



# 28

## Vision and Hearing

---

Lead Agency: National Institutes of Health

### Contents

Goal .....	Page 28-3
Overview .....	Page 28-3
Vision .....	Page 28-3
Hearing .....	Page 28-7
Interim Progress Toward Year 2000 Objectives.....	Page 28-10
Healthy People 2010—Summary of Objectives .....	Page 28-11
Healthy People 2010 Objectives .....	Page 28-12
Vision .....	Page 28-12
Hearing .....	Page 28-14
Related Objectives From Other Focus Areas.....	Page 28-17
Terminology .....	Page 28-17
References .....	Page 28-19



## Goal

---

### **Improve the visual and hearing health of the Nation through prevention, early detection, treatment, and rehabilitation.**

## Overview

---

Among the five senses, people depend on vision and hearing to provide the primary cues for conducting the basic activities of daily life. At the most basic level, vision and hearing permit people to navigate and to stay oriented within their environment. These senses provide the portals for language, whether spoken, signed, or read. They are critical to most work and recreation and allow people to interact more fully. For these reasons, vision and hearing are defining elements of the quality of life. Either, or both, of these senses may be diminished or lost because of heredity, aging, injury, or disease. Such loss may occur gradually, over the course of a lifetime, or traumatically in an instant. Conditions of vision or hearing loss that are linked with chronic and disabling diseases pose additional challenges for patients and their families. From the public health perspective, the prevention of either the initial impairment or additional impairment from these environmentally orienting and socially connecting senses requires significant resources. Prevention of vision or hearing loss or their resulting disabling conditions through the development of improved disease prevention, detection, or treatment methods or more effective rehabilitative strategies must remain a priority.

## Vision

### **Issues and Trends**

Vision is an essential part of everyday life, depended on constantly by people at all ages. Vision affects development, learning, communicating, working, health, and quality of life. In the United States, an estimated 80 million people have potentially blinding eye diseases, 3 million have low vision, 1.1 million people are legally blind, and 200,000 are more severely visually impaired.<sup>1</sup>

In 1981, the economic impact of visual disorders and disabilities was approximately \$14.1 billion per year.<sup>2</sup> By 1995, this figure was estimated to have risen to more than \$38.4 billion—\$22.3 billion in direct costs and another \$16.1 billion in indirect costs each year.<sup>3</sup>

Estimates of the number of people in the United States with visual impairment vary with its definition. Legal blindness represents an artificial distinction and has little value for rehabilitation but is a significant policy issue, determining eligibility for certain disability benefits from the Federal Government. Because of their reliance on narrow definitions of visual impairment, many estimates of the number of people with low vision are understated. When low vision is more broadly defined as visual problems that hamper the

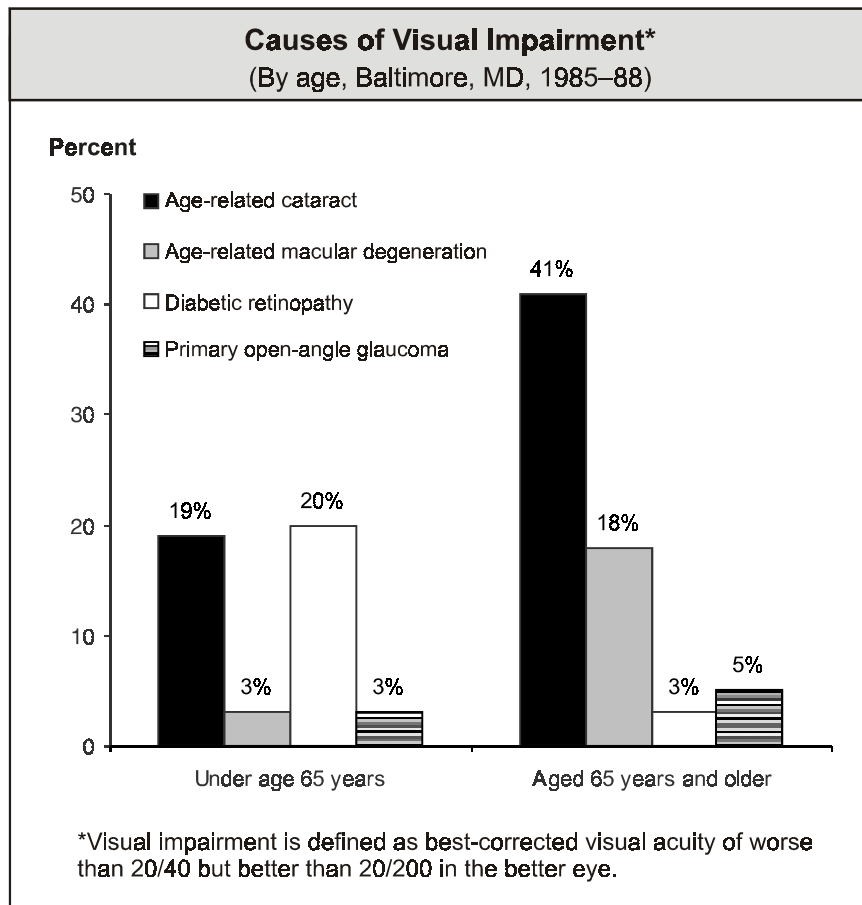
performance and enjoyment of everyday activities, almost 14 million persons are estimated to have low vision. Visual impairment is 1 of the 10 most frequent causes of disability in the United States.<sup>4</sup> In children, visual impairment is associated with developmental delays and the need for special educational, vocational, and social services, often into adulthood. In adults, visual impairment may result in loss of personal independence, decreased quality of life, and difficulty in maintaining employment. Impairment may lead to the need for disability payment, vocational and social services, and nursing home or assisted living placement.

The leading causes of visual impairment are diabetic retinopathy, cataract, glaucoma, and age-related macular degeneration (AMD). People with diabetes are at risk of developing diabetic retinopathy, a major cause of blindness. Because early diagnosis and timely treatment have been shown to prevent vision loss in more than 90 percent of patients, health care practice guidelines recommend an annual dilated eye examination for all people with diabetes.<sup>5,6</sup> Studies indicate, however, that many people with diabetes do not get an annual dilated eye examination. An estimated 50 percent of patients are diagnosed too late for treatment to be effective. People with diabetes also are more likely to have cataracts and glaucoma.

