

Low Vision: Practical and Hi-Tech Solutions for Visual Impairment and Blindness

Access to care of the partially sighted and blind has been limited, for the most part, to developed nations. But that is all beginning to change in our 'flat-world' hi-tech society.¹

On December 16, 2004, the WHO released new data on the prevalence of global blindness.² It was noted that, according to the figures compiled in 2002, there were 161 million people who are visually impaired.³ Of these, 124 million are considered to have low vision⁴ and 37 million are considered to be blind.⁵ Of these, 90% of the world's blind live in developing countries: nine million in India, six million in China and seven million in Africa.⁶

But only four major eye conditions result in almost 75% of the world's individuals having low vision. They include age-related macular degeneration, glaucoma, diabetic retinopathy, and cataracts.

Vision care has become very specialised in developed nations. There are anterior segment (corneal, glaucoma, contact lens, and cataract specialists) posterior segment (retinologists), paediatric, sports medicine, neuro, as well as low vision specialists. The latter are involved in the care of the partially sighted or visually impaired. The low vision clinicians include optometrists or ophthalmologists worldwide who have special training in managing individuals with reduced vision as well as irreversible vision loss in both eyes.

The specialty of low vision is considered to be a tertiary area of care in which patients are not only under the care of a low vision clinician but the care of a specialist managing the eye pathology (eg retinal or glaucoma specialist). The patient, in fact, may be managed in a multi-specialty group practice taking care of all the vision related problems. They may also be in a private practice specialising in low vision, as well as in a vision rehabilitation organisation, a university or hospital based eye clinic, as well as veterans administration blind rehabilitation centers (in the US: Chicago, Atlanta, Palo Alto, W. Haven Ct.).

Vision rehabilitation services and teamwork are generally required and provided, regardless of whether it is a congenital, early onset, or adventitious aetiology. The vision rehabilitation team includes the optometrist or ophthalmologist specialising in low vision and care of the partially sighted. It is their primary responsibility to perform the low vision evaluation as well as prescribe and design low vision devices. The other members of the vision rehabilitation team include the social worker to deal with issues such as: vision loss, depression, family dynamics, and loss of independence. The team also includes a vision rehabilitation specialist or occupational therapist (OT) to instruct patients in the use of the low vision devices as well as to teach them independent living skills. Mobility specialists may be called upon, as well, for the teaching of independent travel, along with educators of the visually impaired and job placement specialists.

The Clinical Low Vision Examination

The specialised low vision evaluation is a functionally oriented examination to determine patient specific objectives and needs, to maximise the residual vision with prescriptive lenses, low vision devices, and hi-tech solutions. These objectives may include such diverse demands as,



A patient with age-related macular degeneration using a strong (microscopic) reading lens.

reading the label on a prescription medication bottle, reading the daily newspaper, being able to access the computer screen, travelling independently and safely in an unfamiliar area, being able to see the Professor's PowerPoint presentation in college, being able to see the markings on the insulin gauge, reducing glare in the environment, accessing your PIN code, seeing the menu at a fast food restaurant, or using the ATM in the Bank. The history will also investigate comorbidities,

such as diabetes or stroke and how they may affect the patient's goals and objectives as well.

The low vision examination also consists of a specialised battery of tests designed to evaluate the patient's visual function. It includes specially designed vision charts that measure even the lowest levels of vision. The preferred visual acuity chart for testing is the ETDRS (Early Treatment of Diabetic Retinopathy) chart which is also used for all clinical trials in the United States.⁷ These logarithmic charts have been statistically validated to record changes in vision over time as well as to record vision as low as 1/40 (20/800). Patients with vision of less than 2/40 (20/400) may have need of other vision rehabilitation services such as mobility in order to learn how to travel safely and independently in their environment. Individuals possessing only light perception or no vision at all (functionally blind) will also be referred for mobility training in the use of a cane.

Contrast sensitivity functional (CSF) testing was added to the low vision battery of tests by the author and Eleanor Faye, MD in 1981. CSF measures the ability to see objects (eg print, road signs), as the contrast decreases. That is, how black does an object have to be, before it can be seen. Contrast sensitivity is becoming an important outcome measure in patient management as it relates to quality of life issues. It is affected by the major pathologies such as macular degeneration, cataracts, and diabetic retinopathy. Magnification, the usual method of improving performance, may not be as effective as much as enhancing the contrast by strategies such as increasing the illumination in all environments.

It is important to map out the visual field using automated perimetry, as well, in eye diseases such as glaucoma, optic nerve disease and systemic conditions such as stroke. Trauma may also lead to significant loss of the visual field as does retinitis pigmentosa. The latter is a progressive disease that generally results, not only in a loss of the peripheral vision but night blindness, and significant mobility problems. There is no treatment at this time to slow the degeneration of the peripheral retina but exciting genetic research (eg ABCR gene)⁸ may lead to a cessation of progression. Again mobility, or newer hi-tech methods such as use of the GPS, especially when the visual field is severely compromised, will be essential for independent travel.

The other examination components include a specialised low vision refraction test to determine whether a spectacle correction will be beneficial for distance, intermediate, and near tasks, an Amsler grid to evaluate the central 20 degrees of the visual field, as well as an ocular health analysis.

The ability to enhance visual function is one of the objectives of the evaluation and magnification and



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enhancing the CSF are ways of achieving this objective. Increasing the magnification can be done in three ways: relative size, relative distance, and angular magnification. In relative size magnification, the object of regard can be physically enlarged such as the print in a large print book. The object of regard can be brought closer to the eye, in relative distance magnification, so that the object subtends a larger retinal image and appears much larger. In angular magnification the object can be made to appear to be closer to the eye and thus appear larger (eg seeing the train or airport departure board).

