

A Guide To

YOUR CHILD'S HEARING



A Guide to Your Child's Hearing

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Your child's quality of life and development vitally depends on hearing. Hearing helps your child learn to read, to appreciate music, and to receive warnings of approaching harm. Your child will have difficulty coping with many of life's challenges and opportunities without good hearing.

This write-up will help you as a parent to understand how your child hears, how to read hearing cues, how to help your child prevent hearing loss, and what to do if you suspect a hearing loss. Suspicion is the key to diagnosis and treatment.



MILESTONES OF COMMUNICATION

A newborn's ability to functionally use hearing develops with experience. Most babies are born with normal hearing. Binaural hearing (hearing in both left and right ears) allows your child to pinpoint sound with great accuracy and understand speech in a noisy background.

Newborns can localize sound accurately to their right and left sides. Eye movement or a slow head turn in the direction of the sound source can be observed if your newborn is awake, alert and quiet. Between 1 month and 4 months of age, your baby may not exhibit the same type of head-turning or orienting behavior. However, at five months, babies begin to seek the sound source. At about this age, the head turn changes from a reflexive activity (in the newborn) to a purposeful response.

Try this with your five-to six-month old: make soft sounds from behind and to one side as your baby looks straight ahead. A soft rattle shaken at ear-level or whispering the baby's name should elicit a head turn towards the source. While we expect infants to startle when they hear very loud sounds, your baby should respond to soft sounds as well. During the first year, a baby's ability to accurately locate sounds is refined. Your baby should look for the sources of common sounds such as the doorbell, the telephone ringing, a door opening, children playing, or a musical toy.

Babies learn to associate what they hear with people, places, objects, or events. It is important to be vigilant to critical milestones which may serve as guideposts for possible normal hearing:

By 6 months, babies recognize speech sounds of their own language more than those of a foreign language. They recognize familiar voices, play with their own voices, engage in vocal play with parents, and experiment with multiple speech and non-speech sounds.

By 9 months, babies demonstrate an understanding of simple words (“mommy,” “daddy,” “no,” “bye-bye”).

By 10 months, a baby’s babbling should sound speech-like” with strings, of single syllables (“da-da-da-da”).

By 12 months, one or more real, recognizable spoken words emerge.

By 18 months, babies should understand simple phrases, retrieve familiar objects on command (without gestures) and point to body parts (“where’s your…” ears, nose, mouth eyes, etc.). At the same time, 18-month olds should have a spoken vocabulary of between 20-50 words and short phrases (“no more,” “go out,” “mommy up”).

By 24 months, a toddler’s spoken vocabulary should be 200-300 words coupled with the emergence of simple sentences. Most should be understandable to adults not with the toddler on a daily basis. A toddler should be able to sit and listen to read-aloud storybooks.

Between 3 and 5, spoken language should be used constantly to express wants, reflect emotions, convey information, and ask questions. A preschooler should understand nearly all that is said. Vocabulary grows from 1,000 to 2,000 words during this period, with words linked together in complex and meaningful sentences. All speech sounds should be clear and understandable by the end of the preschool period.

SIGNS OF HEARING PROBLEMS

Always be alert to situations where your child is not responding to sound appropriately, as this may be a signal of hearing loss. Sometimes it is difficult to detect mild forms of hearing loss, including hearing loss in one ear only. It is important to remember that even mild forms of hearing loss can negatively impact a child’s ability to learn through the auditory channel. This means that children with mild hearing loss may have difficulty in school, and exhibit attention, behavioral or social problems in the classroom. If you are concerned about your child’s performance in school, request a comprehensive hearing evaluation.

Common warning signs for hearing loss include:

- Family member or teacher concern regarding:
 - hearing ability
 - delays or differences in speech and language development
 - lack of attention or behavioral difficulties
 - poorer than expected academic performance
- Not responding to someone talking out-of-view, particularly with minimal distractions
- Displaying a surprised look when the child’s name has been called at a normal or even fairly loud level
- Using “what?” or “huh?” frequently
- Intently watching the faces of speakers
- Difficulty understanding speech in background noise

- Sitting close to the TV set when the volume is adequate for others
- Increasing the TV or stereo/tape/CD player volume to unreasonably loud levels
- Not responding to voices over the telephone or switching ears continually when the phone is utilized
- Not being startled by intense sounds
- Not being able to locate the source of a sound accurately

*The single most important sign of hearing loss in the very young child is the **failure to develop, or delayed development of, spoken language.** Even if your child passed a hearing screening given in the hospital shortly after birth (*newborn hearing screening test*), if you are concerned, tell your child's primary care provider immediately.*

NEWBORN HEARING SCREENING

Today, the vast majority of newborns receive a hearing screening before discharge from the hospital. Two types of objective test technologies are used to screen for hearing loss in newborns: otoacoustic emissions and the auditory brainstem response (sometimes called *ABR test* or *BAER test*). These screening tests can detect 80-90% of infants with moderate degrees of hearing loss and greater. However, no screening test is perfect. Children with mild hearing loss may pass newborn hearing screening. Newborn hearing screening cannot identify children with late onset or progressive types of hearing loss.

