



Healthy People 2010 Focus Area Progress Review

Vision and Hearing

October 20, 2004

1:00 p.m. - 2:30 p.m.

Hubert H. Humphrey Building, Room 729-G

Hearing Health

Goal: Promote hearing health of the Nation through prevention, early detection, treatment, and rehabilitation.

Number Objective Short Title

Newborn Hearing Screening

28-11 Newborn hearing screening, evaluation, and intervention

Otitis Media

28-12 Otitis Media in children

Hearing Evaluation and Rehabilitation

28-13 Rehabilitation – hearing aids, cochlear implants, assistive listening devices

28-14 Regular hearing evaluations

28-15 Referral for audiologic evaluation

Noise-Induced Hearing Loss

28-16 Hearing protection

28-17 Noise-induced hearing loss in adolescents

28-18 Noise-induced hearing loss in adults

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Hearing Health Overview

An estimated 28 million people in the United States have significant hearing loss.^[1] Severe to profound hearing impairment or deafness affects 500,000 to 750,000 Americans.^[2] No age or ethnic group can escape the consequences of these life-altering conditions. Every year numerous deaf or hearing-impaired newborns, children, teenagers, adults, and older Americans must adjust their lives so they can successfully live in a world that depends upon hearing.

Causes of deafness or hearing impairment include genetic, noise or trauma, sensitivity to certain drugs or medications, aging, and viral or bacterial infections. While hearing impairment can be the first sign of an underlying life-threatening condition, deafness is typically not fatal. The impact of hearing loss, however, needlessly reduces the productivity and quality of life of those affected, as well as all of society.

Deaf or hearing-impaired individuals can function with their hearing peers, making untold contributions to the nation's economy and well-being. However, the key to success for these individuals is early identification, evaluation, and appropriate intervention and rehabilitation.

Newborn Hearing Screening

Newborns can be easily and cost-effectively screened for hearing impairment. Many states mandate that hospitals screen all children before they are discharged from the newborn nursery or within the first 3 months of life. In the past, the average age of diagnosis of hearing loss in infants and young children ranged from 14 months to around 3 years of age.^[3] This delay in diagnosis is significant in terms of time lost during unique opportunities in brain development for language acquisition, spoken or signed.^[4] To optimize this critical intensive period of language development, intervention must start as close to birth as possible, preferably before 6 months of age.^[5]

The NIH convened a Consensus Development Conference on the Early Identification of Hearing Impairment in Infants and Young Children in 1993.^[4] The consensus panel recommended the use of objective, physiologic measures of hearing for all newborn infants before leaving the nursery or at least by 1 month of age. The panel also recommended that those infants who fail this first screening return for a comprehensive audiologic evaluation before 3 months of age and that intervention begin before 6 months of age for those with confirmed hearing impairment. The panel rejected use of routine clinical procedures (behavioral observation) as unreliable and judged universal newborn hearing screening to be superior to the practice of screening only infants identified through a high-risk register, which identifies at best half of the infants with hearing loss. The Joint Committee on Infant Hearing Screening endorsed the goal of universal detection of infants with hearing loss and encouraged continuing research and development to improve methodologies for identification of and intervention for hearing loss in its 1994 Position Statement.^[6] Subsequent research has shown that infants with hearing loss who receive intervention before 6 months of age maintain language development, commensurate with cognitive ability, through 5 years of age.^[5]

The CDC Early Hearing Detection and Intervention (EHDI) program monitors universal newborn hearing screening implementation in collaboration with directors of speech and hearing programs in state health and welfare agencies. EHDI reports that a total of 49 percent of hospitals and birthing centers in 22 reporting states/areas screened their newborns for hearing impairment in 1999.^[7] The screening program has grown rapidly since then. The program increased to 52 reporting states/areas with a total of 73 percent of hospitals or birthing centers performing universal hearing screening by 2001.^[7]

