Overview of Technology for Low Vision

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This article provides an overview of technology resources and services to assist persons with low vision in maintaining independent function in the home, community, and educational and vocational settings. Case studies are provided to demonstrate the integration of technology into the lives of persons with low vision.

Advances in ophthalmic surgery, more effective medical control of eye diseases, and a sharp increase in the population of people older than 65 years of age have contributed to a steady increase in the number of persons with useful partial sight. Although persons with visual impairments may retain usable vision, loss of sight requires spending more time and effort in accomplishing tasks. Techniques and devices are available that maximize remaining visual ability. Occupational therapists may find that an increasing number of clients, especially elderly persons, have visual impairments.

Visual impairment may result in a restricted field of vision or in a diminished ability to see sharpness of detail, read standard-size print, determine color or depth perception, see contrasts, adjust to changes in light or glare, or locate objects (Marmor, 1992). Visual loss can affect a person’s activities of daily living (ADL), leisure pursuits, education, vocation, and social interaction. The severity of visual loss and the resulting limitations vary with such factors as age of onset, support systems available, and coping strategies (Bailey & Hall, 1990).

Approximately 4.4% of the population of the United States experiences activity limitation due to visual impairment (Pope & Tarlov, 1991). Among elderly persons, the incidence is higher. One out of 5 elderly persons has difficulty with reading because of a visual impairment, and 1 out of 20 persons older than 65 years of age cannot see words or letters on a page (U.S. Bureau of the Census, 1986).

Compensatory strategies include illumination techniques and use of contrast, magnification, memorization of location, and auditory and tactile feedback. Compensatory strategies may include the use of optical, nonoptical, low-technology, and high-technology devices to improve functional visual performance.

Professionals in the field of low vision who recommend and provide training in the use of optical, nonoptical, low-technology, and high-technology devices include occupational therapists, low vision specialists, orientation and mobility (O&M) specialists, rehabilitation counselors, rehabilitation teachers, teachers of persons with visual impairments, and electronic aids specialists. Optical devices, such as high-powered lenses and telescopic spectacles, are items prescribed by an ophthalmologist or optometrist and may require specialized training and periodic reevaluation. Nonoptical devices include items that are readily available and require no special training, such as felt-tip markers and large-print books. Low-technology devices, such as a standard cassette recorder, require little training and may include simple adaptations such as large-print or raised-line indicators on the controls. High-technology devices refer to more sophisticated electronic technology, such as computers and reading machines, that may require specialized training.
Professional Service Providers for Persons With Low Vision

Occupational therapists are generally recognized as the professional group "trained and experienced in assessing and prescribing assistive devices" (Mann & Lane, 1991, p. 26). Occupational therapists have a wide breadth of training and experience with assistive devices, as well as an understanding of human capacity and disability. Ideally, an occupational therapist participates in evaluating the needs of persons with low vision, makes appropriate referrals to other professionals, and determines appropriate assistive devices.

Low vision specialists are ophthalmologists or optometrists who specialize in the prescription of optical devices for persons with low vision. These devices include reading glasses with high-powered lenses and reading prisms; absorptive lenses; telescopes and telescopic spectacles for tasks requiring vision at near, middle, and far distances (Porter, White, Goldberg, Demer, & Koval, 1992); and reversed telescopes or mirrors for treatment of visual field defects (Bailey & Hall, 1990).

O&M specialists provide training in travel safety. These professionals are trained at the master's degree level. Extended fieldwork is required, much of which is conducted with a blindfold. In addition to providing instruction in the use of public transportation systems and use of the cane, O&M specialists recommend and provide training in the use of mobility lights and electronic travel aids. Visual information to guide night travel can be enhanced by the use of mobility lights such as the Wide-Angle Mobility Light1 and the Streamlight2. Electronic travel aids including the Laser Cane,3 the Sensory 6,4 and the Polaron5 send out light beams or ultrasound waves that come into contact with objects. When the beam or wave hits an object, the device vibrates or emits a sound (Younger & Sardegna, 1991).

Rehabilitation counselors for persons who are visually impaired provide vocational counseling, service referral, and case management to help persons with visual impairments make adjustments to their vision loss. In some states, rehabilitation counselors work for the state vocational rehabilitation program; in other states, they work for a separate commission or bureau. Rehabilitation counselors assist persons in applying for recorded book services and in locating and hiring readers and note writers for college. They additionally refer clients to low vision specialists, O&M specialists, rehabilitation teachers, and electronic aids specialists.

