Facts Related to the Prevalence, Academic and Economic Impact, and Technology for Management of Childhood Hearing Loss

Documented 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, D., Holstrum, W.J., Gaffney, M., Green, D., Oyler, R., and Gravel, J. (2008). Hearing screening and diagnostic evaluation of children with unilateral and mild bilateral hearing loss. Trends in Amplification, 12(1), 27.

Hearing loss affects 12,000 children born in the United States each year, making it the most common birth defect.

Grosse, S, (May, 2001). Cost comparison of screening newborns for hearing impairment and biochemical disorders. Centers for Disease Control and Prevention. Paper presented at the Newborn Screening and Genetics Conference. Retrieved on March 15, 2010 from http://www.hearingloss.org/docs/factsheet.pdf .

White, K.R. (October, 1997). The scientific basis for newborn hearing screening: Issues and evidence. Invited keynote address to the Early Hearing Detection and Intervention (EHDI) Workshop sponsored by the Centers for Disease Control and Prevention, Atlanta, Georgia. Retrieved on April 1, 2010 from http://www.infanthearing.org/resources/fact.pdf

Children with hearing loss who begin early intervention earlier and maintain consistency through age five have significantly better developmental outcomes than similar children who begin intervention later.

Holt, R.E & Svirsky, M.A. (2008). An exploratory look at pediatric cochlear implantation: is earliest always best? Ear & Hearing, 29(4), 492-511.

Moeller, M.P. (2000). Early intervention and language development in children who are deaf and hard of hearing. Pediatrics, 106(3), e43.

Nicholas, J.G. & Geers, A.E. (2006). Effects of early experience on the spoken language of deaf children at 3 years of age. Ear & Hearing, 27(3), 286-98.

92% of children with permanent hearing loss are born to two hearing parents.

Mitchell, R.E. & Karchmer, M.A. (2004). Chasing the mythical ten percent: Parental hearing status of deaf and hard of hearing students in the United States. Sign Language Studies, 4(2), 138-163.

Most children with hearing loss who receive appropriate services from auditory oral trained staff are able to progress at age-appropriate rates.

Geers, A.E., Moog, J.S., Biedenstein, J.B., Brenner, C. and Hayes, H. (2009). Spoken language scores of children using cochlear implants compared to hearing age-mates at school entry. The Journal of Deaf Studies and Deaf Education, 14(3), 371-385, doi: 10.1093/deafed/enn046.

Babies can be fit with hearing aids as early as 4 weeks of age.

Children and hearing aids. (n.d.) Retrieved March 20, 2010 from American Speech and Hearing Association Web site: http://www.asha.org/public/hearing/treatment/child_aids.htm.

Parents usually suspect a hearing loss before the doctor does.

World Health Organization (2006). Deafness and hearing impairment. Retrieved on March 30, 2010 from World Health Organization website: http://www.who.int/mediacentre/factsheets/fs300/en.

Harrison, M. & Roush, J. (1996). Age of suspicion, identification, and intervention for infants and young children with hearing loss: A national study. Ear & Hearing, 17(1), 55-62.

All children can be evaluated for hearing loss. Even children who are only minutes old can have their hearing assessed using tests that are safe, painless and easy to administer.

Gordon-Langbein, A. (n.d.). Facts about hearing loss in children. Alexander Graham Bell Association. Retrieved on December 12, 2009 from http://www.agbell.org/docs/FAHL.pdf .

Left undetected, hearing impairments in infants can negatively impact speech and language acquisition, academic achievement, and social and emotional development. If detected, however, these negative impacts can be diminished and even eliminated through early intervention.

Because of this, the National Institutes of Health's (NIH) Consensus Development Conference on Early Identification of Hearing Loss (1993) concluded that all infants should be screened for hearing impairment, preferably prior to hospital discharge. National Institute of Health (1993). Early identification of hearing impairment in infants and young children. NIH Online Consensus Statement, 11(1), 1-24. Retrieved on April 1, 2010 from http://www.infanthearing.org/screening/index.html .

Documented Facts on the Costs to Taxpayers

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. Penn Data and simple calculations indicate that sign language costs a minimum of $800,000 per child in Pennsylvania.