Otitis Media

One of the most common causes of hearing loss in the young child is otitis media, an infection or inflammation of the middle ear. This inflammation often begins when infections that cause sore throats, colds, or other respiratory or breathing problems spread to the middle ear. Otitis media accounted for 24.5 million visits to doctors' offices in 1990^[8] and is the most frequent reason for taking children to the emergency room.^[9] Also, it is the most frequent bacterial infection of childhood and the most common indication for antimicrobial therapy in children.^[10] Health care costs for otitis media in the United States are 3 billion to 5 billion dollars per year.^[11,12]

More than half of US children will have an episode of acute otitis media before their first birthday, and 90 percent will have an episode by 5 years of age.^[13, 14] Furthermore, up to 7 percent of children less than 3 years old will have surgical procedures, such as insertion of tympanostomy ear tubes, for treatment or management of chronic otitis media.^[14-16] In addition to the discomfort associated with ear infections, there is the potential risk of more serious complications such as mastoiditis and meningitis.^[17, 18] The temporary or permanent reduction in hearing associated with otitis media can affect children during the critical time for speech and language development and may silently impede learning at school.^[19]

The pathogenesis of otitis media is multifactorial, involving the immune system, Eustachian tube dysfunction, viral and bacterial load, and genetic and environmental factors. Observation without antibiotic therapy (watchful waiting) is the first treatment choice for most children with otitis media, but only if appropriate follow-up can be assured. Antibiotics may be effective in children younger than 2 years of age who have an accurate diagnosis of acute otitis media. Surgery may be performed for frequent, recurrent acute otitis media and for persistent or chronic otitis media with effusion, especially if associated with hearing loss. Spontaneous resolution of the effusion with recovery of hearing may occur. The recommended approach for surgery is to start with tympanostomy tube placement, to be followed by adenoidectomy, if necessary. The ideal intervention for otitis media, however, does not yet exist.

Hearing Evaluation and Rehabilitation

More and more Americans are experiencing a gradual reduction in hearing during their adult years. Reports indicate that men are more frequently affected in the 35- to 60-year-old age group now, as compared to previous decades.^[20] Because the change is often gradual, few are aware of the loss until it becomes difficult to manage.

Only 29 percent of adults 20 to 69 years of age have had their hearing tested within the last five years.^[21] Regular hearing testing would likely improve identification, intervention, productivity, and quality of life for many Americans. The American Speech, Language and Hearing Association (ASHA) recommends adult hearing screening at least every decade until age 50, with more frequent monitoring after 50 years of age.^[22]

The nation's elderly are especially vulnerable to hearing impairment. Presbycusis, the loss of hearing associated with aging, affects about 30 percent of adults who are age 65 years or older and about half of those over age 75.^[23, 24] As the population ages and lives longer, the number of people with hearing impairment will increase considerably. The loss of hearing associated with aging usually affects the high frequency sounds, the sounds necessary for understanding speech. The isolation created by difficulty conversing with families and friends can be enormous for individuals with hearing loss. Only 37 percent of Americans age 70 years or older have had their hearing tested in the past five years.^[21]

Once hearing impairment is identified, the goal is to provide appropriate treatment. Strategies for intervention or rehabilitation depend upon the kind of hearing loss, age of onset, services available, and family preferences. Treatment often includes mechanical devices, such as hearing aids, cochlear implants, and augmentative and assistive devices, designed to enhance residual hearing, allowing the individual to function better in the hearing world. Unfortunately, only a small number of adults with hearing impairment use these devices. In 1999 only 211 per 1,000 adults identified with hearing impairment ever used a hearing aid and approximately 2 per 1,000 deaf or very hard-of-hearing adults had a cochlear implant.^[21] It is likely that only about one-fourth of persons 70 years of age and older who could benefit from a hearing aid use one. Many who could benefit from assistive listening devices, instruments that improve hearing in specific situations such as talking on the telephone, do not know about or use these devices.

