possible, get your hearing aids locally, just as you would your dentures or glasses. Hearing aids obtained through the mail rarely work optimally for any given individual, and traveling 100 miles when you have a hearing aid problem or need service, is not ideal for many people.

- A person with one ear (one hearing aid) does not hear as well as someone with two ears (hearing aids for both ears). Monaural = one ear; binaural = two ears.

- Do not wear your hearing aids while using hair spray. It can clog up the microphone.

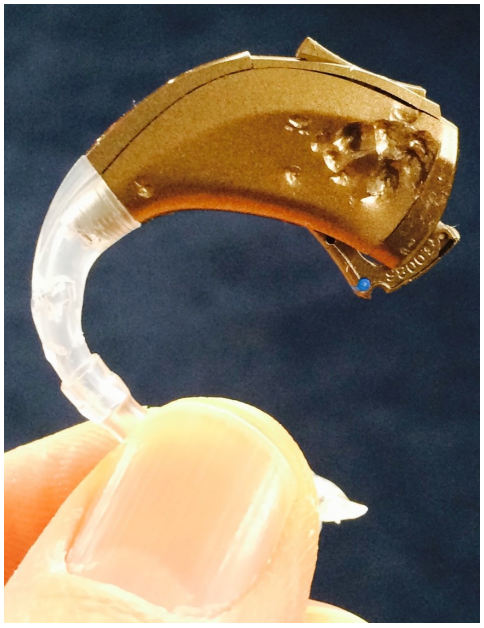
- The state of the science in fitting hearing aids is to verify that fitting with validated real-ear, probe-microphone measures, where a microphone is placed in your ear canal to measure the performance of the hearing aid at your eardrum and then compared back to the results of Step #1 (the hearing test results).

- If your family says you need them, you probably do.

- Hearing everything, or hearing more than what you heard without hearing aids, can take some getting used to. It takes some people up to six weeks to acclimate to their hearing aids.

- Your voice will sound different to you.

- Dogs like hearing aids. They like to bite them.



Step #1—Before You Get Hearing Aids

Impaired hearing reduces background noise

Think Hearing, not Hearing Aids

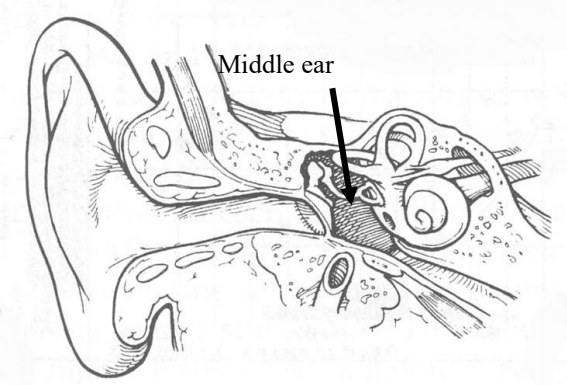
Step #1 is to get a thorough evaluation of your ears and hearing. Hearing is the most complex sense of the body. The outer ear collects sound that is traveling through the air, converts that sound to mechanical vibrations in the middle ear, converts that mechanical energy to hydraulic energy within the inner ear, and the inner ear amplifies and filters that hydraulic energy, converting it to electrical information that the brain can understand. One shouldn't assume that you don't hear well because you are elder or worked in noise. One shouldn't assume that all you need to do is find the best hearing aid and you will hear perfect. Hearing is complex…

- The ear is contained within the temporal bone, the densest bone of the body—if your spouse says you're hard-headed, say 'thank you'.
- Your ear contains the 3 smallest bones in the body. The smallest of these is the stapes.
- It also contains the smallest muscle in the body, the stapedius.
- It is the only organ to contain 2 senses, hearing and balance.
- The cochlea is the hearing part of the inner ear and contains roughly 18,000 sensory cells, about 3000 inner hair cells and 15,000 outer hair cells. The outer hair cells are the only sensory cell in the body that can move/vibrate using their own energy.
- These 18,000 sensory cells within one ear communicate with approximately 30,000 nerve fibers of the VIIIth cranial nerve.
- The hearing nerve is the only nerve that twists around on itself.
- The outer ear is somewhat like a collector and resonator. It collects sound, giving preference to sound coming from in front of you and, in adults, resonates (amplifies) it in the 2000-3000 Hz range. Guess what frequency range is most important for understanding

Solar panels are amazing because of their ability to convert solar energy, sunlight, into electrical energy. Consider, however, the ear. It converts acoustic energy into mechanical energy, then into hydraulic energy and then into chemo-electric energy.

speech?

- Sound in air does not easily transfer its energy to fluid. Since the cochlea is fluid filled, it needs the middle ear to amplify air conducted sound in a manner that will move the cochlear fluids. The middle ear is an impedance matching mechanism designed to do this.



- The middle ear is an air-filled cavity that ordinarily is closed off so that body sounds, including your voice, are not louder than outside sounds.

- The Eustachian tube of the middle ear opens when you swallow so that air pressure is equalized: the middle ear works best when its air pressure is the same as the outside air pressure. This is why you hear a little better when, as you are changing elevation, your ears "pop". That pop is the sound you get from the middle ear air pressure equalizing.

- The cochlea contains 3 fluids: endolymph which is high in potassium and low in sodium, perilymph which is high in sodium and low in potassium, and cortilymph which is similar to perilymph. These different sodium/potassium balances form an electrical battery that help the cochlea work.

- The cochlea has fine capillary beds, much like the kidney, because it uses a lot of oxygen and other nutrients. We are not sure why you do not ordinarily hear blood pulsing through your ear.

- The tympanic membrane, what most call the eardrum, has the look of plastic wrap (used in food storage) and the texture of wax paper.

When you have your hearing evaluated, the doctor will obtain a history regarding your past of noise exposure and ear disease, he/she will inspect your ears with an otoscope checking specifically for the condition of the skin of your ear canal, for the presence of excessive cerumen (earwax), and the appearance your tympanic membrane (eardrum). You may have a tympanogram which is a test that checks for fluid behind your tympanic membrane and the air pressure within the middle ear.

Otoacoustic emissions are sounds produced by the inner ear (this would be analogous to the eyes actually producing light). A microphone can be placed in the external canal and these emissions measured. This is that basis of one method for screening the hearing of newborns.

The middle ear is an air filled space that contains the 3 smallest bones in the body. It is the part of your ear that you may feel 'pop' when you change elevation.

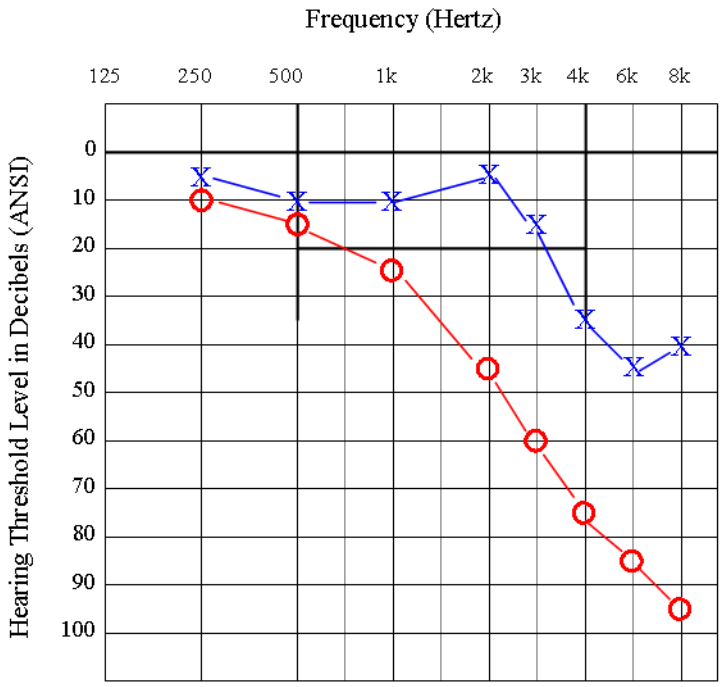
You will have air and bone conduction threshold testing to see how softly you can hear tones of various frequencies, and you will have a speech discrimination test that gives a rough estimate of how well your auditory system handles speech. Comparison of air conduction thresholds to bone conduction thresholds aids in the diagnosis of the part of your ear that is causing hearing loss.

Hz = Hertz, a measure of sound frequency. This used to be called cycles per second. You hear changes in frequency as changes in pitch.

dB = decibel, a measure of sound level (loudness level). There are various types of decibels. When talking about a hearing test (audiogram), the decibel references normal human hearing (0 dB).

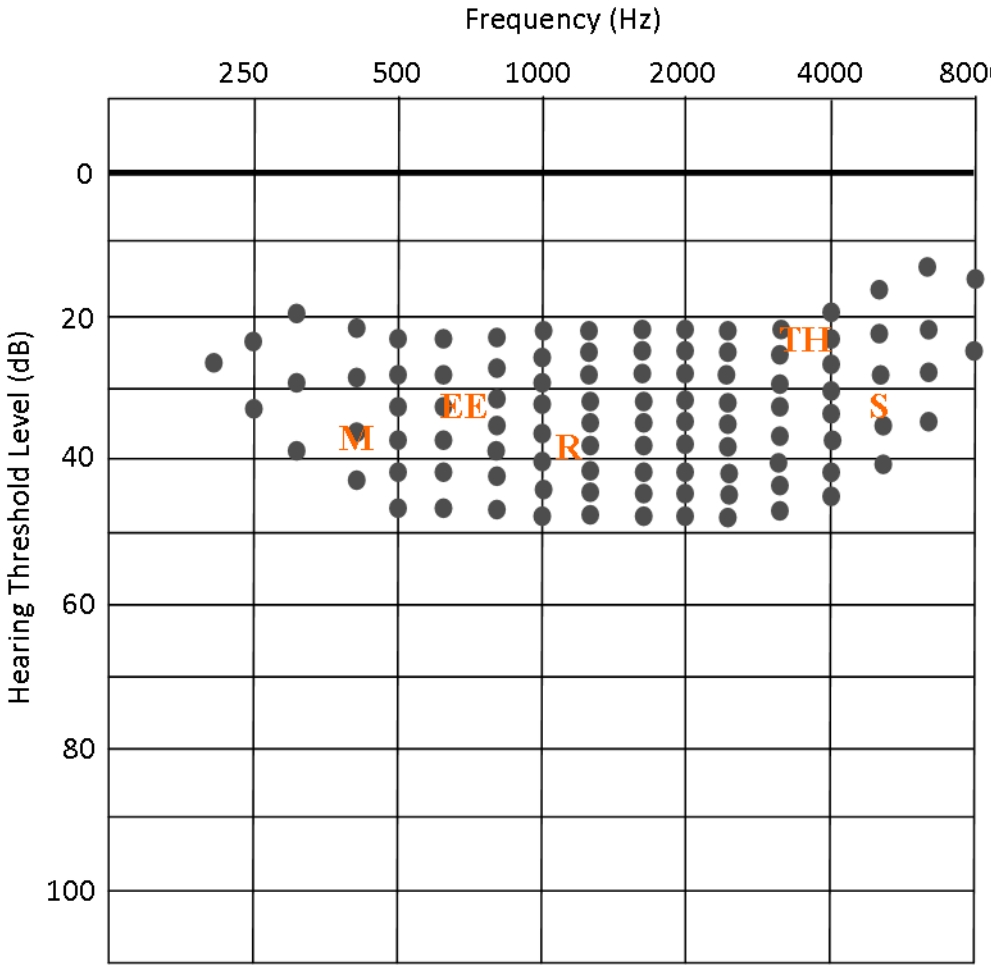
Air conduction refers to sound entering the ear through air and external ear, as it does in the real world. Bone conduction is sound that is transferred (conducted) to the inner ear via bone. This is usually done with a bone vibrator placed on the forehead or on the mastoid bone behind the outer ear.

The most common way of depicting these results is an audiogram as shown here. It shows air conduction thresholds for the right ear, depicted as circles, and for the left, depicted at X's.



Along the left hand side of the audiogram is the sound level, or loudness, of the tone. This is easy to understand; 0 dB (at the top) is extremely soft, 100 dB (near the bottom) is loud.

Along the top of the audiogram is represented frequency. Frequency is very important to how hearing aids work and often explains why some people say:



I Hear OK, I Just Don't Understand What is Said

You hear changes in frequency as changes in pitch. A low frequency sound, 125 Hz for example, is heard as a low pitch or bass tone (think tuba). A high frequency sound like 8000 Hz is heard as a high pitch or treble sound (think of a 'squeak').

Some speech sounds are predominantly low frequency, like the sound "M", while others are high frequency, like the sound "S".

Notice two things on the above figure. There are 100 dots representing where speech energy

falls on the audiogram. This is sometimes called the speech banana because of its shape. We put some speech sounds on the audiogram to give you an idea that different speech sounds have different frequencies.

I _an hea_ _ine.

With most hearing impairments, there are some frequencies that are not heard normally and, therefore, some speech sounds that are not heard normally. The above example (I can hear fine) might be what a hearing impaired person hears. They hear the person talking but may not understand what that person is saying. With a little thought, they might figure out what is said, even though there were "holes" in the words.

Speech is comprised of many frequencies and if you can hear all of those frequencies normally, you hear the entire speech spectrum. If you are hearing impaired, it is likely you are hearing only parts of the speech spectrum.

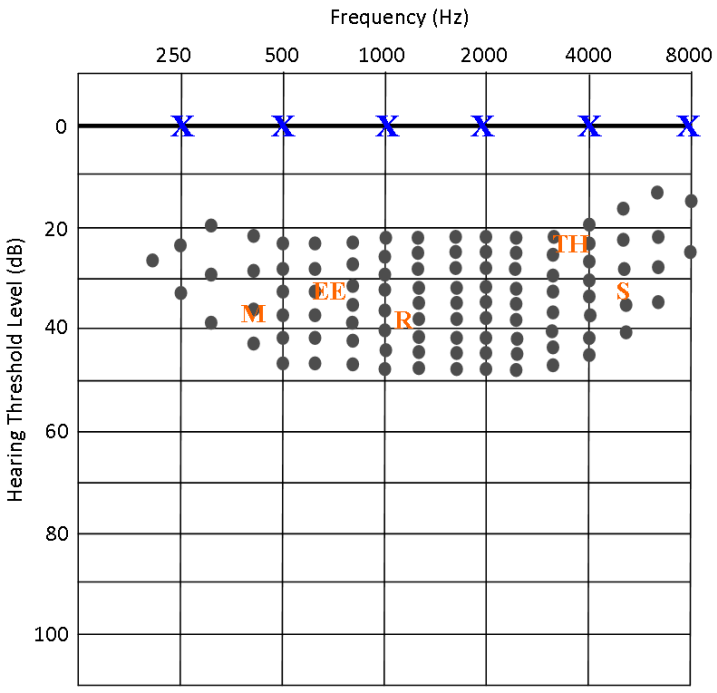
The audiogram shown is often called a pure tone audiogram because the tones used to test your hearing have only one frequency: a pure tone. 1000 Hz (Hertz) is a mid-frequency and in audiometry is one of the tones used test your hearing. In the real world, a given speech sound might be comprised of multiple frequencies of say 250 Hz, 500, and 1000 Hz in combination.

Once a diagnoses is made and it is determined that your hearing impairment is one for which the best solution for is a hearing aid:

Several factors go in to the decision to get hearing aids

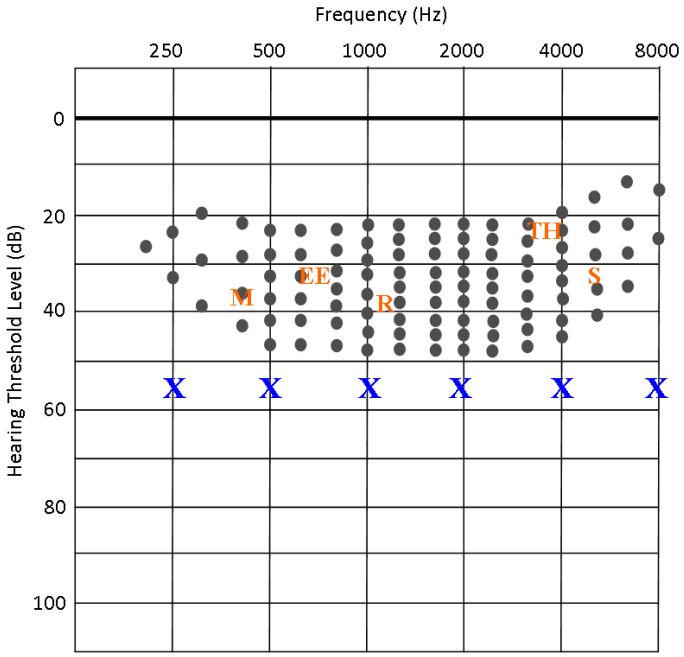
One. The degree of hearing loss as shown on the pure tone audiogram.

In the figure here we have shown a persons pure tone audiogram for the left ear. The blue X's fall on the 0 dB threshold line and all of the 100 dots that represent the speech spectrum exceed the person's threshold. This person would be said to have normal hearing sensitivity and would not, under normal circumstances, be a hearing aid candidate.



In the next figure, the person's thresholds are at 55 dB at all frequencies. None of conversational

speech exceed this person's threshold and so this person does not hear speech unless it is very close to his/her ear or louder than normal. Going by the pure tone audiogram alone, they would be a hearing aid candidate.