Rehabilitation teachers for persons with visual impairment provide assistance in ADL and in college or vocational preparatory skills. They may recommend devices that assist a person with a vision loss with cooking, housekeeping, reading, writing, and leisure activities (Leja, 1990). Rehabilitation teachers work privately within the home, within a community agency such as an association for the blind, or in residential settings that provide intense instruction to persons who have sudden and severe vision loss.

Teachers for the visually impaired (TVIs) work with children who require special educational interventions as a result of severely reduced vision. TVIs provide instruction in reading and writing methods including braille, and they may be responsible for converting printed and other instructional materials into large print or braille for their students. TVIs recommend specialized devices and computer access strategies for students and provide training in the use of low vision devices in the classroom.

Electronic aids specialists, sometimes referred to as technology specialists or adaptive technology specialists, are any one of a group of persons with varied backgrounds, including teaching, computer programming, nursing, rehabilitation engineering, and occupational therapy, who have developed expertise in the use of computer hardware and software and have acquired clinical experience working with persons with disabilities. Technology specialists who have clinical expertise in working with persons with low vision or blindness are knowledgeable regarding video magnifiers including closed-circuit television systems (CCTVs) and character enlargement systems, speech output technology, optical character recognition (OCR) devices, electronic braille devices, and commercial computer peripheral devices that can be used creatively to compensate for visual impairment.

The Range of Assistive Devices for Those With Low Vision

Appropriate selection of low vision devices and technology and subsequent training in their use is crucial for ensuring proper use of such devices. As outlined in a 1993 Consensus Validation Conference held by the National Institute on Disability and Rehabilitation Research, selection of a low vision device is a complex task with many components, including:

- comprehensive clinical evaluation by a low vision specialist
- holistic evaluation of the client
- evaluation of functional abilities
- determination of financial resources and funding options

1Manufactured by Innovative Rehabilitation Technology, 4111 West El Camino Real, Mountain View, CA 94040.
2Manufactured by Streamlight, Inc., 1050 West Germantown Pike, Norristown, PA 19403.
3Manufactured by Nohon Industries, Station Square, Bldg #3, Paoli, PA 19302.
5Manufactured by Nohon Industries, Station Square, Bldg #3, Paoli, PA 19302.
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Environmental Control and Home Safety

Environmental control relates not only to safety but also to self-reliance and self-acceptance (McCulloh, Crawford, & Resnic, 1994). Simple adaptations in decorating may be all that is needed to improve mobility and acquire a greater degree of independence within the home. Light colors such as white, beige, or tan are suggested for walls, ceilings, and carpets (Younger & Sardegna, 1991). Darker colors on furniture, light-switch plugs, and electrical outlets when used with lighter background colors make them easier to see. The use of contrasting colors between placemats and dishes and between curtains and curtain drawstrings make these items easier to identify. Rearranging furniture should be kept to a minimum because consistency aids in location and reduces the chance of injury. For safety, doors should be either open or shut but not partly open (Dickman, 1983). Floor lamps can be replaced with ceiling lamps to reduce glare and provide more open space in a room. Vertical blinds and shades aid in controlling the amount of light in a room.

Motion lights that automatically turn on when someone enters a hallway, pantry, or closet may prevent falls. Inexpensive telephones with large-print numbers and programming capability are easier to use when dialing frequently used or emergency phone numbers. Clocks and watches are available with large print, speech output, and tactile markers. Large-print label-making devices, as well as large-print templates, are available to enlarge the indicators and dials on thermostats, stoves, microwave ovens, and organizational storage units. These same dials can be labeled with tactile marks with use of a high color-contrast substance. Remote control units for operating the television, the videocassette recorder, and the stereo are available with large-print buttons.

In addition to labeling the controls on the stove and microwave, devices to assist in the kitchen include one-cup beverage makers that heat liquids for soup or coffee, elbow-length oven mitts, vegetable and knife slicing guides, large-print cookbooks, and electromagnetic stoves that heat food without heating elements or flames.

