Paparella: Volume II: Otology and Neuro-Otology

Section 2: Audiology

Chapter 11: Assistive Devices: New Opportunities for Rehabilitating Hearing Impairment

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It has been estimated that for over 14 million American people hearing loss is a problem that affects many aspects of their lives. Depending on the severity and scope of their impairment, lifestyle, and the communicative needs of the individual, the impact of a hearing loss can manifest itself in ways varying from an annoying, intermittent problem to that of an isolating restriction of one's ability to interact socially, relate to friends and family, and receive and interpret vital information. Recent technological advances in the hearing health care industry meet the needs of many hearing-impaired people through innovations in hearing aids, assistive listening devices, alerting and signaling devices, and telecommunications equipment. This expanding array of rehabilitative options provides the hearing-impaired person with the necessary alternatives from which to address their individual and unique hearing requirements, better enabling them to live a more independent and satisfying lifestyle.

The successful rehabilitation of a hearing impairment includes evaluating the individual's (1) audiometric profile, (2) concomitant physical limitations, (3) psycho-emotional attitude toward the impairment, and (4) prognosis for improvement. The most effective component in rehabilitating a hearing impairment through the recommendation of a hearing prosthesis is recognizing that the best (not necessarily the most appropriate) recommendation is the one that the patient is willing to accept and is able to implement in his or her own lifestyle on an ongoing basis. In situations in which a hearing loss is not within the acceptable fitting-range for a hearing aid or is problematic only in specific listening situations, the choice of amplification must be carefully weighed against the person's ability to adapt to amplification, and its effect on residual hearing (Pehringer, 1986). Individuals with hearing problems associated with losses in the mild-to-moderate range or with those confined to a narrow band of frequencies (such as in high-frequency losses) are often more difficult to fit with a hearing aid that is both beneficial and acceptable to the user.

Many people, because of the inconsistent nature of their hearing loss and the intermittent problems associated with it, hold unrealistic expectations of a hearing aid's performance and are disappointed when they realize that the aid will not restore their hearing to a "normal" condition (DeBonis, 1985). For those individuals who experience difficulty listening only in certain situations, the full-time use of a hearing aid is often an unacceptable option, and could be disadvantageous to them in light of the potential difficulties associated with listening in noisy areas, tolerating loud sounds, and adjusting to the mechanics of wearing and operating the device. The use of an assistive device to amplify the sound of the TV to an adequate level without disturbing others in the room, or to relay the ring of a telephone through a loud bell or flashing light, could satisfy that specific hearing need without compromising the individual's lifestyle.

The physical limitations imposed by a lack of dexterity, motion impairment, and other handicapping conditions can present insurmountable obstacles to the hearing-impaired user who must locate and manipulate subminiature controls used to adjust and manage the hearing aid. Visual impairments caused by cataracts or declining visual acuity can adversely affect the ability of many hearing-impaired persons to change batteries or adequately orient the hearing aid for proper installation into their ear(s). Since most assistive listening devices feature large, easy-to-operate controls, they offer these hearing-impaired persons the benefits of amplification without the corresponding frustration and dependence on others for assistance with their hearing needs.

In some cases, the greatest obstacle to overcoming a person's nonacceptance of his or her hearing problem is persuading the individual to experience the benefits of amplification. Erroneous, preconceived notions about the function and applicability of a hearing aid can often pose an impenetrable deterrent to one's willingness to evaluate, and potentially to benefit from the use of amplification. Presenting a device that can "assist" a hearing-impaired individual in difficult communicative situations can answer a need without drawing attention to an ill-perceived handicapping condition that the impaired person may still reject emotionally. Recommending a telephone-amplifier or listening device for those individuals who experience isolated difficulties in specific listening situations, such as listening to the television, can shift the focus of their hearing problems toward the source of the sound (ie, to the television or telephone) rather than to their heading dysfunction.

History

Since as early as the 1920s, hearing-impaired people have been advocates for the manufacture and installation of public assistive listening systems. It was during that time that the first public and personal devices were tried, and these original works laid the groundwork for the promulgation and increasing number of installations we enjoy in the USA today. In 1926, one of the first amplifying systems for groups of users was installed. It consisted of about 100 sets of earphones hardwired to an amplifying system. Throughout the remainder of the 1920s and 1930s, many hardwired systems were installed in auditoriums, theaters, and houses of worship.