Many folks fall between these 2 examples. They hear many of the frequencies ok, but not all. There are methods for measuring how much of the speech spectrum is audible and how much is not. One method is called "count the dots" by Killion and Mueller (2010). The greater the number of dots that are inaudible to the person the higher the indication of hearing aid need. In the first example, the person had 100 dots above his/her thresholds. In the second example, with the person having 55 dB thresholds, they had 0 dots above threshold. There are other factors, however, for the potential hearing aid wearer to consider.

Two. Tinnitus

It can be pronounced either "ti-night'-us" or "tin'-i-tus". This is our three paragraph explanation of what is a textbook-length subject.

Most tinnitus is a phantom sound. The person with tinnitus hears a noise in their ears or head but the sound is nowhere in the environment and only the person with tinnitus hears it. There can actually be a type of tinnitus that can be heard by another person because the patient's body is making a sound, but that's another story.

You may have heard of phantom pain. An example of a phantom pain is where someone had his small finger cut off, but that small finger still hurts or has other sensations. Well, the finger isn't there so it can't hurt, but the nerve pathways associated with the finger are registering pain.

Many cases of tinnitus are similar to phantom pain. There is an initial insult, usually to the hair cells of the inner ear. Hair cells don't register pain, but they do register sound and an insult to them can cause them to produce a sound. The insulted hair cells may have recovered from the initial insult, or they may have died (remember, there are 18,000 of them and missing just a few of these hair cells may not be a problem other than tinnitus), or they have gone to a "status quo" of partial recovery. They are no longer producing that sound that the initial insult caused, but the nerve pathways associated with those hair cells are still registering sound.

We bring tinnitus up here because hearing aids often provide some relief to people who want relief from their tinnitus. So if someone has a hearing loss that might be considered "borderline" for hearing aids, tinnitus might help weight the decision toward getting hearing aids. It ties in with the last thing discussed in this section: how much will hearing aids help.

Roughly 25 million of American adults (about 10 percent) have reported having had tinnitus that occurred for five or more continuous minutes in the past year.

Hearing aids are not the only treatment for tinnitus, but can provide benefit, especially if the person with tinnitus also has enough hearing loss that they are not hearing all frequencies normally. Some hearing aids have tinnitus devices built into them. These devices can produce various types of sounds that many people find helpful.

And just as we encourage you to think first things first when it comes to hearing (Step #1 is a hearing evaluation), don't assume that your tinnitus is the most common type and that a hearing aids are what you need. With tinnitus, as with hearing, Step #1 is a hearing evaluation.

Three. Auditory Deprivation

This can be described as a "use it or lose it" phenomenon. Auditory deprivation refers to the fact that even though we hear with our ears, our central auditory system in the brain is where we perceive sound and its meaning. Just as our muscles can atrophy when not used over a long period of time, our central auditory system's ability to distinguish various sounds becomes less and less if it is not used.

The person that belongs to the previous audiogram, where their thresholds are 55 dB over all frequencies, is hearing very little speech. Without a hearing aid he or she is hearing only a smattering of sound and the hearing mechanism, including the central auditory nervous system, is being used little. This person is likely to suffer auditory deprivation. His or her ability to discriminate speech sounds next year may not be as well as she does this year. Since the part of the central auditory system that deals with speech is not being used, it is going to quit trying. The longer he or she goes not hearing, the longer it will take to get used to hearing again.

We have known clinically for many years that if a youngster is fit with a hearing aid on only the right ear, the left ear will become more and more resistant to being helped with amplification.

Auditory deprivation is probably not a factor in adults with mild hearing loss, but in adults with severe hearing loss it is. The harder it can be to get used to hearing all the sounds of life the

longer one waits to get hearing aids.

Four. Do you want to Hear Better. Is Hearing Impairment a Problem to you.

As you can perhaps tell from the sidebar comments here which point out the advantages of wearing hearing aids, we are pro-hearing aid. However, hearing impairment is personal and situational and you are the one who has to wear the hearing aids, not us.

"Hearing aid use improves adults' health-related quality of life by reducing psychological, social and emotional effects of SNHL [sensorineural hearing loss], an insidious, potentially devastating chronic health condition if left unmanaged.

-Healthy People 2010, 2004

The problem caused by hearing loss often depends on the situation. Those with mild hearing loss can sit and talk face-to-face with you all day and not miss a word. Put them in background noise and they may miss lots of words. A child with mild hearing loss may not hear all that is said from the back of the classroom, especially when the teacher has her back turned. But that mild hearing loss may not be so evident at home.

"Workers with untreated hearing loss are twice as likely to be unemployed compared with those using hearing aids.

-MarkeTrak VIII— 2010

A mildly hearing impaired salesperson who travels to Europe does not want to miss conversation nuances or the difference between 'million' and 'billion'. A retired person who rarely leaves the house may not be bothered, or consider a problem, that same amount of mild hearing loss.

37% of children with only minimal hearing loss fail at least one grade.

Because the family of a hearing impaired person may have a different perspective on when mother's hearing impairment is a problem—because of missed phone calls, unheard doorbells, misheard doctors orders—well-meaning family members reasonably think that if only mother tried hearing aids she would see what she is missing.

Unfortunately, we've not found this to be the case. The hearing impaired person may like silence, they don't want to hear the phone from the other room or they don't want to be encumbered by a hearing aid. If they don't want the hearing aid, wearing one for a trial period usually doesn't change their mind.

There are more formal ways of assessing the amount of disability a hearing impairment is causing, or how much a hearing loss might be bothering someone. Two self-report questionnaires for doing this are the Abbreviated Profile of Hearing Aid Benefit (APHAB) and the Hearing Handicap Inventory for the Elderly (HHIE).

Tying in with this is a test call Acceptable Noise Level (ANL). ANL has to do with a listener's reaction to background noise while listening to speech. This is a test developed at the University of Tennessee by Anna Nabelek and others. It can be a formal test (the ANL test) that is part of your pre-assessment for a hearing aid. But in general terms, it relates a little to how much someone wants "silence", and how much someone wants "plugged-in" to all the sounds around us.

Five. An Expert Opinion

Sometimes the likelihood of your success with hearing aids is not clear. Sometimes a second opinion is warranted. In all instances, a second opinion should not be your neighbor who wears hearing aids in a dresser drawer. It needs to be from someone who know both hearing and hearing aids.

Fitting hearing aids is the most difficult thing that an audiologist does, partially because fitting a hearing aid relies on the other steps leading to fitting hearing aids, such as determining accurate hearing thresholds, diagnosing the site of lesion, determining threshold of discomfort, cleaning the ears and taking impressions of the ear.

It is reasonable for you to rely somewhat on an expert in deciding whether to get hearing aids or not. We are calling someone an expert in hearing aids who actually evaluates hearing and fits hearing aids as a profession. He or she understand both hearing and hearing aids and how to couple hearing aids to an impaired ear, has experience fitting hearing aids, and knows what succeeds and what fails.

Yes, they want to fit hearing aids, but they fail if you fail and they do not want to fail. They want you to succeed. You want someone with a permanent office, not someone who is selling hearing aids from a hotel room or from the internet.

Six. How Much Will Hearing Aids Help

Many people with impaired hearing would like us to describe their hearing impairment in one number; a percentage, as in, you have a 25% hearing loss. We don't measure hearing in this manner and when a hearing professional does give your hearing percentage, he/she is using a method that may be unique to them. Take your audiogram to a different person and he/she will likely give you a different percentage based on the same test.

Just as we do not have a single number way to accurately describe your hearing, we do not have a numeric way, or even a way with words, to completely describe the benefit you will get from hearing aids. And I'm not aware of a way to accurately demonstrate how much hearing aids will help you without first having the hearing aids made, adjusting (programming) the hearing aids for your residual hearing, and then having you actually wear them a while to get used to hearing in a new way.

Unlike glasses and the examination gear the Optometrist uses, our audiometric equipment or a loaner hearing aid cannot sound like the actual hearing aid made for your ear. How that hearing aid physically fits in your ear canal and the amount of air space between the speaker and your eardrum it has to drive, how much it is vented, its frequency response and compression characteristics all have an impact on the sound delivered to your eardrum.

This doesn't mean it may not be worthwhile putting a temporary hearing aid on you in the office, but even if we could duplicate the way your hearing aid would sound to you, you might not like it. It will take your central auditory system -your brain- a while to adjust to hearing in a different way. So we are resigned to trying to describe in numbers or words how much hearing aids will help you.

At the extremes, the answer to this question is easy to communicate. For someone with perfect hearing, hearing aids would not help; they would help "0". For someone with complete deafness (which is rare), standard hearing aids would not help; again "0". It's the people in-between for which we do not have a good way to communicate how much hearing aids will help.

The way that we am going to talk about it here is on an unscientific scale of 0 to 10. We often use a similar scale in other aspects of our practice. With tinnitus, for example, we might ask the person to rate the loudness of his/her tinnitus on a scale from 0 to 10 with 0 being no tinnitus whatsoever, and 10 being the loudest you could imagine. We might also use the same scheme to make sure we understand a person's description of a sound that is too loud. For example, if a person is being bothered by the organ music at church being too loud, is it a 10 (painfully loud), or an 8 (very loud, but ok). How loud is the organ without the hearing aids?

So with benefit from hearing aids we try to make an estimate of benefit for the person. One other test result considered in this unscientific method is the speech discrimination or speech recognition test result. The speech recognition test is usually given by having the patient repeat one-syllable words and then the percentage of correct words is the patient's speech recognition score. For example, if the person was given 25 words and they correctly repeated 24 words, their speech discrimination score would be 96%. If they missed 10 words out of 25, the speech discrimination score would be 60%.

The pure tone test previously discussed deals with the detection, or audibility, of sound. The speech recognition test deals with the recognition or correct identification of words.

So for someone where the entire speech spectrum is not heard, but with a speech recognition score of 84%, benefit from hearing aids should be great and I would tell them that without hearing aids they are hearing at about a '3', but with hearing aids they might hear at about an '8'.

If this persons speech recognition score were 12%, I might have revised my estimate to aided hearing of about '7' in quiet, but '4' in noise (still an improvement over unaided hearing, just not as big an improvement).

The take home lesson here is that we don't have a good way of demonstrating beforehand what hearing aids will sound like to you. Even if an expert tells you that hearing aids will help only a little, a little bit better hearing can mean a lot, perhaps the difference between hearing a "million" or a "billion"; or "no-way" and "maybe".

Even if your speech discrimination score is 0%, it doesn't mean that a hearing aid won't help you.

One reason is that the speech discrimination test is most often given by using single syllable words in isolation. That is useful, but how we listen everyday is to sentences in context. A two syllable word is easier to understand than a one syllable word and a sentence is easier to understand than a two syllable word.

If you don't hear the sentence (the sentence is not audible), you don't have a chance at hearing the sentence. But if the sentence is audible, you have a chance at understanding it even if it is mushy and difficult to understand.

Many years ago, David Pascoe put into perspective the importance of speech detection even in the absence of speech recognition: *Although it is true that the mere detection of a sound does not ensure its recognition, it is even more true that without detection the probabilities of correct identification are greatly diminished.*

There is also something to be said about being in touch with the world through hearing, hearing the melody of speech even if you don't discern the specific speech sounds. Hearing signals, hearing birds sing, etc. is important to many people. Not everyone likes silence.

A real-world example of this is some patients with perfect hearing in one ear, but terrible hearing in the other with a speech discrimination score in the bad ear of 0%, wear hearing aids in the bad ear. If they plug their good ear and try to understand what you are saying, they can't (unless they are watching you). However, they wear the hearing aid because it relieves the sense of "deadness" in the bad ear, it lets them know when someone is talking to them on the bad side, they can hear the intonation (melody) of speech and even recognize voices with the bad ear, and there is something to be said about the bad ear and good ear helping each other.

How can a hearing aid provide better than normal hearing, and does it really?

The shape of our outer ears make them directional. They deflect some of the sound coming from behind, while collecting sound coming from the front and side. Hearing aids can also be

directional.

In 2014 Siemens came out with a hearing aid that is “clinically proven to outperform normal hearing”. Other manufacturers will, no doubt, adapt this technology and by 2016 all manufacturers will offer some variation of it. How does it work?

We have had directional hearing aids for years. These are hearing aids that have 2 microphones and can discern whether sound is coming from the front or coming from the back. In the past, directional hearing aids have emphasized sound coming from the front, since what we are facing is usually the signal of interest, de-emphasizing the sound from the back.

In recent years significant improvements in hearing aid directionality have been made. Hearing aids have been developed that can follow the location of speech and emphasize sound from the back or front or even side. These newest hearing aids that “give better than normal hearing” now have the left and right hearing aids communicating with each other and sharing information about the direction of speech and the direction of noise. In this manner, the directionality of the microphones can be very narrowly focused on the person talking and in many situations give a significant improvement over normal to the ratio of speech sound to that of noise. Speech reception thresholds (SRT) can improve up to 2.9 dB for those with mild to moderate hearing loss wearing this technology compared to normal hearing. As the ad says: better than normal.

What’s the catch? Mrs. “Harris” with auditory neuropathy and 0% speech discrimination scores is never going to hear better than normal. She is still going to rely a lot on lip-reading. Consider also that if a person hears a given background noise without hearing aids, the hearing aids are not going to make that background noise softer (than it is heard without hearing aids).

That doesn’t mean this technology is not going to benefit many people. It just means that there are a lot of people for whom this technology cannot make them hear better than normal.

Auditory Neuropathy—Sometimes called Auditory Dysynchrony and even Central Auditory Deficit –*A disruption in the synchronous activity of the auditory nervous system. Results in greater real-world difficulty than would expect on the basis of the pure tone audiogram alone. Standard hearing aids are not able to ameliorate this.*

Step #2—Getting Hearing Aids

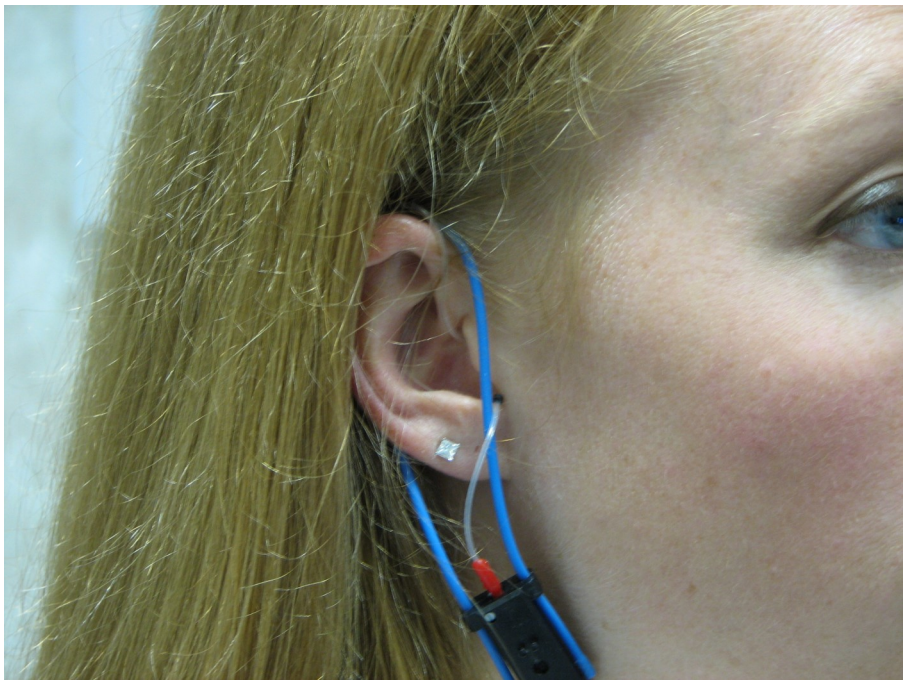
"All generalizations are false, including this one" - Mark Twain

Where

When we fit a hearing aid, its frequency response is adjusted according your residual hearing's frequency response as seen on the audiogram. In other words, if you have normal hearing sensitivity at 500 Hz, we don't want the hearing aid to change sounds in the 500 Hz region. If you have hearing loss at 1000 Hz however, we do want to provide gain to sounds in the 1000 region; the amount of gain, depending on your 1000 Hz threshold and loudness growth.

The way that the hearing aid responds to soft low-frequency sound, to loud low-frequency sound, to soft high-frequency sound, and so on, should be set according to the sound the hearing aid is producing at the eardrum. It doesn't matter what that hearing aid produces in an artificial ear at the manufacturer's location, what matters is what that hearing aid produces in your ear.

The following picture shows a probe microphone used to measure sound at the eardrum.
The piece of blue rubber fitting over and around the ear is simply to hold everything in place. The clear tube with red at its base is the actual probe that ends close to the eardrum and measures the sound close to the eardrum.



There are a variety of ways to accomplish the type of measure we are talking about. One hearing aid manufacturer uses a probe tube that temporarily connects to the hearing aid microphone. In this way the hearing aid is measuring the sound it is producing at the eardrum (the tube is removed after the hearing aid is programmed/adjusted). Some hearing aids test your hearing with the hearing aid in place to more accurately predict its true response in your ear.

The point is that the sound an aid produces in a given ear is not necessarily what the fitting-computer predicts, which is based on an average size ear with average acoustics, and **it is not what that same hearing aid would produce in someone else's ear**. So a method, one of which is probe-microphone measures like the one discussed, to measure the performance of the aid in your actual ear helps make sure that we are making all speech sounds audible and comfortable.

Gain—How much increase in sound, usually as a function of frequency, a hearing aid causes. 25 dB of gain at 1000 Hz in your ear will sound different than 30 dB of gain.

Output— The level of sound in decibels that a hearing aid produces—and what matters is the output in your ear.

Maximum Output—The highest sound level that a given hearing aid will produce. A maximum output at 1000 Hz of 110 dB may be uncomfortable, but a maximum output of 108 dB may result in 'loud but not uncomfortable'.

