

# Facts about Pediatric Hearing Loss

During the past 20 years there has been a revolution in how we identify and educate children with permanent hearing loss in the United States. Below is a list of facts about pediatric hearing loss that are often widely cited with their references. With the support of OPTION Schools, Inc., the following document was compiled by Tamala S. Bradham, PhD, Chair; Teresa Caraway, PhD; Jean Moog; K. Todd Houston, PhD; and Julie Rosenthal.

## Facts on Hearing Loss in Children

- ◆ Approximately 3 in 1,000 babies are born with permanent hearing loss, making hearing loss one of the most common birth defects in America. (Ross et al., 2008)
- ◆ Hearing loss affects 12,000 children born in the United States each year, making it the most common birth defect. (White, 1997)
- ◆ Children with hearing loss who begin early intervention earlier have significantly better developmental outcomes than similar children who begin intervention later. (Holt & Svirsky, 2008; Moeller, 2000; Nicholas & Geers, 2006)
- ◆ Most children with hearing loss who receive appropriate services from trained staff are able to progress at age-appropriate rates. (Geers et al., 2009)
- ◆ 92% of children with permanent hearing loss are born to two hearing parents. 96% of children with permanent hearing loss are born to one hearing parent and one parent with hearing loss. (Mitchell & Karchmer, 2004)
- ◆ Parents usually suspect a hearing loss before the doctor does. (Harrison & Roush, 1996)

## Facts on Early Hearing Detection and Intervention (including UNHS)

Of the 12,000 babies in the United States born annually with some form of hearing loss, only half exhibit a risk factor—meaning that if only high-risk infants are screened, half of the infants with some form of hearing loss will not be tested and identified. (Harrison & Roush, 1996)

Newborn hearing screening has become the standard of care in the United States. While 92% of all newborns are screened for hearing loss shortly after birth, only 54% of these babies actually receive the recommended hearing evaluation; the remaining 46% are "lost to the system". (Joint Committee on Infant Hearing, 2007)

CDC reports that only 61% of children identified with hearing loss begin ANY KIND of Part C early intervention services before 6 months of age. (Centers for Disease Control and Prevention, 2006)

95% of newborns are screened for hearing loss. (White, 2003; Mitchell & Karchmer, 2004)

Despite extraordinary advances in early identification, early access to sound through technology and early intervention, there is widespread agreement among researchers, clinicians, program administrators and policy makers that many children ages 0–5 with permanent hearing loss are not receiving the benefits. (White, 2007; White, 2004)

Until the 1990s, children born with permanent hearing loss typically would not have been identified and diagnosed until 2 ½ to 3 years of age. Since the initiation of newborn hearing screening and EHDI

programs, the average age of hearing loss identification has decreased to 2–3 months of age. (White, 2008; Hoffman & Beauchine, 2007; Harrison et al., 2003)

Left undetected, mild or unilateral hearing loss can result in delayed speech and language acquisition, social-emotional or behavioral problems, and lags in academic achievement. (Yoshinaga-Itano et al., 1998; Bess, 1985; Bess et al., 1988)

Nearly 40% of children identified with hearing loss and their families are not referred to the Part C early intervention system and may not be aware of the broad array of services and funding available to them. Part C is the primary source for families to link to other medical, audiologic and intervention services. (Center for Disease Control and Prevention, 2008)

When clear programmatic alternatives are available, the choices made by parents of children who are DHH have changed dramatically over time. (Brown, 2006)

- In 1995: 40% chose spoken language options, compared to 60% who chose sign-language options
- In 2005: 85% chose spoken language options, compared to 15% who chose sign-language options

With appropriate early intervention, children with hearing loss can be mainstreamed in regular elementary and secondary education classrooms. Recent research has concluded that children born with a hearing loss who are identified and given appropriate intervention before 6 months of age demonstrated significantly better speech and reading comprehension than children identified after 6 months of age. (Yoshinaga-Itano & Apuzzo, 1998; Yoshinaga-Itano et al., 1998)

## Facts on Technologies

Using 2000 US Census data with a total population of slightly over 231 million, 15,219 children presented with severe to profound hearing loss. Taking into account some exclusions, 12,816 children would be considered cochlear implant candidates. Based on the number of children who were implanted in 2000, approximately 55% of the projected number of candidates received a cochlear implant. (Bradham & Jones, 2008)

A cochlear implant can make oral proficiency in more than one language possible for prelingually deaf children. (McConkey Robbinset al., 2004)

