

Community Eye Health

An International Journal to Promote Eye Health Worldwide

SUPPORTING VISION 2020: THE RIGHT TO SIGHT

Selected and Updated Articles
from the *Journal of Community Eye Health*
1988–2003

**A Global Review and Practical Manual for the
Prevention of World Blindness**

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The Founder Editor is deeply grateful to colleagues of the Editorial Committee and Consulting Editors / Regional Consultants who have supported the fulfilling commitment of producing the *Journal of Community Eye Health* since it was first published in 1988 (please see 'Officers' on the next page). At the time of publication of this book, the Journal reaches 178 countries worldwide.

The team at the International Resource Centre; Ms Sue Stevens (Nurse Consultant), Ms Ann Naughton (Director of Finance & Administration) and Mrs Anita Shah (Editorial Secretary) have been hugely supportive in realising the publication of this book. Anita has graciously typed, changed and adjusted her work according my whim and vacillation.

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Finally, my deep gratitude to the many authors who have contributed to the *Journal of Community Eye Health* over fifteen years, through original articles and/or updated articles. These colleagues and friends are, or have become, authorities in their own fields of expertise and experience.

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Dedicated to
Ruth, David (1972–2000), Andrew & Caroline
a supportive and wonderful family

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Preface

'Lord that I might receive my sight' – Luke 18 v 41

Many years ago, in Afghanistan, the *Journal of Community Eye Health* was 'given to me to do' – and the first issue was published in 1988. Now, after fifteen years, the fulfilling task of Editor has been handed over to a very able colleague, Victoria Francis.

Through the role of Editor, there has been the opportunity and privilege of meeting and working with many colleagues and friends committed to the prevention of world blindness and VISION 2020: The Right to Sight. This is truly an international community of health workers which recognises where the needs are greatest, with sufficient vision and selfless purpose to work closely together seeking to eliminate avoidable blindness worldwide. The World Health Organization, the International Agency for the Prevention of Blindness, International and National Non-Governmental Development Organisations, WHO Collaborating Centres for the Prevention of Blindness, Universities, Colleges, Hospitals and Individuals – all demonstrating a common goal of reducing blindness and visual impairment especially for the underprivileged in our world.

During the past fifteen years, the *Journal of Community Eye Health* has sought to provide a service to health workers – not only to specialists but those who are simply 'faced with eye problems' – ophthalmologists, doctors, ophthalmic nurses, general nurses, optometrists, refractionists, ophthalmic medical assistants, ophthalmic technicians, community health workers. . . . Perhaps appropriately, this period of time has seen a growth in the development of eye care services – policies for disease control, human resource development, and infrastructure and appropriate technology provision – all central to VISION 2020: The Right to Sight. It has been the ethos and purpose of the Journal, from the outset, to bring health workers up to date with current thinking and practice – a process of continuing medical and health education. A survey of readers of the Journal, in 1998, found that 60% of readers 'had nothing else' as resource material and a similar percentage said that the Journal had changed or influenced their practice. It is an encouraging thought that the Journal has played some part in providing knowledge and disseminating information, interpreting views and policy in health care practice to its readers and, thereby, preventing blindness and visual impairment around the world.

It was many years ago that thoughts of a book of selected articles from the Journal first appeared. I am so grateful to the many who have contributed to the Journal and, also, to this book. Please see 'Acknowledgements' and 'List of Authors'. While the Journal continues as a quarterly publication with, we anticipate, an increasing circulation (it now reaches 178 countries), this book of selected and updated articles, published electronically and as 'hard copy', is part of the ongoing process disseminating knowledge and information. Many of the photographs in this book are from the Teaching Slides/Text Sets produced by the International Resource Centre, International Centre for Eye Health, at the London School of Hygiene & Tropical Medicine.

This book is dedicated to my own family – Ruth, my wife, David, our son whom we lost in a car accident in 2000 (and a founding Trustee of ICTHES World Care), our second son, Andrew, International Development Director for ICTHES World Care and our daughter Caroline, an occupational therapist. Each has been an enormous support in this labour of love over the years.

I also want to express my gratitude and pay tribute to the team at the International Resource Centre, naming those who have served longest and in the more recent years – Sue Stevens (Nurse Consultant), Ann Naughton (Finance and Administration Director) and Anita Shah (Editorial Secretary).

Thank you, all of you. God bless you each one.

DD Murray McGavin

VISION 2020: The Right to Sight. A Global Initiative for the Elimination of Avoidable Blindness



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The global number of blind and visually disabled seems to be growing despite considerable efforts in many developing countries through national blindness prevention programmes – mainly as an effect of population increase and ageing. Thus, the most recent (1997) projected estimate for world blindness points to some 45 million blind, and an additional 135 million visually disabled ('low vision'). About 80% of blindness is avoidable (preventable or curable), and nine out of 10 of the world's blind live in a developing country.

To address this alarming situation, with its potential doubling of the world's blindness burden by 2020, a series of consultations were held during 1996 and 1997, between the WHO Programme and the Task Force to the Partnership Committee of collaborating Non-Governmental Organisations, with a view to developing a common agenda for global action against avoidable blindness. The expected result would be a strengthened and accelerated movement for blindness prevention, particularly in the developing world.

Following these consultations, the Global Initiative for the Elimination of Avoidable Blindness is focusing on a few priority disorders, and what action needs to be taken from now to the year 2020, to promote eye care delivery in 3 areas:

- Disease control.
- Human resource development.
- Infrastructure strengthening and appropriate technology development.

Disease Control

Cataract stands out as the first priority amongst the major causes of blindness, with an estimated present backlog of 16–20 million unoperated cases. The



Spectacle aphakic correction for an 'only' eye in Uganda

Photo: Murray McGavin

number of cataract operations/million population/per year is a useful measure of the delivery of eye care in different settings. This demonstrates great differences, as follows:

| Operations/Million Population/Per Year | |
|--|--------------------|
| Africa | approximately 200 |
| Latin America | 500–1500 |
| India | approximately 2000 |
| Europe | approximately 3000 |
| USA | approximately 5000 |

Thus, there is a need to increase drastically the number of cataract surgeries in the developing world. In 1995, it was estimated that approximately 7 million operations were performed globally, projecting the need to perform 12 million surgeries in the year 2000, to prevent a further growth of the backlog. Similarly, by the year 2010, 20 million operations should be done – and in 2020, an impressive 32 million cataract operations will be needed. At the same time as

numbers go up, there should also be a change in technology with intraocular lens implantation as a common standard, and the proper follow-up of quality of surgery. This will call for better management and monitoring of services, including patient satisfaction.

Trachoma is still the most common cause of preventable blindness in the world, with some 5.6 million blind, and around 146 million cases of active disease in need of treatment. A suitable strategy, referred to as '*SAFE*' (Surgery, Antibiotics, Facial Cleanliness and Environmental Hygiene) has been defined, and is being increasingly applied in endemic countries. A recently established (1997) WHO Alliance for the Global Elimination of Trachoma will facilitate collaboration with all interested parties, including 46 endemic countries with blinding trachoma. Actions envisaged under the Global Initiative include the provision of around 5 million trichiasis surgeries, from the year 2000 to 2010, and treating at least 60 million people with active disease in the same period. By the year 2020, global elimination of blindness due to trachoma should be achieved.

Onchocerciasis will be brought under control by the year 2010, if ongoing programmes in endemic countries are successfully completed. The recent development of community-directed treatment with annual doses of ivermectin will make it possible to eliminate this burden of blinding disease from the countries affected in Africa and Latin America.

Childhood blindness is caused mainly by vitamin A deficiency, measles, conjunctivitis in the newborn, congenital cataract and retinopathy of prematurity. There is rapid progress in eliminating xerophthalmia and measles, as part of 'child survival' initiatives, supported by several UN and other organisations. However, much more work is needed to detect, at an early stage, the other causes of childhood blindness and to manage them optimally.

Refractive errors and low vision constitute another priority in terms of visual disability. There is an enormous need globally for spectacles and low vision devices. The Global Initiative will focus on refractive services as part of primary health care and school services, while local low-cost production of glasses and optical devices will also be promoted.

Human Resource Development

In the field of **human resource development** emphasis will be put on the primary health care approach to blindness prevention. This implies continuing support for primary eye care training in countries. In addition, there will be strengthened efforts to train more ophthalmologists, improving the present situation of one ophthalmologist per 500,000 people in Africa, to achieve 1:250,000 by the year 2020. The corresponding figures for Asia would rise from 1:200,000 today, to 1:50,000 in 2020. Similarly, increased training of ophthalmic medical assistants and ophthalmic nurses should result in a ratio of 1:100,000 or 1:50,000 in the year 2020, (as compared to 1:400,000 today in Africa

and 1:200,000 in Asia respectively). It is also envisaged that there should be 100% coverage of training in basic eye care in medical schools by the year 2020. Other categories of staff to be trained under the Global Initiative include refractionists, managers for national/regional programmes and major clinics, and also equipment technicians.

Infrastructure and Appropriate Technology

Infrastructure and appropriate technology development is the third essential component of the Global Initiative. Standards for the availability of eye beds, refraction facilities, basic eye medicines, etc. will be applied, to make sure that the availability, access, utilisation and coverage of basic eye care will be at least 90% to all populations in the year 2020.

With regard to appropriate technology development, emphasis will be put on the sustainable use of modern technology, making use of local production in developing countries whenever appropriate. The particular fields of interest, concern instruments and consumables for cataract surgery, basic eye examinations, trichiasis surgery, glasses and other optical devices, as well as computers and other communications systems for effective management and co-ordination of work.

The Global Initiative is still in its early planning phase, but there is a clearly recognised need for a global awareness campaign, to sensitise decision-makers and health care providers as to the rationale and great benefits of blindness prevention. The anticipated future scenario – of a doubling of world blindness by the year 2020, unless more preventive action is taken, is unacceptable from a humanitarian point of view, and would have far-reaching socio-economic and developmental consequences. This is why a strengthened partnership between all those working for blindness prevention is essential for optimal utilisation of resources available today and in the future.

The Global Initiative was launched jointly by the World Health Organization and the Task Force of Collaborating NGOs within the International Agency of Prevention and Blindness (IAPB) in February 1999 in Geneva, under the theme '*VISION 2020: the Right to Sight*'.

This event received considerable coverage in global mass media, and '*VISION 2020*' has since been introduced and officially launched through WHO and IAPB in all regions.

There are a number of ongoing developments and planned projects within '*VISION 2020*', involving countries, NGO partners and international development agencies.

'*VISION 2020*' holds much hope for the future, and it will, no doubt, become a major forum for action in the field of blindness prevention. This is urgently needed to avoid a disastrous situation for future generations of millions of people – needlessly blind.

□

The Resolution of the World Health Assembly on the Elimination of Avoidable Blindness



FIFTY-SIXTH WORLD HEALTH ASSEMBLY
WHA 56.26

Agenda Item 14.17: 28 May 2003

Elimination of Avoidable Blindness

The Fifty-sixth World Health Assembly,

Having considered the report on elimination of avoidable blindness;¹

Recalling resolutions WHA22.29, WHA25.55 and WHA28.54 on prevention of blindness, WHA45.10 on disability prevention and rehabilitation, and WHA51.11 on the global elimination of blinding trachoma;

Recognizing that 45 million people in the world today are blind and that a further 135 million people are visually impaired;

Acknowledging that 90% of the world's blind and visually impaired people live in the poorest countries of the world;

Noting the significant economic impact of this situation on both communities and countries;

Aware that most of the causes of blindness are avoidable and that the treatments available are among the most successful and cost-effective of all health interventions;

Recalling that, in order to tackle avoidable blindness and avoid further increase in numbers of blind and visually impaired people, the Global Initiative for the Elimination of Avoidable Blindness, known as VISION 2020: The Right to Sight, was launched in 1999 to eliminate avoidable blindness;

Appreciating the efforts made by Member States in recent years to prevent avoidable blindness, but mindful of the need for further action,

1. URGES Member States:

- (1) to commit themselves to supporting the Global Initiative for the Elimination of Avoidable Blindness by setting up, not later than 2005, a national VISION 2020 plan, in partnership with

WHO and in collaboration with nongovernmental organizations and the private sector;

- (2) to establish a national coordinating committee for VISION 2020, or a national blindness prevention committee, which may include representative(s) from consumer or patient groups, to help develop and implement the plan;
- (3) to commence implementation of such plans by 2007 at the latest;
- (4) to include in such plans effective information systems with standardized indicators and periodic monitoring and evaluation, with the aim of showing a reduction in the magnitude of avoidable blindness by 2010;
- (5) to support the mobilization of resources for eliminating avoidable blindness;

2. REQUESTS the Director-General:

- (1) to maintain and strengthen WHO's collaboration with Member States and the partners of the Global Initiative for the Elimination of Avoidable Blindness;
- (2) to ensure coordination of the implementation of the Global Initiative, in particular by setting up a monitoring committee grouping all those involved, including representatives of Member States;
- (3) to provide support for strengthening national capability, especially through development of human resources, to coordinate, assess and prevent avoidable blindness;
- (4) to document, from countries with successful blindness prevention programmes, good practices and blindness prevention systems or models that could be modified or applied in other developing countries;
- (5) to report to the Fifty-ninth World Health Assembly on the progress of the Global Initiative.

Tenth Plenary Meeting, 28 May 2003
A56/VR/10

The Resolution of the World Health Assembly on the Elimination of Avoidable Blindness

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The word 'resolution', is a derivative of the French word, 'soluere', meaning 'to solve', and is defined by The Oxford Dictionary as:

'The formal expression of opinion or intention by a legislative body or public meeting'.

The Resolution on the Elimination of Avoidable Blindness adopted by the Fifty-sixth World Health Assembly meeting in Geneva on the 28 May 2003, therefore, has special significance.

The Resolution was adopted by the member states unanimously and testifies first and foremost to the fact that the Right to Sight is not a contentious issue.

The Resolution is a statement of intent based on an assessment of the prevailing situations with regard to avoidable blindness and its consequences. The Resolution first urges member states to take note of the magnitude, and far reaching consequences of needless blindness and visual impairment in their own countries, generally among the poorest of their poor citizens. Next, it urges a course of action for the World Health Organization, to be carried out in collaboration with her various partners. This takes the form of supportive actions to member states, to make their stated intent a reality.

Thus, there is political awareness and commitment, The Resolution also calls for enhanced support from WHO, the International Agency for the Prevention of Blindness, its constituent members, including professional bodies, civil society organisations and the private sector – to assist member states. This provides a new opportunity to stem the rising tide of avoidable blindness through the synergy derived from working in Partnership. This Partnership is seen as an unique strength of the Global Initiative. The international aid

community emphasises national capacity development as a critical factor in poverty alleviation. This is equally applicable to VISION 2020. Such an effort at capacity development, will promote self-reliance and increasing sustainability.

The stated objective of VISION 2020: The Right to Sight is the global elimination of avoidable blindness by the year 2020. In the process of achieving this objective it is hoped that each member state will develop a sustainable, comprehensive eye care system as an integral part of the national health system. This will ensure that avoidable blindness is eliminated as a public health problem in all countries, and within any community.

The Resolution deals with plans of action, implementation, targets, monitoring and evaluation. These are all important elements as we move the Global Initiative forward.

However, plans in themselves mean little unless these are implemented. Enhanced implementation will require better utilisation of existing resources, in the first instance, and new additional resources where appropriate. Acquisition of new resources must go hand in hand with learning how to deploy these resources to accomplish often complex tasks. Implementation without monitoring what is being done, and evaluating their outcomes, is to live in the complacent world of 'presumed merit'.

The WHA Resolution is a wake-up call, based on the realisation of a major escalating public health crisis in the field of eye health – a crisis with far reaching socio-economic, developmental and quality of life implications. It is also a crisis against which we can act, using the knowledge, skills, and cost effective interventions already at our disposal.

The Global Initiative provides us all with an opportunity to translate our resolve and plans into action. History will prove whether we seized and acted on that opportunity to ensure the right to sight for all persons.

BLINDNESS WORLDWIDE

Global Data on Blindness

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Globally, it is estimated that there are 38 million persons who are blind. Moreover, a further 110 million persons have low vision and are at great risk of becoming blind. The main causes of blindness and low vision are cataract, trachoma, glaucoma, onchocerciasis, and xerophthalmia; however, insufficient data on blindness from causes such as diabetic retinopathy and age-related macular degeneration preclude specific estimations of their global prevalence.

The age-specific prevalences of the major causes of blindness that are related to age indicate that the trend will be for an increase in such blindness over the decades to come, unless energetic efforts are made to tackle these problems. More data collected through standardized methodologies, using internationally accepted (ICD-10) definitions, are needed. Data on the incidence of blindness due to common causes would be useful for calculating future trends more precisely.

Introduction

The number of blind in the world is not accurately known, but it has been estimated at various times by WHO. Thus, in 1972, it was reported that there might be 10–15 million blind globally. In the same year, when a WHO Study Group on the Prevention of Blindness was convened, this value was recognised to be an underestimate, even though based on information provided by Member States.¹ The Study Group recommended and made a great contribution to the future collection of data on blindness, by proposing uniform definitions of blindness and visual impairment, which have been included in the *International Statistical Classification of Diseases, and Related Health Problems, tenth revision (ICD-10)*.

When the WHO Programme for the Prevention of Blindness (PBL) was established in 1978, its priority

was to obtain more detailed knowledge about blindness and its causes worldwide. A Task Force on Data on Blindness was therefore convened and this developed an epidemiological model for blindness estimates in relation to the developmental stage of the country.²

The programme has, from its outset, developed a simplified population-based assessment methodology for visual loss and its causes.³ This has resulted in a standard form and method for low-cost, small-scale field surveys that can be conducted mainly by trained non-specialist staff. The application of this methodology in an increasing number of countries had led to a gradual accumulation of epidemiologically reliable data.

In addition to the WHO Global Data Bank on Blindness (BDB) for the collection and dissemination of epidemiological information and trends assessment, work was undertaken in 1993, in collaboration with the World Bank, to measure the burden of blindness. For this purpose, PBL provided estimates of the prevalence and incidence of the following blinding diseases: cataract, glaucoma, trachoma, and onchocerciasis. The 'global burden of disease' approach combines the premature loss of life with the loss of healthy life years from a disability; the global burden of disease is measured in units of disability-adjusted life years (DALYs).⁴

This review reports on, and discusses the available information on the prevalence, distribution, and causes of blindness in the world. Described also are the trends in the prevalence of blindness over the last two decades. Attention is drawn to some of the assumptions made, and the methodological issues involved in the calculation of the data. Finally, areas are identified that require further investigation.

Methods

Definitions

In this article, the definitions of blindness and visual impairment used follow those included in ICD-10.

- Blindness is defined as visual acuity of less than 3/60 (0.05), or corresponding visual field loss in the better eye with best possible correction (visual impairment categories 3, 4, and 5 in ICD-10). This corresponds to loss of walk-about vision.

- Low vision corresponds to visual acuity of less than 6/18 (0.3), but equal to or better than 3/60 (0.05) in the better eye with best possible correction (visual impairment categories 1 and 2 in ICD-10).

Data collection

The background information for this article was obtained from selected, epidemiologically sound data on blindness and visual impairment. Two main sources were used to identify relevant existing information as outlined below.

- Routine, periodic computerized search of relevant information carried out as part of an ongoing updating of the BDB. This involves a three-step process. First, all abstracts are scanned to identify subject matter of interest. Next, all relevant materials are reviewed in depth and a checklist is used for eligibility criteria for inclusion. Finally, an in-house discussion is held to arrive at a consensus for inclusion of the new data in the bank.

For this purpose, the following inclusion criteria have been established:

- Clear, unequivocal definitions of blindness and low vision have to be stated (preferably according to the ICD-10 categorization).
- Cross-sectional design (prevalence survey), ensuring a clear description of the sample design and sampling plan; a random allocation of study sampling units; a large enough sample to achieve the desired degree of precision; and a fair assessment of non-sampling errors with a description of the quality control measures used.
- The data bank also receives unpublished information from national sources: a similar review process to that outlined above is applied to determine its suitability for inclusion.

To overcome the paucity of data on blindness from many parts of the world, a series of WHO consultations was organised. As a result, a consensus

was developed on extrapolating available data to neighbouring areas or in countries that share a similar sociocultural, economic and epidemiological environment. Where multiple sources of data were applicable for such extrapolation, agreement was reached on the most appropriate information for application in the model for a specific region or country, or for some groups at risk.

Assessment of the magnitude of the problem

Five specific models/algorithms were developed in order to estimate the magnitude of blindness and severe visual impairment and the major causes of blindness, i.e., cataract, glaucoma, trachoma and onchocerciasis.

In relation to 'other causes', defined as those causes of blindness and severe visual impairment unrelated to any of those listed above, the paucity of data available, particularly for diabetic retinopathy and age-related macular degeneration, precluded direct estimation of the prevalence of visual loss due to these causes.

Although each of these five models has a specific structure, they share a common framework. The models enable estimates to be made for defined regions, based on the assessment of specific prevalences by age, sex and, where indicated, race.

As a first step, the 229 countries/territories/economies registered worldwide were grouped, as proposed in the *World development report*, 1993, into eight economic regions (Table 1). Next, the demographic structure for 1990 was taken as the population base, by country and for the defined age groups.⁵ Regional totals were also calculated for these age groups and both sexes.

The selected parameters identified by the review process, were applied to the five age groups (0–4, 5–14, 15–44, 45–59, ≥60 years). Where appropriate, the sex, racial distribution (e.g., for glaucoma), and place of residence (e.g., for trachoma and onchocerciasis) were taken into account, as were urban/rural disparities. Projections of the number of blind people on a regional basis were made by applying the 'most valid' age-

Table 1: Distribution of Countries according to Economic Region^a

| Region | No. of countries or economies | Population (x 10³) |
|--|--------------------------------------|--------------------------------------|
| Established Market Economies (Western Europe, North America, Australia, Japan and New Zealand) | 35 | 797 788 |
| Former Socialist Economies of Europe | 14 | 346 237 |
| India | 1 | 849 515 |
| China | 1 | 1 133 698 |
| Other Asia and Islands | 49 | 682 533 |
| Sub-Saharan Africa | 49 | 510 271 |
| Latin America and the Caribbean | 46 | 444 297 |
| Middle-Eastern Crescent (with newly independent states in Central Asia) | 34 | 503 075 |
| Total | 229 | 5 267 414 |

^a See: *World development report*, 1993⁴

Table 2: Global Distribution of Blindness, by Economic Region

| Region | Reference population (x 10 ³) | No. of blind (x 10 ³) | Prevalence of blindness (%) |
|--------------------------------------|---|-----------------------------------|-----------------------------|
| Established Market Economies | 797 788 | 2 400 | 0.3 |
| Former Socialist Economies of Europe | 346 237 | 1 100 | 0.3 |
| India | 849 515 | 8 900 | 1.0 |
| China | 1 133 698 | 6 700 | 0.6 |
| Other Asia and Islands | 682 533 | 5 800 | 0.8 |
| Sub-Saharan Africa | 510 271 | 7 100 | 1.4 |
| Latin America and the Caribbean | 444 297 | 2 300 | 0.5 |
| Middle-Eastern Crescent | 503 075 | 3 600 | 0.7 |
| Total | 5 267 414 | 37 900 | 0.7 |

Table 3: Estimate of the Relationship between Blindness and Low Vision (ICD-10 definitions)^a

| Region | Blindness range (%) | Low vision range (%) | Multiplication factor |
|--|---------------------|----------------------|-----------------------|
| African (Sub-Saharan) (9 countries) | 0.3—1.3 | 1.4—3.6 | 2.0—7.0 |
| Middle-Eastern Crescent (6 countries) | 0.4—1.5 | 1.3—7.8 | 2.5—5.2 |
| Established Market Economy (1 country) | 0.5 | 1.3 | 3.3 |
| Other Asia and Islands (1 country) | 0.8 | 1.9 | 2.3 |
| Total (17 countries) | | | 2.9 ^b |

^a Based on data available in the WHO/PBL Blindness Data Bank from population-based surveys
^b Geometric mean value

Table 4: Regional Burden of Blindness (RBB)

| Region | % of global population (A) | % of global blindness burden (B) | RBB (B/A) |
|--------------------------------------|----------------------------|----------------------------------|-----------|
| Established Market Economies | 15.1 | 6.3 | 0.41 |
| Former Socialist Economies of Europe | 6.6 | 2.9 | 0.44 |
| India | 16.1 | 23.5 | 1.46 |
| China | 21.4 | 17.6 | 0.82 |
| Other Asia and Islands | 13.0 | 15.3 | 1.18 |
| Sub-Saharan Africa | 9.7 | 18.8 | 1.93 |
| Latin America and the Caribbean | 8.4 | 6.1 | 0.72 |
| Middle-Eastern Crescent | 9.6 | 9.5 | 0.99 |

Table 5: Global Distribution of Blindness, by Age

| Age (years) | Reference population size (x 10 ³) | No. of blind (x 10 ³) | Prevalence |
|-------------|--|-----------------------------------|--------------|
| 0–14 | 1 710 000 | 1430 (3.8) ^a | 8 per 10 000 |
| 15–44 | 2 445 000 | 2470 (6.5) | 1 per 1000 |
| 45–59 | 623 000 | 12000 (31.7) | 1.9% |
| ≥60 | 488 000 | 22000 (58.0) | 4.4% |
| Total | 5 266 000 | 37900 (100) | 0.7% |

^a Figures in parentheses are percentages

/sex-/race-specific rates to the demographic structure for 1990.

For estimating the magnitude of low vision, as defined in ICD-10 (categories 1 and 2), 17 relevant population-based surveys were analysed. From the estimate of blindness, this permitted a rough assessment of the extent of low vision, using a corrective factor.

Because of the considerable work already carried out in onchocerciasis control and in new initiatives in ivermectin distribution, data were used from the WHO Onchocerciasis Control Programme and Expert Committee reports. These are discussed below.

Results

Global magnitude of blindness and low vision

According to the algorithm elaborated, there were in 1990 about 38 million blind people in the world (Table 2). The global prevalence of blindness was 0.7%, ranging from 0.3% in the Established Market Economies and Former Socialist Economies of Europe to 1.4% in Sub-Saharan Africa.

Table 3 shows the relationship between blindness and low vision, based on surveys from 17 countries. Applying the multiplication factor 2.9 to the blindness estimate, the number of persons with low vision,

Table 6: Distribution of Blindness among those Aged ≥60 years, by Economic Region

| Region | Total population (x 10 ³) | Population aged ≥60 years (x 10 ³) | No. of blind aged ≥60 years (x 10 ³) | Prevalence (%) |
|---|---------------------------------------|--|--|----------------|
| Established Market Economies + Former Socialist Economies of Europe | 1 144 027 (21.7) ^a | 202 470 (41.5) | 2 450 (11.2) | 1.2 |
| Demographically developing countries | 4 123 385 (78.3) | 285 602 (58.5) | 19 550 (88.8) | 6.8 |
| Total | 5 267 412 | 488 072 | 22 000 | 4.5% |

^a Figures in parentheses are percentages

according to the ICD-10 definition, was about 110 million. Thus, the global burden of visual impairment (people blind or with significant visual loss) is estimated to have been about 148 million in 1990.

Regional distribution and regional burden of blindness

To address this issue and to provide an easy means of

comparison, the ratio of the proportion of the number of blind in a particular region to the global number of blind and the proportion of the regional population to the world population was determined. This ratio is referred to as the regional burden of blindness (RBB) (Table 4). Thus, if a region possesses 0.1 (10%) of world blindness and 0.2 (20%) of the global population, the RBB ratio is 0.5. If the region is characterised by a fair proportionate 'share' of blindness in relation to its

Fig. 1: Major Causes of Blindness by Economic Region

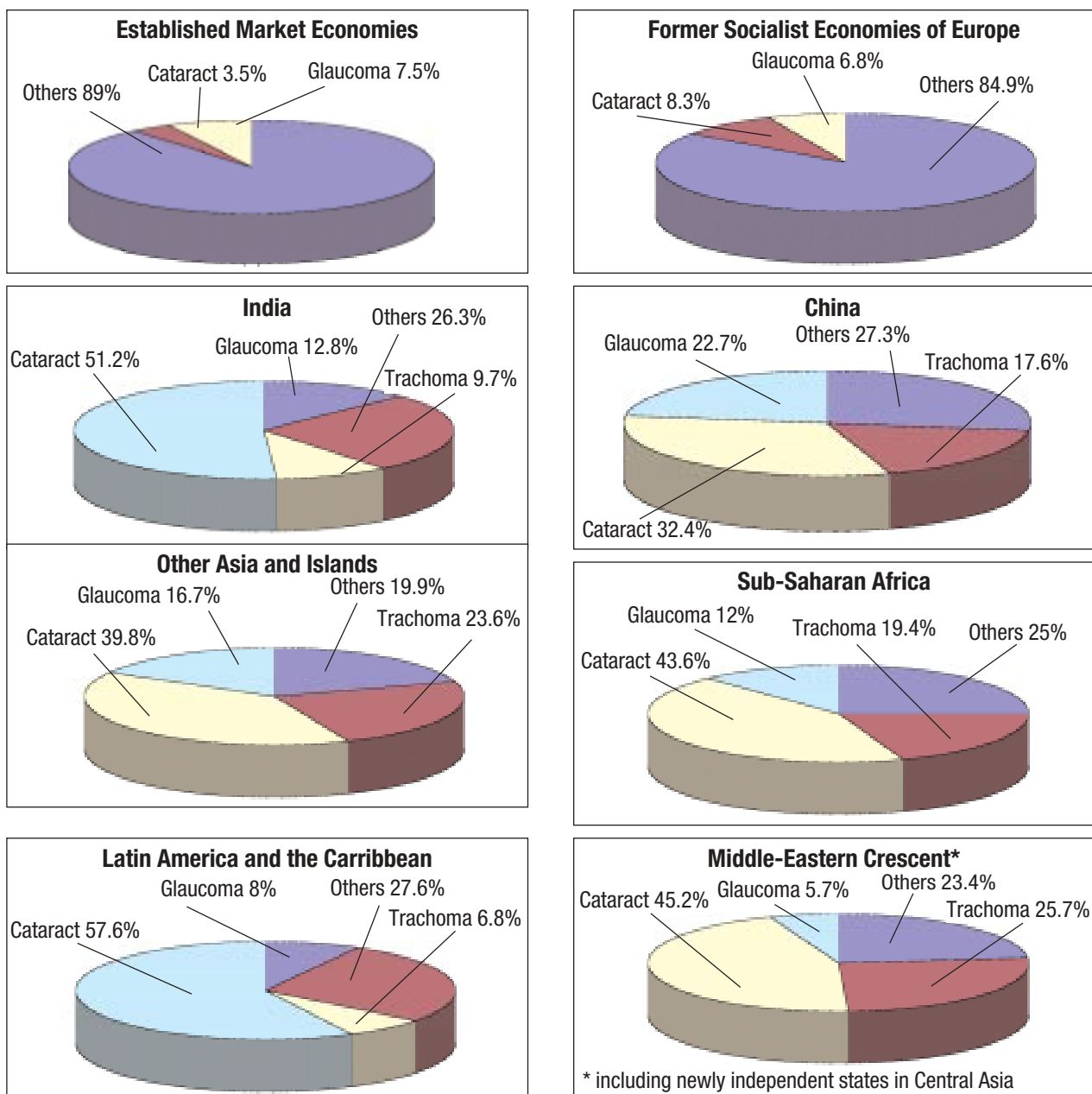


Table 7: Global Distribution of Blindness, by Major Cause and Region

| Region | No. of blind (x10 ³) from: | | | | | Total |
|--------------------------------------|--|-----------------|-----------------|----------------|------------------|-----------------|
| | Cataract | Trachoma | Glaucoma | Onchocerciasis | Others | |
| Established Market Economies | 84 | - | 180 | - | 2 136 | 2 400 |
| Former Socialist Economies of Europe | 91 | - | 74 | - | 935 | 1 100 |
| India | 5 120 | 865 | 1 141 | - | 1 774 | 8 900 |
| China | 2 166 | 1 174 | 1 514 | - | 1 846 | 6 700 |
| Other Asia and Islands | 2 314 | 1 362 | 973 | - | 1 151 | 5 800 |
| Sub-Saharan Africa | 3 101 | 1 380 | 853 | 358.5 | 1 407.5 | 7 100 |
| Latin America and the Caribbean | 1 326 | 158 | 183 | 1.5 | 631.5 | 2 300 |
| Middle-Eastern Crescent | 1 627 | 927 | 205 | - | 841 | 3 600 |
| Total | 15 829 (41.8) ^a | 5 866 (15.5) | 5 123 (13.5) | 360 (0.9) | 10 722 (28.3) | 37 900 (100) |

^a Figures in parentheses are percentages

Table 8: Population Growth and Ageing in Developed versus Developing Countries from 1980 to 2020

| Region | 1980 ^a | | 1990 ^b | | 2020 ^c | |
|---|--------------------------------------|---|--------------------------------------|---|--------------------------------------|---|
| | Total population (x10 ³) | Population aged ≥60 years (x10 ³) | Total Population (x10 ³) | Population aged ≥60 years (x10 ³) | Total population (x10 ³) | Population aged ≥60 years (x10 ³) |
| Established Market Economies and Former Socialist Economies of Europe | 1 136 668 | 173 325 (15.2) ^d | 1 144 027 | 202 470 (17.7) | 1 376 686 | 321 930 (23.4) |
| Others | 3 312 899 | 207 880 (6.2) | 4 123 385 | 285 602 (6.9) | 6 445 507 | 739 710 (11.5) |
| Total | 4 449 567 | 381 205 (8.6) | 5 267 412 | 488 072 (9.3) | 7 822 193 | 1 061 640 (13.6) |

^a Global estimates and projections of population by sex and age: the 1984 assessment. Unpublished United Nations document ST/ESA/SER.R/70, 1987
^b World Bank. World development report 1993. Investing in health⁴
^c U.S. Department of Commerce, 1991
^d Figures in parentheses are percentages

population, the RBB will be unity. Every RBB ratio greater than unity identifies those regions where the burden of blindness is to be taken into urgent consideration, in terms of setting up priorities on a global scale.

The following 'regions' have RBB ratios greater than unity: Sub-Saharan Africa (1.93), India (1.46) and Other Asia and Islands (1.18).

Distribution of blindness by age

Table 5 shows a breakdown of the global blind population, by age. A total of 58% (22 million) are aged ≥60 years, while at the other extreme, blindness is estimated to affect 1,430,000 of 0–14 year-olds, i.e., only 3.8% of the global total. Among those aged 45–59 years, blindness affects 12 million persons, i.e., approximately one-third of world blindness.

Table 6 compares the prevalence of blindness among those aged ≥60 years in developed and developing countries. The Established Market Economies and Former Socialist Economies of Europe account for only 11.2% of the world's blindness, despite having 41.5% of the world's population of those aged ≥60 years (RBB = 0.27). Demographically developing countries, with 58.5% of the global population of those aged ≥60 years,

have 88.8% of the blindness in this age group (RBB = 1.51).

Distribution of blindness by cause

Table 7 shows regional estimates of the major causes of blindness for which specific models have been applied.

- Cataract causes 41.8% of global blindness (15,829,000 persons), operable/curable cataract being the probable cause of the vast majority.
- Trachoma (15.5%) in developing countries and the various types of glaucoma worldwide (13.5% of blindness) are two conditions that cause a major proportion of blindness.
- Onchocerciasis was reassessed by a WHO Expert Committee in 1993; the number of blind caused by this condition was estimated to be 360,000, including blindness due to restricted visual fields and taking into account the detection of new foci of the disease in Africa.⁶

Figure 1 depicts the relative importance of cataract, trachoma, glaucoma, and other disorders as causes of blindness, by economic region. Cataract is the most important cause of blindness in all developing regions,

whereas 'others' (e.g., diabetes, macular degenerations, etc.) largely dominate in the Established Market Economies and in the Former Socialist Economies of Europe.

Discussion

The projections/estimates of global blindness are based on an increasing amount of epidemiological data from various parts of the world. There are, however, several shortcomings in the models developed for disease estimates, due to paucity of population-based data on the prevalence of blindness, particularly for the Established Market Economies, Former Socialist Economies of Europe, and Latin America and the Caribbean.

The estimates presented here highlight the trends between the eight economic regions. Although attempts have been made to standardise the available information, it has not always been possible to do so between regions. This stemmed largely from variations in data collection procedures in the available studies. For this reason, the regional burden of blindness ratio (RBB) was introduced.

Application of the WHO simplified assessment methodology for blindness in more than 30 countries has led to a gradual accumulation of reliable data. This, in turn, was taken as the basis for a revision of the Blindness Data Bank with the 1984 global population. In 1984 the estimated number of blind was 31.2 million, based on a global population of 4,760 million.^a

The estimates for the total number of blind in 1978 (28 million), 1984 (31 million), and 1990 (38 million) are not directly comparable, since they were derived using three different methodological approaches. Globally, there has been an apparent increase of 10 million blind people from 1978 to 1990. The latest projection is based on an increased amount of data and can therefore be considered to be the most accurate.

The 1990 estimate indicates that blindness will experience an accelerated growth unless sufficient resources for its prevention are made available. This increase is occurring almost exclusively in Africa and Asia; 75% of world blindness currently occurs in those two continents, where the high population growth and the rapid increase in the number of elderly contribute to the upward trend. This tendency will be even more marked in those countries where eye care services are particularly scarce.

More attention needs to be given to the issue of low vision, in view of its importance as a cause of disability, and the potential for remedial measures. As shown in this article, available data indicate that for each blind person there are three people with low vision. This is of great socio-economic and public health significance, and more data should be collected on low vision and its causes, to permit proper national programme planning.

The three main causes of blindness in the world, i.e., cataract, trachoma, and glaucoma, together account for more than two-thirds (71%) of all blindness. The

relative importance of each of these three diseases varies greatly by region because of differences in demographic structures, disease incidence, and availability/accessibility of eye care services.

- Cataract remains the single largest cause of blindness (15.83 million persons). The backlog of unoperated cataracts has increased from the number estimated in 1990 by a WHO Consultation (13.6 million persons).⁷ This may have arisen because of the use of more and better data in the latest cataract burden projection, which pays more attention to the effects of ageing in developing countries.
- Trachoma is still an important global cause of blindness, being responsible for approximately 15% of world blindness. There are indications from several countries that trachoma is gradually coming under control,⁸ but there are still large pockets in many of the least developed countries. The remaining high toll of trachomatous blindness should be viewed against the perspective of neglected, underserved rural populations in those countries where the link to poverty makes it difficult to achieve sustainable disease control.
- Glaucoma has been only summarily alluded to in previous blindness estimates. A detailed review of available data and disease projections in 1993 revealed that the problem is greater than previously thought.^{9,10} Effective intervention to prevent blindness from glaucoma is quite difficult, particularly in developing countries, where its early detection and management pose great problems. The likely future scenario is therefore that glaucomatous blindness will continue to increase globally, reflecting the ageing of populations and the lack of sufficient eye care resources for effective intervention against the disease.

Vitamin A deficiency (xerophthalmia) is still the leading cause of childhood blindness. In a recent analysis of data, it was estimated that 70% of the 500,000 children who become blind annually, do so because of xerophthalmia.¹¹ This corresponds to a prevalence of roughly 1 million blind children, in view of the high mortality among affected children.

The lack of relevant epidemiological data makes it impossible to present separate specific statistics for a number of other well-known causes of blindness, such as diabetic retinopathy – generally recognised to be the leading cause of blindness among those of working age in developed economies, and rapidly emerging also in the urban areas of the developing world – and age-related macular degeneration, whose prevalence will increase with the 'greying' of the world population. Other causes of blindness include ocular trauma, estimated to be responsible for about 500,000 cases¹² and ocular leprosy (250,000 cases).¹³

The elderly population is commonly defined as 'persons aged ≥ 60 years', and Table 8 summarises the evolution (from 1980) and projected future trends for this population, up to the year 2020. To date,

population ageing is a prominent issue in the Established Market Economies and the Former Socialist Economies of Europe. In these regions the projected increase in the population aged ≥ 60 years, for the period 1980 to 2020, is 186%. Nevertheless, population ageing is also occurring in developing countries. The pace of demographic changes has been, and is expected to continue to be faster in developing countries. Thus, in these countries, the projected increase for the considered age group from 1980 to 2020, is 356% (Table 8).

In view of the very strong correlation between ageing and the incidence of blindness, eye health services must cope with age-related causes of blindness. By applying the age-specific prevalences of blindness for the elderly, shown in Table 6 – 1.2% for the most developed countries versus 6.8% for the rest of the world and assuming that there will be no additional resources to reduce the expected burden of unnecessary blindness among the elderly, we estimate that there will be about 54 million blind people aged ≥ 60 years, by the year 2020, of whom more than 50 million will be in developing countries.^b

Résumé

Données sur la cécité dans la monde: une mise à jour

L'importance absolue de la cécité n'est pas connue avec précision à l'échelle mondiale. Dans le passé, le nombre d'aveugles avait été estimé à 28 millions (1978) puis à 31 millions (1984). Aujourd'hui, grâce à la disponibilité de procédures simplifiées d'évaluation de la prévalence et des causes de cécité recommandées par l'Organisation mondiale de la Santé, la communauté scientifique dispose de meilleures informations épidémiologiques.

Dans le cadre d'une collaboration avec la Banque mondiale pour tenter de chiffrer le poids imposé par certaines maladies cécitantes (cataracte, glaucome, onchocercose, trachome) et la cécité en général, sur les populations de huit regroupements de pays/territoires proposés par la Banque mondiale en fonction de paramètres économiques, une nouvelle estimation est proposée. En sélectionnant les indices épidémiologiques 'régionaux' les plus pertinents et en ne retenant que la seule définition des déficiences visuelles proposée par la Dixième Révision de la Classification internationale des Maladies, il est estimé qu'il y avait, en 1990, environ 38 millions de personnes aveugles et 110 millions de personnes présentant une acuité visuelle résiduelle comprise entre 0,05 et 0,3 pour le meilleur des yeux avec la meilleure correction possible.

En résumé, 75% des cas de cécité sont concentrés en Afrique et en Asie; 58% des cas (soit 22 millions de personnes) affectent des personnes âgées de plus de 60 ans, alors que 3,8% des cas (soit 1 430 000 enfants) ont moins de 15 ans. La cataracte liée à l'âge et non opérée, représente de loin la principale cause de cécité, alors que le trachome (15,5%) et les différentes formes de

glaucome (13,5%) restent des fléaux préoccupants. L'onchocercose ne représente aujourd'hui qu'environ 0,9% des cas (soit 360 000 personnes), compte tenu des résultats de la lutte efficace contre la maladie entreprise par l'OMS en Afrique occidentale depuis vingt ans.

En raison de la rareté des informations épidémiologiques dans de nombreuses régions, il s'est avéré peu judicieux de proposer des estimations acceptables pour la rétinopathie diabétique et la dégénérescence maculaire liée à l'âge. Des efforts de recueil de données par des enquêtes en population devront être développés dans ces deux directions pour permettre de futures estimations.

Les estimations de 1978 et 1984 avaient été réalisées à partir de modèles de conception différente et ne peuvent être comparées avec les chiffres présentés ici qui s'appuient sur des sources d'informations épidémiologiques plus variées et plus pertinentes. Il semble pourtant que le nombre des aveugles ait effectivement augmenté au cours de la dernière décennie. Cet état de fait est sans nul doute imputable à l'inadéquation existant entre les ressources et les infrastructures en matière de prévention et de soins d'une part et les besoins sans cesse croissants d'autre part en raison même du vieillissement de la population dans toutes les régions du monde.

Ainsi, si les mesures qui s'imposent ne sont pas arrêtées et pérennisées dès à présent, il est prévu que dans le groupe d'âge des personnes de plus de soixante ans, le nombre des aveugles passera de 22 à 54 millions d'ici l'an 2020; 50 millions d'entre eux vivront dans les pays en développement.

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CATARACT

VISION 2020: The Cataract Challenge

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Cataract Blindness

The World Health Report published in 1998¹ estimated that there were 19.34 million people who are bilaterally blind (less than 3/60 in the better eye) from age-related cataract. This represented 43% of all blindness. The number of blind people in the world and the proportion due to cataract is increasing due to:

- **population growth:** 6,000 million people now in the world – will increase to around 8,000 million in 2020.
- **increasing longevity:** true for less economically developed countries, as well as the industrialised world.

The result of these two factors means that the population aged over 60 years will double during the next 20 years – from approximately 400 million now, to around 800 million in 2020. This increase in the elderly population will result in a greater number of people with visual loss and blindness from cataract, who will need eye services.

The incidence of new cases of cataract blindness is unknown. Minassian and Mehra estimated that for India alone 3.8 million people become blind from cataract each year.² Globally the incidence figure is probably at least 5 million. A figure of 1000 new blind people from cataract per million population per year is used for planning purposes in developing countries.

'Operable' Cataract Eyes

The term 'operable' cataract is used to define a cataract where the patient and the surgeon agree to proceed with cataract surgery. The indication for cataract surgery depends on various factors, including the expectations of the patient and the likely visual result of the procedure. As the results of cataract surgery improve, the degree of visual loss at which surgery is



Bilateral cataract in a relatively young woman
Photo: Murray McGavin

indicated becomes less, and therefore the number of 'operable' cataract eyes increases.

It is estimated that globally there are approximately 100 million eyes with cataract, causing a visual acuity of less than 6/60 – and this figure is likely to be 3–4 times more for cataract causing an acuity of less than 6/18. These estimates are projected to double in the next 20 years, if service delivery does not improve (Figure 1).

Cataract Surgical Rate

In order to reduce the backlog of cataract blindness and 'operable' cataract, it is necessary to operate each year on at least as many eyes as develop cataract (Figure 2). The number of cataract operations performed per year, per million population, is called the Cataract Surgical Rate (CSR). The CSR for the six WHO/IAPB regions in 1997 are estimated in Table 1.

