

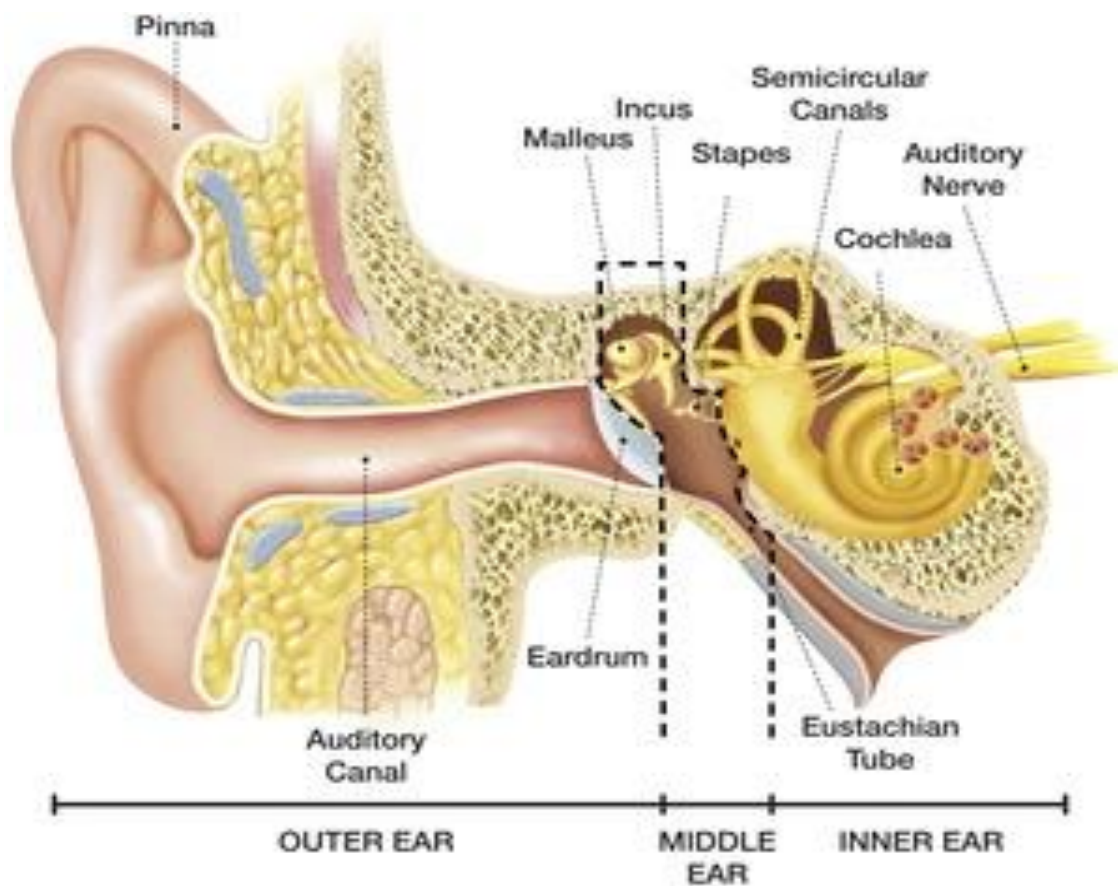
# UNDERSTANDING PAEDIATRIC AUDIOLOGY TESTS.



Belfast Health and  
Social Care Trust

## How do we hear?

There are three main sections of the ear: outer ear, middle ear and inner ear. The outer part of the ear that you can see is the pinna; this picks sounds up and sends them down the ear canal to the eardrum. When the sounds hit the eardrum, they cause it to vibrate, which causes the middle ear bones to vibrate. These then send the sound across the middle ear into the inner ear. Once the vibrations reach the inner ear they cause the fluid in the cochlea to move like a wave. The wave travels along the cochlea and causes the hair cells in the cochlea to vibrate at a certain point. The point at which they vibrate depends on the frequency of the sound. The hair cells then change the sound waves into electrical impulses that travel up the auditory nerve to the brain. Once the electrical impulses reach the brain this is when we 'hear'.



## Types of hearing loss

**Sensorineural Hearing loss** occurs because there is a problem in the inner ear. This could be a fault in the Cochlea or the Auditory Nerve. Most inner ear hearing loss is related to damage to the hair cells of the cochlea. Sensorineural Deafness is usually permanent. There is usually no cure but we can help manage it using amplification with a hearing aid.

**Conductive Hearing loss** happens when the sound cannot travel effectively through the outer and middle ear into the inner ear. There can be a number of reasons for this. Some examples of this are wax, Otitis Media or glue ear- when fluid builds up in the middle ear or otosclerosis- when the middle ear bones do not move as well as they should because of abnormal growth of the bone. There are more treatment options for conductive hearing loss such as surgery, and sometimes-conductive hearing loss resolves spontaneously over time.

