

Hearing Aids



A hearing aid is a small electronic device worn in or behind the ear that amplifies sounds to someone with hearing loss. Hearing aid technology has improved significantly over the years and today's hearing aids are vastly more sophisticated than 20 years ago. Nevertheless, only 20 percent of people who could benefit from hearing aids actually use them. NIH-supported researchers are seeking ways to advance hearing aid technology and to develop new hearing aid fitting strategies and auditory rehabilitation programs to help improve the communication experience and quality of life for millions of Americans who have hearing loss.

Yesterday

- Although hearing devices have been used for centuries, the first electronic hearing aid was developed in the early 1950s. These devices became smaller and more sophisticated over time.
- In the 1970s, directional microphones were incorporated into hearing aids to help a wearer focus on one-to-one conversations in noisy environments. However, early models proved to be of limited benefit, and many manufacturers discontinued their use until the 1990s, when the technology began to improve.
- In 1992, the NIH and Department of Veterans Affairs (VA) began an innovative collaboration to support the development of more advanced hearing aids. Initiatives included grant funding to determine how hearing aids affect speech understanding in noisy and quiet environments as well as how to measure and predict the benefits of hearing aids. In addition, the NIH and VA awarded a contract to support the design and evaluation of creative new technologies and strategies for hearing aids.
- In 1995, the NIH, VA, and National Aeronautics and Space Administration (NASA) joined forces to survey all federal laboratories for acoustic or electronic technology that might be applicable to the improvement of hearing aids. This multi-agency initiative resulted in productive partnerships between

neuroscientists, clinicians, engineers, federal laboratories, and industry.

- The first completely digital hearing aids became available commercially in the mid-1990s. Digital aids can be programmed to amplify some frequencies more than others and can be adjusted to the wearer's needs and to certain listening environments. They also can be programmed to focus on sounds coming from a specific direction.
- In 1996, NIH and the VA initiated the Hearing Aid Clinical Trial, the first large-scale double-blind, multicenter clinical trial to demonstrate the efficacy of three types of analog hearing aids in both quiet and noisy environments for a wide range of individuals with hearing loss. The study showed that all three types provide substantial improvement for people both in quiet and noise.

Today

- An estimated 17 percent of American adults report having some form of hearing loss. Nearly half of adults ages 75 years and older have hearing loss.
- A vast array of hearing aid technologies is currently available, from simple and relatively inexpensive analog circuits to complex and expensive digital devices that require sophisticated fitting procedures. The average price of a digital hearing aid is about \$1500, with top-of-the-line devices costing \$3000-\$5000.
- Over the past two decades, the NIH and VA have cosponsored a biennial conference to facilitate the flow of information among researchers on recent findings and advances in hearing aid technology. The current series, titled the International Hearing Aid Research Conference (IHCON) (<http://www.hei.org/ihcon/index.html>), is a meeting of national and international importance in fields related to hearing aid research and development.
- Scientists continue to search for ways to improve a hearing aid wearer's ability to understand speech in a noisy background, such as a crowded room.

- A partnership supported by NIH and NASA, emerging from the 1995 survey of federal agencies, could potentially revolutionize the technology used for directional microphones. The new technology is based on the ears of a parasitic fly, *Ormia ochracea*. Despite their small size and the short distance between them, *Ormia's* ears are able to rapidly pinpoint the location from which the sound of a potential host—a cricket—is coming, even in a noisy environment. The intriguing mechanism that enables *Ormia* to accomplish this feat has provided a model for scientists and engineers to use in developing miniature directional microphones for hearing aids that can better focus on speech in a single conversation, even when surrounded by other voices.

Tomorrow

- As noted above, only one-fifth of people who could benefit from a hearing aid seek intervention. Even among hearing aid users, most have lived with hearing loss for more than ten years before seeking a hearing aid and, by then, their impairment had progressed to moderate-to-severe levels. Factors that influence whether a person chooses to wear a hearing aid include the perceived versus actual benefits, cost, stigma, and value (benefit relative to price) of hearing aids, as well as the person's accessibility to hearing health care. The NIH has launched a multipronged research initiative seeking to address the pressing public health need of improving the accessibility, affordability, and outcomes of hearing health care.
- An ongoing clinical dilemma in the management of hearing loss is the level of dissatisfaction that many people with severe hearing loss have for even the most technically advanced hearing aids. An NIDCD-supported research team is developing the optimal balance between improved audibility and reduced distortion of speech in modern digital hearing aids. Signal processing and hearing aid fitting strategies emerging from this research will greatly improve the ability of individuals with severe hearing loss to understand conversational speech.
- Scientists are continuing to develop treatments for hearing loss that can be tailored to an individual's unique needs. The combined use of a hearing aid in one ear and a cochlear implant in the other ear is one treatment being explored in individuals who have

some residual hearing. An alternative, promising approach in cases with preserved low-frequency (low-pitch) hearing and severe high-frequency hearing loss provides acoustical stimulation to the low-frequency region of the cochlea through a hearing aid combined with electrical stimulation to the high-frequency portion of the cochlea through a cochlear implant, all within the same ear. More work needs to be done to determine which individuals should receive these combined devices and which devices yield the most benefit.

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