Economically well-developed countries usually perform between 4000 and 6000 cataract operations per million population per year. At this level of service, it is unusual to find people who are blind from unoperated cataract – although several population-based studies show that even in industrial countries, not all those with visual impairment due to cataract, enquire or accept surgery. India has dramatically increased its CSR in the last 10 years, from less than 1500 to a figure of around 3000. However, there is little

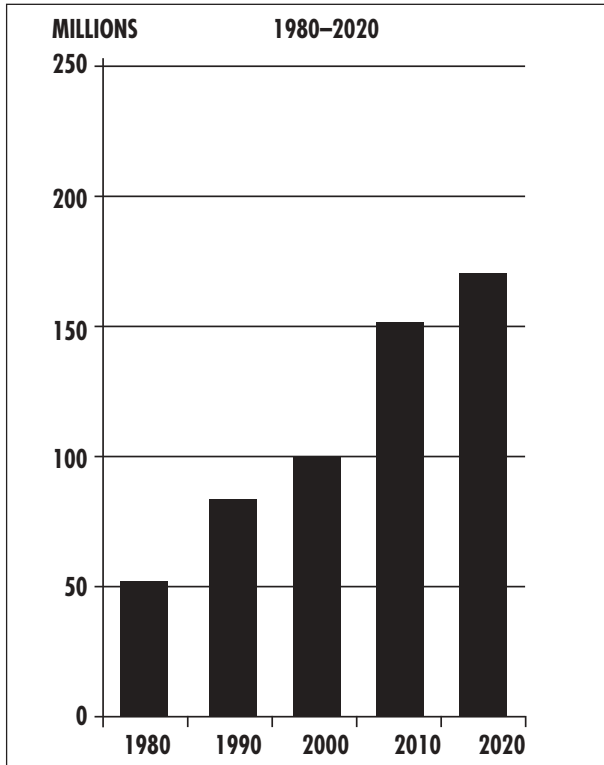


Fig. 1: Global Estimates of the Number of Eyes with <math><6/60</math> due to Cataract

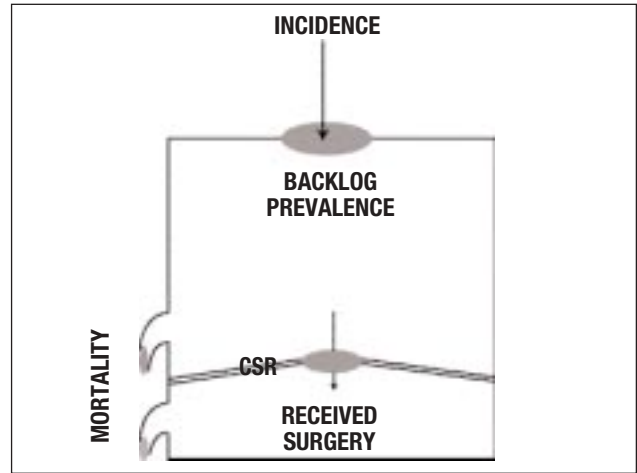


Fig. 2 : Schematic Representation of Cataract

evidence as yet, that this CSR of 3000 in India is sufficient to keep pace with the incidence of cataract causing an acuity of less than 6/60. In middle income countries of Latin America and parts of Asia, the CSR is between 500 and 2000 per million per year, and in most of Africa, China and the poorer countries of Asia, the rate is often less than 500.

Table 1: Cataract Surgery Statistics – Estimates for 1997*

| WHO / IAPB Region | Population (millions) | Number of cataract ops. (millions) | CSR (ops./mill./yr) |
|--------------------|-----------------------|------------------------------------|---------------------|
| Africa | 600 | 0.2 | 300 |
| range | | (0.125–0.250) | (200–400) |
| Americas | 800 | 2.15 | 2700 |
| North | 300 | 1.65 | 5500 |
| Rest | 500 | 0.5 | 1000 |
| range | (0.25–0.75) | (500–1500) | |
| Eastern Med | 475 | 0.5 | 1000 |
| range | | (0.25–0.75) | (500–1500) |
| Europe | 870 | 2.1 | 2400 |
| Western | 385 | 1.5 | 4000 |
| range | | (1.2–1.9) | (3000–5000) |
| Russia | 150 | 0.25 | 1500 |
| range | | (0.15–0.3) | (1000–2000) |
| Rest | 335 | 0.35 | 1000 |
| range | | (0.17–0.5) | (500–1500) |
| S.E. Asia | 1460 | 3.5 | 2400 |
| India | 960 | 3.0 | 3100 |
| Rest | 500 | 0.5 | 1000 |
| range | | (0.25–0.75) | (500–1500) |
| W. Pacific | 1635 | 1.1 | 670 |
| Australia & Japan | 150 | 0.6 | 4000 |
| range | | (0.45–0.75) | (3000–5000) |
| China | 1245 | 0.35 | 280 |
| range | | (0.125–0.6) | (100–400) |
| Rest | 240 | 0.25 | 1000 |
| range | | (0.125–0.4) | (500–1500) |
| TOTAL | 5840 | 9.55 | 1635 |

*author's estimates

Barriers to Cataract Surgery

The major reasons for low cataract surgical rates include:

- Low demand because of fear of surgery.
- Low demand from poor people because of high cost of surgery.
- Low demand because of poor visual results.
- Lack of eye surgeons, particularly in Africa.

Conclusion

The number of people blind from cataract in the world is increasing by approximately 1 million per year, and the number of 'operable' cataract eyes with a visual acuity of less than 6/60 is increasing by 4–5 million per year.

Approximately 10 million cataract operations are performed each year in the world, with rates varying from 100 to 6000 operations per million population per year. In India, the CSR rate has approximately doubled in the last 10 years, and is now around 3000, but in most developing countries of Asia the

current cataract surgical rate is between 500 and 1500, and in many countries of Africa the CSR is less than 500.

In order to reduce the cataract backlog, it is necessary to have a cataract surgical rate which is at least as great as the incidence of 'operable' cataract, where 'operable' depends upon the indication for surgery. In India and other countries of South East Asia, in order to deal with cataract causing an acuity of less than 6/60, it is necessary to do at least 3000 operations per million population per year – and perhaps more. In Africa, and other parts of the world where there is a lower percentage of elderly people in the population, a realistic target for the next 5–10 years is around 2000 operations/million population /year.

It is possible to achieve these rates, if good quality cataract surgery is performed at a reasonable cost, close to where people live. Models for this type of cataract service have now been developed in several developing countries, most notably in India.

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What Do We Mean by Cataract Outcomes?

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Cataract outcome is the result of surgical intervention for visual impairment, or blindness due to cataract. It can be measured as visual acuity in the operated eye, or in the patient (in terms of visual function) as quality of life and as economic rehabilitation. Of these, visual acuity is probably most suited for routine use by ophthalmologists, to measure performance and monitor quality of service.

Clinical Trials: India and Nepal

Table 1 shows the outcome of cataract surgery in clinical trials under optimal conditions. More than 90% of eyes operated on for cataract achieve a best-corrected visual acuity of 6/18 or better. The variation in visual outcome between various surgical techniques is minimal. Less than 3% of the operated patients have



Right eye: mature cataract
 Left eye: aphakia

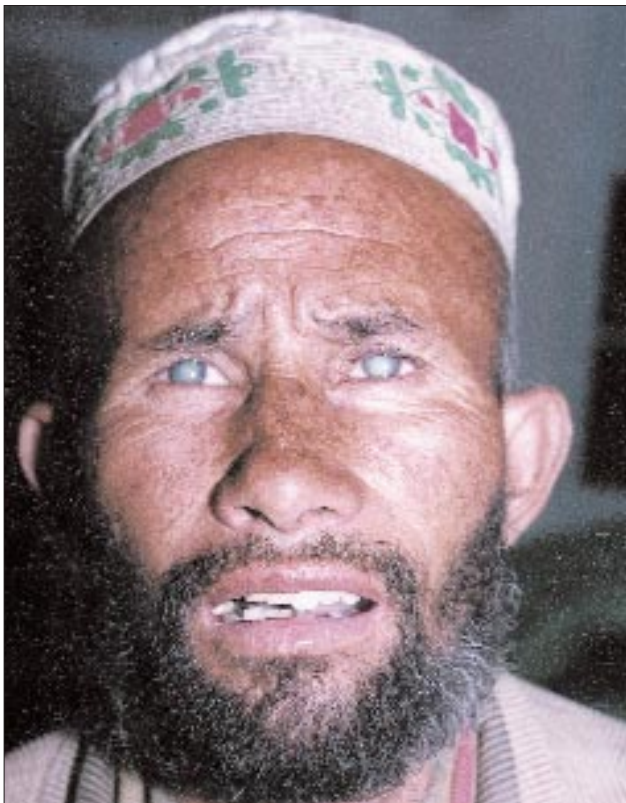
Photo: Pak Sang Lee

a best-corrected vision of less than 6/60. These clinical trial results may reflect one end of the spectrum, suggesting what may be possible in an ideal setting under very controlled circumstances. While setting general standards for hospitals in a developing country situation, this aspect would have to be taken into account.

Recent population-based surveys have shown that of all the patients operated on for cataract, 21–53% had a presenting visual acuity of less than 6/60. With best correction, 11–21% still had acuity of less than 6/60 (Table 2). These figures include patients operated on recently, as well as those operated on decades earlier. They include operations done under excellent as well

Table 1: Visual Acuity by Percentage in the Operated Eye Following Cataract Surgery at 1-Year Follow-up, in Hospital Based Studies in India and Nepal.¹

| Visual acuity | Madurai, India | | Lahan, Nepal | | | |
|--------------------------|-----------------------------|------------------------------|-----------------------------|-----------------------------|---------------------------|----------------------------|
| | ICCE + specs (n=1401) | ECCE + PC-IOL (n=1469) | ICCE + AC-IOL (n=311) | ECCE + PC-IOL (n=311) | ICCE +specs (n=259) | ECCE + specs (n=259) |
| Presenting acuity | | | | | | |
| 6/6 – 6/18 | 84.9 | 83.9 | 44.7 | 54.3 | 59.8 | 58.3 |
| <6/18 – 6/60 | 2.9 | 15.4 | 49.8 | 42.4 | 36.7 | 39.4 |
| <6/60 | 12.2 | 0.6 | 5.5 | 3.2 | 3.5 | 2.3 |
| Best acuity | | | | | | |
| 6/6 – 6/18 | 95.5 | 98.1 | 90.4 | 93.3 | 93.0 | 91.5 |
| <6/18 – 6/60 | 2.9 | 1.3 | 7.1 | 4.8 | 6.6 | 7.3 |
| <6/60 | 1.6 | 0.6 | 2.6 | 1.9 | 0.4 | 1.2 |



Bilateral mature cataracts (with dilated pupils)
Photo: M Murtaza Farrahmand

as less favourable conditions, by experienced as well as less experienced eye surgeons. Results from population-based studies may not do justice to the improved visual outcomes of modern IOL surgery, but they do have an important impact on the confidence and expectations of the public.

WHO Workshop on Outcomes, 1998

Poor visual acuity following surgery will affect the demand and uptake of cataract surgical services. Concerned about these results, the World Health Organization convened a workshop on Outcomes in Prevention of Blindness Programmes in 1998. It recommended the development of a simple method to

monitor and evaluate outcome following cataract surgery, in terms of visual acuity (Table 3), which can be assessed with full spectacle correction ('best vision') or with available correction ('presenting vision').⁸ The purposes of such a tool would be:

- To identify causes of poor outcome of cataract surgery.
- To address these causes and thereby improve the outcome of cataract surgery.
- To improve outcome and thereby increase the output of cataract surgical services.

These guidelines, however, did not specify:

- (a) a time frame for the assessment of outcome
- (b) the condition 'cataract' has not been specified
- (c) the cause of poor outcome is not assessed
- (d) an instrument to measure outcome of cataract surgery has not been provided. Hence, there was a need for more operational research into these issues, and for standardised follow-up periods and conditions for visual acuity assessment. The aim of the monitoring tool is to self-audit, not to compare outcomes between surgeons or institutions.

To measure visual outcome, individual patient records, with well recorded pre- and post-operative visual acuity, have to be analysed by tally sheet or by computer. Operated eyes with a presenting vision of less than 6/60 should be examined to assess the major cause of poor visual outcome. Causes of poor outcome can be classified as:

- 'selection': due to pre-existing eye disease.
- 'surgery': due to surgical or immediate post-operative complications.

Table 3: Adequate Outcome Results

| | Post-operative acuity | Available correction | Best correction |
|------------|-----------------------|----------------------|-----------------|
| Good | 6/6 – 6/18 | >80% | > 90% |
| Borderline | <6/18 – 6/60 | <15% | <5% |
| Poor | <6/60 | <5% | <5% |

Table 2: Long-term Outcome of Cataract Surgery from Population-based Studies in Asia

| Place | Year published | No. of eyes | % eyes with VA < 6/60 (95% CI) | |
|-------------------------------|----------------|-------------|--------------------------------|----------------------|
| | | | With available correction | With best correction |
| Nepal ² | 1998 | 220 | 30.5 (24.4–36.6) | 10.9 (6.8–15.0) |
| Shunyi, China ³ | 1998 | 116 | 44.8 (35.8–53.8) | |
| Doumen, China ⁴ | 1999 | 152 | 52.6 (44.7–60.5) | 21.0 (14.5–27.5)* |
| Karnataka, India ⁵ | 1999 | 2401 | 26.4 (24.6–28.2) | - |
| Ahmedabad, India ⁵ | 1999 | 776 | 24.0 (21.0–27.0) | - |
| Hyderabad, India ⁶ | 1999 | 131 | 21.4 (14.4–28.4) | 16.8 (10.4–23.2) |
| Punjab, India ⁷ | 2000 | 428 | 23.1 (19.1–27.1) | - |

*40% <6/60 with pinhole correction

- 'spectacles': due to inadequate optical correction.
- 'sequelae': due to late post-operative complications.

In most of the population-based studies listed in Table 2, inadequate refractive correction and surgical complications were the major causes of poor outcome. Knowing the cause of poor outcome will enable eye surgeons and centres to address these causes and improve outcome, thereby increasing visual rehabilitation and the output of cataract surgical services.

Rapid Assessment and Monitoring Outcomes

Population-based rapid assessments of cataract surgical services are very useful to assess prevalence of cataract blindness and (pseudo) aphakia, cataract surgical coverage, barriers to cataract surgery and visual outcome. This is an average, long-term outcome, since previous surgery varies greatly and patients would have been operated on by many surgeons in various settings. The causes of poor visual outcome can also be assessed. But because the impact of new improvements will be 'diluted' by old cases, population-based assessments are not the right tool to monitor short-term change.

Routine monitoring of visual outcome of cataract surgery, by individual surgeons or eye centres, will increase awareness of outcome and provide a tool to achieve better results, thereby resulting in better ability to reduce cataract blindness.

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Monitoring Cataract Surgical Outcomes: Methods & Tools

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Methods of Assessing Cataract Outcome

1. Population based studies

Several population-based blindness surveys and rapid assessments, conducted in the late 1990s, indicated that of all eyes operated on for cataract, 21–53% had a presenting visual acuity of less than 6/60.^{1,2,3,4} These figures include patients operated on recently as well as decades earlier. They include operations done under excellent as well as less favourable conditions, by experienced as well as less experienced surgeons, sometimes even by couchers.* Aphakic spectacles may have been lost or damaged. People with initial good outcome may have developed retinal disorders, reducing vision as they get older. Outcome data from surveys may not do justice to recent advancements in IOL surgery, but they do reflect what the public sees and determine their expectations and trust on regaining sight after surgery.

* Couching is the 'surgical' displacement of the cataractous lens, usually posteriorly and inferiorly into the vitreous cavity, often using a needle. It is a method used by some traditional healers.

2. Monitoring case studies

Routine monitoring of pre-operative, operative and post-operative data of each operated patient calculates the visual outcome and assesses the quality of cataract surgery. It is assumed that encouraging eye surgeons to monitor their own results, over time, in itself will lead to better outcomes of cataract surgery. Better results will reduce fear and motivate more patients to come for surgery. Outcome data should not be used to compare surgeons or centres, since case selection, surgical skills, procedures and facilities, follow-up periods and other factors affecting outcome, differ by surgeon and by centre. Routine monitoring should be used to evaluate results of individual surgeons or centres over time. It can be useful to evaluate the surgical learning curve of residents during their training.

The Tools

We developed a manual 'tally' (record) sheet system and two computerised packages. The computer systems use more input data and provide a more detailed analysis. It is important to select the method that is most suitable and usable on a regular and long term basis in your own situation. When skilled data



Age-related cataract – the most common cause of blindness in the world

Photo: John DC Anderson

entry operators are not available it is advisable to use the manual tally sheet system.

1. Manual tally sheets

This system is developed for eye units without computers, or units without data entry staff. Pre-operative, operative and post-operative data are collected from the case sheet normally used by the eye surgeon(s). Alternatively, the standard Cataract Surgery Record (CSR) from the computer systems can be completed and added to the case sheet. Using the CSR would also facilitate an easy change over to a computerised system at a later stage (see Figure 2).

The data are entered on the tally sheets (Figures 1a and 1b), one row for each operated eye. Each sheet has 20 records. When 100 records are entered (5 full sheets), the totals in each column are equal to the percentages. When not all operated patients return for review, care should be taken with the interpretation of percentages in the '>4 weeks post-operative' column as percentages are drawn from less than 100 cases.

For all cases with 'poor' outcome, a cause must be indicated. This helps the surgeon to decide whether current practices need modification to improve results. The causes of poor outcome can be divided into four categories:

- **Selection:** patient-related risk factors, e.g., concurrent diseases affecting vision.
- **Surgery:** surgical or immediate post-operative complications.
- **Spectacles:** uncorrected refractive error, wrong power IOL.
- **Sequelae:** late post-operative complications.

Surgical procedures and provision of optical correction are relatively easy to modify. Selection procedures can also be modified, but patients should not be denied surgery if their vision has a fair chance of improvement by cataract surgery. Late post-operative sequelae are most difficult to control.

When more than one surgeon is operating, all data can be entered on one form, or each surgeon can have his/her own form. The second option will enable each surgeon to follow his/her own outcomes over time. However, the number of operations needs to be sufficient to allow meaningful interpretation.

2. Computer package (MS-DOS)

This package is programmed in Epi-Info 6.04 and runs under MS-DOS and Windows. It can run on all IBM compatible computers with 5 MB free disk space. Data collection for both computer systems is done with the standard Cataract Surgery Record (Figure 2). Data from this form are entered into the computer.

3. Computer package (Windows)

This package is programmed in Visual FoxPro 6.0 and runs under Windows only. It is recommended for computers with a processor faster than a Pentium 1.90 MHz, with at least 8 MB free disk space. The reports produced by both computer packages are exactly the same, but the graphs from the Windows package are of



Age-related cataract

Photo: John D C Anderson

better quality and show the data table. Experienced Epi-Info users can do custom analysis with the DOS package.

Ongoing Report

In the ongoing report the records are placed in chronological order by date of operation and shown in groups of 100. This allows the user to follow trends over time with meaningful percentages. The report provides the following tables:

1. Operative complications: total and type of complication.
2. Percentage of good, borderline or poor outcome at discharge.
3. Cause of poor outcome (VA<6/60) at discharge.
4. Percentage of good, borderline or poor outcome at 4 weeks or more post-operatively.
5. Cause of poor outcome (VA<6/60) at 4 weeks or more post-operatively.

Fig. 1a: The Manual Tally Sheet: Discharge

| | Personal & Surgery | | | | | Discharge | | | | | |
|--|--------------------|--------------------------------|---------|---------|-----------------|---------------|----------------------|------------|-------------------------------|---------|------------|
| | Serial number | Patient number or Patient name | Surgeon | IOL Y/N | Surgical compl. | Good 6/6-6/18 | Borderline 6/24-6/60 | Poor <6/60 | Cause of poor outcome (<6/60) | | |
| | | | | | | | | | Selection | Surgery | Spectacles |
| 1 | | | | | | | | | | | |
| Number of lines/spaces allows 20 records | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| | | | | | | | | | | | |
| | N=total | | | Y | C | G | | P | D1 | D2 | D3 |

Fig. 1b: The Manual Tally Sheet: >4 Weeks Post-operatively

| | Personal & Surgery | | | | | >4 Weeks Post-operatively | | | | | | | |
|--|--------------------|--------------------------------|---------|---------|-----------------|---------------------------|---------------|----------------------|------------|-------------------------------|---------|------------|----------|
| | Serial number | Patient number or Patient name | Surgeon | IOL Y/N | Surgical compl. | No. of wks post-op. | Good 6/6-6/18 | Borderline 6/24-6/60 | Poor <6/60 | Cause of poor outcome (<6/60) | | | |
| | | | | | | | | | | Selection | Surgery | Spectacles | Sequelae |
| 1 | | | | | | | | | | | | | |
| Number of lines/spaces allows 20 records | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | N=total | | | Y | C | G1 | | | P1 | F1 | F2 | F3 | F4 |

The ongoing report can be used to evaluate cataract outcome at any time. Care should be taken with the interpretation of percentages when less than 100 records have been entered.

Annual Report

The annual report is best used to present outcome data for a whole year, or to link data to a particular month. The following tables are provided:

1. Age group and sex of operated patients.
2. Number of first eyes and second eyes operated on.
3. Proportion of known ocular pathology in operated eye.
4. Visual acuity in the operated eye pre-operatively, at discharge and follow-up.
5. Visual acuity in the better eye pre-operatively, at discharge and follow-up.
6. Good / borderline / poor outcome at discharge by month (presenting VA).
7. Proportion of good / borderline / poor outcome by follow-up (presenting VA).

8. Operative complications and type of complications by month.
9. Operative complications by place of surgery.
10. Operative complications by cadre of surgeons.
11. Operative complications by additional ocular pathology.
12. Operative complications by type of surgery.
13. Causes of poor outcome at discharge and follow-up.
14. Percentage of poor visual outcome at discharge and follow-up, by type and by place of surgery.

While the manual tally sheet system can register one follow-up visit at 4 or more weeks post-operatively, the computer system ideally registers three follow-up visits: at 1–3 weeks, 4–11 weeks and 12 or more weeks post-operatively. The pilot study showed that optimal visual outcome was reached at 6 months or more after surgery, and that the World Health Organization visual outcome targets were realistic.

In many countries not all patients return after surgery. The pilot study showed that results from patients who do come for follow-up are similar to those from patients who did not return, but were visited at home.

Bar graphs showing the proportion of good, borderline and poor outcomes per group of 100 operated eyes (Figure 3) should be displayed in the operating theatre.

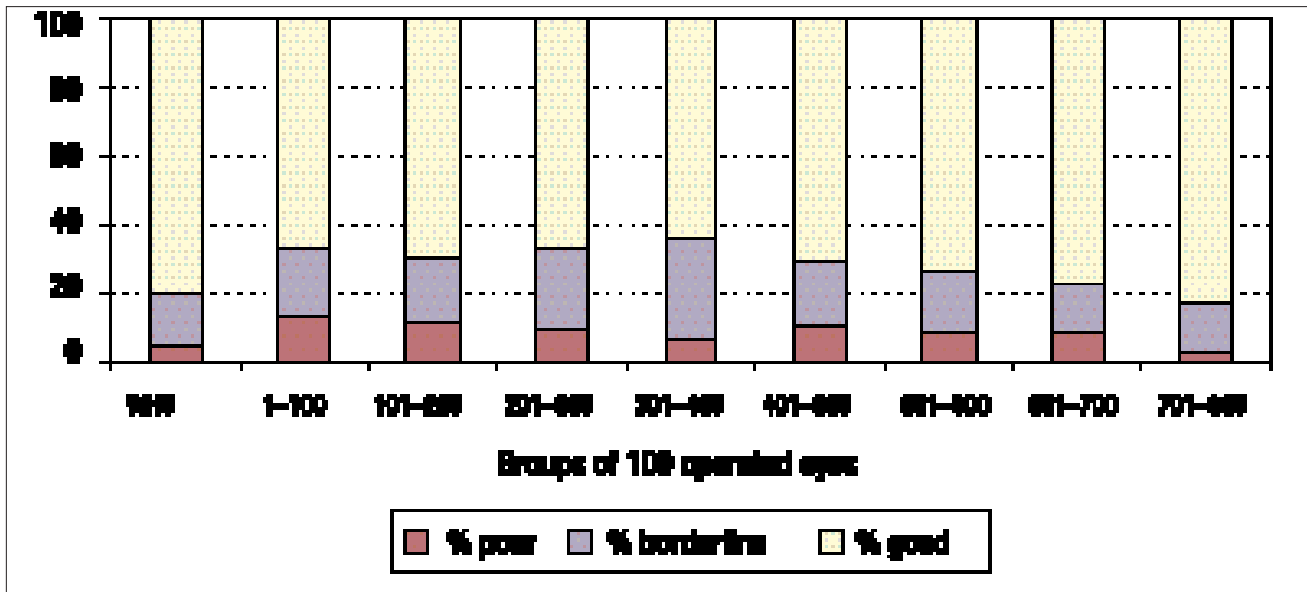
The following guidelines are useful to evaluate quality:

- Proportion of cases with IOL: a target percentage can be set according to local circumstances.
 - If less, improve availability and affordability of IOLs and ensure that all surgeons are adequately trained in IOL surgery and have the necessary equipment.
- Percentage of complications should be less than 10%, with posterior capsule rupture and vitreous loss each not exceeding 5%.
 - If more, improve surgical technique by asking for advice from a good and experienced cataract surgeon. Also, ensure that all surgeons are adequately trained in IOL surgery and have the necessary equipment.
- At discharge, more than 50% of cases should have good presenting vision and less than 10% poor outcome.
- At 4 weeks or more post-operatively, more than 80% of cases should have good presenting vision and less than 5% poor outcome.
- At 4 weeks or more post-operatively, more than 90% of cases should have good vision with best correction and less than 5% poor outcome.

Fig. 2: Cataract Surgery Record

| CATARACT SURGERY RECORD | | | | | |
|--|--|---|-----------------------------------|-----------------------|-----------------------|
| A. PATIENT Name: _____ | | Hosp. Reg. No: _____ | | Social No: _____ | |
| Address (optional): _____ | | Sex: <input type="radio"/> (M) Male <input type="radio"/> (F) Female | | Age: _____ years | |
| B. PRE-OPERATIVE EXAMINATION: | | | Category of Visual Acuity: | | |
| Visual Acuity: Presenting Right eye Y.A.: _____ Left eye Y.A.: _____ | | 1 6/6 | 8 1/50 | | |
| Best or pinhole VA: _____ | | 2 6/9 | 10 PL+ | | |
| Lens Examination: Clear lens <input type="radio"/> | | 3 6/12 | 11 NPI | | |
| Opacity, not ready for operation <input type="radio"/> | | 4 6/15 | 12 Cannot examine, believed <6/60 | | |
| Operable cataract <input type="radio"/> | | 5 6/24 | 13 Cannot examine, believed >6/60 | | |
| Inoperable cataract <input type="radio"/> | | 6 6/36 | | | |
| Aphakia <input type="radio"/> | | 7 6/60 | | | |
| Pseudophakia <input type="radio"/> | | 8 3/60 | | | |
| Cannot examine <input type="radio"/> | | | | CLINICAL DATA: | |
| Other ocular pathology in the eye to be operated, likely affect outcome: | | | | | |
| Corneal scar <input type="radio"/> | | | | | |
| Old iritis <input type="radio"/> | | | | | |
| Retinal disease <input type="radio"/> | | | | | |
| Glaucoma <input type="radio"/> | | | | | |
| Other & specify _____ <input type="radio"/> | | | | | |
| None <input type="radio"/> | | | | | |
| C. SURGERY: | | | | | |
| Date (dd/mm/yy): _____ | | | | | |
| Place: Base hospital <input type="radio"/> | | Training: Qualified / consultant <input type="radio"/> | | | |
| Other hospital <input type="radio"/> | | Resident / trainee <input type="radio"/> | | | |
| Out of hospital <input type="radio"/> | | Cataract surgeon <input type="radio"/> | | | |
| Biometry: Yes <input type="radio"/> (Y) No <input type="radio"/> (N) | | Hospital / Camp ID: _____ | | | |
| Eye operated: Right <input type="radio"/> Left <input type="radio"/> | | Surgeon ID: _____ | | | |
| Type of surgery: IOL: _____ | | Operative complications in operated eye: | | | |
| ICCF <input type="radio"/> PC IOL <input type="radio"/> | | None <input type="radio"/> | | | |
| ECCE <input type="radio"/> AC IOL <input type="radio"/> | | Capsule rupture <input type="radio"/> | | | |
| Manual Phaco <input type="radio"/> No IOL <input type="radio"/> | | Vitreous loss <input type="radio"/> | | | |
| Phaco <input type="radio"/> | | Corneal Oedema <input type="radio"/> | | | |
| | | Other & specify _____ <input type="radio"/> | | | |
| D. VISUAL ACUITY OF OPERATED EYE POST-OP: | | | | | |
| Follow-up visits: Presenting VA "Best" VA | | Cause of presenting vision < 6/60 | | | |
| At discharge: _____ days post-op. Y.A.: _____ VA: _____ | | Selection | Surgery | Spectacles | Squads |
| 1-3 weeks: _____ Y.A.: _____ VA: _____ | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 4-11 weeks: _____ Y.A.: _____ VA: _____ | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 12+ weeks: _____ Y.A.: _____ VA: _____ | | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Fig. 3: Proportion of Good/Borderline/Poor Outcomes at 12 or more Weeks Post-operatively, per 100 Operated Eyes



- If not, analyse the causes of poor outcome. If surgical, take action as above. If refraction, provide at least best spherical correction spectacles at an affordable price.
- The trend over time is static outside the recommended limits, or worsening.
 - Carefully analyse the reasons for lack of improvement and deal with identified problems.

The WHO has recommended that it should be a requirement for all eye surgeons to monitor their own results over time, and identify causes of poor outcome (selection, surgery, spectacles, sequelae). Addressing these causes is likely to improve future outcomes of cataract surgery. Monitoring outcomes is an essential part of the training of everyone who will do cataract

surgery, so that it becomes routine and required practice to think about quality and how it can be improved.

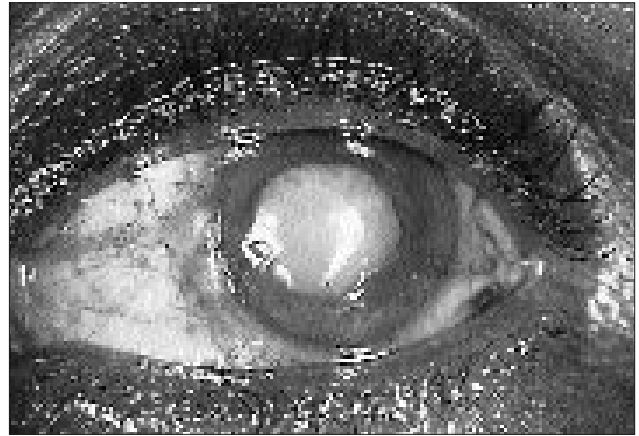
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Monitoring Cataract Surgical Outcomes: 'Hand Written' Registration Method

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Hypermature cataract

Photo: Gordon J Johnson

Introduction

The purpose of this hand written method of monitoring cataract surgery outcomes is to provide a practical method, assisting cataract surgeons and programme managers to monitor qualitatively the results of their cataract surgery. Such monitoring is the key to improving the quality and results of our cataract surgery.

Questions and Answers: Dr Hans Limburg asks Dr Colin Cook

1. Why use the manual tally sheet system?

Monitoring of cataract surgical outcomes is a tool that is guaranteed to ensure that we always continue to improve the quality and outcome of our cataract surgery. The manual tally method is a simple, quick, and inexpensive method of doing this. It is suitable for use in any hospital that does not have access to a sophisticated computer system.

2. What are the experiences in Edendale Hospital?

The system has been used in our hospital since July 2000. It is an integral part of the clinical routine. The data analysis takes about 10 minutes each month. The results are reported and discussed at staff meetings each month. The system facilitates a positive culture of quality control and accountability amongst the staff, with everyone committed to improving results and outcome whenever possible.

3. What are the results in Edendale Hospital?

Because many of our patients have to travel considerable distances for follow-up, fewer than 30% attend for any follow-up. We, therefore, only monitor the day one visual acuities before patients are discharged. We are particularly interested in seeing that <5% of poor outcome (VA <6/60) on day one is due to surgical complication. We are also particularly interested in identifying and discussing the causes of poor outcome due to surgery.

4. How many other hospitals in the region use the manual tally sheet system?

We have encouraged the use of the manual tally system in a number of hospitals in the Southern Africa region. Each of the hospitals has been advised to modify the system to best suit their own situations. We have not monitored their results, only whether they are or are not monitoring. In the planning and development of our Vision 2020 programmes, the manual monitoring of our cataract surgery outcomes is something that can be immediately and simply implemented.

The hand registered method is quick, simple, and friendly to use!

The Process

At discharge

- Before the patient is discharged, the Snellen visual acuity (VA) in the operated eye is tested and recorded in the case notes.
- If the VA is less than (<) 6/60, it is re-checked, both with and without a pin-hole.
- If the VA is <6/60, the eye is carefully examined to determine the cause of the poor vision.
- The details for each patient are recorded on Form A.
- The discharge is only authorised once this has happened.

At 8 week follow-up

- At 8 week or more follow-up, the Snellen visual acuity, with the spectacles that the patient has or will be wearing, is tested and recorded in the case notes.

**Cataract Surgery Outcome
Form A: Discharge Visual Acuity**

HOSPITAL:

SURGEON:

PERIOD:

| Serial number | Patient name | Patient number | Surgeon | IOL Y/N | Surgical complications | Good 6/6–/18 | Borderline 6/24–6/60 | Poor <6/60 | Cause of poor outcome (<6/60) | | |
|---------------|--------------|----------------|---------|---------|------------------------|--------------|----------------------|------------|-------------------------------|---------|------------|
| | | | | | | | | | Selection | Surgery | Spectacles |
| | | | | | | | | | | | |
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| N | | | | I | C | G | | P | P1 | P2 | P3 |

**Cataract Surgery Outcome
Form B: Follow-up Visual Acuity**

HOSPITAL:

SURGEON:

PERIOD:

| Serial number | Patient number or name | Date of surgery | Surgeon | Operation to follow-up(weeks) | IOL Y/N | Good 6/6–6/18 | Borderline 6/24–6/60 | Poor <6/60 | Cause of poor outcome (< 6/60) | | | |
|---------------|------------------------|-----------------|---------|-------------------------------|---------|---------------|----------------------|------------|--------------------------------|---------|------------|----------|
| | | | | | | | | | Selection | Surgery | Spectacles | Sequelae |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

20 cataract surgery records can be inserted as in Form A above

| | | | | | | | | | | | |
|---|--|--|--|---|---|--|---|----|----|----|----|
| N | | | | I | G | | P | P1 | P2 | P3 | P4 |
|---|--|--|--|---|---|--|---|----|----|----|----|

- If the VA is <6/60, the eye is carefully examined to determine the cause of the poor vision. The details for each patient are recorded on Form B.

How to Complete Form A: Discharge Visual Acuity

- Form A is completed at discharge.
- It should be completed for all patients who have had a cataract operation – except those under the age of 20 years and those cases of cataract due to trauma.
- One row of the form is completed for each cataract operated eye.
- Each form has space for 20 cataract operations.

1. *IOL* – record ‘yes’ if an IOL was implanted and ‘no’ if an IOL was not used.
2. *Surgical complications* – record any surgical complications.
3. *Discharge VA* (good, borderline, poor) – tick one of the 3 columns, depending on the measured visual acuity.
4. *Cause of poor outcome* (selection, surgery, spectacles) – if the VA is recorded as less than 6/60, the reason should be recorded in the appropriate column.
 - This should only be done if the VA is <6/60.
 - Only one column should be filled.

- If there is more than one cause for the poor outcome, the clinically most significant cause should be identified.
- **Selection** (co-existent disease or pathology causing poor vision) – specify the disease or pathology.
- **Surgery** (intra-operative complication(s)) – specify the complication(s).
- **Spectacles** (uncorrected refractive error) – tick this column if the VA improves to 6/60 or more with a pinhole, or with spectacles which the patient does not have. ‘No IOL’ operations should be checked with +10.0D spectacles.

How to Complete Form B: Follow-up Visual Acuity

- Form B is completed at follow-up at least 8 weeks after surgery.
 - It should be completed for all patients who have had a cataract operation – except those under the age of 20 years and those cases of cataract due to trauma.
 - One row of the form is completed for each cataract operated eye, which is seen at 8 weeks or more.
 - Each form has space for 20 cataract operations.
1. **Follow-up VA** (good, borderline, poor) – tick one of the 3 columns, depending on the measured visual acuity.
 2. **Cause of poor outcome** (selection, surgery, spectacles, sequelae) – if the VA is recorded as less than 6/60, the reason should be recorded in the appropriate column.
 - This should only be done if the VA is <6/60.
 - Only one column should be filled.
 - If there is more than one cause for the poor outcome, the clinically most significant cause should be identified.
 - **Selection** (co-existent disease or pathology causing poor vision) – specify the disease or pathology.
 - **Surgery** (intra-operative complication(s)) – specify the complication(s).
 - **Spectacles** (uncorrected refractive error) – tick this column if the VA improves to 6/60 or better with a pinhole or with spectacles which are not available to the patient.
 - **Sequelae** (post-operative complication(s)) – specify the complication(s).

Analysis of the Data

- The analysis should be done for every 100 cases, and compared with previous results.
- It can be done either for the department as a whole, or for individual surgeons, or both. You need to decide which option is most suitable for your situation.
- Add up the entries in each column on Forms A and B, and calculate the percentages. It should only take about 10 minutes!

Using the Results to Monitor Performance and Improve

The analysis is a tool to help improve the quality of surgery. This is its purpose.

It is used to compare past results with present results.

It is not to be used to compare one surgeon with another, or one hospital with another.

The aim is to:

- Reduce surgical complications.
- Increase percentage with good outcome.
- Decrease percentage with poor outcome due to surgery or need for spectacles.

What if the Results are Not Good?

Action to improve results is advisable if:

IOLs

- The percentage of cases receiving an IOL is less than 95%.

Take action to improve the availability and affordability of IOLs.

Surgical complications

- The posterior capsule rupture rate is more than 5%.
- The vitreous loss rate is more than 5%.
- The discharge uncorrected visual acuity is poor (<6/60) in more than 10% of cases.

Take action to improve the surgical technique by asking for advice from a good, experienced cataract surgeon.

Visual outcome

- The week 8 visual acuity with available correction is more than 5% poor outcome (<6/60).
- The week 8 visual acuity with available correction is less than 85% good outcome (6/6–6/18).

Analyse whether the major cause of poor vision is surgical problems or correction of refractive errors.

Take action to improve the surgery as above.

Take action to provide at least best spherical correction spectacles at an affordable price.

Trends over time

- The trend over time is static outside the recommended limits.
- The trend over time is worsening.

Carefully analyse the reasons for lack of improvement and take action to deal with the identified problems.

Monitoring Cataract Surgical Outcomes: Computerised Systems

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Introduction: Why Monitor?

It is well known that the world is facing a cataract crisis. The number of people blind from cataract increases annually, and, as the Earth's population ages, this increasing growth in cataract blindness is accelerating.¹ It is estimated that the elimination of cataract blindness will require over 30 million cataract operations to be carried out every year by 2020 – a threefold increase in less than 20 years.

However, the cataract crisis is not solely a crisis due to low surgical output. In addition, there is evidence of a disturbingly high rate of poor surgical outcomes. In India, 15–25% of eyes see less than 6/60 with available correction.^{2,3} In China, nearly 40% of eyes had a poor



Computerised systems

Photo: Murray McGavin

outcome.⁴ The situation in Africa is unlikely to be any better.

Poor outcomes may be due to any of the following:

- *Selection.*
- *Surgery.*
- *Spectacles and uncorrected refractive error.*

Outcomes can be improved by any measures that will:

- *Improve case selection*, and avoid surgery in patients who will not benefit.
- *Improve the quality of surgery*, and avoid surgical complications.
- *Improve post-operative correction of refractive error*, and minimise surgically induced ametropia.

A good cataract outcome monitoring system will contribute to all the above.

How to Monitor

Obviously the more data included in any monitoring system, the more information can be retrieved. However, collecting detailed data on outcomes can be time consuming. Eventually this leads to 'audit fatigue', and the information is no longer recorded. As a bare minimum, data should be collected on pre- and post-operative visual acuity, and on intra-operative complications. In a manual monitoring system, this may be as much data as can be analysed routinely. With a computerised system, analysis can be automated, so it is reasonable to collect more data – but

Table 1: An Example of an Automated Report of Surgical Complications

| Total Operative Complications 01 January 2002 to 30 June 2002 | | |
|--|------------|-------|
| Surgical Complication | | |
| • Nil | 470 | 90.7% |
| • Capsulorhexis extended | 14 | 2.7% |
| • Capsule rupture and vitreous loss | 10 | 1.9% |
| • Unintended damage to iris | 6 | 1.2% |
| • Zonular dehiscence, no vitreous loss | 6 | 1.2% |
| • Capsule rupture, no vitreous loss | 5 | 1.0% |
| • Zonular dehiscence and vitreous loss | 3 | 0.6% |
| • Others | 2 | 0.4% |
| • Small pupil, stretched | 1 | 0.2% |
| • Supra-choroidal haemorrhage | 1 | 0.2% |
| Total | 518 | |

remember that even if analysis is automatic, data entry will still be a tedious manual task. It is important to achieve a balance between collecting all the information that may be useful, and collecting information from every patient. For monitoring purposes, it is better to collect minimum data from everyone than a lot of data from a few patients.

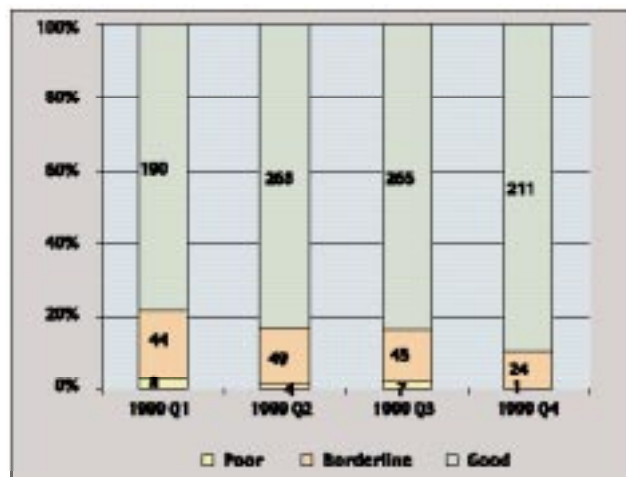
Any cataract monitoring system should minimise the extra work required. If possible, the routine recording of clinical data should be integrated with outcome evaluation. This can be done by using a standard form for all cataract operations. This ensures that the necessary details are recorded, and makes it simple for a clerical worker to transfer them to a computer. The form is placed in the patient's file, and becomes the clinical record of the cataract surgery and post-operative care.

Data should be collected on all patients, even those in whom a good outcome is impossible owing to pre-existing co-morbidity – e.g., previous glaucoma surgery. Although this means that a higher proportion of eyes will have a poor outcome, it permits a more reliable estimate of trends within the clinic.

A defect of many outcome evaluations is that the data are collected, and analysed, but are not readily available to the surgeons, and so fail to influence their practice. If surgeons do not see the results, they are not going to be motivated to collect the data. A vital part of any evaluation of outcomes is to provide regular reports to the surgeons, and to develop ways of including the findings into practice. One way of doing this is to have a quarterly meeting, at which all patients with a poor outcome are discussed, and the cause of the poor outcome is identified. Where possible, a change of practice is planned to avoid poor outcomes in the future. For example, at Kikuyu Eye Unit, Kenya, we identified vitreous loss at surgery as being associated with a ten-fold greater risk of poor outcome. This led to changes in our management of vitreous loss, and a significant reduction in the proportion of eyes suffering a poor outcome following complicated surgery.

Some surgeons may feel threatened by discussing poor outcomes in front of their colleagues. The purpose of monitoring surgical results is not to identify incompetent surgeons, but to enable every surgeon to improve their own outcomes. The World Health Organization has set targets of a minimum of 90% of eyes seeing 6/18, and a maximum of 5% seeing less than 6/60, with correction, by two months after surgery. Although it is important to aim for these targets, no one would suggest that, once they have been achieved, there is no room for further improvement. Monitoring should not be used to check outcomes against other clinics, surgeons, or targets, but to demonstrate trends. Since different surgeons and clinics have different case loads, equipment, and patients, comparisons should be made only against historical data from the same clinic, as this is the only way to show if standards of care at any unit are improving or not.

Table 2: Quarterly Outcomes, Showing an Increase in the Proportion of Good Outcomes from 79% in the First Quarter to 89% in the Final Quarter



Computerised Monitoring of Outcomes

Advantages

The major advantage of using a computerised system to monitor outcomes is that reporting can be automatic. Commercially available databases (such as Microsoft Access) have a reporting function. This allows reports to be designed, and then automatically updated. These reports may be text (see Table 1), or they can be graphical (see Table 2). Surgeons can obtain an immediate report of outcomes at any time, providing they know how to turn on the computer and to open the database!

Computers are good at handling numbers, so the reports can include calculations, such as the mean post-operative refractive error. In clinics that carry out pre-operative biometry, patients whose final spherical error differs from the planned refraction can be identified. Surgically induced astigmatism can be measured, and different surgical techniques compared. If pre-operative visual acuity is recorded for both eyes, it is easy to calculate the number of blind patients who have their sight restored by surgery. Outcomes for specific groups of patients (e.g., diabetics) can be evaluated separately. Although it is possible to do all this from a paper register of outcomes, it is very time-consuming, and it would be difficult to provide regular updates. Once a computerised system is in place, data analysis is easy.

Disadvantages

The major disadvantage of using a computerised system is the cost and complexity of getting it established. Although minimal computing skills are required to use the database, and to obtain reports, the design of the database and the reports do need input from someone with the necessary expertise. The necessary hardware and software should not cost more than \$1,500 – \$2,000. Many clinics will already

have a computer that can be used for outcome monitoring, in which case the costs are minimal.

The second disadvantage of computerised systems is the possibility of data loss. Irregular electricity supplies, theft, or computer viruses can all lead to corruption of vital data. The easy way to avoid this is to have an automated back-up system that copies the database on to a removable disk. This can then be stored in a safe place. If this is done regularly, then data is more secure on a computer than it is in a book, as it is impractical to copy a cataract register at frequent intervals.

Experience of Evaluating Outcomes

At Kikuyu Eye Unit, we found using a computerised system to be a valuable tool. As Table 2 shows, there was a statistically significant improvement in the results of surgery over the first year of using the system. It is hard to identify any single factor that led to this improvement. Management of the complica-

tions of surgery improved, and the number of patients with known pre-existing co-morbidity declined. I believe the most important factor was a change in attitudes. The ready availability of the outcome data meant that surgeons were immediately aware of their own results. This led to a move away from just concentrating on the numbers of operations, to a culture in which quality is as important as quantity.

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Training in Surgical Skills

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It was very interesting to read the letters relating to ICCE / ECCE in the *Journal of Community Eye Health* 2000; 14: 30–31. Many of the comments relate to outcomes of cataract surgery and mention the necessary skills/experience needed to obtain good outcomes. For these to be the norm rather than the exception, a set of conditions is required.

1. Knowledge of the procedure concerned.
2. Supervised training.
3. Practical surgical exposure and practise which leads to
4. Experience.
5. Follow-up and audit of outcomes to inform the previous steps.
6. Changes to steps 1 – 4, as necessary, to improve or maintain outcomes.

In my experience, supervised training and practice are the cornerstones to reaching a level of expertise which allows competent practice and thus experience. In turn, outcomes will improve.

The Role of the Trainee

The old method of 'see one, do one, teach one' does not work as far as surgical training is concerned. In order to learn a practical procedure it is vital to understand what is happening at each stage of the procedure and, to this end, new trainees should first of all observe and question the trainer. When an experienced surgeon operates, he or she is using many small 'tricks' and manoeuvres which may not be obvious to the inexperienced observer. It can be very helpful to write down the steps of an operation in a notebook, firstly, to help learn the order of the procedure and, secondly, as a permanent record of a particular trainer's method.

It can also be very helpful to scrub with the nursing team in order to learn the steps of a procedure, as it is good discipline to anticipate, ahead of the surgeon, what is required next. It has been said that 'a good scrub nurse gives you what you need, not what you ask for!'. Working with nurses in this way can also be useful in terms of team-building.

When learning a new procedure for the first time, it is helpful to break it up into small sections.

