Training Programme
for Public Health Nurses and Doctors
in Child Health Screening, Surveillance and Health Promotion

Unit 3
Hearing Screening & Surveillance

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AUDILOGICAL DEFINITIONS and TERMS

ACQUIRED HEARING LOSS
Loss thought to have developed more than a week after birth, through infection, illness, or genetic causes not manifest at birth (various risk factors are identified).

AUDIOLOGIST
Audiologists have specific training in the science of hearing. Many work with adults in the community or support ENT clinics in hospitals.

AUDIOLOGICAL SCIENTIST
Audiological scientists have specific post-graduate qualifications in audiology and specialise mainly in identification and habilitation of hearing loss in babies and children.

AUTOMATED AUDITORY BRAINSTEM RESPONSES
Screening test using small electrode gel pads to pick up electrical activity generated by sound stimuli; easy to use with newborns.

AVERAGE HEARING LOSS
The amount of hearing loss calculated using the average decibel (dB) detection level for four sound frequencies: 500, 1000, 2000 and 4000 Hz in better ear. Losses are generally grouped into Mild (<40), Moderate (40-69), Severe (70-94) and Profound (>=95) for research and epidemiological purposes.

COCHLEAR IMPLANT (CI)
Electrode permanently placed in or against the inner ear to stimulate the nerve electrically. Some sound perception can result, which often leads to speech recognition with suitable rehabilitation.

CONDUCTIVE HEARING LOSS
Defect or blockage in outer ear canal, eardrum, middle ear space or Eustachian Tube. There are several main risk factors identified for conductive hearing loss.

CONGENITAL HEARING LOSS
Hearing loss thought to be present from birth (including birth-related causes). Risk factors are well-defined for congenital hearing loss and can be used to identify about half of all such children soon after birth.

CRANIO-FACIAL ABNORMALITY (CFA)
A defect in the skull or facial bone structure often causing permanent conductive hearing loss.

dB ‘A’ : A weighted scale, normally used for hearing levels when test is not done under headphones. It can be ‘corrected’ to dB HL using fixed values.

dB HL : Decibel Hearing Level, the commonest measurement unit as shown on a Pure Tone Audiogram
**DEGREE OR SEVERITY OF HEARING LOSS**
Mild, Moderate, Severe and Profound Hearing Loss are the common categories.

**DISTRACTION TESTING (DT) & UNIVERSAL DISTRACTION TESTING (UDT)**
Screen or Test involving 2 testers used for children under 18 months.

**EARLY DEVELOPMENTAL HEARING SCREEN (EDS)**
Generally refers to DT at 7-9 months developmental clinic

**EUSTACHIAN TUBE**
Narrow tube which connects the nasopharynx with the middle ear space; blockage of the tube can result in ear symptoms and OME.

**GROMMETS**
Tiny ventilation tubes put into the eardrums to treat OME; extruded in 4-8 months

**MIXED HEARING LOSS**
Hearing Loss with conductive and sensori-neural elements.

**NORMAL HEARING**
Usually taken as all thresholds lower/better than 25dB HL, or equivalent.

**OTITIS MEDIA (WITH EFFUSION), OR OME OR ‘GLUE EAR’**
Fluid build-up in middle ear space which should be air-filled. OME can cause mild/moderate conductive hearing loss – usually temporary. ~10% of under-fives may have OME at a given time; many improve spontaneously within weeks. OME incidence falls greatly after age seven.

**OTOACOUSTIC EMISSIONS (OAE)**
Signals generated by a healthy cochlea in response to incoming sound; can be utilised as a hearing screening tool. Either Transient Evoked Otoacoustic Emission (TEOAE) or Distortion Product Otoacoustic Emission (DPOAE) are measured.

**OTOSCOPE**
Instrument for examining the ear canals and eardrums

**PERMANENT CHILDHOOD HEARING IMPAIRMENT (PCHI)**
Permanent Hearing loss averaging >=40dB HL in better ear, present by age 5 (for epidemiology purposes); includes children with Congenital HI (approx. 1.1 per thousand) and those with early acquired childhood HI (approx. 0.15 per thousand), but excludes most with OME. Up to 1 per thousand extra children may acquire PHI of this degree before leaving school.

**PREVALENCE RATE**
The average number of children for every 1,000 live births, with a given degree of hearing loss (or other stated condition).

**PURE TONE AUDIOMETRY**
Hearing test normally carried out with children aged 3 and older wearing headphones and requiring co-operation – results are recorded on an Audiogram.

**SCREENING TEST**
A simply administered test which can be passed or not; intended to be applied to an entire, defined population. It is different to SURVEILLANCE.
SENSORI-NEURAL HEARING LOSS (SNHL)
Hearing loss involving defects or damage to the inner ear (cochlea) or the nerve pathways from the cochlea to the brain. Most children with PCHI have SNHL.

SURVEILLANCE
A flexible continuous process that is broader in scope than screening, whereby knowledgeable professionals perform skilled observations on children throughout all encounters during child health care.

COMMON ABBREVIATIONS WHICH MAY BE SEEN ON REPORTS:
AABR = Automated Auditory Brainstem Response Screening
AC = Air Conduction (overall hearing loss)
BC = Bone Conduction (measure of SNHL)
BHFC = Best Health for Children, 1999 (Denyer et al, 1999).
Bil. = Bilateral/ Unil. = Unilateral
CHL = Conductive Hearing Loss
CI = Cochlear Implant
CP = Cerebral Palsy OR Cleft Palate
DNA = Did not attend
ENT = Ear, Nose and Throat (clinic or Surgeon)
ET = Eustachian Tube
FH = Family History
Gr/T/A = Grommets/Tonsils/Adenoid surgery
HA = Hearing Aid
M (on audiograms) = Masking used
NAD = Nothing abnormal detected
NFA = No further appointments
NH = Normal Hearing
NHSP = Newborn Hearing Screening Programme
OAE = Otoacoustic Emissions
   (TEOAE: Transient Evoked OAE; DPOAE: Distortion Product OAE)
O/E = On examination
OME = Otitis Media with Effusion
Perf. = Perforation of the eardrum
PTA = Pure Tone Audiogram/Audiometry
SFA = Sound Field Audiometry
SLM = Sound Level Meter
SNHL = Sensori-Neural Hearing Loss
TM = Tympanic Membrane
UNHS = Universal Newborn Hearing Screening
WL = Waiting List
WNL = Within Normal Limits
RATIONALE

THE IMPORTANCE OF SCREENING FOR HEARING IN YOUNG INFANTS

Congenital permanent childhood hearing impairment (PCHI) affects 1-1.3 babies per 1000 births (Davis et al, 1997; NRB, 1996), making it commoner than all other screenable birth disorders combined (White, 2003). PCHI is a handicap of such significant effect as to warrant our effort to identify it early. There is no medical cure for PCHI.

Early identification is the first step in lessening the effects of hearing impairment. Early identification and habilitation will allow the child time to:

• Develop normal maturation of central auditory pathways
• Develop language to communicate effectively, thus
• Develop better literacy and educational achievements and
• Become accepted and nurtured in the family. Families also say (retrospectively) that early identification is preferable to them, even if it is a shock at the time. They also have a low opinion of services which fail to identify such conditions at the earliest possible opportunity. (Sharma et al, 2004; Yoshinaga-Itano, 2003; Hall, 2003; Kennedy et al, 2004)

In Ireland, the early developmental hearing screen is still often the first preschool screen of hearing – the first formal chance for the hearing loss to come to the notice of health professionals. When used correctly, it has been shown to be helpful in assisting in the identification of children with hearing impairment. (NRB, 1996). ‘Targets’ for all congenital PCHI to be detected by 12 months show how crucial it is for EDS to be completed on time.

NEW METHODS OF SCREENING FOR HEARING LOSS

Newborn hearing screening programmes (NHSP) or universal hearing screening (UNHS) have excellent sensitivity and specificity and are now widely used. 24-48 hours after birth, it usually takes place in maternity hospitals and is the screening method of choice today. (NHMRC, 2002; Denyer et al, 1999)

The commonest screening tool, or instrument, is known as otoacoustic emissions (abbreviated as OAE, TEOAE or DPOAE) which measures sound emitted from the cochlea in response to other sounds. It is fast, accurate, non-invasive and cost-effective. Neonatal OAE testing is the next generation 1st stage screen or sieve for well babies. Follow-up screening is carried out with automated brainstem response audiometry.

High-risk infants are usually screened with a combination of OAE testing and automated auditory brainstem response (AABR) screening. AABR tests the brainstem nerve pathways.

OUTLINE OF SCREENING THEORY

• A screen is a centrally administered system to ensure testing of a high percentage of a specified condition.

• Most screening involves a second test occasion for first-test failures. They are not intended to give highly accurate diagnostic information and should be quick and easy to administer.

• The purpose is to refer onwards for further investigation a proportion of the child population who do not pass the test on two occasions. It is not the purpose of the Developmental Hearing Screen to identify children with a hearing loss per se.

• Some of those failed will turn out to have normal hearing, some will have hearing loss, the majority temporary loss/conductive in nature.

• The ideal outcome would be:

  1. See all children at screen age/stage, i.e. 100% coverage

  2. Refer all children with a specified loss but not those with normal hearing (i.e. 100% sensitivity and 100% specificity)

The purpose of this course is to improve the screening technique currently used to aim for the second point above.

The target coverage for the distraction test is above 90% minimum.

The target referral rate is 4-8%.

BASIC OUTLINE OF SURVEILLANCE THEORY

A flexible continuous process that is broader in scope than screening, whereby knowledgeable professionals perform skilled observations on children throughout all encounters during child health care. Hall refers to it as “oversight of the physical, social and emotional health of children; measurement and recording of physical growth, monitoring of developmental progress; offering and arranging intervention when necessary; prevention of disease by immunisation and other means; and health education”. Parental reports are likely to be a part of the assessment process.

For hearing surveillance purposes it is particularly important to be aware of typical development in listening behaviours, expressive behaviours and social behaviours, without regarding milestones as ‘absolute requirements’ for individual children.

(Hall and Elliman, 2003; Hall, Hill and Elliman, 1999)
DESCRIBING HEARING LOSS – TERMS AND DEFINITIONS

**Frequency** (similar to pitch) is measured in cycles per second or hertz (Hz) or kilohertz (kHz). A person who has hearing within the normal range, can hear sounds ranging between 20 and 20,000 Hz. The most important sounds we hear every day are in the 250 to 6,000 Hz range. Speech includes a mix of low and high frequency sounds. Vowel sounds like “u” have low frequencies (250 to 1,000 Hz) and are usually easier to hear. Consonants like “s,” “h” and “f” have higher frequencies (1,500 to 6,000 Hz) and are harder to hear. Consonants convey most of the meaning of what we say. Someone who cannot hear high-frequency sounds will have most trouble understanding speech.