Devices to manage diabetes-related tasks include syringes marked in large print, raised print, and Braille; needle guides, and insulin-measuring guides. There are talking thermometers, talking scales, and talking blood pressure, pulse, and glucose-monitoring devices. Pill splitting tools and pill storage devices with large-print adhesive labels are available.

Although some devices are designed for persons with low vision, many are mainstream market devices that have been modified for ease of use. Examples include self-threading needles, sewing machine magnifiers, and magnetic padlocks that require no combination and open with a magnetic sensor. Woodworking and mechanical tools can be labeled with large-print or tactile markers.

Reading and Writing

After home safety, the two most pressing needs of many persons with low vision are reading and writing. The ability to read and write affects almost all areas of life. Reading aids include adjustable lighting strategies, prescription reading glasses, large-print publications, non-electronic magnifying devices, CCTVs, cassette recordings, electronic reading machines, computers with large print and speech output systems, braille on paper, and braille in electronic form. Writing strategies include using bold-tip pens or markers to make large, prominent letters; bold-line paper to keep writing in a straight line; signature-, envelope-, and check-writing guides to identify areas of forms that must be completed; stand magnifiers and CCTVs that provide magnification of the writing area; and cassette recorders, typewriters, portable talking notebooks, and computers with large print or speech output access or both.

Lighting

Low vision specialists may prescribe reading glasses with strong lenses that provide considerable magnification. Generally, material viewed must be held close to the eyes to remain in focus, and glare should be eliminated. To limit the amount of light entering the eye by reflection, absorption, or interference, filters or tints can be used (Waiss & Cohen, 1992). Filters or absorptive lenses can be incorporated into prescription lenses. Nonglare paper or a sheet of yellow acetate placed over a page of print reduces glare, and visors and side shields may reduce reflection. Placement, wattage, and types of light such as incandescent, fluorescent, or high-intensity lamps may have a positive effect on reading and writing. For instance, use of a 200-watt bulb while writing with a black felt-tip marker on bold-line paper may enable a person with low vision to create a shopping list or write a note to a friend.

Because increased illumination helps some persons...
with low vision see more clearly, a portable, battery-powered, head-mounted lamp and a small spectacle-mounted clip light were developed by the Smith-Kettlewell Eye Research Institute, San Francisco, California for persons who use high-powered spectacle lenses (Brabyn, Haegerstrom-Portnoy, Schneck, Colenbrander, & Winderl, 1993).

Nonelectronic Magnifiers
Magnification increases the eye’s resolving abilities, making it possible to see fine details. The greater the magnification, the smaller the area available to be magnified at one time. Magnifiers come in a wide range of sizes, styles, and options. They are used primarily to read short items such as telephone numbers, dictionary definitions, and menus (Jahoda, 1993). For tasks that require access to longer lines of information for longer periods of time or where increased magnification is necessary, a CCTV may be beneficial.

CCTVs
CCTVs enlarge printed, handwritten, and graphic material electronically onto a monitor screen. The components include a camera and camera-coupled device with zoom lens and light source, a monitor, and a flat movable table. Material is placed face up on the table, which can be moved in both a horizontal and a vertical direction. The area of material under the camera is displayed on the monitor in enlarged print. Knobs on the front of the device allow the user to select the size, adjust the focus, determine the amount of brightness and contrast, and alter the polarity of the display from black on white to white on black. The display changes as the table is moved, which allows different areas of the material to be magnified. The monitor varies in size from a 14-in. to a 20-in. screen. Larger monitor screens provide a wider field of vision.

CCTV options include foot-controlled motorized movement of the table, full color display of material, and the ability to alter the foreground and background colors of text material. Most CCTVs have user guides that can be positioned above and below rows or to the left and right of columns that allow the blocking out of all other areas of the display. Generally, the table can be locked into a stationary position, which enables the system to be used for writing and filling out forms. Some models of CCTVs developed by specific manufacturers allow the use of a television set or a VGA computer monitor instead of the CCTV monitor. Portable models are available that use rechargeable batteries, have a 4-in. screen, and include a carrying case.

Although CCTVs provide more efficient character enlargement access to materials than nonelectronic magnifiers, they have some disadvantages for reading narrative text. They require the user to sit at a stationary table or desk. The material placed on the moveable CCTV table must be in constant motion to access each line of text from left to right and each page from top to bottom. For some people, this can cause motion sickness when reading for long periods of time. In addition, extended use of the CCTV can cause eye fatigue. To avoid these problems, some persons with low vision may prefer to do their leisure reading with large-print, audiocassette, or Braille books or the use of an electronic reading machine.

