Early Identification of Hearing Loss

Conducting periodic Otoacoustic Emissions (OAE) hearing screening with infants and toddlers during well-child visits

Helping Children Hear and Now

NCHAM National Center for Hearing Assessment and Management Utah State University™

OTICON FOUNDATION

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This guide is a companion to the instructional video entitled, "Helping Children Hear and Now," available in DVD and VHS formats (visit www.hearandnow.org/periodicscreening for more resources)

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Section 1
Overview of Otoacoustic Emissions (OAE) Screening

Across the annual seasons of a child's early life, parents trust health care providers to screen infants and toddlers during periodic well-child visits to ensure healthy development. The American Academy of Pediatrics recommends that a child's hearing be checked repeatedly during each of the first three years of life because hearing is central to a child's language development and communication.[1]

Unfortunately, subjective methods, such as sound makers or sole reliance on parent interviews, have not proven to be reliable for screening young children for hearing loss. Although pneumatic otoscopy and tympanometry are valuable tools for helping to diagnose middle ear conditions, they cannot provide information on inner ear functioning.

Hand-held otoacoustic emissions (OAE) technology represents a significant breakthrough for health care providers screening children birth to three years of age.

This guide will describe how OAE technology can be used to reliably screen the hearing of all infants and toddlers in health care settings. It will also discuss the importance of periodic, physiologic hearing screening throughout early childhood.

OAE hearing screening has proven to be a highly effective procedure for screening newborns in hospitals.[2]

It has also been used successfully to screen children in a variety of early childhood programs.[3]

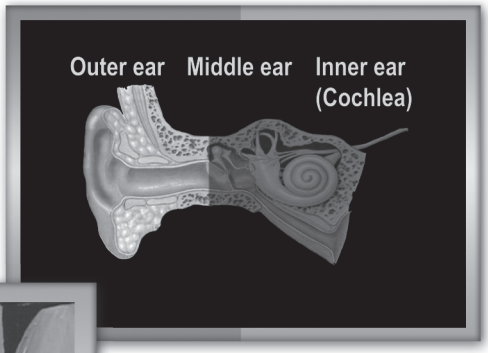
OAE screening is the most practical method for screening infants and toddlers during well-child visits because it:

- Does not require a behavioral response.
- Can help to identify a wide range of hearing health concerns.
- Is quick and painless.
- Is often a reimbursable procedure.
- Can be conducted by anyone who is trained to use the equipment and is skilled in working with children.

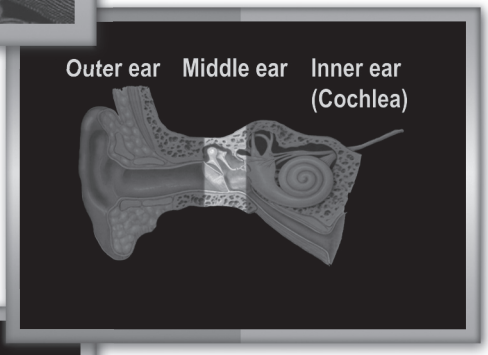
The Auditory System

There are three main parts to the auditory system:

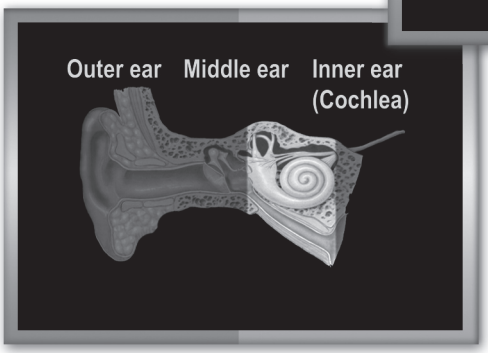
- Outer ear
- Middle ear
- Inner ear (cochlea)



As this mother's voice reaches her child's ear, the incoming sound causes the eardrum to vibrate which then moves three small bones in the middle ear.



This movement stimulates thousands of tiny, sensitive hair cells in the inner ear.