Instruction in a surgical technique should first of all take place away from patients. The use of plastic eyes

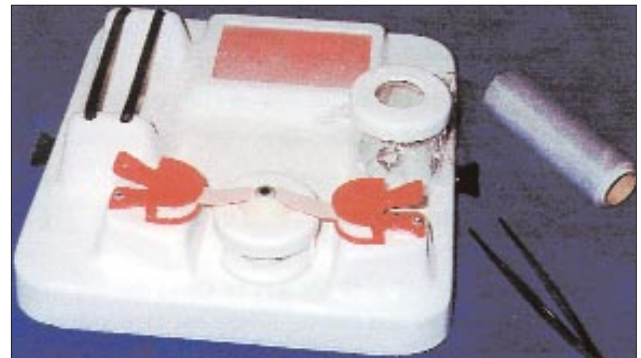


Fig. 1: Prototype of the Royal College of Ophthalmologists' skills board

Photo: Pharmabotics, UK

or animal eyes is helpful, and there are several surgical models which can be used for this.

In my experience it is very useful to attend a micro-surgical skills training course. The importance of learning how to hold instruments, what a particular instrument is for, how to tie knots, etc. cannot be over-emphasised. Traditionally, this has been left to the trainee to pick up by observation and it is interesting to see how many senior surgeons still do not tie reef knots appropriately!

One of the duties of all trainees is to practise. Doing anything to a high level requires dedicated practice and time. Surgery is no exception. This may sound obvious but the number of trainees who practise regularly is very small. If a skills laboratory is not available, then the ordinary operating microscope can be used when the operating theatre is not in use. Only plastic eyes or other non-organic material should be used in the operating theatre and unused sutures (which are no longer sterile) can be saved so that trainees can practise with them. A good set of instruments should be set aside for practice because, just as a bad workman blames his tools, a good workman does not use bad tools.

Figure 1 shows a skills board that has been developed by the Royal College of Ophthalmologists. This allows a number of procedures to be practised.

Figure 2 shows a skills head which can hold an animal eye or a plastic eye. This simulates a human head and can be used under a microscope.

Pieces of fruit such as grapes and tomatoes are useful for practising capsulorhexis under the operating microscope.

Trainers

Once the microscope and instruments have been mastered and the trainee is comfortable using them, progress will be much more rapid in the operating theatre.

When planning a teaching session in surgical training, it is useful to have a well-defined end point.

It is critical that all trainees should have regular and frequent exposure to surgery, and there are a number of ways to achieve this.

1. Dedicate a set time on each operating list for the trainee. I use 40 minutes at the beginning of each list to ensure that each trainee receives supervised training on each list. It is important to take over the case after 40 minutes and although, initially, the trainees may not achieve much in this time, with regular exposure to training they will progress rapidly and, after a few months, may be at the stage of completing an operation.
2. If a trainee needs to practise a specific part of an operation, it is possible to supervise them doing this section for each one of the cases on the list. This way, very rapid progress is made in one surgical session but each case is still completed in a reasonable time by the trainer.
3. 'Reverse training' is a method of learning a procedure from the end backwards. For example, a trainee would start by tying the sutures for an extracapsular cataract operation. If this has been done satisfactorily, they would progress the next time to putting stitches in and then tying them. Following this, they would carry out the irrigation/aspiration and then complete the operation. The principle behind this is that they should be operating with the eye in a good condition each time, as the training surgeon will have carried out each of the previous stages.
4. Positive attitude and approach provides essential encouragement to all trainees. The use of humiliation or shouting has absolutely no part to play in surgical training. It is important to discuss



Fig. 2: The Royal College of Ophthalmologists' skills head

Photo: Pharmabotics, UK

which parts of the operation went well, and then to talk about what might have been done differently. Identifying what needs to be practised for the next time is useful. It is necessary that some of the practice is also supervised.

Modern cataract surgery can be very effective and therefore sight restoring. To give all patients maximum benefit, the surgery must be performed well and to attain a high level of surgical skill, good, supervised training and regular and frequent practice are essential.

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Training a Cataract Surgeon

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Introduction

The major goal of VISION 2020: The Right to Sight is to make high quality eye care services available, accessible and affordable to all, through a sustainable delivery system. One of the key pre-requisites to achieve the above goals is the development of adequate and appropriate human resources. An analysis of current practices reveals problems related to number, distribution, quality of training and utilisation of various categories of eye care personnel. Fundamentally, most eye care delivery services in developing countries lack appropriate human resource development, including planning and training. Implementation of services is, therefore, adversely affected.¹

Identification of Tasks

Cataract surgery is now, in effect, refractive surgery – which is more than just removing the opaque lens. It includes thorough pre-operative assessment, skilled surgical techniques and proper post-operative follow up, with a focus on the best possible visual recovery.

An important step in cataract surgery training is the identification of tasks that a cataract surgeon is expected to learn and practice.

A cataract surgeon should take care of the following important steps (*S's*) of cataract surgery training:

1. **Case selection (Selection).** The cataract surgeon should have a thorough knowledge of the patients before surgery. Diseases such as corneal scars, age-related macular degeneration, diabetic retinopathy, advanced glaucoma, etc. may be present, and cataract surgery will not give the desired and required results.¹
2. **Sterility and the Surgical field (Sterility).** Procedures such as effective 'scrubbing', 'gowning' and 'gloving' should be strictly observed. Cleaning the periorbital skin prior to surgery with povidone iodine will reduce the bacterial load and help prevent post-operative endophthalmitis.²
3. **Anaesthesia and intraocular pressure (Soft eye).**



Bilateral cataract in an Afghan woman (pupils dilated)

Photo: M Murtaza Farrahmand

A soft, well-anaesthetised eye is vital to the success of cataract surgery. Peribulbar injections and intermittent digital pressure are best suited for trainee surgeons or technicians.²

4. **Intra-operative surgical complications (Safe surgery).** The cataract surgeon should have good control over:

- Wound construction.
- Capsulotomy.
- Hydrodissection.
- Nuclear delivery.
- Cortex irrigation and aspiration.
- Lens implantation.
- Wound reconstruction.

A safe cataract surgeon should know how to respect corneal endothelium, uveal tissues and posterior capsule, and should avoid any damage to such tissues. In the case of posterior capsular rupture, he/she should know how to manage vitreous loss.

5. **Uncorrected refractive errors (Spectacles).** Significant astigmatism and uncorrected refractive errors from lost or broken aphakic glasses is an important cause of low vision and blindness

following cataract surgery. It can be overcome by:

- Biometry and the implantation of a customised intraocular lens that will ensure significant improvement in visual outcome.
- The appropriate removal of sutures to reduce significant astigmatism followed by spectacle correction of the residual refractive error 6–8 weeks after surgery.³

6. **Post-operative complications (Sequelae).** There may be early or late complications. Persistent inflammation in the early post-operative period and posterior capsule opacification in the late period can adversely affect visual results. To avoid or minimise these, a cataract surgeon should take care of careful post-operative follow-up, with early detection and treatment of post-operative complications. Routine follow-up on the first post-operative day, after 1 week and 6 weeks, is recommended.³

Training

1. **Length and Content.** The cataract surgeon should have the opportunity of adequate supervised training. There will be considerable individual variations but, as a minimum standard, 2–4 weeks of training in ECCE with IOL of an already qualified person and a minimum of 50 surgeries is recommended to reach a desired level of competency.

Training should include:

- Didactic teaching.
- Videos.
- ‘Hands on’ training.

Training should be an ongoing process and not a one-time activity. Trainees should get an opportunity to refresh their skills and learn new techniques. Refresher training opportunities should be available according to the needs of the trainees. During the basic training period, the trainee surgeon should not operate on ‘only’ eyes (the other eye being blind); eyes where the first eye has had a serious operative complication, e.g., vitreous loss, or children’s eyes.

2. **Monitoring and Evaluation.** The trainee surgeons should monitor their surgical skills. Monitoring for surgeons in the initial phase should be to compare ‘themselves with themselves’ over time.

Evaluation of training needs to be done by the trainer through regular close observation and assessment of skills.

3. **Certification and Competency.** Certification of training is the responsibility of the trainer, certifying trainees as safe cataract surgeons or recommending further training under supervision.

Requirements of a Trainee

- A trainee cataract surgeon should have, at least, basic knowledge of the eye and some experience in ocular surgery.

- A commitment to improvement, which should provide the necessary motivation, enthusiasm and determination that is required.
- A trainee cataract surgeon should have binocular single vision.
- Should be comfortable with the use of the microscope.
- A trainee in cataract surgery should be able to master and practice the safest and simplest techniques.

Equipment and Training Materials

A trainee should be given a kit containing the following:

- A curriculum of the cataract surgery training attended – with information on sterilisation, pre-operative assessment, operating room management and post-operative evaluation.
- Videos of the surgery they have performed themselves.
- A video on standard cataract surgical techniques.
- A microscope.
- Two cataract surgical sets.
- 100 IOLs.

A Cataract Training Centre

A Centre should have:

- Adequate physical space.
- Adequate equipment, good quality instruments and consumables, as requested and required.
- ‘Wet’ laboratory for the trainees to familiarise themselves with the instruments and microscope.
- Audio-visual system for the recording of surgeries, for learning, monitoring and further reference.
- Careful ophthalmic instrument maintenance and care by a trained ophthalmic technician / assistant / nurse, who is also trained in the use of the microscope, other equipment maintenance and operating room management.

Requirements of a Surgical Instructor/Trainer

A trainer should be (or have):

- A highly skilled surgeon.
- An aptitude for teaching and training.
- The necessary time and patience needed for surgical skills transfer.
- Readiness to take over, the moment a patient’s safety is at risk.

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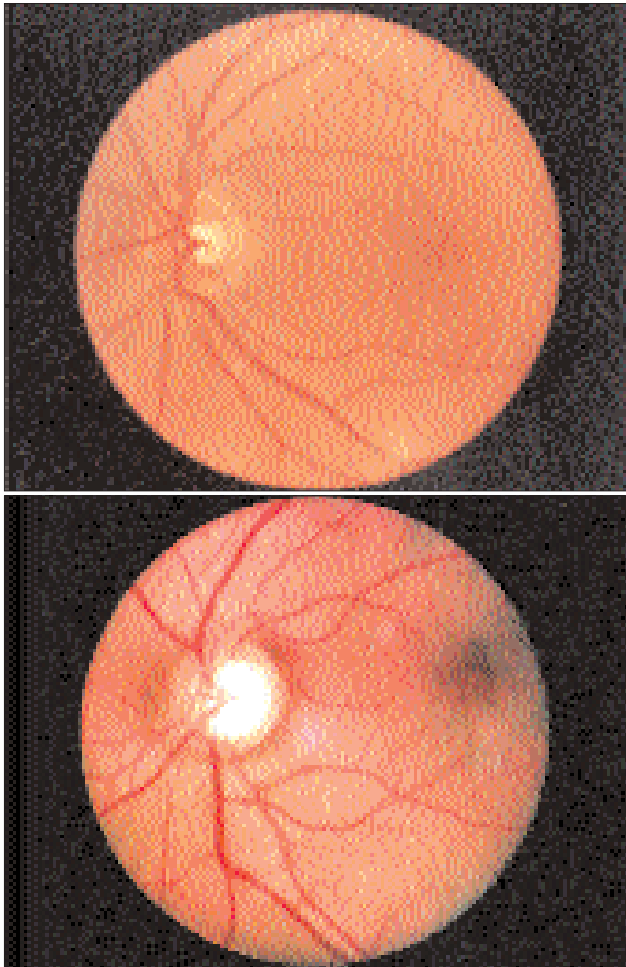
THE GLAUCOMAS

Epidemiology and Primary Open Angle Glaucoma

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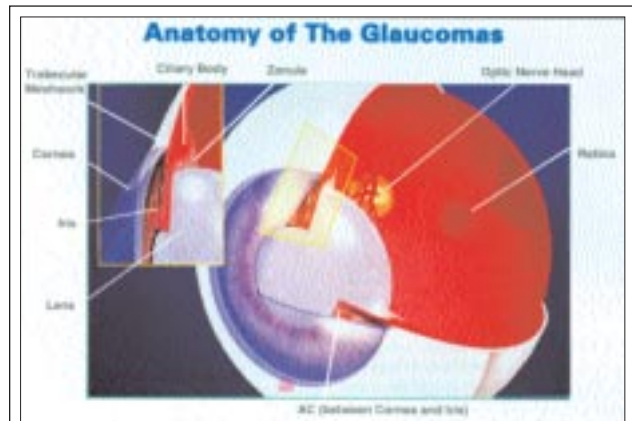
Introduction

One of the main problems with establishing the epidemiology of this common and important disease is the difficulty in defining the disease. Hitchings gave the definition of glaucoma as 'the name given to a group of diseases sharing the characteristic



Compare these optic nerve heads (1) Normal (above) (2) Pathological cupping in POAG (below)

Photo above: Pak Sang Lee
Photo below: Gordon Johnson



Graphics: Hugh Lugg

How does the anatomy of the eye influence the onset and progression of glaucomatous eye disease?

The anatomy of the anterior segment of the eye is important in understanding the type of glaucoma which may occur.

Examine the illustration created by our graphic artist. Note the anatomical position of the cornea, anterior chamber (AC), iris, trabecular meshwork, lens and ciliary body. It is also important to recognise the depth of the AC and the angle of AC, formed between the peripheral cornea and the root of the iris.

The depth of the AC and the angle of the AC indicate whether an eye is more susceptible to primary acute (or sub-acute) **angle-closure glaucoma** or, with a deep AC and an open angle, primary chronic **open angle glaucoma**.

We shall discover that another important feature of the glaucomatous eye is the blood supply to the region of the optic nerve head, where the optic nerve enters the back of the eye. A feature of open angle glaucoma is cupping of the optic nerve head associated with the optic nerve atrophy.

deformations of the optic nerve head (glaucomatous cupping).¹ Primary open angle glaucoma is a diagnosis of default (or exclusion). If we do *not* see a closed or closeable angle of the anterior chamber, peripheral anterior synechiae, pseudoexfoliation, rubeosis iridis, pigment dispersion, angle recession or any other abnormality, and yet we still have this characteristic deformation of the optic nerve head, the diagnosis is firmly pronounced as one of primary open

Screening for POAG: Comment

Whilst a reasonable argument can be made for case finding in well chosen populations, providing the health facilities exist to cope with the increased number of referrals, we must consider objectively whether major population screening programmes for POAG are justified at present. The World Health Organization guidelines drawn up by Wilson and Jungner in 1968 still provide a sound framework for judging whether screening is appropriate:

- The condition being screened for should be an important health problem.
- The natural history should be well understood.
- There should be a detectable early stage.
- Treatment at an early stage should be more beneficial than at a later stage.
- There should be a suitable test for the early stage.
- The test should be acceptable.
- Intervals for repeating the test should be determined.
- There should be adequate health service provision for the extra clinical workload resulting from the screen.
- The risks, both physical and psychological, should be less than the benefits.
- The costs should balance against the benefits.

At present we do not have adequate information on POAG to satisfactorily answer points 2, 4, 5, 6, 7, 9, and 10.

The natural history of POAG is not known, meaning the intervals for any repeat testing are not known. IOP measurement and routine perimetry (visual field testing) are of less value in detecting glaucoma than assessment of the optic nerve head, which is the best method of diagnosis.¹ This in itself has problems. For example, the size of the optic nerve head should be taken into account. Observer variation in disc assessment is well established. (See Garway-Heath's article on Optic Disc Assessment). Even new methods, such as the use of the scanning laser ophthalmoscope, also have problems with repeatability. This means that no fast, reliable method of assessment exists as yet.

The effect of therapeutic interventions has most frequently been measured in terms of effect on IOP, one of the risk factors for POAG. In the end, however, what actually matters is loss of visual function. Comparatively little is known about the effect of therapeutic interventions on visual function. In particular, the question as to whether treatment at an early stage is more beneficial than at a later stage has not been answered, although it seems a reasonable assumption, given that irreversible damage occurs with POAG.

The risks of surgical therapy have been well established. Less is known about the risks of medical therapy. However, growing evidence exists concerning the systemic effects of topical ocular hypotensive therapy.⁸ The psychological impact of false negative and false positive results has not been assessed. Neither has the psychological impact of an early diagnosis of POAG, compared to a late diagnosis. All of these factors have costs, which need to be assessed in terms of health care provision, or lost work hours to the community.

angle glaucoma (POAG). It is equally possible that POAG represents a group of diseases rather than a single disease entity.

With this possibility in mind, many sub-divide POAG by intraocular pressure (IOP) into 'normal tension glaucoma' and 'high tension glaucoma'. Others seek to subdivide POAG (relatively independent of IOP levels) into those with pressure-dependent field-loss progression and those with field-loss progression independent of IOP.²

Epidemiologists who have considered POAG think in terms of risk factors associated with this characteristic deformation of the optic nerve head.³ Risk factors which have been clearly demonstrated include IOP, age, 'race', positive family history, and refractive error >4 dioptres. Other risk factors may include therapy for systemic hypertension (resulting in episodes of reduced blood pressure at night), inadequate local circulation, poor connective tissue support to the optic nerve fibres at the level of the lamina cribrosa, and others yet to be identified. There is continuing debate over factors such as blood-pressure (BP).⁴

Population-based Studies

It has been appreciated since 1966⁵ that 50% or more of POAG cases in any given community are not under medical care. Studies on POAG are therefore subject to substantial potential bias if they are performed on clinic-based populations. The lack of good epidemiological data on POAG was highlighted in an excellent article by Leske in 1983.⁶ Since that article, epidemiological evidence is accumulating from places such as Japan, Baltimore (USA), Barbados, Ireland, Beaver Dam (USA), Rotterdam (The Netherlands), Blue Mountains (Australia) and Melbourne (Australia). The epidemiological difficulties of measuring IOP, due to fluctuations in readings, are being correctly approached using similar methods to those developed in blood pressure studies, such as three readings on separate occasions. The repeatability and reliability of visual field analyses and optic disc assessments are being continuously reviewed.

There are two further points which make good epidemiological data difficult to obtain.

Firstly, it is now well established that considerable

Table 1: Prevalence of Glaucoma Blindness, Meta-analysis from Population-based Surveys of Blindness

| Country | Area | Authors | Crude glaucomatous blindness prevalence (%) | Age range | Estimated prevalence (%) 40 + years | |
|--------------|----------------------------|-------------------------------------|---|-----------|-------------------------------------|------|
| Sierra Leone | Northern Province | Stilma & Bridger ¹⁰ | 0.1 | All ages | 0.6 | |
| Malawi | South | Chirambo et al ¹¹ | 0.2 | Aged 6+ | 0.8 | |
| South Africa | Northern Transvaal | Bucher & Ijsselmuiden ¹² | 0.04 | All ages | 0.2 | |
| Gambia | | Faal et al ¹³ | 0.01 | All ages | 0.1 | |
| Kenya | Eight regional eye surveys | Whitfield et al ¹⁴ | 0.06 | All ages | 0.3 | |
| USA | Baltimore | Tielsch et al ¹⁵ | 'Blacks' | 0.54 | Aged 40+ | 0.5 |
| | | | 'Whites' | 0.03 | | 0.03 |
| Kenya | Turkana tribe | Loewenthal & Pe'er ¹⁶ | 0 | All ages | | |
| | North-West | | | | 0 | |
| Zambia | Luapula valley | Sukwa et al ¹⁷ | 0.04 | Aged 6+ | 0.2 | |

* Calculated from the assumption that 25% of the population are aged <6 years and 17% of the population are aged 40+ years – figures taken from age structure of rural population in Northern Nigeria. The assumption is also made that those recorded as blind from glaucoma, are aged 40+ years in each study.

damage may occur to the optic nerve head before visual field defects are present.⁷ If the definition of glaucoma depends on visual field defects being present, then misclassification of individuals will occur, and those with glaucoma who have not yet developed field defects will be wrongly classified as people without glaucoma. In epidemiological analyses, such misclassification may result in inaccurate prevalence estimates for glaucoma.

Secondly, if there is more than one disease entity within the current diagnostic category of POAG, then risk factors, natural history, and response to various therapeutic interventions may vary for each of the separate disease entities. For example, one group might be 'pressure sensitive' and the other not 'pressure sensitive'. The effect of this again involves misclassification, modifying the conclusions of any study.

POAG and the Developing World

The most recent estimates from the World Health Organization suggest that if 100 million people are glaucoma suspects, over 20 million suffer from glaucoma, and over five million people are blind as a result of glaucoma. Approximately 70% of glaucoma is found in developing countries. It is estimated that two thirds of those blind are cases of POAG, with the majority of the remainder being cases of angle closure glaucoma (particularly common in China and the far East).⁹

Sound epidemiological data is lacking across Africa, on both the type of glaucoma encountered and the prevalence. Blindness surveys that exist may give a crude estimate of the prevalence of blindness from the glaucomas, but the type of glaucoma is rarely stated. The presence or absence of other causes of optic atrophy (such as optic atrophy from onchocerciasis) is not usually fully considered.

Table 1 is a meta-analysis of population-based

blindness studies, looking at the prevalence of blindness due to glaucoma. The final column is an attempt to make all studies comparable, by assuming all those blind from glaucoma are aged 40 years or more, calculating the prevalence by also assuming 17% of the entire population in each situation are aged 40 years or more (this assumed structure of the population comes from the structure of a rural population in Northern Nigeria). As can be seen, the prevalence of glaucoma blindness is greater than for American 'whites' in all but one study. The Kenyan study involved only 900 subjects and found no-one blind from glaucoma. However, the size of the study probably accounts for this finding. All remaining studies had large numbers examined and relatively wide ranging estimated prevalences of glaucoma blindness. This may, in part, be due to differences in criteria for establishing blindness due to glaucoma. However, end-stage glaucoma is generally clearly stated in the papers and much less likely to be a source of diagnostic confusion than early, or even established glaucoma. The possibility of a spread of glaucoma prevalences must also be entertained, as a reason for the varied prevalences of blindness due to glaucoma.

In many respects, POAG in many 'black' patients differs from the condition in the majority of 'white' patients. The condition appears to be more common, has an earlier onset, is more resistant to medical and laser therapy, and is more aggressive – resulting in blindness more frequently and at a younger age than in 'white' patients. There is serious potential error, however, in assuming that the quantity of melanin in the skin is directly related to the nature and prevalence of POAG. The best example was given to the author by a student at the International Centre for Eye Health, London, after the author had finished a long explanation which was much less concise! Imagine a horse race in which a small pony, carthorse and thoroughbred racing horse are to run. Does one expect

The Glaucomas

Glossary of Terms Used

Angle recession: visible changes in the filtration angle following blunt trauma, which may lead to secondary glaucoma.

Antimetabolites: (in the context of eye surgery) drugs which are used to reduce post-operative scarring after glaucoma filtration surgery. **Apposition:** placed against.

Attributable: due to or caused by.

Axial length: the distance between the anterior surface of cornea and the macula (central retina).

Beta blockers: drugs used in the treatment of hypertension, cardiac dysrhythmia and as eye drops, for the control of glaucoma. **Bias:** deviation from the truth by accumulation or review of data which will lead to wrong conclusions.

Case finding: identifying persons having a particular disease, condition or attribute.

Caucasian: a member of the light-skinned or 'white' races of mankind. **Circumferential:** describes a line defining an enclosed area, often of a circle.

Circumlinear: arranged in a circular line(s). **Coexistence:** existing together

Compliance: acceptance and obedience to instructions (in the taking of medicines). **Concentric:** having a common centre.

Concomitant: accompanying.

Configuration: arrangement/Outline.

Confounding: a situation where two or more causal factors influence the outcome(s) of a study.

Continuous spectrum: Uninterrupted, progressive arrangement.

Contour: outline (as in mapping of hills and valleys).

Entities: items that each have single, separate and A-independent existence.

Epidemiology: the quantitative study of the distribution and determinants of health and disease in populations, and the application of these findings to the control of disease.

Ethnicity: the characteristics of ethnic groups where social and cultural traditions are recognised and will have been passed on from generation to generation.

False-positive: a positive test result in a person who correctly should be diagnosed as negative for the disease.

Gonioscopy: examination of the filtration angle of the anterior chamber of the eye using a 'contact' lens (gonioscope).

Incidence (rate): the number of particular health-related conditions newly occurring in a given population over a period of time (usually one year). **Indigenous:** recognised as living, or growing, naturally in a particular place.

Iridocorneal angle: the angle between the peripheral posterior cornea and the peripheral anterior iris.

Iris bombe: the anterior bowing forward of the iris due to pupil block (see below) with the accumulation of aqueous behind the iris.

Keratometry: the measurement of curvature of the central cornea using the keratometer.

Lamina cribrosa: the connective tissue network across the anterior optic nerve.

Meta-analysis: the use of statistical methods to combine the results of different studies which have the same aims and objectives.

Misclassification: the placing of an individual or value within a study into the wrong category.

Nomogram: an alignment chart.

Oblique: slanting. **Observer variation:** difference in conclusions between two or more examiners (or the same observer examining more than once).

Parapapillary: beside the optic nerve head (optic disc).

Pathological: structural and functional evidence of disease. **Perimetry:** the technique of measuring the visual fields.

Peripheral anterior synechiae: inflammatory adhesions in the filtration angle of the anterior chamber.

Phenotypic: individual characteristics.

Pigment dispersion: the distribution and deposition of pigment granules throughout the anterior segment of the eye.

Plateau iris: The dilated pupil causing the iris to crowd into the filtration angle, with the anterior surface of the iris situated more anteriorly.

Polygenic: the transmission of characteristics where expression is influenced by a number of genes.

Predominates: that which dominates (has control over).

Prevalence (rate): the number of particular health-related conditions in a given population at one point in time.

Provocation (provocative) test: a test designed to provoke a rise in intraocular pressure in order to determine if a patient has glaucoma or not.

Pseudoexfoliation: the accumulation of grey-white particles within the anterior segment of the eye, on the anterior lens capsule, pupillary margin, ciliary body and zonule.

Pupil block: the mechanism (physiological or pathological) whereby the passage of aqueous from the posterior chamber to the anterior chamber is obstructed.

Quantification: numerical measurement of an amount.

Racial spectrum: a 'spread' or variety of nationalities.

Regimens: fixed plans (in prescribing treatment).

Reliability: the consistency in results when a measurement is repeated under the same conditions.

Repeatability: tests or measurements which when repeated reach similar conclusions.

Risk factors: factors which are recognised as influencing health-related conditions, such as age, sex, environment, etc.

Rubeosis iridis: formation of new blood vessels on the iris.

Sensitivity: the proportion of people tested for a disease who are correctly diagnosed as having the disease.

Sino-Mongolian: Chinese/Mongolian.

Specificity: the proportion of people without a disease who are correctly excluded from having the disease.

Sphincter and dilator muscles: muscles in the iris; one causing constriction (sphincter) and the other dilatation (dilator).

Stereoscopic: three dimensional view. **Striated veil:** a thin membrane having visible lines within it.

Synechiae: adhesions of peripheral iris to cornea (peripheral anterior synechiae). Adhesions of iris to lens (posterior synechiae).

Therapeutic: treatment that is curative (brings healing).

Topography: the anatomical description of a particular region.

Trabecular meshwork: a connective tissue network in the angle of the anterior chamber through which aqueous drains out of the eye.

Susan Stevens
Murray McGavin

VISION 2020: The Right to Sight and Glaucoma

Primary open angle glaucoma *occurs* the world over, but the *management* varies considerably between different countries. There is much to be made of differences *within* Europe or *between* Europe and the United States, however, I think a fundamental divide can be drawn between management for the rich and management for the poor.

Management for the rich generally consists of regular review over a prolonged period, with monitoring of a variable number of ocular parameters (IOP, disc, field, etc). Action is taken if change is observed in these parameters outside the perceived 'normal' variation. The intervention may consist of a variety of therapeutic options – medical, laser and surgical. A majority of discussions at glaucoma symposia focus on the indications for therapy and appropriateness of the various therapeutic interventions.

Management of the poor more frequently consists of the recognition of a late presentation of the disease process, and immediate operative intervention whilst the patient and ophthalmologist meet! The late presentation and sheer numbers of patients requiring therapy mean diagnosis is not the issue at present. The problem is so large, that initial concentration should be on obvious cases needing urgent therapy from the limited resources available. In a majority of situations, the operative intervention is glaucoma drainage surgery.

Thus, management for the rich has a wide spectrum of therapies and indications for therapy. Management for the poor is reduced to one indication and one therapy for the majority. This is not necessarily a bad thing, but it does mean that we have a duty to ensure that our intervention for the poor is maximally effective.

It is important to recognise that the concept of trabeculectomy surgery can be difficult for patients to understand in the first place. They have a disease that is frequently '*thrust upon them*' by doctors. In other words they are often *asymptomatic* in the eye that the ophthalmologist is *most* concerned with. The therapy at best can only hope to maintain vision as it is, indeed vision may well *deteriorate* slightly, as a result of the therapy. These concepts are vital in the consideration of any eye programme concerning glaucoma. Preventive therapy is always more difficult to begin. I would therefore argue that, for the time being, glaucoma therapy should be done in conjunction with cataract surgery or any similar programme that has 'curative' therapies with 'good press'.

every horse to behave the same way in the race because they all have black hair?

POAG is known to have a familial, genetically determined aspect, probably polygenic in origin.¹⁸ This being the case, it would not be surprising to find large differences in glaucoma prevalence between African and West Indian ethnic groups. Indeed, we should expect these differences. Current thinking places the emergence of modern humans as originating from one genetic ancestor in Africa. One of the main pieces of evidence for this is the greater differentiation of African populations; with modern Europeans, Asians, and Australasians being genetically more closely related to one-another than sub-Saharan Africans.¹⁹

The main body of evidence for POAG in 'blacks' comes from American 'blacks' in Baltimore, and the more recent study in Barbados. Discussions with ophthalmologists across the continent reveal very different clinical experiences from region to region. I believe future work in this field should specify the ethnic origin of the study sample, the term 'blacks' being inadequate. Ethnicity, like social class, is a very difficult variable to define and use in epidemiological studies. The fact remains, however, that ignoring either of these variables in analyses, may lead to substantial confounding. An excellent insight into the use of ethnicity as a variable is given in an article by Senior and Bhopal.²⁰

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☆ ☆ ☆

What is New in Primary Open Angle Glaucoma?

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Primary open angle glaucoma (POAG) encompasses a spectrum of disorders, typified by a characteristic optic neuropathy and field loss in eyes with open drainage angles. It is currently a leading cause of blindness worldwide, and in the future stands to become more important, as populations increasingly age throughout the world. Recently, we have witnessed a number of exciting advances in glaucoma. Developments have occurred regarding diagnosis, treatment, genetics and the relationship of intraocular pressure (IOP) to disease progression.

Recent New Findings

A. Diagnosis

Optic nerve and retinal nerve fibre imaging

Limitations in optic disc and retinal nerve fibre layer assessment have stimulated the development of *imaging devices*, that measure either the optic disc cup and neuroretinal rim area, or the retinal nerve fibre layer. The most advanced, at present, are *scanning laser tomography* (Figure 1) and *scanning laser polarimetry* (retinal nerve fibre analyser). They offer greater objectivity, but are limited by potential sources of error, and so the results must still be interpreted in the context of clinical findings. This quantitative imaging may be useful in early diagnosis before obvious visual field loss occurs and may allow increased sensitivity to detect progression.

Visual field and psychophysical testing

New *fast test visual field strategies*, such as *SITA* (Swedish Interactive Thresholding Algorithm), have

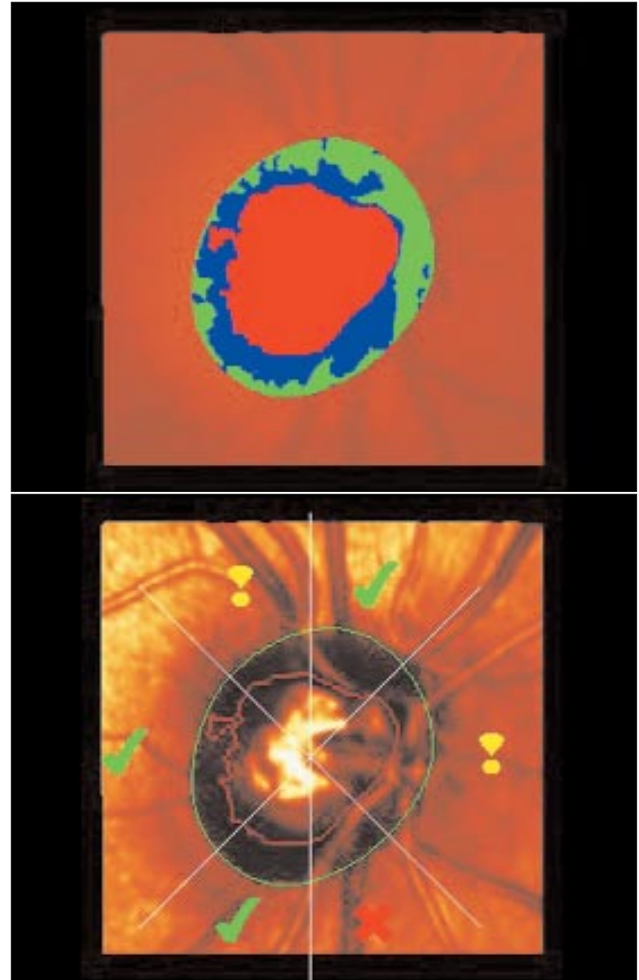


Fig. 1: Image obtained using Heidelberg Retinal Tomograph (HRT II)

Photos: T Garway-Heath

become available, which improve patient test compliance. Computerised programmes for serial visual field analysis (*PROGRESSOR*), which assess progression of disease by accounting for test variability, are available. Other modes of testing, which involve *motion detection*, may enable earlier diagnosis.

B. Treatment

Medical

The introduction of *sustained release*, once a day form of β blocker or pilocarpine, has proved useful in terms of better compliance and convenience. However, *prostaglandin analogues*, which increase uveoscleral outflow, have had the most significant impact. *Latanoprost* (Xalatan) appears to be the *most effective*

IOP-reducing agent currently available, with a low incidence of ocular and systemic side effects. *Unoprostone* (Rescula), *Bimatoprost* (Lumigan) and *Travoprost* (Travatan) have all recently been approved for use by the FDA.

Topical carbonic anhydrase inhibitors, such as *Dorzolamide* (Trusopt) lower IOP, but less effectively than oral acetazolamide. Another form, *Brinzolamide* (Azopt), has a more physiologic pH and so less topical side effects. The alpha agonist, *Brimonidine* (Alphagan) is claimed to be neuroprotective, but no clinical evidence exists. Recent results of the ocular hypertension treatment study have shown that optic disc and field progression can be significantly reduced with early treatment.¹

Surgery

One of the most fundamental questions in glaucoma, 'How low must the IOP be to prevent further glaucoma damage?' has recently been addressed by a multicentre, prospective clinical trial.² Patients with advanced POAG and IOP consistently less than 18 mmHg (mean IOP 12.3 mmHg) were found to have no visual field progression after 8 years of follow up. The clinical implication is that we should aim for a *low normal target IOP range* in patients with moderate to severe glaucoma.

The use of the antimetabolites, *5-Fluorouracil* (5FU) and *Mitomycin-C* (MMC), to prevent surgical failure has been the *greatest advancement in glaucoma surgery* over the last two decades. Single, *intraoperative application* has improved convenience of drug delivery. Strategies that change *bleb morphology* favourably are now available to avoid the development of focal, thin, avascular cystic blebs, synonymous with antimetabolite use. These include a larger surface area of antimetabolite treatment,³ a fornix based conjunctival flap to reduce posterior restriction and a large scleral flap with closure that diverts aqueous posteriorly (Figure 2). These simple modifications can achieve a

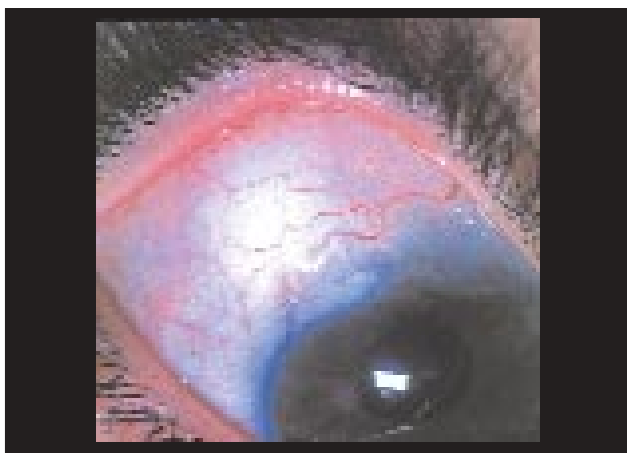


Fig. 2: Diffuse, non-cystic bleb using Mitomycin-C 0.5mg/ml. Large surface area of treatment, fornix based flap to reduce posterior restriction and large scleral flap to divert aqueous backwards

Photo: PT Khaw

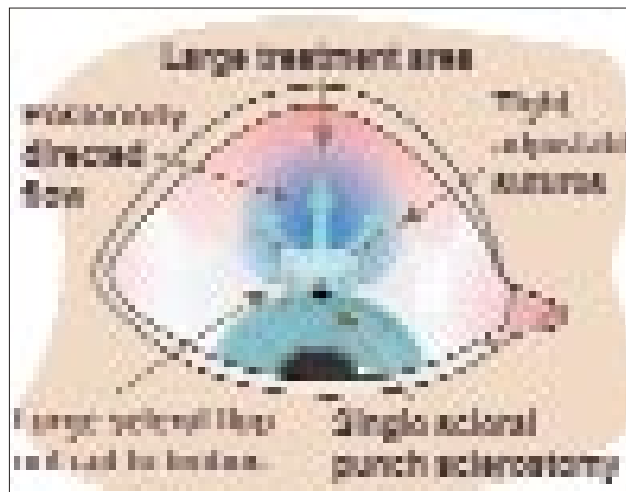


Fig. 3: Changes in surgical technique to reduce the incidence of cystic blebs with antimetabolite use

Diagram: Alan Lacey

much more diffuse, non-cystic bleb, even with high dose antimetabolites (Figure 3).

Recently, there has been a renaissance in *non-penetrating trabecular surgery* because of the desire to avoid potential complications associated with ocular entry, such as hypotony and subsequent cataract. Although prospective, comparative studies with trabeculectomy have demonstrated a *superior complication profile*, it has become evident that non-penetrating surgery is *not as successful in reducing IOP*.⁴ However, a higher incidence of cataract formation following trabeculectomy may in fact negate this advantage it has, once cataract surgery is performed.

C. Genetics

Our understanding of the genetic basis of glaucoma has considerably improved over the past decade. It is likely that the aetiology of POAG is *multifactorial*,⁵ resulting from a combination of mutations in more than one gene, and as yet unidentified environmental factors. With regard to juvenile and adult-onset POAG, several loci have been identified. However, only two genes have been identified. The first was *myocilin / TIGR (trabecular meshwork inducible glucocorticoid response) gene* at the GLC1A locus on chromosome 1q21–q31.⁶ More than thirty mutations of this gene have been identified in ethnically diverse populations worldwide. Studies have shown that it is responsible for only about 5% of POAG overall. More recently the *optineurin gene* on chromosome 10p14 was found to have sequence alterations in 16.7% of families with hereditary POAG.⁷ It is thought to play a neuroprotective role.

Research Issues

Although impressive advancements have occurred in glaucoma, the future appears to be even more exciting.

A. Diagnosis

Another scanning device currently being developed, is the third generation *optical coherence tomography* with ultrahigh resolution (2–3 μm). It allows *in vivo* visualisation of retinal structures and may prove useful for early diagnosis. Similarly, *multifocal visual evoked potentials* (mVEP) objectively may identify visual field defects earlier than white on white perimetry.

B. Treatment

Medical

As the role of IOP-independent mechanisms becomes increasingly recognised, innovative treatments include agents that *improve ocular blood flow*, or are *neuroprotective*. Furthermore, the possibility of a 'medical trabeculectomy' based on biochemical and genetic manipulation of the trabecular meshwork to restore function, is very exciting, as is work on *trabecular meshwork cell transplantation*.

Surgery

The *healing process* is the main determinant of IOP following glaucoma filtration surgery. The ongoing search for safer, less toxic and more effective anti-scarring agents has led to a number of exciting developments. *Transforming growth factor β (TGF β)*, a potent stimulator of healing, can be successfully neutralised *in vivo* and *in vitro* with *humanised antibodies*, and studies are currently underway to assess clinical efficacy. Ultimately, other specific agents may allow us to set safely the IOP after surgery in the 10–14 mmHg range.

C. Genetics

The transmission of disease in GLC1A families is autosomal dominant with variable penetrance. Presymptomatic diagnosis of at risk individuals in pedigrees with GLC1A mutations is already feasible. But, as the mutation is responsible for a small fraction of POAG, the most useful role of screening will be in large families with early onset, severe disease where early diagnosis and intervention may improve prognosis and also allow for genetic counselling. Hopefully, a greater understanding of basic genetic biology will identify patients at risk, and ultimately lead to new treatments that prevent or cure the disease.

VISION 2020

The main problem continues to be *identifying patients* who are in need of intervention, particularly

individuals in developing countries who account for 85% of patients affected with glaucoma. In the developed world, only 50% of people with established POAG are diagnosed, usually through the course of routine eye examination. But in the third world, patients are virtually blind before they are identified. However, screening a population for a rare disease such as glaucoma is difficult, especially when the infrastructure to deal with positive cases is lacking. To achieve the *VISION 2020 goals* to reduce blindness from glaucoma in developing countries, we need strategies that identify individuals with obvious glaucoma, using simple tests. Detection rates can be increased by improving the training of staff in optic disc, IOP and visual field examination, and also by increased public awareness of the potential benefits of regular eye examination.

Currently, glaucoma filtering surgery with adjunctive anti-scarring therapy offers the best single intervention strategy to slow the rate of disease progression, by sufficiently lowering IOP to prevent blindness. The challenge will be to deliver this in a form that is relatively simple, safe, fast and inexpensive, with an acceptable long-term success rate. Given what we now know, this may soon be possible.

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Primary Angle-Closure Glaucoma

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Epidemiology

There is clear evidence of racial differences in the prevalence of primary angle-closure glaucoma (PACG). The condition is least prevalent in Caucasians (0.09% of a population aged 40 and over).¹ At the other extreme are the Inuit (Eskimos) in whom prevalence studies have produced figures between 2.6 and 5.0% in the 40 and over age group.^{2,3,4} Between these two extremes lies the Sino-Mongolian race, in which available evidence suggests a PACG prevalence of 1.6%.⁵ PACG accounts for almost all glaucoma amongst Inuit, and probably at least 75% in Sino-Mongolians. Prevalence data for Africa and the Indian Sub-Continent is similarly scarce, although clinic studies in India and Sri Lanka suggest that PACG accounts for 50% of patients with glaucoma.^{6,7} In Africa, it is our experience that PACG prevalence is highly variable between ethnic groups. In the Cape Province of South Africa, 2.3% of 'Cape Coloured' people (of mixed East African/South-East Asian/Caucasian ancestry), who are aged 40 and over, have PACG.⁸ Manifest PACG is rare before the age of 40. Most epidemiological surveys show females to be 2–4 times more likely to be affected than males. Current World Health Organization figures suggest there are 5.1 million persons blind from glaucoma world-wide.⁹ Over 2.4 million of these persons, blind from glaucoma, live in East Asia, with a further 1.1 million in India.

Definitions and Clinical Features

The main feature of primary angle-closure glaucoma is an iridocorneal angle which is partially or totally occluded (blocked, obstructed) by peripheral iris (see diagram). The most widely used definition of an 'occludable' angle is one in which three quarters or

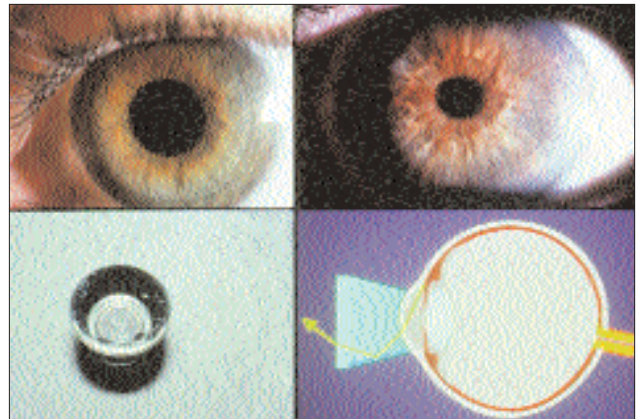


Fig. 1. Shining a torch (flashlight) across the anterior chamber (AC) has no shadow where the AC is deep (top left), but has a shadow when the AC is shallow (top right). Goniolens (bottom left). The optics of Gonioscopy (bottom right).

Photos: (a) John DC Anderson
(b) Gordon Johnson
(c) Pak Sang Lee
(d) Hugh Lugg

more of the trabecular meshwork is occluded by peripheral iris. In an eye with an occludable angle, the process of angle-closure can be divided into three stages which are best considered as a continuous spectrum, rather than three separate clinical features:

1. Suspect:

Occludable angle but no other abnormality.

2. Latent:

Normal intraocular pressure, optic disc and visual field in an eye having an occludable angle with peripheral anterior synechiae or a positive provocation test.

3. Manifest glaucoma:

- Intermittent:** diagnosed on the basis of intermittent symptoms such as haloes and eye pain.
- Acute:** sudden, persistent, symptomatic rise in intraocular pressure (IOP) with conjunctival injection and corneal oedema.
- Chronic:** asymptomatic, persistently raised IOP and/or visual field loss with glaucomatous optic disc damage.

With reference to the manifest glaucomas several points are worth emphasising. Firstly, although acute

angle-closure glaucoma is probably the most common type of PACG in Caucasians (and, therefore, heavily emphasised in some textbooks), chronic angle-closure glaucoma predominates in many other populations. It is currently acceptable to make the diagnosis of chronic angle-closure glaucoma on the basis of raised intra-ocular pressure without visual field loss and optic disc damage (unlike open angle glaucoma), however 'normal' intraocular pressure varies according to race. For example, east Asians have a lower mean intraocular pressure than Caucasians.¹⁰ Intraocular pressure in cases of chronic angle-closure may be found to be anywhere from mildly to severely raised. Cases of chronic angle-closure with an IOP in excess of 70mmHg (and *without* corneal oedema or conjunctival injection) have been documented on several occasions.

Mechanism

Classification of PACG cases into those occurring with pupil block and those without pupil block aids the choice of management strategy. *Physiological pupil block* to aqueous flow from the posterior to anterior chamber is exaggerated when sphincter and dilator pupillae muscles act together, as would occur when reading (sphincter constriction) in low light (dilator contraction). The combined action of these two muscles is to cause apposition of the iris to the lens, leading to an increase in posterior chamber pressure relative to that of the anterior chamber. Iris bombé is the result, although this will be more pronounced in blue/grey/green (thin and flexible) irides than in a dark brown (thick and more rigid) iris. Primary angle-closure glaucoma *without pupil block* is attributed to characteristics of the peripheral iris. Thick (usually dark brown) irides may be thrown into circumferential folds when the pupil dilates, crowding the iridocorneal angle. A sharp posterior angulation in the peripheral third of the iris before it inserts into the ciliary body ('plateau iris' configuration) will accentuate this crowding effect. It is likely that both pupil block and peripheral iris-crowding mechanisms are active to some extent in many cases, although the latter is probably more prominent in races with deep brown irides.

The major risk factor for the development of angle-closure glaucoma is a shallow anterior chamber. In

Caucasians, Lowe found that PACG was almost always accompanied by an anterior chamber depth (ACD) of 2.5mm or less.¹¹ Similar figures were found for Chinese subjects in Beijing.¹² PACG prevalence increases as ACD decreases in Inuit.¹³ Lowe found that, on average, PACG sufferers had an ACD 1mm less than age and sex matched normal subjects. Of this, 0.3mm was due to greater lens thickness and 0.7mm was due to a relatively anteriorly positioned lens.¹⁴ Other less important anatomical risk factors are a small corneal diameter and steeper corneal curvature, short axial length of the eye and a steeper anterior lens surface curvature.