Large-Print, Audiocassette, and Braille Books and Publications
Printed material can be enlarged with photocopy machines. For illustrations, maps, and diagrams where color imparts information to the reader, color photocopiers can be used to provide enlarged color access. Although a small percentage of persons with low vision read braille, advances in computer technology make it possible to convert printed materials to braille more quickly.

Most public libraries have fiction and nonfiction books in regular print, large print, and on audiocassette. Sources for books on audiocassette are the National Library Service for the Blind and Physically Handicapped and Recordings for the Blind (see the Appendix). Recordings for the Blind offers the sale of books on computer disks that, when used in conjunction with a computer program called Book Manager, can be read using a computer equipped with a character enlargement or speech output system.

Cassette recorders can be used as writing tools. Notes, grocery lists, addresses, phone numbers, dictated letters, and memos can all be stored on audiocassette for later retrieval. Useful features of a cassette recorder as a reading or writing device include

- It plays and records at variable speeds (either faster or slower than the original recording)
- It plays and records on two tracks per cassette side
- It permits tone indexing (the insertion of a beep to mark a passage of text)
- It records at fast forward for voice indexing (insertion of words to mark a passage of text)
- It has tactile markings on control keys
- It operates on house current and rechargeable batteries.

Electronic Reading Systems and OCR Systems
Electronic reading systems consist of a scanner, OCR software, a speech synthesizer, and a keyboard. Some models require connection to a computer, and some operate as

Available from Recordings for the Blind (RFB), 20 Roszel Road, Princeton, NJ 08540.
stand-alone units. Printed material is placed face down on the glass surface of the scanner where the image of the text is scanned into memory. Through the speech synthesizer, the words of the scanned text are spoken aloud (Loris, 1993). The user controls the speech rate and volume, as well as the way the text is read. For example, by pressing specific keys on the keyboard, the user can read the text paragraph by paragraph or sentence by sentence. The user can go back to a word and have that word spelled out letter by letter.

Scanners and OCR software are used with increasing frequency by business and industry as time-saving tools. The large market for these devices, as well as the ever-increasing speed and storage capacities of computers, has driven the quality up and their cost down. The better systems consist of “omni-font” software capable of recognizing all printed fonts and document recognition as opposed to simple character recognition. This enables the system to make decisions regarding the format and the structure of a page. When used in conjunction with computer systems equipped with braille printers or font-size word-processing programs, these systems can be used in education and vocational settings to convert standard-size print material to braille or large-print format.

Computers as Reading Devices

The key to using the computer as a reading machine is obtaining optimal access to the keyboard and the screen display. Keyboard access can be maximized for persons with low vision through use of enlarged keyboard labels or tactile indicators for strategic keys. Keyboard label sets are available in black letters on a white background or white letters on a black background.

Nonoptical adaptations for improving access to the screen display include the use of adjustable lighting, high-quality polarized screen filters, and monitor hoods to reduce screen glare. Screen magnifiers can provide some magnification but may cause excess glare or distortion when the screen is viewed at an angle. Larger monitors are an option for persons who do not require excessive magnification because larger monitors display text at a slightly larger size. Monitors are available with 14-, 15-, 17-, 20-, or 21-inch screens measured diagonally, but the expense of monitors larger than 21 inch may be prohibitive. Flat square screens and monitors with a dot pitch of 0.28 or lower provide the best clarity.

Screen Enlargement Systems

If a larger monitor does not provide the necessary magnification, then a screen enlargement system may be a solution. Screen enlargement programs display information on a computer screen in a variety of magnification levels up to 16 times the standard size. The entire screen, a portion of the screen, or just one line may be enlarged. In full screen view, all the information on the screen is enlarged. Similar to the CCTV, to read the entire area, the user must move the display area from left to right and top to bottom by using keyboard commands or a mouse.