**Intensity** (similar to loudness) is measured in decibels (dB). A person with hearing in the normal range can hear sounds ranging from 0 to 140 dB. A whisper is around 30 dB. Conversations are usually 45 to 65 dB. Sounds that are louder than 90 dB can be uncomfortable. A loud rock concert might be up to 110 dB. Sounds over 120 dB can be painful and result in temporary or permanent hearing loss or tinnitus.

**Impairments** in hearing can happen in either frequency or intensity, or both. Hearing loss severity is based on how well a person can hear the “speech range”. Severity can be described as mild, moderate, severe, or profound. The term “deaf” is sometimes used for someone who has an approximately 90 dB or greater hearing loss, who finds hearing aids of limited value, and may well use sign language regularly. The term “hard of hearing” is sometimes used for those with less severe hearing loss. Hearing loss affecting one ear is unilateral loss; affecting both ears is bilateral loss.

[Image of a Familiar Sounds Audiogram]

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**Familiar Sounds Audiogram**

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*Threshold of Pain*
HOW THE EAR WORKS

The Outer Ear

The outer ear collects the sound and conducts it to the middle ear. It is made up of the pinna and ear canal. The canal is about one inch long in adults and shorter in children. It is lined with skin and normally contains some wax to protect it from dust and debris. Impacted wax can also cause temporary hearing problems. The eardrum separates the outer ear from the middle ear. It is roughly circular and firmly attached to the walls of the ear canal; sound waves that enter the ear from the outside cause the eardrum to vibrate.

The Middle Ear

The middle ear amplifies sound to ensure it is transmitted efficiently from the air-filled outer ear to the fluid-filled inner ear. The middle ear is made up of the eardrum or tympanic membrane, middle ear cavity, the ossicles, and the eustachian tube. The middle ear is behind the eardrum and is filled with air. Air reaches it along the eustachian tube, which connects the middle ear cavity with the nose and throat. Yawning, chewing, swallowing and blowing your nose opens the tube and ventilates the middle ear, equalising the pressure in the middle ear with that of the air outside. This allows the eardrum and ossicles to vibrate freely in response to sound. In infants the eustachian tube is shorter, more horizontal and floppy, making it susceptible to collapse or retraction, and allowing infection to pass easily from the nose or throat to the ear.
If the tube becomes blocked, air cannot pass into the middle ear and a vacuum develops which pulls the eardrum inwards. This can cause fluid to collect in the middle ear, which leads to “glue ear”. This condition is the commonest type of hearing loss in children under 5 years, causing a mild or moderate hearing problem. When PCHI already exists, the addition of fluid in the middle ear can cause a further drop in hearing level.

The three tiny bones stretching across the middle ear space are called the ossicles. They form a “bridge” from the tympanic membrane to the inner ear. These bones, which are the smallest in the body, are so lightly hinged together that sound vibration can pass freely from one to another. Sound waves entering the outer ear vibrate the eardrum and are passed along this chain of ossicles to the inner ear.

The Inner Ear

The inner ear contains two parts; the cochlea, which is concerned with hearing, and the semi-circular canals which are concerned with balance and the ability to stand upright. The cochlea is made of bone and shaped like a snail’s shell, coiling 2 ¾ times. Inside the cochlea are fluid-filled corridors, lined with hundreds and thousands of tiny hair cells. Each hair cell is connected to a fibre of the auditory nerve, which runs from the cochlea to the brain. Sound waves enter the fluid of the cochlea, move the hair cells and stimulate their connection with the auditory nerve. Low pitched sounds are processed at the apical/top end of the cochlear spiral while high pitched sounds are “heard” by the basal/bottom end of the spiral, rather like a piano keyboard (and as a result are more susceptible to insult).

These impulses pass up the nerve to the brain where they are recognised as sounds, speech, music etc…

TYPES OF HEARING IMPAIRMENT

The Outer Ear

Failure of development of the outer ear is called atresia. This may occur by itself as an inherited characteristic or as part of the general developmental problem of the facial bones and palate. In some cases the outer ear may appear normal but the ear canal ends blind with a plate of bone covering the tympanic membrane. In all cases of atresia there is an interference with the conduction of sound along the ear and therefore a conductive hearing loss, which is often permanent.

Impacted wax or debris can also cause temporary hearing problems in adults and children. Small ear canals, in e.g. Down Syndrome children, may be prone to blockage. Wax may cause problems for hearing aid wearers by blocking the sound outlet, or by causing feedback/whistling for the wearer.
The Middle Ear

Failure of the development of the middle ear may occur on its own or associated with the external atresia mentioned above. This can occur without any known cause or may be familial.

The middle ear may be the site of acute infection in young children associated with nose and throat infections. If these infections do not clear easily but persist and become chronic, then a hearing impairment may develop.

The middle ear may also develop a fluid, which is associated with blockage of the eustachian tube mentioned earlier. This is known as otitis media with effusion (OME) and can cause temporary hearing problems. OME is extremely common in babies and young children: up to 80% of pre-school children have one or more episodes of OME. However, less than 10% will have a long-term problem meritng regular monitoring/ENT opinion; less than 5% will have surgical intervention. (Bennett and Haggard, 1998; NRB, 1996).

(See also ‘Glue Ear information’ pages 15-17)

In both outer and middle ear origin of hearing loss, the problem is in the conduction of sound to the inner ear, and called conductive hearing loss. Conductive hearing loss may resolve naturally or require intervention in the form of grommets, suction clearance or other surgery. Sometimes hearing aids will be used for very persistent cases of conductive hearing loss.

The Inner Ear

Hearing loss that is associated with the inner ear or cochlea or auditory nerve is described as sensori-neural hearing loss (SNHL). This type of hearing loss is almost always a permanent loss for which there is no cure. There is very little chance of any improvement in hearing in sensori-neural hearing loss (SNHL). However, hearing aids will often help the person to hear better, particularly with cochlear loss.
CAUSES OF PERMANENT CHILDHOOD HEARING IMPAIRMENT
(McCormick, 2004)

Genetic
• Familial hereditary deafness is either autosomal recessive or dominant and non-syndromal (eg. Connexin 26 is thought to be the commonest type genetic type in Ireland for severe-profound PCHI)
• Syndromal deafness – where the hearing impairment is a specific feature of a recognised syndrome such as Treacher-Collin’s or Usher’s Syndrome
• Chromosomal abnormalities eg Trisomy 13-15, 18 and 21
• 50% + of all PCHI is probably caused by genetic factors; these are gradually being identified and simple genetic swab tests may eventually be available to future hearing screening programmes.

Intrauterine infection/causes (STORCH infections)
• Syphilis
• Toxoplasmosis
• Rubella
• CMV
• Herpes simplex
• Toxaemia
• Drug or alcohol use by mother during pregnancy

Perinatal/Prematurity/Low birth weight
• Babies requiring mechanical ventilation for prolonged periods and with a history of hypoxia or foetal distress
• Rhesus incompatibility
• Prolonged jaundice
• Ototoxic medication

Structural middle ear abnormalities
• Sometimes associated with syndromes, often not.
• Failure of development of middle ear structure such as tympanic membrane and ossicular chain. Often outer ear canal is narrow, very small and ends in a bony plate. This is known as atresia.
• A badly formed auricle or pinna and ear skin tags can be an indication of middle ear abnormalities.

Acquired Deafness
• Bacterial meningitis/septicaemia
• Mumps or Measles
• Unknown viral illnesses or viral meningitis
• Ototoxic drugs – e.g. chemotherapy (cisplatin) or gentamicin/kanamycin
• Trauma/noise or explosive damage, head injury such as skull fracture
• Acute or chronic kidney failure and/or associated drug treatments.
• Otosclerosis (usually with family history and in later childhood).
RISK FACTORS FOR PCHI
There are three recognised categories of risk for PCHI (NRB, 1996; Davis et al, 1997)

1. Family history of deafness
One third of congenital PCHI have immediate family history of hearing loss.
- Family history relates to hereditary childhood sensori-neural hearing loss (SNHL) (not hearing impairment following natural ageing, noise at work or meningitis).
- Immediate family members with an apparent, or definite, history of congenital PCHI should be noted.

2. Admittance to Neonatal Intensive Care Unit (NICU) or Special Care Baby Unit (SCBU) for > 48 Hours
A further third with congenital PCHI have this risk category.
The incidence of PCHI is at least 10 times higher in babies admitted to NICU compared with the ‘well baby’ population.
Indicators for NICU births include:
- Low birth weight – less than 1500g.
- History of respiratory distress/anoxia with period of mechanical ventilation
- Hyperbilirubinemia: severe jaundice where exchange transfusion is considered
- Rhesus negative babies
- Viral infections such as rubella, cytomegalovirus, herpes, syphilis or toxoplasmosis (STORCH)
- Post meningitis children
- Ototoxic medications including amino glycosides, eg gentamycin, and loop diuretics.
However, these individual factors have been shown to equate with the simplified statement:

“if a newborn has stayed > 48 hours in an intensive care setting, they have NICU risk factor”

3. Craniofacial Abnormalities (CFA)
About 1 in every 6 newborns with congenital PCHI have a visible CFA.
CFA includes abnormalities of pinna, ear canal, cleft palate and dysmorphic features.
Children with syndromes associated with CFA and hearing loss include
- Treacher Collins Syndrome
- Pierre Robin Syndrome
- Hunter Syndrome
- Down’s Syndrome
*Note that some children will have 2 or more of the risk factors present.

Well over 60% of PCHI cases could theoretically be identified by targeted testing, which can be conducted in the maternity hospital. However, this yield is probably an overstatement, largely due to the problems encountered in fully identifying those with positive family history; 45-50% is a more realistic yield estimate, allowing for non-disclosure, or early discharges failing to be screened.

Recent reports from early evaluations of universal neonatal screening in the U.K. have found risk factors in 54% of newborn babies found to have bilateral hearing loss.
Also note that about one third of children with PCHI had additional disabilities, in a retrospective Irish study of a birth cohort of PCHI children (NRB, 1996).
1. In approximately 40% of PCHI cases, cause is unknown at time of diagnosis. It is thus important to keep ‘universal’ screen with high coverage rates.

2. The distraction test (DT) must remain a universal screen, provided in a high quality and uniform fashion, until earlier Neonatal Hearing Screening is introduced.

   \textit{(Denyer et al, 1999; Pitt et al, 1999)}

3. Knowing the risk factors for PCHI is useful prior to DT, but risk factors alone do not justify referral to Audiology, if the DT or other screen is passed.

4. Ongoing surveillance is recommended for any child where a risk factor is known.
Glue Ear: The facts (adapted from Defeating Deafness.org website.)

