REFRACTIVE ERROR AND LOW VISION AS PUBLIC HEALTH ISSUES

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THIS CHAPTER WILL INCLUDE A REVIEW OF:

- Refractive error blindness and visual impairment
- Andhra pradesh eye disease study (APEDS)
- Prevalence of uncorrected refractive error visual impairment
- Onset of refractive error at younger ages
- Uncorrected presbyopia
- Addressing uncorrected refractive error – disease control
- The Durban declaration on refractive error and service development
- Availability and accessibility of affordable refractive error correction
- Spectacle coverage and spectacle wear compliance
- Infrastructure and establishing sustainable eye care systems
- Advocacy for uncorrected refractive error
- Refractive error correction and quality of life
- Summary of refractive error blindness and visual impairment
- Low vision

REFRACTIVE ERROR BLINDNESS AND VISUAL IMPAIRMENT

THE ABSENCE OF REFRACTIVE ERROR 'ON THE MAP'

Although the World Health Organization (WHO) has a long history of blindness prevention – having started a trachoma program in the 1950s and an onchocerciasis control program in the 1970s – it did not consider uncorrected refractive error as a major cause of blindness and visual impairment until very recently (see Figure 6-1).

WHO believed that the main causes of blindness and visual impairment were cataract, trachoma, glaucoma, onchocerciasis and xerophthalmia.Refractive error was not considered or mentioned.This is largely because the traditional definition of blindness was based on best corrected visual acuity, rather than presenting visual acuity – thus not taking into account the level of vision with which people actually function in their daily lives, and thereby grossly underestimating refractive error visual impairment .

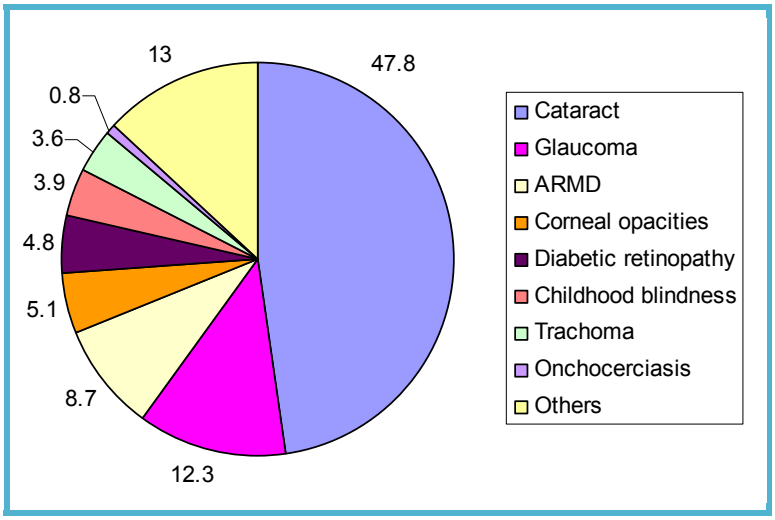

Figure 6-1:*Global causes of blindness as a percentage of total blindness – as estimated in 2002 (uncorrected refractive error was not included)*
Source: *Resnikoff et al, 2004*

When *VISION 2020* was launched in 1999 with the mission statement "*…..to eliminate the main causes of blindness in order to give all people in the world, particularly the millions of needlessly blind, the right to sight*", refractive error was for the first time included in the priority list of causes of preventable blindness.But even then the magnitude of the problem was not apparent yet.

It was only on World Sight Day in 2006, that the WHO revealed for the first time its updated estimates of blindness and visual impairment, outlining the magnitude of refractive error visual impairment. An estimated 153 million people are visually impaired (presenting VA <6/18 in the better eye) as a result of uncorrected refractive error at distance, of which at least eight million are blind (presenting VA <3/60 in the better eye).Around 45 million working age adults and 13 million children globally are affected by uncorrected refractive error, 90% of them living in low or middle income countries.These WHO figures do not include visual impairment as a result of uncorrected presbyopia, which is estimated to affect as many as 500 million people over the age of 45 (see Fig. 6-2).

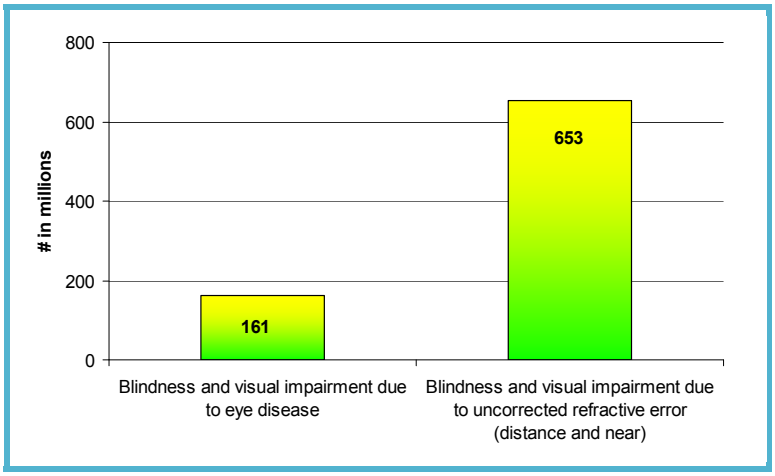

Figure 6-2: *Number of people affected globally by blindness and visual impairment due to eye disease and uncorrected refractive error (including presbyopia)*