Children who receive cochlear implants in the second year of life attain better speech perception and language development outcomes than later implantation. Children implanted between 12-24 months show similar language skills as typical peers on some language measures administered at age six. (Svirsky et al., 2004)

A recent study on cochlear implants demonstrated that special education in elementary school is less necessary when children have had "greater than two years of implant experience" before starting school. These children are mainstreamed at twice the rate or more of age-matched children with profound hearing loss who do not have implants. (Francis et al., 1999)

The skills and knowledge that speech, language, and hearing professionals possess in the area of cochlear implant services will enhance a cochlear implant child's acquisition and use of auditory skills, which, in turn, will impact other aspects of the student's life. (Teagle & Moore, 2002)

Fitting of personal amplification in an infant or young child is an on-going process. Minimally, an audiologist should see the child every three months during the first two years of using amplification and every 4-6 months after that time. (The Pediatric Working Group, 1996)

## Facts on Costs

When children are not identified and do not receive early intervention, special education for a child with hearing loss costs schools an additional \$420,000, and has a lifetime cost of approximately \$1 million per individual. (Johnson et al., 1993)

The Center for Disease Control and Prevention has estimated that the lifetime economic cost to the public for a child with hearing loss is over \$400,000, mostly for special education services. (Honeycutt et al., 2004; Mohr et al., 2000)

Most of the severe to profound hearing loss population are poorer than other Americans. (Blanchfield et al., 2001)

- 53% of family income made less than \$25,000 compared to 35% of the general US population Earnings are less (Mohr et al., 2000)
- 50–70% who have severe to profound hearing loss before retirement age are expected to earn only 50 to 70% of their non-hearing loss peers.

AND

- Lose between \$220,000 and \$440,000 in earnings depending on when the hearing loss occurred.

Based on incidence data, it is estimated that there will be slightly over 15,000 new cases each year (Mohr et al., 2000)

- Societal losses will amount to \$4.6 billion over the lifetime
- If early identification and intervention shifted *10% of the children into mainstreamed settings*, the return on investments would be *more than double!*

## Facts on Listening and Spoken Language

There is evidence that children prefer and encode auditory stimuli over visual stimuli. (Sloutsky & Napolitano, 2003)

There is substantial evidence that hearing is the most effective modality for the teaching of spoken language, reading, and cognitive skills. (Cole & Flexer, 2007)

Hearing is a first-order event for spoken language, reading, and learning. (Cole & Flexer, 2007)

Listening experience in infancy is critical for the development of both speech and language in young children and a strong spoken language base is essential for reading. (Cole & Flexer, 2007)

The critical language learning window is from birth to approximately 3 years of age when brain neuroplasticity is the greatest. (Sharma et al., 2002)

There is a critical window for auditory neural development. Studies in brain development show that sensory stimulation of the auditory centers of the brain is critically important, and indeed, influences the actual organization of auditory brain pathways. (Cole & Flexer, 2007)

Research suggests that children receiving implants earlier may benefit from the relatively greater plasticity of the auditory pathways than children implanted later within the developmentally sensitive period. (Manrique et al., 1999; Harrison et al., 2005; Sharma et al., 2002)

Data show that 90% of children born with a profound hearing loss who obtain a CI before they are 18 months old attain intelligible speech. If a cochlear implant is obtained between 2 and 4 years of age, about 80% of the children born with profound hearing loss will attain intelligible speech. In contrast, only about 20% of children born with a profound hearing loss who wear hearing aids and not a cochlear implant attain intelligible speech. (Cole & Flexer, 2007)

Neural imaging has shown that the same brain area—the primary and secondary auditory areas—are most active when a child listens and when a child reads. (Cole & Flexer, 2007)

Communication mode has been shown to have a highly statistically significant association with speech and language outcomes of children with cochlear implants. Children exposed to spoken language have a greater probability of scoring higher on speech and language assessments than children exposed to some degree of either sign support or sign language. (Percy-Smith et al., 2008)

Children receiving auditory-based intervention score the highest on speech production and speech recognition measures. These results improve as the emphasis on audition increases. (Wie et al., 2007)

Recent data indicates that introducing sign language prior to cochlear implantation does not enhance outcomes compared to emphasis on spoken language alone. (Nittrouer, 2008)

Recent data indicates that use of sign language was detrimental for the development of spoken language for children identified with hearing loss after their first birthday. (Nittrouer, 2008)