Detection and Diagnosis

In view of the large number of individuals blinded by PACG and the often asymptomatic nature of chronic angle-closure, detection of those either at risk or with an early form of the disease is of great importance. Screening for the condition in populations with a high prevalence offers this possibility. The overwhelming evidence that the condition results from the co-existence of several anatomical risk factors suggests that screening should employ measurement of one or more of these. Unfortunately, tests with greater accuracy require more sophisticated instruments and usually require the skill of a doctor or highly trained nursing or paramedical personnel (Table 1). Once subjects have been identified as abnormal by a screening test, the diagnosis should be confirmed and management decided after careful gonioscopy.

Management of Angle-Closure Glaucoma

The management of an eye with suspect, latent or manifest angle-closure glaucoma may be medical or may require laser or traditional surgery. Subjects with suspect or latent angle-closure may be kept under periodic review, if they are likely (and able) to seek immediate medical treatment if acute symptoms should develop. Acute angle-closure glaucoma, which is almost invariably due to pupil block, requires topical pilocarpine 2%, four times daily, (preferred to 4% which may cause shallowing of the anterior chamber). Timolol 0.5% eye drops, twice daily, may be given. If iris ischaemia has caused sphincter paralysis, oral or

Table 1: Comparison of Efficacy of Screening Techniques for Angle-Closure Glaucoma

| Test | Sensitivity* | Specificity** | Criterion for Positive Result |
|-------------------------|--------------|---------------|--|
| Oblique flashlight test | 89% ‡ | 88% ‡ | Nasal iris in shadow (for detection of axial chamber depth of ≤ 2.0 mm) ¹⁵ |
| Van Herick test | 91% | 53% | Temporal limbal chamber depth $\leq 1/4$ corneal thickness (for detection of axial chamber depth of ≤ 2.0 mm) ¹⁶ |
| AC depth measurement | 93% | -N/A- | ACD ≤ 2 mm for detection of a gonioscopically narrow angle ¹⁵ |

*Sensitivity refers to the number of affected cases correctly identified as such by a positive test result.

**Specificity refers to the number of subjects correctly identified as normal by a negative test result.

‡ We have not been able to reproduce such high figures in field trials of this technique.

intravenous acetazolamide should be added. Topical steroids, such as prednisolone acetate 0.5%, may be used to limit the associated inflammation. Hyperosmotic agents such as intravenous mannitol and oral glycerol are usually reserved for cases which fail to respond after several hours of pilocarpine and acetazolamide. A very useful alternative option to these drugs is the technique of corneal indentation. The cornea is anaesthetised and then centrally indented 5 – 10 times with the flat edge of a squint hook or a similar instrument. A similar technique can be performed at a slit-lamp with the edge of a gonioscope, which will also allow a view of aqueous being forced into the periphery, opening up the angle. Analgesics and anti-emetics should be prescribed as required. Once the attack is over and inflammation has settled, a surgical peripheral iridectomy or laser iridotomy should be performed on the affected eye. The fellow eye should be carefully assessed, and if there is any risk of angle-closure, similar surgery must be carried out. Pilocarpine should not be stopped until an iridotomy has been performed.

Chronic angle-closure glaucoma due to pupil block should be treated by laser iridotomy or surgical iridectomy (pilocarpine 1–2% is an alternative if surgical management is not possible). If peripheral iris crowding is thought to be the responsible mechanism, iridotomy alone is unlikely to be sufficient and topical treatment (pilocarpine 1–2%, with or without beta-blockers, e.g., timolol 0.25% or 0.5%) or drainage surgery are required. The choice of medical or surgical management depends on the individual preference of the ophthalmologist, available facilities, and also on the patients ability to obtain regular supplies of medication and attend follow-up. However, it is important to recognise that where patients have a low income or live in remote areas, surgical management is a more reliable course of management and is usually the procedure of choice. Drainage surgery has a much higher chance of success than iridectomy if the amount of angle-closure due to peripheral anterior synechiae is greater than 180°. Similarly to acute angle-closure, assessment and treatment of the fellow eye is of vital importance.

The Future

Screening for angle-closure glaucoma in high-risk populations offers significant hope for early detection of those under threat of blindness from this condition, particularly those in isolated communities. In collaboration with The Central Medical University Hospital, Ulaanbaatar, Mongolia, we have carried out detailed field trials of these techniques and results will

soon be published (please see next article on PACG-Editor. Laser technology is rapidly advancing; smaller, more portable YAG and diode lasers have become available allowing a single unit to be transported to areas where such technology was previously not available. Non-invasive laser iridotomy offers the ideal prophylactic measure for angle-closure. Hopefully the passage of time will see the cost of this technology fall to a more widely affordable level. A major problem with drainage surgery, especially in non-Caucasians, has been an excessive healing response. Drugs which modify the healing response offer the prospect of an effective single treatment which may slow or halt visual loss in populations without access to a regular supply of drugs or medical advice, a description which applies to the majority of those at risk of blindness from primary angle-closure glaucoma.

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Advances in the Understanding of Primary Angle-Closure as a Cause of Glaucomatous Optic Neuropathy

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In the last few years the classification of angle-closure glaucoma has undergone revision. This is a result of population research in regions where angle-closure glaucoma is a major cause of blindness. Several studies have shown that most cases of angle-closure that cause glaucomatous optic neuropathy occur without the symptoms that Western ophthalmologists associate with episodes of acute angle-closure.^{1–3} We have, therefore, started using the classification scheme detailed in Table 1 in our research.

Other ocular tissues may be damaged by angle-closure. These are illustrated in Figure 1. Damage to different structures should be specifically described when recording case details.

Prevalence of Angle-Closure

Ethnicity

Ethnic background is one of the major factors determining susceptibility to primary angle-closure (PAC). Population surveys show PAC is more common among people of Asian descent than those from Europe. Among people aged 40 years and over, the prevalence of PAC (the number of cases present at one point in time) ranges from 0.1% in Europeans,⁴ through 1.4% in East Asians^{2,5} and up to 5% in Greenland Inuit.⁶ In Africa, a clinic-based study found the rate of primary angle-closure (gonioscopically verified closure of the angle with raised IOP) was equal among the black and white populations of

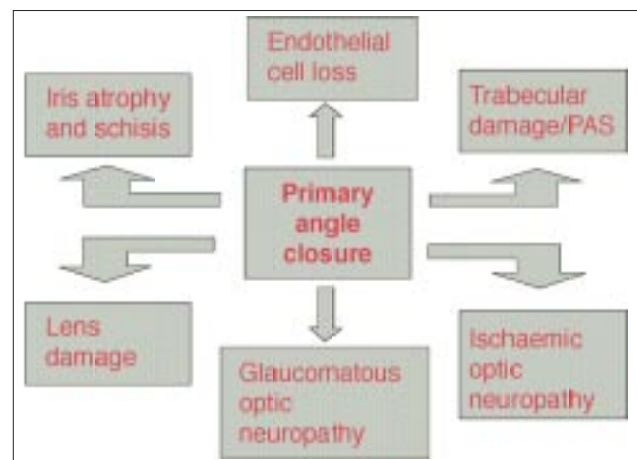


Fig. 1: Damage to ocular tissues in angle-closure glaucoma

Johannesburg. Among the white population 66% of cases were symptomatic, whereas only 31.5% of the black patients reported symptoms.⁷

Age and gender

The manifestations of ocular damage resulting from primary closure of the drainage angle are rare before the age of 40 years. After this, the prevalence of disease increases with age.^{1,2} Female gender is recognised as a major predisposing factor toward development of PAC. The prevalence of occludable drainage angles, PAC and PACG (Table 1), all tend to be higher in women than men.^{1,2}

Incidence of Angle-Closure

While prevalence is the standard measure of population morbidity at a specific time, events that are of short duration are more effectively quantified by calculating incidence (the number of new cases occurring over a specified period). The acute, symptomatic form of PAC is one such event. Incidence figures (given as cases/100,000 persons/year for the population aged 30 years and over) range from 4.7 in Finland to 15.5 in Singapore. As with prevalence, incidence increases with advancing age and shows that an excess of females are afflicted.⁸

Ocular Characteristics Associated with Angle-Closure

A shallow anterior chamber has long been recognised as a factor that predisposes toward angle-closure. The depth of the anterior chamber reduces with age and tends to be shallower in women than men.⁹ Ethnic groups that have a high prevalence of PAC have shallower anterior chambers.⁹

The depth of the anterior chamber is determined by the position of the lens within the globe, which in turn determines the width of the drainage angle. Although the relationship is not a simple geometric one, we examined anterior chamber depth (using an optical pachymeter) and gonioscopic configuration (assessed in four quadrants, using Shaffer's grading scheme) in 942 Mongolians, aged 40–87. We found that 74% of variation in the width of the drainage angle could be explained solely on the basis of variation in anterior chamber depth (Foster PJ, Baasanhu J, Johnson G J: 1995 Unpublished).

Refractive status, anterior chamber depth, lens thickness and axial length are usually associated. Anterior chambers are shallower in hypermetropes than in myopes. Angle-closure is typically associated with a hypermetropic refractive state. Increasing living standards and higher educational attainment in Asian and Inuit populations seem to have been paralleled by an increasing prevalence of myopia.^{10,11} In Singapore, half the male Chinese population aged 15 to 25 years is myopic. Among those with a university education, this figure rises to 66%.¹⁰ This raises the question of whether the high rate of PAC previously encountered in these populations is destined to decline.

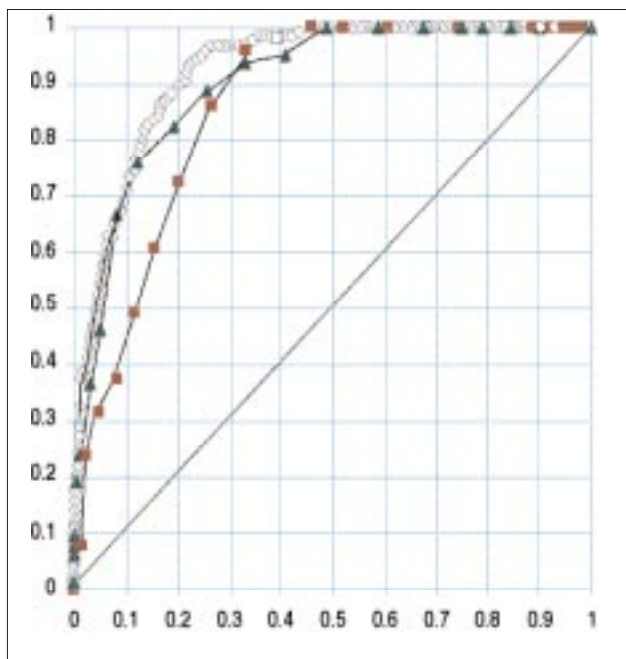


Fig. 2: Detection of narrow drainage angles by measurement of axial AC depth using optical pachymetry (diamonds \diamond), slit-lamp mounted ultrasound (triangles \blacktriangle) and hand-held ultrasound (squares \blacksquare)

Table 1: Classification of Primary Angle-Closure

| |
|---|
| <p>1. Primary angle-closure suspect An eye in which appositional contact between the peripheral iris and posterior trabecular meshwork is considered possible.</p> <p>2. Primary angle-closure (PAC) (a) Non-<i>ischaemic</i>: an eye with an occludable drainage angle and features suggesting trabecular dysfunction, such as peripheral anterior synechiae, elevated intraocular pressure or excessive pigment deposition on the trabecular surface. The optic disc and visual field are normal. (b) <i>Ischaemic</i>: the presence of iris whorling, stromal atrophy or glaukomeflecken signify previous 'acute' PAC. However, as these are areas of ischaemic necrosis, we suggest that 'ischaemic PAC' is the correct description. Differentiating between non-<i>ischaemic</i> and <i>ischaemic</i> PAC is supported by experimental evidence that the iris and ciliary body are the ocular tissues most sensitive to pressure-induced ischaemia. Damage to the optic nerve only occurs at higher pressures, and therefore anterior segment ischaemic sequelae indicate that nerve ischaemia may have occurred, but do not confirm it.</p> <p>3. Primary angle-closure glaucoma (PACG) Glaucomatous optic atrophy, with a characteristic visual field defect in the presence of an occludable drainage angle or signs of PAC.</p> |
|---|

Screening for Primary Angle-Closure Glaucoma: An International Perspective

Glaucoma is now probably the leading cause of irreversible blindness world-wide. It is suggested that 73 million people suffer from glaucoma, and, in 1996, Quigley estimated that 6.7 million were blind.¹² The population of Asia account for the majority of this number and in a recent study of the prevalence of glaucoma in Singapore, we found that only 24% of POAG sufferers were blind in at least one eye, but 57% of PACG sufferers were blind in one eye. This difference was highly significant.³

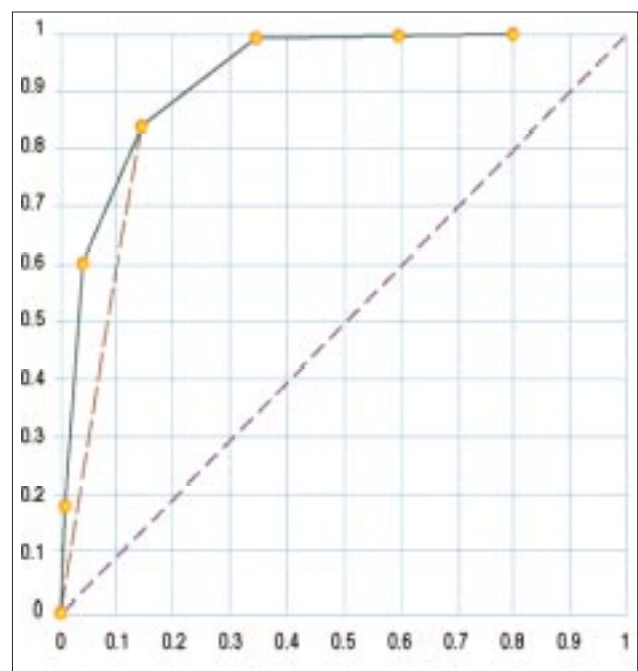


Fig. 3: Detection of narrow drainage angles using the Van Herick technique (limbal chamber depth estimation) using traditional grading (dashed line) and a modified grading scheme (solid line)

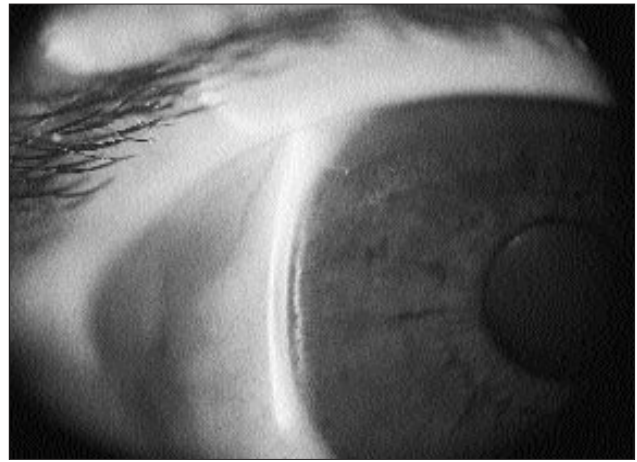
The epidemiology and natural history of POAG are relatively well understood. Until recently the epidemiology of PACG was not as clearly understood, but over the last 5 years there has been an increased research effort, and this deficiency is gradually being re-dressed. Previously, IOP was held to be the most suitable risk-factor for POAG that could be used for screening. However, although raised IOP is sufficient to cause glaucoma, it is not necessary. Between one-half and two-thirds of POAG cases have an IOP consistently within the 'statistically normal' range. Psychophysical tests and disc imaging techniques offer promise although the technology is immature and remains to be proven.

Anterior chamber depth

In contrast, PACG does have features that are more readily identifiable. Closure of the drainage angle requires the iris and the trabecular meshwork to be in relatively close proximity prior to the development of the closure process. The association between PACG and a shallow anterior chamber has prompted the investigation of measurement of central and limbal anterior chamber depth measurement as tools for screening for PACG.

In the context of a screening programme for PACG, the intention would be to detect persons with appositional angle-closure, in the 'latent' phase of the disease before glaucomatous optic neuropathy has developed. These people can be reliably detected by either measurement of the axial anterior chamber depth (either by optical pachymetry or A-mode ultrasound), or grading of the limbal chamber depth by the van Herick technique where the slit-lamp beam is shone at right angles to the cornea at its periphery, close to the limbus. Both these tests will give a sensitivity and specificity of over 80%. Assuming a population prevalence of 5% for people aged 40 years and over with occludable drainage angles, this translates to positive and negative predictive values of the tests of 17% and 99%. These figures mean that 17% of people 'failing' the screening test and being referred for confirmatory examination will have occludable drainage angles. Put another way, about 1 out of 5 people referred to an ophthalmologist for gonioscopic examination would require treatment. One person in 100 would be incorrectly classified as normal.^{13,14}

The suitability of the tests for mass screening varies. Both axial and limbal chamber depth grading have been used in the field on over 1,700 people in Mongolia, and were found to be acceptable and safe. The limbal chamber depth (van Herick) grading requires a slit-lamp, and probably an ophthalmologist or experienced technician. It is, therefore, limited by the need for sophisticated equipment and highly trained staff. Axial chamber depth measurement by optical pachymetry has the same limitations. Ultrasound measurement of anterior chamber depth with a hand-held probe avoids the need for a slit-lamp, but gives much less reproducible measurements than



*Grading the limbal chamber depth by the van Herick technique
Photo: Paul Foster*

slit-lamp-mounted ultrasound.¹⁵ Using a hand-held device in a population-based screening programme would result in a small but significant degradation in test performance.¹³ Therefore, the ideal method would use a joy-stick directed ultrasound probe mounted on a stabilised base-plate with a chin-rest. It is envisaged that a self-contained screening kit would fit into a small suitcase. A prototype of this device is currently in production.

Management

The next consideration, after detection, is the management of persons found to have occludable drainage angles. Prophylactic laser peripheral iridotomy (PI) offers a non-invasive, quick procedure that has few significant short-term complications. Probably the most significant complication from the point of view of care of a patient with glaucoma is the post-laser pressure spike, although adequate pre-medication should prevent this. However, pre-medication, either with topical apraclonidine or oral acetazolamide, may have serious side-effects. Use of apraclonidine has been associated with collapse in one elderly female patient undergoing laser treatment. The risk of erythema multiforme with acetazolamide is small but present. In a regional or national blindness prevention campaign where the number of people treated might run into thousands, these rare but severe adverse effects may become significant factors in the risk benefit equation.

More importantly, the efficacy of laser PI as a prophylactic measure for PACG is uncertain. It has been suggested that PACG in Asian people may often be caused by a non-pupil block mechanism, which would not be amenable to laser iridotomy. However, a follow-up study performed in 1998 looking at Mongolian people with occludable drainage angles treated in our 1995 and 1997 surveys found that the median angle width had increased by 2 Shaffer grades

following laser PI. Patent peripheral iridotomies were found in 98%. Iridotomy alone failed in 3% of eyes with narrow drainage angles and either peripheral anterior synechiae or raised IOP, but normal optic discs and visual fields. However, in eyes with established glaucomatous optic neuropathy at diagnosis, iridotomy failed in 47%. None of the eyes with narrow angles that were normal in all other respects and underwent iridotomy, developed glaucomatous optic neuropathy or symptomatic angle-closure within the short follow-up period. This suggests that Nd:YAG laser iridotomy is effective in widening the drainage angle, and reducing elevated IOP in East Asian people with primary angle-closure without glaucomatous optic neuropathy.

Furthermore, it suggests that pupil-block is a significant mechanism causing closure of the angle in this population. Once glaucomatous optic neuropathy associated with synechial angle-closure has occurred, iridotomy alone is less effective at controlling IOP¹⁶ and trabeculectomy will usually be necessary.

Conclusion

The understanding of the epidemiology and management of primary angle-closure has advanced considerably in the last decade. PACG is possibly the leading cause of blindness in East Asian countries. There is great interest in the natural history of narrow drainage angles and eyes with PAC. Only longitudinal data will help us determine who should receive treatment. Further information is also needed on the effect of laser iridotomy on eyes in the very earliest stages of angle-closure. Most of these low risk eyes will never suffer significant loss of vision from PACG. It is important to be sure that laser PI does not cause significant side effects (such as cataract) in a small number of people, that may outweigh its benefits in preventing a few cases of PACG. However, there is now considerable optimism that screening and prophylactic treatment for PAC and PACG may be a viable method of preventing blindness in very large numbers of people in Asia.

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TRACHOMA • EXTERNAL EYE INFECTIONS

Trachoma and the *SAFE* Strategy

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Introduction

Eight years have passed since the *Journal of Community Eye Health* devoted an Issue to trachoma, the leading cause of preventable blindness. That edition of the *Journal of Community Eye Health* (Vol. 7, Issue 14) noted that it was surprising that the most common cause of blindness after cataract was, in fact, attracting so little attention. Perhaps our recognition that trachoma can disappear with economic development, improved sanitation, and better personal hygiene, led to complacency in Ministries of Health in many countries. The partial success of trachoma control through World Health Organization (WHO) programmes mounted in the 1960s – together with economic development in urban areas where trachoma had been a problem – led to neglect of this disease among the poorest of the world's population, especially in rural areas. It is these poor people, generally without basic sanitation, access to water, and with little or no experience of economic development, who are most likely to become infected with *Chlamydia trachomatis* and are at risk of blindness. Today, trachoma is confined to 46 countries, mainly in Africa, the Middle East and Asia. Almost 150 million people are thought to have active infection and 5.6 million are blind, or at immediate risk of blindness. Ten million people need simple eyelid surgery to prevent consequent blindness.

Trachoma Control: The SAFE Strategy

The good news, however, is that there is a rebirth of interest in control measures and an enthusiasm to launch programmes that include tertiary prevention (surgery), secondary prevention (antibiotic treatment of the infection) and primary prevention (facial hygiene and environmental change to improve sanitation) – the SAFE strategy. The acronym SAFE



The SAFE Strategy: Surgery, Antibiotics, Facial cleanliness and Environmental changes

Photos: Murray McGavin & H Anenden/WHO

provides both an understandable approach and a rallying cry for those who are interested in eliminating this cause of blindness. SAFE combines the three elements of primary, secondary, and tertiary prevention, but in the reverse order:

- Surgery to prevent blindness in those who have trichiasis/entropion.
- Antibiotics (tetracycline ointment or azithromycin) to combat active chlamydial infection.
- Facial hygiene.
- Environmental change.

The importance of environmental change has never been stronger, with the recent evidence by Paul Emerson and his colleagues that fly control can reduce trachoma prevalence.¹ Some have suggested that the final E should include not just environmental change, but education and economic development. Perhaps SAFE with E³!

WHO Manuals and GET 2020

The World Health Organization has led the way in this rebirth, through the publication of the five technical manuals on trachoma control (Assessment, Trachoma Rapid Assessment, Surgery, A guide for Environmental Sanitation and Improved Hygiene, and also Achieving Community Support), and in the formation of the Global Alliance for the Elimination of Trachoma

by the Year 2020 (GET 2020). This Alliance is open to all who are concerned with controlling this disease. It has grown from an original meeting of 12–13 interested parties, to an attendance of representatives of 29 endemic countries, 9 non-governmental organisations and 10 research institutions concerned with trachoma control in Geneva, at the seventh meeting in January 2003. Prior to the 2003 meeting, an informal Trachoma Scientific Workshop was held, to promote scientific exchange, and to provide focus on applied research and to improve control programmes.

Azithromycin

A new long-acting oral antibiotic, azithromycin, is as effective in a single dose as six weeks of daily tetracycline ointment. This has greatly improved the chances of reducing infection within a community and, when combined with the other elements of the SAFE strategy, could lead to elimination of the disease. Robin Bailey and his colleagues first reported the potential of azithromycin in The Gambia.² More recently, community trials using a common protocol in Egypt, Tanzania, and The Gambia have verified the effectiveness of this antibiotic in a rigorous comparison with tetracycline ointment.³ In these studies, compliance was assured. In actual public health campaigns, because of the difficulty in using the ointment and its unpopularity, one would expect that a single dose oral drug would be far superior. Encouraged by these results and the WHO recommendation that azithromycin should be tested in community control programmes, Pfizer Inc, the global pharmaceutical company, has embarked on its largest international philanthropy – a donation so far of more than \$200 million worth of Zithromax®.

International Trachoma Initiative

In November 1998, Pfizer Inc, together with the Edna McConnell Clark Foundation, established the International Trachoma Initiative – an effort to test the SAFE strategy using Zithromax. Beginning in five countries (Tanzania, Mali, Morocco, Ghana and Vietnam) chosen from the WHO's 16 priority countries defined by the GET 2020 Alliance, the International Trachoma Initiative (ITI) has added programmes in Nepal, Niger, and Ethiopia. The ITI also collaborates

with the Carter Center in its programme for trachoma control in Sudan. In the areas where ITI-supported programmes have begun in the first five countries, there has been a reduction in acute infection in young children of 45 – 50%. At the same time, progress has been made against the backlog of patients requiring lid surgery. The International Trachoma Initiative, working with the Global Alliance, hopes to share information on operational research and programme evaluation and monitoring, based on its experience in implementing control in these five countries.

The *Journal of Community Eye Health* provides sound background information concerning trachoma control and recent developments in this area. The brief articles that follow explain and amplify the steps needed to undertake the SAFE strategy. Additional detailed information can be found in the technical manuals available through the Prevention of Blindness Programme of the World Health Organization. In addition, the previous Issue of the *Journal of Community Eye Health* on this theme (No. 14) continues to be highly relevant, and back issues may be available in London from the International Resource Centre. A trachoma teaching CD-Rom that has been produced by the Wellcome Trust and is distributed by CAB International.

The new antibiotic, azithromycin, is important as it may effect a decrease of transmission in a community, while the longer lasting elements of facial hygiene and environmental control are put in place. More important, however, is the rebirth of interest in assessing and taking action to end trachoma as a cause of blindness. If the SAFE strategy can be put into practice where trachoma remains endemic, transmission could be halted well before 2020, the year that the Global Alliance expects to see an end to the need for corrective lid surgery.

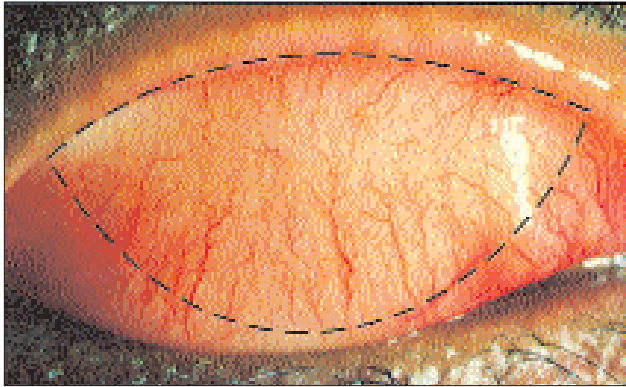
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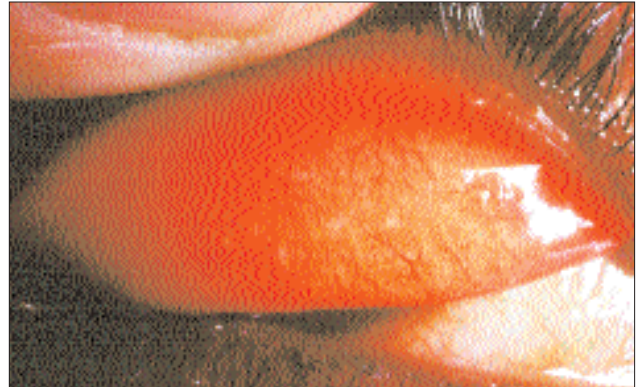
Trachoma Simple Grading System

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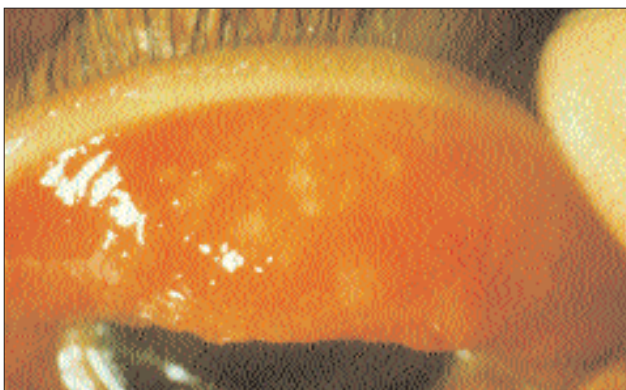
Normal everted upper eyelid (The area to be examined for inflammatory changes is outlined).

Photo: Murray McGavin



TF = Trachomatous Inflammation – Follicular: the presence of 5 more follicles, each of which must be at least 0.5mm in diameter, on the flat surface of the upper tarsal conjunctiva.

Photo: John DC Anderson



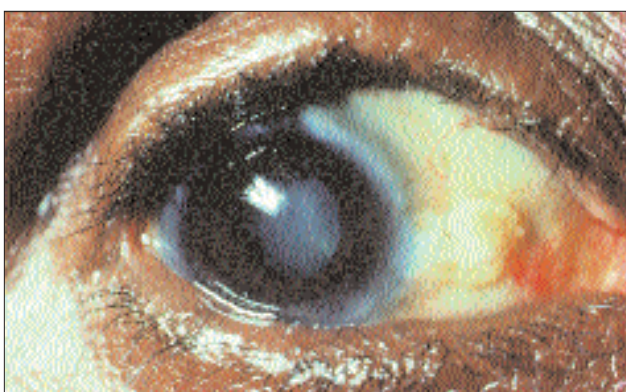
TI = Trachomatous Inflammation – Intense: marked inflammatory thickening of the upper tarsal conjunctiva that obscures more than half of the normal deep tarsal vessels.

Photos: Allen Foster



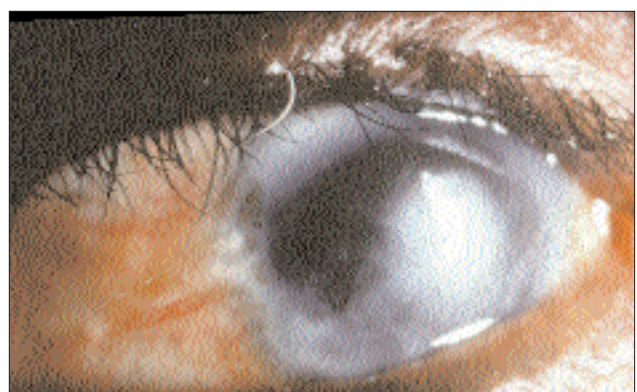
TS = Trachomatous Scarring – the presence of scarring of the tarsal conjunctiva.

Photo: Hugh Taylor



TT = Trachomatous Trichiasis: – evidence of one or more eyelashes rubbing on the eyeball. If one eyelash or a number of eyelashes have recently been removed, then the patient's trachoma should also be graded as trachomatous trichiasis.

Photo: John DC Anderson



CO = Corneal Opacity: corneal scarring due to trachoma where the scarring is central and sufficiently dense to obscure part of the pupil margin.

Photo: John DC Anderson

Achieving Community Support for Trachoma Control: Developing a Training Manual for District Health Workers

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Introduction

Trachoma often occurs in areas which are remote and underserved. Health workers in these areas also often suffer from isolation, and lack opportunities for training and exposure to new ideas and techniques. To address this, the World Health Organization, with the support of the Edna McConnell Clark Foundation, published a set of three manuals for various levels of personnel working to control trachoma:

- Primary Health Care Level Management of Trachoma.
- Trichiasis Surgery for Trachoma: The Bilamellar Tarsal Rotation Procedure.
- Achieving Community Support for Trachoma Control.

This article documents how the third manual in the series – **Achieving Community Support for Trachoma Control** – was developed.

Aim of the Manual

Promoting interest in trachoma amongst communities for whom it may not be a priority problem, demands special challenges of health workers. Developing a manual which acknowledges these challenges and which encourages health workers to rise to them, provided special challenges for the writers of this



Participant testing inquiry activities described in the manual
PHoto: Victoria Francis

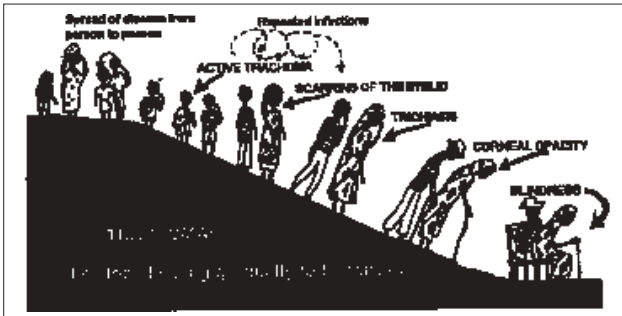
manual. The aim was to develop a manual which could be used as an 'action book' – to provide background information about trachoma and to focus on practical things which could be done with communities to detect, treat and prevent the disease. The emphasis is not on providing a prescription, but on involving communities in finding suitable approaches themselves. The manual is intended for district health workers to use in training and for establishing action teams in areas where trachoma is a problem.

EARLY DEVELOPMENT OF THE MANUAL: Drafts 1–4 (9 months)

Deciding on Audience and Content

The first consideration in deciding upon the content was to specify who would use it. Early attempts to





Trachoma does not cause blindness immediately. We can picture trachoma as a slope leading to blindness. We must try to prevent the disease – or its progress, if infection is established

Drawing: Victoria Francis

include all those who might use it resulted in the first draft 'speaking widely and broadly'. The following points, which were offered at editorial meetings, helped to reshape the content of the manual for a more targeted audience.

- (i) The overall global strategy is to support national plans for prevention of blindness. Therefore, the manual should talk about *community support* for trachoma control, rather than *community control* of trachoma. It should be more to do with the application of strategies than with the development of strategies.
- (ii) The manual should be aimed at health workers in general, not only ophthalmic workers. Integration with existing health activities should be stressed.
- (iii) The manual should focus on practical activities. Deciding what will work in different settings depends on knowing the situation well and deciding on appropriate action *with* the community, rather than offering a prescription.

With this clarity about intended audience and use, the manual's title changed from *Community Control of Trachoma* to *Achieving Community Support for Trachoma Control*. The change in title reflected a significant change in orientation. This led to major revisions in the content, most dramatically illustrated in a reduction of length from 15,700 words to a more 'directly, simply' speaking version of 6,000 words.

Deciding on the Style and Tone

An early decision was that the manual should be more of an activity book than a text book about trachoma, or theories of community participation. An early decision about the tone of the manual was that it should convey a non-judgemental attitude. Much literature on trachoma is laden with words such as 'dirty . . . unhygienic . . . poor . . .' These words then permeate into health education efforts and can discourage, rather than engage community support. Not only do they create a barrier between the 'clean' talking to the so called 'dirty', but the words themselves are subjec-

tive and to some extent meaningless. For example, keeping cattle within the enclosures of human habitation might be labelled 'dirty' by outsiders while keeping cattle far from where people live would be considered dangerous and foolhardy to those who know that theft of animals would seriously affect the family's health.

FIELD TESTING THE MANUAL: IRINGA, TANZANIA: July 1994

Arriving at a version ready for field testing took eight months, two visits to field projects, four drafts and involved two editorial meetings with international experts. The next stage was to put it to the test with the target audience and to use the opportunity of field work to develop the manual further.

The field testing of the manual took place over a five day workshop, held at the Primary Health Care Institute, Iringa, Tanzania. Twelve participants were selected from different regions in Tanzania, some of them ophthalmic workers and integrated eye workers (general health workers with some training in eye work).

The timetable was organised around the need to test four things:

- The readability of the text.
- The illustrations.
- The clarity of the concepts.
- The practicability of the activities.



Setting the Right Atmosphere for the Field Testing

The honest input of participants in field testing is crucial. The relationship between them and the text they are testing needs to be clarified early on. It became apparent at the start of this exercise that many of the participants saw themselves as coming to 'receive knowledge'. It was explained that the main purpose was for the manual itself to 'receive knowledge' from the participants. This was done in a light hearted way, by making an empty seat for the manual – illustrating that it was there as a learner itself. Participants should comment on things that are not clearly explained, unrealistic, or are not easy to put into practice.

Testing the Readability of the Manual

The idea of readability was explained in this way. If you are moving along a road, you want to get to your destination as smoothly and easily as possible. If the road is bumpy, you will have to keep stopping to negotiate the way. The same goes for reading a text. It is the writer's job to try to make a 'smooth road'. It is difficult as a writer to know exactly how your 'road' is travelled by a reader. For this reason tests have been devised to judge the readability of a text. One of these tests is the Cloze readability test. Two pieces of text from the manual were chosen for this. One dealt with disease aspects of trachoma and one with the community aspects. The tests were done four days apart. With both texts selected, the majority of respondents scored over 60%, which indicated that these texts should be easily understood without further explanation by the target audience.

Testing the Illustrations

Projection slides were made of all illustrations in the manual. The format for testing the illustrations was as follows:

1. What do you think this picture means? (to find out how the overall message is interpreted).
2. What does this picture make you feel or think about? (to find out if the picture causes offence or is culturally inappropriate).
3. How do you think the picture could be changed to better convey the intended meaning?

Testing the Concepts

The concept of community involvement in trachoma control is central to this manual. It was important to find out to what extent this concept was successfully communicated in the manual.

This manual tries to include activities which require discussion with communities rather than didactic teaching. Role play (a technique where participants act out the roles of different people in a situation) was used to test how successful we were in this.

However, it is not clear if those individuals would have performed as they did, even without a single reading of the manual. The role play itself proved a valuable teaching tool, suggesting to the writers that training activities, such as role play, should be linked with the use of the manual. This would probably best be included in accompanying materials for trainers.

The other concept which required time to grasp was the theme running through the manual which visualises trachoma as a 'slope leading gradually to blindness'. The activities to intervene can be remembered in the word **SAFE**: Surgery, Antibiotic treatment, Face washing, Environmental changes.

To have confidence in this slope concept, we had to see if it was picked up, unprompted, with any excitement by the participants, during the course of the field testing workshop. After three days one of the participants offered his own explanation of the slope, which received unanimous support and interest from the rest of the group.

An important lesson in testing how unfamiliar concepts are received is to allow some time for the ideas to be understood. Manuals are meant to be used over some time, usually in conjunction with some training, and it is realistic in the testing of them to allow some time for understanding to grow.

Testing the Activities

The activities proposed in this manual fall into two categories: inquiry activities and control activities.

The finding-out activities were tested by sending groups into a village to test them and feedback their findings.

The control activities, categorised throughout the manual into four levels – Surgery, Antibiotic treatment, Face washing and Environmental changes (**SAFE**), were tested by drawing on the participants substantial experience with community work. This was done through focus group discussions and role play.

Outcome from the Field Testing

The experience of field testing this manual illustrates that the collaborative process of developing a manual is not over until input from the target users has been obtained. The changes resulting from this interaction could be summarised as follows:

(1) *Text was clarified and pruned*

In the field test, the participants were taken through the manual and given explanations about the purpose of the different sections. This process of verbal explanation helped to highlight what might be weak in the written explanation. These verbal explanations should be recorded. During this field test a flip chart served this purpose. Another option is to use a tape recorder to capture explanations offered during the field test. The verbal explanation also helps to identify

complicated words. If you do not use them verbally, there is no need for them to be in the text.

(2) *Inconsistencies and problems with the layout were pointed out*

Field testing exposes the manual to the scrutiny of 'new eyes'. A stranger to the materials can often point out illogical arrangements which the writers fail to see. A number of changes to the layout suggested during field testing were adopted.

(3) *The structure of the manual was simplified*

It became clear in testing this manual that one could not expect readers to make connections between different parts of the manual. Theory activities and tools need to be together.

(4) *Material for the final chapter was gathered*

Field testing can also provide an opportunity to develop those parts of the manual which an individual, sitting in an office remote from the scene of use, would probably not write well. This was the case with the final chapter of the manual, *Ideals for Achieving Community Support*. A framework was made before the field testing, but new content came out of discussion and demonstration of practical ideas.

(5) *Illustrations were modified or completely changed*

As a result of testing the illustrations, twelve were identified as needing minor alternations (e.g., put more features on the people's faces), three needed to be redrawn because of more significant changes (e.g., there is too much happening in this picture, it is confusing) and seven would need to be completely redesigned because the image totally failed to communicate the concept (e.g., this picture looks like people having a 'tug of war', when the intention was to illustrate collective effort!)

(6) *Field testing showed the need for an additional guide to be used by trainers*

Achieving community support has much to do with process – how health workers approach the community and how challenges of community development are resolved. These skills are not easily acquired through text alone. Experiential methods of learning are the best preparation. The field testing demonstrated a need to use the manual as part of a training programme. For this, guidelines are needed for the trainers.

Summary

Development of this manual on **Achieving Community Support for Trachoma Control** has proved almost as challenging as the subject matter itself. Useful lessons have been learnt on how to incorporate the suggestions of international experts and the responses of potential users, at the same time not losing the

original vision of the writers. The main lesson in developing this manual is the importance of employing a collaborative approach, while at the same time maintaining a strong vision of the identity of the final product.

ACHIEVING COMMUNITY SUPPORT FOR TRACHOMA CONTROL: DEVELOPING A TEAM MANUAL FOR DISTRICT HEALTH WORKERS

Postscript to the article published in the *Journal of Community Eye Health* Volume 7, Issue No.14, 1994.

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Virginia Turner DrPH**

Achieving Community Support for Trachoma Control is still available from the **World Health Organization: Programme for Prevention of Blindness and Deafness, World Health Organization, Avenue Appia, 1211 Geneva 27, Switzerland.**

Web: www.who.int/pbd

The Manual continues to provide a useful resource for global efforts to eliminate trachoma. It has been translated into French, Spanish, Portuguese and Chinese. Some sections have been adapted for local vernacular translations and publicity materials, such as leaflets and T-shirts.

Perhaps one of the most useful things to come out of the manual was the acronym **SAFE**, which provided a rallying cry for programmes to focus on community-based interventions and to adopt a multifaceted approach – including medical, behavioural and environmental interventions. The now widely recognised **SAFE Strategy** is promoted by the World Health Organization Alliance for the Global Elimination of Blinding Trachoma (GET) and the International Trachoma Initiative (ITI), as the most promising weapon against trachoma.

Although a formal evaluation of the manual has not been undertaken, anecdotal evidence suggests that it has provided a useful framework for discussion with village people, district health workers and board members. It is also a basis for adaptation by local health workers and a quick entry point for newcomers to the field, such as the BBC World Service Trust, who developed trachoma health education campaigns in Tanzania, Ghana, Ethiopia, to name a few. While an update of the manual would be useful to reflect certain advances since the publication of the manual in 1995 (e.g., the use of oral rather than topical antibiotics), the authors feel that with the underlying concept of an 'action book', users are encouraged to make their own adaptations according to their circumstances, and this might be enough to keep it up to date in the field.

Victoria Francis and Virginia Turner, May 2002

Trachoma and Water

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Trachoma Prevalence and Transmission

There are four reasons why one might expect improvements in water supply to reduce the transmission of trachoma in a community.

1. Increased water availability means that children's faces, which are the sources and sites of re-infection with the organism *Chlamydia trachomatis*, which causes the disease, can be cleaned more thoroughly and more frequently.
2. It also means that the objects which carry the organism between one person and another, from fingers to bedclothes, can be kept cleaner and are less likely to be infected.
3. To the extent that trachoma is transmitted by flies, the presence of more water in an arid (dry) environment – including water spilt or thrown on the ground – will provide alternative sources of moisture to flies which would otherwise seek it on children's faces.
4. Finally, the water supply helps people to maintain a cleaner domestic environment (for instance, by washing dishes rather than leaving them around with food remains on them), and so the environment will be less attractive to flies.



Collection of water – at a distance – in Southern Africa

Photo: Erika Sutter

Trachoma and Water Supplies

Certainly, trachoma is generally found in arid and semi-arid parts of the world, such as the Sahel, India, and the Australian interior where water is scarce. However, the relationship between water supplies and trachoma is sometimes more complex than it might seem, and the proof that water supply improvement can help to reduce trachoma can sometimes be difficult. One study from Ethiopia¹ even found that people living farther than 15 minutes' walk from a water source had *less* active trachoma than those with a source of water closer at hand.

Part of the explanation for such negative study results is that hygiene improvements do not follow automatically from the provision of a convenient water tap. If we study overall domestic water consumption as an indicator of hygiene, and the time required to collect a bucket of water as an indicator of water availability, we find that the relationship between them takes a rather surprising form (Figure 1).

The surprising part is where the water source is less than half an hour's round-trip away from the household. In general terms, a half hour round-trip water collection journey corresponds to a distance each way of about 1 km (walking at 4 km/hour, with no queue at the tap). When the existing source is farther away than this, then a tap closer to the home can be expected to lead to an increase in consumption. However, when this level of availability has already been reached, bringing the water source closer to the door has practically no influence on water consumption, unless the water is provided in the yard or in the house.

This 'water use plateau' has been documented by studies in East, West and Southern Africa, Asia and Central America. It means, that for people who are

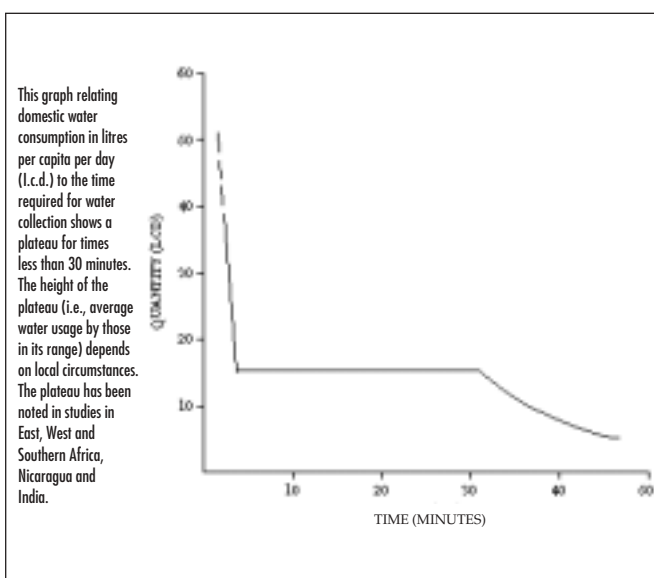


Fig 1: Domestic Water Consumption and Time Required for Water Collection

already on the plateau, a water supply providing an in-house level of service will increase their water consumption, affect their hygiene and, by implication, reduce their level of trachoma. If house connections for water supply are not feasible or affordable, priority in allocating water supplies should therefore go to those who are farthest from their water source, and farthest off the 'edge' of the plateau. That priority will help to ensure the maximum benefit in terms of eye health. Happily, it will also give the maximum benefit in terms of diarrhoeal disease reduction and also help to reduce the weary task of carrying water. Water supplies which are good for health in general are also best for trachoma control.

In fact, both water and sanitation are good for trachoma control. A number of studies^{1,2} have found less trachoma in families with latrines. Latrines help to control the *Musca sorbens* flies which land on children's faces, which may explain why they protect against trachoma.