Even when an infant passes a hearing screening test in the hospital, it is important to monitor developmental milestones for hearing, language and speech. If your child was born with visual, cognitive or motor disabilities, a comprehensive audiological evaluation would be important to ensure your child's hearing is completely normal.



HIGH RISK INDICATORS OF HEARING LOSS

(Joint Committee on Infant Hearing, 2000)

There are certain conditions (*indicators*) that place children at risk for hearing loss that is present at birth (*congenital*) or which may not be present at birth but develop later or be acquired in infancy or childhood. Even if your child does not have a risk indicator, it is important to remember that 50% of children with permanent hearing loss have no apparent risk indicators. This is why screening the hearing of all newborns is important.

Most hearing loss in children who have no obvious risk indicators is genetic in origin. Many deafness genes have been identified recently. If your child has a permanent hearing loss, your child's otolaryngologist will guide you through the medical and genetic evaluations that are used to determine the cause or causes of hearing loss.

The following are Risk Indicators for hearing loss in infants and toddlers from birth through 28 days and from 28 days through 2 years of age that have been identified by the in the Year 200 Position Statement and Guidelines of the Joint Committee on Infant Hearing (www.jcih.org).

Neonates from Birth Through 28 Days

- An illness or condition requiring admission of 48 hours or greater to a NICU
- Stigmata or other findings associated with a syndrome known to include a sensorineural and or conductive hearing loss
- Family history of permanent hereditary childhood sensorineural hearing loss
- Craniofacial anomalies, including those with morphological abnormalities of the pinna and ear canal
- In-utero infection such as cytomegalovirus, herpes, toxoplasmosis, or rubella

Infants Aged 29 Days Through 2 Years

- Parental or caregiver concern regarding hearing, speech, language, and or developmental delay
- Family history of permanent hereditary childhood hearing loss
- Stigmata or other findings associated with a syndrome known to include a sensorineural or conductive hearing loss or Eustachian tube dysfunction
- Post-natal infections associated with sensorineural hearing loss including bacterial meningitis
- In- utero infections such as cytomegalovirus, herpes, rubella, syphilis, and toxoplasmosis
- Neonatal indicators, specifically hyperbilirubinemia at a serum level requiring exchange transfusion, persistent pulmonary hypertension of the newborn associated with mechanical ventilation, and conditions requiring the use of extracorporeal membrane oxygenation (ECMO)
- Syndromes associated with progressive hearing loss such as neurofibromatosis, osteopetrosis, and Usher's syndrome
- Neurodegenerative disorders, such as Hunter syndrome, or sensory motor neuropathies, such as Friedreich's Aataxia and Charcot-Marie-Tooth syndrome
- Head trauma
- Recurrent or persistent otitis media with effusion for at least three 3 months

EVALUATION OF THE CHILD'S HEARING LOSS

Detection of hearing loss in children should occur as early in life as possible. Ideally, infants born with hearing loss should be identified by three months of age so that rehabilitation programs - including the fitting of hearing instruments - can be initiated. The first three years of life are critical to speech and language development. Unfortunately, while some children's hearing losses are detected within the first year of life, many more children with hearing loss are not detected until they enter school (five to six years of age). For this reason, it is now recommended that all infants be screened for hearing loss.

The child with suspected hearing loss is evaluated cooperatively by the audiologist, the physician (*otologist/otolaryngologist*), and other appropriate specialists when required. The extent of the work-up varies greatly depending on the complexity of the problem.

After all the evaluations are completed, a treatment plan is formulated that not only depends upon the degree and configuration of the hearing loss, but whether the loss is expected to progress. Long-term follow-up of children with hearing loss is usually required and other members of the health care team (*family physician, pediatrician, hearing instrument specialist, speech-language pathologist, and social worker*) are frequently involved.