Glaucoma is a major public health problem in this country. The disease causes progressive optic nerve damage that, if left untreated, leads to blindness. An estimated 3 million people in the United States have the disease;<sup>7</sup> of these, as many as 120,000 are blind as a result.<sup>8</sup> Furthermore, glaucoma is the number one cause of blindness in African Americans. Treatments to slow the progression of the disease are available. However, at least half of the people who have glaucoma are not receiving treatment because they are unaware of their condition. Blindness from glaucoma is believed to impose significant costs annually on the Federal Government in Social Security benefits, lost tax revenues, and health care expenditures.

While important strides have been made in the prevention and treatment of eye disease, there is no cure for many causes of vision loss, particularly AMD. In addition to being a leading cause of blindness in the United States, AMD is a leading cause of low vision. People with low vision often cannot perform daily routine activities, such as reading the newspaper, preparing meals, or recognizing faces of friends. The inability to see well affects functional capabilities and social interactions and can lead to a loss of independence.

Myopia, or nearsightedness, is a common condition in which images of distant objects are focused in front of, instead of on, the retina. Myopia occurs in approximately 25 percent of the U.S. population.<sup>9</sup> In children, myopia is found in 2 percent of those entering first grade and 15 percent of those entering high school.<sup>10</sup>



**Source:** Rahmani, B.; Tielsch, J.; Katz, J.; et al. The cause-specific prevalence of visual impairments in an urban population: The Baltimore Eye Survey. *Ophthalmology* 103(11):1721–1725, November 1996.

Many infants and young children are at high risk for vision problems because of hereditary, prenatal, or perinatal factors. These individuals need to be identified and tested early and annually to make sure their eyes and visual system are functioning normally. Research in the 1980s and 1990s found that amblyopia, a leading cause of visual impairment in children, results from visual problems in very early life.<sup>11</sup> These problems can be prevented or reversed with early detection and appropriate intervention.

While nothing medically can be done for patients with low vision, their quality of life can be greatly improved. Many low vision services and devices are available to help patients maintain their independence. Generally, devices fall into two categories: visual and adaptive. Visual devices use lenses or combinations of lenses to provide magnification. They include such aids as magnifying spectacles, hand-held magnifiers, stand magnifiers, computer monitors with large type, and closed-circuit televisions. Adaptive devices include large-print reading materials (books, newspapers), check writing guides, and high-contrast watch dials. Also in this latter category are auditory aids, such as talking computers.

## **Disparities**

More than two-thirds of visually impaired adults are over age 65 years. Although no gender differences exist in the number of older adults with vision problems, more women are visually impaired than men are because, on average, women live longer than men do. By 1999, almost 34 million persons in the United States were expected to be over age 65 years; that number is expected to more than double by the year 2030.<sup>12</sup> As the population of older adults grows larger, the number of people with visual impairment and other aging-related disabilities is expected to increase.

African Americans are twice as likely to be visually impaired as are whites of comparable socioeconomic status.<sup>1</sup> Studies conducted in the United States and the West Indies have shown that primary open-angle glaucoma exists in a substantially higher proportion of Caribbean blacks and African Americans than in whites.<sup>7, 13, 14</sup>

Hispanics have three times the risk of developing type 2 diabetes as whites, and they also have a higher risk of complications.<sup>15</sup> Available data suggest that visual impairment may be an important public health problem in the Mexican-Hispanic population.<sup>16</sup> There also is a higher rate of myopia in Asian children.<sup>17</sup>

Many barriers still need to be overcome in reducing vision disorders. Among the major prevention strategies are educating health care professionals and the general population about the benefits of prevention, improving access to quality health care across socioeconomic classes to decrease disparities, and gaining cooperation of families in the screening and treatment of infants and children.

## **Opportunities**

Blindness and visual impairment from most eye diseases and disorders can be reduced with early detection and treatment. Most eye diseases, however, lack symptoms until vision is lost. Vision that is lost cannot be restored. Therefore, early intervention through regular vision exams needs to be emphasized. Health education programs directed at groups at higher risk for eye diseases and disorders are essential in preventing blindness and visual impairments. The incorporation of vision into health education programs can be beneficial to participants and to agencies seeking to provide quality care to their clients.

The prevention of blindness and visual impairment and the promotion of eye health often result in improved health status and reduced risk factors for illness, disability, and death from diseases and injuries across all age groups. Translation of scientific advances can help people who are blind and visually impaired maintain their quality of life and independence.

