Appendix D: Hearing Screening

Infants Ages Newborn Through 6 Months

Universal Newborn Screening*

All newborns should receive initial hearing screening at birth, before discharge from the hospital. If this is not possible, screening should be completed within the first month of life. Hearing loss is one of the most common conditions present at birth and, if undetected, will impede speech, language, cognitive, and socioemotional development. Mild hearing loss may also have significant consequences for child development. It is essential to (1) conduct initial hearing screening for all newborns before discharge from the hospital, (2) ensure appropriate follow-up for those infants referred for formal audiologic assessment after initial screening, (3) identify infants with congenital hearing loss by 3 months of age, and (4) initiate intervention before 6 months of age.

Risk indicators identify only about 50 percent of infants with hearing loss and are *not* a substitute for universal newborn hearing screening. Infants who pass screening but who have the following risk indicators should be monitored both medically and audiologically on a regular basis: family history of hereditary childhood sensorineural hearing loss; in utero infection; craniofacial anomalies, including abnormalities of the pinna and ear canal; birthweight less than 1,500 g; hyperbilirubinemia at a serum level requiring exchange transfusion; ototoxic medications and chemotherapeutic agents; Apgar scores of 0 to 4 at 1 minute or 0 to 6 at 5 minutes; mechanical ventilation lasting 5 or more days; stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss; bacterial meningitis; neurodegenerative disorders; and persistent pulmonary hypertension. Infants and children with unilateral, mild, and/or chronic conductive hearing losses should also be monitored because they are at risk.

Additional risk indicators include parental or caregiver concerns about hearing and/or developmental delay; anatomic malformations and other disorders that affect eustachian tube function; inner ear malformations; syndromes associated with progressive hearing loss; head trauma; recurrent or persistent otitis media with effusion (OME) for at least 3 months; and neural conductive disorders.

Screening Methodologies*

The two physiologic tests described below are the only valid and reliable measures for use with newborns. The tests can be used alone or in combination. Both are noninvasive and require less than 5 minutes to perform.

- *Auditory brainstem response (ABR).* This test measures the electroencephalographic waves generated in response to clicks via three electrodes applied to the infant's scalp. This method requires the infant to be quiet, and the response may be affected by middle or external ear debris.

- *Distortion product or transient evoked otoacoustic emissions (EOAE).* This test measures sound waves generated in the inner ear in response to clicks or tone bursts emitted and recorded via miniature microphones placed in the external ear canals of the infant. The test may be affected by debris or fluid in the external and middle ear when screening is performed during the first 24 hours after birth.

If a two-step system is used, and the initial screen with ABR or EOAE results in a referral for a second screening, either method (ABR or EOAE) may be used for rescreening. If possible, the second screening should also be performed before discharge from the birthing hospital, but may be done on an outpatient basis. Infants who do not pass the rescreening must be referred promptly for formal audiologic assessment.

Intervention

When hearing loss is identified, families should be referred for early intervention services provided in accordance with the Individuals with Disabilities Education Act (IDEA). Each state has a designated agency responsible for coordinating child find and early intervention services for children ages newborn through 21 years who have special needs.

Infants and Young Children Ages 7 Months Through 3 Years

Health professionals should continue to monitor and refer for formal audiologic screening those infants and children with risk indicators of possible hearing loss. A significant portion of hearing loss is acquired after birth.

Screen audiologically all infants and toddlers not previously screened and those with any of the following risk indicators for delayed onset or acquired hearing loss: parent, caregiver, or health provider concerns about the infant's or toddler's hearing, speech, language, and/or developmental delay; craniofacial anomalies; birthweight less than 1,500 g; hyperbilirubinemia; ototoxic medications; bacterial meningitis; Apgar scores of 0 to 4 at 1 minute or 0 to 6 at 5 minutes; mechanical ventilation lasting 5 or more days; stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss; head trauma associated with loss of consciousness or skull fracture; family history of hereditary childhood sensorineural hearing loss; in utero infection; recurrent or persistent OME for at least 3 months; neurodegenerative disorders; or anatomic disorders that affect eustachian tube function.

Screening Methodologies*

The following methods are recommended for audiologic screening of children functioning at a developmental age of 7 months through 3 years.