WHAT IS GLUE EAR? Glue ear occurs as a consequence of a build-up of negative pressure in the middle ear space. As such, it develops as a ‘mechanical’ fault. Normally the pressure behind the tympanic membrane is equalised with the ambient air pressure by swallowing, yawning, chewing and blowing our noses. In this way we open the eustachian tube and replenish air in the middle ear cavity as it is being absorbed on a constant basis. When this process does not occur, due to nasal blockage (URTI), enlarged tonsils/adenoids or acute ear infections, the middle ear cavity experiences a build-up of negative pressure. Nature, abhorring a vacuum, prompts the walls of the middle ear cavity to exude a fluid which can be quite serous or over time develop as a viscous, glue-like substance. Glue ear is a build up of sticky fluid in the middle ear space of one or both ears. Because the fluid stops the eardrum moving freely, it can lead to hearing problems.

Middle ear fluid is very common in young children. About four in every five children have at least one mild bout of glue ear before their 4th birthday and it often clears up without treatment. Although it is extremely rare for the condition to cause lasting damage to the ear, glue ear can influence educational, behavioural and general development, sometimes with longer-term effects lasting several years. It is therefore important that parents and professionals understand the condition and the steps that they can take to minimise its impact.

WHEN ARE CHILDREN MOST LIKELY TO GET GLUE EAR? Glue ear occurs when fluid collects in the middle ear space of one or both ears, often following ear infections or repeated colds. Therefore winter, in particular, is a common time for glue ear to occur. Although adults can occasionally be affected, glue ear is much more common in children, particularly between the ages of two and five. This is because, in the second half of the first year of life many children begin attending day-care and mothers often stop breast-feeding. As a result, children are more exposed to infection at a time when they are losing some of their maternally conferred immunity but have not yet built up their own. At age five, children once again are more exposed to infections as they start school.

WHO IS MORE LIKELY TO GET GLUE EAR? Children with Down syndrome or cleft palate, and with a family history of significant middle ear problems are more likely to get glue ear. Other risk factors are maternal smoking, daycare attendance and male sex. A child with the latter three risk factors is 3.4 times more likely to have hearing problems (Bennett and Haggard, 1998)

RISK FACTORS FOR GLUE EAR
Glue Ear and Smoking: ‘Several research studies have shown that glue ear is one of the conditions to which children are susceptible if they spend a lot of time in smoky conditions. As with all risk factors, not every child who breathes in ETS will suffer from glue ear, and not all those who have glue ear will breathe in a lot of ETS. All we know is that children are more likely to get glue ear if they do breathe in a lot of ETS.

Glue Ear and Day Care: Children attending groups such as nursery or play-school with a large number of other children are more prone to acute infections and glue ear.

Glue Ear and Breast Feeding: Breast milk is nature’s way of providing infants with a lot of nutrients they need to fight off infections in the first few months of life. It helps prevent the development of allergies. Some studies show that children who are breast-fed are less likely to get early attacks of glue ear. This is probably because some of the mum’s immunity to infection is passed on to the child.

Glue Ear and Allergies: In a few children, food allergies or allergy-related conditions such as hay fever and asthma may also make the child more susceptible to glue ear.

WHAT ARE THE TREATMENTS FOR GLUE EAR?
Antibiotics: Sometimes antibiotics are prescribed for particularly troublesome ear infections. However, they are not prescribed for every ear infection and are rarely used in the treatment of glue ear. Over-prescription of antibiotics is now discouraged, as this leads to the bacteria...
becoming resistant and medicines losing their effectiveness. Consequently, nowadays antibiotics might not be given at all, even in a confirmed case of glue ear, unless there has also been recent acute infection.

Autoinflation: This is a technique in which a child blows up a special balloon using their nose rather than their mouth. The purpose is to force open the Eustachian tube (the tube that connects the middle ear to the throat) and allow pressure in the middle ear to return to normal. One widely available product is called Otovent®. Continued use of autoinflation over several weeks has been shown to help some children with glue ear, though it is a preventative aid and not a cure. Autoinflation is a ‘low-tech’ way of helping some children. It can be made into a game, but it needs adult supervision and it can require quite a bit of practice and it is important to persevere.

Operations: A small proportion of children, those who experience repeated or long episodes of glue ear, eventually need to have grommets put in. However, this is a very simple procedure and is one of the most common operations for children. Under a light general anaesthetic, a tiny cut is made to the eardrum. The fluid is drained away and a miniature tube known as a grommet or ventilation tube is inserted through the small hole. The grommet keeps the middle ear aired and healthy. This operation does not usually involve an overnight stay in hospital. Grommets improve hearing immediately and usually stay in place for between 6 months and a year. They fall out naturally and, when they do, the small hole in the eardrum should heal quickly. For some, the glue ear may return and another set of grommets may be needed. The ENT specialist will advise on what to do while the grommets are in place. In most cases, children who have grommets can continue to go swimming but diving is usually discouraged. It is important to check with the specialist first. Hair washing advice may also be given. The specialist may recommend removing your child’s adenoid at the same time as putting in grommets. In children prone to respiratory infections, this can help prevent the return of glue ear, and it helps with the other infections too.

WHAT RESEARCH IS BEING CONDUCTED INTO GLUE EAR?
Many studies have tried to find out what factors make a child more at risk of getting glue ear and some of these have been discussed above. Researchers have been trying to identify those risk factors most likely to result in more persistent glue ear, and to use that information, in conjunction with new biological discoveries, to develop new treatment methods. The Eustachian tube connects the middle ear to the throat. In children this tube is angled differently than it is in adults, which means that when stomach juices come up into the throat (gastric reflux), they can reach the middle ear more easily, where they can cause damage. It is therefore possible that in cases where glue ear is persistent, it may be due to an allergic inflammation in response to the damage caused by gastric reflux. This research should increase our understanding of the causes of glue ear and enable the development of new diagnostic tests, as well as new treatments, which in the future may reduce the need for surgical intervention (grommets). At present, there is uncertainty amongst health professionals about what kind of treatment is most effective. Some studies have shown that hearing improves in children with glue ear when grommets are fitted and that many children experience further benefit if their adenoids are removed. However, the size and range of these benefits may not be worth the cost and the small degree of risk in a child who is mildly affected. A recent study showed that children who received grommet insertion and underwent an adenoidectomy were less likely to return for further ENT care. This suggests that a combined approach may be a more effective way of preventing recurrences of glue ear.

SURVEILLANCE AND GLUE EAR
Glue ear can affect children in different ways. Although it starts off as a physical problem, glue ear can affect children in other ways. For example, as well as causing painful ears and dull hearing, glue ear can also affect a child’s balance and speech, their emotional well-being and behaviour. Looking at all elements is known as “a whole-child approach”. Older children with glue ear have described experiencing a ‘shut-in’ feeling, resulting from a combination of the dull hearing and the physical sensations from the middle ear (e.g. a sense that the ear is blocked up). Younger children may have problems with their language
development or speech. Particularly when the glue ear lasts a long time, children can develop difficulties communicating or socialising.

WHAT ARE THE SIGNS OF GLUE EAR?
Children with glue ear experience differing degrees of hearing loss. There may be no loss of hearing at all, or it may be quite severe. The level of hearing may also change from day to day. Ask parents if they have any concerns regarding their child’s hearing and be aware of the following signs (but remember that not every child affected will display all the signs):

• Children with glue ear may appear inattentive or prone to daydreaming. They may seem to “hear only when they want to”.
• Children may turn up the TV or say “pardon”, “eh?” or “what?” more than usual. They may mishear words when not looking at the speaker and fail to hear sounds from outside their field of vision.
• Some children talk too loudly - others talk less. They may mispronounce words or speak less clearly than normal.
• Ear infections, which often come before and sometimes follow glue ear, can cause discomfort and pain, making children fretful.
• Some children become quiet and withdrawn or anxious as a result of their difficulty hearing when with a group of people.
• Having to concentrate hard to hear what people are saying is very tiring, so children may be particularly grumpy and tired by the end of the day.
• Not hearing properly can frustrate children and they may become over-active or have temper tantrums, especially when they are tired.
• Children may become unsettled at school or nursery and feel left out of some activities. Children may have difficulty following what is being said in noisy environments or large rooms.
• Some children may appear to have a hearing ability that changes from month to month, especially in winter, when cough and colds are prevalent.

TACTICS FOR GLUE EAR
It is important to look out for signs that glue ear might be affecting the child in these ways. It will help a child feel less frustrated or misunderstood if you;

• first attract child’s attention by calling his/her name or by touch, before speaking.
• can describe the problems and suggest tactics like asking others to speak louder
• arrange for extra support where necessary, e.g. speech therapy or help at school.
• advise parents to put special effort into involving the child in family conversations, for example at mealtimes, also may make everyone more aware and will also help the child to improve his/her communication skills.
• can choose a room with soft furnishings and carpet to talk with the child.
• cut down background noise – turn down the television or turn it off.
• talk face to face, sitting or bending to the same level as the child, if possible.
• check that the child is listening and watching and check that they have understood.
• speak up and speak clearly, but don’t shout. Be direct, keep requests short and simple.
DEVELOPMENT OF SOUND LOCALISATION

The distraction screen is based on the premise that for a 6-9 month old baby the normal response to a quiet sound is to turn to locate the source of that sound, provided s/he is sufficiently free from other distractions.

The development of localisation skills in young infants: the distraction test is only suitable for children in a certain age range, when their ability to localise sound on a horizontal plane has developed. This usually happens at about 6 months developmental age.

It is important to recognise the developmental stages below when screening infants at 7-9 months. The tester behind must be aware of positioning stimuli on the horizontal plane and avoid holding the rattle/warbler too high up when the infant is not yet able to localise above ear level. Stimuli position must be at ear level to ensure the infant has every chance to localise.