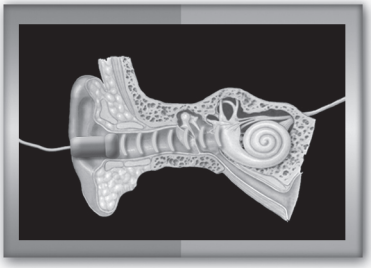
From the inner ear, the sound signal is carried along special nerves to the hearing centers of the brain—and the child experiences the sensation we call "sound."

Overview of the OAE Procedure

The screener first takes a thorough look at the outer part of the ear to make sure it is formed properly and does not show visible signs of infection or blockage.

The OAE screening procedure is then begun by placing a small probe in the child's ear canal. This probe delivers a low-volume sound stimulus into the ear.

A cochlea that is functioning normally will respond by sending the signal to the brain while also producing an "**otoacoustic emission**," sometimes described as an echo, which travels back through the middle ear to the ear canal.[4] This emission is then picked up and analyzed by the screening unit.



In approximately 30 seconds, the result is displayed on the computer screen as a "**pass**" or a "**refer**."

It is important to note that OAE screening does not diagnose a hearing loss. It simply identifies those children who need further medical or audiological assessment.

If a child does not pass the OAE screening after repeated attempts, and tympanometry or pneumatic otoscopy indicates that the pathway to the cochlea is clear, the child is then referred to a pediatric audiologist for a complete evaluation.

Children who are found to have permanent hearing loss are referred to a local early intervention program and are reported to the state's "newborn hearing screening" or "early hearing detection and intervention" public health program (see http://infanthearing.org/status/cnhs.html).

Incidence of Hearing Loss

The incidence of hearing loss is higher than most parents and professionals realize. Hearing loss is the most common birth defect in the United States.

- Approximately 1 of out every 300 children in the U.S. is born with a significant hearing loss.[5]
- Fifty percent of these infants do not have any neonatal risk indicators commonly associated with hearing loss.[6]

This is why most newborns in the U.S. now receive an initial hearing screening prior to hospital discharge. As a result, some babies may be referred to a pediatric audiologist and fitted with hearing aids by 4 weeks of age.

More young children than ever before are benefiting from timely enrollment in early intervention programs that facilitate language development.

Not all hearing loss can be identified at birth, however. Periodic, objective screening throughout early childhood is also important because gradual or sudden hearing loss can occur at any age.

Between birth and school age, the incidence of permanent sensorineural hearing loss triples from:

1 in every 300, to

3 in every 300.[7]

In addition, mild, moderate or unilateral hearing losses are extremely difficult to detect and are rarely identified early through informal behavioral screening techniques.

Further, many preschoolers experience chronic middle ear conditions that limit hearing, sometimes to the degree that it interferes with language development. It is estimated that approximately 35% of preschool children have repeated episodes of otitis media that are nearly always accompanied by some degree of hearing loss.[8]

The repercussions of failing to recognize hearing loss are significant for children and their families. As noted by the U.S. Department of Health and Human Services, if hearing loss is not identified early, it can be nearly impossible for a child to acquire fundamental language, social and cognitive skills.[9]

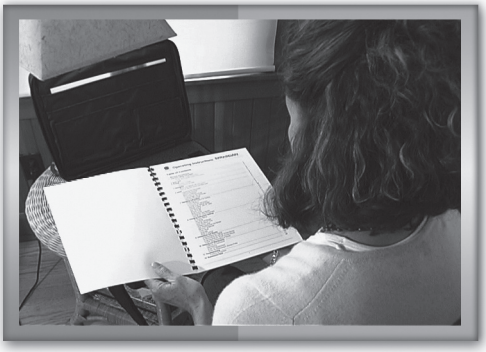
Therefore, regular screening throughout a child's early life is critical for identifying hearing loss that can jeopardize development.

Section 2

OAE Equipment and Screening Process

This section will introduce OAE equipment and review how hearing screening is done. There are a number of handheld OAE screening units available, and the technology continues to change and improve.