Listening and spoken language professionals encourage caregivers to interact with a child through spoken language and create a listening environment that helps a child to learn. (Estabrooks, 2006)

Better speech, spoken language and auditory outcomes are associated with greater emphasis on spoken language. Since 1992, over 90% of children with profound hearing loss developed intelligible spoken language. (Yoshinaga-Itano, 2008)

Speech production, speech recognition, expressive language, complexity of utterances and syntax and narrative ability are better for children using a listening and spoken language approach than children using total communication. (Moog & Geers, 2003)

The literature in developmental psychology tells us that about 90% of what very young children know about the world is from incidental learning. (Moog & Geers, 2003)

- a. The auditory-oral communication mode is important to the speech and language development of children after cochlear implantation.
- b. The dominant educational factor associated with high performance levels was the extent to which a child's classroom communication mode emphasized speech and auditory skill development.
- c. Parents and Professionals can help a child achieve maximum benefit from a cochlear implant by selecting an educational environment that provides a consistent emphasis on developing speech, auditory, and spoken language skills.

Children enrolled in a program focused on listening and spoken language showed an average of one year of language growth for each year in the program. At the end of a four-year period, the gap between chronological age and language age was nonexistent. (Rhoades & Chisolm, 2000)

Children who were deaf or hard of hearing and developed spoken language through listening developed reading ability comparable to their peers who hear normally. (Robertson & Flexer, 1993)

In the recent past, it has been reported that the vast majority of persons educated in deaf schools (95%) reach a reading age of only 9 years. (Traxler, 2000)

Studies examining the effects of cochlear implantation on reading indicate that the improved auditory skills may be associated with better reading outcomes...Above and beyond the positive effects of the cochlear implant, it is anticipated that auditory / speech training may increase the deaf child's access to phonological information and word comprehension. (Geers, 2003)

A study looking at outcomes as related to communication modes for children with hearing loss recommended that all educational programs incorporate a well-designed and implemented speech and language development and auditory training program. (Connor et al., 2000)

Constant use of auditory input to monitor speech production and to comprehend spoken language provides the concentrated practice needed for optimum benefit from a cochlear implant. (Geers & Brenner, 2003)

Listening and spoken language programs seek to improve speech perception, speech production, and spoken language skills by teaching a child to listen. Improved hearing sensitivity (as provided by a CI) does not, by itself, guarantee the ability to discriminate between sounds or to interpret speech for oral communication purposes. Children who receive CI continue to require intensive auditory, speech, and language training. (Wilkins & Ertmer, 2002)

Even mild hearing loss can significantly interfere with the reception of spoken language and education performance. Research indicates that children with unilateral hearing loss (in one ear) are ten times as likely to be held back at least one grade compared to children with normal hearing. (Cho Lieu, 2004; Bess, 1985; Oyler et al., 1988)

## Facts on Educational Environments

### Acoustic environments

All children need a quieter environment and a louder signal than adults to hear well enough to understand. Children with hearing loss need an even greater signal to noise ratio than children with typical hearing (Crandell et al., 2005)

ASHA standards require background noise levels not to exceed 30 dBA, reverberation times not to exceed 0.4 seconds or less, and an overall teacher signal-to-noise ratio (SNR) of + 15 dB. ANSI guidelines for schools call for background noise level to not exceed 35 dBA, reverberation time (RT) not to exceed 0.6–0.4 seconds, and a SNR of + 15 dB. (American Speech-Language-Hearing Association, 2005)

Listeners who are cochlear implant users need a minimum of + 10 SNR to function communicatively but require at least a + 15 SNR if they are to be expected to access verbal instruction, even in a classroom that meets ANSI standards. (American Speech-Language-Hearing Association, 2005)

FM units provide dramatic improvement in signal to noise ratio, especially in noisy mainstream classroom. In addition to helping achieve a +15 SNR in a classroom, it also addresses the degradation of speech across distance and interference of minimal or fluctuating noise for children with hearing loss. (American Speech-Language-Hearing Association, 2005)

## Types of Educational Placement

Early intervention services for infants with confirmed hearing loss should be provided by professionals with expertise in hearing loss, including educators the deaf, speech-language pathologists, and audiologists. (American Speech-Language-Hearing Association, 2007; Joint Committee on Infant Hearing, 2007)

Oral communication performance of children with cochlear implants is not only influenced by the mode of communication used educationally but also the educational setting. (Toby et al., 2003)