READING

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We know now that uncorrected or under-corrected refractive error is a major cause of blindness and the leading cause of visual impairment in the world.It affects people of both sexes, as well as all age and ethnic groups, and may result in lost education and employment opportunities, lower productivity and impaired quality of life for otherwise healthy people.The interventions required to eliminate or prevent refractive error blindness are quite simple and very cost effective. In most cases an eye examination and an appropriate pair of spectacles can provide an immediate solution to the problem – making refractive error the most treatable of all causes of visual impairment.It is a great tragedy then, that millions of people, especially in the developing world, are functionally blind simply because they don't have access to basic eye care services and affordable spectacles.

ANDHRA PRADESH EYE DISEASE STUDY (APEDS)

The APEDS was a landmark study, which helped to draw attention to the issue of refractive error blindness and visual impairment (Dandona et al, 2002).The aims of the study were to determine the prevalence and causes of blindness and visual impairment, the prevalence and risk factors for major eye diseases, barriers to the uptake of eye care services, as well as quality of life among those who are visually impaired.This information could then be used in the design of long-term blindness prevention strategies.

While cataract was found to be the leading cause of blindness, refractive error was identified as the second major cause of blindness and the leading cause of moderate visual impairment.

Higher risk factors for blindness were identified as increasing age, lower socioeconomic status, female gender and rural area of residence.

READING

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PREVALENCE OF UNCORRECTED REFRACTIVE ERROR VISUAL IMPAIRMENT

We estimate that uncorrected refractive error accounts for up to 25% of all blindness and more than 50% of all visual impairment in the world.But there is still insufficient data available on the prevalence and types of refractive error in different populations and age groups.Comparing information from studies that have been done is also not always possible, as they use different approaches to measuring refractive error (with or without cycloplegia, for example) and sometimes even different definitions for visual impairment and cut-off points for refractive error.Figure 6-3 shows the breakdown by region of people who are vision impaired due to uncorrected refractive error around the globe (WHO, 2009).

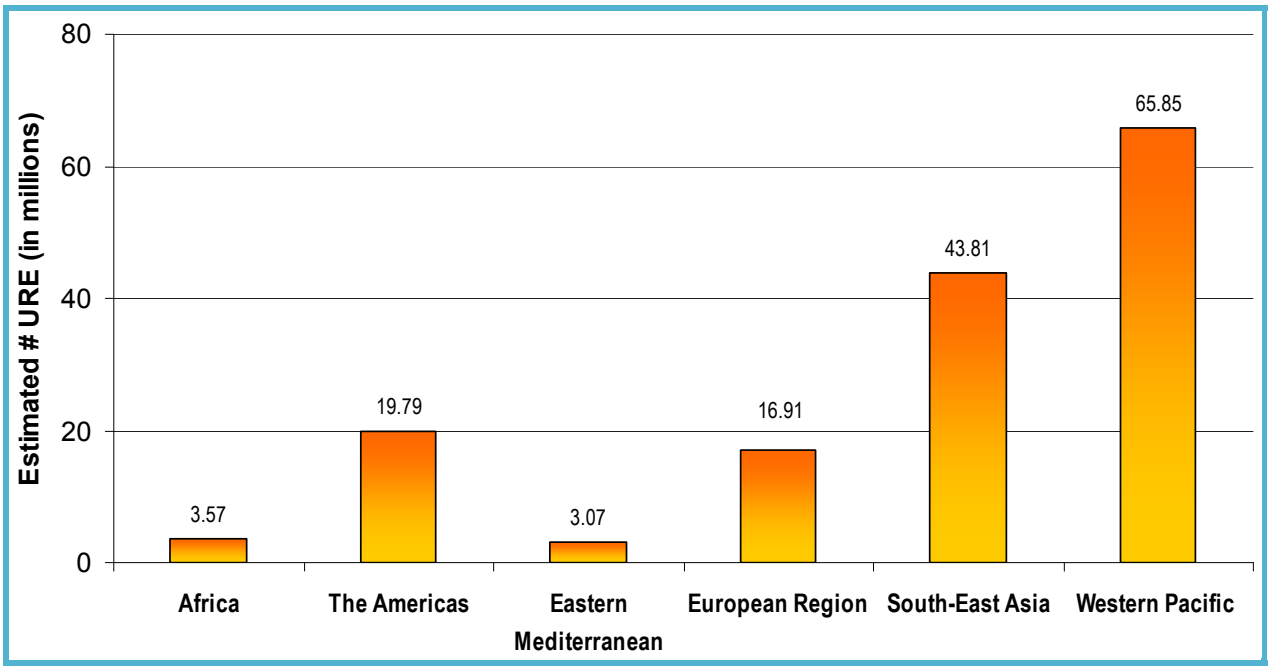

Figure 6-3: *Global Distance Uncorrected Refractive Error Estimates by WHO Region (Total = 153 million)*
Source: *Smith et al, 2009*