There are some aided measures done in the test room booth where you had your hearing test that are worthwhile, like seeing how well you hear speech in background noise. However, it is not generally worthwhile to try and test the softest sound you can hear with the hearing aids—like you did for your original hearing test by raising your hand or pressing the button when you heard the tone. That type of behavioral measure under earphones has a 5 dB variation and putting earphones on over a hearing aid does not often work accurately. Probe-microphone, real-ear measures require no response from the hearing aid wearer, are designed to work with the hearing aid on your ear and have a variation much less than 5 dB.

I heard an advertisement from an eyeglass manufacturer about how their lenses were shatterproof, smudge resistant, blocked UV rays, and were responsive to changes in light. Those excellent features would do you little good if the glasses were not appropriate otherwise to your eyesight or didn't fit correctly on your head. There are hearing aids that do not easily feedback, are nearly invisible, can sync with your smartphone, and can tell the difference between speech and noise. Those excellent features would do you little good if the hearing aids were not properly fit to your residual hearing and ear—gh.

"New hearing aid technology is introduced each and every year: there are constant updates to directional microphone algorithms, noise reduction strategies, variations of amplitude and frequency compression, wireless streaming, and audio data transfer between hearing aids, just to name a few. What is sometimes forgotten, however, is the basic programming of the hearing aids' gain and output, which has a significant impact on the patient benefit obtained from these special features. Moreover, while many convenience features have been added to hearing aids in the past few years, *understanding speech* remains the dominant concern of hearing aid users, and for the most part, this is determined by the frequency-specific gain selected for the patient's instruments."

-Sanders and others, 2015

We still don't, however**,** have everything down to perfection. And some things, like how quickly the hearing aid adjusts to changes in softness and loudness, are still a bit unpredictable on an individual basis. For example, ask ten people with perfect hearing to adjust a stereo. Some prefer more bass (low frequencies), some prefer more treble (high frequencies), and some more volume, even though all have perfect hearing.

Ten people with audiograms exactly like yours will have some of these variations. So it is likely that you will need to be seen for follow-up after you have had experience wearing the hearing aids in the real world. It is also possible that you may not want the hearing aids adjusted for maximum benefit (maximum audibility) until you get used to hearing all the little, and big, sounds of life.

Once the hearing aid characteristics have been adjusted to your hearing and peculiar preferences, it is still desirable to be seen at least yearly by the Audiologist, or more often for some. Wax gets in hearing aids, hearing changes, hearing aids break, and even the size and shape of your ear canal changes with time.

The average need for factory repair of hearing aids is roughly 1½ times in a four year period (Harris and others, 1999), and that doesn't include times that the hearing aid can be repaired

Wax, skin and other debris gets in hearing aids, hearing changes, hearing aids break, and even the size and shape of your ear canal changes with time.

in the office without going back to the manufacturer. You may go four years with your hearing aid and never need service, but that would be unusual.

This follow up, re-measurement of your hearing, and repair of your hearing aid can't be done through the mail or Internet in an efficient or effective manner. As big as a nuisance it may be for you to do locally, it would be an even bigger nuisance should you have to drive 100 miles each way when you're hearing aid broke or when you needed routine follow up.

You can be fit with hearing aids by a specialist some distance away and then be seen for yearly checks by someone closer to you. However, this might end up costing you more money because the person fitting the hearing aid may bundle a certain amount of follow-up visits into the price of the hearing aid. So the person closer to you, who wasn't paid for the hearing aid and its associated services, will want to be reimbursed for his or her time also.

For these reasons, you want to try and buy your hearing aids from a person who will know your successes or failures and, ideally, you want to buy them locally.

Who

With some regularity we get a call from a person who is looking to purchase a certain make and model of hearing aid. They may have a friend who has that make and model, and who loves the hearing aid, or perhaps they saw an advertisement for that hearing aid and the advertisement impressed them.

You didn't pick out your glasses or contacts according to who manufactured them and you shouldn't do so with hearing aids. There are more than 6 companies who manufacture hearing aids. There is no data to confirm, and little reason to believe, that the average hearing impaired person with an average garden-variety hearing loss will hear better with one hearing aid company's products over another company.

Each company does have certain niches that can help determine who manufacturers your hearing aid. Some may have hearing aids that don't feedback as easily, some may make waterproof hearing aids, some may have more varied colors of hearing aids. At any point in time a given company may have a particular technological improvement that is confirmed by data, but very often other hearing aid manufacturers will develop that same improvement within the year. By and large this need not enter into your thinking about hearing aids. Find an expert in hearing and hearing aids and he or she will decide which manufacturer works better for them and you.

We would consider the answer to the question, "Who will you get to fit your hearing aids" by analogy: If you needed foot surgery, you first of all need someone who has been trained in, and does, foot surgery. You also want someone whose bedside manner is to your liking.

You will want the person fitting you with hearing aids to be educated in hearing and hearing aids and you want it to be a person who you can work with. Get a referral from a friend or from your family doctor. Then make an appointment for a hearing evaluation and talk with the Audiologist about hearing aids. If you don't think you will be happy with this expert, get a second opinion and decide from there.

You will not be seeing a company, you will not be seeing a hearing aid manufacturer, but you will want to see an individual who understands both hearing and hearing aids.

Patient Advocate

Wearing hearing aids is not as difficult as the size of this book would tend to make you think. Lots of people wear them. Lots of people put them on first thing of the morning, and take them off last thing at night. For first time hearing aid wearers however, rarely is it so easy that you just stick them in your ears and go about your way. And sometimes people are overwhelmed before or during the fitting and forget things about the hearing aid.

It is reasonable that you can be seen for a hearing and hearing aid evaluation and then be fit with hearing aids by yourself. A patient advocate can be an asset, however. It can be useful if there is a family member or friend present during the fitting. They can see how to put the hearing aid in, learn about batteries and how to clean the hearing aids.

Some people have trouble learning to insert the hearing aid initially. If a family member knows how to do it, they can help you when you get home. If you are having trouble with the hearing aid, they can look at them and make sure you have them properly inserted or even if you have them in the correct ear!

It can also be helpful to your family to get an idea of how well you might hear with hearing aids. Sometimes the family expects the hearing-aided person to hear perfect and that they should be able to hear if someone whispers to them from 30 feet away. The Audiologist can give the family realistic expectations based on the patient's residual hearing and remind them that the patient may not hear well from the back seat of the car (who can?).

Audiology is like the military in its use of a lot of abbreviations.

- *BTE—behind the ear*
- *Slim tube BTE—BTE with small diameter tubing*
- *RIC or RIE—Receiver in the canal or receiver in the ear—BTE with the loudspeaker (receiver) residing in the ear canal instead of in the hearing aid*
- *ITE—in the ear*
- *ITC—in the canal (but still an in the ear aid)*
- *MIH—Mic in Helix*
- *CIC—Completely in the canal (but still an in the ear aid)*
- *iIC—invisible in the canal*

As helpful as a patient advocate can be, they can be counterproductive if they try to belittle the patient and/or not let the patient express themselves. There can sometimes be power struggles between the patient and the family member and we've even seen sometimes a patient want to hear better but want to do the opposite of what their "know-it-all" family member wanted them to do.

So if you are going to be a patient advocate, check your personal agenda and ego at the door.

What

There are a variety of styles of hearing aids that will be discussed here. The advantages and disadvantages listed are generalized guidelines. Generalizations don't apply 100% of the time, so talk with your Audiologist about which style might work best for you. Let's first talk about whether or not you should get a hearing aid with a volume control.

Theoretically, the answer is no, you should not have a volume control. People with normal hearing do not have a volume control. If the hearing aid is set perfectly in how it controls the loudness of sound as a function of frequency for your particular hearing: what is soft to a normal hearing person will be soft to you, what is loud to a normal hearing person will be the same loudness to you. But let's look at things practically.

As a practical matter, some people should still not a have a volume control. They may not have the dexterity to manipulate a volume control. They may not be able to tell when the volume control is set at an optimal volume. They may have a tendency to play with the volume control.

Otherwise, it can be handy to have a volume control. If my normal hearing had a volume control I think I could use it, say when my (gh) grandson is screaming. If the initial fitting of your hearing aid is simply found to be overwhelming, you can turn the volume down a bit while you get used to hearing again. If your hearing fluctuates (varies from day to day), a volume control might be mandatory.

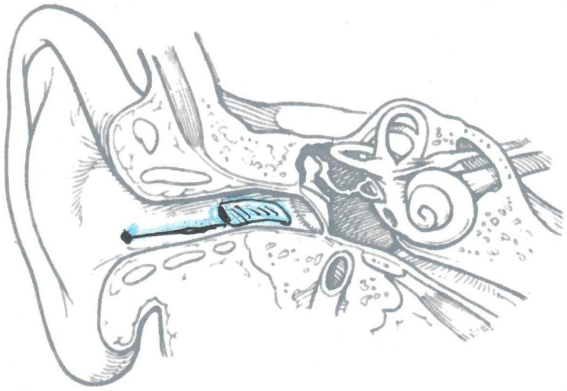
Most hearing aids can be made with volume controls that can be enabled or disabled. Sometimes we may disable the volume control when you first get the hearing aid so that if you have problems with the aid we know that it is not because you had the volume set incorrectly. The volume control can be enabled, or 'turned on', at a later date.

The occlusion effect is an increase in the self-perceived loudness of your own voice caused by something plugging the outer 1/2 of your ear canal.

Some hearing aids can be controlled with a remote control or even controlled with your smartphone.

A few generalizations can also be made about the style of hearing aid. More power can be obtained from a standard behind-the-ear (BTE) hearing aid than from the in-the-ear (ITE) styles. The standard and slim-tube BTE, but not the RIC, is also going to suffer fewer problems from cerumen (earwax). Cerumen can get into the electronics of the ITE styles, but with the standard and slimtube BTE the electronics are not in your ear. The flip-side of this is that ITE styles of hearing aids will suffer fewer problems from perspiration than might a BTE.

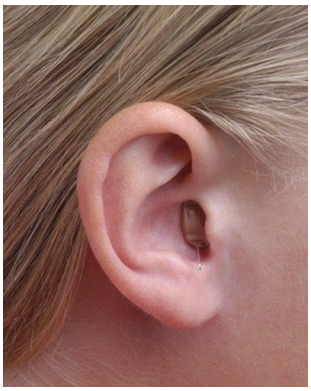
Regardless of the style, the goal of producing the optimal sound at your eardrum is unchanged, so that for the average garden-variety hearing impairment, one style of hearing aid should not necessarily make you hear different than another style.

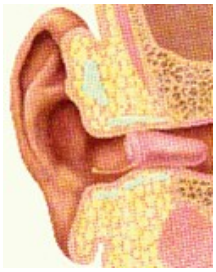


Medial Completely-in-the-Canal (MCIC) or invisible In-the-Canal (iIC)

- This is the smallest style of hearing aid.
- It fits in the inner-half (medial) of the ear canal with its end very close, less than ¼ inch, to the eardrum.
- It may be the most expensive style because of its size, and the time and preparation required to fit it.
- It uses the smallest size of battery, a size 10. The battery is the largest thing in it.
- Some ear canals may not be big enough to accommodate the hearing aid.
- Because it fits in the medial part, or inner 1/2 of the ear canal, there is usually little or no occlusion effect from it.
- It requires a deep impression of the ear, and some patients may find that uncomfortable.
- It has a string (it looks like a piece of fishing line) sticking outward. This is not an anten-

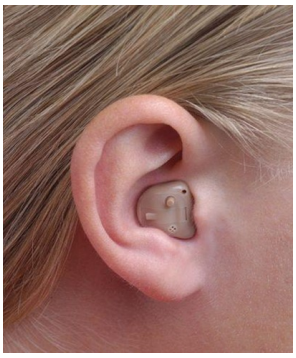
na; it is used to pull the aid out of the ear.
- This may not be the most appropriate aid for someone who needs a lot of power or does not have healthy ear canal skin.





Completely-in-the-Canal (CIC)

- Until the invisible in-the-canal style, this was the smallest style of hearing aid.
- It usually takes a size 10 battery, which doesn't last as long (2-5 days) as larger batteries.
- It usually has a string (it looks like a piece of fishing line) sticking outward. This is not an antenna; it is used to pull the aid out of the ear.
- This may not be the most appropriate aid for someone who needs a lot of power.
- The most common complaint with this hearing aid is that it feels like it plugs the ear and the wearer may hear their own voice "in a barrel" at first (from the occlusion effect).
- If your ear canal is small, this aid may protrude more than what you see in the picture above.
- This aid does not usually have a volume control. It can be made to have a volume control, but that makes it bigger.
- Cerumen from your ear can get in the sound exit (receiver port) of the hearing aid and block it.



In-The-Canal (ITC or Canal)

- This is one of the more common types of in-the-ear hearing aid.
- It usually takes a size 312 battery (3 to 7 days battery life), the next-to-smallest battery.
- These hearing aids are often made with a volume control.
- They can also be made with telephone coils and directional microphones, although this makes the aid bigger.
- The most common complaint with this hearing aid is that it feels like it plugs the ear and the wearer may hear their voice "in a barrel" at first.
- If your ear is small, this aid may protrude more than what you see in the picture above.
- Cerumen from your ear can get in the sound port of the hearing aid and block it.
- Canal aids can also be made with pull strings for removal, but they can removed as follows (and a pull string is not needed).

To remove canal and mic-in-helix aids, push upward on the bottom of your ear with your thumb, as shown.

This exposes enough of the aid that you can grab it with your fingers and remove.

This is the helix of your ear

Mic-In-Helix

- What makes this aid different is that the microphone is placed in the helix of the ear. The rest of the hearing aid is in the canal.
- The microphone connects to the rest of the aid with a wire that runs along the perimeter of the concha.
- These share most other traits with canal hearing aids but vary as follows.
- The 3 advantages to having the microphone in the helix are: protection from wind noise, a slight advantage in directionality (sounds from in front of you arrive at your eardrum different than sounds behind you), and less chance of distortion/interaction between the receiver and microphone (due to their physical separation) when lots of power is used.
- The 2 disadvantages are that the wire connecting the mic to the aid can fail if harshly manipulated and the microphone is subject to getting skin in it. For these reasons, this is usually reserved for someone with the dexterity to carefully remove the aid and clean their helix.

In-The-Ear (ITE or Full Shell)

- Because of its larger size, this is the easiest to manipulate and insert into the ear.
- This aid can be made with or without a volume control.
- It can be made with directional microphones and a telephone coil.
- This hearing aid usually takes a size 13 battery (5 to 10 days), although in some small ears a smaller battery (312 battery) is required. Larger batteries last longer than smaller batteries.

Standard Behind-The-Ear (BTE)

- There are 2 pieces to the BTE, the actual hearing aid that sits on top of your outer ear, and the earmold that attaches to the aid with a tube.
- The BTE is well-suited for children since their ears are small and growing. The earmold is less expensive to replace than the hearing aid if the child's ear grows out of the mold. (Some manufacturers of in-the-ear type hearing aids will "reshell" their hearing aids at no charge during the warranty period to accommodate children who are fit with in-the-ear style hearing aids.)
- It is well-suited for those who require a lot of power.
- The BTE is less prone to feedback than other hearing aids because the microphone is further away from the ear canal. (Feedback is the squealing noise hearing aids can make.)
- It is also well-suited for those with mild hearing loss because the earmold does not have to occlude the ear canal. This can make the wearer's own voice less noticeable to them.
- This hearing aid is more prone than other styles to getting perspiration in it, although some hearing aids like this are being made more water-resistant.
- Since the hearing aid can be separated from the earmold (the plastic piece that actually fits in your ear canal), it is easy to loan a patient a BTE hearing aid if his or her BTE needs sent to the factory for repair.
- For someone with small outer ears, there may not be enough room on the ear for the hearing aid and glasses.
- Wax problems are not as much of an issue with this type of hearing aid since there are no electronics in the earmold.
- The tubing of the earmold needs to be changed periodically because it gets hard and brittle.
- It can be made with any size of battery from 675 to 13 to 312 to 10 (from largest to smallest).

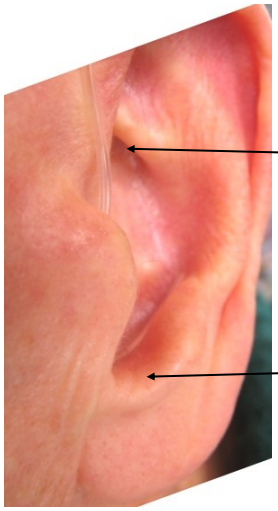

Slim-Tube BTE

- This style is also referred to as an "open fit" BTE since, in its original and typical configuration, the ear canal is not closed off by an earmold or by the hearing aid; that is, the original form of this hearing aid leaves the ear canal "open". Slim-tube BTE hearing aids can now be provided with an earmold that does close the ear canal off when more gain and output are needed.
- The tubing for this type of BTE is smaller than that used with the standard BTE, and so this type is not as visible as the standard BTE.
- It can sometimes be fit without the need for an ear impression and custom earmold. Several sizes of domes and lengths of tubing are available to accommodate various sizes of ears. The domes are sometimes called earbuds.
- Since the tubing is smaller than that for the standard BTE, it is more prone to getting plugged with wax or condensation. The tubing can be cleaned by the wearer.
- Many slim-tube BTE hearing aids are very small and may not be made with a volume control.
- They are not usually suitable for someone with severe hearing loss and in need of lots of power.