<table>
<thead>
<tr>
<th>AGE</th>
<th>WARBLE TONES dB HL*</th>
<th>SPEECH DB HL</th>
<th>EXPECTED RESPONSE of INFANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 wks</td>
<td>75+</td>
<td>40-60</td>
<td>Eye widening, eye blink, stirring or arousal from sleep, startle response</td>
</tr>
<tr>
<td>6 wks -4 m.</td>
<td>70</td>
<td>45-50</td>
<td>Similar to early responses although some head turning starts around 4 mo.</td>
</tr>
<tr>
<td>4-7 m.</td>
<td>50</td>
<td>20</td>
<td>Head turn on lateral plane towards sound; listening attitude; cannot find above or below</td>
</tr>
<tr>
<td>7-9 m.</td>
<td>45</td>
<td>15</td>
<td>Direct localisation of sounds on lateral plane; indirectly below ear level</td>
</tr>
<tr>
<td>9-13 m.</td>
<td>35+</td>
<td>&lt;10</td>
<td>Direct localisation of sounds on lateral plane; directly below ear level</td>
</tr>
<tr>
<td>13-16 m. &amp; older</td>
<td>25</td>
<td>5 (falls to 3 by 2 years of age)</td>
<td>Direct localisation of sound on lateral plane; above and below ear level</td>
</tr>
</tbody>
</table>

Adapted from Northern & Downs, 1984. * Note: dB A, HL & SPL are slightly different values according to frequency range; these tables/diagrams give a good idea of infant responsiveness to sounds.
HEARING SCREENING AND SURVEILLANCE

PROTOCOLS AND RECOMMENDATIONS:

Hearing Screening - Draft National Child Health Core Programme Review Group Report 2005

Working Group Membership

Dr Theresa Pitt, (Chair) Senior Audiological Scientist, SEHB
Ms Majella Doherty, Child Health Development Officer, SHB
Ms Clare Farrell, Public Health Nurse, NAHB
Ms Maria Quaid, Audiological Scientist, OLHSC

Rationale

• Early intervention and habilitation of congenital hearing loss before 6 months of age is best practice

Recommendations

• Early implementation of Universal Neonatal Hearing Screening (UNHS) programmes

• Retention of and staff training in Universal Distraction Hearing Test (UDHT) and School Sweep Test as an interim measure

• Implementation of clear referral criteria as agreed by National Core Child Health Programme Review Group

• Education of parents and professionals in using ‘Can your Baby Hear You’ surveillance tool

Equipment

• “Can Your Baby Hear You?”
• Sound level meters
• Calibrated hand held warblers
• Free field audiometres
• Manchester rattle
• Distraction toys
• Low Table
• Audiometer
• Otoscopes
## Hearing Screening

<table>
<thead>
<tr>
<th>Timing</th>
<th>History</th>
<th>Examination</th>
<th>Equipment</th>
<th>Health Promotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td>Antenatal, birth and family history, risk factors for hearing loss, parental concerns</td>
<td>UNHS is gold standard (two-stage screen as per UNHS report recommendations). Inspection of ears, facial morphology, associated physical findings or syndromes</td>
<td>Otoscope</td>
<td>Encourage parental observation, ‘Can your baby hear you?’</td>
</tr>
<tr>
<td>Postnatal visit</td>
<td>As above</td>
<td>As above</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>6-8 weeks</td>
<td>As above</td>
<td>Observation of auditory behaviour</td>
<td>Otoscope</td>
<td>As above</td>
</tr>
<tr>
<td>3 months</td>
<td>As above</td>
<td>Observation of auditory behaviour</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>7-9 months</td>
<td>As above</td>
<td>Distraction hearing test in the absence of UNHS</td>
<td>Sound treated/Quiet room (ambient noise &lt;35dB(A)- carpets, curtains &amp; low table, toys. Calibrated warbler; trained LF/HF voice; Manchester HF rattle; Access to Sound Level Meter;</td>
<td>As above</td>
</tr>
<tr>
<td>18-24 months</td>
<td>As above</td>
<td>Observation of speech and language behaviour</td>
<td>Encourage parental observation</td>
<td></td>
</tr>
<tr>
<td>3.25 to 3.5 years</td>
<td>As above</td>
<td>Observation of speech and language behaviour</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>School entry (Junior Infants)</td>
<td>As above</td>
<td>In the absence of UNHS - Pure Tone Audiometry (sweep test screen, 1st and 2nd test stages)</td>
<td>Quiet room &lt;40dB(A) ambient noise; Bricks, tapper or hammer for child responses; Small screening audiometer; Sound level meter;</td>
<td></td>
</tr>
</tbody>
</table>
PARTNERSHIP WITH PARENTS
(Denyer et al, 1999; Hitching and Haggard, 1983)

Prior to 7–9 months of age parental observation should be encouraged to assess hearing. This can be done using the following:

EARLY DETECTION OF HEARING LOSS
Here is a checklist of some general signs you can look for in your baby’s first year:

Shortly after birth:
Your baby should be startled by a sudden loud noise such as a hard clap or a door slamming and should blink or open his/her eyes widely to such sounds.

By 1 month:
Your baby should be beginning to notice sudden prolonged sounds like the noise of a vacuum cleaner and he/she should pause and listen to them when they begin.

By 4 months:
He/she should quieten or smile at the sound of your voice even when he/she cannot see you. He/she may also turn his/her eyes towards you if you come up from behind or speak to him/her from the side.

By 7 months:
He/she should turn immediately to your voice across the room or to very quiet noises made on each side if not too occupied with other things.

By 9 months:
He/she should listen attentively to familiar everyday sounds and search for very quiet sounds made out of sight. He/she should also show pleasure in babbling loudly and tunefully.

By 12 months:
He/she should show some response to his/her own name and to other familiar words. He/she may also respond when you say “no” and “bye bye” even when he/she cannot see any accompanying gesture.

PLEASE ATTEND YOUR LOCAL CLINIC WHEN YOUR BABY IS 7 MONTHS FOR A HEARING SCREENING. IF YOU SUSPECT THAT YOUR BABY ISN’T HEARING NORMALLY EITHER BECAUSE YOU CANNOT PLACE A DEFINITE TICK AGAINST THE ITEMS ABOVE OR FOR SOME OTHER REASON THEN SEEK ADVICE FROM YOUR PUBLIC HEALTH NURSE OR G.P.

Based on original material produced by Professor Barry McCormick O.B.E. Children’s Assessment Centre, Nottingham. Printed with permission.

A recent review by Clare O’Farrell, PHN (2002) recommends that guidelines be developed using Guidance to Nurses and Midwives in the Development of Policies Guidelines and Protocols (An Bord Altranais, 2000) as there is a danger that the leaflet may be distributed without systematic questioning. Hitching and Haggard (1983) produced strong evidence suggesting that it was the basic questioning procedure between the parent and the health visitor that reduced the age level at which children with hearing loss were detected and produced a general re-orientation towards hearing problems.
A Standard Audit Tool and Action Plan (See Appendix 1) were developed to ensure that all parents received the leaflet and had the contents discussed with them. In recognition of the increasing diversity in our society, the leaflet has been translated into eleven different languages to address the needs of our new citizens and clients. In collaboration with the NAD, a DVD is currently being developed to address the needs of hearing impaired parents.

The leaflet should not be used in isolation. It complements Neonatal Hearing Screening and the Distraction Hearing Test. (See Appendix 1)

ONGOING SURVEILLANCE IRRESPECTIVE OF ANY SCREEN OUTCOME

Parental concern about hearing should always be taken seriously. Latham and Haggard (1980) state that up to 70% of childhood deafness, particularly severe hearing loss, can be detected by parents. All professionals who may be in contact with a child should be able to refer to Audiology if there is parental concern, or if they themselves are concerned.

Parental or professional concern about the infant’s hearing, development of auditory or vocal behaviour should result in a hearing assessment carried out by appropriately trained audiology staff. Checklists may also be useful in guiding the professionals and parents about expectations for their child’s development of speech and language and listening behaviour

RISK FACTORS FOR ACQUIRED OR LATE ONSET HEARING IMPAIRMENT

The following groups require referral to audiology by whichever professional discovers or becomes aware of the risk factor (may be screener, PHN, AMO, Paediatrician, GP or SLT)

- Confirmed or suspected bacterial meningitis or meningococcal disease within 4 weeks of discharge from hospital (if assessment not already carried out in hospital).

- Those at high risk of chronic middle ear problems including children with Down syndrome or cleft palate who require ongoing assessment by audiology.

- Other cranio-facial abnormalities (CFA) including chromosomal or syndromic conditions such as Branchial Arch and Cervical Spine anomalies. CFA children are at risk of late onset hearing loss although this may not develop until after the first year of life

(From www.nhsp.info website)
**OUTLINE CHECKLIST FOR SPEECH/LANGUAGE/AUDITORY MILESTONES**

<table>
<thead>
<tr>
<th>Time</th>
<th>Speech</th>
<th>Language / Social</th>
<th>Auditory and Understanding</th>
<th>Follow-up if red flags</th>
<th>Health Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 mths</td>
<td>Cooing and Gurgling with inflection. Babble, then ‘Dada/Mama’ with meaning by 12m.</td>
<td>Uses own voice to attract attention; imitates sounds like coughing / raspberries. Responds to ‘no’ &amp; name being called. May wave ‘bye-bye’ and smile at familiar faces.</td>
<td>Locates sounds correctly in their immediate environment by 12 months (localisation skills well developed). Will recognise own name readily.</td>
<td>Failure to develop mature babble &amp; first word progression, or lack of response to name being called at home should be followed up.</td>
<td>Parents should ‘chat’ to their children often, about books or toys, play turn taking games, and reinforce baby’s communication attempts.</td>
</tr>
<tr>
<td>12-24 mths</td>
<td>Growing vocabulary of single words – up to 50 – then some 2-word phrases should start to develop.</td>
<td>Starts to join in with simple conversations and understands turntaking/holds eye contact when communicating. Often gives kisses/hugs. Plays alongside others. May copy older siblings.</td>
<td>Knows some body parts; follows simple commands e.g. ‘get your coat’, ‘pick up your bottle’ - without visual cues. By 24m, points to pictures if asked ‘where’s teddy’?</td>
<td>If the child has no words and/or lacks interest/eye contact when ‘chatting’, they should be followed up.</td>
<td>Parents: ensure that your child has a chance to learn words and feel confident when they try to speak – do not overcorrect mistakes in speech at this age.</td>
</tr>
<tr>
<td>24-36 mths</td>
<td>By 36 months, usually has some 4-5 word sentences with verbs, (e.g. ‘The dog is running away’) even if speech is not fully intelligible to strangers. May repeat part-words, or ‘hesitate’ around 3 years, as if speaking rate is slower than thinking rate!</td>
<td>Able to maintain a conversation for a minute or two, and can tell little stories about themselves. Starting to play co-operatively with other children; uses toys to pretend (cars or dolls). May talk to themselves during play.</td>
<td>Should be willing to listen to stories, and follow more complex commands like: ‘Get the milk and you can give some to the cat’. May enjoy looking at books themselves.</td>
<td>If child is unintelligible by 36 months, says ‘uh?’ a lot, or still depends on gesture to make themselves understood, follow them up.</td>
<td>Parents: include your child in conversations and make sure they can have friends of similar age to play with, not just older brothers and sisters. Focus on developing a child’s understanding, rather than forcing their speech.</td>
</tr>
<tr>
<td>By 4 years</td>
<td>Fully understandable speech with almost no sound substitutions. Uses who, what, where, when – may ask ‘why’ a lot too!</td>
<td>Holds normal conversations and enjoys make-believe games with same-age friends. Talks about their friends to others. May still make some grammatical errors like ‘I runned to the shop’ or ‘The mans are coming’</td>
<td>Listens to stories without pictures and can sing songs fluently. Can learn and remember simple ‘lines’ or poems for school plays etc. e.g. ‘Jesus was born in the stable’.</td>
<td>If the child cannot make friends, or ‘forgets’ words or sentences, or constantly asks for repetition, get follow up before they go to school.</td>
<td>Treat your child as a child and not a baby – do not speak for them in situations where they can speak for themselves! Encourage their independence.</td>
</tr>
</tbody>
</table>

*(Also see: Cox and Cunningham, Am. Academy of Paediatrics, 2003).*
National Child Health Surveillance and Screening Core Programme Working Group:

Updated Recommendations for School Entry Hearing Screening

1. Timing: all children at school entry year or senior infants (4-5 years) to be screened ideally by the Spring following school entry. Test younger children earlier in the day if possible. Parents usually complete history & consent form in advance.