Noise-Induced Hearing Loss

Ten million Americans have permanent, irreversible hearing loss from exposure to loud noise or sound.^[25] In addition, 30 million people are estimated to be exposed to injurious levels of noise each day.^[26] Noise-induced hearing loss (NIHL) is the second most commonly reported occupational disease and is the most expensive disability for military and federal workers' compensation.^[26]

Noise-induced hearing loss is hearing loss caused by either a one-time exposure to very loud sound or by repeated exposure to sounds at various loudness levels over an extended period of time. Hearing loss may occur as either temporary threshold shift (when hair cells in the inner ear are able to recover) or, after a longer or more intense exposure, as permanent damage from loss of hair cells in the inner ear. Tinnitus, or ringing in the ears or head with no external source of sound, is a symptom that frequently accompanies noise-induced damage to the hair cells. Progression of hearing loss is related to noise level, proximity of the harmful sound, time of exposure, and individual susceptibility. Most NIHL can be prevented. Hearing protection devices such as ear plugs or ear muffs are recommended when individuals are exposed to high noise levels, whether at work or during leisure or recreational activities. Prevention of NIHL is necessary for people both on and off the job.

A. Public Health Application and Outreach: Translating Science into Practice

Scientific advancements are providing more knowledge than ever before about hearing and hearing loss. For example, we understand more about its genetic basis, ways to prevent its loss, methods to assess the hearing of individuals of all ages and mental capacities, and we have new ways to compensate for hearing once it is gone.

While research has produced impressive new understanding and technology, hearing loss continues to decrease the quality of life for many. Hearing disorders compromise social, emotional, educational, and vocational aspects of an individual's life. The cost of these disorders in terms of quality of life and unfulfilled potential is substantial. As individuals live longer and the survival rate for medically fragile infants improves, the number of people with hearing disorders will continue to increase.

The National Institute on Deafness and Other Communication Disorders (NIDCD) conducts and supports basic and clinical research and research training in the normal and disordered processes of hearing and other communication processes. NIDCD's research is motivated by intrinsic scientific interest, which will translate into advances that allow individuals to reach their full potential and contribute to the overall health of the Nation.

Objective 28:11

Improve newborn hearing screening, followup evaluation, and intervention

Congenital hearing loss must be identified as close to birth as possible, preferably within the first month of life. Early identification will allow the start of intervention that will help the child absorb language, whether spoken or signed, during the critical time period when the brain is most capable of acquiring language. Appropriate intervention can not begin until the extent and type of hearing impairment is confirmed by a complete audiologic evaluation. Because time is of the essence, this complete evaluation should be accomplished no later than 3 months of age. Language intervention should begin immediately thereafter, hopefully before the child is 6 months of age.

In 2001, 46 states reported that 66 percent of their newborns had hearing screening before 1 month of age.^[21] Also, 2001 data gathered from 27 states revealed that 56 percent of infants who failed their initial hearing screening went on to have a complete audiologic evaluation before 3 months of age.^[21] Data from 10 reporting states showed that 57 percent of infants with confirmed hearing loss in 2001 started an appropriate intervention program before age 6 months.^[21]

Challenges

- The goal of newborn hearing screening is to identify sensorineural hearing loss. Most neonates who fail hearing screening, however, have a conductive hearing loss resulting in a high false positive rate and costly followup diagnostic evaluation.
- The potential impact of false positive results of hearing screening on parental anxiety and subsequent parent-child relationships is not fully known.

- Followup evaluation of infants who fail initial hearing screening is still difficult to track and is lower than original expectations.
- State budgets are getting tighter and keeping track of those who should come for followup examinations and, if appropriate, offered intervention services is a challenge.
- The effects of universal genetic testing for hearing loss in newborns need to be scientifically assessed before implementation.
- A well-defined, scientifically based approach for the selection and fitting of hearing aids in infants and young children is needed.

Strategies and Opportunities

- NIDCD-supported scientists continue to develop new tools and technologies for evaluating and modifying intervention programs in neonates.
- NIDCD-supported scientists are evaluating new methods to improve current techniques for fitting hearing aids to infants and young children.
- The Joint Committee on Infant Hearing Screening is meeting to consider developing new practice guidelines to supplement the training of pediatric audiologists involved in infant hearing screening, evaluation, and intervention programs.
- The NIDCD Information Clearinghouse disseminates information promoting newborn hearing screening and appropriate intervention and followup.