Be sure to select a piece of equipment that has been demonstrated to work effectively for screening children birth to three years of age.



As you familiarize yourself with your equipment, refer to information provided by the manufacturer regarding:

- Probe care and cleaning.
- Power supply maintenance.
- Equipment calibration.
- Modifications that may be needed when screening children with pressure equalizations (PE) tubes.

Familiarizing Yourself with the Equipment

Here are some elements common to all OAE screening equipment:

- **Screening unit** that has a small display screen. This is a sensitive piece of electronic equipment. Be sure to treat it gently and avoid exposing it to extreme hot or cold temperatures.

- **Power supply** (rechargeable battery and/or adapter cord).

- **Probe assembly** that also attaches to the screening unit. This is an expensive component that can be damaged easily — always handle it carefully. Note the visual indicators that help you properly align the two components to avoid damaging the connecting pins. Whenever possible, it is a good idea to leave the probe attached to the screening unit rather than detaching it after each use. Also note that it is very helpful if a clip is supplied to attach the probe cord to the child's clothing during screening. The cord connecting the probe and the screening unit should be about 4 to 5 feet long in order to reach from the child's ear to the table where the unit is sitting.

- **Probe tips or covers** (sometimes called ear tips) in a variety of sizes that are designed to fit snugly on the probe and form a seal in the child's ear canal. You may use the same tip to screen both ears of the same child if it remains free of wax. Always use a new tip for each child.

Preparing to Screen

- Conduct the screening in a relatively quiet setting. The equipment is trying to pick up very small signals generated by the inner ear; therefore, it is best to limit the noise within the room.

- It is equally important to create an environment that maximizes the cooperation of the child with the comforting assistance of parents and the use of quiet toys.

- Unlike some other procedures, **the OAE screening cannot be accomplished if a child is crying or physically resistant**. The screening will typically progress faster if the child is not actively sucking or chewing. If necessary, you can offer a pacifier, bottle, or cracker. If the child does not pass the screening, however, repeat the screening when sucking and chewing is not taking place.

- Obviously, it is critical that you complete hearing screening **PRIOR** to procedures that are likely to make the child upset, such as immunizations.

- Complete a brief case history of the child's hearing-health. Note any parental concerns about hearing or language development.

- Explain to the parent that you are going to place a small microphone, covered by a soft tip, into the child's ear canal, and that the child will hear a series of quiet sounds.

- Check the probe to make sure it is not clogged by debris. Clean or exchange the probe nozzle if necessary.

The OAE Screening Procedure

STEP 1 Visually inspect the ear to be screened.

Look in front of and behind the ear for any abnormalities. Note any small pits, holes, or skin tags. These could be indicative of other abnormalities in the auditory system. Now, placing your index finger in front of the ear, pull gently back on the ear to open the canal. Look in as far as you can to make sure it is not blocked by anything that would obstruct the sound going in or the otoacoustic emission coming back out. If there is drainage coming from the ear, which is occasionally accompanied by a foul smell, or if the child displays heightened sensitivity to having the ear touched, do not proceed with the screening. Instead, bring the condition to the attention of the health care provider. Conduct the screening only when the child has been cleared by the health care provider. If some wax is present, you can proceed with the screening unless the canal appears to be totally blocked.

STEP 2 Select a probe tip and place it on the probe.

Note the size of the ear canal and choose a probe tip that is as large as, or slightly larger than, the ear canal opening. Place the tip over the end of the probe, pushing it all the way down. If you are using a soft, foam-type tip, you will want to compress it into a mushroom shape just before inserting it into the ear canal.

STEP 3 Turn on the equipment.

STEP 4 Clip the probe to the child's clothing.

Clip the probe cord to the back of the child's shirt where the child cannot see or reach it easily. This keeps the cord out of the way and also helps keep the probe in the ear during screening.

STEP 5 Prepare the child.

Make sure the child is comfortable and content.