## Hearing

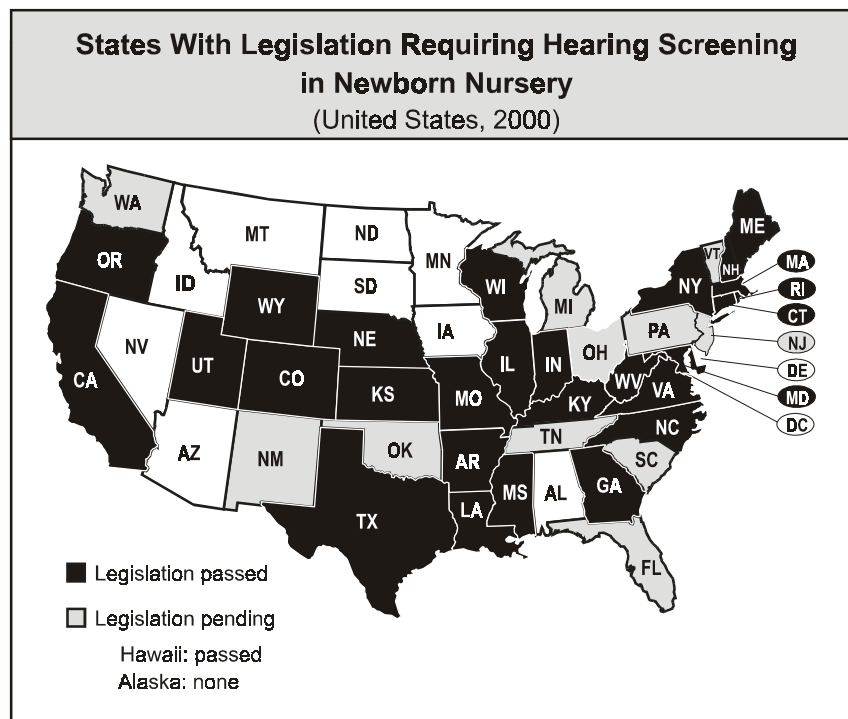
### Issues and Trends

An estimated 28 million people in the United States are deaf or hard of hearing.<sup>18</sup> Some 1,465,000 individuals aged 3 years or older are deaf in both ears.<sup>19</sup> Deafness or hearing impairment may be caused by genetic factors, noise or trauma, sensitivity to certain drugs or medications, and viral or bacterial infections.

Language is the set of rules that allow for the sharing of thoughts, ideas, and emotions. Speaking is one way that language can be expressed. Language also is expressed in writing or through sign language by some groups of individuals. In some cases, language can be expressed in additional ways by people who have neurological disorders. The most intensive period for development of language, either spoken or signed, is during the first 3 years of life. This is the period when the brain is developing and maturing. The skills associated with effective acquisition of language, either speech or sign, depend on exposure to, and manipulation of, these communication tools. Early identification of deafness or hearing loss is a critical factor in preventing or ameliorating language delay or disorder in children who are deaf or hard of hearing, allowing appropriate intervention or rehabilitation to begin while the developing brain is ready. Early identification and intervention have lifelong implications for the child's understanding and use of language.

The standard estimate of congenital hearing loss (1 in 1,000 live births) appears to underestimate actual congenital hearing loss as reported in data from States with universal newborn screening programs. Estimates based on emerging data place the number at 2 to 3 per 1,000 live births.<sup>20</sup> These data do not include children who are born with normal hearing but have late-onset or progressive hearing loss. Hearing loss often is sufficient to prevent the spontaneous development of spoken language.<sup>21, 22, 23, 24</sup> More than 50 percent of childhood hearing impairments are believed to be of genetic origin.<sup>25</sup> Earliest possible identification of infant hearing loss has been endorsed widely as critical for the developing child. Minimal hearing loss also is an important factor in school success and psychosocial development.<sup>26</sup>

Estimates for the average age of diagnosis of hearing loss in infants and children range from 14 months<sup>27</sup> to around 3 years.<sup>28</sup> This delay of diagnosis is significant in terms of time lost for rehabilitation and time lost during unique opportunities provided by brain development in the infant and young child for language acquisition, spoken or signed. Nearly 15 percent of children have a low-frequency or high-frequency hearing loss.<sup>29</sup> Strategies for intervention or rehabilitation depend on the kind of hearing loss, age of onset, services available, and family preferences. Strategies include hearing aids, augmentative and assistive devices, oral-auditory instruction, sign language instruction, interpreter services, cued speech, cochlear implant, or combinations of these devices and strategies.



**Source:** American Speech-Language-Hearing Association.  
[http://www.asha.org/infant\\_hearing/overview.htm](http://www.asha.org/infant_hearing/overview.htm) May 19, 2000.

More than 300 inherited syndromes involve hearing impairment.<sup>30, 31</sup> Hereditary hearing loss can be either syndromic (accompanied by other characteristics, such as visual impairment) or nonsyndromic (where hearing loss is the only identifiable characteristic). Not all hereditary hearing loss is present at birth. Some hereditary hearing loss may be progressive or may appear later in childhood or adulthood as late-onset hearing impairment or deafness. One cause of late-onset hearing loss is otosclerosis. Otosclerosis, an abnormal growth of bone in the middle ear, results in gradual loss of hearing and affects 1 out of 100 adults in the U.S. population. Another form of hearing loss is Meniere's disease,<sup>32</sup> which causes bilateral, often fluctuating, hearing loss in 20 to 40 percent of cases, usually in conjunction with balance disorder and tinnitus.

Otitis media, or middle ear infection, accounts for 24.5 million visits to doctors' offices<sup>33</sup> and is the most frequent reason cited for taking children to the emergency department.<sup>34</sup> Health care costs for otitis media in the United States have been reported to be \$3 billion to \$5 billion per year.<sup>35</sup> Otitis media often occurs in repeated bouts, causing periods of hearing loss that can affect children during the critical time for language and speech acquisition and hamper children in a variety of learning environments.

Approximately 10 million persons in the United States have permanent, irreversible hearing loss from noise or trauma.<sup>36</sup> Additionally, 30 million people are estimated to be exposed to injurious levels of noise each day. Noise-induced hearing loss (NIHL) is the most common occupational disease and the second most self-reported occupational illness or injury.<sup>37</sup> In industry-specific studies, 44 percent of carpenters and 48 percent of



plumbers reported they had a perceived hearing loss.<sup>38</sup> Ninety percent of coal miners are estimated to have a hearing impairment by age 52 years,<sup>39</sup> and 70 percent of male metal and nonmetal miners will experience a hearing impairment by age 60 years.<sup>40</sup> (See Focus Area 20. Occupational Safety and Health.)

Data indicate that people are losing hearing earlier in life and that men are more frequently affected in the 35- to 60-year-old age group.<sup>41</sup> Noise-induced hearing loss can be the result of a traumatic, sudden level of impulse noise, such as an explosion, that can leave an individual immediately and permanently deafened; the result of continuing exposure to high levels of sound in the workplace or in recreational settings; the consequence of years of exposure causing subtle, progressive damage; or exacerbated due to individual vulnerability to noise. Noise-induced hearing loss is related to noise level, proximity to the harmful sound, time of exposure, and individual susceptibility. Many of these causes can be controlled by prevention. Prevention of noise-induced hearing loss is necessary for people both on and off the job.