Low vision devices will generally allow the user to bring an object closer to the eye and thus magnify the retinal image size. Enhancing the contrast is a different story and may require a hi-tech device, a filter, as well as techniques such as using a bold line pen when writing.

In addition to prescriptive lenses for distance (television, theatre), intermediate (reading music, the computer screen), and near tasks (reading) are specialised low vision devices. The low vision devices includes strong reading lenses (microscopic lenses), magnifying systems (hand and stand magnifiers), telescopic systems (for use in museums, independent travel or, classroom work), absorptive lenses and filters (for reducing glare as well as increasing the contrast), and hi-tech devices that are known as closed-circuit televisions.

High plus microscopic lenses are readily available up to 12x (48 diopters – focal distance of less than 2.03cm) magnification. Optical magnification, for all practical purposes is good up to 6x (24 diopters; focal distance 4.1cm). Most individuals cannot manage the close working distance or the restricted depth of field in high magnification systems. Illuminated magnifiers, especially illuminated stand magnifiers that sit on the page are available up to 15x (60 diopters). The image stays in focus since the magnifier sits on the page but the field of view as well as ease in reading significantly decreases as the magnification increases.

That is where the closed circuit television comes into play. As the world moves ahead to a hi-tech age, so will the field of low vision, enabling individuals with the most profound vision loss access to information on the web. The closed-circuit television, which is a dedicated system that can enlarge print up to over 40 times the size of the original print as well as enhance contrast, has been around for 35 years. The ability to reverse polarity, that is changing the black letters on a white background to white on black is perhaps the major feature of the closed-circuit television. There are brightness and contrast controls as well as systems that allow a user to isolate a line. This feature is extremely beneficial when it is difficult to locate or isolate a line of print. It is also helpful in the loss of the visual field from a stroke or tumour.

Assistive technology has become much more common in the workplace in the United States. Microsoft found that 27% of computer users have a vision difficulty and have added much greater accessibility in their programme updates. These include screen enlargers that move around the screen like a magnifier, screen readers that present graphics and text as speech,

speech recognition systems that allow for voice input commands, screen synthesisers also known as text to speech systems that allow blind users to play back their Word document including the words, numbers, and punctuation. Other programmes for the blind include refreshable Braille in which a line of print is displayed and then will refresh to play another line, a Braille embosser that has the capability of transferring computer generated images into embossed Braille, talking word processors, as well as large print processors.⁹ In addition Microsoft has included tutorials for the blind and visually impaired for programmes ranging from Windows XP to accessing the internet.

Accessing the ATM has been difficult if not impossible for the blind and partially sighted. This has begun to change with the Northern Bank and Clydesdale Banks in Belfast and Glasgow as well as Bank of America in San Francisco launching systems that are truly accessible. The Northern Bank's 'cashpoint' is used by plugging a set of headphones into a jack, which is fitted to the front of the ATM. The machine uses an automated voice to give instructions about the exact location of items such as the numbers on the keypad, the cash dispenser and all other devices on the machine. It also talks through each stage of the process, whether a user wants to check a balance or withdraw cash. Sighted users can also use the machine by following instructions displayed on screen.^{10,11}

Even shopping in mega stores such as WalMart in the United States is becoming more accessible. WalMart has begun to install state-of-the-art point of sale devices in their stores to protect the privacy and security of shoppers with visual impairments. They explain that the¹² new devices have tactile keys arranged like a standard telephone keypad and will allow shoppers who have difficulty reading information on a touchscreen to privately and independently enter their PIN and other confidential information.

But the holiday season will also be accessible throughout the world with talking catalogues, accessible accounting and cheque writing programmes for the blind and visually impaired, talking barcode readers, as well as talking mobile phones and PDAs.¹³

One of the ways to keep up with innovations for the blind and visually impaired is through the use of websites such as VisionConnection from Lighthouse International in the United States. VisionConnection allows for customisation of the screen with the ability to change the font size as well as enhance the contrast.

Additional vision rehabilitation services may be indicated when the vision is severely compromised. As mentioned mobility may be indicated when the visual field is reduced, especially when it is less than 6 to 8 degrees in diameter. Cane travel is generally taught by individuals who have lost their vision later in life from conditions such as macular degeneration. It is generally the most frequent recommendation by vision rehabilitation organisations in the United States. Individuals with congenital and early childhood loss however, may be taught the use of guidedogs as well. There is a significant

dichotomy in the preferred method of travel among the different vision rehabilitation organisations in the US.

One of the newer methods of travel is by use of the GPS systems such as Trekker. They have adapted the system for people who are blind or visually impaired and allow them access to talking menus, talking maps and GPS information. There are other features enabling the user to determine his or her position, including the street address and the surrounding intersections.

There are traditional as well as hi-tech strategies that will significantly improve the quality of life, regardless of the extent of vision loss. And accessing those strategies is easy for everyone through websites such as <http://www.VisionConnection.org/>¹⁴

Access to low vision care, as well as access to reimbursement for low vision devices varies tremendously around the world. The Medicare programme in the United States, for example, does not cover the cost of a low vision evaluation or low vision devices. Governments as well as non-governmental organisations have to begin recognising the low vision health crisis throughout the world as well as include the visually impaired in health care programmes. We have the solutions for improving the quality of life in visually impaired people of all ages. We must now look for the collective strategy as well as funding to increasing access and availability, regardless of level of vision impairment, as well as socio-economic status.

References

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3. Visual impairment is vision loss involving the loss of an area of visual function (e.g. Visual acuity, visual field, contrast sensitivity, color vision)
4. The definition of low vision used by the WHO: Low vision is visual acuity less than 6/18 (20/60) and equal to or better than 3/60 (in the better eye with best correction).
5. Blindness refers to a total loss or no usable vision.
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