**Assessment and Intervention for Children with Hearing Impairment**

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**Abstract**

# Hearing impairment is diagnosed when a person’s hearing thresholds are above 20 db HL. Infants receive Universal Newborn Hearing Screening (UNHS) on the first day after birth. Empirical studies show that post-neonatal screening is also indispensable, which has already been implemented in some countries. Once children fail in the screening, they should immediately receive a full screening conducted by audiologists after which appropriate treatment can be prescribed. An educational approach includes the language to acquire and the technology to use, which will influence children’s communication way and thereby their whole life. Whatever approach children adopt, in order to develop mature language and communication abilities, a large amount of language input is essential.

# *Keywords:* hearing impairment, children, assessment, intervention

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**Introduction**

Hearing impairment is the inability of an individual to hear sounds adequately. With the measurement of decibels of hearing levels (db HL), hearing levels are normally divided into 6 degrees, among which hearing thresholds above 60 db HL indicate severe impairment, 90 db HL profound impairment, and 121 db HL total impairment. While since the ability to understand speech can’t be predicted from a pure-tone audiogram, the functional descriptors, namely an individual’s functional communication abilities, are also used as the dividing lines(Brill et al., 1986). A hearing loss can happen when any part of the ear is not working in the usual way, including conductive hearing loss caused by damage in the external ear canal, sensorineural hearing loss caused by damage to the inner ear, Central hearing loss caused by the problem with the auditory nerve or sound centers, and mixed hearing loss which is the combination of both sensorineural and conductive hearing loss. Hearing loss can affect a child's ability to develop communication, language, and social skills. Therefore, it’s imperative to screen children with hearing loss and design individualized intervention programs for them at an early age, especially within 6 months after their birth (Wroblewska-Seniuk et al., 2016; Spivak et al., 2009; Keren et al., 2002).

## Assessment

Universal Newborn Hearing Screening (UNHS) is a prevalent screening program conducted on the first day after birth. Different tests are conducted according to guidelines in different areas, among which AABR and OAE are techniques most commonly adopted and successfully used. The automated auditory brainstem response (AABR) test is a neurologic test of auditory brainstem function in response to auditory stimuli which tells how the inner ear and the brain pathways for hearing are working (Bhattacharyya, 2022). The otoacoustic emission test assesses cochlear function by measuring sounds given off by hair cells in the inner ear in response to the outside sound stimulus. The reasons for containing these methods in UNHS lie in that both of these tests don’t require responses and are not influenced by infants’ attention. Moreover, studies demonstrate that with the combination of OAE and AABR tests, the number of inaccurate reports will largely decrease (Dedhia et al., 2013; Watkin & Baldwin, 2010).

Despite the success of neonatal screening in the detection of hearing impairment, post-neonatal screening is also indispensable. In a study conducted by P. Watkin and Baldwin (2012), they followed up a 10-year cohort of 35668 children who enrolled in a Universal Newborn Hearing Screening until they had completed the first year of primary school, and found over a quarter of children had been already in school before deafness was confirmed, whose acquisition of language was therefore retarded and communication skills largely deficient. Similar results were also elicited from studies by Lü et al. (2011) and Dedhia et al. (2013). Leaving a group of children’s hearing impairment undetected until they grew up is mostly because of false-negative results of UNHS and delayed-onset hearing impairment. According to the study by Dedhia et al., false-negative results appear when a patient with auditory neuropathy spectrum disorder simply has an OAE test in their UNHS and therefore can be avoided by adding ABR tests in every infant’s neonatal screening. The delayed-onset hearing loss is the hearing loss that develops after an infant’s birth so that can only be detected through post-neonatal screening. In the research by Lü et al., 3-6-year-old children with delayed-onset hearing loss who previously passed the newborn hearing screening account for 0.75/1000, suggesting the necessity of preschool hearing screening. In fact, in many countries such screening has already been implemented with scientific guidelines. For instance, School entry hearing screening (SES) is a preschool hearing screening implemented throughout the U.K. (“Current Practice, Accuracy, Effectiveness and Cost-Effectiveness of the School Entry Hearing Screen,” 2008). American Speech-Language-Hearing Association (ASHA) has also recommended the detection of hearing loss in early childhood and school-aged populations (American Speech-Language-Hearing Association, 2022). The methods of screening are largely different from those in UNHS. Specifically, many subjective assessment methods that require response such as behavioral observation audiometry (BOA) are added to post-neonatal screening.