2. Equipment: quiet room, preferably carpeted with ambient noise <40dB’A’ and few interruptions; bricks/bucket, soft hammer or tapper, screening audiometer with suitable headphones.

3. Method: Audiometry Sweep Screen Test; 1st and 2nd sweep test occasions:
   1st Sweep Test: 2 clear responses (but not necessarily obtained in this order) to each test frequency in each ear as follows:
   - 1000Hz @ 20dBHL
   - 2000Hz @ 20dBHL
   - 4000Hz @ 20dBHL
   - 500Hz @ 30dBHL (250Hz /8000Hz are not part of sweep screen)

4. Outcome of 1st Sweep
   Pass: notify parents and GP
   Not a Pass: make arrangements to repeat screening within two months, at local health centre (if conditions are quieter than in school).

5. Outcome of 2nd Sweep (carried out as in 3 above)
   Pass: notify parents and GP
   Not a Pass i.e. one or more frequencies missed: measure hearing threshold using standard Audiometric protocols, at frequencies above (this is done continuously with Sweep task so the headphones remain on throughout). If thresholds meet Sweep test criteria, then child has Passed. If average is 20-25dB HL, this counts as a Pass, although a review audiogram may be suggested if the parents have minor concerns. Notify parents & GP of position.

6. If the average threshold is greater than 25dB HL across 4 frequencies on either ear, child is referred; parents and GP are notified. For example, left ear is:
   - 1000Hz – 30dBHL
   - 2000Hz - 25dBHL
   - 4000Hz – 20dBHL
   - 500Hz - 35dBHL Avg. loss = 110/4 = 27.5dB HL, i.e. 25dB HL (Refer)
   (Note: Best Health For Children gives ‘failure’= 25dB HL at 1000-4000Hz. At least 2 of the frequencies should be >=25dB HL if ‘average approach’ is adopted).

7. Referral to Audiology clinic or 2nd tier clinic as per local arrangements; send copies of both screening audiograms dated with referral form.

8. History outline/form obtained should be sent with referrals, such that parental/teacher concerns, ear infections/illnesses, risk factors, speech and language delay, may be taken into account in follow-up. Less than 10% of children should be referred by a School Screening Programme – many children will have already attended other services and had hearing tests by this age, so the history form is particularly important.
DISTRACTION SCREENING TEST OF HEARING
(adapted from www.nhsp.info/workbook/shtml protocol by Prof. B Mc Cormick)
(cf Training Video:)

This is appropriate for children between 6 and 12 months developmental age
The recommended age of first screen is 7-8 months and second screen before 10 months.

The Essentials

A quiet room (see Appendix 2 and Appendix 3 for details.)
A low coffee table
A range of sound generators with known frequency content
A sound level meter
Two- people - well trained and working in partnership

Set-up for Screening Distraction Test
PERFORMANCE OF THE DISTRACTION TEST: PARENT’S ROLE

Motto: support but do not join in

• The parent holds baby facing forward in midline, with knees together, holding baby just slightly out from chest to allow freedom of movement.

• The parent places hands under the baby’s armpit with her thumbs at the baby’s back. This steadies the baby and helps to prevent him/her from falling backwards. This distance between parent and child also prevents the child getting too comfortable and sleepy and promotes independent movement when searching for the sound.

• Avoid allowing the baby-sitting on the end of the parent’s knees. Babies need a firm-sitting base, not a ‘wobbly’ one, to locate sound well.

• Parent should be told not to react to any sound or the tester behind.

PERFORMANCE OF THE DISTRACTION TEST: THE DISTRACTOR’S ROLE

Motto: control baby’s attention

• It is helpful to explain the screen to parents

• Arrange parent and baby’s sitting position i.e. baby upright, and not leaning back but sitting securely on parent’s knees. If position alters during testing, direct parent to hold baby back in the middle again. This is essential, as a baby will not respond on the correct side if the sitting position is skewed. The baby must sit in centre of lap, not leaning to either side. Break the test to gently inform parent to “straighten” child if necessary.

• Front tester sits or kneels at the low table and with various small toys, commands the baby full attention. It is vital that the tester in front takes responsibility for control of the baby’s attention.

• Person holding baby must be advised not to move or react to the sounds when they are presented, as this can cue the baby.

Engage the attention of the baby but avoid over-stimulation. To be successful here, you can use a soft voice to get the baby’s attention to the table. A variety of 3-4 spinning tops/balls can be used on a low surface, keeping the toys just below the baby’s eye level. It is important to keep the activity level quiet to avoid the baby becoming less responsive to testing sounds.

Wait until the tester behind is in position before you phase or break the activity. The tester behind must be ready and in position to allow maximum opportunity for the baby to turn, and minimum amount of movement/noise.

If baby becomes distracted before or during sound stimuli presentation, bring his/her attention back to midline by tapping toy or table or clicking fingers.
Plateau child’s attention and let tester behind “enter” with sound.
Don’t alert baby to the tester behind by looking directly at the person. Minimise eye contact with baby so that they do not fixate on tester in front.

Sound is presented after the stimulation level is dropped or phased by covering toy or freezing activity.

Young babies will allow you to cover the toy with your hand, as they may not have yet developed object permanence. It can help to move your fingers whilst covering the toy to help keep the baby’s attention on the table.

Older babies may only allow a short break in activity i.e. freeze on the spot, as they may get frustrated if the toy is constantly covered.

More mature infants will anticipate sound presentation if the routine becomes too predictable. It helps to vary the routine.

Evaluate the responses of the baby
The majority of children will locate (correctly or incorrectly) the sound by turning 90 degrees. A few will be too shy or unable physically to turn. In these cases, alert person behind that baby is eye searching/pointing to sound sources i.e. nod gently.

Bring child’s attention back to the table
Bring child’s attention back to the table once he/she has located sound. Don’t let child dwell on tester behind. Child’s attention should be brought forward before tester behind moves away.

It is vital that the tester in front takes the responsibility for control of the baby’s attention.

PITFALLS FOR DISTRACTOR

If the distractor in front is uncertain, or not in control
This often happens with older or more active babies who are difficult to distract. To hold such a child’s attention it may be necessary to engage in more sophisticated activities, such as symbolic play with teddy/dolly and a sequence of activities with verbal commentary. “Look here’s teddy and he’s hungry – Oh don’t cry teddy, let’s get your dinner”.
The activity of feeding teddy is often the signal for the child to watch and tester behind to enter with sound presentation.
Other activities are building up a tower of blocks, man going in a car, man chasing a cow.
Once more remember, don’t over-stimulate and keep chat to a bare minimum. Be prepared to change activities quickly for the very active ones! Use your voice and eyes to engage the child’s attention.

Tester behind is not ready or not in the correct position
The tester behind is not ready to present the sound when toy is removed therefore there is a delay and the child has either lost interest or picked up a clue. This can be avoided if the two testers work as a team; there is an optimum number of seconds between the toy being removed and the sound being presented, for the child to respond. The more active the child, the more necessary it is to make sure that there is only a split second delay between cessation of the activity and presentation of sound.
Child picking up clues or turns in anticipation of sound presentation
Use ‘no sound’ trials to ensure the baby is not predicting when the sound will enter.
Vary the distraction presentation. For example, lift the spinning top as if you are about to spin it but pause, to let the tester behind in with a sound presentation. This is an excellent method of holding a baby’s attention rather than covering the toy.
Also babies are often more interested in what’s behind them than what’s in front so be sure you keep his/her interest in front!

Also after having located the sound, if the child spends a longer period of time watching the tester behind, he is likely to get involved with the tester.
Distract the child’s attention back to the table in front immediately – before the tester behind moves away from the position of sound presentation. This way, the child’s attention to what is behind is kept to a minimum. Remember, distractor, you control the child’s attention.

Do not glance at tester behind before ceasing activity in front.

If you give a consistent clue that the sound behind is being made i.e. drop gaze, remove a toy or look away, a child is very quick to pick this up and react by turning not to sound but to your clues.

PERFORMANCE OF THE DISTRACTION TEST: ROLE OF TESTER BEHIND

Motto: Be in the right place at the right time

USE FREQUENCY SPECIFIC SOUND STIMULI

Never leave out the high frequency part of screening test
Screen with at least 2 different high frequency stimuli e.g. “s” and rattle on one side or 4000Hz and ‘s’ on the other, and likewise for 2 different low frequency stimuli.

Importance of high frequency screening
High frequency stimuli screening is the most important element of the screen in identifying PCHI. It is recommended to perform this part of the screen first while you have the best of the child’s attention/cooperation.

HIGH FREQUENCY STIMULI
1. Manchester high frequency rattle
2. “sss” presented softly and rhythmically
3. 4000Hz warble tones
   (See Appendix 5 for equipment contacts)

LOW FREQUENCY STIMULI
1. Voiced (not whispered) “ooooo.....” as in “shoe”
2. 500Hz warble tones.
3. 1000Hz warble tones (note: not available on MEG warbler)
4. Humming – continuous soft “mmm” if 1000Hz warbler not available
DISTANCE
Present rattle, humming, ‘sss’ and voice at a distance of 1 metre or approx. 3 feet from the child’s ear. This is approximately arm’s length from the back of the chair. This should give a level of 40-45dBA, as practiced on the course.
Care, practice and regular monitoring are required with a sound level meter (SLM), which can confirm that your voice is staying within the required limits.

Warble tones are normally presented at 50cm (0.5m) as the level is calibrated for this distance. This is approximately the length from your fingertip to your elbow, or the distance from the parent’s shoulder to the child’s ear. Use the warbler set at 40dB.

ANGLE
A useful rule of thumb is to use the back of the parent’s chair and step no further forward (this is a 45-50 degree angle). This ensures that you stay out of the child’s vision.

HEIGHT
Present all sounds on a horizontal plane with the child’s ears for ease of localisation for young infants.

SOUND LEVEL
Present sounds at a very quiet level for approx. 5 seconds only.
Use the warbler set at 40dBA.
Use your rattle, humming, voice and ‘S’ at 40-45dBA.
Use your sound level meter to practise these levels, setting the SLM at the required distance as noted above.