Honeycutt, A., Dunlap, L., Chen, H., al Homsi, G., Grosse, S., & Schendel, D. (2004). Economic costs associated with mental retardation, Cerebral Palsy, hearing loss and vision impairment – United States 2003. MMWR Weekly, 53(3), 57-59.

Johnson, J.L., Mauk, G.W., Takekawa, K.M., Simon, P.R., Sia, C.C.J., & Blackwell, P.M. (1993). Implementing a statewide system of services for infants and toddlers with hearing disabilities. Seminars in Hearing, 14(1), 105-119.

Mohr, P.E., Feldman, J.J., & Dunbar, J.L. (2000). The societal costs of severe to profound hearing loss in the United States. International Journal of Technology Assessment in Health Care. 16(4), 1120-1135.

Most of the severe to profound hearing loss population are poorer than other Americans. 53% of family income made less than $25,000 compared to 35% of the general US population.

Blanchfield, B.B, Feldman, J.J., Dunbar, J.L., Gardner, E.N. (2001). The severely to profound hearing-impaired population in the United States: prevalence estimates and demographics. Journal of the American Academy of Audiology, 12(4),183-189.

Earnings are less:

- **60%-70% of signing adults are unemployed.**
- **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.**

Mohr, P.E., Feldman, J.J., Dunbar, J.L., McConkey-Robbins, A, Niparko, J.K., Rittenhouse, R.K., & Skinner, M.W. (2000). The societal costs of severe to profound hearing loss in the United States. International Journal of Technology Assessment in Health Care, 16(4), 1120-1135.

Based on incidence data it is estimated that there will be 15,000 new babies identified nationwide each year.

- **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!**

Mohr, P.E, Feldman, J.J., Dunbar, J.L., McConkey-Robbins, A., Niparko, J.K., Rittenhouse, R.K., & Skinner, M.W. (2000). The societal costs of severe to profound hearing loss in the United States. International Journal of Technology Assessment in Health Care, 16(4), 1120-1135.

Documented Facts on Educational Impact of Listening and Spoken Language

There is substantial evidence that hearing is the most effective modality for the teaching of spoken language, reading, and cognitive skills.

(Sloutsky & Napolitano, 2003; Tallal, 2004; 2005; Werker 2006. as cited in Cole & Flexer, 2007).

Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

There is evidence that children prefer and encode auditory stimuli over visual stimuli.

Sloutsky, V.M. & Napolitano, A.C. (2003). Is a picture worth a thousand words? Preference for auditory modality in young children. Child Development, 74(3), 822-833.

The critical language learning window is from birth to approximately 7 years of age when brain neuroplasticity is the greatest.

Sharma, A., Dorman, M.F., & Spahr, A.J. (2002). A sensitive period for the development of the central auditory system in children with cochlear implants: implications for age of implantation. Ear and Hearing, 23(6), 532-539.

Acoustic accessibility of intelligible speech is essential for brain growth.

Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

Hearing is a first-order event for spoken language, reading, and learning.

Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

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.

(Sloutsky & Napolitano, 2003. as cited in Cole & Flexer, 2007)
Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

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.

Boothroyd, 1997; Berlin & Weyand, 2003; Chermak, Bellis & Musiek, 2007.

Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

Research supports that children receiving implants and appropriate educational habilitation earlier may benefit from the relatively greater plasticity of the auditory pathways than children implanted later within the developmentally sensitive period.

Harrison, R.V., Gordon, K.A., & Mount, R.J. (2005). Is there a critical period for cochlear implantation in congenitally deaf children? Analysis of hearing and speech perception performance after implantation. Wiley Periodicals., Inc. Developmental Psychobiololgy, 46(3), 252-261.

Manrique, M., Cervera-Paz, F.J., Huarte, A., Perez, N., Molina, M., & Garcia-Tapia, R. (1999). Cerebral auditory plasticity and cochlear implants. Journal of Pediatric Otorhinolaryngology, 49(Suppl. 1), S193–S197.

Sharma, A., Dorman, M.F. & Spahr, A.J. (2002). A sensitive period for the development of the central auditory system in children with cochlear implants: Implications for age at implantation. Ear & Hearing, 23(6), 532-539.

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 appropriate educational habilitation is provided. 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.

Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

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, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

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, L, Jensen, J.H., Caye-Thomasen, P., Gudman, M., & Lopez, A.G. (2008). Factors that affect the social well being of children with cochlear implants. Cochlear Implants International, 9(4), 199-214.