The total amount of water people use gives only a crude indication of their hygiene. How the water is used determines whether it will help to control trachoma. For example, a study in The Gambia³ found that the total quantity of water used by a household had no effect on the prevalence of active trachoma, but that trachoma-free households used more water for washing children than households with trachoma cases.

Trachoma and Health Education

This raises the possibility of using health education to encourage the use of water for specific hygiene

purposes such as face-washing. Health education is probably cheaper than building water supplies; even so, there are no specific resources in most poor countries for health education simply to prevent trachoma. On the other hand, adding too many messages to an existing health education programme weakens its impact, so that health educators may be unwilling to add a trachoma message to an already overburdened programme.

One promising possibility is that hand-washing, increasingly promoted to prevent diarrhoeal diseases, may also help to prevent transmission of trachoma and other eye infections. Fingers have been considered an important means of transmission of trachoma for over seventy years,⁴ and a field study from Indonesia⁵ has shown that an intervention to promote hand-washing could be successful in reducing not only diarrhoea, but also eye infections. As with water supply itself, this is an example of how good primary health care can help to prevent trachoma best when it also prevents other diseases.

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Azithromycin for Control of Trachoma

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Introduction

The new Global Initiative by the World Health Organization has an ambitious goal of eliminating blinding trachoma by 2020. GET 2020 consists of a four-pronged strategy to reduce active trachoma through community-based antibiotic distribution and health education on face washing and environmental sanitation, and to reduce vision loss from trichiasis through provision of appropriate surgical services. The SAFE strategy – Surgery, Antibiotics, Face-washing, Environmental change – is currently being implemented or planned in several countries, including ten where the antibiotic component will be based on the drug azithromycin under a donation programme by Pfizer, Inc. through the International Trachoma Initiative.

Azithromycin represents a breakthrough for the community-based, antibiotic treatment of ocular *Chlamydia trachomatis* infection. Trachoma is a community disease which clusters in neighbourhoods and within families – children having the highest rates of disease.¹ Treatment of a few cases in such a setting guarantees re-infection from familial or neighbourhood sources, unless the treatment is more widespread. Moreover, re-infection from extra-ocular sites can occur if only topical treatment is used,² and re-infection from other people can occur if treatment of members of the community is not carried out at the same time. Topical agents, such as tetracycline, have previously been the agents of choice because of the absence of systemic side effects in children (seen with oral tetracycline), or the high cost and lack of availability of oral erythromycin in many of these remote communities.

However, topical tetracycline must be used every day for four to six weeks to be effective, and it stings, is messy to use, and results in blurred vision because of its oily base. Compliance (regular use of the prescribed medicine) with topical agents is typically quite poor.



Community health volunteer, Kerege Joseph, dispensing azithromycin suspension

Photo: Anthony Solomon

Azithromycin

Azithromycin, on the other hand, has been shown to be effective against *C. trachomatis*, with one dose administered orally.^{3,4} Azithromycin is in the azalide class of antibiotics, with chemical modifications that result in greater stability in acid than erythromycin, from which it is derived. It has unique pharmacokinetic properties that make it ideal for treating trachoma; good oral bioavailability and distribution to tissues; sustained high tissue levels with low protein binding; and high intracellular concentration which is important in treating *Chlamydia trachomatis*.⁵ Serum, aqueous and tear samples, collected 4 days after azithromycin administration, showed pharmacologically active concentrations – and conjunctival specimens continued to have high levels 14 days after administration.⁶ The safety of a three dose regimen (once per week for three weeks), or a single dose, has been demonstrated in clinical trials.^{3,4,7} Side effects include occasional mild gastrointestinal upset, and cases of nausea, vomiting and diarrhoea – although, in large clinical trials few side effects were reported. The reports from the widespread use of azithromycin in trachoma-endemic regions in the last few years indicate excellent tolerance and no adverse reactions.

Azithromycin for Trachoma Control in Communities

A large, community-based randomised trial in three countries was carried out to determine the long term effect on trachoma at the community level of mass treatment with azithromycin, compared to tetracyc-

line.⁷ At one year post-treatment, both clinical disease and laboratory evidence of infection in the community were reduced in both groups, with evidence of a greater reduction in villages treated with azithromycin. Administration of the drug, and monitoring of compliance was considerably easier with azithromycin, compared to tetracycline topical ointment. Azithromycin offers an important new weapon in antibiotic intervention for trachoma control.

The enthusiasm for the use of this drug for trachoma control is very high, which has raised a new set of difficult questions. First, the drug is very expensive – prohibitively so for countries where trachoma control is important. Cost-effectiveness concerns have led program directors in The Gambia to conclude that for their country with low rates of trachoma, azithromycin should not supplant the use of topical tetracycline.⁸ At present about ten countries have been selected for a donation programme, and other countries are not eligible to receive the drug without charge, except for research purposes. While other countries can proceed with topical antibiotics as part of their programme, the issues of compliance and likely coverage remain a problem. Second, the widespread use of oral azithromycin has raised concern for the potential development of resistant strains of *C. trachomatis*, as well as other sensitive organisms such as *S. pneumoniae*. While the development of resistance, based on a once-per-year dosing, may be unlikely, this possibility needs to be addressed. Third, azithromycin has not been approved for use in pregnant women by the Food and Drug Administration in the United States. This is based on the absence of studies, not on concerns for safety. Women are at increased risk of active infection because of their ‘care taking’ activities with young children. If compliance is inadequate with topical preparations, women may form a significant source of re-infection of the community, as well as the ongoing personal risk for themselves.⁹ Each country programme must currently weigh the risks and benefits of using azithromycin for treating active disease in pregnant women.

Operations Research

Operations research projects underway in Tanzania, Nepal, Morocco, and Mali are addressing questions of the effect on communities of targeting treatment to individuals or families, as opposed to mass treatment. Infections which are not obvious on clinical examination have been reported as high as 30% in Gambia and Egypt – and, if treatment is restricted to those with clinically apparent disease, the long-term impact on trachoma in the community, if not treating these cases, is unknown. Studies using quantitative techniques will help to address the potential significance of these adult infections. Alternative strategies for mobilising communities, to ensure high coverage rates, are also being tested. Such research has high priority for informing programmes of ways to maximise scarce resources for the long term control of trachoma in their communities.

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□

Training in Trichiasis Surgery

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Introduction

It is estimated that each village in central Tanzania has between 5 – 25 persons with in-turned eyelashes due to trachoma. Half of these people constantly epilate their eyelashes to ease the irritation and pain from in-turned eyelashes.

Aims

The aims of training in trichiasis surgery are to teach:

- Identification of patients needing trichiasis surgery
- A good and safe surgical procedure
- The principles and practice of competent follow-up.

Selection of Trainees

Trainees are recommended by their respective Health authorities. They are required to have:

- Previous experience in eye examination.
- Experience in giving injections.
- Knowledge of sterile surgical techniques.
- Previously observed eye surgery.

Two weeks is the minimum time recommended to train a trichiasis surgeon.



Stitching exercises on an orange

Photo: Sidney Katala



Trichiasis surgery might have prevented blindness....

Photo: Murray McGavin

Objectives of Training in Trichiasis Surgery

At the end of the course the trainee should be able to:

- Perform the tarsal rotation method for trichiasis.
- Complete at least 5 supervised operations to receive certification.
- Follow-up trichiasis patients and recognise any complications.
- Complete reports and keep records of trichiasis surgery.
- Assess competence and improve surgical skills, under supervision.
- Recognise the barriers to trichiasis surgery and how these can be overcome.
- Assist in the planning and implementation of (community-based) mobile eye clinics.
- Demonstrate trachoma assessment methods.
- Demonstrate skills in trachoma grading.
- Implement SAFE interventions as part of comprehensive eye care.

Handouts

Handouts on the following topics are distributed to participants, to support teaching sessions during the training period:

1. Primary Health Care.
2. The 8 Elements of Health Care.
3. The 5 Principles of Primary Health Care.
4. Anatomy of the Eye (main emphasis on the upper eyelid).
5. Checklist of Supplies and Materials.
6. Sterilisation Methods.
7. Record Keeping.
8. The SAFE Strategy.

Incision and Stitching Exercises

The trainer demonstrates the procedure. It is then practised on oranges and bananas.

The steps include:

- Incising the 'eyelid'– orange peel or banana.
- Everting and incising the 'conjunctiva and tarsal plate'– inside of orange peel.
- Completing the incision with scissors.
- Suturing the 'eyelid'.

Handling Surgical Instruments

The key skills in which each participant must be competent are:

- Holding the needle holder in the dominant hand.
- Mounting the needle (with suture) on the needle holder.
- Making sure the needle holder holds the needle one-third away from the tip.
- Holding the toothed dissecting forceps with the other hand.



Trichiasis screening with the aid of a magnifying loupe in rural central Tanzania

Photo: Sidney Katala

- Holding the edge of the distal skin edge and inserting a needle with suture.
- Holding the skin on the proximal side, and pushing the needle through the skin.
- Pulling the suture and making the first, second, and third knots.
- Cutting the two ends of the suture material (about 0.5mm long above the wound; this helps when removing sutures).

After everyone has successfully mastered incision and suturing skills, they each receive their own surgical kits for the field visits.

The trainer reviews the schedule for the field visits and reviews the sterilisation procedures for surgical kits during the visits and at the end of each day.



Bilamellar tarsal rotation procedure (BTRP) training in session

Photo: Sidney Katala

Mobile Eye Clinic: Procedure for Trichiasis Patients

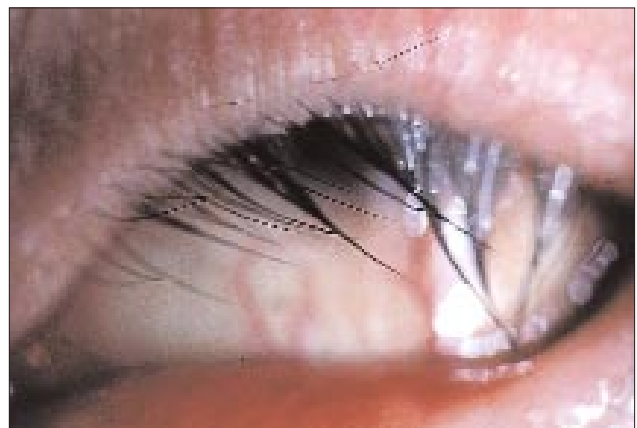
During the mobile eye clinic, priority should be given to:

- Patients with trichiasis.
- People who are blind.
- Patients with painful red eyes.

Patients with trichiasis are sent immediately for visual acuity testing. These patients are then guided to the operating area. The outpatient form is carried with the patient into the operating area. Numbers are written on the outpatient form so that surgical teams will know how many patients to expect.

The following procedures are followed:

- Identify who will take the patient home and make sure all the procedures are understood, the need for return in 7 days clearly stated, and verbal consent given.
- Written consent is advised.
- Before the patient lies on the operating table, the



Severe trichiasis

Photo: Murray McGavin

surgical team checks the fitness of the patient for surgery (checking blood pressure, allergies to drugs, shortness of breath, heart problems, mental state . . .).

- Ask the patient if they have consumed any alcohol that day. If so, trichiasis surgery should be postponed.
- Community health workers and/or the advance team should advise patients of this requirement during the preparation screening, before the days of the clinic.
- After surgery, the patient takes the outpatient form and follow-up requirements are explained to the patient.

Normally, trichiasis surgery is performed on one eye at a time. The second operation can take place when the sutures of the first eye are removed after eight days. Some patients may choose to delay the second operation until the first eye is completely healed.

The Trichiasis Surgical Procedure: Bilamellar Tarsal Rotation Procedure (BTRP)

With sterile instruments and other supplies at hand, the procedure should be done following these steps:

Preparations:

- (a) Clean the skin surrounding the eye with an antiseptic solution.
- (b) Instil amethocaine eye drops on the eye (or similar topical anesthetic).
- (c) Scrub the hands with soap and water for at least 5 minutes.
- (d) Put on sterile gloves (gloves must be worn).
- (e) Clean the patient's face and eyes.

Surgical procedure:

- (a) A local anaesthetic injection is given into the upper lid (ask the patient to look down).
- (b) Usually 3 mls are sufficient (never inject more than 5 mls in any single operation).



An outreach eye clinic in central Tanzania

Photo: Sidney Katala



Surgery for upper eyelid trichiasis

Graphic: Hugh Lugg

Photos: Mark Reacher & John DC Anderson

- (c) An operation is performed, seated at the head of the patient.
- (d) For better visibility, a magnifying loupe is used and a flashlight (torch) held by an assistant.
- (e) The eyelid is 'fixed'.
- (f) The upper eyelid is incised (incision of the skin and muscle must be parallel to the lid margin and 3 mm above it, the entire distance between the haemostats).
- (g) Eversion of the eyelid is then done.
- (h) Incision of the conjunctiva and tarsal plate, through its full thickness, parallel to the lid margin and 3mm above it, the entire distance between the haemostats.
- (i) The incision is then united by inserting the points of the closed scissors into the incision in the conjunctival-tarsal plate, through remaining intact muscle and out through the skin-muscle incision.
- (j) Open the scissors while still held across the lid: the blunt aspect of the blades will spread apart intact muscle. Repeat until it is a full thickness hole.
- (k) Remove the haemostats.
- (l) Complete the incision medially and laterally using the scissors.
- (m) Suturing the eyelid is then done using 4/0 silk or chromic catgut. This is to re-attach the distal fragment in an outwardly rotated position, so that the eyelashes no longer rub on the cornea. This is achieved by anchoring sutures on the conjunctival surface of the proximal fragment, and running them over the distal tarsal plate to exit through the skin near the eyelashes, thus drawing the lash margin outwards and upwards.

Summary of Follow-up Care

Day 1: Lid surgery patients advised of time to return for follow-up care.

Day 2: Patient returns to meet health worker, who removes eye patch, cleans wound and applies tetracycline eye ointment. Any patient with excessive

bleeding, swelling and/or severe pain should be referred immediately.

Day 3–7: Patients continue to see health worker on daily basis – to have the wound cleaned and to have tetracycline eye ointment applied.

Day 8: Mobile eye team returns – sutures are removed.

At the end of the trichiasis operation day, the principal trainer reviews follow-up procedures for patients who have undergone community-based trichiasis surgery with community health workers or their equivalents. Each community health worker should receive a list of the trichiasis patients.

Each patient is given tablets of paracetamol to be taken as needed for pain relief, once in the morning and once in the evening.

Overcoming Fears

Patients who are afraid of having trichiasis surgery receive counselling. Fear of the injection, cutting, pain and bleeding are most often the concerns expressed. Patients are asked to speak to someone who has had the operation and will talk about his/her experience.

Constraints to Surgery

1. People do not know that this is a problem that can be solved.
2. People are afraid of the operation.
3. Communities lack transport to take patients to the hospital or clinic.
4. The number of people who are able to do the surgery is limited.

5. Bad service by service providers, e.g., bad language, etc.
6. The cost of surgery in some hospitals is not affordable to most patients.

Graduation and Certification

Each participant is given the following:

1. A Certificate after successfully performing the operations – under supervision.
2. A copy of the WHO Manual 'Trichiasis Surgery for Trachoma – The Bilamellar Tarsal Rotation Procedure'.
3. 100 tubes of tetracycline eye ointment.
4. 24 sutures, a surgical set for minor operations, and other supplies, as available.
5. A set of bi-monthly reporting forms to be used within their health system.

Further Reading

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Example of a Trichiasis Register

| Date | No: | Name | Sex | Address | VR | VL | TT situation | Remarks |
|------|-----|------|-----|---------|----|----|--------------|---------|
| | | | | | | | | |

Suppurative Keratitis: A Blinding Corneal Infection

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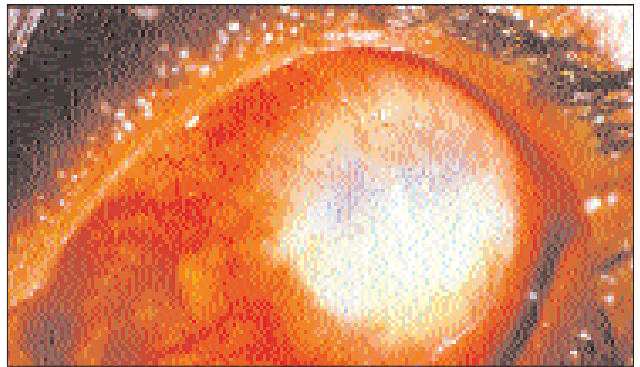
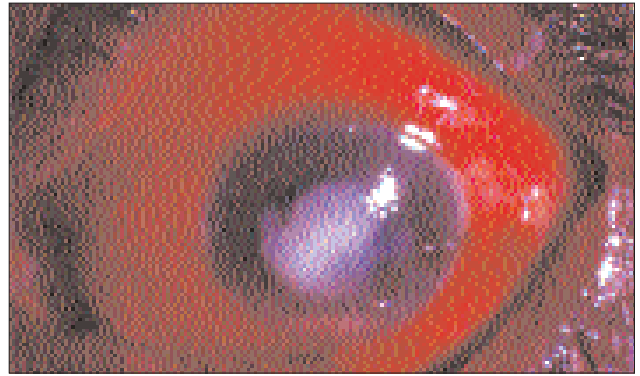
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Bacterial and fungal corneal infections are a serious problem in many tropical areas. Without prompt and adequate treatment, they lead to blindness through corneal scarring and endophthalmitis. Patients often present with large neglected lesions, microbiology laboratory facilities may be unavailable, and antimicrobial drugs, particularly antifungal agents, are often in short supply or unavailable, so that management of these patients is usually difficult.

This article gives information relating to the causes

Table 1: Important Corneal Pathogens

| Organism | Characteristics in Gram stained smear |
|---|---|
| Bacteria | |
| <i>Streptococcus pneumoniae</i> | Gram positive diplococci (pairs) |
| <i>Staphylococcus aureus</i> | Gram positive cocci (clusters/pairs/single) |
| <i>Streptococcus pyogenes</i> | Gram positive cocci (chains) |
| <i>Pseudomonas aeruginosa</i> | Gram negative rods |
| <i>Enterobacteriaceae</i> (e.g., <i>Klebsiella</i>) | Gram negative rods |
| <i>Moraxella lacunata</i> | Gram negative rods (pairs) |
| <i>Neisseria gonorrhoeae</i> | Intracellular Gram negative diplococci |
| Fungi | |
| <i>Aspergillus</i> spp | Hyphae – walls unstained |
| <i>Fusarium</i> spp | |
| <i>Candida albicans</i> | Hyphae, pseudohyphae and bud formation |
| Protozoa | |
| <i>Acanthamoeba</i> | Cysts can be seen with Gram Stain or Lactophenol blue preparation |



(a) Fungal keratitis with hypopyon

(b) Suppurative keratitis and endophthalmitis

Photos: (a) John Sandford-Smith (b) Murray McGavin

of suppurative keratitis and practical guidelines as to how one may manage and treat the patient.

Pathogens

Almost any organism can invade the corneal stroma if the corneal defence mechanisms – particularly the intact epithelium – are defective. Predisposing factors for bacterial, fungal or amoebic infection include corneal trauma, viral keratitis, contact lens use, and immunosuppressive disorders or agents, particularly steroids.

Table 1 lists important corneal pathogens with their Gram staining characteristics. Many bacterial species have been reported as causative agents of keratitis, but the most common are *S. pneumoniae*, *S. aureus* and *Pseudomonas* spp. In the tropics, fungal keratitis is due mainly to filamentous fungi, most commonly *Aspergillus* spp. and *Fusarium* spp. *Candida* spp. are more frequently associated with endophthalmitis rather than with keratitis following ocular trauma. Mixed bacterial and fungal infections may occur.

Acanthamoeba, a free living amoeba, is now recognised as an important cause of keratitis in both tropical and temperate areas, particularly in contact lens wearers.

The spectrum of corneal pathogens shows wide geographical variations and is influenced by climate, occupation of the patient and the use of traditional eye preparations, which may be heavily contaminated. Fungal keratitis is relatively common in humid tropical areas (e.g., coastal West Africa and South East Asia), where up to one half of corneal ulcers have a fungal aetiology.

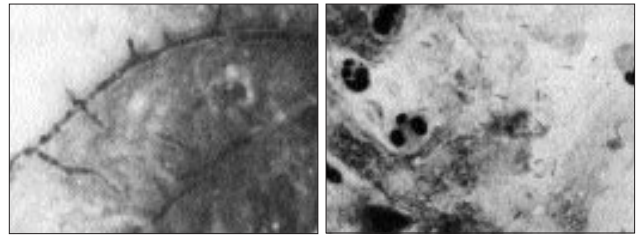
Clinical Assessment

Details of the date of onset, severity of symptoms, report of any trauma, use of eye preparations (including steroids) and previous medical and ophthalmic problems, should be noted. Important information concerning aetiology may be obtained from these records and can reveal possible preventive measures. A diagram of the ulcer is an important method of recording the initial findings and provides an objective guideline for evaluating therapy. This includes the size of the ulcer and associated stromal infiltrate, the appearance of any infiltrate, satellite lesions, the height of hypopyon and the extent of corneal thinning. Visual acuity should be measured in both eyes.

Clinically, it is not possible to definitely distinguish bacterial from fungal infections. A long insidious course, with no response to adequate antibacterial treatment, suggests a fungal infection; however, some fungal infections – notably those caused by *Fusarium* spp., may progress rapidly. A feathery stromal infiltrate, multifocal lesions and a heaped up dry

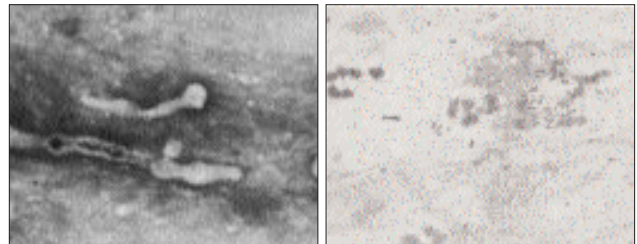
Table 2: Materials and Procedure for a Corneal Scrape

| |
|--|
| <p>Materials</p> <ul style="list-style-type: none"> • Topical anaesthetic (ideally preservative-free, if culture is to be performed) • Scalpel blades, needles or platinum spatula • Alcohol or gas burner • Matches or lighter • Clean glass microscope slides (labelled) • Wax or diamond marker • Culture media (labelled) <p>Procedure</p> <ul style="list-style-type: none"> • Put nothing in the eye except anaesthetic, until the specimen is taken • Explain the procedure to the patient • Children require sedation • Apply topical anaesthetic if required • Use sterile, cooled blade or needle to sample representative areas of ulcer (a spirit lamp may be used for sterilisation) • Avoid touching lids and lashes • Use each scrape to prepare one smear or culture • Spread material thinly onto microscope slides • Re-sterilise and cool instrument between scrapes • Fix slides for microscopy with gentle heat (or alcohol) • Label slides and cultures with name and date |
|--|



Hyphae of filamentous fungi (*Fusarium*) × 100 obj

Pseudomonas aeruginosa × 100 obj.



Candida albicans × 100 obj

Streptococcus pneumoniae × 100 obj

necrotic ulcer suggest fungal infection, but these signs are not always present. The clinical features of *Acanthamoeba* keratitis are described fully by John Dart in Volume 8, Issue No. 15 of the *Journal of Community Eye Health*. Laboratory investigation is therefore required, if the causative organism is to be identified.

Laboratory Diagnosis

Two laboratory procedures are of value in the management of suppurative keratitis. First, microscopy of Gram stained material from the corneal ulcer can demonstrate a bacterial aetiology and whether the organisms are Gram positive or negative, rods or cocci. It can also allow visualisation of fungal hyphae. Second, material from the ulcer can be cultured to isolate the causative organism, and sensitivity to various antimicrobial agents can be demonstrated.

Gram staining and microscopy are simple and quick to perform, and can give useful information from which the most appropriate antimicrobial agent can be chosen. Culture and sensitivity tests require more sophisticated laboratory facilities and the results will not be available for at least 24 hours and often several days.

The materials and procedures for taking a corneal scrape are shown in Table 2. Superficial necrotic material can be removed without anaesthesia if the surface is insensitive. If a topical anaesthetic is used, ideally it should be preservative-free to avoid inhibiting microbial growth on culture. Large ulcers yield sufficient material for multiple smears and cultures, but very small lesions and those with severe thinning should be scraped only with great care.

When making smears, material must be spread thinly on the slides to aid examination. Fungal hyphae are visualised under a ×40 objective, and a ×100 oil

immersion objective is required to recognise bacteria. Genera of fungi cannot be distinguished by hyphal morphology. Bacterial staining characteristics may be altered by under – or over- decolourisation, excessive heat fixation – or prior antibiotic therapy. Failure to see organisms may be due to insufficient material, failure to spread the material thinly, failure to examine the entire smear, or prior antibiotic treatment.

Table 3 gives the routine stains and culture media used in the laboratory diagnosis of suppurative keratitis.

Acanthamoeba keratitis can be diagnosed with a wet preparation of a corneal smear with lactophenol cotton blue stain. Rounded up trophozoites or cysts maybe seen.

Management

Ideally, patients with suppurative keratitis should be admitted to hospital, but this is not always possible. Hospitalised patients should be nursed separately from eye patients undergoing surgery.

The management of a patient with suppurative keratitis may be considered under the following three headings, depending on the availability of laboratory facilities:

- (A) No laboratory facilities.
- (B) Microscopy available, but no facilities for cultivating micro-organisms.

Table 3: Routine Staining Methods and Culture Media for Suppurative Keratitis

| |
|--|
| <p>Gram Stain</p> <ul style="list-style-type: none"> • Shows most bacterial organisms and visualises fungal organisms • Allows differentiation between fungal and bacterial suppurative keratitis • Identifies bacteria as Gram positive or negative, cocci or rods <p>Blood agar</p> <ul style="list-style-type: none"> • Suitable for growth of most bacterial organisms and fungal isolates may grow: 37°C for 3 days <p><i>Or</i></p> <p>Chocolate agar</p> <ul style="list-style-type: none"> • As above: in addition, grows fastidious bacteria (e.g., <i>Neisseria</i> spp., <i>Moraxella</i> spp): 37°C with CO₂-rich atmosphere for 3 days <p>Sabouraud's dextrose agar</p> <ul style="list-style-type: none"> • (Without cycloheximide): grows most filamentous fungi and yeasts: room temperature for up to 3 weeks (27 – 30 °C) |
|--|

Table 4: Treatment of Suppurative Keratitis of Unknown Aetiology

| |
|--|
| <p>ciprofloxacin 0.3% drops or gentamicin drops (14mg/ml) + cefuroxime drops (50mg/ml) or gentamicin drops (14mg/ml) + chloramphenicol drops 0.5% or gentamicin drops (14mg/ml) + enriched tetracycline 1%</p> <p>If there is no response to therapy in 48 hours, then an antifungal should be added: econazole 1% drops or natamycin 5%</p> |
|--|

- (C) Microscopy, culture and antimicrobial sensitivity testing facilities available.

(A) No laboratory facilities

Having made a diagnosis of suppurative keratitis, broad-spectrum antimicrobial agents should be used if microscopy is not possible, or if the Gram stain does not visualise any organism. In hospitalised patients, intensive topical medication (every 30–60 minutes) should be given, while outpatient treatment usually requires the administration of a subconjunctival injection. Table 4 lists possible antimicrobial regimens for treating suppurative keratitis of unknown aetiology.

(B) Gram stain result available

Obtaining a Gram stain result should take less than half an hour, so that initial treatment can be delayed until the result is available. Table 5 gives recommended antimicrobial agents depending on the result of Gram stain microscopy.

(C) Culture and sensitivity available

Initial therapy can be given according to the Gram stain results. If there is no response, or a limited response to therapy, then the treatment can be changed, if appropriate (e.g., infection not responding to initial therapy), once the results of culture and sensitivity are available.

Table 5: Topical Treatment of Suppurative Keratitis According to Results of Gram Stain

| | Ideal Circumstances | Practical Alternatives |
|----------------------------|---|---|
| Gram positive cocci | cefuroxime 50mg/ml or ciprofloxacin 0.3% | gentamicin 14mg/ml or chloramphenicol 0.5% or enriched tetracycline 1% (with polymyxin) |
| Gram negative rods | ciprofloxacin 0.3% or gentamicin 14mg/ml | gentamicin 14mg/ml or chloramphenicol 0.5% or enriched tetracycline 1% (with polymyxin) |
| Gram negative cocci | ciprofloxacin 0.3% or cefuroxime 50mg/ml | enriched tetracycline 1% (with polymyxin) |
| Fungal elements | econazole 1% or natamycin 5% | ketoconazole 2% |

Table 6: Treatment of Acanthamoeba Keratitis

| |
|---|
| <p>Ideal Circumstances</p> <p>Topical biguanide 0.02%, e.g., chlorhexidine + diamidine 0.1%, e.g., brolene</p> <p>Alternative if above treatment not available: neomycin 0.5% (effective in only 50% of cases)</p> |
|---|

Antibiotics

Commercial Gentacin (3mg/ml) is ineffective for *Pseudomonas* keratitis and a concentration of 9–14mg/ml must be given. To prepare fortified drops (14mg/ml), add 80mg (2mls) of IV gentamicin (40mg/ml) to a 5ml bottle of commercial gutt. Gentacin (3mg/ml). The final concentration is 14mg/ml. Gentamicin has limited effectiveness against strains of *Streptococcus* spp.

Chloramphenicol has activity against many Gram-positive and Gram-negative organisms, but not *Pseudomonas* spp. Resistance in Gram-negatives may be common in some areas.

Ciprofloxacin has excellent activity against all Gram-negative organisms, including *Pseudomonas* spp. It also has good activity against many Gram-positive species and is a reasonable empirical first line treatment.

Penicillin is appropriate for *S. pneumoniae* and *S. pyogenes*, but at least 80% of *S. aureus* strains and some *Neisseria gonorrhoeae* strains are now resistant to penicillin G.

Tetracycline 1% ointment, enriched with polymyxin, is commercially available. This is a practical first line antibiotic in rural areas where diagnostic facilities and medications are in short supply.

Subconjunctival injections should be used where intensive topical therapy is impracticable. Subconjunctival dosages are: gentamicin 40mg, penicillin G 500,000 units.

Antifungals

Natamycin and econazole are the antifungal drugs of choice. It is thought that econazole has the best activity against ocular fungi, but it is more irritant to the epithelium. Amphotericin B is toxic to the cornea and natamycin penetrates the cornea poorly. Flucytosine is active only against yeasts and should be used with an imidazole to prevent the development of acquired resistance. Fluconazole is effective against yeasts, but should not be used in combination with another antifungal agent. Recent studies from India and Bangladesh have reported beneficial results with 0.2% aqueous chlorhexidine, but these findings need to be confirmed in other settings.

Antifungal eye drops, ketoconazole 2%, fluconazole 3mg/ml and clotrimazole 1% have become available in India and Bangladesh recently, and are under assessment.

Other Modes of Treatment

Cycloplegia, e.g., atropine 1%, is necessary to prevent posterior synechiae formation. There is no clear evidence that collagenase inhibitors, such as acetylcysteine, prevent perforation. The use of steroids is very controversial. Certainly topical steroids should never be considered in suppurative keratitis, unless there is secure knowledge that the correct antimicrobial is already being given.

Simple debridement of necrotic debris, or superficial keratectomy performed in conjunction with intensive topical therapy, may be useful to facilitate drug penetration. Penetrating keratoplasty is an alternative treatment if medical therapy fails, or perforation occurs. Topical antimicrobials should be continued after keratoplasty, and steroids avoided in the early post-operative period.

Prevention

Early recognition of suppurative keratitis by primary health workers at a stage when treatment is likely to be successful, followed by prompt referral to a treatment centre, will help reduce ocular morbidity. In situations where immediate referral is not possible, intensive treatment with a broad-spectrum antibiotic (see Table 4) should be carried out by the health worker.

Two important pathways to suppurative keratitis are minor ocular trauma and the use of contaminated traditional eye medicines. If a broad-spectrum antibiotic (e.g., enriched oc. tetracycline 1%), or similar effective and affordable antimicrobials, were more widely available for use in the treatment of acute red eye and after minor ocular trauma, this may reduce the amount of suppurative keratitis after eye injuries and the use of traditional eye medicines.

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Newborn Ophthalmia (Ophthalmia Neonatorum)

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Definition

Ophthalmia neonatorum (ON) is defined as conjunctivitis in an infant less than 30 days old – with clinical signs of redness, swelling of the eyelids and palpebral conjunctivae, purulent eye discharge, and one or more polymorphonuclear leucocytes per oil immersion field on a Gram stained conjunctival smear.

A Widespread Problem

Gonococcal ON is still an important problem in developing countries. The prevalence of gonorrhoea among antenatal attenders in African countries ranges from 4 to 15%.¹ Genital chlamydial infections are also highly prevalent. In Kenya 4 – 9%, in The Gambia 7–18% and in South Africa 1–13% of ante-natal women studied have been shown to harbour *Chlamydia trachomatis*.^{2,3,4} Between 25% and 50% of infants exposed to *Neisseria gonorrhoeae* or *C. trachomatis* during birth develop a corresponding eye infection, if no eye prophylaxis is given. Both of these sexually



Newborn Conjunctivitis due to *N. Gonorrhoeae*

Photo: Murray McGavin & Allen Foster

transmitted pathogens are therefore still very common potential causes of ON in these countries.

The global incidence of ON is not known. Incidences from 1 to 24 per 100 live births have been reported from different areas. In a Kenyan hospital where ocular prophylaxis had been discontinued, the incidence of ON was 23.2 per 100 live births; with incidences of gonococcal and chlamydial ophthalmia recorded as 3.6 and 8.1 per 100 live births.⁵ Recently, Cr  de's prophylaxis with silver nitrate 1% drops has become a controversial issue, both because of concern about the occurrence of chemical conjunctivitis and also because of its questioned effectiveness against *C. trachomatis*.

A further problem is that up to 52% of gonococcal strains, isolated from infants with ON in the developing world, have been reported to be beta-lactamase (penicillinase) producing strains (52.4% of gonococcal isolates in Kenya; 50% in Nigeria). Intrinsic resistance to penicillin, not mediated by penicillinase, is also increasing.

Causation

The aetiology of ON can be microbial or chemical in origin. The infectious causes are subdivided into sexually transmitted diseases (STD), acquired from the mother during birth, and other micro-organisms which have been less well investigated (Table 1). The two eye infections of major public health importance are caused by the STD agents, *N. gonorrhoeae* and *C. trachomatis*.

Table 1: Causation of Newborn Ophthalmia

| |
|--|
| Microbial: |
| (A) Sexually transmitted diseases (STD): |
| <i>Chlamydia trachomatis</i> |
| <i>Neisseria gonorrhoeae</i> |
| (B) Other micro-organisms, often mixed: |
| <i>Haemophilus</i> species |
| <i>Staphylococcus</i> |
| <i>Streptococcus pneumoniae</i> |
| <i>Streptococcus</i> group D |
| <i>Escherichia coli</i> |
| <i>Pseudomonas</i> |
| Chemical: |
| Silver nitrate |

C. trachomatis was the most frequently identified cause of ON in a prospective study of the eye infection in Kenya,⁶ in contrast to a study of infants seen at a Kenyan STD clinic, where *N. gonorrhoeae* was the predominant cause.⁷ This difference may be due to the fact that parents may seek medical advice in gonococcal ophthalmia because of the severity of symptoms and signs, whereas many neonates with less severe eye inflammation may never come to medical attention.

Other causes of ON and patterns of transmission are unclear. Some causes may be missed. *Haemophilus* spp., *Streptococcus pneumoniae*, *Streptococcus* group D, *Staphylococcus*, *Escherichia coli*, *Enterococcus* and *Pseudomonas* are known to be associated with ON (Table 1). In a number of infants with conjunctivitis, no aetiological cause is found and further investigation is required in these cases.

Parents of infants with ON are at high risk of STD. It has been demonstrated that 40% of mothers of infants consulting for ON had gonorrhoea, and 9% had positive syphilis serology.⁶ These mothers are also at high risk of developing complications like post-partum endometritis. However, they often do not present with their own complaints, but request advice and treatment for the sticky eyes of their newborn child. STD are almost as frequent in fathers as in the mothers, but infections are often asymptomatic. Also, a large number of fathers have received previous treatment with antimicrobial drugs, but their partners have remained untreated.

Clinical Features

Gonococcal ON tends to be more severe and has an earlier onset than chlamydial ON. The cornea can be involved – and this first appears as diffuse epithelial oedema which gives the cornea a hazy, greyish appearance. Coarse white opacities (infiltrations) appear near the border of the cornea and sclera. When new blood vessels invade the cornea, scarring may result. Ulceration can progress to perforation of the eye and loss of vision. Although the actual risk of blindness is difficult to estimate, 16% of infants with gonococcal ON proved to have corneal lesions in a clinic based study in Kenya.⁶ Furthermore, a corneal ulcer and disseminated gonococcal infection developed in 1 of 70 such patients. Gonococcal infection of the newborn is not limited to the eyes – the respiratory tract, middle ear, mouth and digestive tract can also be involved. Meningitis and septicaemia may develop. The start of treatment dramatically changes the course and outcome of the disease, usually with recognisable improvement within 24 hours.

Chlamydial ON appears later than gonococcal ophthalmia. Inflammatory membranes (pseudo-membranes) may occur, in some cases during the second week. If the disease is active after the fourth week of life, discrete nodules (lymphoid follicles) can appear on the upper conjunctivae. Blindness is rare

and the disease process is much slower than in gonococcal ON. Corneal scarring is not due to direct corneal involvement, but to eyelid scarring and distortion, together with pannus formation – as in trachoma or paratrachoma. Chlamydial neonatal infection can also be extraocular; and pneumonitis, otitis, pharyngeal and rectal colonisation have been described. The ocular discharge usually disappears within 2–3 days with treatment, but inflammatory hypertrophy and follicles of the conjunctivae may persist for several weeks.

ON due to other microbial agents usually presents a milder picture. Corneal complications are rare, but have been reported in cases of ophthalmia due to *Pseudomonas*.

Herpes simplex keratoconjunctivitis is rare in the newborn, but the cornea may be involved in an infant with generalised *herpes simplex* disease.

Chemical conjunctivitis usually develops in the 24 hours following instillation of silver nitrate drops.

Laboratory Diagnosis

Clinical signs alone are not sufficiently specific for identification of the infecting organism. However, laboratory facilities are not always available and case management will depend, to some extent, on the level of resources available.

A Gram stained conjunctival smear should be performed on all cases. The presence of intracellular Gram negative diplococci has high sensitivity, specificity and predictive value, and therefore gives a fast presumptive differential diagnosis between gonococcal and non-gonococcal conjunctivitis. Inclusion bodies on Giemsa staining may also be helpful in diagnosing chlamydial ON.

If facilities are available, all cases of neonatal conjunctivitis should be cultured for *N. gonorrhoeae* and *C. trachomatis*, and the results can influence treatment schedules when available a few days later. Only well equipped laboratories will be able to detect beta-lactamase producing strains of *N. gonorrhoeae*, and diagnose chlamydial infection. Also, a distinction can be made between chlamydial and non-chlamydial ON. In the diagnosis of chlamydial ON, conjunctival smears can be stained with monoclonal antibodies against *C. trachomatis* and read in a fluorescence test. An ELISA test, or polymerase chain, can also be performed.^{8,9}

Treatment of parents

These results are not only important in determining effective treatment for the infants involved, but also give guidance in the required treatment of their parents.

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Management

Gonococcal ON

In view of the seriousness of the disease and possible complications, the highly predictive Gram stain of a conjunctival smear can be used to direct the choice of treatment immediately the child presents. The recommended treatment for gonococcal ON includes intramuscular or intravenous penicillin, with or without topical antimicrobial therapy, and hospital admission of the infant. However, these regimens are only suitable in areas where gonococci are not resistant to penicillin.

A cheap, single dose treatment given to the infant as an outpatient would be better adapted to the needs of developing countries. Several such regimens have recently been shown to be effective in the treatment of ON in areas with a high prevalence of penicillin resistant gonococci (Table 2).

The World Health Organization has recommended that when PPNG (penicillinase-producing *Neisseria gonorrhoeae*) prevalence is more than 1%, ON should be treated with cefotaxime 100 mg/kg or kanamycin 25mg/kg, as a single intramuscular dose, with tetracycline 1% or erythromycin 0.5% eye ointment for 10 days.⁸

In some countries spectinomycin may be available and prove equally effective, but there are as yet only two preliminary reports available. A single dose of 75mg kanamycin, combined with topical gentamicin ointment for 7 days has also been shown to be effective.^{11,12}

Chlamydial ON

None of the above proposed regimens adequately treat associated chlamydial infections. Therefore, a mixed infection treated in these ways can result in post-gonococcal conjunctivitis due to *C. trachomatis*.

Infants with ON and negative laboratory tests for gonococci, but with presumed or definite chlamydial

Table 2: Management

| |
|---|
| Gonococcal |
| (A) Admission to hospital: Penicillin I.M. or I.V. Topical antimicrobial therapy, e.g., tetracycline 1% ointment, intensively at first (hourly) then reducing to 3 times/day for 14 days. |
| (B) If PPNG prevalence more than 1%: Single I.M. injection of cefotaxime 100 mg/kg or kanamycin 25 mg/kg plus tetracycline 1% ointment or erythromycin 0.5% ointment as indicated in (A) |
| Chlamydial: Systemic treatment: erythromycin estolate orally (syrup) 50 mg/kg per day for 14 days |
| Non-gonococcal, non-chlamydial: Tetracycline 1% ointment or erythromycin 0.5% ointment 4 times/day for 14 days |

Table 3: Prevention

| |
|---|
| (A) Detection and treatment of infected pregnant women: <ul style="list-style-type: none"> • screening of all pregnant women is difficult in most countries, and expensive • it may be possible to screen high risk groups |
| (B) Eye prophylaxis in the neonate at birth: <ul style="list-style-type: none"> • mechanical cleaning of the eyelids immediately at birth, plus tetracycline 1% ointment or silver nitrate 1% drops |
| (C) Treatment of the neonate as an index case: <p>Only applicable where:</p> <ul style="list-style-type: none"> • prevalence of gonococcal infection is low • main STD causing ON is <i>C. trachomatis</i> • all infected infants can be detected and treated • facilities exist for the diagnosis of <i>C. trachomatis</i> |

ON, can be treated with erythromycin estolate (50 mg/kg per day) by mouth for a minimum of 14 days. Another derivative of erythromycin with adapted dosage may also be used. Systemic treatment is necessary; topical antimicrobial therapy is not required. It is argued that chlamydial pneumonitis develops in 20% of infected infants which may be a cause of long term pulmonary problems.

Washing of the eyes with saline or water should be performed. As with gonococcal ON, the mothers and their partners should be investigated and adequately treated.

Most non-chlamydial and non-gonococcal conjunctivitis of the newborn can be treated with topical tetracycline 1% or erythromycin 0.5% eye ointment, 4 times each day for 14 days.

Prevention

Intervention can be considered early or late in pregnancy, during labour or after delivery, in the mother as well as in the neonate. Different preventive regimens can be chosen to include all pregnant women, all infants at the time of delivery, or only high risk groups (Table 3).

(a) Detection and treatment of STD in pregnant women

This strategy, to prevent infection or colonisation of the neonate and also to prevent disease complications in the mother, can only be used on its own where medical care is well organised, i.e., where pregnant women at risk can easily be screened for STD and adequately treated, if infection is found. This is not always possible, even in industrialised countries. The high risk groups for STD among pregnant women are not easily motivated to accept screening, and they are often rapidly reinfected. However, in areas where this policy is possible, treatment of infected pregnant women should be considered. This would prevent neonatal infection, and also infection in the mother, who is at increased risk of pre- and post-partum complications, or secondary infertility. The use of condoms to prevent transmission of HIV is also likely to result in a reduction of STD and ON.

(b) Eye prophylaxis in the neonate

Crédé introduced this method in Leipzig, Germany, in the nineteenth century.¹³ The original procedure had two steps: first, mechanical cleaning of the child's eyelids as soon as the head was born and before the eyes opened, and second, instillation of an antiseptic into the conjunctival sacs as soon as possible. Crédé recommended an aqueous 2% silver nitrate solution, but the concentration was later changed to 1% which was less irritating. Other silver preparations such as argyrol (5%) have been used.

This preventive measure was very effective. Within a few years, the incidence of gonococcal ophthalmia (and blindness caused by it) reportedly fell from 10% to 0.3% of births. Prophylaxis with silver nitrate was later criticised both because it caused chemical conjunctivitis and because it is not effective against extraocular infection by gonococci. It was abandoned in several places, and alternative prophylactic treatment with erythromycin 0.5% or tetracycline 1% ointment was used. Erythromycin and tetracycline were considered to be more effective in preventing chlamydial ophthalmia. Recent data from Kenya show that both silver nitrate 1% drops and tetracycline 1% ointment are highly effective in the prevention of gonococcal ophthalmia caused by multiresistant strains.¹⁴ Additionally, the study reports the prevention of a considerable amount of chlamydial conjunctivitis. Silver nitrate 1% must be well preserved, avoiding any exposure to light, with each preparation used as a single dose. The need for prevention of chlamydial ophthalmia is less certain. It is argued, however, that chlamydial pneumonitis develops in 20% of infected infants, which may be a cause of long term pulmonary problems. Also, untreated *C. trachomatis* ON may progress to eyelid scarring, corneal vascularisation and pannus formation.

To prevent ON by both organisms, a single application of tetracycline 1% ointment could be used as the first choice in countries such as Kenya, where the prevalence of maternal gonococcal and chlamydial infection is high. Tetracycline ointment is widely available, cheap, and has less side effects than the silver nitrate solution. However, silver nitrate can still be recommended if used in single dose applications, and stored with protection from exposure to light. Single dose applications, however, are not available at low cost.

Recently, povidone-iodine has been shown to be effective in preventing ON.^{15,16,17,18} Treatment results were comparable with those obtained with silver nitrate and erythromycin for gonococcal ON, and superior in the prophylaxis of chlamydial ON. Other advantages are that chemical conjunctivitis does not occur and there is no development of resistance. Additionally, povidone-iodine is also effective against HIV and *herpes simplex* virus. Further, it is by far the cheapest of all substances available. In Kenya, a 5 ml container of povidone-iodine costs \$0.10, tetracycline

ointment \$0.31, erythromycin ointment \$0.74, and one dose of silver nitrate \$7.30.¹⁹ These data clearly indicate povidone-iodine to be the ideal antiseptic substance for broad, cheap and safe use in developing countries to prevent ON.

According to these advantages, in a recently held consensus meeting of the Ophthalmological Society of Austria, povidone-iodine was considered to be the substance of choice for the prophylaxis of newborn children against ophthalmia neonatorum, and was recommended for use in the future for the treatment of the newborn.²⁰

Treatment of the neonate (index case) and parents

Infants with neonatal conjunctivitis may be used as index cases of probable STD in parents. The infant, the mother and her partner(s) are then treated. This policy requires a situation where medical care is readily available, where the prevalence of gonococcal infection in pregnant women is low, and where investigation and treatment for chlamydial infection is easy. Often it has the advantage of effectively treating disease in the mother and her partner, and also preventing complications and extraocular manifestations of gonococcal and chlamydial colonisation. It has been advocated in Belgium and other European countries.