## **Disparities**

The work environment of the 21st century will require intense use of communication and information skills and technologies. The individual who has a communication disability, disorder, or difference will be at a disadvantage.

Data show that students with disabilities, including hearing impairment and deafness, are disproportionately disadvantaged.<sup>42</sup> The average reading level for deaf persons aged 18 years is estimated at the fourth grade.<sup>43</sup> Early intervention for language acquisition, spoken or signed, can improve later ability to use language. Hearing impairments also are a major barrier to health care access and information.<sup>44, 45</sup> (See Focus Area 6. Disability and Secondary Conditions.)

Older people also are a major concern in terms of hearing health disparity. Presbycusis, the loss of hearing associated with aging, affects about 30 percent of adults who are aged 65 years and older.<sup>46</sup> About half of the population over age 75 years has a significant hearing loss.<sup>47</sup> As the population ages and lives longer, these numbers are increasing. Only about one-fourth of those who could benefit from a hearing aid actually use one.<sup>48</sup> More than 8 percent of the population aged 70 years and older report both hearing and vision impairment.<sup>49</sup> With the exception of increased hearing loss in men, there are no currently available data on these disparities.

## **Opportunities**

Two activities have yielded opportunity for early identification and intervention for infants who are born deaf or with hearing impairments. As of 1999, 20 States had laws requiring hearing screening in the newborn nursery. Early identification allows for language acquisition, either spoken or signed, during the critical time period when the child is developing communication skills. Research in the field of molecular genetics has identified genes that contribute to hereditary hearing impairment. The potential exists for early identification and intervention for hearing impairment. Identifying individuals who

may experience late-onset or progressive hearing loss provides time to make the appropriate treatment or rehabilitation options available.

Public education can promote hearing health and behavior to reduce noise-induced hearing loss, which is a fully preventable condition. An education effort, WISE EARS!,<sup>50</sup> has been launched by a coalition of government agencies headed by the National Institute on Deafness and Other Communication Disorders at the National Institutes of Health and the National Institute on Occupational Safety and Health at the Centers for Disease Control and Prevention. 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.

A further opportunity exists with noise-induced hearing loss prevention. Tinnitus, a ringing, buzzing, or roaring in the ears, is a symptom that accompanies many forms of hearing loss and can be debilitating. Data indicate that tinnitus affects almost 15 percent of adults aged 45 years and older.<sup>51</sup> Because tinnitus often is associated with preventable noise-induced hearing loss, hearing protection is key to reducing one important cause of tinnitus.

Assistive technologies are providing additional strategies for individuals with disabilities. For individuals who are deaf or hard of hearing, improved technologies will facilitate their ability to have an equal opportunity in the workplace and in society. (See Focus Area 6. Disability and Secondary Conditions.)

Early identification for improved intervention strategies, prevention of noise-induced hearing loss through health education, and the development of innovations in assistive technology could improve significantly the hearing health of the Nation.

## **Interim Progress Toward Year 2000 Objectives**

---

Three Healthy People 2000 objectives addressed vision and hearing. Two of these objectives, to reduce the number of cases of significant hearing impairment and to reduce the number of cases of significant visual impairment, have shown progress toward the targets. One objective, early detection of significant hearing impairment, shows no change from baseline.

Note: Unless otherwise noted, data are from the Centers for Disease Control and Prevention, National Center for Health Statistics, *Healthy People 2000 Review, 1998–99*.

## Healthy People 2010—Summary of Objectives

---

### Vision and Hearing

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

<b>Number</b>	<b>Objective</b>	<b>Short Title</b>
---------------	------------------	--------------------

<b>Vision</b>		
---------------	--	--

28-1	Dilated eye examinations	
28-2	Vision screening for children	
28-3	Impairment due to refractive errors	
28-4	Impairment in children and adolescents	
28-5	Impairment due to diabetic retinopathy	
28-6	Impairment due to glaucoma	
28-7	Impairment due to cataract	
28-8	Occupational eye injury	
28-9	Protective eyewear	
28-10	Vision rehabilitation services and devices	

<b>Hearing</b>		
----------------	--	--

28-11	Newborn hearing screening, evaluation, and intervention	
28-12	Otitis media	
28-13	Rehabilitation for hearing impairment	
28-14	Hearing examination	
28-15	Evaluation and treatment referrals	
28-16	Hearing protection	
28-17	Noise-induced hearing loss in children	
28-18	Noise-induced hearing loss in adults	

## Healthy People 2010 Objectives

---

### Vision

**28-1. (Developmental) Increase the proportion of persons who have a dilated eye examination at appropriate intervals.**

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

Many eye diseases and disorders have no symptoms or early warning signs. Dilated eye examinations should be performed at appropriate intervals to detect changes in the retina or optic nerve or both. Eye care professionals can view the back of the eye for subtle changes and, if necessary, initiate treatment at the right time.

**28-2. (Developmental) Increase the proportion of preschool children aged 5 years and under who receive vision screening.**

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

Many vision problems begin well before children reach school. Every effort must be made to ensure that, before they reach age 5 years, children receive a screening examination from their health care provider. Early recognition of disease results in more effective treatment that can be sight-saving or even life-saving.

**28-3. (Developmental) Reduce uncorrected visual impairment due to refractive errors.**

**Potential data source:** National Health and Nutrition Examination Survey (NHANES), CDC, NCHS.

**28-4. Reduce blindness and visual impairment in children and adolescents aged 17 years and under.**

**Target:** 20 per 1,000 children and adolescents aged 17 years and under.

**Baseline:** 25 per 1,000 children and adolescents aged 17 years and under were blind or visually impaired in 1997.

**Target setting method:** Better than the best.

**Data source:** National Health Interview Survey (NHIS), CDC, NCHS.

Children and Adolescents Aged 17 Years and Under, 1997	Blindness and Visual Impairment
	Rate per 1,000
<b>TOTAL</b>	25
<b>Race and ethnicity</b>	
American Indian or Alaska Native	DSU
Asian or Pacific Islander	DSU
Asian	DSU
Native Hawaiian or other Pacific Islander	DSU
Black or African American	27
White	24
Hispanic or Latino	23
Not Hispanic or Latino	25
Black or African American	27
White	25
<b>Gender</b>	
Female	24
Male	26
<b>Family income level</b>	
Poor	39
Near poor	30
Middle/high income	20
<b>Disability status</b>	
Persons with disabilities	92
Persons without disabilities	19

DNA = Data have not been analyzed. DNC = Data are not collected. DSU = Data are statistically unreliable.