Children receiving auditory oral-based educational intervention score the highest on speech production and speech recognition measures. These results improve as the emphasis on audition increases.

Wie, O., Falkenberg, E., Tvete, O., & Tomblin, B. (2007). Children with a cochlear implant: Characteristics and determinants of speech recognition, speech-recognition growth rate, and speech production. International Journal of Audiology, 46(5), 32-243.

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

Nittrouer, S. (2008). Outcomes for children with hearing loss: Effects of age of ID, sign support, and auditory prosthesis. A presentation to the National Early Hearing Detection and Intervention Conference, New Orleans, LA.

Recent data indicates that use of sign language was detrimental for the development of spoken langauge for children identified with hearing loss after their first birthday. It further indicates that it is detrimental to the development of spoken language in the control group of typically hearing children.

Nittrouer, S. (2008). Outcomes for children with hearing loss: Effects of age of ID, sign support, and auditory prosthesis. A presentation to the National Early Hearing Detection and Intervention Conference, New Orleans, LA.

Human beings are rich in auditory brain tissue – but children can't listen like adults. Neural development and organization of the auditory brain centers require sensory input and extensive auditory experence.

Estabrooks, 2006; Sharma et al., 2004; Sharma, Dorman, & Kral, 2005. as cited in Cole & Flexer, 2007.

Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

Listening and Spoken Language Specialists (LSLS) help children who are deaf or hard of hearing develop spoken language and literacy primarily through listening. LSLS professionals guide parents in helping their children develop intelligible spoken language through listening and coach them in advocating their children's inclusion in the mainstream school. Ultimately, parents gain confidence that their children will have access to the full range of educational, social and vocational choices in life.

A.G. Bell Academy for Listening and Spoken Language. (2005). About the Academy. Retrieved, April 1,2010from http://www.agbellacademy.org/aboutacademy.htm.

Developing a child's spoken language skills through listening involves a partnership between Listening and Spoken Language Specialists and the parents /families. Working in partnership results in the most effective intervention. The idea is to maximize the family's capacity to help their child learn spoken language through listening.

Cole, E. & Flexer, C. (2007). Children with Hearing Loss Developing Listening and Talking Birth to Six. San Diego, CA: Plural Publishing.

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, W. (2006). Auditory-verbal therapy and practice. Washington D.C.: Alexander Graham Bell Association of the Deaf and Hard of Hearing.

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, C. (May, 2008) Presentation to Widex International Pediatric Congress, Amsterdam, Netherlands.

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, J. & Geers, A. (2003). Epilogue: Major findings, conclusions and implications for deaf education. Ear & Hearing. 24(1), 121S-125S.

The literature in developmental psychology tells us that about 90% of what very young children know about the world is from incidental learning.

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.**

Moog, J. & Geers, A. (2003). Epilogue: Major findings, conclusions and implications for deaf education. Ear & Hearing. 24(1), 121S-125S.

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.

Rhoades, E. & Chisolm, T.H. (2000). Global language progress with an auditory-verbal approach for children who are deaf or hard of hearing. The Volta Review, 102(1), 5-24.

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, L., & Flexer, C. (1993). Reading development: A survey of children with hearing loss who developed speech and language through the auditory-verbal method. The Volta Review, 95(3), 253-261.

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

Traxler, C.B., (2000). The Standford Achievement Test, 9th Edition: National norming and performance standards for the deaf and hard of hearing students. Journal of Deaf Studies and Deaf Education, 5(4), 337-348.

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, A. (2003). Predictors of reading skill development in children with early cochlear implantation. Ear & Hearing, 24(1), S59-S68.

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, C.M., Hieber, S., Arts, H.A., & Zwolan, T.A. (2000). Speech, vocabulary and education of children with cochlear implants: Oral or total communication? Journal of Speech, Language, and Hearing Research, 43(5), 1185-1204.

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, A. & Brenner, C.(2003). Background and educational characteristics of prelingually deaf children implanted by five years of age. Ear & Hearing, 24(1), S2-S13.

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, M. and Ertmer, D. (2002). Introducing young children who are deaf or hard of hearing to spoken language: Childs voice, an oral school. Language, Speech and Hearing Services in Schools, 33(3), 196-204.