Receiver-In-The-Canal BTE (RIC)

- This is sometimes denoted as an RITE hearing aid, meaning "Receiver in the Ear" and sometimes also called an "open fit" BTE.
- These look almost identical to the slim-tube BTEs. Instead of a hollow tube going from the hearing aid into the ear like the slim-tube however, there is a wire going from the hearing aid down to a receiver (speaker) that is placed in the ear canal.
- The receiver can be placed in the ear canal with a dome/earbud which comes in various sizes, or with a custom earmold.
- Some RIC hearing aids can be made with lots of power, but not without a tight fitting custom earmold.
- The receiver can fail if wax gets in it.

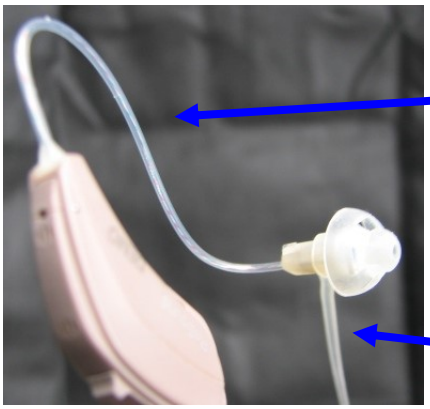
After you have had your hearing evaluated, the audiologist can give you an idea of how much hearing aids might help you, show you these different styles (and other styles that might be available), and give recommendations about what might be appropriate for you. See if you can handle the batteries and make sure that you can change the battery in the smaller hearing aids if that is what you want.



slim tube or RIC wire

slim tube and RIC hearing aids often have an “anchor’ or “sports lok” or “pigtail” to help secure the dome in place

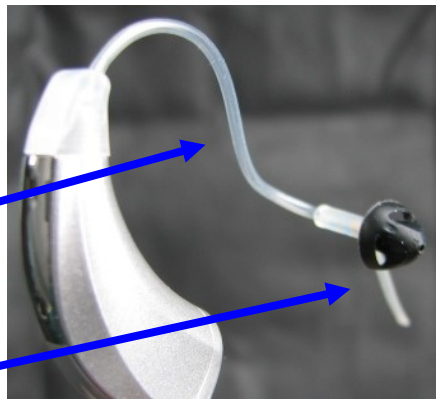
RICs (left) and slim tube (right) aids look almost identical



This is the wire leading to the receiver and dome

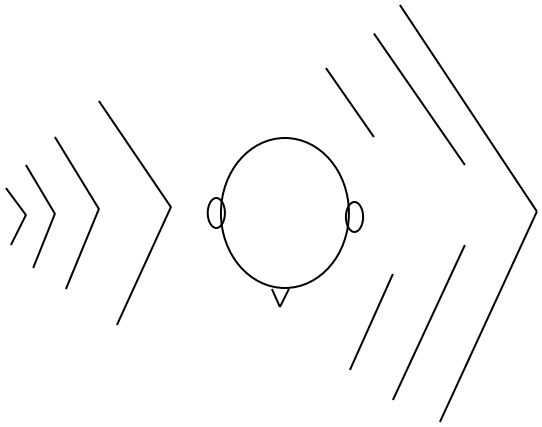
This is the hollow tube leading to the dome

This is the plastic anchor that fits in the bowl (concha) of the ear



CROS and other Variations

The above examples are by far the most common styles but there are lots of variations on these themes. One variation is CROS hearing aids. CROS stands for Contralateral Routing of Signals. It means that sound from one side of your head is routed to the ear on the other side of your head. It is a type of hearing aid that is used when one ear is unusable and the other ear is ok. This is sometimes called single-sided deafness.



Your head casts a small, but significant sound shadow. This is obvious if you consider someone trying to whisper into a right deaf ear - the left ear can't hear that whisper. But if the right ear is deaf, and the left ear is ok, then a CROS hearing aid will allow the person to hear that whisper. They hear it in the good ear, but they hear it. CROS hearing aids eliminate the sound shadow cast by the head.

The most common way that a CROS hearing aid works is by placing a microphone and radio transmitter (which looks like a regular hearing aid) on the bad ear and then placing a radio receiver and the rest of the hearing aid on the good ear. In this way the good ear hears sound (even from a telephone receiver) from the side of the head with the bad ear.

This goal of eliminating the head shadow in cases of single-sided deafness, can also be accomplished with bone conduction hearing aids. One type of bone conduction hearing aid is partially implanted into the bone behind the bad ear. Since it vibrates that bone and since that bone is ultimately connected to the bone in which the good ear is housed, the result is that the good ear hears sound from the bad side.

The mastoid area of the temporal bone is a common area for placement of a bone conduction hearing aid. The mastoid is the raised area behind your outer ear. Other sites can be used however. Even the teeth can transmit bone conducted sound throughout the skull.

A bone conduction aid can also be made without the need of implanting part of it. Another way of coupling a bone conduction aid is by a special earmold that vibrates the bones from within the ear canal. This is usually called a transcranial CROS hearing aid.

Impressioning

There are a few hearing aids where an impression of your ear is not taken. If you have a mild loss and the shape of your ear is not too different from average, you may wear a slim-tube or RIC BTE where a standard ear piece is used. Your ear is measured for tubing or wire length and

dome size, and no impression is taken.

In most cases however, an impression is taken of your ear. This is done by first inserting an ear-dam made of cotton or foam into your ear canal. The ear-dam serves as a block so that the impression material will not go all the way to the eardrum. It is not unusual that placement of the ear-dam makes you cough. A branch of the Vagus Nerve that serves your throat passes close to the ear canal, very close in some people, and moving the ear-dam through the ear canal can cause your throat to tickle, making you cough.

Once the ear-dam is in place, an impression material, usually made of silicone, is squirted into your ear canal. The impression material feels cold in your ear because the impression material is room temperature and your ear canal is about 98 degrees.

The ear canal is about an inch long from its entrance to the eardrum. The outer half of the canal is cartilage covered with thin skin. The inner half of the canal is bone covered with even thinner skin.

The outer portion of most people's ear canal is pliable, as is the pinna (that easily-visible, funny-shaped flap of skin and cartilage most people call their ear). The person making the impression will take care not to distend your ear when he or she injects it with impression material.

The shape of your ear canal is also influenced by your jaw. The temporomandibular joint (TMJ) is located just beneath the ear canal. If you put your finger in your ear canal and move your jaw you can feel the ear canal changing shape.

Most ear canals expand when the jaw is open and some experts have you hold your jaw open while taking an impression, especially if the hearing aid needs to fit snugly in your ear. Some may even take one impression with your jaw open and then another with your jaw closed to show the hearing aid factory the amount of movement in your canal.

Some people find removal of the impression material uncomfortable because their ear canal is very sensitive. It can also be uncomfortable if there is a sharp bend in your canal that the impression material is pulling against, or if the impression material is sitting on the tympanic membrane. If the impression material is deeply seated in the canal, it is helpful to break the seal so that there is no vacuum when the impression is removed.

Monaural, Binaural

People hear better with two ears that cooperate with each other, including people who wear

hearing aids. Let us give you an example. Our old fitting room was about 12 X 10 feet and had a ventilation register in the ceiling. Because this room was located in the center of the rest of the office area, it didn't' get much air circulation unless the central fan was running. For this reason, we left the fan running all day to keep the fitting room from getting too hot and stuffy.

Most people who need hearing aids do not hear the sound from the air exiting the register above them… until a hearing aid is placed on them. When we put one hearing aid on (a monaural fitting) they may hear the ventilation sound and comment that the *hearing aid* is making a noise; that there is a soft rushing sound in the hearing aid. When we put a hearing aid on the other ear, so that they are wearing two hearing aids (a binaural fitting) they say, "Oh, it's not the hearing aids making that noise, I can hear that it's your air conditioner" and point to the air register above them because now they can tell where the sound is coming from.

Many people with good hearing in only one ear do very well, but normal hearing is hearing from two ears. You cannot find a hearing animal in the world that has only one ear.

Having said that, there are some reasons for a monaural fitting, that is, having a hearing aid for only one ear. If only one ear is impaired you don't want the normal ear fit of course (unless you decide on a CROS hearing aid). If you can hear nothing from one ear, I mean nothing, fitting a deaf ear with a standard hearing aid may do no good. Some people's hearing is such that both ears do not work together and this person actually does better with a monaural fitting. This is an unusual situation and a sign of impairment in the central auditory pathways beyond the inner ear.

Someone who has worn a hearing aid in only one ear for a long time can have a very hard time getting the unaided ear to handle sound again because of Auditory Deprivation.

A binaural fitting costs more and can actually make your voice sound a little odder to you at first than a monaural fitting, but is closer to normal hearing than is a monaural fitting.

We'll mention one other thing about this that comes up frequently in our practice. Most people assume that the worse your hearing, the greater the need for a binaural fitting and conversely, the closer your hearing is to normal, the easier it will be to get away with a monaural fitting. It is just the opposite.

For someone with a severe hearing loss, they are hearing very little without hearing aids. If we fit them monaurally, they hear conversation and hear so much better in so many situations that they are very happy. They may not hear as well as they would with a binaural fitting, but the difference between no hearing aid and a monaural hearing aid is so much that the difference is very noticeable to them.

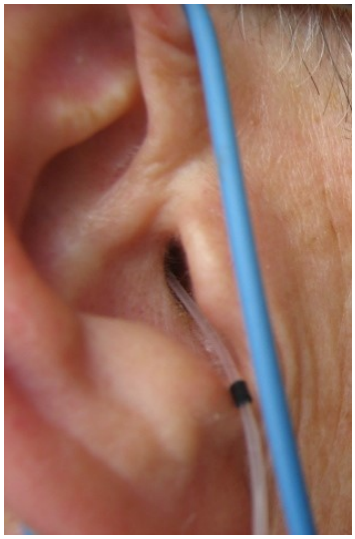
For someone with a very mild binaural hearing loss, a monaural fitting may be as bad as going without hearing aids. The person with a mild hearing loss in both ears usually has noticeable

hearing impairment only in difficult listening situations, situations where there is background noise, high reverberation, or a large distance over which he or she is trying to listen. It is important to have two equally responding, or two balanced, ears in difficult listening situations. They need binaural hearing to hear better in difficult listening situations.

Probe-Microphone Real-Ear Measures

A few decibels louder or softer can make a big difference in some fittings. We could try to test a person with the hearing aids in place just as we did when we tested without the hearing aids, but it would take a lot of time and is not as precise as probe-microphone measures.

The science of fitting hearing aid acoustic characteristics to the particular specifics of your residual hearing has advanced tremendously since I (gh) started fitting hearing aids 40 years ago, with probe-microphone measures being one example of that improvement. Probe-microphone measures began in the early 1980s (Harford, 1981; Nielson, 1985), and have gradually won wide acceptance and usage.



The picture here (and at the beginning of this chapter) shows a probe-microphone assembly. Basically, a hollow tube (the probe) is placed close to the ear drum and connected at its other end to a microphone. A hearing aid can be placed in the ear and now the probe-microphone measures the sound the hearing aid is producing at the eardrum. This can be compared back to your audiogram to see if the sound produced by the hearing aid is set to "target" or set to what most would "prescribe" for your residual hearing.

Being able to place a microphone in the ear canal and measure the sound produced by the hearing aid at your eardrum was a big advance in the science of hearing aid fitting. It is fast, and it is reliable.

How Long Does a Hearing Aid Last?

I once fit a lady who used her hearing aid every day for 13 years without a problem. But this is rare!

I do not know statistics for how often patients end up replacing hearing aids, but I usually tell people that roughly five years is about average for replacement of hearing aids and that it would be unusual to try and have a hearing aid over ten years old repaired instead of replaced. Here are some of the factors that enter into the decision whether to repair a hearing aid or replace it.

The shape of your ear canal changes with time, even without a hearing aid in it. Plus, when you wear a hearing aid it will often wallow-out your ear, much like the ring on your finger will indent your finger. If you have an old aid that no longer fits properly, it will in most cases be better to replace it.

The plastic of the hearing aid also deteriorates over time, faster for some wearers than others. The amount of sunlight exposure, the skin oils and perspiration to which the aid is exposed, and other factors help determine how quickly the plastic will deteriorate. The plastic can harden and crack and discolor with time. We've seen hearing aids so yellow that they look dirty, even though they might not be.

We've also seen the insides of a hearing aid get so corroded that the entire hearing aid needs to be replaced. Manufacturers have a limited time that they will carry replacement parts, especially amplifiers. So if the amplifier of your ten year old hearing aid goes bad, the part may no longer be available from the manufacturer, although you might be able to find a hearing repair firm who stockpiles old hearing aids and can get an amplifier that way.

It is likely that your hearing will change over time, maybe not a lot, but a little can make a big difference. If your hearing has changed significantly and the hearing aid cannot be programmed (readjusted) to match targets for your new hearing, it might be time to replace the hearing aid. While I'm on the subject, there is usually no way to know how stable your hearing loss might be. Some people might have been told that they would be deaf by the time they were some particular age, but that was a guess. It is reasonable to have your hearing checked every one to two years, sooner for hearing impaired children.

Technology changes. If there is a hearing aid that will provide you better hearing than your old hearing aid, it might be time to replace the aid. Hearing aids are getting smarter in how they respond to sound and communicate with other devices. Sometimes people just want a smaller hearing aid. Sometimes dogs eat hearing aids and the aid has to be replaced.

Hearing Aid Warranties

Hearing aids usually come with a one or two year warranty, sometimes longer. There are some variations in exactly what this means.

It almost always means that if the hearing aid breaks and needs to be returned to the factory for repair during the warranty period, that the factory will repair it at no charge. Some manufacturers may make an exception when it comes to the shell of the hearing aid.

In-the-ear type hearing aids have a faceplate and shell. The shell is the part of the aid that touches the skin of the ear and is not seen when the hearing aid is in place. If you step on the hearing aid and break the shell, some audiologists and manufacturers will charge to have the

shell repaired or replaced even if the aid is in warranty.

With behind-the-ear hearing aids you might have an earmold that is not made by the same company as your hearing aid. The warranty on the earmold is probably different than the warranty on your hearing aid.

If your hearing aid breaks during the warranty period and you return to the audiologist from whom you purchased your hearing aid, there *may* be no charge from the Audiologist during the warranty period. There are some exceptions. Some Audiologists include or "bundle" the likely cost of their services for a year into the purchase price of your hearing aid, but some do not and may charge you for service on an "as seen" basis.

If you have an Audiologist troubleshoot a hearing aid that you did not purchase from him or her, you might pay for the Audiologist's service even if the hearing aid is under warranty.

We have seen one Internet seller of hearing aids give a three year warranty, but only the first year was a manufacturer warranty; the second and third years were self-warranted by the Internet seller. In one instance the Internet seller covered the second year warranty but made an exception if the hearing aid broke because of ear wax; that is, they charged for the repair if wax was the problem, and we estimate that 80% of the time it is wax.

If you lose your hearing aid or it is damaged beyond repair, many manufacturers have a loss and damage warranty and will remake, usually for a deductable, the hearing aid one time under this warranty.

3—Now You Have New Hearing Aids

Hearing in noise is arguably one of the most computationally difficult things we ask our brain to do—Northwestern University's Auditory Neuroscience Laboratory

Getting Used To Hearing Aids

Adult-onset hearing impairment usually advances gradually, slowly reducing our sensitivity to high frequency sounds as it inches its way toward the lower frequency sounds. Over time this muffling of sound becomes the norm.

If we could magically give you perfect ears and hearing such that you did not need hearing aids, you would be shocked at all the little noises you would start hearing. It would take you a while to get used to hearing with perfect ears.

A normal hearing person is used to, and usually ignores, hearing their hair rub on their shirt collar, the crickets through the window at night, the loud crunch of eating popcorn, and the sound of their urine stream hitting the toilet water.

Some first-time hearing aid users often nudge us away from the best hearing they can get toward the auditory world to which they have grown accustomed. There can be a trade-off between a hearing aid setting that gives the best speech understanding, usually a setting where you hear everything, and adjusting the hearing aids until they sound "normal". At first if the hearing aids are ideally adjusted, it might seem as if you are hearing too much.

- *Your voice will sound different to you at first*
- *You will hear road noise*
- *WalMart is loud*
- *Eating carrots is loud*
- *Normal hearing individuals can't choose what they do and don't hear, but they do learn to ignore some sounds*
- *If a normal hearing individual hears a sound, we usually want you to hear it too*

Your voice will likely sound different to you at first. It is one thing if outside sounds are different, but it is a bit of a jolt when your own voice sounds different. It is a little like hearing your self over a tape recorder; it just doesn't sound right (see the section "Your Voice" later in this chapter.)

Many people want hearing aids that do not pick up background noise. And that makes sense because that is where most hearing impaired people have inordinately greater difficulty understanding speech.

If you hear background noise without the hearing aid, the hearing aid is not going to make that background noise softer.

Consider three things about reducing background noise. One is that if you hear the background noise without the hearing aid, the hearing aid is not going to make that noise softer. The other is that what is background noise to one person is a noise of particular importance to another person. Music is one example. Some would prefer a hearing aid that reduces music, while others would hate that.

The third consideration is that very often the background noise is voices. If you are in a group of ten people who are all talking, the hearing aid does not know whose voice you want to hear and whose you do not want to hear. (Although it can make the assumption that where your head is facing is usually toward the sound of interest, and also that the loudest voice is the one you want to hear.)

Hearing aids do have a few tricks up their sleeves when it comes to background noise. They can tell wind noise and mechanical noise from speech and make adjustments accordingly. They can also be made to be directional.

Your outer ear is naturally directional. Because of its cupped shape you hear sound coming in front of you better than sound in back of you. CIC, iIC and Canal aids benefit from this natural directionality because their microphones set inside the bowled part of your outer ear.