More epidemiological research is needed on the prevalence of uncorrected refractive errors and its trends.In a study in Australia, more than half of those who presented with visual impairment could have their vision improved with appropriate spectacles (Taylor et al. 2005) (see Fig. 6-4, 6-5, 6-6).

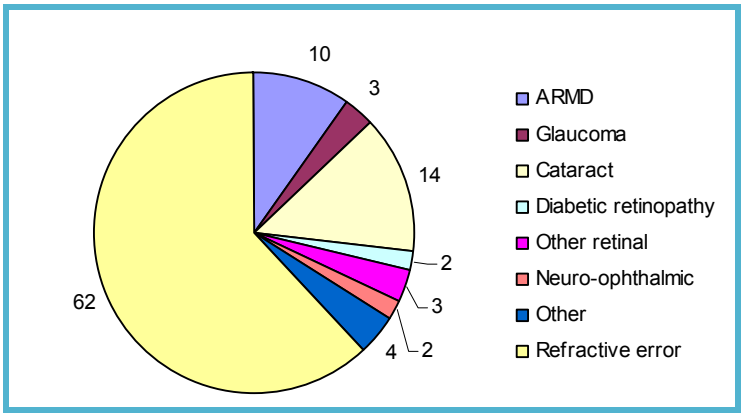

Figure 6-4: *Estimated numbers of people with presenting visual acuity* <6/12 caused by different conditions in Australia, 2004 (expressed as a percentage)*
** Presenting Visual Acuity = with spectacles if usually worn for distance viewing*
Source: *Taylor et al, 2005*

PREVALENCE OF UNCORRECTED REFRACTIVE ERROR VISUAL IMPAIRMENT(CONT.)

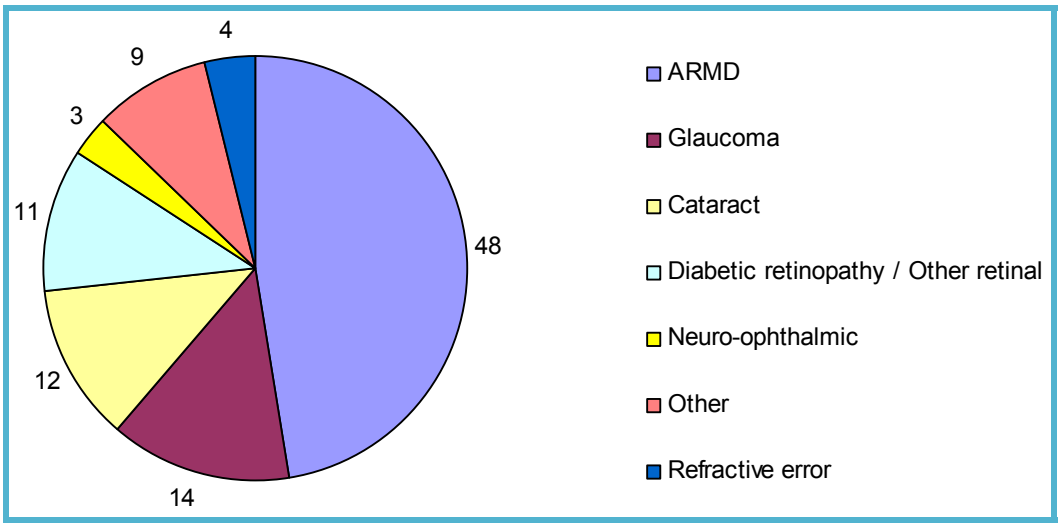

Figure 6.5: *Estimated numbers of people with blindness (presenting visual acuity* <6/60) caused by different conditions in Australia*
**Presenting Visual Acuity = with spectacles if usually worn for distance viewing*
Source: *Taylor et al, 2005*

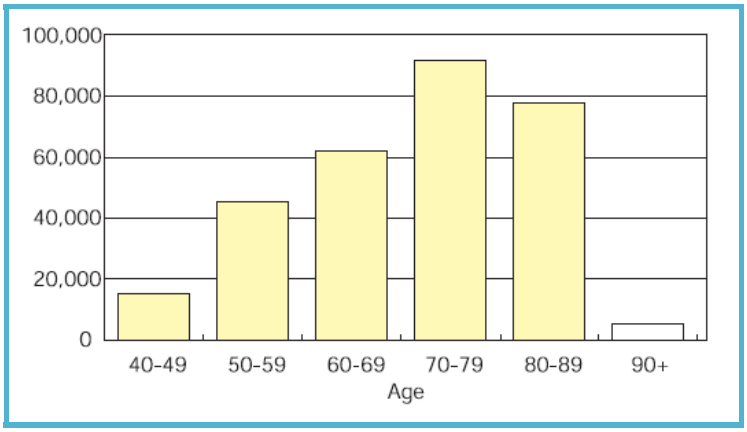

Figure 6-6: *Visual impairment due to uncorrected refractive error by age, estimated numbers.*