**28-5. (Developmental) Reduce visual impairment due to diabetic retinopathy.**

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

**28-6. (Developmental) Reduce visual impairment due to glaucoma.**

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

**28-7. (Developmental) Reduce visual impairment due to cataract.**

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

**28-8. (Developmental) Reduce occupational eye injury.**

**Potential data sources:** Annual Survey of Occupational Injuries and Illnesses (ASOII), U.S. Department of Labor, Bureau of Labor Statistics; National Electronic Injury Surveillance System (NEISS), CPSC, and NIOSH.

**28-9. (Developmental) Increase the use of appropriate personal protective eyewear in recreational activities and hazardous situations around the home.**

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

Almost all eye injuries can be prevented. Many sports and recreation activities, including baseball, basketball, tennis, racquetball, and hockey, carry some risk of eye injury. Some injuries may go unnoticed because only one eye is involved. Activities at home, such as cooking and yard work, also may present eye injury risk.

**28-10. (Developmental) Increase vision rehabilitation.**

**28-10a.** Increase the use of rehabilitation services by persons with visual impairments.

**28-10b.** Increase the use of visual and adaptive devices by persons with visual impairments.

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

## Hearing

**28-11. (Developmental) Increase the proportion of newborns who are screened for hearing loss by age 1 month, have audiologic evaluation by age 3 months, and are enrolled in appropriate intervention services by age 6 months.**

**Potential data sources:** State-based Early Hearing Detection and Intervention (EHDI) Program Network, CDC and/or specific State data.

**28-12. Reduce otitis media in children and adolescents.**

**Target:** 294 visits per 1,000 children and adolescents under age 18 years.

**Baseline:** 344.7 visits per 1,000 children and adolescents under age 18 years were for otitis media in 1997.

**Target setting method:** Better than the best.

**Data sources:** National Ambulatory Medical Care Survey (NAMCS), CDC, NCHS; National Hospital Ambulatory Medical Care Survey (NHAMCS), CDC, NCHS.

<b>Children and Adolescents Under Age 18 Years, 1997</b>	<b>Visits for Otitis Media</b>
	Rate per 1,000
<b>TOTAL</b>	344.7
<b>Race and ethnicity</b>	
American Indian or Alaska Native	DSU
Asian or Pacific Islander	DSU
Asian	DNC
Native Hawaiian or other Pacific Islander	DNC
Black or African American	294.9
White	369.1
<b>Hispanic or Latino</b>	
Hispanic or Latino	DSU
Not Hispanic or Latino	DSU
<b>Gender</b>	
Female	321.8
Male	366.5
<b>Age</b>	
Under 3 years	1,160.4
3 to 5 years	456.6
6 to 17 years	113.8
<b>Family income level</b>	
Poor	DNC
Near poor	DNC
Middle/high income	DNC
<b>Disability status</b>	
Persons with activity limitations	DNC
Persons without activity limitations	DNC

DNA = Data have not been analyzed. DNC = Data are not collected. DSU = Data are statistically unreliable.

**28-13. (Developmental) Increase access by persons who have hearing impairments to hearing rehabilitation services and adaptive devices, including hearing aids, cochlear implants, or tactile or other assistive or augmentative devices.**

**Potential data sources:** National Health Interview Survey (NHIS), CDC, NCHS; National Health and Nutrition Examination Survey (NHANES), CDC, NCHS.

**28-14. (Developmental) Increase the proportion of persons who have had a hearing examination on schedule.**

**Potential data sources:** National Health Interview Survey (NHIS), CDC, NCHS; National Health and Nutrition Examination Survey (NHANES), CDC, NCHS.

Audiologic screening serves both primary and secondary prevention purposes, resulting in prevention and amelioration of the effects of hearing loss using developmentally appropriate assessment and treatment. Differing milestones and screening strategies are needed for pediatric populations depending upon their status for impairment screening, disorder screening, or disability screening and their age from birth through 18 years. In the adult population, both impairment and disability screening should occur every decade after age 18 years until age 50 years with more frequent monitoring after age 50 years.<sup>52</sup>

**28-15. (Developmental) Increase the number of persons who are referred by their primary care physician for hearing evaluation and treatment.**

**Potential data sources:** National Ambulatory Medical Care Survey (NAMCS), CDC, NCHS; National Health Interview Survey (NHIS), CDC, NCHS.

**28-16. (Developmental) Increase the use of appropriate ear protection devices, equipment, and practices.**

**Potential data source:** National Health Interview Survey (NHIS), CDC, NCHS.

Noise-induced hearing loss (NIHL) can be caused by one-time exposure to an impulse noise, such as gunfire or an explosion, or by repeated exposure to sounds at various levels over an extended period of time from sources such as combustion engines, electric motors, or woodworking equipment. The effects of NIHL may be immediate hearing loss that is permanent—resulting from an impulse sound that severely damages the structures of the inner ear—and may be accompanied by tinnitus. Tinnitus is a ringing, buzzing, or roaring in the ears or head. Hearing loss and tinnitus may be experienced in one or both ears. Tinnitus may continue constantly or intermittently throughout a lifetime. The damage that occurs slowly over years of continuous exposure to loud noise is accompanied by various changes in the structure of the hair cells. It also results in hearing loss and tinnitus. Both forms of hearing loss can be prevented. For the worker, hearing conservation involves engineering controls, noise monitoring and measuring, employee



notification, audiometric testing and evaluation, health education, and followup that includes hearing protection and fitting and/or audiologic/otologic evaluation.<sup>53, 54</sup> For the public, knowledge of potentially dangerous noise, fitting and use of hearing protection, careful product selection, and audiologic/otologic evaluation are all significant factors in prevention of NIHL.