With the technology [hearing aids and cochlear implants] and early auditory-verbal intervention available today, a child with hearing loss CAN have the same opportunity as a child with typical hearing to develop audition, speech, language, cognition, conversational competence, literacy skills and academic skills.

Estabrooks, W. (2006). Auditory-Verbal Therapy and Practice. Washington D.C: Alexander Graham Bell Association for the Deaf and Hard of Hearing.

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, J.E. (2004). Speech-language and educational consequences of unilateral hearing loss in children. Archives of Otolaryngology—Head & Neck Surgery, 130(5),124-130.

Bess F. (1985). The minimally hearing-impaired child. Ear & Hearing, 6:43-47; Bess, F., Dodd-Murphy, J. & Parker, R. (1998). Children with minimal sensorineural hearing loss Prevalence, educational performance, and functional status. Ear & Hearing, 19(5) 339 354.

Oyler R, Oyler A, & Matkin, N. (1988). Unilateral hearing loss: Demographics and educational impact. Language, Speech and Hearing Services in Schools; 19(2), 201-209.

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). Executive summary for JCIH year 2007 position statement: Principles and guidelines for early hearing detection intervention programs. Available from www.asha.org.

Joint Committee on Infant Hearing (2007). Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. Pediatrics, 120(4),898-921. doi:10.1542/peds.2007-2333.

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, E.A., Geers, A.E., Brenner, C., Altuna, D., & Gabbert, G. (2003). Factors associated with development of speech production skills in children implanted by age five. Ear & Hearing, 24(1), 36S-45S.

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, E.A., Geers, A.E., Brenner, C., Altuna, D., & Gabbert, G. (2003). Factors associated with development of speech production skills in children implanted by age five. Ear & Hearing, 24(1), 36S-45S.

Children with cochlear implants who are mainstreamed into 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, E.A., Geers, A.E., Brenner, C., Altuna, D., & Gabbert, G. (2003). Factors associated with development of speech production skills in children implanted by age five. Ear & Hearing, 24(1), 36S-45S.

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, J.S. and Geers, A.E. (2003). Epilogue: Major Findings, Conclusions and Implications for Deaf Education in Ear and Hearing Monograph, 24(18), 124.

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, Koch, Wyatt, & Niparko (1999). Trends in educational placement and cost benefit considerations in children with cochlear implants. Archives of Otolaryngology Head and Neck Surgery, 125, 499-506.

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). Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. Pediatrics, 120(4), 898 921. doi:10.1542/peds.2007-2333.

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). Executive Summary for JCIH Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection Intervention Programs. P. 3 Available from www.asha.org.

Joint Committee on Infant Hearing (2007). Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. Pediatrics, 120(4), 898-921. doi:10.1542/peds.2007-2333.

Speech Language Pathologists (SLPs) with backgroud in articulation and language development may have the skills to work with a hearing impaired child in those areas (langauge 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). School-based services for children with cochlear implants. Language, Speech and Hearing Services in Schools, 33, 162-171.

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 F. (1985). The minimally hearing-impaired child. Ear & Hearing, 6(1), 43-47. Bess, F., Dodd-Murphy, J. & Parker, R. (1998). Children with minimal sensorineural hearing loss: Prevalence, educational performance, and functional status. Ear & Hearing, 19(5), 339-354.

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, A. (2003). Predictors of reading skill development in children with early cochlear implantation. Ear & Hearing, 24(1), S59-S68.

Signing children who are deaf and hard of hearing are at risk for serious reading deficiencies.

Carney & Moeller, 1998. Treatment efficacy; Hearing Loss in Children. Journal of Speech, Language, and Hearing Research, 41, S61-S84.

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, L.J., & Oleson, J.J. (2008). Early listening and speaking skills predict later reading proficiency in pediatric cochlear implant users. Ear and Hearing, 29(2), 270-280.

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

Shanahan, T. (2006). The national reading panel report: Practical advice for teachers. Naperville, IL: Learning Point Associates/North Central Regional Educational Laboratory. (ERIC Document Reproduction Service No. ED489535.

Vocabulary is another influential component in literacy development. In children with typical hearing higher-level vocabulary affects reading outcomes for struggling readers.