Access Economics Pty Ltd. 2004. . The economic impact and cost of vision loss in Australia.Eye Research Australia and Clear Insight.Source http://www.cera.org.au/uploads/CERA_clearinsight.pdf

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PREVALENCE OF UNCORRECTED REFRACTIVE ERROR VISUAL IMPAIRMENT(CONT.)

REFRACTIVE ERROR DEFINITIONS

The Refractive Error Working Group (REWG) of the WHO recommends the following definitions for global use in refractive error studies, to achieve uniform and comparable data collection:

Myopia

For children: ≤ –0.75 DS

For adults:≤ –1.00 DS

Hypermetropia

For children: >+2.00 DS

Consider a near acuity standard

Anisometropia

≥ 2.00 DS in children

Astigmatism

> 2.00 DC

Presbyopia

Subject for whom the sum of distance correction and near add result in a net + lens of >+1 to achieve best near vision or < – 4.

VISUAL ACUITY DEFINITIONS

Uncorrected

Visual acuity without optical correction

Presenting

Visual acuity with habitual optical correction

If spectacles are not used, presenting and uncorrected visual acuities are equal

Best-corrected

Visual acuity with optimal spectacle correction

VISUAL IMPAIRMENT DEFINITIONS

Blindness

Presenting visual acuity less than 3/60 in the better eye

Visual impairment

Presenting visual acuity less than 6/12 in the better eye (0 to 15 years of age)

Presenting visual acuity less than 6/18 in the better eye (16 years of age and older)

Low vision

Best-corrected visual acuity less than 6/18 in the better eye

Near-point blindness

Presenting visual acuity at 40 cm less than N64 in the better eye

Near-point visual impairment

Presenting visual acuity at 40 cm less than N10 in the better eye

Rapid assessment can provide practical and cost-effective means to estimate prevalence in countries with limited resources for full-scale studies.

PREVALENCE OF UNCORRECTED REFRACTIVE ERROR VISUAL IMPAIRMENT(CONT.)

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ONSET OF REFRACTIVE ERROR AT YOUNGER AGES

Globally, uncorrected refractive error is the main cause of visual impairment in children aged 5–15 years.The prevalence of myopia is increasing dramatically – especially in children – and particularly in the urban areas of South-East Asia.

Compared to the other major causes of visual impairment (like cataract), refractive error usually sets in at a younger age.Therefore, if it is not corrected, refractive error causes significantly more blind years than most other causes.

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ONSET OF REFRACTIVE ERROR AT YOUNGER AGES(CONT)

REFRACTIVE ERROR STUDIES IN CHILDREN (RESC)

These are a series of population-based surveys of refractive error and associated visual impairment in school-age children of different ethnic origins, which were conducted in different geographic regions, using a common protocol.These studies illustrated that visual impairment in this age group is largely due to refractive error, which remains uncorrected in almost half the cases – especially in low and middle class populations.This is a serious public health problem which requires cost-effective solutions.The RESC studies also proved that the prevalence of myopia and hyperopia varies considerably across geographic regions.

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UNCORRECTED PRESBYOPIA

Although more refractive error studies have been conducted in children than in adults, uncorrected refractive error probably affects a larger percentage of the adult population – especially those over the age of 45, when presbyopia usually sets in. Uncorrected presbyopia causes widespread, avoidable visual impairment across the globe – but predominantly in the developing world.

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ADDRESSING UNCORRECTED REFRACTIVE ERROR – DISEASE CONTROL

We currently have insufficient evidence of the most cost-effective ways of delivering refraction services in different settings.But we do know that refraction services need to be strengthened and/or developed in target populations if we are to be successful in eliminating refractive error visual impairment and reducing the magnitude of uncorrected presbyopia.

Uncorrected refractive errors are increasingly being included in national blindness prevention plans.Assessment of individuals for refractive error also provides an opportunity to screen for, and refer, other potentially blinding conditions such as cataract, glaucoma and diabetic retinopathy.