By the 1940s, hardwired amplifying systems had fallen out of favor with many in the hearing-impaired population, largely because of problems with maintenance and inconvenience of the devices. Around the late 1940s and early 1950s, systems using audio-induction loops began to be used in the USA. There was not wide usage or acceptance of this technology at first, due to the fact that only people with a telephone-switch on their hearing aid could use these systems. The loop system's performance was limited by the T-coil within the hearing aid. As manufacturers improved on the performance of telecoils, loops systems began to gain popularity.

A major technological advancement in assistive listening devices occurred in the 1960s, when radio frequency-based amplifying systems were developed. By the early 1970s, hearing-impaired persons had begun to use AM (amplitude modulation) radio amplifying systems in auditoriums and houses of worship. It was typical for the user to furnish his or her own receiver, usually a pocket-sized AM radio. This type of system, however, was plagued with many problems from the beginning, including a substantial amount of interference,

distortion, and a weak signal.

Research and development of FM (frequency modulation) radio amplifying systems were underway at approximately the same time, and FM technology was mainly employed in the late 1960s as auditory trainers for use in schools. In the early 1970s, the Federal Communications Commission (FCC) in the USA allocated certain bands of FM frequencies for FM systems to be used in educational settings. Throughout the 1970s, systems for use in settings other than schools, such as auditoriums, theaters, and houses of worship, were being developed and tested. By 1981, large-area FM systems had become quite popular, and in 1982 the FCC approved the use of FM frequencies for assistive listening systems in buildings other than schools.

Assistive listening systems operated by infra-red light were first introduced in Europe in 1976 and brought to the USA in 1979. Throughout the 1980s they have been gaining in popularity and are considered to be good, high-quality systems for use in large rooms and also as personal amplifiers for listening to television. In 1979, Gerald I. Williams of the Williams Sound Corporation coined the phrase "assistive listening devices and systems", which has become widely accepted. The popularity of these devices has grown tremendously in the past few years. As the hearing-impaired population and professionals involved with the hearing-impaired realize the benefits of these various devices and systems, the demand for assistive devices will continue to grow.

Assistive Listening Devices and Systems

The term "assistive listening device" represents a broad category of equipment designed to improve a hearing-impaired person's ability to communicate in specific listening situations, particularly where background noise, multiple talkers, reverberation, or large distances may degrade the integrity of the message. The devices' functional advantage over other forms of amplification such as hearing aids can be attributed to their unique design, dedicated to maximizing the efficiency of hearing in specific listening situations, and to their higher overall quality of sonic performance. These devices can be separated into two major categories: (1) assistive listening devices (ALDs) designated for personal use to assist the individual when listening in noisy places, small groups, or conversations over the telephone; and (2) assistive listening systems (ALSs), intended for general use in large areas such as houses of worship, auditoriums, and theaters, where long distances and background noise may interfere with the ability of a hearing-impaired person to hear the presentation clearly.

Primary Function and Mechanism

The primary function of an ALD is to maximize hearing efficiency by electronically enhancing the listener's ability to hear the desired sound signal over that of competing sounds or noise in the background. This concept results in improving the signal-to-noise ratio of the message to effectively increase understanding. This can be accomplished either by moving the listener closer to the talker or source of sound or by electronically sending the speaker's message directly to the listener's ear, in effect bypassing the acoustic distance and the noise between the speaker and listener. ALDs can be categorized according to the specific listening need they fulfill (ie, amplifiers for telephones, TV listeners, or auditorium listening systems), or according to the technology utilized to accomplish these functions (infra-red, AM, FM, or

loop systems).

Types of Systems

In the order of their evolution, five technological systems have been employed to increase the signal-to-noise ratio or to electronically relay the sound from the source directly to the listener to improve their hearing ability: (1) hardwired systems, (2) systems using induction-loops, (3) AM radio, (4) FM radio, and (5) infra-red signals.

Hardwired Systems

The most basic and elementary approach used to develop an ALD device is to extend the listener's hearing range by placing a microphone closer to the source of sound. The term "hardwired" is used to describe the wired connection made between the microphone, amplifier, and earphone that will amplify the sound and then direct it to the listener's ear. Many popular personal amplifier systems utilized this hardwired concept to position one or more microphones a short distance away from the listener to enhance his/her ability to hear more effectively in small groups, noisy automobile, or to increase the volume of a television set without disturbing others in the room. Personal amplifiers are generally compact, portable devices that are simple to operate and can be used independently or in conjunction with personal hearing aid(s). As a generic universal listening system, these personal ALDs are being used by many hospitals, clinics, and emergency facilities to communicate with hearing-impaired patients, residents of nursing homes, and victims of accidents, who may have difficulty hearing or may not be wearing their personal hearing aid. More and more public facilities are beginning to use personal amplifiers to accommodate hearing-impaired patrons while maintaining the privacy and character of their conversation.