### Intervention

After the confirmation of hearing impairment through screening, children should start their individualized intervention programs as soon as possible. An audiologist from local hospitals or hearing organizations works with the family to implement a full assessment and design an educational approach for the child. A full assessment evaluates children’s hearing ability and language competence. The Nottingham Early Assessment Package is a collection of assessments that covers the evaluation of auditory perception, communication language development, and speech production development (Nikolopoulos et al., 2005). Normal educational approaches include auditory-oral, auditory-verbal, bilingual-bicultural (Bi-Bi), cued speech and total communication. Auditory-oral and auditory-verbal approaches rely heavily on auditory input so hearing aids or cochlear implants are required. A bilingual-bicultural approach aims to teach children American Sign Language (ASL) and English, and cued speech approach uses mouth movements as cues to allow children access the fundamental properties of spoken languages (*Cued Speech | Parent’s Guide to Hearing Loss | CDC*, 2014). A total communication approach uses a combination of speech, sign language and technology. After the decision on educational approach has been made, children and their parents start their learning. In particular, Parents and other family members learn about hearing loss, hearing aid management, and ways to stimulate age-appropriate play and language in order to provide a language stimulating environment at home during their children’s critical period for language acquisition(*Educational Programmes for the Hearing Impaired Children*, 2021).

The technology for hearing impairment includes hearing aids, cochlear implants, tactile aids and assistive listening devices. Hearing aids are battery-powered electronic devices aimed to improve hearing. There are six types of hearing aids categorized by where they’re worn by users: body aids, behind-the-ear (BTE) aids, in-the-ear (ITE) aids, in-the-canal (ITC) aids, completely-in-canal aids and eyeglass aids, among which BTE is the most common type of hearing aid for infants and children. Audiologists offer advice on children’s choice of devices based on variables such as age, the extent of hearing loss and the ability one can manage small devices (Round, 2001). Moreover, audiologists offer an orientation to the family which covers instruction for care and how to conduct a listening check and ongoing counseling once a hearing aid is fitted, which enables the daily monitoring from either children or their parents (Reed, 2017).

Cochlear implants are mainly for children with hearing impairment to the extent that hearing aids are not enough (*Hearing Loss Treatment and Intervention Services | CDC*, 2021). Unlike hearing aids which amplify voices, a cochlear implant directly sends sound signals to the hearing nerve. It’s recommended to get a cochlear implant at an early age, especially during the most sensitive time for central auditory development (Sharma & Nash, 2009). The benefits of early implantation include the development of communication abilities (Kirk et al., 2002), the vocabulary system (Schorr et al., 2008) and academic performance (Marschark et al., 2007). To maximize the benefit of a cochlear implant, not only does the time of implantation matter, but children’s training and knowledge about the device are also crucial. Such communication training includes speech training, auditory training and lip-reading training ([Center for Devices and Radiological Health](/taxonomy/term/814), 2017). It’s noteworthy that people with severe hearing loss due to an absent or very small hearing nerve or severely abnormal inner ear (cochlea), should have an auditory brainstem implant instead of a cochlear implant (Wong et al., 2019).

Tactile aids and assistive listening devices are recommended in particular conditions. Tactile aids enable the wearer to hear sounds through vibration or electronic pulses on the skin and therefore apply to children whose hearing impairments are so profound that they hardly benefit from conventional hearing aids and cochlear implants (Goldstein & Proctor, 1985). Assistive listening devices are personal amplifiers used in public environments. The types of assistive listening devices include FM, infrared and inductive loop technologies (*Assistive Listening Systems and Devices*, 2022).

Whatever approach and technology are adopted, a large amount of language input in family and school is essential for children’s language acquisition. Children with hearing impairment attend either integrated education in regular school or segregated education in special school according to the extent of their hearing loss. Through audiologists’ recommendations and information on the internet, parents can soon get access to appropriate resources for their children.

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