Refractive services should be comprehensive, available at all levels, and include:

- *Case identification* of individuals with poor vision that can be improved through spectacle correction
- *Effective eye examination and refraction* to determine correction required and to identify co-existing eye conditions
- *Spectacle correction* for individuals examined who have disabling refractive error, ensuring good fit of the correct prescription
- *Visual health promotion* to build client and community awareness about refractive error, the benefits of correction and the availability of services
- A*ppropriate referrals* for individuals who have eye or vision problems beyond the scope of the provider's training, with particular emphasis upon problems prioritized by the national *VISION 2020* program
- *Follow-up* to ensure compliance with prescription, and repair or replacement of spectacles if required

Children between ages 11 and 15 years, and adults over 45 years of age should receive priority in the provision of refractive error services.Public awareness could be improved through community-based services and eye health programs in schools – which would help generate demand for services.

To ensure the uptake of refractive services by the community, every effort should be made to provide refractive services which are:

- *Affordable*
- Of good *quality*, with a high success rate in terms of visual acuity
- Culturally *acceptable*
- *Equitable* – accessible regardless of race, ethnicity, gender, socio-economic status, religion of geographic location
- *Consistently* available
- Developed, managed and evaluated in *partnership* with the community

ADDRESSING UNCORRECTED REFRACTIVE ERROR – DISEASE CONTROL(CONT.)

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THE DURBAN DECLARATION ON REFRACTIVE ERROR AND SERVICE DEVELOPMENT

On 16 March, 2007, more than 650 international delegates at the Inaugural World Congress on Refractive Error and Service Development in South Africa witnessed the signing of the Durban Declaration on Refractive Error and Service Development (Naidoo et al, 2007). The purpose of the Congress was to advocate public health strategies and identify priorities for meeting the global burden of avoidable blindness from uncorrected refractive error and presbyopia.

The Durban Declaration recognises that:

- The greatest contribution to a severe worldwide lack of refractive error services is the lack of trained personnel to provide them
- The need for refractive error services is most pronounced in poor and marginalised communities

The Durban Declaration resolves to:

- Create global awareness of the impact of refractive error on sufferers, their families and community and the need for services
- Advocate to National Governments and world health care agencies for the policies, services and resources required to meet the needs
- Strive to overcome the barriers that prevent those with refractive error and low vision from obtaining the same services, rights and opportunities as others
- Ensure refractive error services are prioritised in planning and development of National Health Plans
- Invest in training of eye care workers and professionals
- Support the establishment of global distribution channels to make high quality spectacles available
- Encourage research and application of the results to achieving the most effective solutions
- Work to build relationships with private sector and service providers to expand availability of sustainable services

READING

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AVAILABILITY AND ACCESSIBILITY OF AFFORDABLE REFRACTIVE ERROR CORRECTION

In addition to well-trained mid-level personnel, the elimination of refractive error visual impairment requires access to new, affordable, good quality spectacles.However, in many areas of the world, the spectacles needed for refractive error correction are too expensive or not available at all.

Most blindness prevention programs, at least initially, opt for mass-produced, 'low cost' ready-made spectacles – similar to the low-cost reading glasses available in pharmacies and department stores.These ready-mades provide spherical correction (both plus and minus) of the same power in both eyes, and may provide adequate correction (or at least a good starting point) for many presbyopes and people with distance vision problems where little or no astigmatism or anisometropia is present.Ready-made spectacles are convenient for both the refractionist and the patient, and can be dispensed directly following the refraction, thus saving the patient from the effort and expanse of having to return to the clinic to collect spectacles at a later date.

Because ready-made spectacles are produced at a low cost per unit, their quality may not always be very high, and care should be taken when selecting a brand of ready-mades for blindness prevention programs.Spectacles with unsatisfactory appearance and fit, poor optical quality and questionable durability should never be used, no matter how 'low cost' they are.

Not all patients can be corrected with ready-made spectacles – especially if they have conditions like significant anisometropia and/or astigmatism.Prescribing and dispensing custom-made spectacles requires access to an optical workshop staffed by personnel trained to edge and fit lenses into spectacle frames.

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SPECTACLE COVERAGE AND SPECTACLE WEAR COMPLIANCE

A study in Bangladesh measured spectacle coverage to be 25.2%, while a similar study in Timor Leste showed that only 15.7% of those with distance refractive error and 26.2% of presbyopes had spectacle correction (Aldebasi Y, 2011); Ramke et al, 2007).

The results of studies looking at spectacle compliance vary widely.A survey in India of people over 15 years old with refractive error of +/–3.00D or higher, found that only 34.2% of them were wearing their glasses at the time of the follow-up (Dandona et al, 2002). Of those not wearing their spectacles, 43.8% stated it was either because the prescription was incorrect, or the frame was too uncomfortable.Since people with refractive error of +/–3.00D or higher are quite likely visually impaired, their poor compliance was most likely due to poor quality refractive services.

But even in cases where the refraction was performed adequately, and the correct prescription is properly fitted in a comfortable and attractive spectacle frame, spectacle compliance is not always guaranteed.

SPECTACLE COVERAGE AND SPECTACLE WEAR COMPLIANCE(CONT.)