Testing Your Child's Hearing

Many modern methods can accurately determine the hearing of a newborn, infant or child. Comprehensive hearing assessment can be completed at any age if there is any suspicion that a hearing problem exists. Hearing is not an all or nothing phenomena. Without direct testing, it is impossible to determine that a child hears perfectly across the range of frequencies necessary for understanding speech. Since speech consists of both low and high-pitched sounds, a hearing loss in one region can cause the child to misperceive speech. Even a slight or mild hearing loss, such as may occur with persistent otitis media (OME) during critical years for language and speech development, may cause a delay in normal communication skills.



Types of Audiologic Evaluations

An audiologic evaluation can help determine if a hearing loss exists in one or both ears at frequencies (*itches*) that are critical to normal speech and language development, and if any hearing loss is conductive or sensorineural. An audiologist skilled in working with young children completes a comprehensive hearing assessment. The results of the test are recorded on an audiogram, a graphic chart of audiometric results. Results are used to determine the type of hearing disorder and whether hearing instruments are needed. The physician determines whether medical or surgical treatment is required based on the audiometric findings and otologic examination.

Conventional hearing tests usually require that the child respond in some way (verbally, by picture pointing, raising a hand, or through a “game”) to soft sounds produced by an audiometer. By the age of three, these types of tests are generally appropriate. For younger children, beginning at about six months of age, other behavioral hearing tests that reinforce a baby’s response to test sounds using an animated toy can be used very accurately.

For younger infants, or for children who cannot reliably do behavioral test procedures, more objective tests can help determine hearing abilities. One is known as the Auditory Brainstem Response (ABR). Test signals (*brief clicks or tonal “pips”*) are sent to the child’s ears through microphones. Minute electrical responses produced by the cochlea in response to the test signals are recorded from the scalp using small disc electrodes. These are averaged by the computer and displayed as a wave form. The child must be sleeping quietly to record the ABR. The ABR can provide 1) an estimate of hearing sensitivity, and 2) information about the function of the auditory pathway to the level of the brainstem.

Other objective tests are also used in audiologic assessments. “*Otoacoustic emissions*” (OAEs) involve recording a “*cochlear echo*” in response to test signals. This provides further information on hair cell functioning in the cochlea.

Middle ear function can be examined through “*acoustic admittance*” testing, also known as “*tympanometry*,” that may help determine the presence of fluid behind the eardrum or aid in the diagnosis of middle ear problems. Eardrum movement is recorded in response to air pressure changes. The test is quick and painless.

Should your child have a hearing loss which cannot be treated medically or surgically, specialists can provide various types of amplification to assist the child in hearing sound. Hearing instruments can be provided at any age.

SOME COMMON HEARING PROBLEMS IN CHILDREN

Wax (cerumen)

Wax in the ear canal can act as an ear plug, blocking sound waves from striking the eardrum. Wax softening drops can help. Softened wax may spontaneously leave the canal, be irrigated out or be removed by a physician, audiologist or other trained personnel. Cotton swabs should never be used by parents in an attempt to remove wax. The cotton swab may actually push the wax deeper into the canal or even puncture the eardrum.

Foreign Objects

Parents should guard against children putting small objects in their ears such as beads and food items. Sound can be impeded or an eardrum ruptured. The ear canal may become inflamed if the surface lining is damaged by the object.

Swimmer's Ear

Another common condition affecting the outer ear canal is called “*swimmer's ear*.” This external ear canal infection may be painful and cause the ear canal to swell shut, resulting in temporary hearing loss. Usually this is a bacterial infection which develops in an ear canal that remains wet after bathing or swimming.

OTITIS MEDIA

The most common cause of conductive hearing loss in children is otitis media, a condition of the middle ear. Most primary of many forms are acute otitis media and otitis with effusion, both of which will be discussed below.

Acute Otitis Media (AOM)

An AOM episode (sometimes termed “*suppurative OM*” is characterized by a sudden onset of ear pain that may be associated with fever, restlessness and some hearing loss. The ear infection will usually respond to medical treatment. In some unusual cases, AOM may result in a rupture or perforation of the tympanic membrane with drainage into the outer ear. If left untreated, ear infections may lead to more severe middle and inner ear conditions. More than 85% of all children experience at least one ear infection. Ear infections are second only to routine baby checks as the reason for office visits to the physician. Otitis media accounts for approximately 30 million office visits annually in the United States alone. Long, persistent otitis media with effusion may lead to permanent damage to the tympanic membrane or middle ear structures.