Hearing aids with directional microphones can go a step further and form a more narrow beam of directional sensitivity, especially if the left and right hearing aids are communicating with each other.

Another way that hearing aids can improve the signal of interest is through the use of a remote microphone, where a separate microphone is provided. This microphone is housed outside of the hearing aid and can be given to the spouse who can wear it on her/his shirt collar, or can be put on the preachers pulpit so that the person-of-interest's voice sounds as close to your ear as the remote microphone is close to their mouth. A remote microphone is often used with school age children and the teacher wears the microphone. Historically, this has been called an auditory trainer.

Gradual or All At Once

Most experienced hearing aid wearers wear their hearing aid most of the day and take them off at night when they go to bed. Part-time hearing aid usage is not usually the best. However, wearing hearing aids all day can be overwhelming to some new wearers.

When a new hearing aid wearer first wears his or her hearing aids out in the real world they can get an avalanche of sound that they are not used to hearing. So, some people may do better if they wear the hearing aids only in quiet situations at first and gradually increase the amount of time and situations where they wear their hearing aids.

For many new hearing aid wearers, my suggestion is that they wear their hearing aids at first as much as possible, excluding bedtime. If the hearing aids allow some sounds to exceed an uncomfortable loudness, adjustments probably need to be made. If the hearing aids are rubbing a sore spot on the ear, adjustments need made. However, if the wearer is simply overwhelmed by sound, tired of hearing, or their ear is tired of having something on/in it, removing the aid and gradually increasing the wearing time may be the answer.

For other new hearing aid wearers it may be preferable to use a schedule of gradually getting used to hearing aids. For example, wear the hearing aid in quiet settings for a few hours the first day. The next day, wear the aid for 4-5 hours in quiet. On subsequent days, gradually include wearing the hearing aid in noisy situations until after one or two weeks you are wearing the aids most of the day.

Audiologist Dr. Robert Martin leans toward a progressive approach in getting used to hearing aids. He uses a baseball analogy: “Learning to use a hearing aid is like playing baseball. First you need to get on base. It is foolish to try and hit a homerun every time you bat.” His first goal is to make the hearing aid comfortable to wear and make sure his patient can hear the people at home. With follow-up in subsequent weeks, he gets the hearing aid settings to a level closer to what allows maximum benefit.

How It Might Feel In Your Ear

The skin of your ear and ear canal is very thin. The outer half of your canal has skin over a little fat which is over cartilage. The inner half of your ear canal is thin skin over bone. It is unforgiving.

It will feel like something is in your ear, but it should not hurt. If the hearing aid does hurt, or is causing a sore spot on your ear, you will need to return to the person who fit the hearing aid. It might be that you are not getting the hearing aid in correctly or it might be that the hearing aid has a high spot and needs reduced accordingly.

If the hearing aid hurts or is causing a sore, your ear will not toughen and time will not usually take care of this problem. Time will take care of getting used to how a hearing aid sounds strange to you, but time will not make your ear stop hurting. Remove the aid and return to the Audiologist.

The outer ear is odd in shape and the ear canal is tortuous, and a hearing aid can be a chal-

lenge to insert for some people. It may be helpful to take a family member or friend with you when you get the hearing aid. That way, that person can help you insert the hearing aids should you have difficulty doing so.

At first it will feel like something is in your ear, but it should not hurt.

There can be instances where, after years of fitting ok, the hearing aid starts rubbing a spot on the ear. Some earmold and hearing aid plastics can shrink, crack or break, but the usual cause of this is a change in the shape of the ear. Your face is not the same shape today as it was ten years ago. The same is true for your ear and ear canal.

Some tight fitting hearing aids will also tend to "wallow out" the ear canal. Most hearing aids are a little tighter in the ear when you first get them than they are a few years later.

I liked my old hearing aids better than my new hearing aids

If you like your old aids better than your new ones, is it because of the physical fit, because of the sound of the aids, or both? If the new hearing aids are tighter than your old ones, this is probably good and expected. Hearing aids will tend to loosen-up in your ears with time. If they are too loose, you might lose too much sound around them and therefore weren't hearing well with your old, loose-fitting aids.

If it is because you don't like the sound of the new hearing aids as well, could it be because you are hearing more with them than you did with the old ones? You probably should be. Just as it may have been a bit overwhelming when you first got your old hearing aids and were hearing the noisy world in a new way, your new hearing aid may be better suited to your new hearing loss and it is a bit of a challenge again.

If it is because you actually still understand speech better with your old hearing aids, then it is time for follow-up. Take both sets of hearing aids with you so that the Audiologist can compare their settings and determine what it is about the old hearing aids that works better for you.

Follow Up

There is often a conflict between what you need in order to hear well and what you want. You may not want your voice to sound funny to you. You may not want to hear yourself eating something crunchy. You may not want to hear the refrigerator run. So sometimes we start you with a fitting that is a little softer, with a little more venting, than you may ultimately end up with. With follow up, we can tell a few things about your hearing aid fitting that might not have been evident at the initial fitting, and we can gradually get you to hearing everything you should be hearing (as you get used to ignoring these new sounds).

If you take 10 people with perfect hearing and ask them to adjust a radio, some will turn the volume higher than others, some will turn the treble up; some will turn the bass up. All 10 have

perfect hearing but all 10 arrive at different settings. This variation among 10 perfect hearing individuals can also be evident in 10 people with your same hearing.

Sometimes also, your auditory system can become so attuned to the way that your old hearing aids processed sound, and even distorted sound, that it can take a while to get used to newer, less distorted hearing aids.

What I am trying to say is that you will probably need to go back for follow up after your initial fitting. You may not. But we can tell a lot about your fitting after you have worn your hearing aids for a while. If you come back, say after a week, we can take a look at your ear and make sure that the shell of the aid does not have a high spot, make sure that you are correctly inserting it, check where you have been setting the volume control, show you where your hearing aids are collecting wax and how to remove it. We can get an idea of what types of sounds might be bothering you. Sometimes we might make changes to the way hearing aids amplify sounds, but sometimes we might leave alone with the expectation that what you are experiencing is normal for someone whose hearing has gradually diminished over many years.

Come back and let us know how you are doing. You won't hurt our feelings. You won't use our time unnecessarily. Let us know what is wrong and what is right.

What I am also saying is that fitting hearing aids is partially a matter of matching the characteristics of the hearing aid to the characteristics of your hearing on a scientific basis. However, our tests are imperfect and how the hearing aids sound to you is important and worth considering.

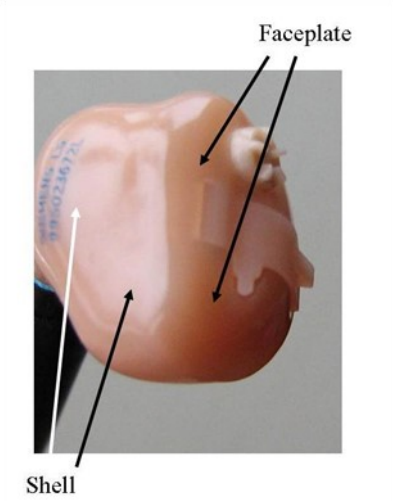
It might also be helpful to keep a diary of your first week's experience wearing the hearing aid. What sounds might have surprised you? What sounds were too loud? Does the TV volume you prefer now coincide with your spouse's preferred volume?

Here are a few things to make note of and report back to your Audiologist:

- Did any sounds get uncomfortably loud? What were they?
- Is the TV volume you now use with your hearing aid, the same as your spouse prefers? Is your spouse hearing impaired?
- Is your own voice sounding less disagreeable to you now that you have had a chance to get used to the aid?
- Were you able to use the phone ok?
- Are you able to insert and remove the hearing aids ok?
- Do you know how to clean wax from the hearing aids and how to change batteries?

- Is your ear sore anywhere?

"The Hearing Aid Goes till 3 O'clock and Then It Gradually Stops"



This is referred to as fading. The hearing aid works ok in the morning after it has set out all night, but then during the day as you wear it, it gradually stops working. This is usually from wax or other debris in the receiver port of the hearing aid.

Over night when the aid is setting out of your ear, the wax dries. When you put the aid on in the morning, there is enough room around the dried wax for sound to exit the hearing aid.

In your ear the wax absorbs moisture and the wax swells, gradually blocking off the sound from the hearing aid. This will eventually happen to most hearing aids. The following will help postpone it from happening.

Cleaning In-The-Ear Hearing Aids

One-piece hearing aids that fit entirely within the outer ear are categorized into 4 sizes or styles: 1) invisible-In-The-Canal or iIC, 2) Completely-In-The-Canal or CIC, 3) In-The-Canal or ITC or Canal and, 4) In-The-Ear or ITE or Full-Shell ITE.

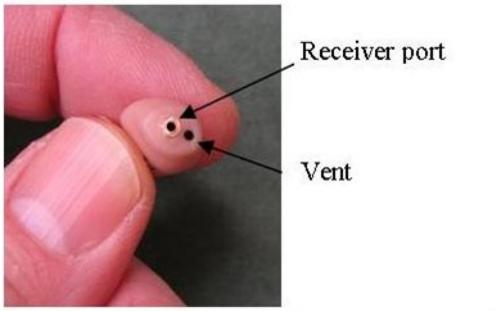
All of these hearing aids are cleaned the same. They have a shell, a faceplate, and a receiver port. Any time you see the word "receiver" associated with a hearing aid, think of "loudspeaker" or "speaker", the part of the hearing aid that turns electrical current into sound.

The faceplate is mostly flat and faces the outside when it is in your ear, and is the part of the hearing aid in which the battery fits.

The shell is the contoured portion that touches your ear canal and is not seen when the aid is in your ear. You can often see the seam between the faceplate and shell. Most of the components of the hearing aid are assembled on the faceplate and then the faceplate is adhered to the shell.

Clean the wax and skin debris from the shell by wiping it with a cloth or tissue that has been moistened with a solution made for hearing aids, vinegar or alcohol. Since alcohol tends to age and harden plastic it should be your last choice. Your first choice will be cloths/solutions made just for cleaning the shell. These can be purchased where you bought your hearing aid. They do not age the plastic, they clean the debris from the shell, and they kill many of the germs that like the warm, damp environment of your ear canal.

All of these hearing aids have a receiver port. The receiver port is located at the end of the hearing aid, the part that points toward your eardrum. Often there is another opening here also: a vent. Pictured is a hearing aid showing the vent and receiver port. The receiver port usually has either a rubber tube in it or a wax filter over it.



The vent can range in size from very large to very small and sometimes there is no vent at all. The size of the vent is determined primarily on the severity of your hearing loss. It is a channel that travels from the canal of the hearing aid to the faceplate of the hearing aid. Since there are no electronic components in it, it can be easily cleaned by pushing a small nylon string through it (if it is large enough) or by brushing the wax from it.

When cleaning the vent you will want to be careful in 2 ways. First, sometimes the vent can have a sleeve or other piece of plastic that has been placed to make the effective size of the vent smaller. Do not remove this. The size of the vent is almost always critical to the way the hearing aid performs in your ear.

Second, do not to poke a hole in the wall of the vent, particularly between the wall of the vent and the inside of the hearing aid. So don't stick a metal pin into the vent, use only a plastic string or the bristles of a brush.

The most common thing that causes an ITE hearing aid to stop working is wax in the receiver port. Even if your ear canal does not make much wax, the hole can plug with skin and what little wax you do make.

- Clean the receiver port in the morning after the hearing aid has been out of your ear all night. This allows the wax to dry. If you clean the port when the wax is moist it may smear and not crumble away from the hearing aid.

- Turn the hearing aid upside down over a toothbrush so that the receiver port is pointing to the ground and run the receiver port back and forth in the bristles of the toothbrush. Much of the dried wax will fall away from the hearing aid in this manner.

- Most hearing aids have a wax filters, sometimes called a wax guard, in or over the receiver port. Some of them you can change, some of them you can't. Ask your Audiologist about your wax filter. If the wax filter happens to dislodge when you clean the receiver port with a toothbrush, the aid will work just fine without the filter. However, you'll want to have the wax filter replaced when you can to help keep the receiver protected.

- Clean the aid over a table or desk. This will help keep the aid from falling to the floor. The aid will usually survive the fall to the floor, but it will not survive you stepping on it.

- One more tip. Don't tell anyone I told you this. As a last resort if your hearing aid is not working and changing the battery or cleaning the receiver port did not revive it: *lightly* tap the hearing aid against a hard surface with the receiver port turned toward the ground. Occasionally this will dislodge some wax and the aid will work. Again, you would do this as a last resort. Do this after the aid has set out of your ear over night and the wax has dried.

If you tend to get a lot of wax in your hearing aid, if your ear canals itch, or if your ear canals tend to get infected easily, you should consider purchasing an electronic hearing aid drier/ cleaner. There are many variations on these but most commonly they contain:

- An ultra-violet light to kill germs.
- A fan and heater to blow warm air over the hearing aid.
- Some also have a desiccant or chemical drying agent.

If you do use an electronic drier with an ultra-violet light you might also lay the aid into the chamber facing up one night, and then facing down the next night so that the light can reach all parts of the hearing aid.

After reading this you may be thinking that you will just clean your ears everyday with a cotton swab so that you don't have to worry about getting wax in the hearing aid. Read the "Cleaning Your Ears" section to find out why this is not a good idea.

Cleaning Behind-The-Ear (BTE) Hearing Aids

There are 3 basic parts to BTE hearing aids: the hearing aid, the earmold, and the tubing connecting the mold to the aid. The earmold is what touches you ear canal and therefore what gets wax in it.

Since there are no electronics in earmolds, you can pick the wax out and brush and wipe the mold just like with the ITE hearing aids. Molds are made of plastic and you wipe them with a

cloth and cleaning solution, our first choice is a solution made just for this, second is vinegar, and last is alcohol (since alcohol has a drying effect on the mold).

Many earmolds also have a vent and, if your mold has a vent, you can usually get a bit of fishing line to run through the vent and keep it open.

The tubing connecting the mold to the aid gets hard and brittle with time. Once the tubing loses its flexibility you will need to have it replaced. For most people this should be done about once a year.

Usually the BTE hearing aid itself doesn't require much cleaning but keep hair spray out of it and wipe debris off it with a dry cloth.

RIC hearing aids are a hybrid between a BTE and ITE. They will have a receiver located in the earmold or in a plastic dome earpiece. You can brush and clean the dome like you would an ITE aid. If the dome plugs with wax it will usually come off of the receiver and you can run a plastic line through to clear the wax. Since the domes are plastic, they harden over time and need replaced occasionally.

Receiver of a RIC hearing aid. The black dome here is plastic and can be taken off for cleaning.

When the dome is removed you can get at the receiver which will have a wax filter. This filter can usually be changed and you will need to ask your Audiologist how to do this.

Germs and Hearing Aids

Healthy ears tolerate hearing aids and earmolds in them very well. However, if you are diabetic, if your wear your hearing aid 24 hours a day, or if you do not have a normal immune system, having the hearing aid close off your ear canal can make it a more prone to infection because your ear canal will be a bit damper and warmer.

Since germs can stay on your hearing aid it is a good ideas to wipe them off at night after you take the aids out of your ears. Use a cleaning cloth made for this or use a little vinegar on a tissue. I've seen some people, especially kids, stick the aid in their mouth, wetting the hearing aid before inserting it in their ear. Do not do this.

When you bring your hearing aid to us do not get your feelings hurt if we use a glove to handle the hearing aid or if we don't immediately touch your hearing aids. We can't see if there are unwanted germs on your hearing aid or not.

Your hearing aid should not have an odor when you remove it from your ear. If it does (have an odor) chances as you have an infection in the skin of the ear canal.

Cleaning Your Ears

We have several brochures in our office about hearing aids, about vertigo, about testing kids' hearing and so on. One brochure is about cleaning your ears. It is the brochure that everyone takes. It needs replenished 3 times as often as the other brochures. Anyone who has ever brought a non-functioning hearing aid to me and we showed them how wax was plugging the receiver port often starts inquiring about cleaning their ears to keep the wax gone.

"Cerumen" is used interchangeably with the word "earwax", although typically we will call it cerumen in the ear canal and wax when it is in the hearing aid.

Cerumen is made by glands in the outer third or half of your ear canal, the sebaceous glands and modified apocrine sweat glands. The waxy secretions from these glands combine with hair and sloughed skin (epithelial) cells to form what most people call earwax.

Cerumen protects the ear by repelling moisture, bacteria and fungi. Normally, cerumen is eliminated or expelled by the slow movement of the outer layer of skin of the ear canal which carries cerumen to the outside.

Hearing aids can interfere with this conveyor belt movement of cerumen outward. Since the holes of the hearing aid are small it doesn't take much cerumen to plug them, and the cerumen probably does collect in your ear canal faster when you wear hearing aids.

The first thing people think about when trying to keep cerumen out of their hearing aids is a cotton swab.

Cotton swabs are the #1 cause of wax impaction, #1 cause of itchy ears, and an avoidable cause of tympanic membrane (eardrum) perforation.

If you push a swab into your ear canal, some cerumen usually adheres to the swab but, very often, some will be pushed deeper into your ear and does not come out with the swab. Do this enough and the cerumen gets jam-packed deep in your ear canal.

Boy, it feels good to scratch your ear canal with that swab, doesn't it? Repeated cleaning with a swab not only takes the protective layer of cerumen off of the skin; it removes the top layer of skin and irritates the nerve endings within the skin. This makes your ear itch and makes your ear canal dry and prone to infection, particularly if you wear hearing aids, which tend to hold in heat and moisture.