In light of contemporary, more efficient technologies, however, hardwired systems are often impractical for use in large areas such as in houses of worship, auditoriums, or theaters because they require the listener to sit in selected areas equipped with special earphones. This arrangement imposes limitations on the number of people who can use the system and draws attention to them when they sit in the "deaf row", as it has been called. With the advent of wireless technology, many of these limitations have been largely overcome, enabling listeners to monitor the transmitted signal from almost anywhere within the facility, giving them the freedom to sit where and with whom they please.

Induction Loop Systems

Induction loop technology has its roots in Europe and is commonplace in many public buildings in Europe, especially in Scandinavian countries (Williams, 1985). As with any listening system, the microphones used to pick up the signal are placed close to the source of the sound. The signal is then amplified and fed into a loop of wire placed around the perimeter of the listening area. The electromagnetic field generated from the loop can be picked up by using any hearing aid that has a built-in telephone pick-up coil (T-coil) or by using a special receiver with an induction loop to hear the message.

Loop systems are available in a variety of styles and sizes to accommodate the needs of the hearing-impaired. Small personal loops called Neckloops or Sillohets can be worn

around the neck to listen to a tape-recorder, personal amplifier, or FM system through the T-coil of the user's hearing aid. Small loop amplifiers can be used to "loop" a dining room area, television listening area, or in an automobile to improve a person's hearing ability in those environments. Travelers can use portable loop systems to improve their ability to hear in touring groups or to listen to TV in a hotel room without disturbing other guests.

Loop systems are ideally suited for use in nursing homes, classrooms for the hearing-impaired, meeting rooms, and other large facilities where the majority of listeners already own a hearing aid with a T-coil. To use the system, the listener simply moves within the looped area and flips the T-switch on his or her hearing aid to hear the amplified message. The performance of induction loop systems can vary depending on the quality of the receiving portion of the system (ie, the hearing air or induction loop receiver) and on the amount of electromagnetic noise generated from wiring in the room, fluorescent lamps, or motors present in the listening area.

Systems Using AM Radio Signals

The next development in wireless systems used for hearing assistance was a system employing AM radio signals to relay sound signals. A radio transmitter operating on or just below the commercial broadcast band was used to transmit a radio signal throughout the listening area. Listeners would have the freedom to sit anywhere within the range of reception by using a modified AM pocket-radio or special AM radio receiver to monitor the broadcast message. Systems using AM radio were generally installed in churches and auditoriums as a low-cost alternative to the expense of routing a loop of wire under a carpet or in the ceiling of a finished building.

Hearing assistance systems using AM radio are limited in power and range of output and are susceptible to electrical interference caused by thunderstorms and by electrical apparatus such as motors, fan controls, and lamp dimmers. Their overall performance is affected by large amounts of structural steel within the building and by the quality of the AM receiver used. Many of these AM radio systems have been replaced with FM systems because they are not vulnerable to the previously mentioned interference, provide a much higher quality of sound to the listener, and cover a greater listening area more efficiently.

Systems Using FM Radio Signals

Wireless systems using FM radio signals have been used for many years to assist hearing-impaired students to communicate more effectively in the classroom. In 1982, the FCC further authorized their use for general hearing assistance to benefit hearing-impaired people in any setting. ALSs using FM operate on the same basic principle as do AM systems, except that they use frequency modulation to encode the sound signal and a higher radio frequency to transmit the message to the listener. The broadcast signal can be received by one or more listeners, each employing a pocket-sized FM radio receiver.

Personal FM systems are very effective and versatile, and can be used almost anywhere to relay and amplify sounds to a hearing-impaired listener a distance away from the sound source. The transmitter can be placed on a lectern in a classroom, in the middle of a conference table, or next to the speaker of a television or radio, where it can broadcast sounds

clearly and distinctly to the listener. The personal FM system can be worn inconspicuously while traveling or while participating in vigorous recreational activity, without the constraints of an interconnecting cord. FM radio technology provides the listener with a clear signal that is virtually immune to outside interference and can be used with or without a personal hearing aid.