**28-17. (Developmental) Reduce noise-induced hearing loss in children and adolescents aged 17 years and under.**

**Potential data source:** National Health and Nutrition Examination Survey (NHANES), CDC, NCHS.

**28-18. (Developmental) Reduce adult hearing loss in the noise-exposed public.**

**Potential data sources:** National Health Interview Survey (NHIS), CDC, NCHS; National Health and Nutrition Examination Survey (NHANES), CDC, NCHS.

---

## Related Objectives From Other Focus Areas

- 5. **Diabetes**
  - 5-13. Annual dilated eye examinations
- 6. **Disability and Secondary Conditions**
  - 6-11. Assistive devices and technology
- 20. **Occupational Safety and Health**
  - 20-11. Work-related, noise-induced hearing loss

---

## Terminology

(A listing of abbreviations and acronyms used in this publication appears in Appendix H.)

**Age-related macular degeneration (AMD):** Deterioration of the macula that results in a loss of sharp central vision.

**Amblyopia:** Developmental abnormality of the central nervous system that causes impaired vision in one or both eyes.

**Assistive devices:** Technical tools and devices used to aid individuals who have communication disorders in performing actions, tasks, and activities. Examples of assistive devices include alphabet boards, text telephones (TT/TTY/TDD), and text-to-speech conversion software. (See Focus Area 6. Disability and Secondary Conditions.)

**Audiologic evaluation:** Tests and procedures that measure the ability to hear. Identifies type and degree of hearing loss. Included are tests of conduction, speech perception and speech discrimination, and case history; can include a central test battery. Evaluation can include recommendations about appropriate assistive devices.

**Augmentive devices:** Tools that help individuals with limited or absent speech to communicate, such as communication boards, pictographs (symbols that look like the things they represent), and ideographs (symbols representing ideas).

**Cataract:** Cloudiness of the lens that may prevent a clear image from forming on the retina.

**Cochlear implant:** Medical device that bypasses damaged structures in the inner ear and directly stimulates the auditory nerve, allowing some deaf individuals to hear and to maintain or develop speech and language.

**Cued speech:** Method of communication that combines speech reading with a system of handshapes placed near the mouth to help deaf or hard-of-hearing individuals differentiate words that look similar on the lips (for example, “bunch” versus “punch”) or understand words when the lips do not move (for example, “kick”).

**Diabetic retinopathy:** Complication of diabetes that damages the retina.

**Dilate:** Process by which the pupil is temporarily enlarged with special eyedrops, allowing the eyecare specialist to view the fundus better.

**Ear infection:** See *Otitis media*.

**Fundus:** Interior posterior lining of the eye that includes the retina, optic nerve, and macula.

**Hearing aid:** Electronic device that brings amplified sound to the ear. A hearing aid usually consists of a microphone, amplifier, and receiver.

**Hereditary hearing loss:** Hearing loss passed down through generations of a family—that is, with a genetic basis.

**Legal blindness:** Determines eligibility for benefits from the Federal Government; however, it has little or no value for rehabilitation purposes.

**Low vision (limited vision):** A visual impairment, not correctable by standard eyeglasses or contact lenses, medication, or surgery, that interferes with an individual’s ability to perform activities of daily living.

**Meniere’s disease:** Inner ear disorder that can affect both hearing and balance and can cause episodes of vertigo, hearing loss, tinnitus, and the sensation of fullness in the ear.

**Myopia:** Nearsightedness, or the ability to see close objects more clearly than distant objects. Myopia may be compensated for with glasses or contact lenses.

**Noise-induced hearing loss:** Hearing loss that is caused by either a one-time exposure to very loud sound(s) or by repeated exposure to sounds at various loudness levels over an extended period of time. Hearing loss may be temporary or permanent.

**Nonsyndromic hereditary hearing loss:** Hearing loss or deafness that is inherited and is not associated with other inherited features.

**Open angle glaucoma:** Disease characterized by increased intraocular pressure that damages the optic nerve.

**Optic nerve:** Bundle of over 1 million nerve fibers that carry visual messages from the retina to the brain.

**Oral-auditory instruction:** Techniques used with persons who have hearing loss to improve their ability to speak—for example, speechreading, communication management, language and auditory skill development, and counseling.

**Otitis media:** Commonly called ear infection; an inflammation of the middle ear caused by viral or bacterial infection.

**Otosclerosis:** An abnormal growth of bone in the middle ear that results in gradual loss of hearing and affects 1 out of 100 adults in the U.S. population.

**Presbycusis:** Loss of hearing that gradually occurs because of inner or middle ear changes in some individuals as they grow older.

**Rehabilitation:** As used in this focus area, addresses the needs in daily living skills that are directly related to vision or hearing loss.

**Retina:** Light-sensitive layer of tissue that lines the back of the eyeball. The retina sends visual impulses through the optic nerve to the brain.

**Sign language:** Hand movements, gestures, and facial expressions that convey grammatical structure and meaning.

**Syndromic hereditary hearing loss:** Hearing loss or deafness that is inherited or passed down through generations of a family along with other features.

**Tactile devices:** Mechanical instruments that make use of touch to help individuals to communicate who have certain disabilities, such as deafness and blindness.

**Tinnitus:** Sensation of a ringing, roaring, or buzzing sound in the ears or head. Tinnitus is often associated with various forms of hearing impairment.