Objective 28:12

Reduce the number of physician visits for otitis media by children and adolescents under 18 years of age

Otitis media, an infection or inflammation of the middle ear, is one of the most common reasons for visits made by children and adolescents to physicians, costing the United States some 3 to 5 billion dollars annually (accounting for as many as 30 million visits annually).^[11,12] Eighty-three percent of children experience at least one episode of acute otitis media by their third birthday^[13] and it is the most frequent reason for taking children to the emergency room.^[9]

Public education can promote hearing health and behavior to reduce hearing loss from conditions such as otitis media. However, we also need to learn more about the factors underlying particularly vulnerable children or populations. A recent scientific study reported a complex genetic basis for susceptibility to otitis media.^[27]

Otitis media occurs at a disproportionately high rate among Native American children.^[28-31] Studies suggest that differences between Native Americans and other Americans in the anatomy of the Eustachian tube^[32] may contribute to the higher incidence of otitis media in Native Americans. There may also be differences in the rate of otitis media among various Native American tribes.^[33] Additionally, Hispanic or Mexican-American school-age children have been found to suffer from higher rates of otitis media with effusion compared to non-Hispanic white and black children.^[34, 35]

Challenges

- Babies are at an unusually high risk for ear infections.
- Otitis media often occurs in children who have not yet developed speech and language making it difficult for parents to know when their child is suffering from an ear infection. Parents need to be aware of the various signs that may indicate otitis media and they should be encouraged to call their physician as soon as they notice any of the signs.
- Treatment options are varied, ranging from observation to antibiotics to surgery.
- There are a number of risk factors which may increase or reduce the risk of otitis media. We need to know more about predisposing factors, whether environmental or genetic.
- A severe or untreated ear infection can cause serious complications.

Strategies and Opportunities

- The NIDCD supports research on otitis media to improve scientific understanding and to formulate more effective preventive strategies.
- The NIDCD published a program announcement in October 2002 calling for development of novel diagnostics for the identification of specific pathogens causing otitis media.
- The NIDCD also published a Request for Applications (RFA) calling for research on specific pathogenic mechanisms that trigger otitis media, genomic approaches to the development of an otitis media vaccine and studies of genomic markers in individuals that might identify a predisposition to chronic otitis media infections. Several grants were funded in response to this RFA.
- The NIDCD supports research to study the epidemiology of otitis media in Native Americans.
- New clinical practice guidelines on the diagnosis and management of uncomplicated, acute otitis media in children from 2 months to 12 years of age recommend observation (watchful waiting) without use of antibacterial agents if other appropriate conditions exist, depending upon diagnostic certainty, age, illness severity, and assurance of followup. The guidelines were written by a subcommittee representing the American Academy of Pediatrics and the American Academy of Family Physicians in partnership with the Agency for Healthcare Research and Quality.^[36] Implementation of these guidelines could significantly slow the evolution of drug-resistant strains of OM causing pathogens.
- Vaccine development for otitis media is a high priority. Investigators funded by NIDCD and NIAID participated in a workshop in June 2004 to evaluate the status of vaccine development, identify obstacles to progress, and propose a plan of action. The summary of the workshop's recommendations has been submitted for publication to inform the research community with the intention of accelerating progress in vaccine development.

- The recent discovery of bacterial biofilms, which remain in the middle ear space long after acute onset of otitis media, is providing new insight into the pathogenesis of chronic otitis media with persistent middle ear effusion and, eventually, should lead to new treatment options.
- The NIDCD Information Clearinghouse disseminates information to help parents and care givers learn about otitis media including risk factors and symptoms.

Objective 28:13b

Increase the number of people who are deaf or very hard-of-hearing who use cochlear implants.

Once hearing impairment is identified, the ultimate goal is to provide the most appropriate treatment. That treatment often includes mechanical devices designed to enhance or compensate for residual hearing, allowing the individual to function better in the hearing world. One of those devices is a cochlear implant, a small, complex electronic device that can help provide a sense of sound to a person who is profoundly deaf or severely hard-of-hearing. Part of the implant is surgically placed under the skin behind the ear; the other part is implanted into the inner ear or cochlea. Only a small number of adults with hearing impairment use these devices.