Bowyer-Crane, C., Snowling, M.J., Duff, F.J., Fieldsend, E., Carroll, J.M., Miles, J., Gotz, K., & Hulme, C. (2008). Improving early language and literacy skills: differential effects of an oral language versus a phonology with reading intervention. Journal of Child Psychology and Psychiatry, 49(4), 422-432.

Vocabulary plays an important role in reading for children who are Deaf or Hard of Hearing.

Geers, A.E. and Moog, J.S. (1989). Factors predictive of the development of literacy in profoundly hearing-impaired adolescents. The Volta Review, 91(2), 69-86.

Paul, P.V. (1996). Reading vocabulary knowledge and deafness. Journal of Deaf Studies and Deaf Education, 1(1), 3-15.

Many children with hearing loss who start school with out adequate auditory oral educational habilitation have significant gaps and fewer words in their lexicons when compared to children with typical hearing, which may be another cause of reading challenges.

Prezbindowski, A. K., & Lederberg, A. R. (2003). Vocabulary assessment of deaf and hard-of-hearing children from infancy through the preschool years. Journal of Deaf Studies and Deaf Education, 8(4), 383–400.

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, S.R., Lederberg, A.R., Miller, E.M., Bergeron, J.P. & Connor, C.M. (2008). Emergent literacy skills during early childhood in children with hearing loss: strengths and weaknesses. Volta Review, 108(2), 91-114.

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, S.R., Lederberg, A.R., Miller, E.M., Bergeron, J.P. & Connor, C.M. (2008). Emergent literacy skills during early childhood in children with hearing loss: strengths and weaknesses. Volta Review, 108(2), 91-114.

Documented Facts on Special acoustical adaptations used by approved auditory oral schools in their intense intervention programs (not necessarily needed for successful mainstreaming of an auditory oral "graduate" into public school)

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). Guidelines for addressing acoustics in educational settings (Guidelines). Available from http://www.asha.org/policy.

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.

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). Guidelines for addressing acoustics in educational settings (Guidelines). Available from http://www.asha.org/policy.

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 C.C., Smaldino,, J.J. & Flexer, C. (2005). Sound-field amplification: Applications to speech perception and classroom acoustics (2nd ed..) Clifton Park, NY: Thomson Delmar Learning.

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). Guidelines for addressing acoustics in educational settings (Guidelines). Available from http://www.asha.org/policy.

Documented Facts on the Technology Available

A cochlear implant can make oral proficiency in more than one language possible for prelingually deaf children.

McConkey Robbins, A., Green, J.E., & Waltzman, S.B. (2004). Bilingual oral language proficiency in children with cochlear implants. Archives of Otolaryngology Head and Neck Surgery, 130(5), 644-647.

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, T.S. & Jones, J. (2008). Cochlear implant candidacy in the United States: prevalence in children 12 months to 6 years of age. International Journal of Pediatric Otorhinolaryngology, 72(7), 1023-8.

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, M.A., Teoh, S.W., & Neuburger, H. (2004). Development of language and speech perception in congenitally, profoundly deaf children as a function of age at cochlear implantation. Audiology & Neurotology, 9(4), 224-233. doi:10.1159/000078392.

In the United States, about 41,500 adults and 25,500 children have received cochlear implants.

National Institute on Deafness and Other Communication Disorders (2009). Cochlear Implants. Retrieved on March 7, 2010 from http://www.nidcd.nih.gov/health/hearing/coch.asp.

Nearly half of all cochlear implant recipients are children.

National Institute on Deafness and Other Communication Disorders (2009). Cochlear Implants. Retrieved on September 27, 2009 from http://www.nidcd.nih.gov/health/hearing/coch.asp.

Approximately 250 hospitals across the country perform cochlear implant procedures.

Cochlear Corporation, www.cochlear.com, (2003). Multiple sites in Pennsylvania perform pediatric implantation including CHOP.

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, H.W., Koch, M.E., Wyatt, J.R., Niparko, JK. (1999). Trends in Educational Placement and Cost-Benefit Considerations in Children With Cochlear Implants, Archives of Otolaryngology-Head & Neck Surgery, 125(5), 499-505.

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). School-based services for children with cochlear implants. Language, Speech and Hearing Services in Schools, 33(3), 162-171.

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). Amplification for infants and children with hearing loss. American Journal for Audiology, 5(1), 53-66.