So, how do you clean your ears? Cover your finger with a dry or water-moistened handkerchief or washcloth and wipe what you can get with your finger. Do not worry about wax that is deeper than the ear canal entrance: it is supposed to be there and is not a sign of poor hygiene.

Earwax is not soluble in water and so getting water in your ear doesn't help. If you do get water in your ear canal, you want to allow it enough time to dry before putting in your hearing aid. Trapped moisture tends to make ears itch.

A word about ear candling: No. It does not work (Seeely and others, 1996; FDA, 1998).

So, what about the hearing aid and getting wax in the hearing aid? Hearing aids do tend to cause cerumen to accumulate more in your ear than otherwise. So, try to keep wax out of your hearing aid as previously discussed. And you may have to have your ears checked periodically for cerumen. The Audiologist can do this and check your hearing aid at the same time and this is usually done once a year, sometimes more.

Your Voice

There are several reasons why your voice will sound different to you with a hearing aid in place. One reason has to do with simply hearing your voice through the hearing aid now, just as you are hearing other peoples voices through the hearing aid. Since you are used to hearing your voice with muffled hearing, it is a surprise to hear your own voice when unmuffled. I've had people comment that every time they say a word with "s" in it, that they hearing something making a sound, or making an "s" sound, or making a distorted sound. The reason is that they have not been hearing themselves say "s", probably for many years.

It can also be compared to hearing yourself over a tape recorder. Your voice seems odd when you hear it over a tape recorder or through a hearing aid. A lot of your own voice is normally heard through your body (bone conduction), whereas you normally hear someone else's voice through the air and then your ear (air conduction). With the hearing aid you are probably hearing more of your air conducted voice.

Another reason that your voice may sound different is the occlusion effect. The occlusion effect is best explained by example. Firmly plug your ears with your fingers and say the vowel "ee". When you do this, it is as if you are hearing the "ee" sound in your ears, and the "ee" sound is louder than it would be with your ears unplugged.

The reason for the occlusion effect is that much of your own voice is conducted through your body and escapes outward through your ear canal. You can actually place a microphone in someone's ear and record their own voice. When you occlude the ear with your fingers, or with a hearing aid, less of your voice escapes outward

A lady removed her hearing aid in the bathroom and dropped it. She couldn't find it and figured it might have fallen into the sink trap. A plumber took the trap off but the hearing aid wasn't there, so they tried the toilet. The aid wasn't stuck in the toilet plumbing either. A month later when she getting ready to do laundry, she found the hearing aid in the hem of her pants.

and more goes inward to your hearing mechanism. This is one of the reasons for a hearing aid vent.

If You Are Going To The Hospital

Hearing loss is invisible and not often understood by those with normal hearing. Doctors and nurses may not be aware of your hearing difficulties. Many hearing impaired people feel that their hearing worsens when they are ill. Their hearing may not actually be poorer, but those with impaired hearing have to exert more effort to understand what is said, increasing their cognitive load. When you are ill, this is harder to do and you cannot devote the same energies to trying to hear what is said.

- Tell the nurses and aides that you have a hearing loss. Don't assume they know.

- Ask that the International Symbol for hearing impairment be placed on your chart and door as a reminder to the hospital staff.

- Hearing aids have a tendency to get lost during hospital stays. When off your ears, place them in a special container with your name on it. By all means, do not wrap them in a tissue and place the tissue on the bedside stand. Tissues tend to get swiped into the trash.

- Ask for assistive listening devices for the television and telephone.

4—It Isn't Often Like Normal Hearing

Two Things That are Different are not the Same

Even a person with excellent hearing will mishear things. Here are two examples of commonly misunderstood song lyrics.

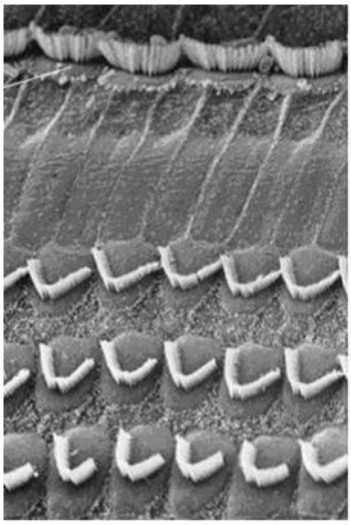
> The actual words: "There's a bad moon on the rise."
> What some people hear: "There's a bathroom on the right."
>
> The actual words: "The girl with kaleidoscope eyes."
> What some people hear: "The girl with colitis goes by."

Don't expect that you will hear every word correctly with your hearing aids, even if you do actually hear perfectly well with them— and most people do not hear perfectly well with hearing aids. Some people hear very poorly even with hearing aids, although most people fall somewhere in the middle.

A Little Background

Just as there are two types of sensory cells in the retina of the eye: the rods and cones, there are two types of sensory cells in the cochlea of the inner ear: the inner hair cells and outer hair cells.

Inner hair cells are called that because they are located along the inner spiral of the cochlea of the inner ear, while the three rows of outer hair cells are located along the outer portion of that spiral. They are called hair cells because under a microscope the cilia projecting from their top look like hairs. Incidentally, there is no other way to actually see hair cells other than under a microscope. They don't show up on X-rays or other imaging techniques while they are still in your head. Since we are not going to remove your hair cells and put them under a microscope, the only way to infer their condition is through hearing tests.



Ninety-five percent of the auditory nerve fibers that lead from the cochlea to the brain are served by the inner hair cells (IHCs), which number about 3000 per ear. The IHCs are responsible for coding most of the sound information from the ear to the brain.

The above picture shows three rows of outer hair cells and a single row of inner hair cells, looking down on the tops of the cells from above and seeing the cilia. The cilia of the outer hair cells form a "W" pattern.

The outer hair cells (OHCs) number about 15,000 per ear and actually have both a sensory and a mechanical function. This mechanical function of the OHCs is referred to as electromotility. OHCs actually move – they move more than what could be caused by the incoming sound; they move under their own energy (think of a muscle). No other sensory cell in the body does this. **OHCs amplify soft sound so that the IHCs can be stimulated.** This OHC motility is how the ear can respond to extremely soft sound, sound so soft that it moves your eardrum less than the diameter of a hydrogen molecule.

Why is this important to how well you will hear with hearing aids? The part of the ear corresponding to your hearing impairment has a great deal to do with how well you might hear with hearing aids and to how your hearing aid should be adjusted. When the reason for the hearing loss is in the middle ear, it is called a conductive hearing loss.

If adjusted properly, hearing aids can make someone with conductive hearing loss, but normal hair cells and central auditory system, hear perfectly. On my scale of 0 to 10, hearing aids for conductive hearing loss can make you hear 10. With solely conductive hearing loss, there is little or no compression used in the hearing aid except for limiting the maximum hearing aid output.

Compression is a means of squeezing loud sound and soft sound closer together. In this manner, the hearing aid amplifies soft sound more than it amplifies loud sound.

When the reason for the hearing loss is solely the outer hair cells, which is the most common hearing loss, hearing aids can do very well, partially because we have learned how use compression to amplify soft sound in a manner similar to the OHCs. On my 0 to 10 scale, hearing aids for outer hair cell loss can make you hear at 8 or 9.

For the purpose of fitting hearing aids, inner hair cells can be considered like the nerves and central auditory system - hearing aids don't do as well in this case. On my 0 to 10 scale there is a wide range, from 1 to 7 depending on the amount of inner hair cell impairment and the details of that impairment. With no inner hair cells or no nerves communicating with those inner hair cells (only the outer hair cells are working), then the distinctness of hearing with a hearing aid can be very low. With no, and I mean zero, inner hair cells and no outer hair cells working, you are not going to hear with a standard hearing aid. A cochlear implant might work however.

Some are under the mistaken assumption that if hearing aids cannot make you understand words in isolation without visual cues, that hearing aids are not indicated. There are hearing impaired people who wear, and derive significant benefit from, hearing aids even though they are not able to understand words in isolation with those hearing aids, and they would be devastated if you took away their hearing aids. With hearing aids, they can piece together with visual

cues what someone is saying much of the time. Without hearing aids, they might understand half of what they understand with hearing aids.

One should not also underestimate the value of being auditorily "plugged in" to the world: being able to hear a car coming, being able to hear the baby crying, and being able to hear the dog bark. Many severely hearing impaired people may not be able to turn their back to you and understand if you uttered the word "bus," the word "cup," or the word "yes," but they know you didn't utter the words "French fries," and they don't like the dead silence feeling they have without hearing aids.

Many people with sensory hearing loss have both outer and inner hair cell impairment, and there are many instances where it isn't actually the hair cells themselves that are not working, it is their supportive system. For example, the stria vascularis is a capillary bed in the cochlea that nourishes and readies the hair cells for work. The stria vascularis is often what is impaired in sensory hearing loss, but the result is the same; the hair cells aren't quite capable of doing the work they can do otherwise (but hearing aids can help significantly).

When we evaluate you for hearing aids, we don't think in anatomical terms so much, but instead look at your hearing functionally. One of the tests that is somewhat predictive of how well you will do with hearing aids is the word recognition test, often called the speech discrimination test.

Most word recognition tests are single syllable wordlists where the examiner says a word and you repeat what you think you heard. At the end of the test, a score is tallied that ranges from 0% to 100%, with 100% meaning that all of the words in the wordlists were correctly repeated. Someone with a 100% person speech recognition score will understand more with hearing aids than will someone with a 0% score.

If you a have pure tone thresholds of 90 dB at most frequencies and a speech recognition score of 0%, you probably have some outer and inner hair cell impairment, and you are not going to hear as well with hearing aids as some with 40 dB thresholds and a speech discrimination score of 96%.

Second Opinion

A successful hearing aid fitting depends on many pieces of information about your hearing getting put together with many pieces of a hearing aid fitting. How do you know if you are hearing as well as possible with hearing aids, and that your hearing aids are adjusted ideally for you?

You won't know by talking to your hearing impaired friends. Their hearing is not like your hearing. And even if their hearing were like yours, patient reports can vary. We have fit some people with hearing aids whose hearing ability went from a 5 to 7 and they were ecstatic and loved

their hearing aids. We have others whose hearing went from a 5 to 9 but who hated their hearing aids and felt they should hear better.

If you went to an expert in hearing and hearing aids, if your hearing evaluation was thorough, if your hearing aids' performance was evaluated on your ear and referenced to your unaided hearing evaluation, if you went back for follow up and reported to your Audiologist about your initial experience with the hearing aids, then the hearing aids are probably set ideally for your hearing.

If you are concerned about whether you are getting the maximum from hearing aids, if the person who fit your hearing aids did not verify in some manner how the hearing aids are performing when actually in your ear (beyond asking how they sound to you), it is reasonable to have another look at your fitting. If you do this (go to another person for a second opinion about your fitting), expect that they will start at the beginning. If you are not hearing as well as you could with hearing aids, that reason could be how the hearing aids are fit, but it also could be because the fitting is based on a faulty or incomplete hearing evaluation, or it could be because your hearing has changed since you first got your hearing aids. The second opinion will likely start with Step #1 (a complete hearing evaluation).

What sounds 'normal' to many hearing impaired people is how they hear without hearing aids, or how they heard with their old hearing aids. New hearing aids won't necessarily sound normal to you.

We want to emphasize that this probably isn't the case. That is, the hearing test is probably accurate and the fitting probably appropriate. However, fitting hearing aids to impaired ears is a matter of many detailed ingredients and we can sometimes fail to get every detail correct. Having a second person take another look at the fitting can sometimes uncover something that might help.

It is also reasonable to go back to the same person that evaluated your hearing and fit your hearing aid and ask that he or she take another look at everything. This is especially reasonable if you do not live in an area with more than one specialist.

Even if you think that things are going well and that the aids are working properly for you, hearing changes, ear canals change shape, and other things may happen. Go back periodically and have things checked. At least yearly have your hearing aid checked and your ear canal checked, and at least every two years have your hearing checked. Sometimes you'll want these follow-up rechecks done sooner.

Suggestions For Talking To A Hearing Impaired Person

One of my (gh) more memorable couples came to see me about "their" hearing. When the husband came to the examination room he said: "My hearing is ok, but my wife is driving me crazy. She doesn't hear a thing I say."

When the husband's exam was done, the wife came back for her exam. She said: "My hearing is ok, but my husband is driving me crazy. He doesn't hear a thing I say."

Both had significant hearing loss, but the husband thought that he heard ok and the wife thought she heard ok. It reminds me of the joke where a husband stood 30 feet behind his wife and said: "Can you hear me?"

No answer.

He moved to 15 feet away from his wife and said "Can you hear me?"

Still no answer.

Now he moved within three feet of his wife and asked if she could hear him. Her reply was, "For the third time, I can hear you."

When you talk with strangers you talk directly to them, facing them, perhaps at a distance of about three to five feet. When talking to your family however, it is common that you talk to them when your back is turned, when their favorite TV show is on, or while looking out the window of the car. Even with well-fit hearing aids, many hearing impaired do not hear as well as someone with perfect hearing, particularly in difficult listening situations.

- Talk directly to the person. If you are facing them they not only get a better speech signal, they can make use of the visual cues of speech. About 30 percent of speech sounds are visible on the face and most people, even normal hearing people, can make use of at least some of these visual cues.

- Position yourself at the same height as the hearing impaired person.

- Move closer, try to get closer to the person talking. If you're 8 ft from someone and you move to within 4 ft, you voice is significantly easier to understand.

- Talk at a normal, or *slightly* above normal, loudness. Shouted speech is difficult to understand, and soft speech may still be difficult for some aided individuals.

- Do not talk too fast, but not too slow either. No hearing aid in the world will slow down fast speech. Slow, exaggerated speech is also difficult to hear.

- If the person does not understand you or asks you to repeat, it may not help to raise your voice. When your raise your voice, your articulation often suffers, but you also raise mostly the vowel sounds of speech (predominantly low frequency) and not the consonants (predominantly high frequency). Most hearing impaired need just some of the frequencies of speech raised and that is the job of the hearing aid, and the hearing aid is probably al-

ready doing that. So, if you are asked for a repeat, remember that even some normal hearing individuals need a repeat sometimes. Try rewording what you said. For example, if you said: “It is supposed to rain today.” When you have to repeat it you might consider saying, “The weather report this morning said that we are supposed to get some rain.”

- Speak clearly. Again, you don’t need to exaggerate, but there is a difference between clearly spoken speech and mumbled speech.

Suggestions for the Hearing Impaired Person

- If you are the hearing impaired person, it is helpful to tell the talker what part of their conversation you understood and what part you did not. When all else fails, ask them to spell a key word.

- Move closer.

- Quiet the room—When you walk into a restaurant and hear loud music, what do you do? If you explain that music makes speech comprehension virtually impossible, the manager may graciously comply with your request– and other diners will thank you.

- Ask for the quietest table. Seat your self in the center of your group, where it’s easier for you to see and hear everyone.

- At home the television should be turned down or off when you are conversing with someone, or try to move your personal conversation to a quieter area in the house.

Some Other Avenues to Better Hearing

Telephone

You can purchase amplified telephones that will work better for telephone conversations than your hearing aids. These sometimes come with volume controls, and sometimes tone controls that adjust the frequency response. 30 dB of amplification on the phone is plenty for most people but some amplified telephones are even stronger. You can get amplified telephones in the corded and cordless variety.

Cordless phones and cell phones can give off enough electronic interference/noise that some hearing aids may respond to that electronic interference with noise. If you are going to leave your hearing aid on when talking on the phone, try the phone with your hearing aid to make sure that the phone is compatible with your hearing aid. Most newer hearing aids are shielded against the electromagnetic radiation of cell phones.

There are also now captioning phones that display on a screen the persons words who you are

talking with. They may require an internet connection along with a telephone connection.

If you are going to leave your hearing aids in when you talk on the phone, and after all it is a nuisance to remove them and some people work on the phone, there are various ways to use the phone with a hearing aid.

If you have an "open-fit" BTE hearing aid, one where the ear canal is not occluded, you may be able to hold the phone to your ear just as you would without the hearing aid. You can hear the phone just as you would without the hearing aid in this manner, and since the microphone of a BTE hearing aid is located near the top of the ear, feedback does not usually occur.

For other fittings, where the ear canal is not open, you may be able to hear by holding the phone over the microphone of the hearing aid. If you don't take a lot of power/gain from a hearing aid (you have a mild hearing loss), you may be able to hold the phone receiver to the microphone of the hearing aid without feedback. Feedback produces a "squealing" sound. If your hearing aid feeds back when you cover it with the phone, you can try tilting the phone slightly so that only part of the phone is actually covering your ear.

If you are unable to hear well by covering the microphone of the hearing aid, you might need to use a telecoil (telephone coil). A telecoil is a magnet wrapped in wire that senses electrical information from the telephone receiver. Some hearing aids have telecoils and some do not. This is a consideration to address prior to ordering the hearing aid as a telecoil cannot always be added after the hearing aid has been made.

A telecoil is an induction coil. It is a magnet wrapped in wire that respond to the magnetic receiver of the telephone.

When the telecoil is turned on , the hearing aid microphone is usually disabled or turned down (there are exceptions). With the microphone off, the aid will not feedback when the phone is held to the hearing aid. The magnet of the phone receiver needs to align with the telecoil and so you may need to experiment with exactly where to hold the phone for best reception.

Some telecoils are switched on manually by the hearing aid wearer and other telecoils come on automatically when the phone is held close to the ear.

Telecoils can be used for purposes other than just with telephones, as discussed in the next section.