In China, about 70% of the children who needed spectacle correction were wearing their glasses at the time of their examination (He et al, 2005).Lack of parental awareness was identified as the problem in 50% of the cases where spectacles were never purchased.In cases where the parents were aware, about half did not want their children to wear spectacles, while about 25% had a problem with the cost (He et al, 2007).

Affordability was also one of the main reasons for people to discontinue spectacle use in the APEDS.In a study of Mexican school children who received spectacles (in round frames) at no charge through Helen Keller International, only 13.4% of them were wearing their spectacles during a follow-up check (Castanon Holguin et al, 2006).Another 34% had their spectacles with them, but were not wearing them.The main problem here seemed related to the appearance of the round spectacle frames.

It is clear that new, creative strategies are needed to improve spectacle compliance, and we cannot assume that the provision of spectacles has solved the problem of uncorrected refractive error visual impairment.

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INFRASTRUCTURE AND ESTABLISHING SUSTAINABLE EYE CARE SYSTEMS

The recruitment and retention of eye care human resources depend not only on the training they receive, but also on factors such as working conditions.Appropriate infrastructure and clinical facilities should be established where eye care personnel can function upon completion of their training.

Considering the barriers to utilization of eye care services as perceived by the community, and developing effective strategies for optimal use of the infrastructure, is also important.

The establishment of optical workshops in a community facilitates the availability of affordable eyewear and builds capacity for sustainable delivery systems, with the additional advantages of job creation and skills transfer for local personnel. Such optical workshops should become sufficiently sustainable and operate within a full cost-recovery model.

The delivery of refractive services creates opportunities to also screen for other ocular conditions like cataract. At the same time, spectacle supply and dispensing can generate income – not only to provide an income to the mid-level personnel, but to fund more costly initiatives such as cataract surgery or the provision of low vision devices. In this way, sustainable and comprehensive eye care delivery systems are created.

All blindness prevention initiatives should aim to become self-sufficient as soon as possible, to ensure long-term sustainability of the program.

This could happen through a variety of strategies, or combinations thereof, such as:

- Engaging with the community and developing local partnerships
- Integration within the existing health care system/services in the country

INFRASTRUCTURE AND ESTABLISHING SUSTAINABLE EYE CARE SYSTEMS (CONT.)

- Cost recovery through reduced fees for spectacles to those in need, and by offering value-added services to wealthier patients, when appropriate
- Continuing education provision to ensure that staff provide excellent services and follow-up
- Committing sponsors for the program

READING

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ADVOCACY FOR UNCORRECTED REFRACTIVE ERROR

Because health care providers and policy makers alike underestimate the potential socio-economic impact of uncorrected refractive errors in the community, the issue requires continued advocacy.

Advocacy for refractive error should aim to:

- Increase knowledge of refractive error blindness and visual impairment
- Mobilize resources to address the refractive error problem
- Increase the quality of eye care provision
- Enhance the credibility of the VISION 2020 initiative

Key audiences which should be challenged to eliminate disabling refractive error include:

- At-risk groups and their communities
- Governmental and health officials
- Eye care professionals
- Corporations in the eye and vision care industry
- International not-for-profit organisations
- Donor agencies and donor communities

VISION 2020 advocacy resources include:

- World Sight Day
- The VISION 2020 website (www.vision2020.org)
- The VISION 2020 newsletter
- Coordinated projects with international and professional organisations
- A VISION 2020 public relations group

Other useful resources for advocacy can be found at:

Useful Resources for advocacy. Journal of Community Eye Health. 2007. 20(64).Source: http://www.cehjournal.org/download/ceh_20_64_076.pdf Accessed 21 Aug 2012

ADVOCACY FOR UNCORRECTED REFRACTIVE ERROR(CONT.)

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REFRACTIVE ERROR CORRECTION AND QUALITY OF LIFE

Eliminating visual impairment due to uncorrected refractive error will significantly improve worldwide standards of eye care, health and quality of life.

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SUMMARY OF REFRACTIVE ERROR BLINDNESS AND VISUAL IMPAIRMENT

Until recent years, uncorrected refractive error was virtually ignored as a cause of blindness and visual impairment.The problem is now getting the worldwide attention that it deserves, and is recognised as the primary cause of moderate vision impairment throughout the world.

Without appropriate spectacle correction, millions of children lose educational opportunities and adults face vocational limitations. Families are frequently pushed into a cycle of deepening poverty because of their inability to see well.

Even though the provision of appropriate spectacles is one of the simplest, most cost-effective strategies to improve vision, intervention strategies are yet to reach many of the people most in need, as a result of inadequate service delivery, human resources, affordable technology, equipment and infrastructure to create capacity in each country in need.

SUMMARY OF REFRACTIVE ERROR BLINDNESS AND VISUAL IMPAIRMENT(CONT.)