**Visual aid:** Optical and nonoptical devices that help people with low vision make use of their remaining sight.

**Visual field:** Entire area that can be seen when the eye is looking forward, including peripheral vision.

## References

---

- <sup>1</sup> Teilsch, J.M.; Sommer, A.; Will, K.; et al. Blindness and visual impairment in an American urban population. The Baltimore Eye Survey. *Archives of Ophthalmology* 108:286-290, 1990.
- <sup>2</sup> Hu, T. *Economic Costs of Visual Disorders and Disabilities, Special Report to the National Eye Institute (NEI), National Institutes of Health (NIH), United States*. 1981.
- <sup>3</sup> Ellwein, L. Personal communication. Bethesda, MD: NIH, NEI, 1998.
- <sup>4</sup> Verbrugge, L.M., and Patrick, D.L. Seven chronic conditions: Their impact on U.S. adults' activity levels and use of medical services. *American Journal of Public Health* 85:173-182, 1995.
- <sup>5</sup> Ferris, I. The Early Treatment Diabetic Retinopathy Study Research Group. How Effective are Treatments for Diabetic Retinopathy? *Journal of the American Medical Association* 269(10):1290-1291, 1993.
- <sup>6</sup> American Diabetes Association. Clinical practice recommendations 1999. *Diabetes Care* 22(Suppl. 1):S70-S73.
- <sup>7</sup> Rahmani, B.; Tielsch, J.; Katz, J.; et al. The cause-specific prevalence of visual impairment in an urban population, the Baltimore Eye Survey. *Ophthalmology* 103(11):1721-1726, 1996.
- <sup>8</sup> Kahn, H.A., and Moorhead, H.B. *Statistics on Blindness in the Model Reporting Area, 1969-70*. Pub. No. (NIH) 73-427. Washington, DC: U.S. Department of Health, Education, and Welfare, Public Health Service, 1973, 120-143.
- <sup>9</sup> Sperduto, R.D.; Siegel, D.; Roberts, J.; et al. Prevalence of myopia in the United States. *Archives of Ophthalmology* 101(3):405-407, 1983.
- <sup>10</sup> Zadnik, K. The Glenn A. Fry Award lecture 1995. Myopia development in childhood. *Optometry and Vision Science* 74(8):603-608, 1997.

- <sup>11</sup> Levi, D.M., and Carkeet, A.C. Amblyopia: A consequence of abnormal visual development. In Simons, K., ed. *Early Visual Development—Normal and Abnormal*. New York: Oxford University Press, 1993, 391-408.
- <sup>12</sup> U.S. Bureau of the Census. Population Projections. <http://www.census.gov/population/www/projections/projections/popproj.html>>November 24, 1999.
- <sup>13</sup> Klein, B.E.K.; Klein, R.; Sponsel, W.; et al. Prevalence of glaucoma, the Beaver Dam Eye Study Group. *Ophthalmology* 99(10):1499-1504, 1992.
- <sup>14</sup> Leske, M.C.; Connell, A.M.; Wu, S.Y.; et al. Distribution of intraocular pressure, the Barbados Eye Study Group. *Archives of Ophthalmology* 115(8):1051-1057, 1997.
- <sup>15</sup> National Institute of Diabetes and Digestive and Kidney Diseases. *Diabetes in America*. 2nd ed. Washington, DC: U.S. Department of Health and Human Services (HHS), NIH, 1995.
- <sup>16</sup> Novella, A.C.; Wise, P.H.; and Kleinman, D.V. Hispanic Health. Time for data, time for action. *Journal of the American Medical Association* 265(2):253-255, 1991.
- <sup>17</sup> Voo, I.; Lee, D.; and Oelrich, F. Prevalences of ocular conditions among Hispanic, white, Asian and Black immigrant students examined by the UCLA Mobile Eye Clinic. *Journal of the American Optometric Association* 69(4):255-261, 1998.
- <sup>18</sup> National Institute on Deafness and Other Communication Disorders (NIDCD). *National Strategic Research Plan: Hearing and Hearing Impairment*. Bethesda, MD: HHS, NIH, 1996.
- <sup>19</sup> Collins, J.G. Prevalence of selected chronic conditions: United States 1990–1992. National Center for Health Statistics. *Vital and Health Statistics* 10(194):1-89, 1997.
- <sup>20</sup> Reports of prevalence from State programs. [Texas, 3.14 per 1,000] Albright, K., and O’Neal, J. The Newborn With Hearing Loss: Detection in the Nursery. *Pediatrics* (102):142-146, 1998; [Hawaii, 1.4 per 1,000] Mason, J.A., and Herrmann, K.R. Universal Infant Hearing Screening By Automated Auditory Brainstem Response Measurement. *Pediatrics* (101):221-228, 1998; [New Jersey, 2.9 per 1,000] Barsky-Firsker, L., and Sun, S. Universal Newborn Hearing Screenings: A Three-Year Experience. *Pediatrics* 99(6):E4, 1997; [Colorado, 2.56 per 1,000] NCHAM *Sound Ideas* (2):3, 1998.
- <sup>21</sup> Yoshinaga-Itano, C., and Apuzzo, M.L. Identification of hearing loss after 18 months is not early enough. *American Annals of the Deaf* 143(5):380-387, 1998.
- <sup>22</sup> Joint Committee on Infant Hearing Screening. 1994 Position Statement. *American Speech-Language-Hearing Association* 36(12):38-41, 1994.
- <sup>23</sup> Yoshinaga-Itano, C.; Sedy, A.; Coulter, D.; et al. Language of early and later-identified children with hearing loss. *Pediatrics* 102(5):1161-1171, 1998.
- <sup>24</sup> NIDCD. Recommendations of the NIDCD Working Group on Early Identification Hearing Impairment on Acceptable Protocols for Use in State-Wide Universal Newborn Hearing Screening Programs, 1997. <[www.nih.gov/nidcd/news/97/recomnd.htm](http://www.nih.gov/nidcd/news/97/recomnd.htm)>June 27, 2000.
- <sup>25</sup> Morton, N.E. Genetic epidemiology of hearing impairment. *Annals of the New York Academy of Science* 630:16-31, 1991.
- <sup>26</sup> Bess, F.H.; Dodd-Murphy, J.; and Parker, R.A. Children with minimal sensorineural hearing loss: Prevalence, educational performance and functional status. *Ear and Hearing* (19)5:339-354, 1998.