- *Visual reinforcement audiometry* (VRA). In this procedure, stimulus tones and visually animated reinforcers (e.g., lighted toys) are paired and presented together. After the child has been conditioned to expect a relationship between the visually animated reinforcers and sounds, the visual reinforcer is withheld and the sound is presented alone. The child looks for the visual reinforcer in response to the sound, and the visual reinforcer is then presented as a reward.
- *Conditioned play audiometry* (CPA). CPA is the most commonly used behavioral audiometric procedure for preschool children. The child is taught to play listening games, using blocks, rings, or other objects. The child learns to wait and listen for a sound, then perform a motor task in response. The motor task is the response, followed by social reinforcement.

For children ages 6 months to 2 years, VRA is the recognized method of choice. At a developmental age of about 2 years, CPA may be used. (Noncalibrated toys or noisemakers and signals that lack frequency specificity are inappropriate screening methods.)

Children Ages 4 Through 10 Years

Screen audiologically all children at ages 4, 5, 6, 8, and 10 years. Children may need more frequent screening if they have any of the following risk indicators: parent, caregiver, or health provider concerns about the child's hearing, speech, language, and/or developmental delay, based on observation and/or standardized screening; family history of hereditary childhood hearing loss; in utero infection; ototoxic medications; bacterial meningitis; craniofacial anomalies; stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss; head trauma with loss of consciousness or skull fracture; neurodegenerative disorders; or recurrent or persistent OME for at least 3 months.

Screening Methodologies*

If the child can reliably participate in CPA or conventional audiometry, screen under earphones (conventional or insert earphones) using 1000, 2000, and 4000 Hz tones at 20 dB HL. Teach the child the desired motor response before screening, and administer a minimum of two conditioning trials at a presumed suprathreshold level to ensure that the child understands the task. At least two presentations of each test stimulus may be required to ensure reliability.

Following are pass/refer screening criteria: pass if the child's responses are judged clinically reliable at criterion dB level at each frequency in each ear. If the child does not respond at criterion dB level at any frequency in either ear, reinstruct, reposition earphones, and rescreen in the same screening session. Pass if the child passes rescreening; refer to an audiologist if the child fails rescreening or cannot learn the screening task.

Adolescents Ages 11 Through 21 Years

Screen audiologically all adolescents at ages 12, 15, and 18 years, or more frequently if needed. In addition, screen at entry into special education, at grade repetition, at new entry to a school system without evidence of having passed a previous hearing screening, or if absent during a previously scheduled screening. Assess risk of hearing loss annually and screen if any of the following risk factors are present: parent/caregiver, health professional, or educator concerns about the adolescent's hearing, speech, language, or learning abilities; family history of late or delayed onset hereditary hearing loss; recurrent or persistent OME for at least 3 months; craniofacial anomalies; stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss; head trauma with loss of consciousness; or reported exposure to potentially damaging noise levels or ototoxic medications.

Screening Methodologies*

CPA and conventional audiometry are the procedures of choice for this age group. Conduct screening under earphones using 1000, 2000, and 4000 Hz tones at 20 dB HL.

Following are pass/refer screening criteria: pass if the adolescent's responses are judged clinically reliable at criterion dB level at each frequency in each ear. If the adolescent does not respond at criterion dB level at any frequency in either ear, reinstruct, reposition earphones, and rescreen in the same screening session. Pass if the adolescent passes rescreening; refer to an audiologist if the adolescent fails rescreening or cannot learn the screening task.

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*Hearing screening must be done with audiometric equipment that is calibrated in accordance with American National Standards Institute (ANSI) standards and in locations where ambient noise levels meet ANSI standards and reliable and valid measures can be obtained.

Source: Information in "Infants Ages Newborn Through 6 Months" has been adapted from AAP[1] with permission and from the Joint Committee on Infant Hearing 1994 Position Statement.[2] Risk indicators, and screening methods for children 7 months to 21 years, are drawn from ASHA[3] with permission.

References

1. American Academy of Pediatrics. 1999. Newborn and infant hearing loss: Detection and intervention [policy statement no. RE9846]. *Pediatrics* 103(2):527–530.
2. Joint Committee on Infant Hearing 1994 Position Statement. 1994. ASHA 36:38–41; also available in *Pediatrics* 95(1):152–156.
3. American Speech-Language-Hearing Association, Panel on Audiologic Assessment. 1997. *Guidelines for Audiologic Screening*. Rockville, MD: American Speech-Language-Hearing Association.

Suggested Reading

American Academy of Pediatrics, Committee on Environmental Health. 1997. Noise: A hazard to the fetus and newborn. *Pediatrics* 100(4):724–727.

White KR, Maxon AB. 1999. *Implementing Universal Newborn Hearing Screening Programs: Early Identification of Hearing Loss*. Logan, UT: National Center for Hearing Assessment and Management.