**Mixed hearing loss** occurs when there is an element of both types of hearing loss involved.

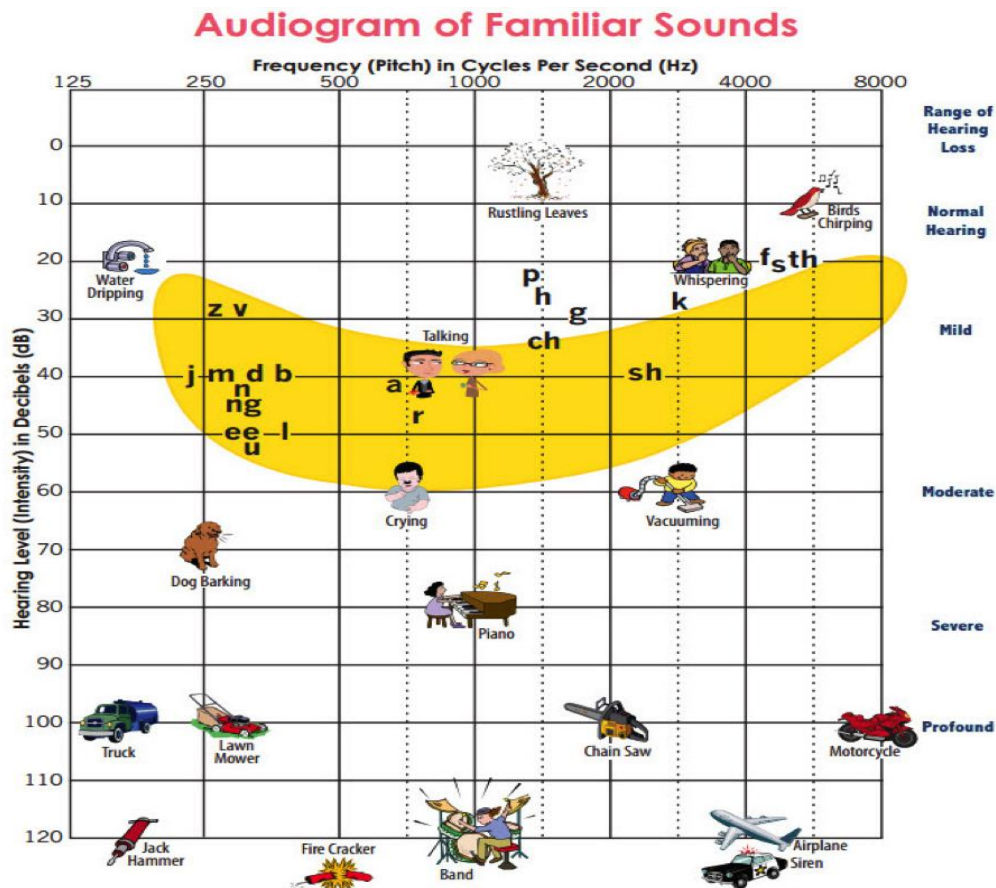




## Frequency of Sound

When we describe hearing, we also talk about frequencies. The frequency of the sound gives it its pitch. Frequency is measured in Hertz (Hz) and is shown along the top of the audiogram below. Speech is made up of sounds from approx. 250Hz to 4000Hz. You may hear better at some frequencies. For example, you may have good hearing in the low frequencies and it gradually gets worse in the higher frequencies. We describe this as a High frequency hearing loss. Alternatively, you may hear the high frequencies well and the low frequencies worse; we would talk about this being a low frequency hearing loss.

Below is a graph that illustrates dB (decibels) against frequency (Hz). We call this an Audiogram. We can see from the graph where certain sounds are with regards to dB and frequency.



## Hearing tests

### OAE- Oto acoustic Emissions

OAE's are sounds that are generated by movement of the outer hair cells in a healthy functioning cochlea in response to external stimuli. If a child has recordable OAE's it indicates, the outer hair cells in the cochlea are working correctly. Testing for OAE's is very quick in a quiet / settled child. They are routinely used in the national newborn hearing screening of newborn babies in an effort to detect significant hearing loss at birth. If OAE's are absent further testing is required to establish the type of hearing loss.

### ABR – Auditory Brainstem Response

An ABR objectively measures the response of the auditory nerve and pathway of hearing when a sound is presented. The test is used with children or others who cannot complete a typical hearing test, it is therefore very useful for testing very young babies and children who are not developmentally ready for behavioral testing as it allows us to measure hearing levels without the child having to respond. The ABR give us information about mid and high frequency hearing.