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Transmission and Control of Infection in Ophthalmic Practice

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Introduction

Eye infection may be bacterial, viral, chlamydial, fungal or acanthamoebic, and these infections account for a large proportion of the workload in ophthalmic centres.¹ Cross-infection may occur through contaminated instruments, hands, communal towels and droplets. Patients with dry eye or inadequate lid closure are more susceptible. Other risk factors are low immunity, malnutrition, general disease, contact lens wear and extremes of age.²

An overview of some common eye infections, causative pathogens and spread mode is given. This is followed by an outline of general infection control principles, with additional specific considerations for ophthalmic practice.

Common Eye Infections and Spread Mode

Conjunctivitis may be bacterial, viral or chlamydial and is a common cause of unilateral or bilateral infected red eyes.

- Bacterial conjunctivitis, usually caused by *Staphylococcus aureus*, is more common in children. The signs and symptoms are sticky, purulent discharge, foreign body sensation, with peripheral conjunctival redness. The pupils are normal and the



Lid scrubs are essential for blepharitis management

Photo: Pak Sang Lee

cornea is clear. The visual acuity is usually unaffected, unless there is corneal complication. Bilateral purulent discharge in the newborn requires urgent referral, as this may indicate infection with *Neisseria gonorrhoeae* or possibly *Chlamydia*. The patient and parental sexual partners must be examined and treated by a specialist health care worker as soon as possible. *Neisseria gonorrhoeae* infection may result in loss of sight, if treatment is delayed.

- Viral conjunctivitis is bilateral and more contagious, with redness developing acutely in one eye first, followed some days later in the second eye. Adenovirus types 8 and 19 can cause keratoconjunctivitis and subsequent blurring of vision. Other strains may be associated with upper respiratory tract infection. Signs include serous discharge, tarsal follicles, swollen lids and tender pre-auricular nodes. Patients should not attend work or school until infection has cleared, over 1–3 weeks.³

Other viral infections include herpes simplex, varicella zoster and molluscum contagiosum.

Herpes simplex conjunctivitis may be present together with a dendritic corneal ulcer. Varicella zoster conjunctivitis occurs secondarily to ophthalmic shingles. Molluscum contagiosum is commonly associated with a mild, but chronic, follicular conjunctivitis and superficial keratitis, which does not respond to antibiotics. Measles and mumps are also causes of conjunctivitis.



The correct wearing of caps, masks and gloves is important for control of infection

Photo: Murray McGavin

Blepharitis (inflammation of the eyelids) tends to run a chronic course and may occur together with conjunctivitis, because the structures involved are anatomically joined.

Staphylococci and *Propionibacteria* are common pathogens. In the USA, *Staphylococcus epidermidis* is more commonly isolated in patients with blepharitis (95.8%) than *Staphylococcus aureus* (10.5%).⁴ Signs and symptoms are red, crusty lid margins, mild lid swelling, itchiness, dry sensation and occasional lacrimation. Vision is normal, unless the cornea becomes involved. The condition commonly occurs in unhealthy environments or in those with skin problems. Daily lid ‘scrubs’ and a healthy diet are essential in managing this chronic disorder. A course of antibiotic eye ointment may be prescribed.

Contact lenses have become increasingly popular for reasons of convenience, efficiency in improving vision in certain sports and occupations, and also for their cosmetic advantage. A host of pathogens have been found in ocular tissues, storage contact lens cases and solutions. Studies reveal that in over 50% of asymptomatic contact lens wearers, lens cases are contaminated and these may contain *Pseudomonas aeruginosa* and other gram-negative bacilli. These readily adhere to the plastic surface of cases. These pathogens produce slime which enable them to survive disinfecting solutions. Rakow (2000) reported

that non compliance with an effective hygiene regime can lead to corneal infection and sight loss.⁵

Home made saline and tap water are known to harbour *Acanthamoeba* species and individuals who use these are at risk of developing sight threatening corneal infection. Education of the contact lens wearer is the key to preventing complications.

Infection may have a profound effect on the patient’s general health as well as damaging sight. The health care worker must be aware of the sequence of events in the transmission of infection. Figure 1 shows a possible chain of infection leading to acute conjunctivitis.

Table 1 shows how some viruses can be transmitted in a health care environment (see also reference below to adenoviral infection in ophthalmic practice).

In addition, patients with an eye infection need to be given clear instructions as well as appropriate medication to encourage recovery. This may be supported with a written advice sheet. **Box No. 1** gives the necessary information. This could be reproduced as an individual handout, or for notice board display in the clinic.

| Table 1: Viruses that can be Transmitted in a Healthcare Environment | |
|--|--|
| Virus | Transmission |
| Varicella zoster | Direct personal contact Droplet Airborne |
| Herpes simplex type 1 | Direct contact with carrier saliva |
| Cytomegalovirus | Excreted in saliva and urine Transmitted by close contact, droplet spray and kissing |
| HIV | Body fluids: • blood • semen • breast milk • vaginal secretions • synovial fluid • cerebrospinal fluid |
| Rubella | Direct or indirect personal contact Droplet Crosses the placental barrier infecting and damaging a growing foetus |

Adapted from: Daly J. Biological Hazards. *Nursing Standard* 1998; 13 (3):43–46

Box 1: Instructions for Patients with Eye Infection

Remember:

- Eye infection is easily passed to others

DO!

- wash hands before and after instilling eye medication
- use only the drops or ointment prescribed
- wash the face frequently, especially before instilling medication
- wear sunglasses, if available, to provide comfort
- eat a healthy diet to aid recovery
- return to the health centre if the eye does not improve
- destroy medication when the infection clears

- Flies will be attracted to sticky eyes

DO NOT!

- do not touch or rub the eyes
- do not touch the lids or lashes with the dropper or applicator
- do not share face cloths or towels
- do not wipe the face with clothing
- do not cover the eye with a dressing
- do not go to work or school until the infection clears
- do not store medication in direct sunlight or within reach of children
- do not share medication with others

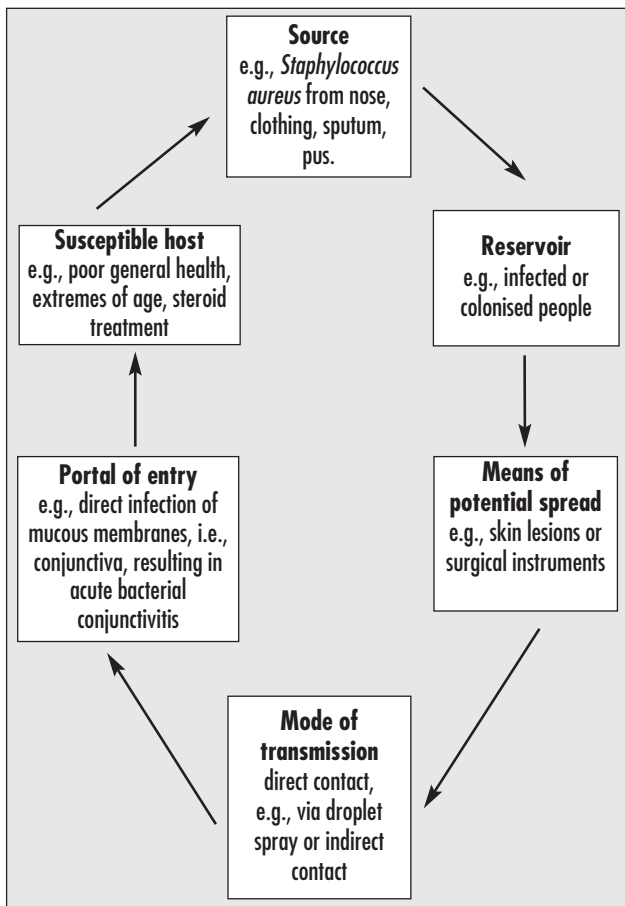


Fig. 1: Possible Chain of Eye Infection

General Principles of Infection Control

In many western hospitals, in recent years, the appointment of a Control of Infection Officer (usually a nurse) has become commonplace. This highlights the significance and challenge of infection control within clinical areas. Indeed a considerable number of infections are actually acquired within a hospital setting.

• Personal hygiene and clothing

All healthcare workers of all disciplines have responsibility for infection control and this begins with their own personal hygiene. Individuals with any infection should not have direct patient contact. Any infected, or potentially infected, lesion must be covered with an occlusive dressing and reported to the person-in-charge who will decide if the staff member should take sickness leave until the infection has cleared.

Clothing should be changed daily. Studies have shown that hospital uniforms, over the course of a day, become a source of bacterial infection.

Jewellery, including wristwatches, should not be worn and fingernails should be kept clean and cut short. Clothing worn in the operating theatre must not be worn in other areas. Hair must be kept clean and covered. Beards are a source of infection. Facemasks must be worn properly to cover the nose, mouth and chin completely, changed for each operation and

disposed of carefully. Cotton masks must be washed before re-using.

• Handwashing

Hands are the most important 'instruments' of healthcare workers and also the principal source of cross-infection in a healthcare setting.

Handwashing is the *most important* of all infection control procedures, yet it is usually performed inadequately. Both technique and frequency are important – see Boxes 1 and 2.

• Gloves

The proper use of gloves prevents cross-infection between patient and healthcare worker and vice versa. Despite the risk to self, a study in Nigeria showed that the main reason for non-compliance in wearing of gloves by healthcare workers with direct patient contact was because the practice was considered unnecessary.⁶

Gloves should be worn on both hands whenever there is potential contact with blood and other body fluids. The wearing of gloves is recommended for all eye surgery. For many years it was accepted that some ophthalmic surgeons chose not to wear gloves because of reduction in touch sensitivity, but this practice is no longer an option because of the risk of HIV and hepatitis B infection. A new, sterile pair of gloves should be worn for each patient contact.

Good quality gloves may be re-sterilised, but should be checked for damage – e.g., by filling with water, turned inside out and allowed to dry before re-sterilising.

Box 2: Handwashing Technique

- Wet hands with clean, preferably running water
- Apply soap or cleanser
- Rub palm to palm
- Rub right palm over back of left hand
- Rub left palm over back of right hand
- Rub palm to palm with fingers interlaced
- Rub backs of fingers on opposing palms with fingers interlocked
- Rub around right thumb with left palm
- Rub around left thumb with right palm
- Rub around fingers of right hand with palm of left hand
- Rub around fingers of left hand with palm of right hand
- Rinse off soap thoroughly with clean, preferably running water, before drying well

N.B. Disposable paper towels are ideal but if a communal towel only is available for drying hands a clean one must be provided daily.

Hot-air hand dryers are not recommended!!

This is known as **social handwashing** and will take no longer than 30 seconds and is required before and after routine procedures in clinical areas.

Hand hygiene/disinfection, using the same technique, is achieved by using an antiseptic for 15–30 seconds and is necessary in the event of known infection, before aseptic procedures, and following contact with blood and body fluids.

An adequate supply of gloves should always be available.

Allergy and sensitivity to the latex material is currently being widely discussed.

- **Waste, spillages, linen and sharps disposal**

All clinical waste must be disposed of carefully. Soiled dressings and surgical remnants must be burned immediately. Soiled linen must be removed immediately and washed separately from routine changes of bedding, etc.

Disposable needles must be disposed of immediately after use, and separately in a closed impenetrable container, appropriately labelled. This may be burned or buried, preferably daily. Therefore, a small container is better than a large one.

If an accident occurs, i.e., a prick with a used needle or instrument, the wound should be allowed to bleed freely for a few minutes, then washed with soap under running water and covered with a sterile dressing. The HIV and hepatitis status of the patient, on whom the needle was used, should be noted. The incident must be reported to the person-in-charge and the injured worker examined by a medical practitioner.

Needles should not be used more than once, but if this is not possible it is essential that proper sterilisation procedures are followed. Needles, used for the removal of corneal foreign bodies, etc., must not be left on the slit-lamp table top!

Spillages of body fluids must be wiped with disposable paper tissue or cloth, which must then be burned, and the surface cleaned immediately with detergent and water. Heavy-duty gloves should be worn when disposing of any waste material and cleaning after spillages.

- **Environment and equipment**

Patients expect, and have a right, to be cared for in a clean, safe environment. All health care workers have a responsibility to provide this. Basic cleaning of the hospital environment is a cost-effective method of infection control and must always be a pre-requisite for any subsequent disinfection and sterilising procedures. The areas/items requiring regular



Expiry dates on drop bottles must be checked

Photo: Pak Sang Lee

attention are walls and ceilings (often forgotten or ignored), floors, tables, stools and chairs, shelving and work surfaces.

Disposable healthcare materials appeared on the western market almost 40 years ago with the promise of raising standards, labour-saving and guarantee of reduction of infection rates. Some economic climates, however, have encouraged the practice of the re-use of disposable items to save money. Recycling must be carefully considered and monitored closely to ensure safety is not threatened.

Where the patient's meals are provided by relatives, care must be taken because contaminated food can contribute to hospital-acquired infection.

Specific Considerations For Ophthalmic Practice

A separate unit for eye patients is ideal, but where this is not possible, care must be taken that patients with open infected wounds, ulcers or bed-sores are not accommodated in the same area as eye patients. Patients with eye infections should be separated from other ophthalmic patients in the ward, especially those who have had eye surgery. If surgery is performed on an infected eye, the operation must be scheduled last on the operating list and the theatre cleaned thoroughly afterwards.

- **Hands of the examiner and patient**

Eye infection can be spread by healthcare workers through simple social greeting of patients, i.e., shaking of hands. Patients often rub their eyes and contaminated hands will transfer the organism to the healthcare worker. It is important that hands are washed immediately before performing an eye examination and after the patient has left, before greeting another patient.

Box 3: Handwashing is Required in the Following Situations

- Before any aseptic procedure
- Before and after handling any patient
- After handling any soiled item
- Before and after handling food
- Whenever hands are, or even feel, soiled
- When entering or leaving a clinical area
- After using the toilet

Surgical hand-scrubbing includes washing the hands and forearms and nail brushing, requiring a minimum of 5 minutes *scrubbing* and a defined technique to remove micro-organisms before participating in invasive surgical procedures. It is an acquired skill needing supervised practice.

- *Slit-lamp biomicroscope*

The areas which come into contact with the patient must be washed with soap solution between patient examinations – chin rest, head rim, not forgetting the hand grips!

- *Tonometer prisms*

These should be wiped after use on disposable paper tissue and then placed (tip only) in a small pot of sodium hypochlorite 1% for at least 10 minutes between patients.

(NOTE: *The prism must be rinsed in sterile water and dried before use!!*) If there is suspected adenoviral infection the soaking must be extended to 30 minutes before re-using the same tonometer prism. A fresh sterile pot and new solution of sodium hypochlorite must be provided for every clinic session.

- *Occluder/pinhole*

This should be stored in a container of sodium hypochlorite 1% for at least 10 minutes between patients and wiped dry before use. There is no need to rinse. A fresh solution must be provided before each clinic session.

NOTE: *Sodium hypochlorite causes corrosion – do not use stainless steel containers for the above.*

- *Eye drops*

Ideally, each patient should have their own bottle of drops and, where there is known infection, separate bottles for each eye! However, in many situations this may be economically impossible. Care should therefore be taken to avoid eyedropper contact with eyelids, lashes, eyebrows and facial skin. Where possible a single-use dispenser should be used in out-patient examinations. Expiry dates must be checked, as out of date drops can be a source of infection.

- *Pathological specimens*

Scrapings of the cornea and conjunctiva may be taken using a disposable sterile surgical needle or blade. If a spatula or loop is used it must be sterilised before and after each procedure by flaming, and allowed to cool. Alternatively, it may be sterilised by chemical soaking.⁵

- *Eye dressings*

An infected eye must never be covered with a pad and/or bandage. Used eye dressings must be disposed of immediately and burned. Eye shields must be washed before being re-applied and, in known infected cases, must not be used on other patients. Cotton wool, gauze swabs or tissues used when instilling drops or ointment must be disposed of immediately.



Good personal hygiene and clean uniforms are important for prevention of infection

Photo: Sue Stevens

- *Spectacles*

Wearers should be encouraged to wash their spectacles daily.

Policy

Eye infection can happen anywhere as eyes are particularly susceptible to Gram-negative bacilli, adenoviruses, herpes simplex virus and fungi.

Cross-infection is a costly and continuing concern. Multi-resistant *Staphylococcus aureus* (MRSA) has made alarming news worldwide as treatment is very difficult. Lives, as well as sight, have tragically been lost.

Health workers must aim to limit hospital-acquired infection. Lack of motivation and poor microbiological knowledge will result in non-compliance. Eye units are advised to develop and teach an appropriate infection control policy with regular reinforcement and review.

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DIABETES • ARMD • THE RETINA

Diabetic Retinopathy: Clinical Features and Management

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In the western world approximately 1% of the population is diabetic, and at least another 1% are undiagnosed diabetics. Juvenile onset, or insulin dependent diabetes (IDDM), accounts for approximately 10–15% of cases – the remainder being maturity onset or non-insulin dependent diabetics (NIDDM). Diabetic retinopathy remains the major cause of blindness in developed countries in patients under 55 years of age, and since it is avoidable in the majority of cases with current treatment techniques, early diagnosis and appropriate management are critically important. In recent years, large, prospective multi-centre trials of therapy in the USA, including the Diabetic Retinopathy Study (DRS), the Early Treatment of Diabetic Retinopathy Study (ETDRS), the Diabetes Control Complications Trial (DCCT) and the Diabetic Retinopathy Vitrectomy Study (DRVS), have provided clear management guidelines.

Terminology

The term, 'background diabetic retinopathy' is gradually being replaced by the terms 'mild' and 'moderate non-proliferative diabetic retinopathy'; the term 'pre-proliferative retinopathy' by the term 'severe non-proliferative retinopathy'; whilst the term 'proliferative diabetic retinopathy' remains unchanged.

Diagnosis (Table 1)

Non-Proliferative Diabetic Retinopathy

Mild Non-Proliferative Diabetic Retinopathy

This is the mildest form of non-proliferative diabetic retinopathy and is characterised by the presence of at least one microaneurysm, and also by dot, blot or flame-shaped haemorrhages in all four fundus quadrants, of less severity than those shown in Figure 1. Hard exudates and cotton wool spots are not a feature of mild non-proliferative diabetic retinopathy.

Moderate Non-Proliferative Diabetic Retinopathy

This is characterised by intraretinal microaneurysms and dot and blot haemorrhages of greater severity than those seen in Figure 1, in one to three quadrants. Cotton wool spots, venous calibre changes including venous beading, and intraretinal microvascular abnormalities (IRMA), are present but mild.

Severe Non-Proliferative Diabetic Retinopathy

At least one of the following should be present:

- (a) haemorrhages and microaneurysms in all four quadrants of the fundus, greater than Figure 1;
- (b) venous beading, more marked than Figure 2 in at least two quadrants, and
- (c) intraretinal microvascular abnormalities, more severe than in Figure 3 in at least one quadrant.

Very Severe Non-Proliferative Diabetic Retinopathy

This is defined as two or more of the criteria for severe non-proliferative diabetic retinopathy, but without any proliferative diabetic retinopathy.

Proliferative Diabetic Retinopathy

High-risk characteristics

There are four features of proliferative diabetic retinopathy which are used to determine the level of risk to vision (see below). A patient with one or two characteristics is considered to have non high-risk proliferative retinopathy. A patient with three or four characteristics has high-risk proliferative retinopathy. The characteristics are:

- any new vessels on the optic disc, or new vessels elsewhere in the fundus
- new vessels on the disc
- new vessels on the optic disc greater than those in Figure 4, or an area of new vessels elsewhere in the fundus greater than half a disc area
- vitreous haemorrhage.

For example, a patient with a one-third disc area of flat, peripheral new vessels, no new vessels on the disc and no vitreous haemorrhage, would score one high-risk characteristic and therefore have non-high risk proliferative retinopathy. A patient with new vessels

Table 1: Level of Retinopathy, Clinical Features, Natural History and Management

| Level of Retinopathy | Clinical Features | Natural History | Natural History | Management |
|--|--|--------------------------------------|---|--|
| | | Rate of progression to PDR at 1 year | Rate of progression to high-risk disease at 5 years | |
| Mild non-proliferative diabetic retinopathy | More than 1 microaneurysm. Haemorrhage and microaneurysms less than in Figure 1. | 5% | 15% | Review 12 months |
| Moderate non-proliferative diabetic retinopathy | Haemorrhage and microaneurysms more than in Figure 1 in 1 – 3 quadrants, cotton wool spots, venous beading less than in Figure 2 and IRMAs less than in Figure 3 | 12–27% | 33% | Review 6–8 months |
| Severe non-proliferative diabetic retinopathy | Haemorrhage, microaneurysms more than in Figure 1 in all quadrants or venous beading more than Figure 2 in more than 2 quadrants, or IRMA more than Figure 3 in 1 quadrant | 52% | 60% | Review 3–4 months |
| Non high-risk characteristic proliferative diabetic retinopathy | One or two high-risk characteristics | 75% | | Review 2–3 months. Consider laser treatment if extenuating circumstances |
| High-risk characteristic proliferative diabetic retinopathy | Three to four high-risk characteristics | | | Immediate laser treatment |

on the disc involving the entire disc surface (Figure 5) and with vitreous haemorrhage, would be graded as high risk.

Tractional retinal detachment

These patients either have peripheral tractional retinal detachment without macular involvement, or tractional retinal detachment with macular detachment or traction.

Vitreous haemorrhage

In patients with vitreous haemorrhage in whom no view of the retina is possible, B-scan ultrasonography should be performed, to determine whether a tractional or rhegmatogenous retinal detachment (retinal detachment associated with a retinal break/tear/hole) is present.

Neovascularisation of the iris/neovascular glaucoma

At their initial visit, all patients should be examined prior to dilating the pupil, and gonioscopy performed to exclude iris neovascularisation.

Maculopathy (Figures 6a; 6b)

The terms, 'diffuse', 'exudative' and 'ischaemic

diabetic maculopathy' were not employed in the Early Treatment of Diabetic Retinopathy Study (ETDRS). Instead, patients were given macular focal laser therapy, based on whether 'clinically significant macular oedema' was present or not (Figure 7). This is defined as:

- (1) Retinal thickening at, or within 500 μ (one third of the diameter of the optic disc) at the centre of the macula.
- (2) Hard exudates at, or within 500 μ at the centre of the macula, if there is thickening of the adjacent retina.
- (3) An area of retinal thickening greater than one optic disc area in size, at least a part of which is within one disc diameter of the centre of the macula.

The ETDRS showed a clear benefit from treating these cases. Fluorescein angiography is performed prior to focal laser therapy, to determine where to treat.

Management

Diabetic Control and Other Factors

Clinical trials have conclusively shown that good glycaemic control (less than 155 mg/dL or less than 8.6 mmol/L) substantially reduced the risk of diabetic retinopathy developing and subsequently progressing.

Table 2: Treatment of Diabetic Retinopathy

| | Proliferative Retinopathy | Clinically Significant Macular Oedema | |
|------------------------------------|---|--|---|
| | | Retinal microaneurysms | Retinal thickening & areas of non-profusion |
| Type of laser | Argon | Green or yellow (577) argon laser | Green or yellow (577) argon laser |
| Spot size | 500 μ at the retinal, i.e, 250 μ on setting of laser | 50 – 200 μ | 50 – 100 μ |
| Power | 0.2 – 0.8 watts | 0.1 – 0.3 watts | 0.1 – 0.3 watts |
| Duration | 0.2 seconds | 0.1 seconds | 0.05 – 0.1 seconds |
| End point | Faint white burn at level of retinal pigment epithelium (RPE) | Faint whitening of RPE or darkening of microaneurysm | Very faint white burn at level of retinal pigment epithelium (RPE) |
| How to treat | Do not overlap burns Do not treat within temporal arcades Do not treat within one disc diameter of optic disc Do not treat within two disc diameters temporal to fovea Avoid retinal arterioles and veins | Apply burns directly to microaneurysms | Place burns at least one burn width apart, to make a grid which includes the area of retinal thickening Do not treat within 500m of fovea at first session |
| Number of burns | Approximately 2,000 | Variable | Variable |
| Number of sessions | Two sessions. Treat the lower half of the retina first (1,000 burns) | One | One |
| Other Signs of resolution | Topical steroids and mydriatic after treatment New vessels regressing Reduced blood flow in new vessels More fibrous tissue Less beading of retinal veins | Less retinal thickening/exudate | Less retinal thickening |
| Indications for retreatment | Fresh new vessels on the optic disc or elsewhere in the fundus | Significant macular oedema after 3 monts | Significant macular oedema after 3 months |
| Retreatment | Between previous burns, avoiding retinal vessels | Do not retreat areas lying in the macular-pavalar bundle | Treat to within 100m of the edge of the foveal avascular zone |

Whilst it is probably unwise to give patients specific targets to achieve for their blood glucose, the importance of good control should be stressed. The UK PDS (United Kingdom Prospective Diabetes Study) demonstrated the importance of good diabetic and blood pressure control in Type II patients. Other factors which should be identified and treated appropriately in diabetic patients include renal disease and hyperlipidaemia.

Panretinal Photocoagulation for Proliferative Retinopathy

Clinical trials have unquestionably demonstrated the beneficial effect of panretinal photocoagulation (Figure 8) in high-risk proliferative retinopathy, reducing the risk of severe visual loss (VA < 5/200) from 44% in untreated eyes to 20% in treated eyes, at four years' follow-up.

Indications for panretinal photocoagulation

- High-risk proliferative retinopathy
- Neovascularisation of the iris
- Tractional retinal detachment, with or without macular involvement, if active new vessels on the optic disc or elsewhere in the fundus are present
- Non high-risk proliferative retinopathy if extenuating circumstances exist, such as imminent cataract surgery, pregnancy, poor outcome in the first eye after treatment for high risk disease, and poor compliance for follow up.

Method

See Table 2.

Focal Photocoagulation for Maculopathy

Clinical trials have shown that the incidence of moderate visual loss at three years' follow-up, in eyes with clinically significant macular oedema, was reduced from 30% in untreated eyes to 15% in treated eyes.

Indications

Clinically significant macular oedema, which includes the following:

- Focal leaks greater than 500 μ from the centre of the macula, causing retinal thickening or hard exudates
- Focal leaks 300 μ – 500 μ from the centre of the fovea, without significant damage to the perifoveal capillary network
- Areas of diffuse leakage on fluorescein angiography within the macular area
- Avascular areas within the macular area.

Method

Treatment can be given to close leaking microaneurysms, and for diffuse macular oedema (see Table 2).

Pars Plana Vitrectomy

Indications

- Vitrectomy is indicated for vitreous haemorrhage, which should be performed early for insulin dependent diabetics. In non insulin-dependent diabetics vitrectomy should be undertaken if the haemorrhage fails to clear after six months.
- Complex vitreoretinal surgery is indicated if the macula is detached or threatens to detach, and should be performed early. If there is extensive active neovascularisation, panretinal endophotocoagulation should be undertaken at the end of surgery. If the macula is attached and unthreatened, vitrectomy is not indicated, and panretinal photocoagulation should be performed if there is active neovascularisation.

Screening for Diabetic Retinopathy

Insulin-dependent/juvenile-onset diabetes

- Dilated funduscopy examination every year beginning 5 years after diagnosis, from puberty onwards
- Examinations more frequently once diabetic retinopathy is diagnosed (Table 1).

Non insulin-dependent/maturity-onset diabetes

- Dilated funduscopy examination every year once diabetes diagnosed
- Examination more frequently once diabetic retinopathy diagnosed (Table 1).

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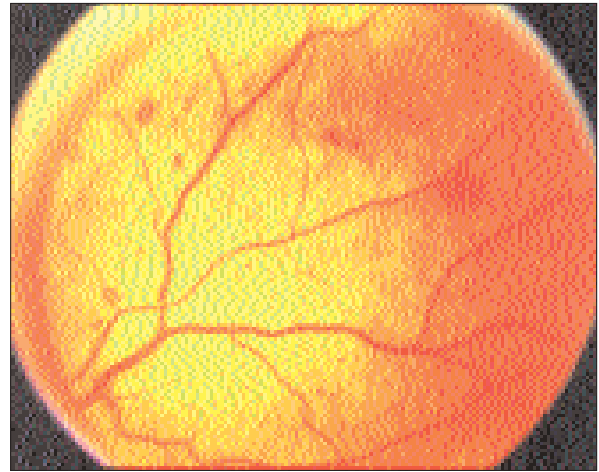


Fig. 1 Haemorrhages and microaneurysms, standard photograph No 2A of the modified Airlie House Classification of Diabetic Retinopathy

Photos: Courtesy of ETDRS

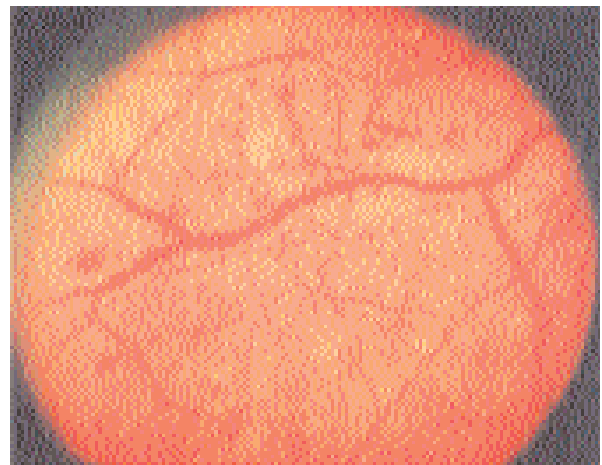


Fig. 2 Standard photograph 6A of the modified Airlie House Classification of Diabetic Retinopathy demonstrating significant venous beading

Photo: Courtesy of ETDRS

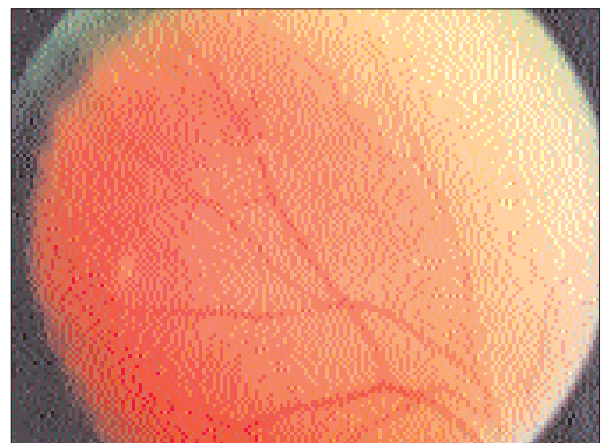


Fig. 3 Intraretinal microvascular abnormalities from standard photograph No 8A of the modified Airlie House Classification of Diabetic Retinopathy

Photo: Courtesy of ETDRS

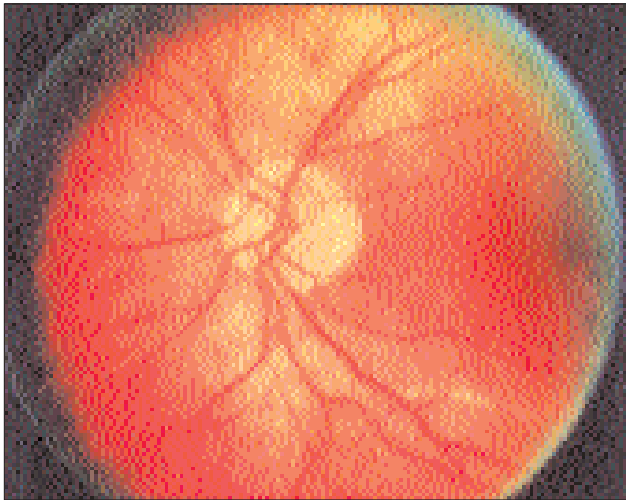


Fig. 4 Disc new vessels from standard photograph No 10A of the modified Airlie House classification of Diabetic Retinopathy

Photo: Courtesy of ETDRS

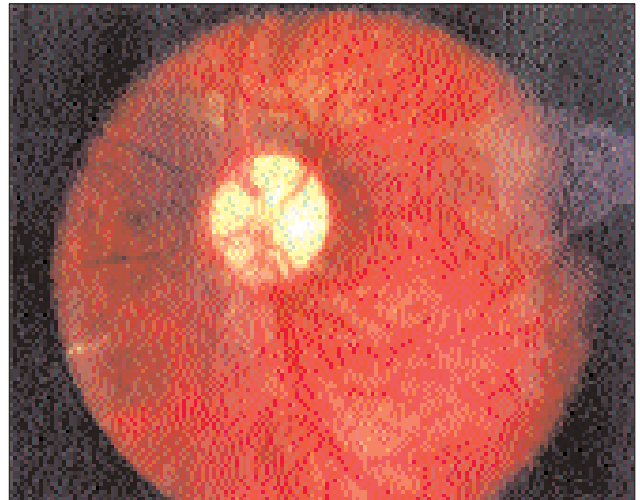


Fig. 5 Marked disc neovascularisation

Photo: Courtesy of ETDRS

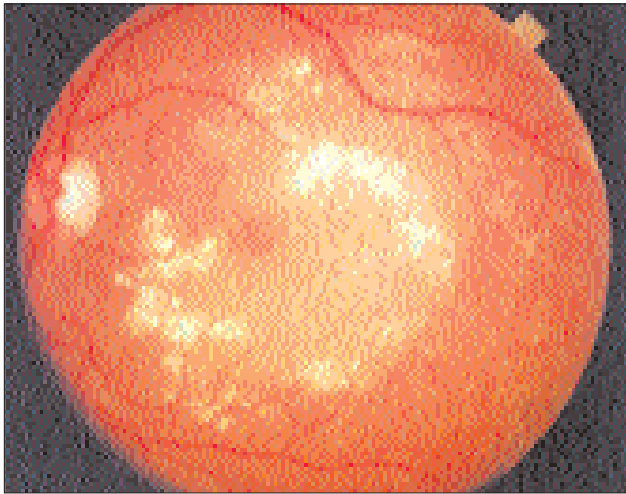


Fig. 6a. Diabetic Maculopathy demonstrating microaneurysms and hard exudates

Photo: Courtesy of ETDRS

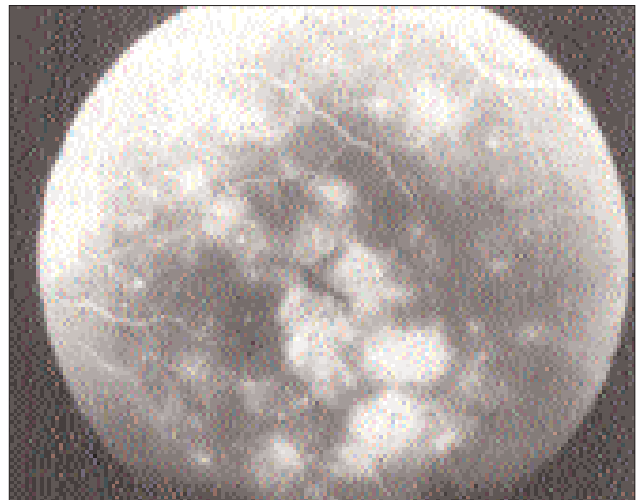


Fig. 6b. Focal and diffuse leakage on fluorescein angiography

Photo: Courtesy of ETDRS

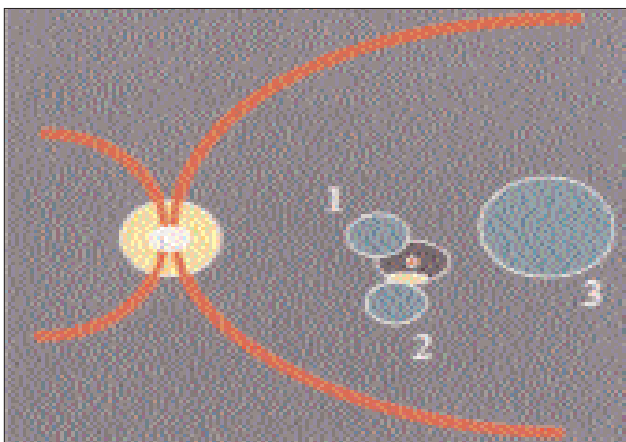


Fig.7 Criteria for Clinically Significant Macular Oedema. 1) Retinal thickening at or within 500µ at the centre of the macula; 2) Hard exudates at or within 500µ at the centre of the macula, if there is thickening of the adjacent retina; 3) An area of retinal thickening greater than one disc area in size at least a part of which is within one disc diameter of the centre of the macula.

Graphic: Hugh Lugg (adapted)

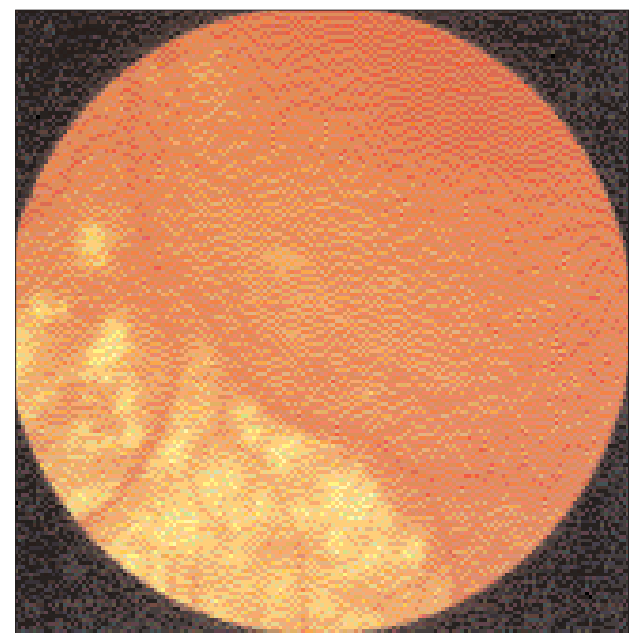


Fig. 8 Panretinal photocoagulation burns outside the inferotemporal arcade

Photo: Courtesy of ETDRS

Glossary for Diabetic Retinopathy

Avascular areas: Areas without blood vessels, due to closure of retinal capillaries caused by diabetic changes.

B-scan ultrasonography: Ultrasound technique used to investigate abnormalities in the posterior segment of the eye usually because the retina is not visible as a result of cataract or vitreous haemorrhage.

Capillary leakage: Healthy retinal capillaries do not leak, but in diabetes the capillaries can be damaged and leak blood, serum or lipids which accumulate within the retina.

Compliance: Positive response by a patient to advice given on treatment, with careful following instructions.

Cotton wool spots: Small, white-grey areas in the retinal nerve fibre layer caused by capillary closure and damage due to ischaemia.

Fovea: A small depression at the centre of macula

Foveal avascular zone: Physiological area, approximately 500µm in diameter, centred on the fovea which does not contain retinal capillaries.

Fluorescein angiography: Technique to investigate details of the retinal vessels and integrity of the retinal pigment epithelium and choroid, obtained by taking serial fundus photographs using a series of filters after intravenous injection of fluorescein dye.

Hard exudates: Yellow-waxy deposits situated in the inner layers of the retina. They are formed by protein and lipid material.

Hyperlipidaemia: High fat content in the blood.

Hypertension: High blood pressure.

Insulin-dependent diabetes (IDDM): Type 1 diabetes requiring insulin for control, typically presenting in young people (juvenile-onset).

Intraretinal microvascular abnormalities (IRMA): Distinct blood vessel abnormalities affecting very small blood vessels within the retina.

Macula: Central Retina

Maculopathy: Abnormal changes affecting the macula (central retina).

Microaneurysms: Visible out-pouching of weakened blood vessel walls, situated in the inner-nuclear layer of the retina.

Neovascularisation of the iris: New blood vessels on and in the iris.

Neovascular fronds: Abnormal, new blood vessels, which branch and 'interlace'.

Neovascular glaucoma: Secondary glaucoma following new vessel formation in the angle of the anterior chamber.

Non insulin-dependent diabetes (NIDDM): Type II diabetes not requiring insulin for control, typically presenting in middle or older age (maturity-onset). Diet and hypoglycaemic agents may be used.

Panretinal photocoagulation: Treatment (of proliferative diabetic retinopathy) by the application of multiple laser burns to the retinal pigment epithelium. Initial treatment may involve the placement of 2,000–3,000 burns.

Pars plana vitrectomy: Removal of the vitreous gel through openings made in the pars plana (a few millimeters posterior to the corneo-scleral limbus).

Retinal pigment epithelium: Layer of pigmented cells lying between the neural retina and the choroid.

Temporal arcades: The main retinal blood vessels which arch above and below the macula on the temporal side of the optic nerve head.

Tractional retinal detachments: Detachments of the retina due to traction of abnormal attachments of the vitreous to the retina, usually in areas of new blood vessels.

Vitreous haemorrhage: Blood within the vitreous cavity.

Venous calibre changes/Venous beading: Variation of the retinal veins – size and shape, 'thick' and 'thin' appearances, lumen differences, sometimes like beads.

Age-related Macular Disease: Aetiology and Clinical Management

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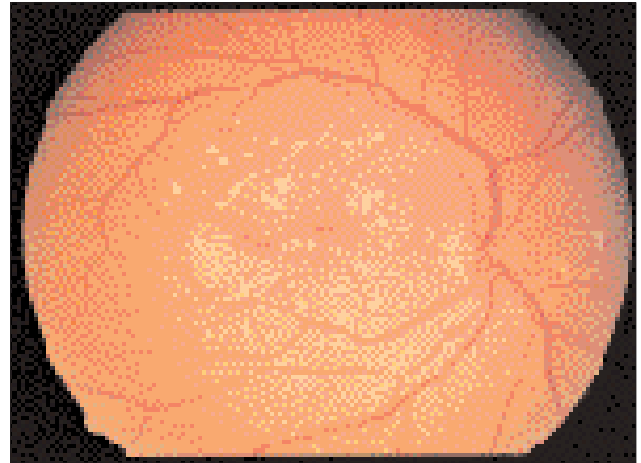
Caucasian Communities

Age-related macular disease (AMD) accounts for about 50% of registered blindness in England and Wales, and this high prevalence is likely to exist in all economically developed Caucasian communities. A recent analysis indicates that the prevalence appears to be increasing at a rate not fully explained by the increasing age of the population, and, as a cause of visual loss, AMD is as common now as diabetes and glaucoma during working life.¹ Despite the early expectations, it is now evident that the present techniques of laser treatment will not have a major impact on blindness due to AMD.² Other forms of treatment are under trial, such as ionising radiation and photodynamic therapy, but they may not be vastly more successful than photocoagulation. This means that our knowledge of the behaviour and pathogenesis of the disorder must be re-examined, in the hope that alternative approaches to management can be identified.

Twin and sibling studies provide good evidence of genetic predisposition in AMD, and it is believed that the predisposition becomes manifest in the presence of appropriate environmental influences. It is likely that more than one gene is involved, although the number is probably small. In these respects AMD is similar to other complex traits. It follows that ageing at the macula would vary qualitatively within a community, occurring in those with the most severe genetic predisposition and environmental pressures. The high prevalence of clinically detectable age-related maculopathy (ARM) in those over the age of 65 years implies that the causative genes are common in industrial societies.

Non-Caucasian Communities

In the past AMD was rarely recognised in Japan.



Drusen and macular disease

Photo: Clare Gilbert

However, disability due to macular disease in middle or late life,³ and hospital referrals with this disorder, suggest that AMD has become common in the last two decades, at least in urban communities. A similar trend is appearing in other parts of Eastern Asia. There is also a strikingly high prevalence of macular disease in elderly Inuit in Greenland.

The phenotype (clinical appearance) of AMD appears to vary in different communities. In Japan the impression is that polypoidal choroidopathy is common, whereas, in Caucasians, the growth of new vessels is the most prevalent complication. In the Inuit population the characteristic process is atrophy. In both Inuit and Japanese the visual loss occurs without there being pre-existing recognisable age changes at the level of Bruch's membrane, such as soft drusen. In neither has genetic predisposition been sought so far, although the increasing incidence implies environmental factors are important.

Future Research

Cross sectional studies in populations with different genetic backgrounds but similar environment, and populations with similar genetic background with different environments, would serve to prove that both influences are important.

Future research seeking the abnormal genes is likely to be rewarding. The techniques of linkage disequilibrium and sibling pair analysis have been

well worked out, and have met with success in other complex disorders such as multiple sclerosis, diabetes, bipolar illness and schizophrenia. Both investigative techniques benefit from knowledge of candidate genes. Candidate genes may be found by recognition of associated characteristics, such as loss of iris colour,⁴ or identification of genes causing disorders with phenotypic similarities to AMD such as Sorsby fundus dystrophy and Doyme macular dystrophy, together with knowledge of the disease processes.

In Caucasians, visual loss results from choroidal neovascularisation, detachment of the retinal pigment epithelium (RPE) or geographic atrophy. It is widely believed that these occur in response to accumulation of debris in Bruch's membrane, which is recognised clinically as drusen and pigmentary changes, referred to as age-related maculopathy (ARM). It is believed that the debris in Bruch's membrane is derived from the RPE, which discharges cytoplasmic material throughout life into the inner portion of Bruch's membrane, in order to achieve cytoplasmic renewal. It is likely that the material is cleared through the choriocapillaris. Some information exists concerning age changes in the RPE, Bruch's membrane and choroid, from laboratory studies of donor eyes. However, the inter-relationship between age change in the different tissues is not established. Clinical and laboratory studies imply that the quantity, distribution and chemical composition of the debris determine both the magnitude of risk, and the type of lesion causing visual loss. From these observations it is possible to speculate on the potential genetic influences that may modulate ageing. Increased outer segment turnover may explain the high levels of RPE autofluorescence in diseases due to mutations in the *RDS* gene. A similar effect may occur if there is reduced activity of RPE degradative enzymes, or free radical damage to the substrate of degradation. Age change in Bruch's membrane, such as cross linkage of collagen, would predictably accelerate accumulation of debris. The mechanisms whereby material is cleared from Bruch's membrane may also be under genetic influence. Considerable variation of age changes exists from one donor to another of a similar age, reflecting the complexity of genetic and environmental influences.

Thus, there are potentially many candidate genes influencing ageing at the macula. Whether or not a single gene determines risk in an individual or family is unknown, although the reputed high gene

frequency in the population implies that a single gene should not be assumed.

Of the environmental influences, smoking has most consistently been associated with increased risk, but surprisingly not all studies have demonstrated this. Dietary intake of carotenoids, other micronutrients and hypertension have also been implicated. However, none of these readily explain the apparent increase in prevalence of disease with change of life style, suggesting that the most important factors have not yet been identified.

In non-Caucasians, relatively little information is available on AMD. There is a need to determine whether or not there is genetic predisposition. The natural history of disease has not been documented. In addition, those structural changes predisposing to visual loss are unknown. They have not been documented in any detail clinically, and there is little histopathological documentation of ageing at the posterior pole. It is important that studies of AMD in Caucasian societies should now be repeated in Eastern Asia.

What benefits would there be from this new information? Defining the genetic influences would point to the relevant pathogenic mechanisms involved, and identify those at high risk of visual loss. If the environmental pressures conferring risk were known, public health measures could be taken. New therapeutic measures may come to light, and those most likely to benefit from such measures would be identified. The high prevalence of the disease in Caucasian communities, and the apparent rise in the prevalence in communities previously not considered to be at risk, highlight the urgency for an increasing level of research. Over the last 5 years there has been steadily increasing research activity investigating the pathogenesis of AMD, and the hope is that this continues.

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Retinal Diseases and VISION 2020

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Historically, retinal disease has had a low priority in prevention of blindness programmes in developing countries. There are several reasons for this. Firstly, it was thought that retinal disease was an uncommon cause of blindness in the developing world; secondly, that the results of treating retinal disease did not justify the effort and expense involved; and, thirdly, that the equipment required was too costly and unreliable for use in a developing country environment. Finally, there is a lack of skilled personnel with sub-speciality training in retinal disease.