Telecoil/Induction Coil and Other Ways of Improving the Signal

The more background noise, the longer the distance from the speaker, or the more the reverberation (large rooms will usually have a lot of reverberation, especially if the walls are hard and reflective) the greater the chances that the hearing aid wearer will have difficulty under-

standing what is being said. The more things there are to listen to, the more difficult it is for an impaired ear to handle these multiple signals.

There are several types of assistive systems that can help in large rooms, like houses of worship, or in even small noisy rooms like a classroom: infrared (IR), radio signal (usually FM), direct audio input (DAI), and induction loop systems. All of these can perform better than hearing aids alone because the microphone of the assistive system is close to the source of what you are listening to. So if the microphone is on a preacher's shirt and you are using one of these systems, it will be like he is talking to you from 1 foot away (or whatever distance his mouth is away from the microphone).

Many hearing aids are made with telecoils and will work with induction loop systems.

In a public address (PA) system, there is a microphone, amplifier, and loudspeaker. In an induction loop system, there is a microphone, amplifier, and signal-transmitting wire looped around the room. This loop transmits an electro-magnetic signal. If your hearing aid has a telecoil, it is capable of picking up the signal that the loop system is sending. There will be less noise and less reverberation in the telecoil/loop system arrangement than listening through the microphone of the hearing aid – because the microphone of the loop system is so near to the talker.

What's the catch? The room has to be set up with an induction loop system, common in many European countries but not so much in the United States. And your hearing aid has to have a telecoil.

FM (radio signal) and IR (Infra-red) systems offer the advantage of a loop system, but hearing aids do not have FM or IR receivers, and so they must be removed and an FM or IR receiver worn when using these other methods.

With direct audio input (DAI) the hearing aid either connects physically with a wire to the microphone, or the hearing aid connects with a wire to an FM or IR receiver. These are most common with behind-the-ear hearing aids and are seen commonly in the classroom. Bluetooth systems are similar to FM systems.

Bluetooth

Bluetooth is a wireless technology that uses radio waves to exchange information over short distances. In hearing aids, the bluetooth hearing aid is "paired" or "synced" with a bluetooth phone or remote control. The remote control can be used to make adjustments to the hearing aid, but sometimes can also be paired/synced to another device like a cell phone.

So hearing aids can be synced with cell phones directly, or to a remote control that is synced with a cell phone. In this manner, the phone call can be heard directly through the hearing aid, or you can even stream music from your phone into the hearing aid!

Implantable Hearing Aids

The cochlear implant is the most common type of implantable hearing aid. Its most common indication is when a person's hearing with a standard hearing aid is projected to be worse than what their hearing would be like with a cochlear implant. The pure tone audiogram and speech discrimination test scores figure into this decision, but the person also has to be able to withstand the surgery and travel for follow up. Cochlear implants are specialized, require both an Otologist and Audiologist, and aren't available on every street corner. In West Virginia, for example, there are only 4 practice groups that provide cochlear implants.

With a cochlear implant, there is a microphone and amplifier/sound processer (just like with a standard hearing aid), but there are electrodes implanted in the cochlea of the inner ear. These electrodes stimulate the nerves that ordinarily would be stimulated by the inner hair cells. The electrodes are surgically implanted, but couple (connect) with an external sound processor that is worn outside the body, commonly on the ear like a standard hearing aid.

Alerting Devices

There are a variety of alerting devices designed to alert the hearing impaired individual that something has happened, with that something being: a phone is ringing, the doorbell is ringing, the baby is crying, the alarm clock is ringing, etc. The following examples are not exhaustive of all the choices.

The average hearing impaired person hears low-frequency sound better than high-frequency sound. Most smoke detectors produce a high-frequency sound. That high frequency sound is very loud, but still not audible to some hearing impaired. A smoke detector that produces a low-frequency sound has a better chance of being heard by hearing impaired people.

Your typical smoke detector produces a very intense, high frequency sound when smoke is detected. Not all hearing impaired people can hear that sound, especially without hearing aids. Some smoke detectors produce a low frequency sound that is usually much more audible to hearing impaired people, since the most common hearing loss is worse in the high frequencies than the low. Other smoke detectors for the hearing impaired will flash a strobe light.

The alarm clock for the hearing impaired is usually very loud, flashes a light, or initiates a vibrator. The vibrator can be put under the pillow, but some are designed to actually vibrate the mattress when the alarm goes off.

Normal doorbells also usually produce a high frequency sound that is not readily heard by many hearing impaired. Door knockers might be an inexpensive try for the hearing impaired. A door knocker where a metal piece is banged against another metal piece produces a sound

that is spread out over a wide range of frequencies and is often easier to hear than a doorbell. Even a good tap on the door with your knuckles may be easier to hear than the doorbell. Doorbells made for the hearing impaired will usually flash a light, or multiple lights.

With baby-cry-detectors a microphone is placed in the room where the baby sleeps. The microphone often has a sensitivity adjustment so that it will pick up the baby's cry, but not be set off by a passing car. The microphone has a transmitter that sends a signal to the receiver that is often in the parents' room and connected to a light that then flashes when the baby cries.

Aural Rehabilitation

This term implies anything we do to overcome the impact of impaired hearing. Our first line of treatment toward aural rehabilitation is hearing aids, and making sure that the sound arriving at the eardrum from the hearing aids is the correct sound, and also that the wearer is using the hearing aid properly. Many people hear extremely well with hearing aids. They can do everything that a normal hearing person does and do not need further aural rehabilitation.

Some do not hear well with hearing aids, even when those hearing aids are used properly, and can benefit from counseling, vocational guidance, speechreading (lipreading) training, and auditory training. Counseling can be as simple as suggesting that the person with single sided deafness not be shy about telling people that he or she needs to sit with the better hearing ear toward everyone else at a restaurant. Even simple things like having the person with impaired hearing prevail on their friends to get the closed-captioning working on their television can make a big difference to quality of life. I have had people, who had trouble using the telephone in the normal one-eared manner, do well after getting a speaker phone so that they could hear the telephone with both ears (and both hearing aids).

Everyone can read lips—speechread—to an extent, but there is a lot of variability from one person to the next in just how well different people can do this. Younger adults will do better at speech reading than their older counterparts, who might benefit from training in this regard.

I think of auditory training as the counterpart to Auditory Deprivation. Auditory Deprivation occurs as a result of not using one's hearing system. Auditory training uses, stimulates, and challenges the hearing system—exercises it, if you will. There are several computer applications that provide lipreading and/or auditory training materials. This includes:

- LACE—Listening and Communication Enhancement. Intended to retrain the brain to comprehend speech up to 40% better in difficult listening situations by improving processing speed and working memory. www.neurotone.com/lace.

- NAL Listen and Learn—Designed to train children (but can be used with adults) who are experiencing listening difficulties in the classroom. This was developed for those children who have spatial processing disorder (SPD). Those with SPD are less able than their peers to se-

lectively attend to sound coming from one location and suppress noise coming from another location. http://capd.nal.gov.au/lisn-learn-about.shtml.

- CAST—Computer-Aided Speechreading Training. An interactive, automated course that simulates face-to-face speechreading training.

- Seeing and Hearing Speech—Distributed by the Sensimetrics Corporation. www.seeingspeech.com.

- Conversation Made Easy—Published by the Central Institute for the Deaf in St. Louis. There are 24 exercises consisting of tasks that require consonant discrimination. You have the option of just listening, just looking, or both.

- Sound and Beyond—An auditory training program designed for cochlear implant user but may also be useful for standard hearing aid users with severe and worse hearing loss.

- Music training : Intriguing research continues to focus on music, the brain, and music's potential in honing auditory acuity, including speech-in-noise performance and the enhancement of listening abilities (Kraus and Anderson, 2014). And according to a 2014 study from the University of Vermont College of Medicine, learning to play the violin or piano might help kids' brains by giving them some added benefits in brain development.

Having said all this about auditory training, don't think that if you only tried hard enough, or if your family member only tried hard enough, they could hear better. No amount of auditory training can make you hear a sound that you cannot hear. But also do not expect to get the most from your hearing aids if you wear them only on Sunday mornings.

Having said all this about auditory training, don't think that if you only tried hard enough, or if your family member tried hard enough, they could hear better. No amount of auditory training can make you hear a sound that you cannot hear. But also do not expect to get the most from your hearing aids if you wear them only on Sunday mornings.

5—Batteries

Hearing loss separates us from people—Helen Keller

Most hearing aid wearers put a lot of focus on batteries. If a purist looks at this chapter, he/she will say that to be accurate they should be called “button cells.” We are going to call them batteries.

Hearing aid batteries range in size from 3 millimeters thick by about 5 mm in diameter for the smallest battery, the size 10, to the largest battery that measures about 5 by 11 millimeters, a 675 battery. Batteries of this size could power your watch a year or so, but hearing aids use a lot more power than watches.

Hearing aid batteries are not like watch batteries in materials or voltage, and they are less expensive than watch batteries. How quickly the battery is used depends on a number of factors, including the size of the battery. The largest battery is a 675 and might, MIGHT, last two or three weeks in a hearing aid. The smallest battery is size 10 and will generally last between two to five days. Other factors that affect battery life include, but are not limited to, how much electrical current your hearing aid draws from the battery and how fresh the battery is.

In some hearing aids how much noise you are around also affects battery life. If a hearing aid is squealing (feedback) or almost squealing it will draw more battery power. If you wear your hearing aid 24 hours a day, your battery will not last as many days as someone with the same hearing aid but who wears the hearing aid ten hours a day (please don’t use this as an excuse not to wear your hearing aids!).

There are hearing aids designed to be placed and worn in your ear for months before having the aid removed and replaced. In other words, the battery in these extended wear hearing aids lasts several months, and the aids are not designed to be removed by the wearer. There is a trade-off between this convenience of not having to change the battery, and having to keep the hearing aid in your ear 24 hours a day. In our way of thinking, not having to change the battery is not worth the trade off of having to leave the aid in your ear for 24 hours a day and then having to go to the specialist to have the aid removed and reinserted. As you know by now, we advocate removing your aid over night and giving the skin of your ear canal a chance to ”breathe”.

Modern hearing aid batteries are zinc-air and have a voltage of about 1.35 to 1.4 volts. Batteries of years past were mercury or silver oxide and had a much smaller capacity than current batteries. Most hearing aids stop working when the battery voltage drops below 1.2 volts. Making a digital hearing aid amplifier work on these small voltages was one of the hearing aid industry's shining moments.

Hearing aid batteries come in four sizes, from smallest to largest: 10, 312, 13 and 675. (There is also actually a size 5 that is smaller than a 10 but you hardly ever see that.) Don't worry about the letter before or after the size number; for example, 10A is the same size and power as S10. It is the number (10, 312, 13, 675) that dictates what you need.

One of my patients had new hearing aids that would have a male voice say the word "battery" when the battery was about to stop working. It did this in church to her surprise (either I had failed to demonstrate how the aid would do this or she forgot). She turned to her husband and said "God is talking to me".
"What did he say," he asked?
"He told me to change my battery".

True story

Don't bother trying to using a watch battery. Besides being more expensive than a hearing aid battery, a watch battery voltage is usually 1.5 volts. In old hearing aids this increased voltage could actually make the hearing aid produce a bit more power. The few times we've seen a watch battery in a newer (digital) hearing aid, the hearing aid simply would not work on that battery.

What is the sticker on the battery?

Hearing aid batteries are called zinc-air because air is an active ingredient in making the battery work. The colored tab (sticker) on the battery is designed to keep air out of the hearing aid battery. This tab prevents air from entering the battery and activating it before it is ready to be used. Removing the tab activates the battery and makes it ready to use in your hearing aid.

If you look closely at the battery once the sticker is removed, you will see that one side of the battery has an air hole or even several air holes. In some hearing aids, you may have to give the battery up to a minute to fully come to charge once you have removed the sticker and allowed air to start entering the battery.

Some people will take the sticker tab off of a new battery and place the sticker on the calendar as soon as they put the battery in their hearing aid. They keep track of when to change the battery or how long the battery lasts in this manner. Once they are familiar with their hearing aid, they know how long a battery lasts, and they might change it before the battery goes dead. Some people change their battery every Sunday morning before church.

Battery manufacturers recommend letting your battery sit about a minute once you remove the sticker/tab before putting the battery in the hearing aid. Giving the battery that extra minute allows air to enter and fully activate your battery.

Do not remove the sticker until you need a battery. The sticker extends the shelf-life of the battery.

Don't Skimp On Batteries

You have paid thousands of dollars for a hearing aid and your hearing aid should be worn. Don't avoid wearing the hearing aid just because you want to get a few days longer on a battery. Even if there is no one to talk to, you need to hear if the doorbell rings, you need to be able to turn the TV volume down to a level that the neighbors don't hear, and you need to hear when the microwave oven "beeps."

Once you have taken the sticker off of a hearing aid battery, that battery will slowly discharge even if not in use. So even if you are wearing your hearing aid only occasionally to keep from using the battery, that battery is probably not going to last longer than a month or so once the sticker has been removed.

Checking The Battery

There are two ways to check if a battery is good or not. One way is: if the hearing aid is working properly, then the battery is ok. The problem with this method is that if the hearing aid is not working, you don't know if the problem is the hearing aid or the battery.

A better way to check the battery is with a voltmeter. You can purchase a meter made just for checking hearing aid batteries. These usually show "good" when the battery is ok. You can also get a regular volt meter.

If you use a hearing aid battery tester you will learn how far up into the "good" region the needle moves when the battery is fresh. Usually the batteries will not peg the needle all the way into the "good" region.

If you use a voltmeter, a fresh battery will show about 1.35 to 1.4 volts. Most hearing aids will not work once the battery drops below 1.2 volts. Battery voltage is usually very stable up to within minutes of the battery going below a usable voltage. If your voltmeter has a setting for checking batteries, do not use it because this setting drains more current than appropriate for hearing aid batteries; use the DC voltage setting. When you check a battery, hold the leads to the battery for a few seconds to make sure that the meter needle stays in the good region. Sometimes a weak battery can spontaneously renew enough to show a good voltage for a few seconds, but it won't last longer than a few seconds.

Throw Away Used Zinc-Air Batteries

- Zinc air batteries are not recycled; throw them away in the trash.
- Do not leave them laying around where a child or pet can get them and swallow them.
- Do not leave them laying around where you might confuse them with a new battery and try to use them again.
- A spent battery can spontaneously regain enough power to work your hearing aid a few seconds or more. Throw the battery away.
- Store batteries at room temperature. Refrigeration is not recommended for zinc-air batteries.
- Change the battery over a table or desk. This will help keep the battery from falling to the floor. If it does fall to the floor, a magnet will pick it up.
- Do not carry loose batteries in your pocket since metal objects such as coins or keys can short out batteries.
- Most modern hearing aids are designed to produce a low battery signal whenever the battery needs to be changed. In other words, some hearing aids will make a noise in your ear or even have a voice that says “battery” when the aid recognizes that the battery is about to go dead. Sometimes, however, that battery can go dead so fast that the hearing aid does not have time to produce a low battery signal.

Fresh Batteries

The length of time a hearing aid battery stays on the shelf can make a big difference to how long that battery lasts in your hearing aid. Battery manufacturers put a shelf-life date between three to four years after the battery is made; that is, they rate the shelf life of the zinc-air battery up to almost four years.

We think that is optimistic. A two-year-old battery will not last as long as a two-month-old battery, especially in the smallest size (10).

Old batteries will sometimes have a powdery substance on them,

like that seen on this picture, or be swollen. Do not use them.

Factors Affecting How Long A hearing Aid Battery Lasts

- Amount of hearing loss—as severity increases, increased amplification is required, increasing the battery drain and reducing battery life.
- The battery size.
- An individuals hearing aid usage—Some people wear their hearing aids 24 hours a day, some 8 hours a day.
- Differences between hearing aids and their features—Things like noise cancellation, wireless and bluetooth features, anti-feedback controls, tinnitus sounds.
- Streaming from external devices to your hearing aid will use the battery faster.
- Environment—Extremes in humidity, low or high, temperature and altitude. As temperature is reduced hearing aid battery voltage is lowered, reducing battery life. As altitude increases the percentage of oxygen in the air reduces, lowering battery voltage, causing the battery to reach its endpoint sooner.
- Freshness of the batteries.
- When the colored tab is removed. The colored tab on the zinc-air battery is covering air holes. Once the tab is removed the battery is activated and the life cycle of that battery starts accelerating.

Rechargeable Batteries

Many hearing aids can be obtained with rechargeable batteries. These have been around for years but have improved in ease of use and hours of use per charge. However, rechargeable batteries are still not as commonly used as standard hearing aid batteries.

Keep in mind that, since most rechargeable batteries won't power your hearing aid over 20 hours before needing charged, you may still need to have a few conventional zinc-air batteries around in case you don't get your rechargeable batteries charged for some reason (for example, if the electricity goes out).

Rechargeable batteries also need to be replaced. A year is a commonly given period of replacement time for a rechargeable battery, but sometimes the battery life is given in the number of charges. In other words, a rechargeable battery may be good for 400 charges. This means that

if you take the aid off in the afternoon for a nap, that you shouldn't put the aid back in the charger because doing say may be reducing the battery life. That is, charge the battery once a day—not twice a day. If you charge it twice a day you are reducing its life.

Rechargeable batteries are currently not available for small hearing aids like the CIC (completely-in-the-canal) that use a size 10.

If you do have an aid with a rechargeable battery you have the convenience of not having to change the battery very often, a definite plus for some who lacks the dexterity or sight to do so. However, you may still want to open the battery every few weeks or so and wipe the battery with a clean cloth. Batteries will accumulate moisture and other debris, and wiping a rechargeable battery off occasionally will make sure that it will continue to work properly.