The graphic-user interface has some advantages over DOS-based software when it comes to large-print access. One can change the font size, foreground and background colors, cursor size, and mouse icon color and size. A larger monitor and an adjusted font size and color may be all that is needed to enhance vision for most tasks. A screen enlargement program can remain in the background and be used on demand to read menus or dialog boxes. Because of the way the graphic-user interface works with screen displays, inexpensive software-only character enlargement systems provide accurate mouse movement when scrolling the enlarged text area. With DOS-based software programs, that is not the case—a more expensive hardware and software solution is necessary to maintain smooth, accurate, and efficient mouse movement when scrolling the viewing area.

For some persons with low vision, combining screen enlargement with audio feedback through the use of a speech output system reduces the need to continually view the screen when typing and, thus, reduces eye fatigue.

Speech Output Systems

Speech output systems provide both audio feedback when pressing keys on the keyboard and speech access to information displayed on the monitor. A speech output system consists of both a software program and a speech synthesizer. The software program sends information from the computer to the synthesizer, where phonemes are combined into words and the words are spoken. Speech output systems are available for most computer hardware systems. Compatibility with specific graphic-user interface application programs must be determined on a case-by-case basis.

Electronic Braille Displays

Most persons with low vision who use the computer prefer to use screen enlargement or speech output systems. However, some proficient braille readers may benefit from the use of electronic braille displays. These devices provide dynamic, tactile access to information displayed on the screen through the use of cells with movable pins. Each cell contains six or eight pins that electronically raise and lower to reproduce one character displayed on the screen as a braille character. Cells are arranged in a contiguous line and, depending on the size of the device, can display 18, 20, 40, or 80 characters at once.

Although the cost of electronic braille displays is still high, the price of computer hardware and software is dropping. Multimedia computers include sound systems.
and run software programs that may include video clips and stereo sound stored on compact disk (CD).

CD-ROM

CD read-only-memory (CD-ROM) is a software storage device capable of holding large amounts of information. An entire set of encyclopedias or hundreds of novels can be accessed through the use of one CD. Information displayed on the computer screen from the CD can be accessed through the use of screen enlargement, speech output, and electronic braille displays. Many schools and public libraries have computers with CD-ROM drives and an assortment of CDs including science, reference, and historical documents.

Devices for Writing

The ability to write information and then access it at a later time is extremely important for managing home activities and for educational and vocational tasks. In addition to using bold-line paper with felt-tip markers or cassette recorders as writing devices, persons with low vision use carbonless paper notebooks, large-print typewriters, electronic presentation boards, electronic notebooks, and computers.

A variety of note-writing strategies can be used throughout the day as illustrated in the following example of a high school student with low vision. In math class, the student uses a hand-held telescopic monocular to view problems written on the blackboard. His classmate writes the problems down in a carbonless paper notebook that makes a copy of the written information on the page beneath. At the end of class, the classmate hands him a copy of the notes. The student can view this material on his CCTV at home. His economics class has a device called a Panaboard. This is an electronic presentation easel that contains a built-in photocopying and printing device that plugs into an electrical outlet. When the teacher is finished writing on the board, she simply presses a button and a copy of the information written on the board is printed and can be handed to the student. In other classes that are mostly lecture based, the student uses a cassette recorder. The student is taking a keyboard class so that, when he enters college, he will be able to write his own notes with a laptop computer.

Large-Print Typewriters

Large-print typewriters enlarge print output up to twice the normal width and up to four times the normal height of standard-size print. Most use a standard keyboard layout that can be adapted by the use of large-print keyboard labels. Many have built-in spelling checkers and editing capability, but these features require visual access to the small screen display area and may be difficult for persons with low vision to use. To have access to the more sophisticated features of a word processor, many persons with low vision use a computer with a word-processing program.

Computers as Writing Devices

A word-processing program transforms the computer into a sophisticated electronic typewriter. Written information can be created, edited, printed, and stored for later use. Optional writing tools include a thesaurus, a dictionary, spelling and grammar checkers, drawing tools, and even clip art to incorporate graphics into a document. “Smart” features may include the automatic creation of an envelope on the basis of the format of a letter and the storage of a handwritten signature for inclusion in the letter closing. Electronic notebooks and laptop computers provide portable writing systems. Many of these devices are battery operated and can be connected to an external computer monitor. Access to printed information and to information on the screen for persons with low vision can be provided through large print, speech output, and braille.