Children with cochlear implants who are in programs emphasizing listening and talking have higher speech production scores than children in programs that put less emphasis on these actions. (Toby et al., 2003)

Children with cochlear implants who are in mainstream classrooms where they must rely on listening and talking outperform children who are in special education classrooms where they may rely less on listening and talking. (Toby et al., 2003)

Data indicated that higher expectations are appropriate for children with cochlear implants than were previously realistic for profoundly deaf children who wore hearing aids. The data also indicate that parents and professionals can help a child achieve maximum benefit from a cochlear implant by:

1. Selecting an educational environment that provides a consistent emphasis on developing speech, auditory, and spoken language skills.
2. Making sure that the child receives audiological management that includes access to the most up-to-date speech processing strategies and careful monitoring of the implant to ensure a well-fitted Map.

In this study all performance outcome measures were significantly higher for cochlear implanted children in educational environments emphasizing listening and speaking...the current findings represent the most compelling support for an oral emphasis educational environment to be found in the pediatric cochlear implant literature. (Moog & Geers, 2003)

Cochlear implantation aided by aural habilitation a) enhances the growth in language skills that presumably underlies the increased rate of mainstream placement, b) equips most children with an increasing ability to participate in and benefit from the mainstream classroom. c) increases access to acoustic information of spoken language, leading to higher rates of mainstream placement in schools and lower dependence on special education support services. (Francis et al., 1999)

The Commission on Deaf Education states the IEP should also address the child's emotional and psycho-social needs. Deaf children are too often inappropriately placed in a classroom with a wide range of ages, or in cross-categorical groupings of children with different types of disabilities. (Joint Committee on Infant Hearing, 2007)

In response to a previous emphasis on natural environments, the Joint Committee on Infant Hearing (JCIH) recommends that both home-based and center-based intervention options should be offered. (American Speech-Language-Hearing Association, 2007; Joint Committee on Infant Hearing, 2007)

Speech Language Pathologists (SLPs) with background in articulation and language development may have the skills to work with a hearing impaired child in those areas (language and speech); however, frequently they have little training or experience in auditory learning strategies for children with hearing loss. The task of developing an auditory learning program for a child with a cochlear implant can be challenging. (Teagle & Moore, 2002)

Children with mild hearing loss miss 25–50% of speech in the classroom and may be inappropriately labeled as having a behavior problem or learning disability. Accommodations need to be made for these children. (Bess, 1985; Bess et al., 1998)

## Literacy

Studies examining the effects of cochlear implantation on reading indicate that the improved auditory skills may be associated with better reading outcomes. Above and beyond the positive effects of the cochlear implant, it is anticipated that auditory/speech training may increase the deaf child's access to phonological information and word comprehension. (Geers, 2003)

Children who are deaf and hard of hearing are at risk for serious reading deficiencies. (Carney & Moeller, 1998)

Recent reports suggest a better long-term prognosis related to improved speech perception skills resulting from universal newborn screening and advances in technology, such as cochlear implants. (Spencer & Oleson, 2008)

For typical developing children, phonological awareness, alphabetic, and vocabulary form the foundation to read words and passages meaningfully. (Shanahan, 2006)

Vocabulary is another influential component in literacy development. In children with typical hearing higher-level vocabulary affects reading outcomes for struggling readers. (Bowyer-Crane et al., 2008)

Vocabulary plays an important role in reading for children who are Deaf or Hard of Hearing. (Geers & Moog, 1989; Paul, 1996)

Many children with hearing loss start preschool with significant gaps and fewer words in their lexicons when compared to children with typical hearing, which may be another cause of reading challenges. (Prezbindowski & Lederberg, 2003)

Results of study suggest that many of today's self-contained early childhood classes successfully help children who are DHH to develop auditory-based phonological and phonics skills. Scores on literacy tasks that involved recognition of letters, recognition of common written words suggested performance of children who are DHH was similar to that of children with typical hearing. (Easterbrooks et al., 2008)

First, similarities between children who are DHH suggest that research on effective reading instruction for children with typical hearing may form the basis for effective intervention for children who are DHH. Second, instructional strategies need to be adapted to meet the specific needs of children who are DHH, including instructional language that is more explicit, especially for rhyming and vocabulary. This instruction has to be individualized to the language and phonological sensitivity skills of children who are DHH. All of these can occur more easily in self-contained classes, such as those provided by Option schools. (Easterbrooks et al., 2008)