In 1999 approximately 2 per 1,000 deaf or very hard-of-hearing adults received a cochlear implant.^[21] The vast majority of deaf adults with cochlear implants derive substantial benefit when the implant is used in conjunction with speech reading. As a result of cochlear implantation, many of these individuals are able to understand some speech without speech reading, and some are able to communicate by telephone. Benefits have also been observed in children, including those who lost their hearing prelingually (before acquiring speech); moreover, there is evidence that the benefits derived improve with continued use. New speech-sound processing techniques continue to improve the effectiveness of cochlear implants, increasing user performance over time.

Challenges

- It is difficult for parents of deaf infants to decide whether cochlear implantation is appropriate for their child.
- It is difficult to predict which people will benefit greatly from cochlear implantation compared to others of the same age and similar clinical characteristics who will not fare as well.
- Medicare for older adults and disabled persons and Medicaid for economically disadvantaged patients do not reimburse fully the cost of cochlear implants, resulting in disparities in healthcare access and utilization.
- The benefits of cochlear implantation in adults with lesser degrees of hearing loss are not fully known.
- Electrophysiological measures to improve fitting of existing and high-rate speech processors for young children and adults are still developing.

- The benefits of binaural (both ears) cochlear implantation are not fully known.
- The long-term effects of cochlear implantation in children and adults need further investigation.

Strategies and Opportunities

- The NIDCD provides support for a number of studies of clinical outcomes research studying cochlear implants in children and adults.
- The NIDCD supports research to improve cochlear implants.
- Children with hearing loss face challenges learning to speak and interact with other people. Early identification of and appropriate intervention for children with hearing impairment leads to improvements in speech and language development in affected children, thereby improving the likelihood of positive social, emotional, cognitive, and academic development. With the interface of early identification and cochlear implants, children are receiving implantation at a much younger age, some as young as 18 months of age. Generally, earlier implantation yields better outcomes.
- New short electrode technology promises greater benefit from cochlear implants. Scientists have developed a new shorter electrode to help an additional population of individuals with hearing loss, those who are unsuccessful hearing aid users. These individuals have a considerable amount of residual hearing and their primary hearing loss is in sounds in the high-frequency range. The short electrode is inserted into the base of the cochlea to restore hearing at high frequencies, while preserving low-frequency, or residual, hearing in the implanted ear.
- A new treatment is being developed for deafness caused by Neurofibromatosis Type 2 (NF2 is a genetic disorder that causes deafness). For many individuals with NF2, surgical intervention is required to remove tumors, which involves resection of both acoustic nerves so that sound perception cannot be restored with cochlear implantation. To help these individuals, NIDCD is supporting research to develop a specialized auditory prosthesis for NF2 patients. Multiple, ultraminiature microelectrodes are implanted directly into the cochlear nucleus in the brain to restore auditory perception. Evaluation with human subjects of this procedure has just begun.
- The NIDCD will work with the Healthcare Cost and Utilization Project and the National Health Interview Survey of the CDC to gather epidemiologic data regarding the use of cochlear implants.
- The NIDCD Information Clearinghouse disseminates public information about cochlear implants.

B. Reducing Hearing Health Disparities

In this age of information, the ability to hear is central to a successful life for all Americans, and the labor force of the 21st century will require intense use of communication skills that depend upon hearing. America's population is diverse, composed of cross-sections of the entire world. Every person of every age or ethnic background is vulnerable to the ravages of deafness or impaired hearing. The NIDCD devotes numerous resources to making

Americans of all backgrounds aware of proper hearing health and of available resources for those with impaired hearing.

Challenges

- Hispanic or Mexican-American school-age children suffer from higher rates of otitis media with effusion compared to non-Hispanic white and black children.^[34, 35]
- Hearing health information is not always available to minority individuals and families.
- Decreased participation of women, disabled, and minority scientists exists in human communication research.