REINFORCER
A small congratulatory smile or clap can encourage continued turning.

NO SOUND TRIALS
These are routine ‘distract, pause while tester behind enters’ but tester behind makes no sound.
The tester behind must get in the normal position holding rattle/ warbler but makes no sound. No sound trials should be interspersed throughout the screen.
These should be used routinely to see if the baby is using ‘checking’ responses before a sound is heard. They may also prevent a baby from checking by making the sound presentation noncontingent on distraction periods.

FREQUENCY SPECIFIC STIMULI
Just as we use the audiometry to screen hearing for speech across high and low frequencies, we also use sound stimuli to screen babies hearing in the high and low frequencies.
PITFALLS FOR THE TESTER BEHIND

Make no noise except the sound you are testing.
Ensure that your movement behind the child does not alert him/her to your presence. Creaky floors/shoes are out! Carpets or floor covering will help.

If a door slams on the corridor while you are testing a specific sound
This cannot be accepted as a pass. Repeat the signal when it is quiet again.

Stay out of the child’s vision at all times
If your partner ensures that the child is sitting in midline throughout the test, it will reduce the risk of catching a glimpse of you out of the corner of an eye.

Check the area around and in front of the child for shadows.
You may need to pull curtains/blinds and switch on the lights to eliminate shadows. If all else fails relocate the test position so that shadows fall behind you rather than in front of you.

Do not wear perfume.

Do not touch the child with the exception of a child who does not turn or react to any sound. Then the baby may be touched lightly on a cheek, to see if this elicits a turn or a reaction.
SCREENING OUTCOMES AND REFERRAL CRITERIA

BABY ACHIEVES THE REQUIRED NUMBER OF RESPONSES

To achieve a Pass the baby must show 2 clear head turns to high frequency stimuli and 2 clear head turns to low frequency for each ear out of a maximum of 6 trials on each ear. This means 4 out of a possible 6 trials must be passed for each ear, or 8 out of 12 for both ears. Almost all sounds trials should elicit a clear response, interspersed with ‘no sound’ trials.

This is an example of a passed test in both ears:

<table>
<thead>
<tr>
<th>Low frequencies:</th>
<th>High frequencies:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500 Hz warble tone</td>
</tr>
<tr>
<td>Right ear</td>
<td>Y</td>
</tr>
<tr>
<td>Left ear</td>
<td>X</td>
</tr>
</tbody>
</table>

Y = Clear Head Turn     X = No Response

Low frequencies:
Baby needs to turn to 2 out of 3 presentations to pass on right ear
Baby needs to turn to 2 out of 3 presentations to pass on left ear

High frequencies:
Baby needs to turn to 2 out of 3 presentations to pass on right ear
Baby needs to turn to 2 out of 3 presentations to pass on left ear
Overall baby needs to turn to 8 out of a possible 12 presentations to pass the test.

(See Appendix 6 for a sample scoring sheet).

BABY DOES NOT GIVE THE REQUIRED NUMBER OF RESPONSES

If any responses are missed or a baby loses interest/becomes tired, re-screen within 8 weeks OR within 2 weeks if there are concerns.

If the baby does not pass the second screen, see referral criteria below.

REFERRAL CRITERIA

Audiology referral should be standard for any child not passing a second screen.

Where there is concern by either the parent or referral agent, this should be noted as urgent on the referral form.

Children should be seen within 3 months from date of referral and within 6 weeks or earlier if concern is expressed by PHN/AMO or parents.
Reasons for Poor Screen Specificity and Sensitivity

REASONS WHY A NORMAL HEARING BABY MAY NOT RESPOND

• Lack of interest in sound.
• Discomfort from hunger, wind or wet nappy.
• Tired and irritable.
• Too engrossed in the activities of the distractor.

REASONS WHY A HEARING IMPAIRED BABY MAY RESPOND

• Stimuli too intense/loud.
• Child may have good hearing for certain frequencies but not others.
• Child may respond to other stimuli (eg visual clues).
• Tester may misinterpret “random” responses.

AUDITING YOUR SCREENING PROGRAMME PERFORMANCE

It is most important that effectiveness, efficiency and coverage of any Screening Programme are estimated, and that information can be shared between Audiology and Community Health Services. Whilst a computerised Child Health Records System is ideal, a good check can still be made using manual records. The way to do this is to:

Whoever is responsible for the Clinic List should note at the bottom of the list (or in a diary etc):

1. HOW MANY INFANTS PASSED IDT at FIRST APPOINTMENT (P1);
2. HOW MANY WERE RETESTS WHO PASSED (P2);
3. HOW MANY CHILDREN HAVE NOT ATTENDED (DNA)
4. HOW MANY WERE REFERRED (R), from the list.

NOTE HOW MANY INFANTS WERE PAST THE RECOMMENDED AGE FOR THE IDT (OVER 10 MONTHS), BY MARKING THEM WITH A STAR(*).

<table>
<thead>
<tr>
<th>DATE</th>
<th>P1</th>
<th>P2</th>
<th>DNA</th>
<th>REFER</th>
<th>PAST REC. AGE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/01/05</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>15/01/05</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>4 ETC..</td>
</tr>
<tr>
<td>TOTAL</td>
<td>15</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

(You may already keep similar clinic lists for DNA rates, so all you add is Pass and Refer rates).

Periodically (perhaps quarterly), the Secretary adds up numbers from lists/diaries for auditing:
• P1 should be >7 out of 10 of all babies eligible for the test (except perhaps in mid-Winter when many children with epidemic cold/flus may attend).
• P2 should be <~2 in every 10 babies who pass the IDT.
• R rates should be <~1 in 10 (i.e. 1-2 babies per clinic) and may well be lower – the maximum in Irish programmes in 2003-2004 was 8% (Nat. Audiology Database evaluation carried out for PAC Working Group).
For Internal Review: DNA rate - could it be reduced by changing appointment notification system? Also check how many babies are in the optimal age group and consider ways of improving this – it will be much easier to persuade management that more resources may be needed to clear a backlog if you have exact figures.

Note: the Secretary may be able to identify children who have never attended any EDS (NA) quite easily – NA% (of all infants in the age group) is inverse to Coverage % (100%-NA%)

OK – so you’ve checked your IDT programme – now speak to your local Audiological Scientist and get them to send information on a regular basis using the Audiology Database. Although, there are a lot of limitations, it can tell you:

1. How many children were referred following EDS referral (and for other reasons) for a particular clinic in a particular time period, at our ‘Under-4 clinics’.

2. How many children have been fitted (annually) with hearing aids, and their ages/DOBs (these will be a small number) & referral sources/reasons entered.

ASK Audiology to check the EDS result for these children with hearing aids and feed this information back to you, to establish an estimate of SENSITIVITY, SPECIFICITY and YIELD. If the aim of Hearing Screening is to DETECT ALL CONGENITAL PCHI by 12 months – we require dedication, high coverage, Timely Screening and Referral System, and MONITORING.

DISCUSS AND EVALUATE REFERRAL SYSTEMS/PROBLEMS WHICH NEED TO BE FIXED! OTHERWISE, THE IDT PROGRAMME MAY BE A WASTE OF TIME.
PARENT INFORMATION

Before The Screen:

• Ask parents what they think of child’s hearing
• Child’s history (include family history, birth history, ear infections)
• Describe the test – “to see that the child can hear the quietest of sounds”.
• Outline parent’s role in the screen

After The Screen:

If the child responds to all sounds in the screen
Explain that the next screen of child’s hearing is in early primary school years
If at any stage in the child’s development, parents have any worries about their child’s hearing, advise them to contact their PHN or local health centre.

If the child misses sounds in the screen
Explain the screening protocol of 1st and 2nd screen and onward referral if necessary. Go through the “Hints for parents” list and give it to parents to read before the next test.
If the baby has missed sounds on one side or a small number of sounds, ask the parent their opinion, as it helps allay anxiety.

If the child responds to no sounds in the screen
Discuss the results with parents and seek their opinion as to why the baby did not respond. Rescreen as soon as possible allowing for the baby’s sleeping/appointment time. If there is concern, refer onwards.

Remember when talking to all parents

For some, their baby’s screening not being passed can cause a lot of anxiety.
If there is genuine concern by you or the parents, mark your referral urgent

Urgent cases can and should be seen urgently.
SERVICES FOR CHILDREN WITH PERMANENT CHILDHOOD HEARING IMPAIRMENT

1. Habilitation/hearing aid provision and long term follow-up provided by paediatric audiological scientists in community clinics.

2. Visiting teacher service providing information and support for families, children and educational staff; one per county in most areas. Tel 090 64 74621 (Dept.Education) for further information on local Service.

3. Local speech and language services

4. ENT clinics providing intervention for children with conductive loss as necessary eg. myringotomy/vents

5. National Association for Deaf People (NAD) family support service provides counselling and support services for all PCHI children and their families; they also supply technical equipment. Head Office: 01-8723800

6. Genetic investigations where applicable

7. Cochlear Implant programme at Beaumont Hospital provides assessment of candidacy for cochlear implantation, implantation surgery, habilitation and follow-up services for those implanted. Phone 01-8377755.

CHILDRENS’ COMMUNITY AUDIOLOGY SERVICES

The Childrens’Community Audiology Services provide a range of services to children with hearing impairment, and their families, including:

- **The identification of hearing loss in children.** A wide range of assessments can be carried out to determine the level and type of the child’s hearing impairment.

- **Hearing aid and ear mould provision.** The hearing loss determines the type of hearing aid & strength of amplification that is necessary to hear speech; earmoulds need regular fitting. Hearing impaired children are eligible until completion of education.

- **Follow up of children with hearing loss** throughout childhood to maximise the child’s hearing potential. This includes checking of the child’s hearing levels and hearing aids regularly and providing information to families and children.

- **A link-up** service to other support organisations/services for hearing impaired children and their families. This includes referral to the:

  - Visiting Teacher Service (*see 'Visiting Teacher Service'*) for children with hearing impairment (Department of Education and Science),
  - Ear, Nose & Throat Consultant
  - Speech and Language Therapy Service,
  - National Association for the Deaf (*see NAD leaflets*)
  - Genetic Counselling Services, where applicable, at Our Lady’s Hospital for Sick Children, Crumlin, Dublin.
  - Cochlear Implant Centre at Beaumont Hospital, where applicable.
VISITING TEACHER SERVICE FOR CHILDREN WITH PCHI:
staffed by qualified teachers of hearing-impaired children with extensive experience; it offers longitudinal support to students, families, teachers and schools, from diagnosis (often in early infancy) to the completion of full-time education.

Referral Procedure: When PCHI is identified, the child is referred to the local Visiting Teacher by the Audiology service. They arrange with parents to visit.