Retinal Disease Worldwide

As countries become wealthier, and per capita income increases, the prevalence of blindness decreases, and the causes of blindness change. In a poor African country, the major blinding conditions are likely to be cataract and corneal scar. In a middle income country in Latin America, the leading causes of blindness will be glaucoma and diabetic retinopathy. Because cataract surgery is more readily available, fewer people become blind from cataract. In a wealthy country, glaucoma and cataract will continue to be very common and important conditions, but most of the blindness will be due to retinal disease.

Retinal diseases are already the most common cause of childhood blindness worldwide.¹ Some of these children are blinded by inherited retinal conditions, such as retinitis pigmentosa, which can neither be treated nor prevented at present. However, many of them have retinopathy of prematurity, which can be prevented, and is treatable in its early stages. The excellent and very detailed Andhra Pradesh Eye Disease Study (APEDS) found that retinal diseases were a much more common cause of adult blindness in India than had previously been thought.² The APEDS study dilated the pupils of every subject, and all those with reduced vision had their fundus checked by an ophthalmologist. Blindness surveys in which the fundus is not routinely examined may underestimate the prevalence of blindness caused by retinal disease.

Diabetes is a growing problem in developing countries. In India, it is estimated that 8–10% of the population is diabetic, and the prevalence is increasing.³ Although population-based studies suggest that diabetic retinopathy is not a major cause of blindness in India at present,⁴ this is likely to change in the future.

Our own efforts will increase the incidence of retinal disorders. At present, there are about 10 million cataract operations per year. By 2020, it is intended to increase this to over 30 million. Almost all this growth will take place in poorer, developing countries. More cataract surgery will lead to more posterior segment complications of cataract surgery, such as retinal detachment, and retained lens material. These complications are very treatable, provided a skilled and well-equipped vitreo-retinal surgeon is available.

In view of these trends, it is likely that retinal diseases are already a significant and increasing problem in every part of the world.

Treatment of Retinal Disease

The second reason for the low priority of retinal disease is the belief that little can be done to treat these conditions. It is true that there are many retinal degenerations for which no cure is available. However, patients can benefit greatly from receiving an accurate diagnosis, with a detailed explanation and clear prognosis; provision of low vision aids; and genetic counselling. Even where the disease is untreatable in one eye, prevention may be possible in the other eye. For example, the Age Related Eye Disease Study showed that in patients with age-related macular degeneration in one eye, daily vitamin and zinc supplements reduced the risk of macular degeneration in their other eye.⁵

Recent studies have shown that surgery for retinal detachment in India and East Africa can be very effective. Retinas were successfully re-attached in 70–80% of patients, and even in 'macula-off' detachments, over 60% of eyes could see 6/60 or better.⁶ Approximately 25% of retinal detachment operations restored sight to a blind person.

Equipment

The third issue is the availability and reliability of equipment. Newer technology offers significant improvements. For example, conventional fundus cameras rely on film to record the images. This is expensive, and developing the films is also costly.

Digital fundus cameras are more expensive to buy, but record the image directly to a computer, and do not need film, which substantially reduces the running costs. The first Argon lasers were bulky, expensive, and fragile. However, newer diode lasers are robust and portable. While they are not cheap, the running costs are very low. Assuming a cost of \$40,000, and a five year life expectancy (which is pessimistic), if 400 treatments are carried out each year, the cost per treatment is \$20. The key to cost effectiveness is volume – if the number of treatments is reduced, the cost per treatment increases. Vitrectomy equipment is also expensive, and can be more difficult to maintain. However, it is useful not only for retinal surgery, but also for managing congenital cataract, trauma, and complicated cataract surgery. Because the capital cost of lasers and vitrectomy machines is so high, they should only be used in centres that have sufficient volume of patients to justify the expense.

Training in Retinal Disease

To summarise, retinal disease is likely to become more common in the developing world. Treatment of retinal conditions is improving, and may be cost effective, even in a developing world eye clinic. Owing to advances in technology, equipment to treat retinal disease, although still expensive, is now much more suitable for use in a developing country. However, a significant limitation remains the shortage of skilled personnel. Ophthalmic education should prepare eye workers not only for the challenges they will face

today, but also for future developments. This means that we need more developing world ophthalmologists with sub-speciality training in retinal disease who can train future generations of eye workers.

Questions:

1. Is your training programme orientated towards diseases that are becoming less common, or is it aimed at preparing eye workers to manage the conditions that are going to be most important over the next twenty years?
2. Is retinal disease an increasing problem in your country – and if so, how is your training programme planning to address this challenge?

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Retinal Detachment

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Detachment of the retina is a serious event, which may result in complete blindness. The outer segments of the photoreceptors receive oxygen and nutrition from the choroid. If the retina is detached from the choroid, the photoreceptors will fail. The fovea has no retinal blood vessels and depends wholly on the choroid for its oxygen, so detachment of the macula leads to permanent damage to the cones and rods at the posterior pole, and loss of vision. If the macula is not detached, then good vision can be retained if the retina is re-attached promptly.

Types of Retinal Detachment

Retinal detachment (RD) is broadly classified into three types based on the clinical appearance and underlying aetiology.

1. **Rhegmatogenous retinal detachment (RRD)** where the RD develops due to a retinal break ('rhegma', meaning a rent or a fissure) (Figure 1). Fluid, from the vitreous cavity, passes through the retinal break into the potential space under the retina, leading to separation of the retina from the underlying choroid. This requires surgical treatment.
2. **Tractional retinal detachment (TRD)** which occurs due to pre-retinal membrane formation and scarring that pulls the retina from its attachment. This may require surgery depending on the extent

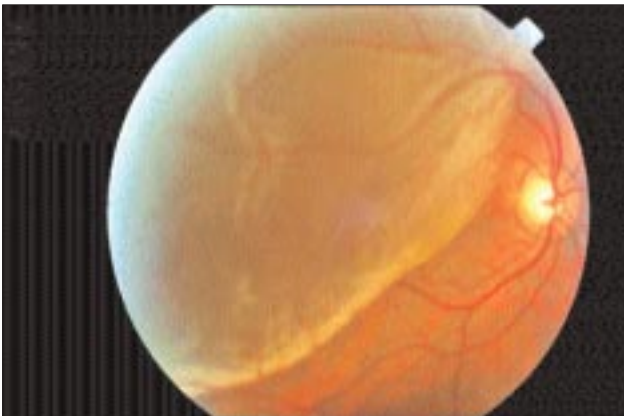


Fig 1: Recent subtotal rhegmatogenous retinal detachment

Photo: Subhadra Jalali

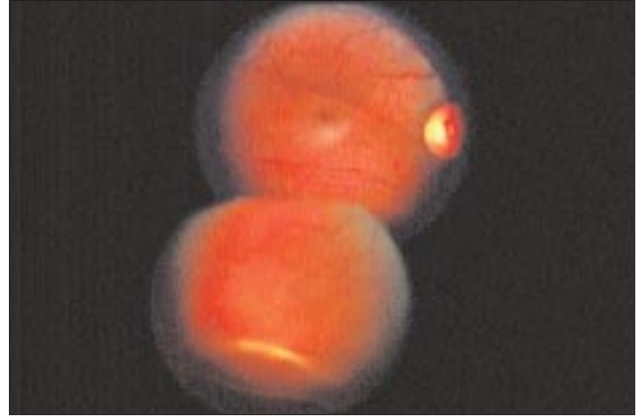


Fig. 2: Shallow retinal detachment with traumatic dialysis misdiagnosed as serous macular detachment due to central serous retinopathy – can be managed by simple scleral buckling

Photo: Subhadra Jalali

of the RD. The commonest causes of TRD are diabetes, Eales's disease, sickle cell retinopathy and trauma.

3. **Exudative and serous retinal detachments** occur due to abnormalities in water transport across the bed of the retina (retinal pigment epithelium) or in its blood supply.

Tractional and exudative/serous retinal detachments are less common and will not be discussed in this paper.

Symptoms and Signs

The commonest presenting symptom of RD is sudden, painless loss of vision or blurring of vision in the affected eye. Some patients with partial RD notice field loss, i.e., loss of vision in only one part of the visual field and describe this as a veil or shadow in one area of their vision. Flashes and floaters may occur in the affected eye a few days or weeks before the loss of vision. This is due to vitreous degeneration and its traction on the retina. Inferior retinal detachments can often be silent and slowly progressive so that the onset of RD goes unnoticed until it reaches the posterior pole. Sometimes RD is accompanied by mild discomfort and redness due to associated uveitis and hypotony, and this may be mistakenly diagnosed as idiopathic anterior uveitis. In children and young adults, RD may be asymptomatic initially and is diagnosed only after the affected eye develops squint, or redness, or a white pupillary reflex due to rapid progression of cataract.

In developing countries, retinal detachment frequently presents late, and this means that the macula is detached in approximately 90% of eyes at

presentation. Patients are more likely to have scarring and fibrosis of the retina, and other problems associated with long-standing retinal detachment. Because the abnormalities that caused the detachment are often bilateral, up to a third of patients may be blind in their other eye at presentation – often because of untreated retinal detachment.¹

Diagnosis of Retinal Detachment

The best method of diagnosing RD is by binocular indirect ophthalmoscopy with scleral indentation. An obvious RD is recognised by loss of the red fundus reflex and marked elevation of the retina (Figure 1). The retina appears grey, and shows folds and undulations. Shallow detachments are difficult to diagnose but can be seen with stereoscopic visualisation of the retinal vessels that cast a shadow on the underlying retinal pigment epithelium (Figure 2).

It is important to assess the state of the macula. If the macula is still attached, this is a medical emergency, and the patient should have surgery within 24 hours in order to prevent macular detachment and permanent loss of vision. If the macula is already detached, then surgery should be carried out within a week or two.

In eyes with opaque media, ocular B-scan ultrasonography is useful for diagnosing RD and associated pathology, like proliferative vitreoretinopathy (PVR), intraocular foreign bodies, etc. Ultrasonography also rules out many lesions associated with exudative retinal detachments such as tumours, posterior scleritis, etc.

Predisposing Causes

Although RD can occur in any eye, certain eyes are predisposed to develop detachment. The risk factors are given in Table 1. All eyes that are predisposed to RD should undergo periodical, dilated retinal examination (including the retinal periphery by scleral

Table 1: Risk Factors for Rhegmatogenous Retinal Detachment*

1. Axial myopia.
2. Post cataract surgery (aphakia/pseudophakia) especially if the posterior capsule is ruptured during surgery and/or there is vitreous loss.
3. Yag laser capsulotomy.
4. Lattice degeneration of the retina.
5. Symptomatic (flashes/floaters) retinal tears.
6. Ocular trauma.
7. RD in one eye.
8. Family history of RD.
9. Certain genetic disorders such as Marfan's syndrome, Stickler's syndrome.
10. Pre-existing retinal diseases like coloboma choroid, retinoschisis.
11. Following acute retinal infections as in acute retinal necrosis syndrome (ARN) or CMV retinitis.

* Excludes causes that result in combined rhegmatogenous and tractional retinal detachment

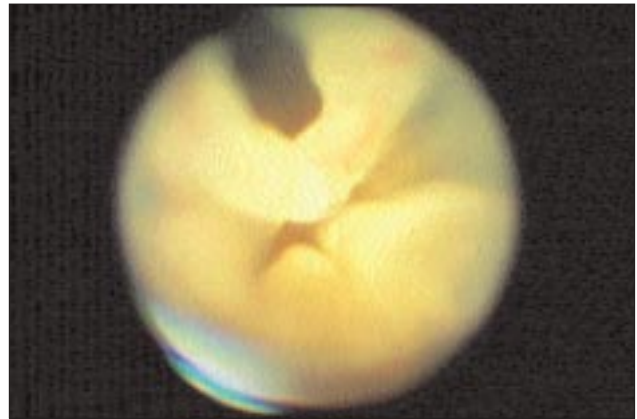


Fig. 3a: Chronic retinal detachment with advanced PVR and large horse-shoe tear

Photo: Subhadra Jalali

indentation), to detect any retinal breaks/areas of lattice degeneration, that can predispose to RD. Early detection of some of these conditions can give an opportunity for prophylactic treatment.

Management

Most retinal detachments progress to total retinal detachments and complete loss of vision. If the retina is not re-attached promptly (usually less than a week after macular detachment), then visual recovery is progressively affected. Also, long-standing retinal detachments start to develop scarring, called 'proliferative vitreoretinopathy' (PVR) that can prevent re-attachment. Besides PVR changes, chronic retinal detachments can develop other complications such as hypotony, pigmentary glaucoma, new iris vessels, cataract and uveitis, which can compromise visual outcome. Rarely, the detachment does not progress, either due to spontaneous closure of the retinal break or by development of demarcation lines.

The principle of retinal re-attachment surgery is to close all the retinal breaks and create strong chorioretinal adhesions so that these breaks do not open and new breaks do not occur.

Two approaches are established to achieve this objective. One is an external approach using scleral indentation with silicone material called 'scleral buckling'. This approach needs minimal instrumentation and materials, and is widely available. It is suitable for uncomplicated forms of retinal detachment, with a high success rate. However, this surgery is not appropriate for complicated retinal detachments such as those with PVR (Figures 3a, 3b), giant retinal tears, coloboma choroid, penetrating ocular trauma, etc.

In these situations, an internal approach called 'vitrectomy' is used. This requires expensive and complex equipment and is available in few centres in developing countries. However, vitrectomy techniques have revolutionised retinal detachment surgery, giving a higher rate of successful re-attachment than previously.

Results of Treatment

RD is no longer an incurable condition. Surgical results have improved considerably in the last two decades.^{2,3} In developing countries, the final re-attachment rates vary from 77–87% with the use of modern technology.¹ The anatomical success depends on a variety of factors including the type of retinal detachment, age of patient and surgical expertise. Unfortunately, visual results do not always match the anatomical success. If the macula has been detached for a long time, central vision will not be regained, however, the patient will usually obtain useful navigational vision. In India, 80% of successfully re-attached retinas obtained a vision of 6/60 or better.¹

Prophylaxis

It is important to prevent RD, since 5–15% of retinal re-attachment operations are unsuccessful and only 55–60% eyes with re-attached retinas get good visual outcomes.^{3,4} Also RD surgery is more expensive than prophylactic treatment and can be associated with serious complications. Most rhegmatogenous RDs are due to retinal tears that occur from vitreoretinal traction in areas of abnormally firm vitreo-retinal adhesions. Exceptions are post-traumatic tears and round holes in areas of lattice degeneration in myopic eyes of young patients. Prophylactic treatment aims to create strong chorioretinal adhesions in areas of retinal tears or areas of strong vitreoretinal traction. Visible lesions that could be considered for prophylactic treatment include:^{4,5}

1. Horseshoe tears (high risk of progression to RD without treatment).
2. Lattice degeneration with or without holes and with or without vitreous traction (risk of progression uncertain).

To 'treat or not to treat' depends on other factors that predispose to a high risk of retinal detachment (Table 1) and on the known complications of prophylactic treatment. Methods of prophylactic treatment include cryotherapy, laser photocoagulation and, very rarely, prophylactic scleral buckling.

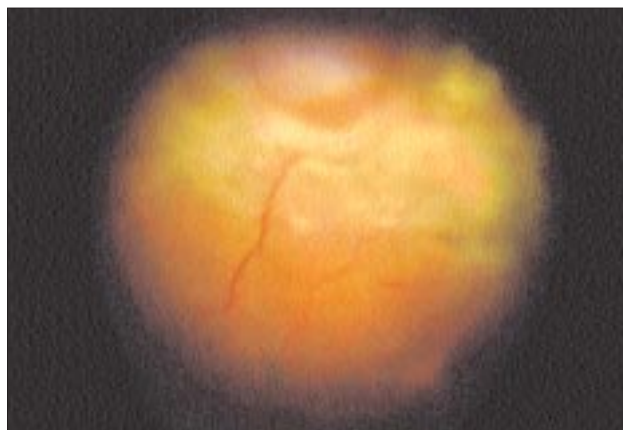


Fig. 3b: Same eye after re-attachment surgery with vitrectomy and silicone oil injection

Photo: Subhadra Jalali

Conclusion

Retinal detachment is a vision threatening condition that requires early surgery. It can be diagnosed best by retinal examination using indirect ophthalmoscopy. Treatment outcomes have improved with modern surgical techniques, but the key to successful re-attachment is early detection and prompt referral by primary eye care workers. More widespread availability of trained human resources and equipment is essential to manage and prevent retinal detachments that can cause unilateral and, not uncommonly, bilateral permanent blindness.

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Retina Picture Quiz: Questions (Figs. 1 to 6) David Yorston

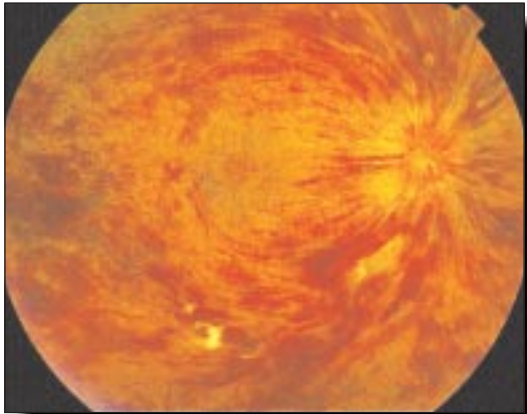


Fig 1: 55 year old man. Open angle glaucoma in left eye. Noticed loss of vision in right eye on waking this morning. VA right eye 2/60.



Fig 2: 23 year old woman. Headache for two months. Worse on waking. VA 6/6 in both eyes.



Fig 3: 75 year old man. Noticed distortion of vision in right eye, then loss of central vision. VA right eye 2/60.



Fig 4: 65 year old man. Gradual loss of vision right eye for one year. Also polydipsia and polyuria. VA right eye 6/18.



Fig 5: 58 year old woman. Sudden loss of vision in right eye one week ago. Floaters in right eye two weeks previously. VA right eye HM.

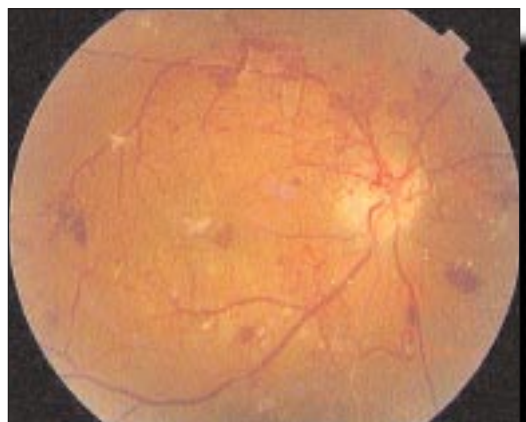


Fig 6: 28 year old woman. Type 1 diabetic for 13 years. VA right eye 6/12.

Retina Picture Quiz: Answers (Figs. 1 to 6)

Fig. 1: Central retinal vein occlusion

The large number of haemorrhages, the white cotton wool spot, and the poor vision all suggest that this is probably an ischaemic CRVO. There is a high risk that this will progress to rubeotic glaucoma within the next three months. If iris new vessels are detected, then pan-retinal laser can prevent secondary glaucoma. A high IOP greatly increases the risk of CRVO, so it is important to treat the glaucoma in the other eye.

Fig. 2: Papilloedema

There is a swollen optic disc. As the vision is normal it is unlikely to be optic neuritis, so the most likely diagnosis is papilloedema. Possible causes include raised blood pressure, and benign intra-cranial hypertension as well as intra-cranial space occupying lesions.

Fig. 3: Age-related macular degeneration

There is a sub-retinal scar (retinal blood vessels pass in front of the paler scar tissue) under the macula. The dark area is due to haemorrhage. Fibrous and vascular tissue has grown from the choroid under the retina at the macula, destroying the photoreceptors at the fovea, and causing irreversible blindness. This is the commonest cause of blindness in Europe and North America.

Fig. 4: Diabetic maculopathy

Diabetic retinopathy may occur before the patient knows he has diabetes. This patient has multiple haemorrhages and cotton-wool spots, due to capillary closure, as well as hard exudates, which indicate leaking capillaries. Laser treatment at this stage reduces the risk of further loss of vision over the next five years. Diabetes is becoming a problem in developing countries and health education programmes must raise awareness of the loss of vision due to diabetes.

Fig. 5: Retinal detachment

The wrinkled surface of the retina, and the loss of the normal red reflex are characteristic of a retinal detachment. The flashes and floaters are caused by a vitreous detachment, which caused the retinal break that led to the retinal detachment. The macula is already detached, but surgery to re-attach the retina will at least restore navigational vision.

Fig. 6: Proliferative diabetic retinopathy

There are active new vessels arising from the optic disc and from the retina. Untreated, there is a high risk of blindness within five years. This can be greatly reduced by urgent pan-retinal laser treatment. Screening for diabetic retinopathy and offering appropriate treatment is essential to reduce loss of vision. □

PREVENTION OF CHILDHOOD BLINDNESS

New Issues in Childhood Blindness

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The main new issues in relation to blindness in children relate to a better understanding of the epidemiology, which has led to improved priority setting. In this article the most recent epidemiological data will be presented, the consequences for the VISION 2020 programme will be discussed, and research priorities considered.

Definitions

A blind child is an individual aged less than 16 years, who has a visual acuity in the better eye of $<3/60$. However, many studies do not use this definition, which makes it difficult to compare the findings of different studies.

Prevalence and Incidence

The prevalence of blindness in children (i.e., the proportion of the child population who are blind), varies from approximately 0.3/1,000 children in wealthy regions of the world, to 1.2/1,000 in the poorer countries / regions.¹ Blindness in children is more common in poor regions for two main reasons: firstly, there are diseases and risk factors which can lead to blindness from causes that do not now occur in industrialised countries (e.g., measles, vitamin A deficiency, ophthalmia neonatorum, malaria), and, secondly, there are fewer well equipped eye departments with ophthalmologists, nurses and ophthalmic paramedics trained in managing treatable causes of blindness (e.g., cataract and glaucoma). The incidence is therefore higher, and fewer blind children have their sight restored.

Incidence data are very difficult to obtain, but it has been estimated that there are 8 new blind children for



Children's eye care in Tanzania

Photo: Sue Stevens

every 100,000 children each year in industrialised countries. The figures are likely to be higher in developing countries.

Magnitude of Blindness

Globally, there are estimated to be 1.4 million children who are blind, and around three quarters live in developing countries. Although the actual number of children who are blind is much smaller than the number of adults blind, (e.g., from cataract), the number of years lived with blindness by blind children is almost the same as the total number of 'blind years' due to age-related cataract. The high number of blind years resulting from blindness during childhood is one of the reasons why the control of childhood blindness is a priority of the WHO/IAPB VISION 2020: The Right to Sight programme.²

Causes of Blindness in Children

The available data suggests that there is wide regional variation in the major causes of blindness in children. Tables 1 and 2 show the causes of blindness obtained

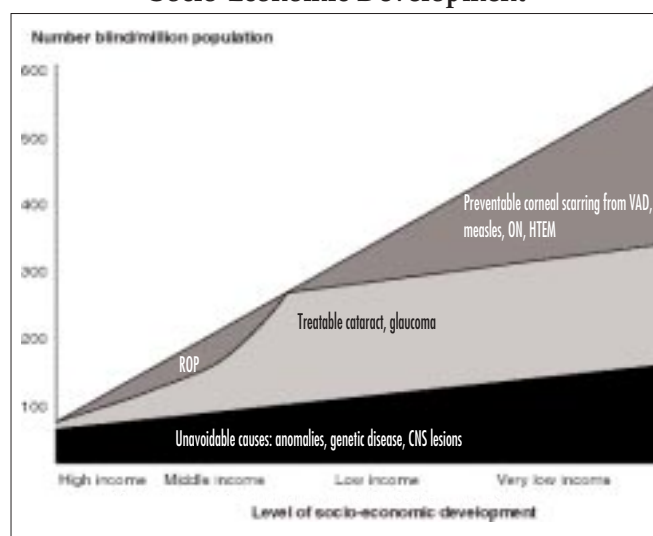
from examining over 10,000 blind children, using the World Health Organization's classification system.³ These data do not take account of children who are 'blind' from refractive errors.

In wealthy parts of the world lesions of the central nervous system predominate, while in poorer countries corneal scarring as a result of acquired diseases are the most important causes. Table 3 shows estimates of the number of blind children by anatomical site, and by underlying cause.

Regional Variation in the Magnitude and Major Causes of Blindness in Children

It is possible to combine what we know about the prevalence of blindness in children with data on causes, and apply this to a total population of one million people (Table 4). This information is perhaps more useful for planning. Figure 1 shows this data.

Fig. 1: Pattern of Blindness in Children by Level of Socio-Economic Development



VAD = vitamin A deficiency ON = ophthalmia neonatorum
HTEM = harmful traditional eye medicines

Table 1: Regional Variation in the Causes of Blindness in Children: Descriptive Classification by World Bank Region (%)

| Region | Wealthiest Region ← → Poorest Region | | | | | | | |
|-------------------------|--------------------------------------|------------|------------|------------|------------|------------|------------|------------|
| | EME | FSE | LAC | MEC | China | India | OAI | SSA |
| Number examined: | * | 504 | 1,007 | 866 | 1,131 | 2,283 | 850 | 1,702 |
| Globe | 10 | 12 | 12 | 14 | 26 | 25 | 21 | 9 |
| Cornea | 1 | 2 | 8 | 8 | 4 | 27 | 21 | 36 |
| Lens | 8 | 11 | 7 | 20 | 19 | 11 | 19 | 9 |
| Uvea | 2 | 5 | 2 | 4 | 1 | 5 | 3 | 5 |
| Retina | 25 | 44 | 47 | 38 | 25 | 22 | 21 | 20 |
| Optic nerve | 25 | 15 | 12 | 8 | 14 | 6 | 7 | 10 |
| Glaucoma | 1 | 3 | 8 | 5 | 9 | 3 | 6 | 6 |
| Other (incl. CNS) | 28 | 8 | 4 | 3 | 2 | 1 | 2 | 5 |
| Total: | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

* data from published studies

EME = Established Market Economies; FSE = Former Socialist Economies; LAC = Latin America and Caribbean; MEC = Middle East Crescent; OAI = Other Asia and Islands; SSA = Sub-Saharan Africa.

Table 2: Regional Variation in the Causes of Blindness in Children: Aetiological Categories by World Bank Region (%)

| Region | Wealthiest Region ← → Poorest Region | | | | | | | |
|-------------------------|--------------------------------------|------------|------------|------------|------------|------------|------------|------------|
| | EME | FSE | LAC | MEC | China | India | OAI | SSA |
| Number examined: | * | 504 | 1,007 | 866 | 1,131 | 2,211# | 850 | 1,702 |
| Hereditary | 45 | 18 | 22 | 53 | 31 | 26 | 27 | 20 |
| Intrauterine | 7 | 6 | 8 | 2 | 0 | 2 | 3 | 3 |
| Perinatal | 24 | 28 | 28 | 1 | 2 | 2 | 9 | 6 |
| Childhood | 10 | 5 | 10 | 7 | 14 | 28 | 14 | 34 |
| Unknown | 14 | 43 | 32 | 37 | 53 | 42 | 47 | 37 |
| Total: | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

* data from published studies

aetiological data not available for 72 children

Avoidable Causes

In all regions of the world there are causes which are amenable to primary, secondary and tertiary prevention, but the proportions vary from region to region (Table 5).

VISION 2020 Priorities

Given these findings, the following conditions are priorities for control:⁴

- Corneal scarring, due to measles, vitamin A deficiency, harmful traditional eye medicines, and ophthalmia neonatorum: priorities in poor and very poor regions

- Cataract and glaucoma: important treatable causes in all regions
- Retinopathy of prematurity: preventable and treatable, important in middle income countries, and in urban centres in developing countries
- Refractive errors: treatable cause in all regions
- Low vision: services need to be expanded or developed in all regions.

Targets for disease control

The following targets have been agreed for disease control:

1. Reduce the global prevalence of childhood blindness from 0.75/1,000 children to 0.4/1,000 children.

Table 3: Estimates of Number of Blind Children by Anatomical Site, and Underlying Aetiology

| Anatomical site | Number affected | Examples | Aetiological category | Number affected | Examples |
|-----------------|------------------|--------------------|-----------------------|------------------|-----------------------|
| Retina | 381,000 | Dystrophies | Hereditary | 423,000 | Cataract |
| Cornea | 231,000 | Scarring | Childhood | 260,000 | Measles |
| Whole eye | 230,000 | Microphthalmos | Perinatal | 151,000 | Ophthalmia neonatorum |
| Lens | 170,000 | Cataract | Intrauterine | 50,000 | Rubella |
| Optic nerve | 167,000 | Optic atrophy | Unknown | 516,000 | Phthisis |
| Glaucoma | 68,000 | Glaucoma | | | |
| Uvea | 50,000 | Aniridia | | | |
| Other | 103,000 | Cortical blindness | | | |
| Total: | 1,400,000 | | | 1,400,000 | |

Table 4: Estimates of the Magnitude and Major Causes of Blindness in Children per Million Total Population

| | High income | | Middle income | | Low income | | Very low income | |
|-----------------------|--------------|----|---------------|----|--------------|----|-----------------|----|
| % population children | 20% | | 30% | | 40% | | 50% | |
| Number of children | 200,000 | | 300,000 | | 400,000 | | 500,000 | |
| Blindness prevalence | 0.3/1000 | | 0.6/1,000 | | 0.9/1,000 | | 1.2/1,000 | |
| No. of blind children | 60 | | 180 | | 360 | | 600 | |
| | Cause | % | Cause | % | Cause | % | Cause | % |
| | CNS/Other | 80 | CNS/Other | 55 | CNS/Other | 60 | CNS/Other | 35 |
| | ROP | 10 | ROP | 25 | ROP | 0 | ROP | 0 |
| | Cat/glaucoma | 10 | Cat/glaucoma | 20 | Cat/glaucoma | 20 | Cat/glaucoma | 15 |
| | Scarring | 0 | Scarring | 0 | Scarring | 20 | Scarring | 50 |

CNS = central nervous system ROP = retinopathy of prematurity Cat = cataract

Table 5: Regional Variation in Avoidable Causes of Blindness

| High income Blind = 90,000 | | Middle income Blind = 290,000 | | Low income Blind = 1,020,000 | |
|-------------------------------|---------------------|----------------------------------|----------------------|---------------------------------|----------------------|
| ROP | 9,000 (10%) | Cataract | 45,000 (15%) | Corneal scar | 200,000 (20%) |
| Teratogens | 5,400 (6%) | ROP | 29,000 (10%) | Cataract | 133,000 (13%) |
| Cataract | 5,400 (6%) | Glaucoma | 17,000 (6%) | Glaucoma | 60,000 (6%) |
| Glaucoma | 2,000 (2%) | Teratogens | 12,000 (4%) | Optic atrophy* | 60,000 (6%) |
| Total avoidable: | 21,800 (24%) | Total avoidable: | 103,000 (35%) | Total avoidable: | 453,000 (45%) |

2. Elimination of corneal scarring caused by vitamin A deficiency, measles, or ophthalmia neonatorum.
3. Elimination of new cases of congenital rubella syndrome.
4. All children with congenital cataract to receive appropriate surgery, with immediate and effective optical correction, in suitably equipped specialist centres.
5. All babies at risk of retinopathy of prematurity to have fundus examination, by a trained observer, 6–7 weeks after birth. Cryotherapy or laser treatment to be provided for all those with treatable disease.
6. All school children to receive a simple vision screening examination, with glasses provided for all those with significant refractive error. This should be integrated into the school health programme.

Human resource development

The implications and recommendations for human resources development are as follows:

1. Ensure that prevention of childhood blindness is an explicit aim of all primary health care programmes.
2. Ensure that all secondary level eye clinics have facilities to provide appropriate spectacles for children with refractive errors.
3. Train one refractionist per 100,000 population by 2010.
4. Train at least one low vision worker for every 20 million children by 2010, and for every 5 million by 2020.
5. Train one paediatric-orientated ophthalmologist for every 50 million population by 2010, and one per 10 million population by 2020.

Appropriate technology and infrastructure

There is the following need for appropriate technology and infrastructure development:

1. Development of low cost, high quality low vision devices, which should be widely available, even in low income countries.
2. Establish a network of specialist 'childhood blindness' tertiary centres.

Research Issues

Corneal scarring. The control of diseases that cause corneal scarring lies in primary health care, public health interventions, and child survival programmes. However, there is still a need to develop cost effective, sustainable interventions at the community and household levels, for the control of vitamin A deficiency – interventions that do not depend on vitamin A supplementation.

Cataract. Cataract surgery is much more difficult in children, and very few clinical trials have been undertaken to explore the optimum management. Further research is also needed into the aetiology of cataract in different parts of the world, as well as qualitative research to investigate barriers to the uptake of cataract surgery.

Retinopathy of prematurity. The pattern of disease in middle income countries seems to be different from that currently seen in industrialised countries. There is a need for research into risk factors in different settings, and the validity of different methods of screening for threshold disease needs to be investigated.

Low vision. There are very few studies of low vision in children. It is not really known how common it is, and what the major causes are at the population level. There are virtually no studies which have addressed the issue of best low vision devices for children.

Diseases of unknown cause. There are many blinding eye diseases where the underlying cause is not known (e.g., congenital anomalies of the eye). Research is needed to try and clarify the relative contribution of genetic and environmental risk factors.

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Vitamin A Deficiency Disorders (VADD): New Name, Challenge and Opportunity

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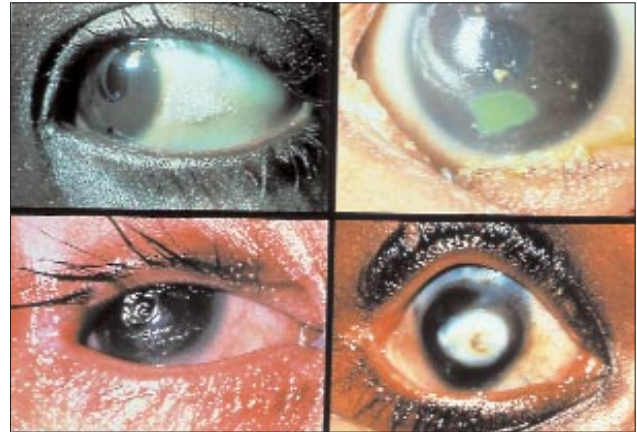
Introduction

The original article on this subject, written by Nicholas Cohen, was entitled 'Vitamin A Deficiency and the Eye'. At that time, in the late 1980s, the main focus was still on xerophthalmia, but even then the massive implications of sub-clinical vitamin A deficiency on aspects of health in the young child – such as morbidity and mortality, immune status, growth, and haemopoiesis – were becoming increasingly evident. In recent years, similar evidence has been emerging in relation to maternal health and survival in childbirth. Hence, the growing acceptance of the term Vitamin A Deficiency Disorders, designed to cover all kinds and degrees of human vitamin A deficiency.^{1,2}

A logical consequence of this significant change that has taken place is the necessity for re-adjustment and adaptation in the means of delivery of preventive health services. Thus far, eye care services in the community have been targeted – and the early detection, treatment and prevention of vitamin A deficiency eye signs should still be an integral part of their role. However, we now know that throughout developing countries VADD are widespread and have serious consequences on health, long before eye signs become apparent. This clearly means that Maternal

Table I: Some Indications of the Global Magnitude of VADD

- Approximately 300,000 preschool-age children are blind from xerophthalmia (about 60% of these do not survive longer than 1 year)
- There are about 3 million blind children worldwide
- Approximately 3 million children have clinical xerophthalmia (including night blindness and Bitot's spots)
- Approximately 250 million preschool-age children are sub-clinically vitamin A deficient and have significantly increased morbidity and mortality as a result
- An uncalculated percentage of the approximately 500,000 women who die in childbirth annually, do so as a consequence of impaired vitamin A status).



Vitamin A deficiency

Photos: Simon Franken, Allen Foster, Donald McLaren & Gordon Johnson

and Child Health (MCH) services especially must take over responsibility. In practical terms this may mean different approaches in different countries. The essential point is that whoever is delivering health care to mothers and their young children in the community should be made aware of the relevance of improved vitamin A status in all aspects of their work.

The Magnitude of the Problem

Table 1 gives a few estimated figures. Those that relate to xerophthalmia have not changed greatly over the past 20 years or so. It must be remembered, however, that the world population has increased by almost 2 billion in that period – and consequently, in terms of percentages, the situation has improved considerably.

The estimate for sub-clinical VAD is quite recent and represents almost 50% of preschool-age children in developing countries.³

Global Distribution

In recent years the World Health Organization has been monitoring data from around the world on the prevalence of VADD.³

Countries are now categorised according to the degree of their VADD problem, with almost all of the developing countries having a problem at least at the sub-clinical level.

Table 1: (Fig 8.1 of Sight & Life Manual) Countries Categorised by Degree of Public Health Importance of Vitamin A Deficiency, by WHO Region (from information available to WHO as of February 1997)

| WHO Region | Clinical | Severe | Sub-Clinical Moderate | Mild | No Data Available | VAD Under Control/No Problem Likely |
|-----------------|-----------------------------|--------------------|-----------------------|------------|---|---------------------------------------|
| Africa | Angola | Burundi | Botswana | Madagascar | Algeria Central African Republic Equatorial Guinea Gabon Guinea Guinea-Bissau Liberia Mauritius Sao Tome & Principe Seychelles Swaziland Zaire | |
| | Benin | Cape Verde | Namibia | | | |
| | Burkina Faso | Congo | Sierra Leone | | | |
| | Cameroon | Cote d'Ivoire | Eritrea | | | |
| | Chad | Gambia | | | | |
| | Comoros | Lesotho | | | | |
| | Ethiopia | Senegal | | | | |
| | Ghana | | | | | |
| | Kenya | | | | | |
| | Malawi | | | | | |
| | Mali | | | | | |
| | Mauritania | | | | | |
| | Mozambique | | | | | |
| | Niger | | | | | |
| | Nigeria | | | | | |
| | Rwanda | | | | | |
| | United Republic of Tanzania | | | | | |
| | Zambia | | | | | |
| | Zimbabwe | | | | | |
| | Americas | Dominican Republic | Brazil | | | |
| Haiti | | Colombia | Bolivia | | | |
| | | El Salvador | Ecuador | | | |
| | | Mexico | Guatemala | | | |
| | | Nicaragua | Honduras | | | |
| | | Peru | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| South East Asia | Bangladesh | Indonesia | Thailand | | Maldives Mongolia | Democratic People's Republic of Korea |
| | Bhutan | Myanmar | | | | |
| | India | | | | | |
| | Nepal | | | | | |
| | Sri Lanka | | | | | |
| | | | | | | |

It is encouraging to note that the countries in South East Asia – the traditional ‘home’ of xerophthalmia – have, for a variety of reasons, nearly all undergone a considerable reduction in the blinding degree of the disease. Data that demonstrate this improvement come from India, Indonesia and Bangladesh.⁴ It is not yet clear what impact the recent financial crisis in Asia will have. There are still some notable gaps in our knowledge of global occurrence – for example, in the former Soviet Union countries. This alone means that we pass into the year 2000 far from meeting the ‘Health for All’ goals relating to VADD.

Methods of Assessment

There is still no ‘gold standard’ against which vitamin A status may be assessed. It is unlikely that there will ever be one that could be readily and widely applied in the field. The RDR (Relative Dose Response) and MRDR (Modified Relative Dose Response) estimate liver reserves of vitamin A indirectly, as does the more recently introduced stable isotope dilution test. CIC (Conjunctival Impression Cytology) and the dose response tests were relatively new when Nicholas Cohen wrote the original article in 1988. They have provided useful data but are difficult to interpret when

applied to communities deficient in many nutrients and suffering from endemic infections. Increasing recognition is being given to the frequency with which serum retinol and serum retinol-binding protein are depressed in the presence of the acute phase response in infections.⁵ Failure to recognise this often leads to the conclusion that vitamin status is low under these circumstances.

Some tests of ocular function, such as scotopic vision testing and vision restoration time are under study. The use of the level of retinol in breast milk samples, as a readily obtained guide to vitamin A status in a community, has an increasing number of advocates.⁶

All of these tests are designed to detect VAD at the sub-clinical level. As has already been stressed, it is at this level that the problem of VADD is generally being encountered nowadays. Consequently, the importance of general agreement on how VAD should be assessed at this level cannot be over-emphasised.

Over the past 20 years there has been no revision of the eye signs of VAD and the criteria based on their detection, which WHO recommended be used for the identification of a problem of xerophthalmia of public health magnitude.⁷

This scheme has been used on many occasions around the world and, if applied as directed, appears to be fully reliable. Unfortunately, instructions as to its use have not always been followed, making interpretation difficult, or even impossible. In particular, the following should be noted:

- XIA (conjunctival xerosis) should not be used as it is subject to great inter- and intraobserver error
- XIB (Bitot's spot) is not a reliable sign of active VAD in older children and, therefore, the subject group should be children up to the age of 6 years
- Great care should be taken not to attribute corneal scars to VAD (i.e., XS) unless a careful history and examination suggest this aetiology.

Table 2: (Table 4.3 of Sight and Life Manual) Criteria for Assessing the Public Health Significance of Xerophthalmia and Vitamin A Deficiency, Based on the Prevalence among Children Less than Six Years Old in the Community (WHO Expert Group,1982)

| Criteria | Minimum Prevalence |
|--|--------------------|
| Clinical (primary) | |
| Night blindness (XN) | 1.0% |
| Bitot's spot (XIB) | 0.5% |
| Corneal xerosis and/or ulceration/keratomalacia (X2 + X3A + X3B) | 0.01% |
| Xerophthalmia-related corneal scars (XS) | 0.05% |
| Biochemical (supportive) | |
| Serum retinol (vitamin A) Less than 0.35 mmol/l (10 mg/dl) | 5.0% |

Risk Factor

The young child and his or her pregnant and lactating mother are still most vulnerable. Breast feeding is highly protective, mainly through reducing the impact of serious infections. Diarrhoeal disease and acute lower respiratory tract infections have long been known to be closely associated. However, in recent years other infections have also come into the picture. Prominent among these is measles, which not only mounts a severe attack on the immune system, but also may invade the eye directly. HIV/AIDS is more readily transmitted to the foetus in mothers with low vitamin A status, and has a less favourable course in the presence of VAD. Several groups have recently demonstrated that a considerable fraction of the daily intake of vitamin A may be lost by excretion in the urine in the presence of severe infections.¹

Treatment

From time to time WHO has reissued recommendations for the treatment of xerophthalmia in the acute stage.⁸ These have not differed materially and the latest statement is give in Table 3.

Secondary infection of the eye is frequently a complicating factor and appropriate antibiotic eye ointment should be give, e.g., tetracycline or chloramphenicol.

Prevention

There are four broad categories of approach to the prevention of VADD. Many local political, social, technical and economic factors will conspire to determine which approach or mix of approaches will be chosen in any given circumstance.

Table 3: Treatment Schedule for Xerophthalmia for All Age Groups Except Women of Reproductive Age^a

| Timing | Vitamin A Dosage ^b |
|---------------------------------|-------------------------------------|
| Immediately on diagnosis: | |
| <6 months of age | 50 000 IU |
| 6–12 months of age | 100 000 IU |
| > 12 months of age ^a | 200 000 IU |
| Next day | Same age-specific dose ^c |
| At least 2 weeks later | Same age-specific dose ^d |

^a Caution: women of reproductive age with night blindness or Bitot's spots should receive daily doses of < 10 000 IU, or weekly doses of < 25 000 IU. However, all women of childbearing age, whether or not pregnant, who exhibit severe signs of active xerophthalmia (i.e., acute corneal lesions) should be treated as above.

^b For oral administration, preferably in an oil-based preparation.

^c The mother or other responsible person can administer the next-day dose at home.

^d To be administered at a subsequent health-service contact with the individual.

1. Combat associated infectious diseases

Improvement in vitamin A status may often be a welcome side effect of an immunisation programme, such as that for measles.⁹ In addition, the opportunity to add vitamin A supplementation to immunisation is being increasingly implemented.¹⁰

2. Vitamin A supplementation

This may be by capsules or syrup and the WHO recommended schedule is given in Table 4.

It should never be forgotten that this cannot convey prevention in any permanent sense. Unless circumstances improve each succeeding child has to be given vitamin A. It should be the first intervention to be applied when an emergency arises, but it is well known that programme efficiency falls rapidly thereafter, and immediate thought should be given to replacing it by measures that have long-term results.

3. Fortification

The incorporation of micronutrients in common foodstuffs is a practice carried out by many countries, both developed and developing. Only partially successful fortification measures with vitamin A, using table salt or monosodium glutamate, have been carried out in Central America and South East Asia. For sustainable success many hurdles have to be overcome. There is renewed interest on the part of the food industry and multinutrient fortification, including vitamin A, is being explored.

4. Dietary interventions

In nearly all situations where VADD are of public health magnitude, correct use of the local food sources should be, on its own, a sufficient means of



Unilateral staphyloma after vitamin A deficiency

Photo: Murray McGavin

maintaining vitamin A status in the great majority of the population. Over dependence on a single staple food, such as rice, is often at the root of the problem. Dark green leaves, such as spinach, and yellow fruits like mango, papaya and pumpkin are rich in provitamin A carotenoids. However, in recent years evidence has been accumulating that their bio-availability is much less than had previously been assumed.¹¹ As a consequence, present nutritional advice is not only to increase the intake of fruit and vegetables, but also to add, as far as possible, suitable animal sources of preformed vitamin A, such as dairy products, eggs and liver.

The dietary approach provides several benefits which do not apply to the other measures. The intake of other micro- and macronutrients, dietary fibre and non-nutrient dietary antioxidants will also be increased, in a situation where they too tend to be deficient. The family income will be spared to some extent if food is home grown, and may be actually increased if any surplus can be sold. The women of the household may be primarily responsible and have their status improved as a result.

Conclusion

The aims for the control of VADD have been changed. The target is no longer to eliminate nutritional blindness due to VAD. It is to ensure that the great majority of the world's people have a vitamin A status that protects them against any increased risk of mortality or morbidity.

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Table 4. High-Dose Universal-Distribution Schedule for Prevention of Vitamin A Deficiency

| | |
|---|--|
| Infants < 6 months of age ^a | |
| Non-breast-fed infants | 50 000 IU orally |
| Breast-fed infants whose mothers have not received supplemental vitamin A | 50 000 IU orally |
| Infants 6–12 months of age | 100 000 IU orally, every 4–6 months ^b |
| Children > 12 months of age | 200 000 IU orally, every 4–6 months ^b |
| Mothers | 200 000 IU orally, within 8 weeks of delivery. |

^a Programmes should ensure that infants < 6 months of age do not receive the larger dose intended for mothers. It may, therefore, be preferable to dose infants with a liquid dispenser to avoid possible confusion between capsules of different dosages.

^b Evidence suggests vitamin A reserves in deficient individuals can fall below optimal levels 3–6 months following a high dose; however, dosing at 4–6 month intervals should be sufficient to prevent serious consequences of vitamin A deficiency.

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Intraocular Lens (IOL) Implants in Children

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IOLs in Children

The insertion of an intraocular lens (IOL) is a routine part of cataract surgery in adults, even in many developing countries. It is now over fifty years since the first IOL was implanted. However, until recently, IOLs were not widely used in children.