Eliminating avoidable blindness due to refractive error requires:

- Effective screening programs to detect refractive error blindness in the population
- The training and appropriate deployment of adequate numbers of eye care personnel to perform reasonable-quality refractions, especially in remote and rural areas
- The development of suitable infrastructure for eye care, including the provision of new, affordable, good quality, spectacles to those in need, especially in underserved areas
- Spectacles which are culturally acceptable, attractive, comfortable and durable

To help improve the awareness of the benefits of spectacles to improve vision, cultural differences need to be taken into account so that efforts and resources are not wasted through non-compliance.

Refractive services should focus on children, the poor, and adults of 45 years and older, and should be integrated at all levels of eye care provision, including outreach.

The lack of refraction services and spectacle provision in underserved communities impacts negatively on quality of the life, not only for the individual, but also for their families and society as a whole.

In order to achieve the goals of VISION 2020, models of sustainable vision care need to be developed and adapted to the cultures of each country (see Fig. 6-7).

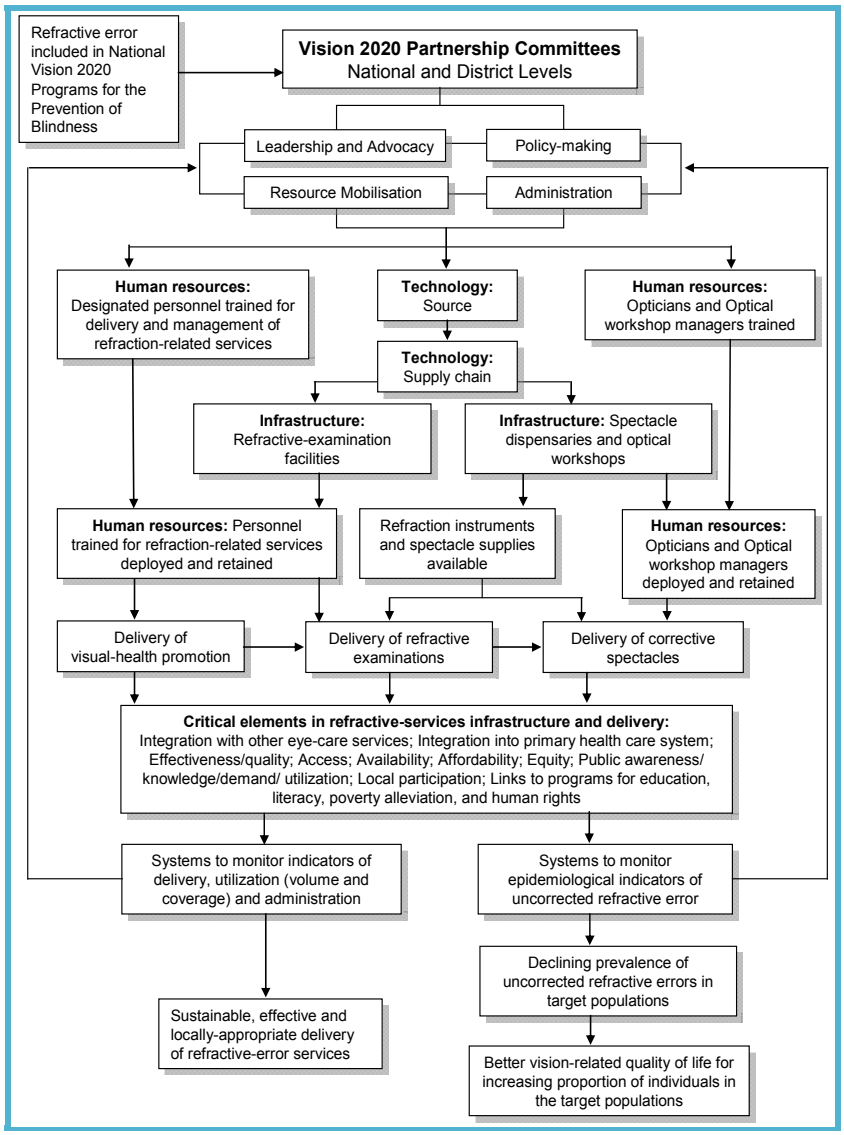

Figure 6-7:*Conceptual framework for the elimination of refractive error blindness and visual impairment*
Source:*Refractive Error Working Group of WHO*

LOW VISION

Low vision is defined as permanent visual impairment which is not correctable with refractive error correction or surgical intervention.According to WHO, 'low vision' is visual acuity <6/18 and ≥3/60 in the better eye with best correction, or a visual field less than 10 degrees from the point of fixation.Low vision services are aimed at people who have some residual vision that can be used or enhanced by specific aids.

Currently, an estimated 124 million people worldwide have low vision, or serious visual impairment short of blindness.About a fourth of them would benefit from low vision services (see Fig. 6-8).