Visits to the Home

The Visiting Teacher supports the family; home visits take place by mutual agreement. In addition, the Visiting Teacher discusses with parents the educational options available and makes recommendations regarding appropriate placement.

Visits to the School

Visits continue throughout mainstream education of a child with PCHI – the majority of such children – according to need. Visiting teacher provides advice and guidance on the education of the child, in areas like:

• Recommending and monitoring of amplification equipment
• Direct teaching and demonstration teaching
• Monitoring progress
• Assessments, evaluations and setting of appropriate educational targets
• Liaison and co-ordination with other professionals and agencies
• Recommending suitable procedures in State Examinations
• Assisting and advising school staff.
• advising personnel working with children with additional disabilities and who may be attending special schools / facilities for children with other disabilities
• advising staff in third level institutions and post-school training facilities
• liaising with other professionals and agencies involved in education, training and health with hearing impaired children.

National Association of Deaf People (NAD): Phone 01-8723800 or e-mail www.nadp.ie for more information or to obtain fact sheets on adult and childhood hearing loss.

Summary of Services Provided by NAD: Family Support and counselling, Deaftech, Citizen’s Information centre, Deaf awareness training, Speedtext services, Parent Support groups, Training courses in Aural Rehabilitation, and Tinnitus/Hard of Hearing support groups around the country.
APPENDIX 1

STANDARD STATEMENT

*Can Your Baby Hear You?*

<table>
<thead>
<tr>
<th>Implementation Date:</th>
<th>Audit Date:</th>
<th>Re-Audit Date:</th>
<th>Signature of DPHN:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

**Topic:** Hearing Loss in Young Infants.

**Sub Topic:** Early detection of hearing loss in infants, incorporating the giving of a leaflet and carrying out a discussion with a parent.

**Client Group:** Parents of neonates.

**Standard Statement:** All parents of neonates will receive a leaflet on early detection of hearing loss and have a discussion regarding its use.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Process</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>A stock of leaflets is available on early detection of hearing loss to the PHN to give to parents of all neonates</td>
<td>PHN will give the leaflet on early detection of hearing loss to all parents of neonates</td>
<td>The parents of neonates receive a leaflet on early detection of hearing</td>
</tr>
<tr>
<td>Training will be given to all PHNs on the use of the leaflet</td>
<td>The PHN discusses the leaflet with the parent</td>
<td>The parent receives instruction from the PHN on the use of the leaflet</td>
</tr>
<tr>
<td>The PHN will always have a birth notification card</td>
<td>The PHN will document giving the leaflet and discussing it with the parent</td>
<td>The documentation is available that all parents had the leaflet given to them and it was discussed</td>
</tr>
<tr>
<td>Procedure file available at the Health Centre.</td>
<td>Leaflet is stored in procedure file</td>
<td>Information on leaflet is available to all new PHNs</td>
</tr>
</tbody>
</table>
AUDIT ON HEARING LEAFLET (CAN YOUR BABY HEAR YOU?)

LOCATION ________________________________                                         DATE____________________________

NAME OF AUDITOR_______________________________________________________________________________

Please circle correct answer

1. Is there a stock of leaflets on early detection of hearing loss available to the P.H.N. to give to parents of all neonates?
   
   Source: Ask P.H.N. (Public Health Nurse).

   Yes                                         No                                   N/A

2. Did the P.H.N. give the leaflet on early detection of hearing loss to all parents of neonates?

   Source: Ask P.H.N.

   Yes                                         No                                   N/A

3. Did the parents of all neonates receive a leaflet on early detection of hearing loss?

   Source: Ask parent.

   Yes                                         No                                   N/A

4. Did all PHNs receive training in the use of the leaflet?

   Source: Ask P.H.N.

   Yes                                         No                                   N/A
5. Did the P.H.N. discuss the leaflet with the parent?
   Source: Ask parent / Ask PHN

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Did the parent receive instruction from the P.H.N. on the use of the leaflet?
   Source: Ask Parent.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Did the P.H.N. always have a birth notification card?
   Source: Ask P.H.N.

   Score YES if the P.H.N had a card within 48 hours of birth.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Did the P.H.N. document giving the leaflet to the parent and discussing it with them?
   Source: Ask P.H.N., check documentation

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Is documentation available that all parents have had the leaflet given to them and that it was discussed with the parent?
   Source: Check documentation.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10. Is a procedure file available in the health centre?

Source: Check availability.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
</table>

11. Is the leaflet stored in the procedure file?

Source: Check procedure file.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
</table>

12. Is information on the leaflet available to all new P.H.N.s?

Source: Ask new P.H.N.s.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
</table>

Signed __________________________       Date _______________________
**AUDIT RECORD** (Sample)

**Audit Objective:** To find out if every parent received a leaflet on the early detection of hearing loss and had a discussion on its use.

**Sample Group:** The parents of every baby born in our area between 11\textsuperscript{th} June 02 and 25\textsuperscript{th} June 02.

**Staff Sample:** Public health nurses in Millmount Avenue Health Centre.

**Auditor:** Clare Farrell, PHN.

**Actual sample size:** 11 parents and babies 4 PHNs Documentation.

<table>
<thead>
<tr>
<th>Target Group</th>
<th>Code</th>
<th>Observation</th>
<th>Totals</th>
<th>Compliance</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHN</td>
<td>Q1</td>
<td>Y Y Y Y</td>
<td>4 4 0</td>
<td>100% 100%</td>
<td></td>
</tr>
<tr>
<td>PHN</td>
<td>Q2</td>
<td>Y Y Y Y</td>
<td>4 4 0</td>
<td>100% 100%</td>
<td></td>
</tr>
<tr>
<td>Parent</td>
<td>Q3</td>
<td>Y Y Y Y Y Y Y Y Y Y</td>
<td>10 10 0</td>
<td>100% 100%</td>
<td>1 family moved</td>
</tr>
<tr>
<td>PHN</td>
<td>Q4</td>
<td>Y Y Y Y</td>
<td>4 4 0</td>
<td>100% 100%</td>
<td></td>
</tr>
<tr>
<td>PHN+parent</td>
<td>Q5</td>
<td>Y Y Y Y Y Y Y Y Y Y</td>
<td>10 10 0</td>
<td>100% 100%</td>
<td></td>
</tr>
<tr>
<td>Parent</td>
<td>Q6</td>
<td>Y Y Y Y Y Y Y Y Y Y</td>
<td>10 10 0</td>
<td>100% 100%</td>
<td></td>
</tr>
<tr>
<td>PHN</td>
<td>Q7</td>
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</tr>
<tr>
<td>PHN</td>
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<td>4 4 0</td>
<td>100% 100%</td>
<td>Documentation checked by auditor</td>
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<tr>
<td>PHN</td>
<td>Q9</td>
<td>Y Y Y Y Y Y Y Y Y Y</td>
<td>10 10 0</td>
<td>100% 100%</td>
<td>Documentation check by auditor</td>
</tr>
<tr>
<td>PHN</td>
<td>Q10</td>
<td>Y Y Y Y</td>
<td>4 4 0</td>
<td>100% 100%</td>
<td>Procedure file checked by auditor</td>
</tr>
<tr>
<td>PHN</td>
<td>Q11</td>
<td>Y Y Y Y</td>
<td>4 4 0</td>
<td>100% 100%</td>
<td>Procedure file checked by auditor</td>
</tr>
<tr>
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<td>Q12</td>
<td>No new PHN</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KEY**

| YES | Y |
| NO  | N |
| OBSERVATIONS | OBS |
| EXPECTED | E |
| ACTUAL | A |
| QUESTION | Q |
### AUDIT RECORD

**Audit Objective:** To find out if every parent received a leaflet on the early detection of hearing loss and had a discussion on its use.

**Sample Group:**

**Staff Sample:**

**Auditor:**

**Actual sample size:**

<table>
<thead>
<tr>
<th>Target Group</th>
<th>Code</th>
<th>Observation</th>
<th>Totals</th>
<th>Compliance</th>
<th>Comments</th>
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<tr>
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**KEY**

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<tr>
<td>QUESTION</td>
<td>Q</td>
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# ACTION PLAN

<table>
<thead>
<tr>
<th>IDENTIFIED PROBLEM</th>
<th>SUGGESTED ACTION</th>
<th>MEMBER OF STAFF RESPONSIBLE</th>
<th>TIME PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
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APPENDIX 2

UPDATED PROTOCOL FOR DISTRACTION TESTING FOR SCREENING PURPOSES – 29/11/04

IMPORTANT: The full protocol listed below must be met if the Distraction Test Screening Standard is to be maintained. Failure to implement part of the protocol is likely to reduce the sensitivity and specificity of the test greatly.

USEFUL REFERENCE: Screening for Hearing Loss in Young Children (McCormick, 1994).

Training
All persons involved in Distraction Test Screening should have undertaken a minimum 2-day training course, covering basic audiological knowledge of hearing loss and risk factors for same in infants, plus theoretical and practical issues raised in the training video/manual, relating specifically to this test format.
A requirement for supervised practice in the screening of at least 10 ‘well babies’ in the required age range is a core requirement of the training.
The training should be followed by a supervision period lasting 2-3 months, when a more experienced screener accompanies the newly trained person, so that any further issues can be resolved, and more difficult screening situations can be encountered with support. There may be issues to consider around staffing, protected time for DT, and drop-in clinic facilities, which need to be agreed locally in order to maintain high standards & coverage for the Screen.
Follow-up ‘refresher’ training days should be held every 3yrs or so for any staff continuing to carry out DT.

RECOMMENDATION 1:
Undertake 2-day training; be familiar with ‘well-babies’ before working independently. Consider local arrangements to improve screening programme.

Age of infants to be screened
The IDEAL age range is 6 to 8 months, or as soon as a baby can sit unsupported; it can be applied with reasonable success to about 12 m. developmental age; babies are too ‘socially aware’ to continue standard DT beyond this.

RECOMMENDATION 2:
Undertake 1st screen before 9 months; call at least 90% of all babies for screen by this age.

Requirements For Test:
- Two trained workers, familiar with working as a team (either an AMO/PHN, or 2 PHNs or a PHN or AMO with a regular trained assistant)
- Quiet room (ambient noise below 35dB(A) – no creaky floors or frequent disturbing external noise – preferably carpeted & sound treated); at least 3m x 3m working space for DT; relaxed atmosphere, few visual distractions – blinds/curtains that can be used to block outside view.
- It is very important that the tester at the back does not cast visual shadow, smell of perfume, or otherwise create a non-auditory signal, which can be observed by the baby.
- Low (coffee-type) table on which to place the distraction toys.
- Range of sound generators with known frequency content, and Sound Level Meter.
RECOMMENDATION 3:
Noise level (monitored), room layout & relaxed atmosphere are all vital elements of DT in addition to trained staff. Specific, suitable rooms must be ‘protected’ for DT, and not altered without staff agreement.