STEP 6 **Insert the probe.**

With one hand, take hold of the ear, pulling it out to open the canal. With the other hand, take the probe and insert the tip into the ear canal, toward the nose, and then turn it slightly back, pushing it firmly into the canal. If you have chosen the correct size of probe cover, the probe will stay inserted firmly in the ear canal after you let go of it. **Never be tempted to hold the probe in the ear during the screening.** Learning how to select the right size tip and how to insert the probe firmly into the ear canal is central to reliable screening.

STEP 7 **Push the button to start the screening and monitor the progress of the test.**

Watch the displays. They will often help you know if you have a secure probe fit. Help the child sit quietly while the screening is progressing. Some equipment will indicate the progress of the test, showing sound frequencies or pitches, while other equipment will simply indicate the test is in progress.

STEP 8 **Document the screening result.**

When the screening is complete, the screen will either say "pass" or "refer." Instead of the word "refer," some equipment says "fail." It is helpful to record the OAE screening results on a form that guides you through each step of the recommended screening protocol.

STEP 9 **Prepare to screen the other ear.**

Remove the probe, check the probe cover and nozzle to make sure they are not blocked with wax, and test the other ear. You may use the same probe cover to test the other ear if it is not clogged with wax.

Helpful Hints to Effective Screening

As you practice screening, notice how external noise can disrupt the screening procedure. For example, if someone is speaking loudly near the ear being screened, the equipment cannot continue to screen because the signal it is sending to the ear becomes mixed with the louder outside stimuli. The screening unit has to wait until the excess noise stops before proceeding with the screening.

Also notice how the screening stops when the child being screened becomes restless and moves a lot. This is called internal noise. Again, the unit has to "wait" until the movement has stopped before continuing the screen.

Obviously, if the child moves too much, the probe will become completely dislodged, and the test has to be started again.

The three keys that will allow you to screen efficiently are:

- Ensuring good probe fit.
- Minimizing external noise in the environment.
- Minimizing internal noise caused by the child's movement.

A good probe fit will reduce both internal and external noise! The more firmly the probe fits into the ear canal, the less external noise will "leak" into the ear canal, and the less likely it is that the probe will be dislodged by the child's movements.

Additional Helpful Hints

- **Check the equipment** at the beginning of the day by screening your own ear or by running the equipment's manual calibration check.

- **Elicit help from the parent** in keeping the child quiet and content while the screening is being done. The parent may need to gently hold the child's hands and redirect them to touch and play with a quiet toy.

- **Engage the child** in a listening game.

- **Gently tell the child** what you are about to do rather than ask permission. Questions are usually met with a "no" or an uncooperative response.

- Keep a variety of **visually interesting toys**, appropriate for different ages, with your screening unit. Be creative—find out what works for you!

- **Screen while the child is asleep.** If a child arrives asleep or relaxed in a car seat, perform the hearing screening before he or she awakens.

Section 3

Implementing a Hearing-Health Protocol

To be effective, OAE screening must be integrated into a broader hearing-health protocol that ensures appropriate follow-up when children do not pass the screening. Therefore, it is important to:

- Develop a working relationship with at least one pediatric audiologist in your community who will understand your screening protocol, promptly evaluate children not passing the screening, and answer questions as they arise.

- Get acquainted with your state's newborn hearing screening or Early Hearing Detection and Intervention (EHDI) Program (see www.infanthearing.org/status/cnhs.html.)

It is also helpful to record the OAE screening results on a form that guides you through each step of the recommended screening protocol.