Otitis Media with Effusion (OME)

Otitis media with effusion (*fluid*) frequently follows an episode of AOM. In OME, fluid persists in the middle ear space, often for long periods of time. Fluid in the middle ear impedes the vibration of the tympanic membrane, as well as movement of the middle ear bones. This leads to various degrees of conductive hearing loss, depending on the thickness of the fluid. Usually the hearing loss associated with OME is mild to moderate. This may prevent the child from being able to hear all speech sounds. This is particularly harmful during the early years of language learning.

To diagnose ear infections and middle ear effusion (*fluid in the middle ear space*), the physician can use a pneumatic otoscope to see the appearance of the eardrum and examine its ability to move (*mobility*) in response to small changes in air pressure.

Causes of Otitis Media

The most frequent cause of otitis media is dysfunction of the eustachian tube. The adenoids, which lie behind the nose in the area where the opening of the eustachian tube is located, may obstruct the eustachian tube. More frequently, the adenoids may become infected and harbor bacteria that contribute to middle ear infections.

Ear infections may also result from upper respiratory infections (URIs). Most middle ear problems occur during the winter months. Smoking in the home increases the risk of middle ear infections, and children with respiratory allergies have a greater incidence of otitis media. The child's resistance to infection and his/her individual immune system status also play a role in the development of otitis media.

Treatment of Otitis Media

The treatment of acute otitis media usually includes antibiotics with or without other medications as prescribed by the physician. The treatment for otitis media with effusion is controversial. Often the condition subsides spontaneously or responds to medical treatment, usually without prolonged hearing loss or other complications. When OME does not resolve and hearing loss persists, ventilation or pressure equalizing (PE) tympanotomy tubes may be inserted in the eardrum. These tubes remain in the ear for several months or even a few years. Often when the tubes fall out, the eustachian tube has further matured and has begun to function better. If this does not occur and middle ear fluid and hearing loss recur, a new set of tubes can be placed.

While some children appear to suffer no negative consequences from OME, others may be at risk for delays in communication development and later academic problems. Most ear physicians (otologists or otolaryngologists), audiologists and other hearing specialists feel that children who have both OME and hearing loss persisting for three months should be considered for tube insertion. This is particularly true when the child is displaying speech, language, or academic problems.

Tubes restore hearing to normal levels, prevent persistent middle ear fluid from recurring, diminish the frequency of acute ear infections, and prevent destructive changes to the bones as well as other, more serious ear complications. Some physicians also feel that frequent, repeated episodes of OME in early life, indicates the need for tube insertion.

New clinical practice guidelines have recently been developed for the treatment of otitis media with effusion in young children. They suggest that the combination of unresolved OME and the presence of bilateral hearing loss indicate the need for tube insertion. Physicians and parents work together to individualize treatment plans.

WHEN PERMANENT HEARING LOSS EXISTS

Hearing Instruments

For children with permanent hearing loss, optimizing their auditory skills is most important. All children with hearing loss benefit from early intervention, which includes hearing instruments, assistive devices, and/or other sensory aids that are prescribed for the child's specific auditory problem. When a hearing loss exists binaurally, a hearing instrument is provided for each ear. This is to help the infant or child achieve stereophonic reception of sound.



According to National Early Hearing Detection and Intervention (EHDI) goals developed by the Maternal and Child Health Bureau (MCHB), the Centers for Disease Control and Prevention (CDC) and the recommendations of the Joint Committee on Infant Hearing (JCIH, 2000), all children should be screened for hearing loss before 1 month, hearing loss should be confirmed by 3 months, and children with diagnosed hearing loss should receive intervention which means enrollment in early intervention programs.

It is important to remember that infants may be fit with amplification soon after the confirmation of the hearing loss. As such infants may begin to use hearing instruments as early as 2 to 4 months of age.

Assistive Devices

In some cases, FM systems may be provided instead of or in addition to conventional hearing instruments. The FM system allows the child to hear better with background noise. The speaker (parent or teacher) wears an FM transmitter, with the microphone of the device placed about six inches from the speaker's mouth. The child wears an FM receiver tuned in to the same channel as the transmitter. The speaker's voice is conveyed to the child's receiver via FM sound waves. The advantage of the FM listening system is that the speaker's voice is heard above the level of the background noise, and no matter where the speaker is located (as far away as 100 feet), the child hears the speaker's voice as if he/she were only about six inches away. These systems have proved very beneficial for hearing-impaired children in school. Today, even young infants are utilizing FM systems as a means of optimizing their hearing during the critical early years of language development.