What To Do If A Hearing Aid Battery Is Swallowed

Yep, this happens. Kids will put anything in their mouth, especially if it is the size of a skittle. Do not leave batteries laying around where a child or pet can get them. I've occasionally had adults swallow batteries because they looked about the same size and shape of their medicine.

Do not store batteries with your medicines and do not let young children handle batteries as they have a tendency to put things in their mouth.

If a battery is swallowed, *From the National Capital Poison Center:*

- Call the 24-hour National Button Battery Ingestion Hotline at 202-625-3333 immediately.

- If available, provide that battery identification number from the package or from a matching battery (Hearing aid batteries are zinc-air, size 10, 312, 13 or 675.)

- An X-ray must be obtained immediately to be sure that the battery has gone through the esophagus into the stomach. Do not wait for symptoms to develop before getting an X-ray. If the battery remains in the esophagus, it must be removed immediately. CAUTION: Batteries lodged in the esophagus can cause severe burns in just two hours. Battery removal is done with an endoscope; surgery is rarely indicated. Do NOT give ipecac to induce vomiting.

- If a battery has moved beyond the esophagus, it can be expected to pass by itself. Passage may take many days, or even months. Removal is NOT indicated if the battery has passed beyond the esophagus and the patient is asymptomatic. Once you are sure the battery is not in the esophagus, the patient can be sent home to wait for the battery to pass. Continue to watch for fever, abdominal pain, vomiting, or blood in the stools.

- Send passed battery to:

  National Capital Poison Center
  3201 New Mexico Ave. Suite 310
  Washington, DC 20016

Glossary

Acoustic Nerve – The branch of Cranial Nerve VIII that serves hearing and innervates the hair cells of the cochlea. The vestibular branches of Cranial Nerve VIII serve the balance system of the inner ear.

Acoustic Trauma—Hearing loss resulting from a brief but very intense sound, often an explosive sound.

Acoustic Tumor—Neoplasm of the VIIIth cranial nerve (the hearing and vestibular nerve). Often referred to as acoustic neuroma or vestibular Schwannoma. The initial symptom of this is usually unilateral (one ear only) hearing loss.

Air Conduction – Refers to sound that is transmitted (conducted) to the ear through the air, which is how we ordinarily think of how we hear sound. Some hearing tests use air conduction and some use bone conduction. Most hearing aids are air conduction hearing aids, but a few transmit sound via bone conduction.

Air-bone gap—Difference in dB (decibels) between air-conducted and bone-conducted hearing thresholds. It is used to describe the magnitude of conductive hearing loss. (from Stach)

Arn—A metallic instrument used to press clothing; when combined with TAR, which is what a pickup runs on four of, you have TAR ARN, a formidable weapon.

Assistive Listening Device—A sound amplifying device that is not custom fit to a patient's ear and is usually not adjusted to a patient's audiogram. One example of this would be an infra-red system where the microphone is placed on the preacher's stand and that microphone transmits the preacher's voice via infra-red light to a receiving device worn by the church member.

Audible – Heard. The detection of a sound.

Audiogram – 1. Graph showing your hearing sensitivity as a function of frequency. 2. Graph showing the measurement results of your hearing evaluation.

Audiologist – Specialist in hearing, hearing aids, and balance. They will have completed an advanced college degree in the study of audiology. They are the only professional with college courses and experience in both hearing and hearing aids.

Auditory Deprivation – Decrease in auditory performance (ability to understand words and use sound) associated with lack of use of one's hearing. Decrease in auditory performance as a result of the reduced availability of sound to the auditory system.

Auditory Neuropathy – Sometimes called Auditory Dysynchrony or Central Auditory Deficit. Disorder of the acoustic nerve and/or structures associated with the acoustic nerve, including the inner hair cells. It results in greater real-world hearing difficulty than one would expect on the basis of the pure tone audiogram (and hearing sensitivity) alone.

Aural Rehabilitation – Treatment of persons with adventitious hearing impairment to improve the efficacy of overall communication ability, including the use of hearing aids, auditory training, speechreading, counseling, and guidance.

From Comprehensive Dictionary of Audiology Illustrated. Brad Stach. Thomson Delmar Learning,. 2003.

BAHA—Originally referred to as Bone Anchored Hearing Aid. Bone conduction hearing aid in which, in its usual manner, a metal screw is anchored in the mastoid bone of the ear. It is designed originally for conductive hearing loss due to intractable middle ear disease, but can also be used for single–sided deafness. In children it can also be coupled to the head with a headband instead of a metal screw.

BCHIS – Board Certified Hearing Instrument Specialist. The International Hearing Society Board certifies hearing aid dispensers who have two years of supervised experience and have passed a national exam.

Best Hearing Aid – 1. There is no such thing. 2. The hearing aid that you will use and that maximizes your residual hearing.

Bilateral – Pertaining to two sides, or two ears.

Binaural – Both ears.

Cerumen – Yellow to brown wax-like substance (earwax) secreted in the outer one-third of the ear canal by sebaceous glands and modified apocrine sweat glands. These are sometimes collectively called cerumenous glands.

Cochlea – The hearing part of the inner ear.

Cochlear Implant - Special type of hearing aid where the microphone and amplifier/processor is worn externally, usually on the pinna, but an electrode array is surgically implanted into the cochlea and the electrode array is driven by the hearing aid amplifier. In standard hearing aids, the amplifier drives a receiver.

Compression – Can be used to limit how intense a loud sound can get (compression limiting), or it can be used to squeeze loud and soft sounds together into a smaller range to better match the dynamic range of a hearing-impaired person.

Conductive Hearing Loss – Hearing loss in which there is a breakdown or obstruction in the sound transmission system of the outer and/or middle ear.

Decibel (dB) – A unit of measure of sound pressure. We hear changes in sound pressure as changes in loudness. When used to measure hearing, it is usually a decibel called dB HTL (hearing threshold level) that references human hearing. Most often in hearing aids we use dB SPL (sound pressure level).

Directional Microphone – A microphone, or usually 2-microphone system, designed to give preference to a certain direction. A hearing aid with a directional microphone system can give more emphasis to sound in one direction, usually (but not always) the front of the wearer, than from another direction, usually the back of the wearer (since the wearer is most often facing what they want to hear best).

Earmold – These are used with behind-the-ear (BTE) hearing aids, attaching to the BTE aid with a tube. They are made of plastic which has been shaped from an impression of your ear to fit the shape of your ear.

Eustachian tube—Passageway leading from the back of the nasal cavity to the middle ear. Its purpose is to equalize air pressure in the middle ear; that is, make the air pressure within the middle ear space the same as the air pressure in the environment.

Eustachian Tube Dysfunction—Impairment in the proper functioning of the eustachian tube resulting in negative middle ear air pressure. If the negative middle ear air pressure becomes great enough or lasts long enough, fluid collects within the middle ear space.

Faceplate – Attaches to the shell of the hearing aid. The microphone physically attaches to the faceplate and the battery is inserted into the faceplate. It is the portion of an in-the-ear hearing aid that does not touch the skin when the aid is in place.

Feedback - Sometimes called oscillation or feedback squeal. It is the noise that a hearing aid makes when the sound coming from the receiver (hearing aid speaker) gets back into the microphone and keeps getting re-amplified.

Feesh—Aquatic animals.

Frequency – Sound is characterized by repetitions of sound waves, with the number of those repetitions in a second being the frequency. We hear changes in frequency as changes in pitch. The frequency of sound is described in Hertz (Hz).

Gain—Acoustic gain in a hearing aid is the difference in dB (decibels) between the input to the microphone and output of the receiver (loudspeaker).

Genetic Hearing Loss—Hearing loss, usually sensory-neural, related to heredity.

Hair Cells – Microscopic sensory cells within the cochlea that play the major role in our hearing. They are so-named because of the cilia (hair-like projections) that extend from them. There are two types of hair cells, inner hair cells and outer hair cells. Inner hair cells number about 3000 per ear and outer hair cells about 15,000 per ear. Outer hair cells are the only sensory cell in the body that can move of their own volition.

Hearing Aid - According to Sam Lybarger in 1957, "A hearing aid is an ultra-miniature electro-acoustical device that is always too large. It must amplify sounds a million times, but bring in no noise. It must operate, without failure, in a sea of perspiration, a cloud of talcum powder, or both. It is a product that one puts off buying for ten years after he needs it, but cannot do without for thirty minutes when it has to be serviced."

Hearing Instrument Specialist – Sometimes called hearing aid dispenser or hearing aid dealer. Person licensed by the state to sell hearing aids.

Hearing Threshold Level—Amount, in dB, by which an individual's hearing differs from average normal hearing listeners. Has as its reference human listeners.

Hertz (Hz) – Unit of measurement of frequency, numerically equal to cycles per second.

Inner Ear - The organ of hearing and balance, containing the cochlea (hearing) and vestibular system (balance). It is the only organ in the body to contain two senses.

Mastoid – Raised portion of the temporal bone behind the outer ear.

Middle Ear Disease—Any abnormal condition of the middle ear, usually as a result of eustachian tube dysfunction and repeated middle ear infections. Causes conductive hearing loss.

Nerve Hearing Loss – Used to be referred to as the type of hearing loss one had if they did not have a conductive hearing loss. This term is rarely used anymore. Many people were wrongly told that hearing aids would not help them because they had a nerve hearing loss.

Occlusion Effect – Increase in sound transmitted to the ear as a result of the ear canal being plugged. Much of your voice is transmitted to your ear via bone conduction and so your voice sounds louder to you if your ear canal is plugged. Firmly plug your ears with your fingers and say "ee". This change in your perception of "ee" is the occlusion effect.

Organ of Corti – That portion of the cochlea that houses the hair cells and their supportive cells.

Ossicles – The three bones of the middle ear which form the ossicular chain: malleus, incus, and stapes. They are often referred to as hammer, anvil, and stirrup. These are the smallest bones in the body.

Otitis Externa – Infection of the outer ear.

Otitis Media – Infection of the middle ear.

Otolaryngologist – A physician specializing in diagnosis, treatment, and surgery of disorders of the ear, nose and throat.

Otologist – A physician specializing in diagnosis, treatment, and surgery of disorders of the ear.

Ototoxic Drug—Any of a variety of antibiotics and other chemotherapeutic agents that are toxic to the ear, often causing sensory-neural hearing loss and/or vestibular impairment.

Otosclerosis—In its typical form it results in conductive hearing loss due to the formation of spongy bone around the stapes. There is also a cochlear-otosclerosis form where this spongy bone forms in the cochlea and causes sensory-neural hearing loss or mixed hearing loss.

Pinna or Auricle – That strange looking appendage protruding from each side of the head that most people call the ear.

Pure Tone – A sound with energy at one frequency and only one frequency. It is the stimulus used in pure tone air conduction audiometry and also pure tone bone conduction audiometry.

Presbycusis—Age-related hearing loss, but is often a 'waste-basket' term used when we do not know the cause of the sensory-neural hearing loss. Some prefer the term **Sociocusis** which includes the combined influences of age, noise exposure and environmental factors.

Probe-microphone real-ear measures – A test where sound is measured in a real ear (your ear) using a probe-microphone that is placed in the ear canal close to the tympanic membrane (eardrum). It can be done with or without a hearing aid in place.

Visible speech or **speech mapping** is when speech is used as the sound we measure with probe-microphone real-ear measures.

Receiver – The loudspeaker of the hearing aid. It turns the electrical signal from the amplifier into sound.

Recognized – As it pertains to hearing, a sound that is both detected and identified.

Residual Hearing – That portion of hearing remaining after the loss of hearing.

Sensory-Neural Hearing Loss—Hearing loss involving either the cochlea (hearing part of the inner ear) and /or the auditory nerve fibers that serve the cochlea. Also spelled sensorineural.

Shar—A bath taken standing up.

Shell – That portion of an in-the-ear hearing aid that houses the hearing aid and touches the skin of the ear when it is in place.

Sound Pressure Level—Physicists reference for 0 dB. 20 microPascal (uPa). Used to be called 0.0002 uBar, and before that 0.0002 dynes per squared cm.

Speed of Sound—Amount of time it takes for sound to move from one point to another. Depends on the sound medium and pressure. The speed of sound in air is approximately 343 meters per second, 1024 ft per second, 750 miles per hour, 12.5 miles per minute, 0.28 miles per second. Sound travels 4.4 times faster in water than it does in air.

Stria Vascularis – A highly vascularized band of cells in the cochlea that is important to the functioning of the hair cells.

Threshold – Level at which a stimulus is just sufficient to produce a sensation; the softest sound you can hear.

Tinnitus—Sensation of ringing or other sound in the head, without an external cause of that sound. It is also called “phantom sound” because of its similarities to phantom pain.

Telecoil – An induction coil that is included in many hearing aids. Its purpose is to receive the electromagnetic signals from a telephone or loop amplification system.

Temporal Bone – Houses the ear. It is the densest bone in the body. If your spouse calls you a “hard-head,” say, “Yes, thank you.”

Tympanic Membrane – Commonly referred to as the “eardrum.” A membrane, the approximate texture of plastic wrap, which ends the outer ear canal and begins the middle ear. It measures about 8mm across in diameter.

Tympanogram—Graph showing the air pressure within the middle ear air space, or in the instance of fluid within the middle ear, showing no air.

Vent – A sound pathway through the hearing aid. It allows some sound from the ear canal to escape outward through the hearing aid, and it allows some environmental sound to pass around the hearing aid and into the ear canal. When the hearing aid vent is extremely large, it is often referred to as an “open fitting.” The better someone’s hearing, the bigger the vent should be. In a severe hearing loss there may be no vent at all.

Vestibular Apparatus – The portion of the inner ear concerned with balance and equilibrium.

Word Recognition Score – The percentage of correctly identified words from a list of single-syllable words. This is also sometimes called speech discrimination score.

References

Bennett C. (1989). Hearing aid use with minimal high-frequency hearing loss. *Otolaryngol Head Neck Surg*, 100 (2): 154-157.

Cox R, Alexander G. (1991). Hearing aid benefit in everyday environments. *Ear & Hearing*, 12 (2): 127-139.

Cox R. (1997). Administration and application of the APHAB. *The Hearing Journal.*

FDA Import Alert, #77-01. (1998). Detention without physical examination of ear candles.

Stach B. (2003). Comprehensive Dictionary of Audiology Illustrated.

Harford E. (1981). A new clinical technique for verification of hearing aid response. *Arch Otolaryngol.*

Harris G, Simmerman G, Whitmore P. (1999). Hearing instrument repairs and patient satisfaction. *The Hearing Review.*

Killion M, Niquette P. (2000). What can the pure-tone audiogram tell us about a patient's SNR loss?. *The Hearing Journal.*

Killion M, Mueller H. (2010). Twenty years later: a new count the dots method. *The Hearing Journal.*

Kraus N, Anderson S. (2014). Music benefits across lifespan: Enhanced processing of speech in noise. *The Hearing Review.*

Nabelek A. (2005). Acceptance of background noise may be key to successful fittings. *The Hearing Journal.*

—— (2010). MarkeTrak VIII: The efficacy of hearing aids in achieving compensation equity in the workplace. *Thehearing journal/fulltext/2010/10000/MarkeTrak.*

Nielson H. (1985). Hearing aid fitting based on insertion gain measurements. *Audecibel.*

Palmer C, Solodar H, Hurley W, Byrne D. (2009). Self perception of hearing ability as a strong predictor of hearing aid purchase. *Journal of American Academy of Audiology.*

Sanders J, Stoody T, Weber J, Mueller H. (2015). Manufacturers' NAL-NL2 Fittings Fail Real-ear Verification. *The Hearing Review.*

Seely D, Quigley S, Langman A. (1996). Ear candles; efficacy and safety. *Laryngoscope.*

Taylor B. (2008). The acceptable noise level test as a predictor of real-world hearing aid benefit. *The Hearing Journal.*

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Dogs like hearing aids. They like to bite them.

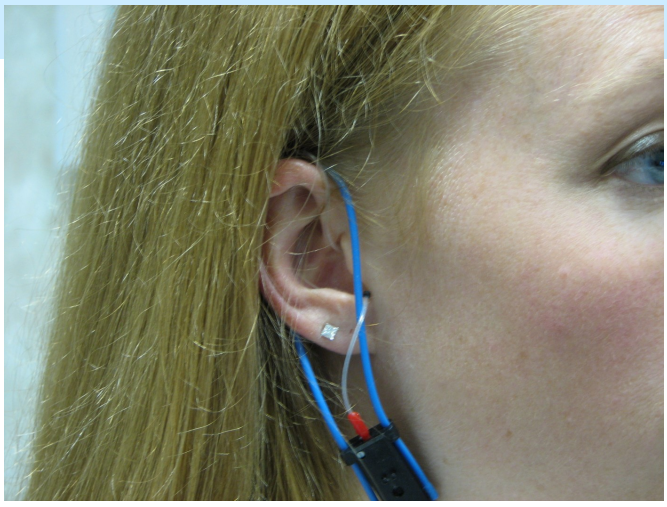
If you hear the troublesome background noise without the hearing aid, the hearing aid is not going to make that background noise softer.

Your voice will sound different to you.

Wax is the most common reason for a hearing aid breaking.

"Hearing aid use improves adults' health-related quality of life by reducing psychological, social and emotional effects of SNHL [sensorineural hearing loss], an insidious, potentially devastating chronic health condition if left unmanaged.

-Healthy People 2010, 2004



It doesn't matter what the hearing aid is producing in an artificial ear at the manufacturing facility, what matters is the sound the hearing aid produces in your ear.