Suggested Protocol & Documentation Form

Hearing Screening Record

Child's Name _____ **ID #** _____

Date of Birth _____ **Clinic** _____

Birth Hospital _____

☐ **Periodic Screen - OAE**

Child's Age — **Days** ☐ 2 - 4

Months ☐ 1 ☐ 2 ☐ 4 ☐ 6 ☐ 9 ☐ 12 ☐ 15 ☐ 18 ☐ 24 ☐ 36

- **Is this the first time the OAE hearing screening has been performed on this child in this clinic/practice?**
  ☐ No ☐ Yes -- if Yes:
  - **Was child screened for hearing loss at birth?** ☐ Unknown ☐ Not Screened ☐ Passed ☐ Referred
  - **Any neonatal risk factors or complications?** ☐ Unknown ☐ No ☐ Yes: _____
  - **Any family history of early hearing loss?** ☐ No ☐ Yes: _____
- **Is the parent/caregiver concerned about the child's:** **Hearing?** ☐ No ☐ Yes: _____ **Speech?** ☐ No ☐ Yes: _____
- **Has the child experienced:** **Head trauma?** ☐ No ☐ Yes: _____ **Recurrent ear infections?** ☐ No ☐ Yes: _____
- **Does the child have Pressure Equalization (PE) tubes?** ☐ No ☐ Yes _____

☐ **Rescreen – OAE** (Conduct rescreen and refer for Audiological Assessment unless OAE pass is obtained.)

☐ **Other** _____

Screener: _____ **Date**: ___/___/___

CPT code:
- ___ 92587 OAE limited
- ___ 92567 Tympanometry

Dx code:
- ___ V72.1 "Passed" hearing screen
- ___ 389.9 Unspecified hearing loss
- ___ 382.9 Unspecified otitis media
- ___ 388.6 Discharging ear, otorrhea

___ Other Dx Code: _____

LEFT

Middle Ear Evaluation (Tympanometry/Pneumatic Otoscopy)

OAE

- **Pass** ☐ → **Pass** ☐ → ☐ Schedule OAE Rescreen (w/in 2 weeks) or ☐ Refer for **Audiological Assessment**
- **Can't test** ☐
- **Refer** ☐ → **Refer** ☐ → ☐ If wax removal / ☐ If OM, PE tube problem, or other → ☐ Schedule OAE Rescreen (after treatment)* or ☐ Refer for **Audiological Assessment** **

Follow up Recommendation/Target Date ___/___/___

RIGHT

Middle Ear Evaluation (Tympanometry/Pneumatic Otoscopy)

OAE

- **Pass** ☐ → **Pass** ☐ → ☐ Schedule OAE Rescreen (w/in 2 weeks) or ☐ Refer for **Audiological Assessment**
- **Can't test** ☐
- **Refer** ☐ → **Refer** ☐ → ☐ If wax removal / ☐ If OM, PE tube problem, or other → ☐ Schedule OAE Rescreen (after treatment)* or ☐ Refer for **Audiological Assessment** **

Follow up Recommendation/Target Date ___/___/___

* For OM, rescreen 4 - 6 weeks after treatment completion allowing time for any remaining fluid to dissipate

** If OM remains unresolved for 3 months, refer for audiological assessment

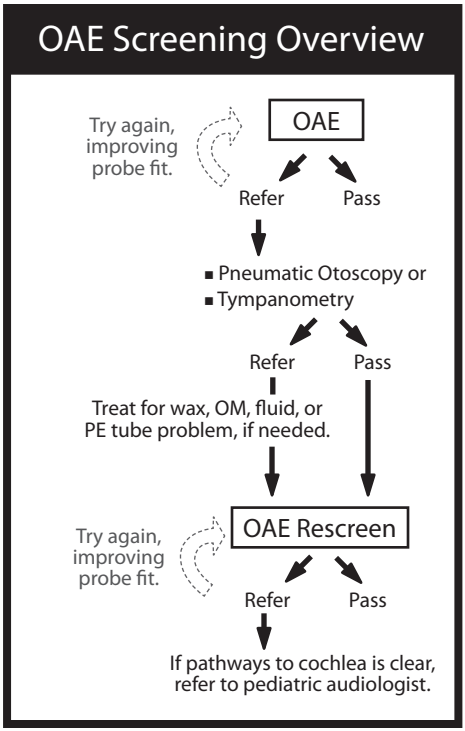
This form is available for reproduction at www.hearandnow.org/periodicscreening

Recommended OAE Screening Protocol

An effective screening protocol helps you know what to do in response to specific screening outcomes.