Cochlear Implants

The cochlear implant has provided a means for receiving sound for some children with profound or total hearing loss who do not receive sufficient benefit from hearing instruments or FM systems. Through a surgical procedure, a wire containing numerous electrodes is fed into the cochlea. A magnetic receiver is implanted in the mastoid bone just behind the ear. This couples to an externally-worn receiver/simulator that provides a signal to the electrode array in the cochlea. Infants age 12 months with profound hearing loss who have not made sufficient progress with conventional hearing instruments are considered candidates for cochlear implants. In some cases (as when meningitis is the cause of deafness), younger infants may be candidates for a cochlear implant.



A WORD ABOUT NOISE EXPOSURE

One of the most common and yet completely preventable causes of permanent sensorineural hearing loss is exposure to sound levels that are excessively loud. High noise levels first cause temporary and then permanent damage to the sensory hair cells within the cochlea. Even young children may be exposed to sounds that could be damaging to their hearing. Noise produced by various modes of transportation (subways, trains, airplanes, snowmobiles, etc.) and home appliances (stereo music equipment, power tools, lawn maintenance equipment, hair dryers, etc.) may be damaging to hearing depending upon the closeness to the noise source and the exposure time. Moreover, some toys may actually produce intense sound, and certainly sound levels at some music concerts can damage hearing.



Monitor the level of noise your child is exposed to. If speech must be raised (shouted) to communicate, it is very likely that the noise is excessive and possibly damaging. Ringing in the ears (*tinnitus*) after noise exposure also indicates excessive sound levels. Children should be told about the dangers of noise exposure and the use of ear protection (ear plugs, ear muffs, etc.). When ear protection is unavailable, simply block the ear canal opening with your fingers. This serves as to reduce the level of sound going to the eardrum. Obviously children should be protected from excessive noise exposure whenever possible.

As a parent, you can set examples for your child. When mowing the lawn or using noisy tools or appliances, use hearing protection, and insist that your child playing nearby does the same. Such habits will save both your hearing and that of your child.

FEDERAL LEGISLATION AND CHILDREN WITH HEARING LOSS

Through the Individuals with Disabilities Education Act (IDEA, 1997), the federal government provides funds to states for children birth to 21 years who have disabilities.

Grants to individual states are provided through Part C funding to support early intervention (EI) programs (sometimes called 'birth to three services') for infants and toddlers with disabilities. This includes referral, comprehensive multidisciplinary assessment, the development of an individualized family service plan (IFSP), the provision of appropriate intervention, and the assignment of a service coordinator to coordinate among the family and health, medical and EI providers. The IFSP developed with the family, delineates the options, goals, types and frequency of services, and providers among other services. Eligibility criteria (the degrees and types of hearing loss covered under Part C services) are not uniform across states. State Early Hearing Detection and Intervention (EHDI) programs are provided specifically for children with hearing loss.



IDEA also provides services for children with hearing loss 3 to 21 in the educational setting through Part B funding. IDEA legislation provides a free and appropriate public education (FAPE) in the least restrictive environment (LRE). This includes provision of devices (e.g., *assistive technologies*) that are used in the classroom (e.g., *FM systems*) and services (*audiological*) including assessment, and selection and fitting of assistive technologies. Usually, personal devices such as hearing instruments are not included. Regular monitoring of the function of the child's personal hearing instruments in the classroom is a service covered under the legislation. This is important, as hearing instruments

worn by children in the classroom have been found to be non-functioning or not meeting manufacturers' specifications nearly half of the time. IDEA also covers support for families and teachers who have children with hearing loss in their classrooms.

In the case of children 3-21 years, families and educators formulate an individualized education plan (IEP) that delineates goals, frequency and duration of services and ongoing monitoring of outcomes. Families are entitled to procedural safeguards including informed consent, records examination, confidentiality, the right to disagree and due process hearings. In addition, families have the right to: be present at all meetings regarding their child; receive prior written notice; obtain an independent evaluation; and file a complaint.

PREPARING YOUR CHILD FOR BETTER HEARING

You are your child's role model for attitudes on hearing loss and hearing conservation. If hearing and the use of hearing protection are important to you, it will be important to your child as well. With your understanding, encouragement, and support, your child will enjoy a world of better hearing.

This write-up has provided you with some general guidelines for monitoring your child's hearing and communication development. If you have any further questions, please call BHI Hearing HelpLine at 1-800/EAR WELL for additional information or contact us on this website or by mail.



Remember:

Your child's hearing is the means through which communication will **develop** and **flourish**.

Guard your child's hearing **carefully** and **seek professional help** if you are concerned at any time.



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