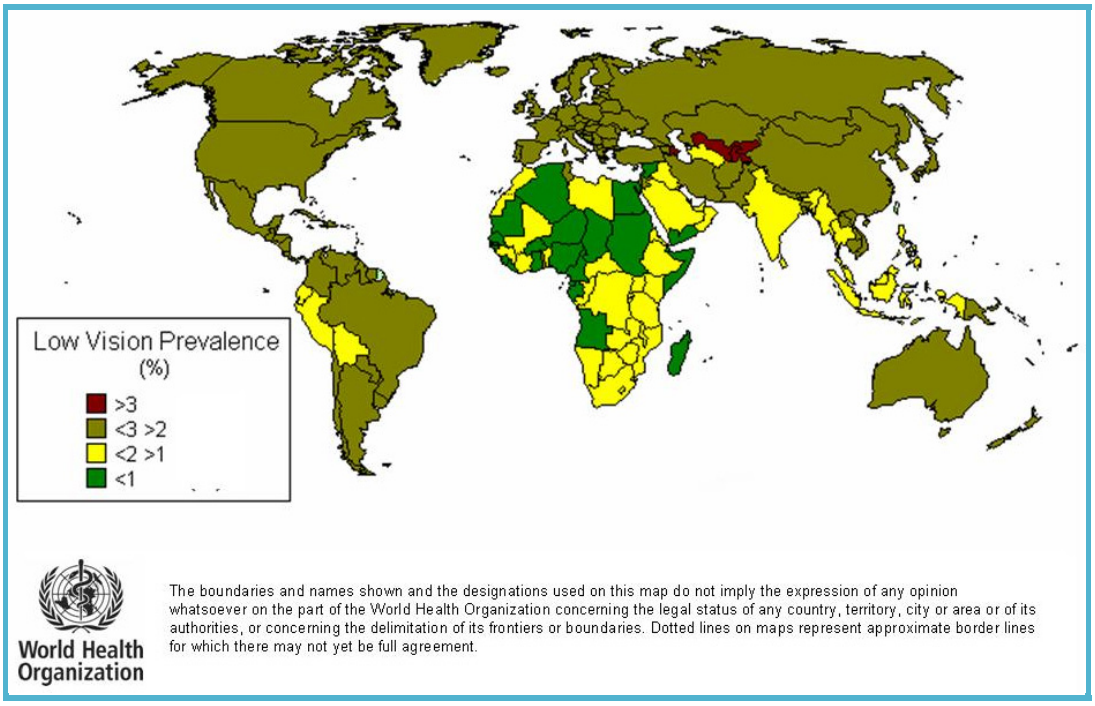

Figure 6-8: *Prevalence of Low Vision*
Source:*http://www.who.int/blindness/data_maps/low_vision.jpg*

THE VISION 2020 AIMS FOR LOW VISION

- Enhance vision-related quality of life for people with functional low vision
- Increase awareness about low-vision care among eye-care professionals and persons with functional low vision
- Provide evidence on the prevalence and causes of functional low vision
- Establish comprehensive low-vision care for children and adults
- Provide evidence for barriers to access to low vision services
- Provide evidence for the impact of low vision services on quality of life

These objectives are achieved through a combination of the following strategies:

- Intense advocacy for the increased awareness of low vision services, the inclusion of low vision care as part of eye care, education and rehabilitation services, and for awareness about low vision and low vision services in the community and among health, education and rehabilitation professionals
- Inclusion of low vision in the curriculum of ophthalmologists, optometrists and other eye-care practitioners
- Courses to train national focal persons in low vision program management, and mentoring of those who have participated in training – to ensure that they work with national VISION 2020 committees to establish low vision services
- Dissemination of the existing curriculum and materials for training primary- and secondary-level personnel in the provision of low vision services
- The establishment and/or promotion of low vision services in tertiary- and secondary-level eye care centres
- The development of networks with other global campaigns, such as those of the World Blind Union and the International Council for Education of People with Vision Impairment

LOW VISION(CONT.)

- Summarizing available evidence and conducting new research on the best practice for the provision of low vision services, their impact on life, and limitations or barriers to their provision and uptake
- Documentation of existing models of effective and comprehensive low vision care at primary, secondary and tertiary levels of eye care – in both developed and developing countries
- The transfer of knowledge between countries to encourage the establishment of new programs where needed
- Promotion of the development of high quality, affordable low vision devices to increase access
- The distribution of good quality, affordable low vision devices and equipment to all regions through low vision resource centres, such as the one currently operating from Hong Kong
- The establishment of new regional low vision resource centres as required

CHALLENGES FACING THE DEVELOPMENT AND PROVISION OF LOW VISION SERVICES

- There is usually a lack of adequate epidemiological data to assist with the planning process
- There is not much available evidence on the cost-effectiveness of low vision services interventions
- The provision of low vision services is often not favoured by eye care practitioners because it is usually not very profitable
- Persons who would benefit from low vision services are often not aware that they can be helped to make the most of their remaining vision
- Inadequate communication and referral between eye care personnel, special education teachers, and rehabilitation and low vision services
- Planning for low vision services is inadequate in many national blindness prevention plans

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