Many word-processing programs designed for young children include large-print, speech output, and color tracking options. These programs are modestly priced and use a speech synthesizer. The writer has the option of enlarging the text size up to 2 in. and using voice output for each letter, each word, and each sentence as text is created. With the use of an OCR scanning system, educators can scan instructional materials and textbooks into the computer and then use these inexpensive talking word-processing programs as reading machines.

The following case illustrates the integration of technology purchased by a school district into the regular classroom activities of a third-grade student with low vision. The student uses a laptop computer with a large-print talking word-processing program and a snap-on screen magnifier. Large-print keyboard labels and increased font size of the characters displayed on the desktop provide enhanced access to the keyboard and the screen. She uses a color CCTV to view book illustrations, maps, and diagrams in color. A teaching assistant trained in the use of the technology uses an OCR scanner to enter reading and instructional materials directly into the computer. When using her laptop to read independently at her desk, the student uses headphones so that the speech output does not interfere with other classroom activities. A braille printer and a braille translation program are used to convert materials stored in the laptop computer into braille so that the student’s mother, who is blind and reads braille, can assist her with reading and translation.

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homework assignments.

Access to word-processing programs is provided by first loading a character enlargement or a speech output program or both into memory before loading the word processor. The most difficult aspect of using these programs in the background is ensuring that they are compatible with each other and with the application program. IBM-compatible computers have the largest selection of large-print and speech output systems. The Macintosh computer is unique in that a character enlargement program called Close View is provided as part of the software at no additional cost.

Managing Money and Banking Tasks

Reading and writing tasks associated with home and business finance include reading bills and bank statements, writing checks, calculating totals, balancing bank accounts, identifying paper money, and using a cash register. In addition to the devices used for other reading and writing tasks, there are large-print and talking calculators, cash registers, and credit card machines; pocket-size devices that identify denominations of paper currency; and computer programs for accounting and bookkeeping tasks, calculating and filing income taxes, and printing checks.

Access to Electronically Stored Information and Remote Computers

Through the use of a modem and a telephone line, library resources can be accessed by home personal computers equipped with large-print or speech output access. Prodigy, America OnLine, and CompuServe are computer-based commercial information services that can be accessed by a personal computer with a modem (see the Appendix). They provide a wide variety of information for a flat fee per month and in most communities use a local phone number. Informational topics available include

- national and international news
- stock market information
- articles from encyclopedias
- consumer product reviews
- lists of hotels, restaurants, and other travel information
- film reviews
- restaurant reviews
- electronic messages sent to and received from other subscribers of the service.

Many of these services list and briefly describe merchandise from a variety of catalogs. Items can be ordered with the computer and paid for with a credit card (Jahoda, 1993).

The following example demonstrates how remote access technology can provide vocational opportunities for someone with low vision. A man in his late 30s was a systems analyst for a major metropolitan hospital before health problems and a visual loss related to diabetes forced him to stop driving. With help from a rehabilitation counselor and an electronic aids specialist, he is now operating a computer support business from his home. He works with a variety of computer programs and has a computer with a 20-in. monitor and a character enlargement program. He uses a modem, his telephone line, and a software program to remotely control computers in offices as far as 30 miles away. From his home office, he can install software, enter data, and print reports on the office computers. He uses a CCTV for access to printed information he receives from his fax machine. In addition, he uses a cordless telephone with a headset in conjunction with a voice-activated cassette recorder to record incoming calls so that he does not have to write notes.

Leisure Activities

Many mail-order companies sell large-print games, bingo cards, and playing cards, but leisure activities for persons with low vision are not limited to board games. With proper evaluation, modification, and consideration of safety factors, a wide variety of leisure activities are accessible including bicycling, running, camping, hiking, sailing, skiing, and even mountain climbing. Often, the adaptations necessary are nonoptical, such as the use of brightly colored flags mounted at strategic locations on a sailboat (Whittaker & Lovie-Kitchin, 1991).

Television is another important leisure activity that can be modified for persons with low vision. Narration systems are available for videocassettes and some television programs. In 1990, Descriptive Video Service began providing narrated descriptions of visual elements to some of its public broadcast programs (see the Appendix). To receive Descriptive Video Service, viewers need a stereo television, stereo videocassette recorder, or an adapter or decoder that will convert a monaural television set into stereo. Descriptive Video Service sells popular videotapes with descriptive narration. The narration of key visual elements does not interfere with the normal dialogue.