Once a child has reached approximately 8-9 months corrected age, they may be able to perform behavioral hearing tests. These are hearing tests where children are awake and alert. For behavioral testing, reactions are observed or actions made when a sound is played. Some children who have developmental delay will not be ready at this stage and in these cases; the test may be individually adapted.

***\*\*please note all age ranges are just a guideline as every child's abilities differ- the Paediatric Audiologist will have a chat with you before testing about your child's development\*\****

### Visual Reinforcement Audiometry (VRA) 7months – 2.5 years

This test requires the child to sit on the accompanying adult's knee and relies on the child's response to sound. Adult and child will be seated between two loud speakers and the audiologist will play sounds at different intensities and frequencies. The distracter who will be sitting in front of you will show the child how to respond by encouraging them to turn to the speaker and toy reinforcement when a sound is played. Once they have turned in response to the sound they will be rewarded by a light up or animated toy. This will hopefully maintain their interest throughout the test. The purpose of this test is to

determine the lowest sound your child will respond to at a range of frequencies. When the sound is presented through speakers, it does not give us ear specific information. To get ear specific information earphones are needed. If the child will not tolerate headphones, we can check if the child can localize the presented sound, which gives us information on how similar both ears can hear. If a child can localize well and can differentiate which side the sound is coming from it suggests hearing is similar on both sides.

### **Performance (conditioned play Audiometry) 2.5 years- 3.5 years**

This test is carried out in the same setting as VRA; however, as the child is older they may want to sit on their own small chair rather than on the adult's knee. Again, the sounds can be played from the loud speaker and your child will be asked to play a game. The game usually involves a simple task for example, 'put a teddy in the box when you hear a sound' or 'put the man in the bus when you hear a sound'. The distracter will demonstrate this to your child then they will hopefully copy the actions to be able to complete the task by themselves. We are again trying to determine the lowest sounds your child responds to at a range of frequencies.

If possible the audiologist will try to gain ear specific information using headphones but if not ability to localize will be measured.

### **Pure Tone Audiometry (including play audiometry) 3.5 years and above**

Once a child is approx. 3 or 4 years old, we will move to Audiometry. In younger or very shy children, the Paediatric Audiologist will adapt the test into a game using toys but older or more confident children may do the test independently with a button. Headphones are used and a range of sounds will be presented at different intensities and frequencies, the child is asked to press the button when they hear a sound or play a game. We can test each ear individually and gradually increase the amount of frequencies we test as your child becomes more confident.

In order to get information about whether your child's hearing loss is conductive or sensorineural we carry out two other tests.

### **Tympanometry**

This is a probe test to assess the function of the middle ear. Some sound and pressure is presented into the ear through a probe with a soft tip. The movement of the eardrum and middle ear is measured and a graph is produced. The graph can show us if there is any restriction in the movement of the middle ear structures and can confirm if there is an issue in the middle ear, which may be causing a conductive hearing loss.

## **Bone conduction**

A vibrator is placed behind the child's ear. This allows the sounds to travel directly to the inner ear, bypassing the outer and middle ear. This test is useful in identifying whether the hearing loss is Conductive or Sensorineural.



## **People you may meet at the Paediatric Audiology Clinic**

**Paediatric Audiologist** – professionals who examine children for hearing loss and related issues. They perform hearing tests and evaluations to determine the presence, extent, and reason for hearing loss in babies, toddlers, children, and teens. After determining the presence and extent of hearing loss, paediatric audiologists provide the appropriate intervention so as to prevent further hearing loss and to treat any hearing damage. Treatment may include hearing aids. They will be able to answer questions and help you deal with any queries or concerns you may have.

**ENT consultant** - Medical consultants in health and medical treatment of the Ears, Nose and Throat. They will take a full history about your child's health, birth and any issues you may have had in pregnancy. They will do a physical examination of your child and discuss any further any investigations they may want to carry out in order to try to determine the cause of your child's hearing loss. ENT consultants are also skilled surgeons and can offer surgery options if required. They can also answer any questions or queries you may have.

**ENT Nurse** - Nursing support for the ENT consultant and is there to offer support and information, as you require it.

**Peripatetic Teacher (Teacher of the deaf)** - educational teachers with a specialty in the development and education of children who are deaf/hard of hearing. Any child who is diagnosed with a permanent childhood hearing impairment is referred to the peripatetic teacher service. They offer support in dealing with the diagnosis, help with hearing aids if required and carry out some basic hearing tests at home. They will also help and advise you when it comes to deciding on nursery and schools for your child.

**Clerical Officer** – administrative support for the staff in audiology and ENT. Prepares charts and clinic notes and checks patients in for appointments and helps with smooth running of appointments.

**Medical secretary** – types letters for consultants and liaises with other health professionals to ensure additional tests and enquires are dealt with efficiently.