- <sup>27</sup> American Academy of Pediatrics. Newborn and infant hearing loss: detection and intervention. *Pediatrics* 103(2):527-530, 1999.
- <sup>28</sup> NIDCD. Recommendations of the NIDCD Working Group on Early Identification of Hearing Impairment on Acceptable Protocols for Use in State-Wide Universal Newborn Hearing Screening Programs (1997). <<http://www.nih.gov/recomnd.htm>>.
- <sup>29</sup> Niskar, A.S.; Kieszak, S.M.; Holmes, A.; et al. Prevalence of hearing loss among children 6 to 19 years of age—the Third National Health and Nutrition Examination Survey. *Journal of the American Medical Association* 279(14):1071-1075, 1998.
- <sup>30</sup> Gorlin, R.J.; Toriello, H.V.; and Cohen, M.M. *Hereditary Hearing Loss and Its Syndromes*. New York, NY: Oxford University Press, 1995.
- <sup>31</sup> Van Camp, G., and Smith, R.J.H. Hereditary Hearing Loss Homepage <<http://dnalab0www.uia.ac.be/dnalab/hhh>> and Morton, N.E. Genetic epidemiology of hearing impairment. *Annals of New York Academy of Science* 630:16-31, 1991.
- <sup>32</sup> NIDCD. *Because You Asked About Meniere's Disease*. Washington, DC: HHS, 1-7.
- <sup>33</sup> Schappert, S.M. Office visits for otitis media: United States, 1975–90. *Advance Data* 13(137):17, 1992.
- <sup>34</sup> Freid, V.M.; Makuc, D.M.; and Rooks, R.N. Ambulatory health care visits by children: Principal diagnosis and place of visit. *Vital and Health Statistics* 13(137):17, 1-23, 1998.
- <sup>35</sup> Alsarraf, R.; Jung, C.J.; Perkins, J.; et al. Otitis media health status evaluation: A pilot study for the investigation of cost-effective outcomes of recurrent acute otitis media treatment. *Annals of Otolaryngology, Rhinology and Laryngology* 107(2):120-128, 1998.
- <sup>36</sup> NIDCD. *Fact Sheet on Noise-Induced Hearing Loss*. Washington, DC: HHS, 1998.
- <sup>37</sup> National Institute for Occupational Safety and Health (NIOSH). *Fact Sheet: Work-Related Hearing Loss*. Washington, DC: HHS, 1999.
- <sup>38</sup> Lusk, S.L.; Kerr, M.J.; and Kauffman, S.A. Use of hearing protection and perceptions of noise exposure and hearing loss among construction workers. *American Industrial Hygiene Association Journal* 59:566-570, 1998.
- <sup>39</sup> Franks, J.R. *Analysis of Audiograms for a Large Cohort of Noise-Exposed Miners*. Cincinnati, OH: HHS, Centers for Disease Control and Prevention, NIOSH, Division of Biomedical and Behavioral Science, 1996.
- <sup>40</sup> Mine Safety and Health Administration. Health Standards for Occupational Noise Exposure in Coal, Metal, and Nonmetal Mines: Proposed Rule. *Federal Register* 61:243:66347-66397, December 17, 1996.
- <sup>41</sup> Wallhagen, M.I.; Strawbridge, W.J.; Cohen, R.D.; et al. An Increasing prevalence of hearing impairment and associated risk factors over three decades of the Alameda County Study. *American Journal of Public Health* 87(3):440-442, 1997.
- <sup>42</sup> HHS, NIDCD. *Economic and Social Realities of Communication Difference and Disorder*. Bethesda, MD: NIH, 1998.
- <sup>43</sup> Kelly, L.P. Using silent motion pictures to teach complex syntax to adult deaf readers. *Journal of Deaf Studies and Deaf Education* 3(3):217-230, 1998.

- <sup>44</sup> Steinburg, A.G. Issues in providing mental health services to hearing-impaired persons. *Hospital & Community Psychiatry* 42(4):380-389, 1991.
- <sup>45</sup> Steinburg, A.G.; Sullivan, V.J.; and Montoya, L.A. Lipreading the stirrups: An investigation of deaf women's perspectives of their health, health care, and providers. Paper presented at National Health Service Corps 25th Anniversary Meeting in Washington, DC, in 1998.
- <sup>46</sup> Gates, G.A.; Cooper, Jr., J.C.; Kannel, W.B.; et al. Hearing in the elderly: The Framingham Cohort, 1983–1985. Part I. Basic audiometric test results. *Ear and Hearing* 11(4):247-256, 1990.
- <sup>47</sup> Cruickshanks, K.J.; Wiley, T.L.; Tweed, T.S.; et al. Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin: The Epidemiology of Hearing Loss Study. *American Journal of Epidemiology* 148(9):879-886, 1998.
- <sup>48</sup> Popelka, M.M.; Cruickshanks, K.J.; Wiley, T.L.; et al. Low prevalence of hearing aid use among older adults with hearing loss: The Epidemiology of Hearing Loss Study. *Journal of the American Geriatrics Society* 46(9):1075-1078, 1998.
- <sup>49</sup> Klein, R.; Cruickshanks, K.F.; Klein, B.E.K.; et al. Is age-related maculopathy related to hearing loss? *Archives of Ophthalmology* 116(3):360-365, 1998.
- <sup>50</sup> NIDCD. WISE EARS! (For full listing of coalition members:)<<http://www.nih.gov/nidcd/health/wise>>December 15, 1999.
- <sup>51</sup> Ries, P.W. Prevalence and characteristics of persons with hearing trouble, United States, 1990–91. *Vital and Health Statistics* 10(188), 1994.
- <sup>52</sup> American Speech-Language-Hearing Association. *Guidelines for Audiologic Screening*. Rockville, MD: the Association, 1997.
- <sup>53</sup> Lusk, S.L.; Kerr, J.J.; Ronis, R.L.; et al. Applying the Health Promotion Model to development of a worksite intervention. *American Journal of Health Promotion* 13(4):219-227, 1999.
- <sup>54</sup> Lusk, S.L.; Hogan, M.M.; and Ronis, D.L. Test of the Health Promotion Model as a causal model of construction workers' use of hearing protection. *Research in Nursing & Health* 20(3):183-194, 1997.