Another device that may be used for viewing television is the Low Vision Enhancement System or LVES (pronounced "Elvis"). LVES is a 16-oz. headset that provides a magnified view equivalent to a 60-in. television screen display as if it were 4 feet away. A small camera sends signals to cathode ray tubes in the arms of the headset.

Manufactured by Apple Computer, 20525 Mariani Avenue, Cupertino, CA 95014.

Available from Lions Vision Center, Johns Hopkins Wilmer Eye Institute, 550 N. Broadway, 6th Floor, Baltimore, MD 21205.
where small mirrors reflect the images from the headset through prescription lenses and into the wearer's eyes. Adjustments to alter the contrast and magnification levels are controlled via knobs on a power pack worn on the belt. The device is designed for persons with visual acuity ranging from 20/100 to 20/800. When the LVES is connected to a television or videocassette recorder, the person wearing the headset can view a show at a normal distance. By pressing a button, the person can return to camera input and look around the room, then switch back to watching television. The LVES can be connected to a computer to read text on the screen ("Eyewear: The Next Generation," 1993). The primary disadvantage of headborne devices is that of cosmetic appeal and client acceptance.

Often a rekindling of vocational interests along with a change in environment and participation in leisure activities can bring meaning back into the life of an older person experiencing a vision loss, as illustrated by a retired newspaper editor 82 years of age with age-related macular degeneration. The man uses large-print playing cards to participate in weekly bridge tournaments, a programmable phone with large-print numbers, and a CCTV to read his mail. Through the use of a word-processing program on a computer equipped with a character enlargement and speech output system, he writes a weekly column for a small newspaper. After correcting typing errors with the spelling checker, he uses a fax/modem to send his article directly from his computer to the computer in the newspaper office.

Summary

Devices and technology are tools that assist persons with low vision in ADL and educational, vocational, and leisure pursuits. Selecting the appropriate devices and ensuring their use is a multifaceted task that often requires a team of professionals working on both interpersonal and clinical levels with the client in multiple environments. As the number of persons with a vision loss is increasing, team members must be aware of the existing technology and resources. A resource guide for obtaining more information on all the devices and services described in this article is included in the Appendix. Many of the resources will provide free catalogs on request.

Appendix

Resources

America OnLine
8619 Westwood Center Drive
Vienna, VA 22182-2285
800-827-6564

American Foundation for the Blind
National Technology Center
15 West 16th Street
New York, NY 10011
212-620-2080

American Printing House for the Blind, Inc.
1839 Frankfort Avenue
PO Box 6085
Louisville, KY 40206
800-223-1839

Ann Morris Enterprises, Inc.
26 Horseshoe Lane
Levittown, NY 11756
516-292-9252

Assistive Devices for Reading
National Library Service Sept. 93 (78 pages)
Reference Circular No. 93-02
Library of Congress
Washington, DC

Bosser Specialties, Inc.
PO Box 15441
Phoenix, AZ 85060
800-776-5885

Brytech (Sensory 6)
E. L. Bryenton & Associates, Inc.
Suite 102, 28 Concourse Gate
Nepean, ON, Canada K2E 7T7
800-265-4065

CompuServe
5000 Arlington Center Boulevard
Columbus, OH 43220
800-848-8990

Dazor Manufacturing Corporation
4483 Duncan Avenue
St. Louis, MO 63110
314-652-2400

Descriptive Video Service
WGBH-TV
125 Western Avenue
Boston, MA 02134
617-492-2777

Don Johnston, Inc.
1000 North Rand Building-115
PO Box 639
Wallcondra, IL 60084-0639
800-999-4660

Eschenback Optic of America, Inc.
904 Ethan Allen Highway
Ridgefield, CT 06877
203-438-7471

Hoolean
260 Justin Drive
Cottonwood, AZ 86326
800-937-1337

Independent Living Aids, Inc.
27 East Mall
Plainview, NY 11803
800-537-2118

Innovative Rehabilitation Technology (Wide Angle Mobility Light)
1411 West El Camino Real
Mountain View, CA 94040
800-322-4784

Job Accommodation Network
West Virginia University
809 Allen Hall
Vis-Aids, Inc.
102-09 Jamaica Avenue
PO Box 26
Richmond Hill, NY 11418
800-346-9579

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