FM systems for large listening areas have been installed in many houses of worship, theaters, and auditoriums to assist individuals in listening to the presentation or sermon without restricting their freedom to sit where they desire or even to remain in the same room. FM systems operate with higher radiating power and therefore cover a greater area than do AM systems. They are immune to the sources of interference that plague AM broadcasts. FM systems can be used during day or night, and multiple systems operating on different channels can be used simultaneously in the same area for translation of language or for interpreters for the deaf and blind.

Infra-Red Systems

Infra-red systems utilize beams of invisible light to relay the sound signal to the listener. The transmitter converts sounds into a modulated wave of light in the infra-red spectrum that is picked up by an infra-red receiver worn by the listener(s) a distance away. Even though the infra-red wave is invisible, the characteristics of its radiation are similar to those of ordinary visible light (Ross, 1985). Waves of infra-red light are totally absorbed by opaque materials and can be "drowned out" by other sources of infra-red light such as direct sunlight or in some cases incandescent lamps. For these reasons, infra-red ALSs are confined to use in indoor spaces with limited window exposure. Because infra-red light cannot penetrate barriers such as dark curtains and walls, systems using infra-red light are ideal for applications requiring the use of many hearing-assistance systems in adjacent areas, without "spill-over" from one listening area to another. Infra-red technology has been used mostly in theaters and auditoriums where security from eavesdropping on performances is a major concern.

Personal infra-red ALDs are available for use in the home, primarily as an assistive listening device for the television. A small transmitter is placed on top of the television set, with a microphone positioned near the loudspeaker. One or more listeners can each wear a wireless infra-red receiver to hear the sound signal transmitted across the room at the desired volume level without disturbing others. The fidelity of these systems is excellent and they are immune to interference from electromagnetic noise created by devices operating on AC alternating electrical current.

Using an Assistive Listening Device with a Hearing Aid

Assistive-listening devices (ALDs) can meet the needs of hearing-impaired people whose hearing loss is only marginally restricting or for those experiencing difficulty hearing in specific listening situations. People with severe-to-profound losses are those who continue to experience extreme difficulty in discriminating and understanding speech even while aided can use an ALD to gain greater flexibility in listening situations and improve the performance of their personal hearing aid. The key to using the benefits of an ALD to supplement the performance of a hearing aid is the ability to interface the electrical signal from the ALD to

the input of the hearing aid's amplifier. This can be accomplished by one of three methods: (1) magnetic coupling of the signal to the telecoil of the hearing aid, (2) utilizing a hardwired connection to the hearing aid with a direct audio-input (DAI), if the hearing aid is so equipped, and (2) acoustic coupling of a small loudspeaker to the microphone of a hearing aid.

The telecoil was originally designed to pick up the electrical fields generated from a telephone receiver and convert them into a signal that could be directly amplified by the hearing aids. This direct, electromagnetic coupling from the telephone to the listener's hearing aid resulted in an improvement in the understanding of speech over the telephone, particularly in areas where high levels of background noise often made telecommunications impossible. The telecoil can be used alternatively as a means of delivering a high-quality signal from an ALD directly to the listener's hearing aid, thereby permitting the user to improve the signal-to-noise ratio in many listening situations and to bypass the adverse effects of background noise.

The DAI capability affords a listener the opportunity to "plug in" an electrical signal from a tape recorder, dictating machine, hand-held microphone, or other assistive device, directly into a jack located on the bottom of the aid. This hardwired connection to the listener's hearing aid preserves the fidelity of the sound and eliminates any potential disturbance from background noise or other electrical interference.

As the trend in personal hearing aids has continued to emphasize cosmetic concerns about size and inconspicuousness of the aid, manufacturers have had to eliminate from custom-made in-the-ear and in-the-canal aids such options as telecoils because there simply was no room for them. Consequently, the only available means of delivering an outside signal to a miniaturized hearing aid is to position an earphone or headphones over the opening to the microphone in the aid. Discomfort and problems with feedback are two factors limiting use of this approach. This leaves the user with the alternative of getting a new hearing aid (most likely a behind-the-ear instrument) offering a T-coil with DAI option to effectively utilize an ALD to improve his or her hearing ability.