Visual Inspection and Case History

If the child:	The next step is to:
PASSES the visual inspection…	**Document the outcome and proceed with the OAE screening.**
Has blockage of the ear canal, signs of an infection, or a malformation of either ear (pit, skin tags, etc.)…	**Document the condition** and proceed with the OAE screening only after obtaining medical clearance from the health care provider.
Has PE tubes…	**Adjust screening equipment, if needed,** and proceed with OAE screening. The ear should pass if tubes are functioning properly.



OAE Screening in Detail

If the child:	The next step is to:
PASSES the OAE screening on both ears…	Assume that both the **middle ear and inner ear are functioning properly.** This is true for children with PE tubes as well. Unless there are additional concerns about the child's hearing or language development, no further action is necessary until the next scheduled screening.
DOES NOT PASS both ears on the **first** OAE screening attempt…	Check the probe tip and opening to make sure it is not blocked with wax; **select a different size tip**, if needed; **refit** the probe and **try the OAE screening again, making sure the environment and child remain relatively quiet.**
DOES NOT PASS both ears after **multiple attempts** during the OAE screening session…	Inform the health care provider, who will perform **tympanometry or pneumatic otoscopy** to determine if the pathway to the cochlea is clear or if blockage or fluid is impeding the screening. ▪ **If blockage, often wax, is found and removed from the ear canal**, rescreen within 2 weeks (or attempt OAE again during the visit if child is cooperative). ▪ **If NO blockage or fluid is evident**, the health care provider will decide whether to schedule the OAE rescreening within 2 weeks or refer the child directly to a pediatric audiologist. ▪ **If middle ear fluid, active otitis media (OM), or blockage of the PE tube is noted**, a treatment plan is outlined and an OAE rescreen is scheduled.

OAE Rescreening in Detail

If the child:	The next step is to:
Is treated for otitis media/middle ear fluid…	**Wait approximately 4 – 6 weeks after treatment completion**, allowing time for fluid to dissipate, before conducting the OAE rescreen. Note that rescreening after medical clearance is extremely important. The OAE equipment is able to screen the inner ear **ONLY** when the pathway through the middle ear is clear. **If OM remains unresolved for 3 months, refer the child to a pediatric audiologist for audiological assessment.**
DOES NOT PASS the OAE RESCREEN, and the ear canal and middle ear are clear…	**Refer the child to a pediatric audiologist for a full audiological evaluation.**

When to Refer to an Audiologist

Referral to a pediatric audiologist is warranted when a child:

- Does not pass a follow-up OAE screening, and there is no evidence of temporary blockage or fluid in the middle ear.
- Is experiencing chronic otitis media that is not resolved in three months or less.
- Is consistently uncooperative across two or more visits and an OAE screening cannot be completed.
- Demonstrates hearing or language delays, or when parents are concerned about the child's development, even though the child passed the OAE screening.

When to Contact the State Early Hearing Detection and Intervention (EHDI) Program

- To report screening outcomes of children who did not pass their newborn hearing screening and for whom you are providing the follow-up screening.
- To report any children who are ultimately identified with a permanent hearing loss.
- To obtain contact information for pediatric audiologists in the state.
- To obtain information about available resources for families of children with hearing loss.

When to Pay Extra Attention to Hearing

Conducting regular hearing screening on all children is important. However, you will want to pay particular attention to a child's hearing health whenever a parent has a concern about hearing, speech or language development or a child has:

- A family history of childhood hearing loss.
- A tendency toward repeated ear infections.
- Recently experienced a head injury or serious illness involving high fever.
- Risk factors for hearing loss (see position statement at http://www.jcih.org/).

By integrating OAE technology into an appropriate screening protocol, health care providers no longer have to take a "wait and see" approach to identifying hearing loss.

Conducting periodic OAE screening is a way you can help children

Hear and Now!