Arrangement For Test
Baby is seated centrally on parent’s/carer’s lap, facing forward and kept upright (normally by parental hands being placed lightly under the baby’s armpits).
Other children should be out of sight and preferably, audible range (or asked to sit very quietly).
Person holding baby must be advised not to move or react to the sounds when they are presented, which can cue the baby.

Front tester sits or kneels and, with various small toys, commands the baby’s full attention, keeping the toys just below baby’s eye level.

Sound is then presented after the stimulation level is dropped (or phased) by the front tester, by covering or removing the toys on which baby are focused.

At this point, it is important to limit eye contact with the baby so that they do not ‘fixate’ on front tester. (SEE VIDEO)

Be alert to parent/carer inadvertently cuing baby.

The front tester can see the baby’s expressions and therefore has a major role in deciding when baby has responded to sound, particularly if baby makes partial head turns.

RECOMMENDATION 4
Front tester controls baby’s attention level & has a major responsibility in deciding if a response to sound has occurred.

The tester at the back remains out of vision, presenting various sounds at the appropriate time, when the attention level at the front has fallen.
The tester at the back presents signals out of the peripheral visual field of the baby, but on a direct horizontal plane with the child’s ears. Signals for conventional or speech sounds are usually presented 1m from the ear, back at about 45-50 degrees angle.

Warble tones are usually calibrated for use at 50cm (0.5m) and thus are kept more within the ‘head shadow’, which can help to show ear threshold differences.
Warble tones are therefore strongly advisable, as the level is also more predictable than voice.

When baby turns correctly, a small congratulatory smile or clap can be useful, more so with older babies. However, the front tester should ensure the attention has been brought back fully before further sounds are presented.

RECOMMENDATION 5
Back tester avoids being noticed, makes sounds at the correct ‘attention level’ and in ‘unpredictable’ order, to which the baby must turn promptly.
Levels And Frequencies Screened
Presentation level: Generally 40dB(A) is recommended (or a MAXIMUM of 45dB(A) for variable voice sounds (recorded with ‘A’ weighting on Sound Level meter). NOTE: this presentation level does NOT detect every baby with mild hearing loss, but is intended to detect children likely to need either amplification (if permanent loss) or follow up for early-onset conductive loss. Parents need to know the limitations, and get appropriate advice if they feel a hearing problem exists later on.

Sounds: Low Frequency – 500Hz warble tone (or continuous ‘ooo’); 1kHz warble tone (or soft unbroken hum).

High Frequency – 4kHz warble tone (or soft continuous ‘sss’ sound);

Manchester High Frequency Rattle, moved very gently (optional to test frequencies primarily above 4kHz).

It is vital that the sound level at baby’s ear is monitored with a Sound Level Meter, within normal test room. Ideally, during training days, real frequency spectrum and typical levels produced by tester can be measured. Any change to room layout, furniture, soundproofing or personnel positioning can significantly affect the level reaching the baby and requires rechecking with the Sound Level meter.

Order: Start with a voice sound or Manchester Rattle, as these may be more familiar types of sounds. However, warble tones are invaluable in producing a fixed, measurable signal.

RECOMMENDATION 6
40dB level should detect babies with moderate+ loss, (low &/or high frequency) – but may not detect all babies with a milder loss.

Criteria For Passing The Distraction Screening

2 clear head turns to low frequency and 2 clear head turns to high frequency sounds for each ear, i.e. 4 out of 6 (maximum) trials on each ear. That is, almost all the sounds should elicit clear response unless the baby becomes tired or restless (or has another condition preventing clear head turns).

Sounds are given for up to 5 seconds but may be randomly presented according to ear and type of sound. Normally developing babies of the correct age usually respond within 1-2 seconds.

Sound trials should be interspersed with occasional ‘no sound trials’ lasting 5-10 seconds to see if baby is using ‘checking’ responses before a sound is heard.

If any responses are missed or if baby loses interest/becomes tired, baby should be re-screened within 8 weeks (or within 2 weeks if parents are very concerned about hearing).

Note- if baby does not turn or react to any sound, baby may be touched lightly on a cheek, to see if it elicits a turn or a reaction.

The same pass criteria apply to the second screen.
AUDIOLOGY REFERRAL should be standard for any child not passing the second screen.

RECOMMENDATION 7
Passing the DT Screen generally requires 4 clear head turns on each side (i.e. 8 in total) to a range of frequencies, ensuring that baby is not using ‘checking turns’ – particularly with older babies. If baby tires, or has vision or motor delay, then eye movements may also need to be observed in addition to head turns.

Criteria & procedure for referral
Any infant who does not pass the first and second screen should be referred to the local Paediatric Audiology clinic for hearing assessment, normally to be called within 3 months. Babies who pass the first or second screen have ‘passed’. Exceptionally, if baby has an ear infection or is being treated with antibiotic, delaying a second screen may be justified, and/or a prior referral to the GP or ENT clinic may be warranted.

RECOMMENDATION 8
2 screens not passed mean that Audiology referral is indicated. The Audiologist should see all infants under 12 months within 3 months of date of referral. Where parental concern is marked, the referral should be MARKED ‘Urgent’ and baby be seen within 6 weeks, OR specific alternative referral arrangements should be clearly agreed with the parents. Referrals to Audiology Clinic should be made using standard Referral Form (available from the Audiology clinic secretary), ensuring that suitable background information is given.

SUMMARY OF TRAINING POINTS:
Types and causes of deafness; Treatments available
Need for Early detection; Consequences of childhood deafness
Parental Suspicion of deafness

The Distraction Test:
• Test Setting: room arrangement, test organisation, equipment
• Pitfalls: unwanted clues, shadows, reflections, floor vibration, perfume etc.
• Techniques for controlling baby’s attention; timing of stimulus presentation
• Need for control (no sound) trials
• Age of application and modifications for older/younger babies
• Role of the front and back testers
• Suitable sounds
• Sound levels for screening; use of Sound Level meters
• Number of trials and pass criteria;
• Positioning of observers including siblings
• Beyond the test/conveying results/follow-up/referral pathways and time limits
• Surveillance and counselling/advice to parents (additional forms and leaflets).
APPENDIX 3

Specifications For Hearing Test Room

Room Size
A minimum working space of 3m x 3m is advisable to accommodate a child, parents and 2 testers for baby hearing test. During testing approximately 2-3 metres distance is required between tester 1 and tester 2.

Location
A ground floor location is preferable for accessibility, located in a quiet area such as the end of a corridor or on a sub-corridor, away from waiting area noise. The outside window should not face on to car park or traffic loading area. If possible, heating systems and toilets should be located away from testing room. If the ceiling adjoins a top floor, ceiling area may need to be isolated or the top floor space planned as stock/store room i.e. ‘quiet’ area.

Sound proofing
The following has been found to attenuate noise by 30-40dBA:
100mm block wall fitted on one side with two layers of 12½mm plasterboard.
The stud partition uses a 100mm stud and 100mm of rockwool insulation.
The two layers of 12½mm plasterboard joints are filled and staggered for each layer to minimise access of airborne sound.
The equivalent of a ‘one hour’ fire resistance door with seals top and bottom is required to attenuate noise – bottom door sealing is essential.
Double doors can be used as an alternative or a small antechamber 1 metre square with doors at either end before entering into the room.
Windows should be double-glazed to reduce noise from outside.

Fittings
Lighting should be of high enough wattage to eliminate all shadows.
Fluorescent tubing should not create any buzzing sounds.
Floor carpet is advisable to eliminate footstep noise, which can alert a child during testing.
Curtains or blinds are necessary to screen out strong sunlight and shadows.
APPENDIX 4

Sample Case History Sheet

1. Have you any concerns about your child’s hearing? Why?

2. Any head cold at the moment?

3. Has s/he had any ear infections that you are aware of? When?

4. Was pregnancy normal?

5. Did s/he spend any time in the NICU or special care baby unit?

6. Any family history of hearing loss? I.e. those born with a hearing loss or wearing a hearing aid at a young age.

7. How is her/his speech coming along or what is s/he trying to say these days?

8. Is s/he attending any other clinics/specialists?
APPENDIX 5

Equipment Contacts

Warble tone generators and sound level meters available from

- Meg screening warbler and SLM (Guymark UK)
- Kamplex warbler (PC Werth, from agent Bonavox, 13 North Earl Street, Dublin1)

High frequency rattle available from

- Ewing Foundation Centre for Audiology, Education of the Deaf and Speech Pathology,
- University of Manchester, Oxford Rd., Manchester M13 9PL, UK.
APPENDIX 6

Scoring sheet

<table>
<thead>
<tr>
<th></th>
<th>Low frequencies:</th>
<th>High frequencies:</th>
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<tbody>
<tr>
<td></td>
<td>500 Hz warble tone</td>
<td>1 kHz warble tone</td>
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<tr>
<td>Right ear</td>
<td></td>
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<tr>
<td>Left ear</td>
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Y = Clear Head Turn
X = No Response

Low frequencies:
Baby needs to turn to 2 out of 3 presentations to pass on right ear
Baby needs to turn to 2 out of 3 presentations to pass on left ear

High frequencies:
Baby needs to turn to 2 out of 3 presentations to pass on right ear
Baby needs to turn to 2 out of 3 presentations to pass on left ear
APPENDIX 7 - EVALUATION SHEET

Evaluation Sheet
Training Programme in Child Health Screening, Surveillance and Health Promotion
Hearing Screening and Surveillance Module

1. Three words to describe your experience of this training day
   __________________________________________  __________________________________________  __________________________________________

2. How well were the training objectives achieved?
   Not at all  Quite well  Very well  Completely
   [ ]  [ ]  [ ]  [ ]

3. Please rate by circling a number on a scale of 1 to 5, where
   1 = inadequate, 2 = poor, 3 = satisfactory, 4 = very good, 5 = excellent
   a. Content
      1  2  3  4  5
      A reason for your rating
      ____________________________________________________________

   b. Manual/training materials
      1  2  3  4  5
      A reason for your rating
      ____________________________________________________________

   c. Facilitation of learning by tutors
      1  2  3  4  5
      A reason for your rating
      ____________________________________________________________

   d. Presentation by tutors
      1  2  3  4  5
      A reason for your rating
      ____________________________________________________________

4. Gaps in the training, if any?
   ____________________________________________________________

5. What was most relevant/useful?
   ____________________________________________________________

6. What was least relevant/useful?
   ____________________________________________________________

7. A question/concern/comment arising from this day’s work
   ____________________________________________________________

Signature (optional) ________________________________

Thank you for your help in evaluating the work
REFERENCES


http://www.defeatingdeafness.org – updated information/research on glue ear and other aspects of deafness


Neonatal Hearing Screening Programme for England: http://www.nhsp.info/ (extensive updated site)