Assistive Alerting Devices

Many sounds around the home or workplace that most people take for granted, can pose real dilemmas for people with hearing impairment. Hearing-impaired people often have a difficult time adjusting to the auditory demands of daily life that keep us in touch with the world around us. They may not hear the telephone or doorbell ringing, and more importantly, they may not hear sounds of danger, such as a fire-alarm, a smoke detector, or a baby crying in another room. It is for these types of situations that the use of assistive alerting devices is recommended. The term "assistive alerting device" refers primarily to devices that can allow a hearing-impaired person to hear sounds around them by means of an extra-loud signal or by relaying the signal to an area closer to the individual.

A variety of alerting devices are available for use with a telephone. Loud bells and phone-ringers can be added to the telephone to make the ring more perceptible and easier to hear; extension ringers can be added in rooms around the house to allow the hearing-impaired person to hear the telephone ring in other rooms. Amplifying telephone handsets and modular

in-line amplifying devices with a volume control are also available. These units allow the person to adjust the loudness of the caller's voice to help them hear better over the phone. Portable amplifiers designed to convert a sound signal into an electromagnetic signal for use with the telephone switch of a hearing aid are also available.

Smoke-detectors with an extra-loud alerting horn (as well as a signaling light or strobe) can be purchased and easily installed in the home or office of a hearing-impaired person. They look like, and function the same as, an ordinary smoke detector but produce a much louder alarm sound for a hearing-impaired person to hear when activated. Portable smoke detectors are convenient to place in rooms that are not protected by built-in smoke detectors; and can also provide protection and peace of mind for the hearing-impaired person who travels.

Intercommunication systems are often used by hearing-impaired parents to enable them to hear their baby crying in another room. This system consists of a transmitting unit placed close to the baby and a receiver with a volume control that the parent can keep close by or clipped to a pocket or belt. These devices are also used by parents with normal hearing who want to be sure they are alerted to their baby's crying if they are in another part of the house or outdoors.

Assistive Signaling Devices

For people with very severe to profound hearing loss, or those who are totally deaf, it is not possible to amplify the sounds around them sufficiently to make them aware of environmental or alerting sounds. In these instances, when the sound of the doorbell, telephone, alarm clock, or crying baby might otherwise go undetected, assistive signaling devices can be used to make them perceptible. The term "assistive signaling device" refers to a unit that electronically changes the sound into a light or a vibration. The light or vibration indicates to the hearing-impaired person that a sound has occurred.

There are many devices that can signal the hearing-impaired when an alarm clock has gone off or when a timer has ended a cycle. Alarm clocks with built-in flashing lights and strobes will work for those who are awakened by light. Others may find that a vibrating alarm clock is more effective for them. Units are available that attach to the frame of the bed or to the boxspring and shake the whole bed; other units are small enough to be placed under the pillow or mattress. Portable vibrating or flashing alarm clocks are also available for those who travel.

Some integrated systems have multi-purpose functions, that can signal up to six different inputs indicating that, the doorbell, the fire alarm, or the telephone is in need of attention. Separate transmitters are necessary for individual placement near each of the monitored sources of sound. A control unit located near the listener then receives and interprets which condition to signal the user. The control unit is about the size of a clock-radio and is often placed on a bedside table. It can be connected to a lamp or vibrator that reacts to the received transmission and indicates the associative signal for the sound that has occurred. This multi-function system can have any number of remote receivers as well as transmitters to assist the individual, in monitoring many different conditions in his or her environment.

Another type of system uses a receiver that is a wrist-worn paging device. The wristband vibrates when one of the transmitters picks up a sound. The person using the system can look at the lights on the wrist receiver to identify the source of the sound.

Hearing-impaired and deaf drivers of automobiles face dilemmas ranging from not being able to hear the sound of the turn signal to more serious problems such as not hearing police and emergency sirens. To help solve these problem situations, signaling devices can be placed on the dashboard to alert the driver. Devices are available that amplify the sound of the turn signal or flash a bright light when a sound is produced by nearby sirens on police, ambulance, or fire vehicles or by horns on other cars, trains, or busses.

Telecommunications

One of the most limiting and handicapping aspects of hearing impairment is the inability to use a telephone to make plans, socialize with family and friends, and keep in contact with others who live some distance away. Communication over the telephone can be a frustrating experience for the hearing-impaired, since it can present restricted intelligibility due to poor acoustics in the telephone's transmission line, and since the conversation is devoid of any nonverbal cues. A variety of telecommunicative assistive devices are available to help the hearing-impaired to use the telephone more effectively.