Billing and Reimbursement Codes

The primary codes typically needed for billing and reimbursement purposes related to OAE screening are:

Procedure code (CPT)	**92587**	OAE Limited
	92567	Tympanometry
Diagnosis Codes (ICD-9)	**V72.1**	Pass OAE Hearing Screening
	389.9	Refer on OAE screening*

*Children who **refer on OAE** screening will typically be coded as 389.9—unspecified hearing loss—based on the following description:

> *"If the diagnosis documented at the time is qualified as 'probable,' 'suspected,' 'likely,' 'questionable,' 'possible,' or 'still to be ruled out,' code the condition as if it existed or was established. The bases for these guidelines are the diagnostic work up, arrangements for further work up or observation, and initial therapeutic approach that correspond most closely with the established diagnosis."*
>
> *—ICD-9-CM Official Guidelines for Coding and Reporting, p. 48*

Children with high-risk factors can be coded on that basis. In these cases, the signs and symptoms, chief complaint, or reason(s) for the encounter should be reported as the primary diagnosis. The provider can also use additional codes that describe any coexisting or chronic conditions. Do not code conditions previously treated that no longer exist—although history codes may be used as secondary codes if the historical condition or family history has an impact on current care or influences treatment.

Additional diagnostic codes that providers may commonly need to use related to early childhood hearing disorders—based on a hearing-specific patient complaint—include:

315.31	Delayed Speech and Language Development
315.39	Articulation Errors
783.42	Unintelligible Speech
384.20	History of Tympanic Membrane Perforation, Perforation of the Tympanic Membrane, Unspecified
388.11	Noise Effects, Unspecified
388.12	Noise-Induced Hearing Loss
388.6	Discharging Ear Otorrhea, Unspecified
388.7	Ear Pain Otalgia, Unspecified
388.8	Aural Fullness, Other Disorders of the Ear
389.9	Unspecified Hearing Loss
783.42	Expressive Language Disorder or Late Talker

OAE Screening Implementation Checklist

- ❑ 1. Decide on the specific protocol to be followed and whether it includes tympanometry or pneumatic otoscopy for children not passing an OAE screening (see Suggested Protocol and Documentation Form).

- ❑ 2. Determine how often children will be screened as a matter of standard protocol (see AAP Recommendations for Preventative Pediatric Health Care, http://pediatrics.aappublications.org/cgi/content/full/105/3/645/F1). Objective OAE screening can now replace less reliable subjective screening procedures.

- ❑ 3. Decide how often children with risk factors and other concerns will be screened.

- ❑ 4. Develop a working relationship with at least one pediatric audiologist in your community who will understand your screening protocol, promptly evaluate children not passing the screening, and answer questions as they arise.

- ❑ 5. Get acquainted with your state's newborn hearing screening or Early Hearing Detection and Intervention (EHDI) Public Health Program (http://infanthearing.org/status/cnhs.html).

- ❑ 6. Select and purchase appropriate OAE equipment that has been demonstrated to work effectively for screening children birth to three years of age. Also purchase disposable probe tips.

- ❑ 7. Identify who will perform the OAE screening (and tympanometry or pneumatic otoscopy), at what point during the visit this will occur, and where.

- ❑ 8. Provide training for all individuals responsible for conducting screenings and overseeing follow up.

- ❑ 9. Designate where the equipment will be stored and who will be responsible for equipment care, maintenance, ordering supplies, training new staff, etc.

- ❑ 10. If multiple physicians and/or staff are sharing a single piece of equipment, plan how this will be coordinated.

- ❑ 11. Decide how OAE results will be documented.

- ❑ 12. When children do not pass screening and need a follow-up screening, establish a plan for how children will be tracked and flagged for rescreening.

- ❑ 13. Determine what documentation of screening results, if any, will be provided to parents and who will explain the screening results.

- ❑ 14. Determine what documentation of screening results will be provided to audiologists when children are referred from OAE screening for further audiological evaluation.

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