Strategies and Opportunities

- The NIDCD is supporting development of a Web site to help parents, healthcare workers, daycare providers, educators, and other individuals and institutions as they make decisions about how best to help hearing impaired children. The site will address the needs of underserved children with hearing loss, including the rural poor, rural and inner-city minorities, young households, female-headed households, and other groups.
- The NIDCD continues to create initiatives for Hispanic/Latino/Latina individuals through participation with various Spanish language and Hispanic interest-meetings, exhibit opportunities, and collaborative efforts with the NIH Hispanic Communications Work Group that includes the Radio Unica/WalMart Hispanic Latino/Latina Health Fair series.
- Most NIDCD health information materials are available in Spanish.
- The NIDCD information for parents about early identification of hearing impairment is available in Spanish and Vietnamese.
- The NIDCD has implemented a student research trainee program in collaboration with the National Center on Minority Health and Health Disparities to recruit and retain individuals who are under-represented in the human communication sciences. Currently, students are selected from minority and majority institutions throughout the country to conduct research in cutting-edge NIDCD laboratory facilities. Since the program's initial class, 101 participants have trained under the program.
- The NIDCD and Howard University's Graduate School joined an official partnership to increase the participation of minority faculty and graduate students in human communication research. Since the program's beginning, two graduate students have complemented their academic training by conducting research in NIDCD intramural research laboratories.

C. Prevention, Early Detection, Treatment, and Rehabilitation of Hearing Diseases and Disorders

The NIDCD places high priority on the prevention of hearing loss and other disorders of human communication. When prevention measures are unknown, not utilized or fail, the

earliest possible detection and subsequent intervention will lead to the most successful adaptation to life in the hearing world. The desired goal of all NIDCD basic and clinical research is to improve the hearing health of the nation through identifying and implementing prevention strategies, early detection of any degree of hearing loss, and improving and promoting treatment and rehabilitation options.

Strategies and Opportunities

- The NIDCD conducts and supports research and research training in normal and disordered processes of hearing and other disorders of human communication including genomic and proteomic approaches. Knowledge of these processes should aid preservation of hearing disorders, as well as provide novel treatment approaches.
- The NIDCD has developed and distributes the program, "I Love What I Hear!" which teaches children in the 3rd through 6th grades about noise, the effects of noise on hearing, and about hearing protection.
- The NIDCD Information Clearinghouse distributes information about the prevention, early detection, treatment, and rehabilitation of hearing and hearing disorders.
- The NIDCD contributes to the Combined Health Information Database (CHID), which catalogues health information for the public.
- An education effort, WISE EARS![®] has been launched by a coalition of government agencies headed by the NIDCD and the National Institute on Occupational Safety and Health (NIOSH) at the Centers for Disease Control and Prevention (CDC). They have joined with state agencies; some 70 public interest, advocacy, and patient organizations; businesses; industries; and unions, as well as health professional organizations in a national effort to educate the public about ear defense. The education effort focuses both on the public, with special emphasis on children, and on the workforce and has important World Wide Web-based components.

D. Research Needs and Opportunities for Hearing Diseases and Disorders

Since its inception in 1988, NIDCD-supported scientists have made remarkable progress in research on hearing and its disorders. This progress was accelerated by related research supported by other institutes at the NIH. This combined effort has provided the foundation for current and future research to achieve the Institute's goal of improving the lives of individuals with hearing loss and other communication disorders. Despite these advances, more work needs to be done.

With help from scientists and the public, the NIDCD has identified four research areas that offer extraordinary research opportunities in the field of human communication sciences:

- I. Determine the Molecular and Epidemiological Bases of Normal and Disordered Communication Processes
- II. Study the Development, Deterioration, Regeneration, and Plasticity of Processes Mediating Communication
- III. Study Perceptual and Cognitive Processing in Normal and Disordered Communication
- IV. Develop and Improve Devices, Pharmacologic Agents, and Strategies for Habilitation and Rehabilitation of Human Communication Disorders

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