The most common of these is the telephone amplifier, which can be connected to the handset of most residential phones, or a portable version, which can be attached to a business phone or a public phone when the listener travels. Telephone couplers attach to the phone in the same manner as do telephone amplifiers, to both amplify and transform the telephone signal into a signal that can be picked up by a hearing aid with a T-coil. Some of these telephone couplers can also be used as listening devices by placing the coupler near the speaker of the television set or radio to pick up sounds, and to route the amplified signal back to the listener's hearing aid.

A new generation of sophisticated telephones designed to assist hearing-impaired persons to hear more effective over the phone has opened up a new world to those previously restricted from using the telephone. Signal processing techniques and enhancement features provide the user with greater control over the loudness and quality of the sound signal to maximize his or her hearing effectiveness over the phone.

Communicating over the telephone is impossible for the severely to profoundly hearing-impaired and deaf. Teletypewriters (TTY) were first used in order to allow severely impaired and deaf people to communicate with one another by typing telex messages. In 1965, telecommunicative devices for the deaf (TDDs) were developed, enabling those who could afford them the opportunity to communicate for the first time using the standard telephone line. These devices converted the typed message into tones that could be sent over the telephone lines. At the other end of the line, another TDD converted the message into typewritten copy. Many business, public offices, and emergency facilities have added a TDD device to accommodate hearing-impaired people in their community.

Some personal computers can be adapted to perform the functions of a TDD through the use of a modem connecting the computer to telephone lines. Other telecommunications

decoders are available that will permit the caller to send simple messages such as "yes", or "no", "repeat", and "I don't know" to a severely hearing-impaired person by pressing the buttons on a standard touch-tone telephone. This device can provide an inexpensive means of keeping in contact with a severely hearing-impaired or deaf person without traveling to rely a simple message or to confirm their safety.

Closed-caption television is a technological innovation that is becoming increasingly available to the severely and profoundly hearing-impaired and deaf populations. Telecaption decoders can be built in or attached to a television set, to decode the captioned broadcast sent from the television station. Captioning of newscasts, movies, and general programming has opened up the airwaves to many hearing-impaired people, providing them with readable cues to help them to follow along and understand the program.

Future Trends

Assistive devices are playing a larger role in the rehabilitation of hearing impairment, offering the health care provider an ever-widening spectrum of alternatives from which to approach the problem. Specialized design of each device for assistive learning, alerting, signaling, or telecommunications maximizes their effectiveness in those applications, affording greater social benefit from their use. For those who experience minimal difficulties in hearing or whose hearing loss does not fall within the prescribed fitting range of a hearing aid, assistive devices can offer greater flexibility in coping with communicative needs without the stigma attached to wearing a hearing aid. In addition, assistive devices can serve as useful alternatives in situations where a physical, emotional, or intellectual handicap may limit the success of fitting a hearing aid.

Technological advances in the areas of wireless communicative devices are opening up new ways to help hearing-impaired persons stay in touch with the world around them and to provide them with greater access to public functions which they had been acoustically isolated from fully participating in previously. New assistive products are being developed to enhance an individual's awareness of sound and to improve the intelligibility of speech for the listener. Innovative designs incorporating signal-processing techniques to eliminate background noise and interference are on the horizon, with greater emphasis placed upon their functional effectiveness rather than on cosmetic concerns of hiding their use.

Federal and state legislation has been introduced in the USA that mandate the use of assistive devices in public and emergency facilities to accommodate hearing-impaired persons. Section 504 of the Rehabilitation Act of 1973 requires all federal agencies in the USA to provide the necessary accommodations to all handicapped people (including the hearing-impaired) to enable them to participate in, and derive the same benefit as others from, programs receiving federal assistance (Subcommittee on Health, HR 4437, 1973). Other legislation has been passed that will ensure equal access to telephone service for the hearing-impaired, requiring that all "essential telephones" in hotels, emergency facilities, and workplaces be compatible with hearing aids. Many hotels are currently installing telephones compatible with hearing aids and systems of visual alerts for the safety and convenience of hearing-impaired guests. Nursing homes and health care facilities are further complying with the Rehabilitation Comprehensive Services and Developmental Disabilities Amendments of 1978 by providing signaling and warning devices in their facilities for residents with visual

and auditory impairments.

Assistive devices have proved to be a valuable and effective means of rehabilitating hearing impairment for a large segment of the hearing-impaired population. Through the combined efforts of audiologists, physicians, and other allied health care professionals, the benefits of these devices can be promoted to serve the needs of the hearing-impaired, to improve their quality of life, and to permit them to function more independently in a society that sometimes presumes that all individuals have normal hearing.