As evidence for the long-term safety of IOLs in adults accumulates, there is a growing willingness to use IOLs in children. Provided the zonule is stable and the eye is not inflamed, IOL implantation is already routine in children over five years old, and increasingly in children between two and five years. The use of IOLs in children under two years remains very controversial. One reason for this is that the eye changes very rapidly in young children. In a three month old baby, an IOL power of 28–30D (dioptres) may be required for emmetropia. However, this will lead to significant myopia in later life. Unlike a spectacle lens or contact lens, it is not simple to change the power of an IOL. Secondly, the diameter of the lens in an infant is 2mm less than an adult lens. This makes it difficult to implant a standard adult IOL into the capsular bag. The maximum diameter of the IOL should not exceed 12 mm. Smaller IOLs designed for use in children can be obtained. The lens should be placed in the capsular bag to reduce intraocular inflammation and the risk of complications, such as aphakic glaucoma.

Possible Complications of IOLs in Children

Fibrous uveitis. A major problem with implantation of IOLs in children is the increased inflammatory response, particularly in heavily pigmented eyes. A fibrinous uveitis is often seen about 3–7 days after surgery. This may be controlled by intensive topical steroids (hourly Gutt. prednisolone 1%), or by orbital floor, steroid depot injections. In a developing country, it is probably sensible to keep the child in hospital for a week after surgery to ensure early detection and treatment of uveitis. The risks of steroids should be



Healthy eyes (left). Bilateral congenital cataract (right)

Photos: Murray McGavin & Allen Foster

considered. Despite steroid treatment, some children will develop a dense fibrous membrane, which may require surgical removal.

Astigmatism and residual refractive error. While an IOL corrects the aphakia, it does not correct astigmatism, and there will almost certainly be some residual spherical error. This means that spectacles will still be necessary to achieve the best possible vision. These spectacles will be lighter and easier to wear than the thick lenses required for spectacle correction of aphakia. As they are relatively low powered lenses, there are fewer optical aberrations. It is important that the parents – and the medical and nursing staff – realise that insertion of an IOL does not mean that glasses will not be required.

We recommend that children should be refracted within a month of IOL implantation. Thereafter, children should be refracted every four months until they are two years old, and then every six months. If there is any amblyopia, it may be wise to refract even more often. Refraction must be carried out by someone who is skilled at accurate retinoscopy.

In young children, the glasses should leave the child slightly myopic (approx. $-1.0D$) as this will give them a good depth of field, and most things and people they want to look at will be within one or two metres. As the child gets older and starts to read small print, an additional reading correction will be required.

Unsuitable eyes. Some eyes are unsuitable for IOL insertion. For example, microphthalmic eyes may be too small to receive an IOL. It is inadvisable to insert an IOL if the corneal diameter is less than 9mm. Eyes with chronic uveitis – associated with juvenile rheumatoid arthritis and rubella syndrome, for example – should

never have an IOL, as the presence of an IOL may worsen the intraocular inflammation.

If the surgery is difficult, and it appears that it may be impossible to implant an IOL without damaging the corneal endothelium, it is better to leave the child aphakic with an intact cornea rather than risk later corneal decompensation.

Advantages of IOLs in Children

The major advantage of an IOL is that it provides permanent continuous correction of the aphakia. This may be important in preventing amblyopia, and encouraging normal visual development. Although glasses are necessary to obtain the best vision, uncorrected pseudophakic vision is probably better than uncorrected aphakic vision.

Which Lens Should Be Used?

Many different materials and designs of intraocular lens (IOL) are available. Although anterior chamber lenses have been shown to be safe and effective in adults, there is no evidence confirming their safety in children. It is recommended that anterior chamber lenses should not be used in children at this time.

Polymethyl methacrylate (PMMA) has been the material of choice for all IOLs until recently. Coating the PMMA lens with heparin greatly reduces intraocular inflammation and fibrin formation. If coated lenses are not available, intra-operative addition of heparin to the infusion fluid may be beneficial. There are now silicon IOLs, hydrophilic acrylic IOLs, and hydrogel IOLs. Some of these new materials may have specific advantages in children – particularly increased bio-compatibility and a reduced risk of uveitis. However, this has not yet been proven. Before inserting an IOL made of a newer material, consider that it may need to last for 60 years, and we have barely ten years experience of most of the newer IOL materials, compared to 50 years experience of PMMA.

Which Power of IOL?

The most difficult question is what power of IOL to use. In children over five years, where biometry is available, the IOL that will come closest to emmetropia should be used. If biometry is not available, and there is no information on the previous refractive state of the eye, then the standard power adult IOL (usually 21–22 D) should be used.

In children between two and five, it is usual to leave them with 1–2 D of hypermetropia, as this should come close to emmetropia later in life. If no biometry is available, a 23 – 24 D IOL is used.

In children under two, there is no clear consensus regarding appropriate IOL power. Correction of aphakia in an infant will probably require a 28–30 D IOL. This is likely to lead to myopia in later life. It is currently recommended that children under two should have an IOL with a 20% under correction. This means that if biometry shows that the child needs a 30 D IOL, a 24 D IOL is inserted. The disadvantage of this is that it leaves the child with significant hypermetropia, which may lead to a blurred retinal image and abnormal visual development.

Even with an IOL, children will have no accommodation, and it is important to provide reading correction, or bifocals, for older children. Although multi-focal IOLs are available, there are few reports of their effectiveness in children.

Conclusion

IOLs are increasingly regarded as the best treatment for aphakia in all age groups. However, insertion of an IOL into a child can be a difficult procedure, and, if there are serious complications, the vision may be permanently lost. It is possible that good pseudophakia may be better than good aphakia. However, it is absolutely certain that bad pseudophakia is much worse than good aphakia.

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ONCHOCERCIASIS • LEPROSY HIV: AIDS

Onchocerciasis: Elimination on the Horizon

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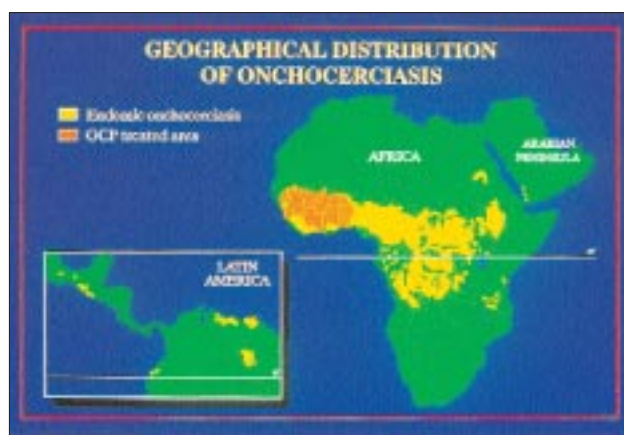
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The Disease

Onchocerciasis, more commonly known as 'river blindness', is a parasitic, blinding disease, endemic in 30 African and six Latin American countries. Recent estimates point to around 17 million people infested with the parasite, the nematode *Onchocerca volvulus*, and some 270,000 who are blind from ocular complications.¹

The parasite *Onchocerca volvulus* is transmitted by a vector fly, *Simulium damnosum*, of which there are a number of sub-species. This fly breeds in running water courses. Thus, as most cases of disease and its complications occur close to rivers where *Simulium* breeds and transmits the parasite, the term 'river blindness' came into use. As the fly bites an infected person, it ingests some microfilariae of *Onchocerca* migrating in the skin. These microfilariae then transform into infective larvae within the fly and, at a subsequent bite, the fly will transmit one or several of those infective larvae, which subsequently mate and create a nodule ('onchocercoma') in the subcutaneous tissue. The adult female worm produces millions of microfilariae, which invade a number of organs, including the eyes. The ocular manifestations of onchocerciasis have been described since the 1930s, but the pathogenesis is still not well known in all instances. The anterior segment lesions (onchocercal punctate keratitis, sclerosing keratitis, iridocyclitis)



Geographical distribution of onchocerciasis

Graphics: International Centre for Eye Health

seem clearly related to the number of microfilariae, but the posterior segment abnormalities (choroidoretinitis and optic neuritis) do not show such a clear relationship. It is, therefore, likely that immunological factors intervene in the appearance and evolution of these lesions, which may follow even at very low microfilarial loads. This has important implications in terms of the microfilarial load reduction needed to truly eliminate the incidence of blinding posterior segment lesions. As it has been demonstrated that severe visual field constriction, due to the appearance of onchocercal optic nerve disease, is responsible for a substantial part of onchocercal blindness, the incidence of posterior segment lesions are of particular importance for the prevention of visual disability. This is often overlooked in advanced cases of ocular onchocerciasis where the presence of anterior segment lesions, in particular severe sclerosing keratitis, makes a fundus examination impossible.²

Epidemiology

The epidemiology of onchocerciasis is very particular, given the interaction between human settlements and the vector fly. As the *Simulium* fly breeds only in running, well-oxygenated water, most transmissions

occur in remote rural areas, where there are no irrigation schemes or other exploitation of water sources. Onchocerciasis is, therefore, often referred to as the 'disease at the end of the road', affecting the poorest population groups. Because of the discomfort of numerous biting flies, and the recognition of consequent onchocercal blindness when living close to rivers, the population has moved away from infested rivers in several African countries. This has caused the abandonment of the best agricultural areas and left villages deserted.

As onchocerciasis is a disease of accumulation of parasites, with a gradual build-up of the microfilarial density in the skin and elsewhere, it is predominantly adult males who go blind. In typical societies, the males work in the fields close to the rivers, or go fishing, or work as ferry men, etc. The proportion of blind males can be very high in the most hyper-endemic communities, up to or more than 35%, in small 'first-line' communities close to *Simulium* breeding sites. The social and economic implications of such a high prevalence of blindness, affecting the working age population, are obvious. This was, in fact, the reason why the World Bank became interested, in 1972, in setting up a programme for the control of onchocerciasis in the worst affected areas in West Africa.

Treatment

The treatment of onchocerciasis used to be worse than the disease itself, implying considerable discomfort and risk of severe adverse reactions. The commonly used microfilaricide, diethylcarbamazine (DEC), taken in the form of tablets, was effective, but could provoke an acute, severe, sometimes life threatening, allergic, so-called 'Mazzotti' reaction because of the instant death of millions of microfilariae. Undergoing the usual period of three weeks' treatment with DEC was, therefore, not appreciated by heavily infested patients, and the Mazzotti reaction, with its intense itching and other discomforts, often led to bad compliance. Various treatment dosages and schemes, adding on antihistamines and cortisone, did little to change the fact that DEC could not safely be given on a large scale basis to affected populations. The same was true for the only available macrofilaricide, suramin, which had to be given as weekly injections over a period of six to eight weeks. Suramin is a nephrotoxic compound, and its use could also give rise to optic atrophy, sometimes with itching and discomfort similar to that caused by DEC, because of its partial microfilaricidal effect. For these reasons, the use of suramin had to be limited to selected patients in a hospital setting.

When ivermectin first became available in the early 1980s, it was an important breakthrough for several reasons. Ivermectin killed the microfilariae without provoking an acute allergic manifestation, and there were very few adverse reactions. It, therefore, became possible to treat large populations without constant medical supervision. Furthermore, ivermectin became



(a) Skin disease with severe itching (b) Subcutaneous nodule
(c) Sclerosing keratitis

Photos: (a) Ian Murdoch
(b) Clare Gilbert
(c) Jan Stilma

available as a donation programme by the manufacturer, Merck & Co., thus providing access for millions of people with onchocerciasis to the treatment they need, without cost barriers. The introduction of ivermectin treatment against onchocerciasis is a great success story – from the initial trials to today's annual distribution to around 18 million cases. This has become possible through the combined effort of the manufacturer, a group of dedicated non-governmental development organizations, United Nations agencies and collaborating 'endemic' communities. A number of studies on delivery systems and cost recovery for ivermectin delivery to those in need have been tried and analysed.³ The result, which is today referred to as 'community-directed treatment with ivermectin', is a model for drug distribution systems for populations in remote rural areas.

Control Efforts

Since before 1972, onchocerciasis had been subject to attempted control of transmission and of the disease, beginning in the late 1940s in Africa. One unique success was the elimination of transmission of *Onchocerca volvulus* in one valley in Kenya, through the use of DDT. This has produced a lasting result because of the ecological situation, within a very isolated focus. However, similar attempts of vector control in other foci in West Africa had all failed, because of re-invading flies from nearby endemic areas. In a meeting in 1968, in Tunis, the idea was put forward of having a large vector control zone in the Volta River Basin Area, which could encompass all known transmission and breeding sites and rule out re-invasion. This was the philosophy behind the creation of the Onchocerciasis Control Programme (OCP) in West Africa, which was planned by WHO from 1972 to 1974, with joint input from the United Nations Development Programme (UNDP), the Food and Agricultural Organization (FAO) and the World Bank. OCP started its aerial

operations for vector control in seven West African countries in early 1975, covering an area of 1,235,000 km² and 50,000 km of river stretches. It has since been expanded to 11 countries, and has undergone significant changes in terms of strategies and operations for control of onchocerciasis. It soon became clear that the problem of re-invading flies could occur, even in the new, vast programme area. After a few years, resistance became evident against the first insecticide used (temephos, or Abate ®) in *Simulium*, in certain foci. Despite these difficulties, OCP managed to continue its operations, with rotational use of other insecticides, until the availability of ivermectin (Mectizan ®) from Merck & Co., allowed a strategic change, implementing ivermectin distribution to affected populations in certain foci. As it had been demonstrated that ivermectin, taken in annual doses, had a pronounced suppressive effect on onchocercal disease, reducing the microfilarial skin load down to very low levels for many months, it became possible both to control the disease and contribute to transmission interruption in affected areas.

25 Years of Progress

OCP is now coming to an end. It is a hugely successful programme, which has protected 15 million children against onchocerciasis, and more than 500,000 people have been saved from blindness. In addition, there has been tremendous socio-economic gain in the resettlements of new communities in the previously infested areas, including some 250,000 km² of 'new' riverline land, for resettlement and cultivation. New agricultural and other development schemes in these onchocerciasis-free areas have contributed to an Economic Return Rate of around 18%, which is significant. At this time of writing OCP is preparing for its closing down by the end of 2002, although surveillance activities for possible recrudescence of disease will continue.⁴

In parallel with the OCP developments, making use of ivermectin, new control programmes were also being planned. In Latin America, where onchocerciasis is endemic in six countries, but with less blinding potential, a new project was created – the Onchocerciasis Elimination Programme in the Americas (OEPA). In that setting, with different and less 'effective' vector flies, the regular dosing of population by means of ivermectin is likely to lead to complete interruption of transmission. The total

elimination of the disease is possible, and good progress is being made in this direction. In Africa, a new African Programme for Onchocerciasis Control (APOC) was established in 1995, through a partnership formula with a group of dedicated non-governmental organizations, in addition to the agencies already involved in OCP. APOC covers onchocerciasis in the remaining 19 endemic countries in Africa, in addition to the 11 OCP countries. APOC has made rapid progress in implementing Community Directed Treatment with Ivermectin (CDTI), through national task forces in all participating countries. The CDTI strategy promotes cost-effective and large-scale ivermectin distribution to those populations in need in endemic areas. Thus, the present estimated annual treatments are in the order of 15 million cases in the OCP and APOC areas.

It can be safely stated today that the elimination of onchocerciasis as a public health problem is now within reach. The ongoing and planned operations in the three control programmes (OCP, OEPA and APOC) will cover all disease foci, where intervention is necessary. Thus, by the year 2010, it will be possible to conclude that visual loss due to this dreadful disease will disappear. This would be one of the major achievements within the Global Initiative for Elimination of Avoidable Blindness – launched in 1999 by WHO in collaboration with a dedicated group of non-governmental development organizations, under the theme of 'VISION 2020: The Right to Sight.' The Initiative, which focuses on five major causes of avoidable blindness, is an outstanding effort for global action and partnership in the prevention of blindness. The possibility of eliminating onchocerciasis as a public health and socio-economic obstacle to development, is perhaps the first victory in sight in the 'VISION 2020' Global Initiative.

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VISION 2020: Update on Onchocerciasis

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Onchocerciasis, also known as 'river blindness', is an insect-borne disease, caused by a nematode worm, *Onchocerca volvulus*. It is the world's second leading infectious cause of blindness, and is present in 37 countries of sub-Saharan Africa, the Arabian Peninsula and the Americas. In most of these countries it constitutes a public health problem, and a serious obstacle to socio-economic development.

Disease Prevalence and Burden

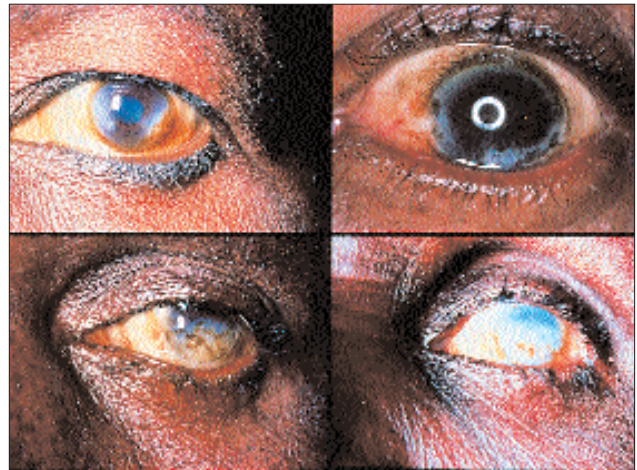
- About 125 million people worldwide are estimated at risk of onchocerciasis. Of these, 96% are in Africa
- Of the 37 countries where the disease is endemic, 30 are in sub-Saharan Africa and six are in the Americas
- A total of 18 million people are infected with the disease, of whom 99% live in Africa and at least one million are either blind, or severely visually disabled. To these are added each year an estimated 40,000 new blind.

As the name 'river blindness' suggests, onchocerciasis is essentially a focal disease. However, where it exists, its impact on affected communities may be extensive and devastating. Thus, in many hyperendemic areas with blinding onchocerciasis, almost every person will be infected, and half of the population will be blinded by the disease before they die. Once blind, affected individuals have a life expectancy which is only one third of those who are sighted. Most die within 10 years.

Recent studies in Ethiopia, Nigeria and Sudan have also shown that onchocerciasis is responsible for poor school performance and a higher drop-out rate among infected children (due to itching, lack of sleep, etc.), while low productivity, low income and higher health-related costs are found among infected adults.

Disease Transmission

The parasite. *Onchocerca volvulus* (the causal agent of



Sclerosing keratitis in onchocerciasis

Photos: Ian Murdoch & Allen Foster

onchocerciasis) is one of a large group of nematodes. The adult worms live encysted in fibrous nodules. Each nodule contains between 2–3 female worms lying in a twisted, tangled mass. Hence the term *volvulus*. Adult female worms have a life span of 8 to 10 years but may live up to 15 years, during which time each releases millions of first-stage larvae, also known as microfilariae. In hyperendemic areas, the total microfilaria load in the body of affected individuals may be as high as 150 million.

The vector. Onchocerciasis is transmitted from one individual to another by a black fly of the genus *Simulium*. The blackfly larvae require well-oxygenated water to mature, and eggs are laid in rapids in fast flowing rivers and streams. Female black flies require a blood meal to initiate ovulation, and it is during this meal that they may transmit or receive the onchocercal infection.

Cycle of infection. Microfilariae enter a female blackfly when she bites an infected person. A small percentage of these reach the insect's thoracic muscles where after several moults, they become third-stage infective larvae. They then migrate to the insect's salivary glands and are ready to be transferred during the next blood meal.

After entering the skin of the human host through the bite of an infected blackfly, the infective larvae (usually two to six) migrate through the subcutaneous tissues, where, over the next 12 months, each larva will mature into an adult male or female worm. This sequence is repeated many times over, and many years of exposure are usually required before a heavy load of adult worms and pathogenic microfilariae builds up in the human host.

Clinical Manifestations

The people most at risk from onchocerciasis are those who, for reasons of occupation (e.g., fishermen, farmers, sand diggers) or residence, spend long work hours or live nearer to the breeding sites. Early manifestations of the disease in infected persons usually appear one to three years after the entry of infective larvae. Nearly all the lesions of onchocerciasis, including those in the eye, are directly or indirectly related to local death of microfilariae. Generally, live microfilariae stimulate very little inflammatory response and the mechanisms that protect them from the host's immune response are still largely unknown.

The clinical features of onchocerciasis (Boxes 1 & 2) may be divided into two main groups: *ocular* and *non-ocular*, as summarised below:

Control of Onchocerciasis

The past ten years have seen a rapid and remarkable

Box 1: Non-Ocular Manifestations

- Pruritus: often severe and unrelenting
- Nodules: subcutaneous, painless, typically found around bony prominences (iliac crest, greater trochanters, ribs, knees, coccyx and skull)
- Severe, disfiguring skin disease: may lead to social stigmatization, psychological and sleep disorders
- Lymphatic: lymphadenopathy, hanging groin
- Unproven but suspected associations: hyposexual dwarfism, higher prevalence of epilepsy

Box 2: Ocular Manifestations

Anterior segment

- Live microfilariae in anterior chamber (AC)
- Punctate keratitis, leading on to sclerosing keratitis
- Early uveitis, leading on to chronic uveitis

Posterior segment

- Choroido-retinitis, leading on to choroido-retinal atrophy or optic nerve atrophy
- Acute optic neuritis, leading on to optic atrophy

Others

- Night blindness
- Visual field loss and constriction
- Irreversible blindness

Box 3: Exclusion Criteria for Ivermectin Treatment

- Children under 5 years (age), or
- Less than 15 kg (weight), or
- Less than 90 cm (height)
- Pregnant women
- Lactating mothers of infants less than one week old
- Severely ill persons
- Use with extreme caution in areas co-endemic with *Loa loa*

expansion of onchocerciasis control activities worldwide, thanks to joined efforts and support from WHO and other UN agencies, the World Bank and a growing coalition of Non-Governmental and Development Organisations (NGDOs). These efforts are co-ordinated by three major regional programmes – one in Central and Latin America, the *Onchocerciasis Control Programme of the Americas* (OEPA); and 2 in Africa, the *Onchocerciasis Control Programme* (OCP), and the *African Programme for Onchocerciasis Control* (APOC). Together, these three regional programmes cover more than 99% of all endemic populations and all but one (Yemen) endemic countries.

Strategy Options for the Control of Onchocerciasis

The control of onchocerciasis today is based essentially on two strategies: *Simulium* vector control, and large-scale chemotherapy with ivermectin. Each may be used alone or in combination.

Vector control. This is the chief strategy used in West Africa by the Onchocerciasis Control Programme (OCP) since 1974. The main goal in vector control is to interrupt transmission of *O. volvulus* by regular aerial spraying of all *Simulium* larval breeding sites – and to maintain this for at least 14 years until the infection has died out in human populations. This strategy, used alone at the beginning and now in combination with ivermectin, has been highly effective. Onchocerciasis has been virtually eliminated in the original seven OCP countries, and progress elsewhere in the programme area is so advanced as to justify the closing down of OCP in 2002. For reasons of cost and operational feasibility, vector control could not be applied or extended to other endemic countries outside the OCP area of operation.

Chemotherapy. Ivermectin is the only chemotherapeutic agent recommended for use against onchocerciasis and its mass distribution constitutes the main strategy for the other two regional programmes, APOC and OEPA. It is a semisynthetic, macrocyclic, lactone antibiotic, widely used in the field of veterinary medicine against a wide range of animal parasites. It was developed during the 1980s and donated free for the treatment of human onchocerciasis, 'to as many as needed and for as long as required' by the manufacturers, Merck and Co., in 1987. Its main characteristics can be summarised as follows:

- It is a microfilaricide, with a very wide therapeutic range (150 – 800 micrograms/kg).
- It is highly attractive and popular in endemic communities for its many other beneficial effects on intestinal worms, scabies, head lice, and for its supposed enhancing effect on libido.
- Given at the recommended single dose of 150µ/kg, it is effective for up to a year.
- When given to the largest sections of affected communities, it may significantly reduce disease transmission.

- However, because ivermectin has no demonstrable direct effect on the adult worm, it must be given repeatedly for up to 12–15 years, i.e., the time it takes for most adult worms to die.

Table 1: Recommended Doses of Ivermectin in Mass Treatment

| Weight (kg) | Height (cm) | No. of Tablets (3 mg) |
|-------------|-------------|-----------------------|
| 15–25 | 90–119 | 1 |
| 26–44 | 120–140 | 2 |
| 45–64 | 141–158 | 3 |
| 65 or more | 159 or more | 4 |

Table 2: Treatment Approaches Based on Endemicity Levels

| | |
|---|-------------------------------|
| Hyper-endemic (40+% nodule carriers) | Mass treatment (CDTI) |
| Meso-endemic (20–39% nodule carriers) | |
| Hypo-endemic (<20% nodule carriers) | Clinic-based treatment |
| Non endemic | No treatment |

Current Uses of Ivermectin in Onchocerciasis Control

There are two main uses of ivermectin in the treatment of onchocerciasis: passive or clinic based, and active, as in large scale or mass treatment of entire communities.

Passive or clinic based treatment. This is the form of treatment available to all those seeking medical treatment and in whom a clinical diagnosis of onchocerciasis has been made in a hospital or health centre. It is directed primarily to infected individuals and is the main method of treatment in hypoendemic areas where the risk of blindness or severe skin disease is virtually non-existent.

Community mass treatment. Also known as *community-wide treatment*, this is the method of choice in meso- and hyperendemic areas of onchocerciasis, i.e., where onchocerciasis is considered a public health problem. In these areas, ivermectin is given once a year for at least 14 years to all members of the community, (as recommended in Table 1 – except for the exclusions defined in Box 3).

Over the years, mass treatment has evolved from mobile strategies used in the early days, following ivermectin donation to various forms of community-based treatment. In nearly all cases, these changes have been dictated by the need to reduce operation costs, increase treatment coverage and maximise programme impact on affected communities. The latest and most widely used of these community-based strategies is known as **Community Directed Treatment with Ivermectin (CDTI)**, a method in which considerable efforts are made to involve affected communities themselves in the planning, implementation and

monitoring of treatment activities. CDTI is the preferred and official method used throughout Africa by both OCP and APOC.

Table 2 is a summary of current uses of ivermectin in onchocerciasis control based on endemicity levels.

Ivermectin treatment greatly reduces transmission of the parasite, but does not halt it. As the adult worm may live for as long as 14–15 years, annual large scale treatment will, therefore, have to continue for a very long time. Recent predictions with a simulation model have indicated that, at coverage levels of around 65%, annual treatment may have to continue for up to two decades. The main challenge facing ivermectin-based control, therefore, is to develop and implement simple methods of ivermectin delivery which can be sustained by the communities themselves. Thus, the attractiveness of CDTI.

The risk of resistance to ivermectin is remote within the time frame of existing programmes. Though recent model simulations and molecular biological studies have shown that this could become a problem over a twenty-to-thirty year time period, the history of parasite disease control based on chemotherapy would suggest that a cautious approach should be adopted. Such an approach would be one that promotes and supports the development of alternative strategies for the treatment of onchocerciasis, particularly those with a long-lasting impact on the viability (life) or ability to reproduce (fecundity) of the adult female. Ongoing research efforts fall into 4 main categories:

- Alternative uses of mass treatment with ivermectin.
- Search for safe and cost-effective microfilaricides.
- Use of antibiotics in onchocerciasis control.
- Development of an effective vaccine.

Shorter treatment intervals and ivermectin. Two recent studies have looked at the effects on the adult female worm and disease transmission, with different regimens of mass treatment with ivermectin.

One study, using ONCHOSIM, a microsimulation model for onchocerciasis transmission, explored the implications of different treatment intervals, coverage levels and pre-control endemicities for the likelihood of elimination, and concluded that the elimination of onchocerciasis from most endemic foci in Africa appears to be possible. The other study suggested that this was mainly due to the fact that increasing the frequency of ivermectin distribution from annually to every 3 months can decrease fecundity of the adult female worms 2–3 fold, and that this effect is long-lasting. However, it was also quite clear from both studies that the requirements in terms of duration, coverage, and frequency of treatment, as well as the additional financial costs required to carry out these strategies, did not make them a realistic option at the moment.

Macrofilaricides. Research into the development of a macrofilaricidal drug, i.e., one which kills the adult worms, is coordinated through MACROFIL, a WHO based project. Of the many candidate drug compounds

that have been tested and identified so far, moxidectin, a fermentation product from *Streptomyces cyaneogriseus* spp *noncyanogenus*, and chemically related to other avermectins, has shown to be the most promising. Final results of moxidectin trials in animal models were reviewed by WHO in March 2000. These pre-clinical studies have shown it to fulfil many of the criteria for a potential macrofilaricide: easy to use, safe and effective. At present, moxidectin is only available in veterinary formulations, but plans are underway to start clinical trials in humans.

Another recent ONCHOSIM study explored the potentials of a hypothetical macrofilaricidal drug for the elimination of onchocerciasis under different epidemiological conditions, as characterised by previous intervention strategies, vectorial capacity and levels of coverage. This study concluded that macrofilaricides have a substantially higher potential for achieving onchocerciasis elimination than ivermectin. Furthermore, provided high coverage levels are sustained, these drugs, once available, could greatly shorten the duration of current control efforts.

Antibiotics for the treatment of onchocerciasis and other filarial infections. The search for the identification of potential biochemical targets for antifilarial compounds has led to the discovery that *Onchocerca volvulus*, as well as other closely related filarial species (*Wuchereria bancrofti* and *Brugia malayi*), harbour rickettsial endobacteria of the genus *Wolbachia* in symbiotic relationships. Animal experiments have shown that the elimination of these endobacteria causes inhibition of embryogenesis, and with *Onchocerca ochengi* (a cattle form of the parasite), a macrofilaricidal effect. Trials with human onchocerciasis patients using doxycycline have demonstrated a long-term sterilising activity. These effects, if confirmed by subsequent studies, could open the way for the possible use of antibiotics in future control strategies. In the meantime, many operational issues will need to be addressed, namely, the current six weeks course which makes it impractical for mass treatment; the real risks of adverse reactions, and the important exclusion criteria, such as children below eight years old, and pregnant and lactating women, which would further limit large scale use and elimination of the parasite reservoir.

Vaccines against onchocerciasis. Vaccinations aimed at preventing infection (directed toward infective-stage or adult worms), transmission and/or pathology (directed toward skin microfilariae) could provide the

necessary 'final push' to eliminate human infection with *O. volvulus* altogether. Various approaches to identify potential vaccine candidates against onchocerciasis have resulted recently in the cloning of recombinant proteins, which confer protection in vaccinated mice. Despite these interesting developments, research efforts to develop an effective vaccine against onchocerciasis remain poorly funded.

The 'End of the Tunnel' at Last in Sight

The closing down of OCP in December 2002, after 27 years of operation, is the clearest indication yet that the prospects of eliminating onchocerciasis as a public health problem are not only real, but may be achieved in the not too distant a future – provided current distribution activities and their support by the international community are sustained. The time frame may even be further reduced if, with ongoing research efforts, a safe and effective macrofilaricidal drug, or a safe and easy to administer antibiotic are made available, facilitated by the extensive and highly effective distribution network now operating in nearly all endemic areas.

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Ivermectin Treatment for Onchocerciasis

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Pharmacology

Ivermectin is a semisynthetic macrocyclic lactone antibiotic that has proved successful in veterinary medicine, having been used against a wide range of animal parasites in cattle, sheep, horses and dogs. It is also effective against a variety of insects and arthropods.

Ivermectin is fat soluble, but under normal circumstances does not cross the blood-brain barrier. It has a high therapeutic index with a serum half-life of 12 hours. After oral dosing, a small amount is secreted in breast milk of nursing mothers. Its exact action is unknown, although it does have a pharmacological effect similar to the neurotransmitter, gamma amino butyric acid (GABA) and may, therefore, interfere with neural transmission causing paralysis of parasites.

Clinical Trials

The first reports of the use of ivermectin against *Onchocerca volvulus* were published by Aziz and co-workers in 1982.¹ They studied a small number of people in Senegal and found that ivermectin appeared to be a useful microfilaricide.

A further series of studies assessed the efficacy of 3 different dosages of ivermectin and collected information on its safety. These studies showed that, at 12 months, ivermectin produced a marked drop in skin microfilarial counts. About one quarter of patients showed some clinical reaction. However, the reactions were relatively mild and had essentially resolved within a few days in most patients. No serious ocular lesions were precipitated by treatment and the ocular



Ivermectin (Mectizan)

Photo: Pak Sang Lee

status was markedly improved one year after treatment.² Reactions were even less with re-treatment.

These studies confirmed that ivermectin is both safe and effective and induces only a minimal Mazzotti reaction without a significant adverse ocular reaction. The studies suggested that 150µ/kg once every 12 months is the optimal dose of ivermectin in terms of antiparasitic effect and lack of side effects.

Larger studies showed ivermectin was more effective and safer than the existing drug diethylcarbamazine.³

Further studies in Nigeria and Sierra Leone confirm the positive effect of ivermectin on ocular lesions in the anterior segment,^{4,5} and the study in Nigeria reported a positive effect in preventing optic nerve disease.⁴

More recent studies, conducted under the supervision of WHO/TDR have also indicated a positive effect on reducing symptoms due to skin lesions.

Effect of Ivermectin on Adult Worms

Ivermectin does not kill the adult worm. However, an effect is seen on microfilariae in the uterus of female adults. After treatment, there is cessation of microfilarial production with the accumulation of large numbers of degenerate microfilariae in the uterus. From 6 to 12 months, there is a gradual resumption of production of microfilariae. The effect on the female worm is probably responsible for the delayed repopulation of the skin after ivermectin treatment.

Exclusion Criteria

At present, the following exclusion criteria apply to ivermectin distribution. People in any of these groups should not be given ivermectin.

- Children aged less than five years, or who weigh less than 15kg or are less than 95cm tall.
- Patients with central nervous system disorders, especially meningitis or trypanosomiasis.
- Patients with severe concurrent illness.

Adverse Reactions

Treatment of patients with onchocerciasis is associated with a mild reaction in approximately 10–30% of persons when first treated. This occurs within the first 2–3 days in most cases and resolves spontaneously. The common components of this reaction include pruritus, fever, rash, oedema, lymph node swelling and pain, muscle pain and headache. Almost always these symptoms respond rapidly to aspirin and/or antihistamine therapy. More severe adverse reactions occur with a frequency of less than 1 per 100 and are usually only seen with heavy infection. Again, these symptoms relate to the death of microfilariae and settle with aspirin.

In patients with severe loasis, who have been given ivermectin for onchocerciasis, there have been a few reported cases of coma and death. Medical supervision should be available for individuals and communities who have known combined infection with onchocerciasis and loasis.

As of 2002, a total of more than 200 million tablets of Mectizan (ivermectin) had been donated by the Mectizan donation programme since 1987, and an estimated more than 25 million individuals have been receiving annual treatment.

Effect of Community-based Ivermectin Treatment on Transmission of Onchocerciasis

In community-based programmes one attempts to treat everyone who is eligible and this represents 60–80% of

the total population. The result is an immediate dramatic reduction in skin microfilarial loads in treated people, but some repopulation of the skin gradually occurs over 6–12 months after treatment. It is not yet clear whether ivermectin given for many years can permanently interrupt transmission of disease in Africa, however this does seem likely in Latin America.

Ivermectin and other Parasitic Infections

Ivermectin has also been found effective against other filarial infections, especially lymphatic filariasis, many intestinal parasites, lice and scabies. To date there is no evidence to suggest that resistance to ivermectin is likely to develop in *O. volvulus*.

Summary

After large scale use for more than a decade, ivermectin has been shown to be a safe, easily administered, highly effective microfilaricide against onchocerciasis. Once yearly oral administration is sufficient to prevent visual loss in individuals and communities presently affected by the disease.

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☆ ☆ ☆

Table 1: Adverse Reactions (Mazzotti)

| | |
|--|------------------------|
| Mild | |
| Pruritus | Oedema |
| Fever | Lymphadenopathy |
| Rash | Myalgia |
| Headache | Generalised body aches |
| Severe (rare) | |
| Hypotension | |
| Asthma attacks (in known patients) | |
| Bullous skin lesions (after 1–2 weeks) | |

Leprosy and the Eye

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Introduction

Leprosy is a disease which is still endemic in 120 developing countries and also continues to be a significant cause of blindness. At the end of 2000, according to the World Health Organization, 597,000 leprosy patients were registered for treatment.¹ During 2000, 719,000 new patients had been detected worldwide.

Since 1982, with the introduction of fixed duration multiple drug treatment (MDT), the prevalence of leprosy has decreased continuously from an estimated 10–12 million to the present numbers. The reason is that, after completing the course of treatment, patients are 'released from treatment' (RFT) and are no longer counted as leprosy patients, even though they may have leprosy related disabilities. Previously, treatment of leprosy was life long.

WHO had aimed at the elimination of leprosy as a public health problem by the year 2000 (prevalence < 1/10,000) but has recently extended its leprosy elimination campaign until 2005. In 2000, there were still 15 countries in which leprosy is a public health problem (prevalence rate > 1/10,000). India, Brazil and Myanmar are among the countries with most registered patients at present.

About 2 million former leprosy patients, now released from treatment, are disabled; so-called PALs – persons affected by leprosy. Most blindness and long standing eye complications are found in this unfortunate group of patients, who are often not considered the responsibility of the leprosy services, but who are also not welcome in the general health system.

In 1997, the WHO estimated that up to 100,000 persons could be blind as a consequence of leprosy. However, if associated age-related cataract is included, the total number of blind persons with leprosy will be at least twice that number. This includes former leprosy patients, released from treatment.

Most of this blindness is avoidable and could have been prevented by early diagnosis of leprosy, early systemic anti-leprosy treatment, timely treatment of the immune reactions and prompt treatment of the eye complications. In addition, to avoid blindness due to cataract, there is a great need for better access for leprosy patients to the general eye services for cataract surgery.

A leprosy patient especially requires good eyesight. A blind or severely visually impaired leprosy patient



Leprosy. *Mycobacterium leprae*

Photos: Margreet Hogeweg & CIBA Vision

cannot see or feel a wound or ulcers – and cannot take care of these.

General Information on Leprosy

Leprosy is a chronic bacterial disease caused by the organism *Mycobacterium leprae*. Leprosy is transmitted as an airborne infection by untreated patients with multibacillary leprosy, through nasal discharges and sneezing. Most people have a natural immunity against leprosy. With modern anti-leprosy treatment patients are made non-infectious almost immediately. The risk of infection to those who work with leprosy patients is, therefore, very small.

M. leprae is an acid fast bacillus with a strong preference for cooler temperatures. Therefore, bacilli are mainly found in the skin, nose, earlobes and in certain peripheral nerves. Within the eye, the organism is only found in the slightly cooler anterior segment and not in the posterior segment, nor in the optic nerve.

The clinical picture of leprosy is determined by the immune response of the individual. If the immune response is high, the corresponding bacterial count will be low – paucibacillary (PB) leprosy. If the immune response is low, the corresponding bacterial count will be high and multibacillary (MB) leprosy will develop.

Leprosy is divided into three groups:

- Paucibacillary leprosy (PB): single lesion
- Paucibacillary leprosy (PB): 2–5 skin lesions
- Multibacillary leprosy (MB): > 5 skin lesions

Each group has its own clinical picture and its own specific treatment schedule.

Previously, leprosy was clinically divided into 5 groups: PB leprosy was subdivided into tuberculoid (TT) and borderline tuberculoid (BT) leprosy; MB leprosy was subdivided into borderline borderline (BB), borderline lepromatous (BL) and lepromatous (LL) leprosy, as a continuous spectrum. In the past, classification was also based on bacterial counts through skin smears. This is less used at present in order to avoid blood contact and sharps (e.g., needles).

General Treatment of Leprosy

Fixed duration Multiple Drug Treatment (MDT), as introduced by WHO in 1982 and modified in 1997, is the preferred treatment regimen (Table 1):

Patients are thereafter released from control and instructed to present again in case of late reactions, or other complications.

Treatment of leprosy should be integrated into the general health services and/or under supervision of the leprosy services – and is free of charge.

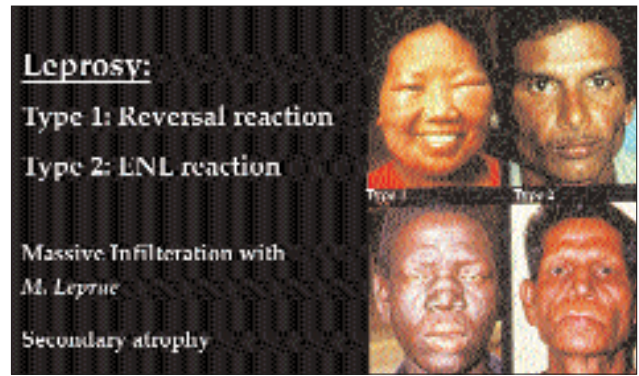
Complications in Leprosy

Two mechanisms are responsible for complications in leprosy:

- (A) Immune reactions.
- (B) Atrophy due to massive bacterial infiltration.

Reactions are sudden immunological phenomena, and are divided into Type I reactions (Reversal Reaction, RR) and Type II reactions (Erythema Nodosum Leprosum, ENL). Reactions occur most commonly early in the disease, either before the diagnosis has been made, or within the first 6–12 months of anti-leprosy treatment. Late reactions are relatively rare.

Type I reactions may occur in PB and MB leprosy, as a result of a sudden increase in cellular immunity. There is sudden redness and swelling in the skin and



Photos: Margreet Hogeweg

painful swellings in certain peripheral nerves. This may cause loss of both sensory and motor nerve function, and may lead to anaesthesia and muscle weakness. For the eye, involvement of the VIIth cranial (facial) nerve and the Vth cranial (trigeminal) nerve may lead to lagophthalmos and corneal hypo-/anaesthesia, respectively.

Type II reactions occur only in MB leprosy and are due to antigen-antibody reactions. Type II reactions are characterised by a sudden, but often recurring syndrome with fever, subcutaneous nodules, swelling of nerves and inflammation of certain organs. Acute iritis, episcleritis and scleritis are manifestations of Type II reaction affecting the eye. Type II reactions have become less frequent due to the suppressive effect of clofazimine (Lamprene) in the MDT drug regimen.

Treatment of Reactions

The treatment of recent type I reaction with nerve involvement (within 6 months after onset) is with systemic steroids, to restore or improve nerve function. The WHO recommended standard course for field use starts with 40 mg prednisolone/day, gradually decreasing over 12 weeks. If Type I reaction with nerve damage is not treated within 6 months after onset, nerve damage becomes permanent.

The treatment of severe Type II reactions requires short courses of systemic steroids (40–80 mg) and clofazimine (300 mg), and – under clinical supervision, and for men only – thalidomide.

Atrophy, due to massive bacterial infiltration, occurs only in patients with MB leprosy of long-standing duration. This results in madarosis of the eyebrows and collapse of the nose and thin earlobes. Iris atrophy, with a pinpoint pupil, is an example of infiltration and secondary atrophy within the eye.

Infiltration and atrophy can only be prevented by early and effective systemic anti-leprosy treatment.

Eye Complications in Leprosy

Eye complications in leprosy are confined to the anterior segment of the eye and to the ocular adnexae.

Table 1: General Treatment of Leprosy*

| | |
|---------------------------------------|--|
| • Patients with a single skin lesion: | • a single dose of rifampicin (600 mg), ofloxacin (400 mg) and minocycline (100 mg) ('ROM') |
| • Paucibacillary leprosy patients: | • daily DDS (100 mg) (dapson), unsupervised, and once/month rifampicin (600mg), supervised, for a minimum of 6 months |
| • Multibacillary patients: | • daily DDS (100 mg) and clofazimine (50 mg) and once / month rifampicin (600 mg) and clofazimine (300 mg), supervised, for a minimum of 12 months |

*Children receive adjusted doses

The four potentially sight threatening lesions (PST lesions) in leprosy are:

- Lagophthalmos and exposure keratitis
- Corneal hypo/anaesthesia
- Acute and chronic iritis
- Cataract (secondary).

Lagophthalmos and acute iritis may occur early in leprosy, even before the patient is diagnosed as having leprosy. In leprosy endemic countries, the diagnosis of leprosy should be considered in the differential diagnosis of patients with Bell's palsy and iritis.

Eye complications are divided into three groups (Table 2) associated with:

- Type I reactions, which occur in PB and MB leprosy
- Type II reactions, which occur in MB leprosy only
- Massive bacillary load and secondary atrophy within or around the eye, which occur only in long standing MB leprosy.

Once the patient has been put on systemic anti-leprosy treatment, the greatest risk for eye complications due to reactions, is during the first 6 – 12 months of treatment. Complications due to high numbers of bacilli and secondary atrophy occur much later.

Most eye complications are found in patients with long-standing MB leprosy, usually elderly patients with a disease history of more than 15 years duration. Such patients tend to cluster in leprosaria, leprosy hospitals and leprosy settlements. Most of these patients have completed their course of MDT therapy and have now been released from control. Since effective MDT was introduced in 1982, over 20 years ago, this group of patients with a long history of disease is gradually passing away.

Table 2: Eye Complications in Leprosy, Related to Classification

| Cause of Complications | Complications | Paucibacillary* | Multibacillary |
|--------------------------------|--------------------------|-----------------|----------------|
| Type I reaction | lagophthalmos | + | + |
| | corneal hypo/anaesthesia | + | + |
| | | | |
| Type II reaction | acute iritis | - | + |
| | scleritis | - | + |
| ? | chronic iritis | - | + |
| Bacilli in high numbers | madarosis of eyebrows | - | + |
| | dermatochalasis | - | + |
| | blocked lacrimal sac | - | + |
| | limbal leproma | - | + |
| | leprosy keratitis | - | + |
| | iris pearls | - | + |
| | neuroparalytic iritis | - | + |
| | iris atrophy | - | + |

* PB leprosy with single skin lesion does not cause eye complications



Lagophthalmos

Photos: Margreet Hogeweg

Most reports have been cross sectional studies from leprosaria, which tend to have much higher prevalence rates of eye complications than in leprosy control programmes. Field studies from Nepal and Uganda have reported potentially sight threatening lesions in 15 – 20% of patients, and blindness in 1–3%. Effective and early instituted MDT treatment is very successful in reducing eye complications.

Eye Complications in Relation to Type I Reaction

Lagophthalmos is the most common eye complication in leprosy and is seen in PB as well as MB leprosy. Even though lagophthalmos does not usually lead to blindness, it is an important cause of ocular morbidity (chronic watering and burning sensation of the eye), which, with the cosmetic appearance as well, may 'stigmatise' a patient as a leprosy patient. Severe lagophthalmos may lead to exposure of the lower part of the cornea, slowly progressive exposure keratitis, visual impairment, and finally loss of vision.

In paucibacillary leprosy, lagophthalmos and corneal anaesthesia are the only complications that may occur. Patients most at risk of developing lagophthalmos are those with reactive red and raised patches of the face, near to the eye. In recent lagophthalmos due to leprosy, such patches are usually still visible. Reactive facial patches around the eye and recent lagophthalmos of less than 6 months duration should be considered a Type I reaction, and given treatment with systemic steroids, in order to prevent nerve damage or restore facial nerve function.

Eyes with lagophthalmos of more than 6 months duration should be treated conservatively by protective measures, such as sunglasses. Artificial tears may not be possible for a life long condition, because of availability and costs. Lid surgery is indicated in case of exposure keratitis, ectropion, or in lagophthalmos with severe corneal hypoaesthesia. In lagophthalmos, with a lid gap in mild closure of 6 mm or more, lid surgery could also be considered. It is sur-

prising, however, how many eyes with lagophthalmos remain in good condition provided corneal sensitivity is intact.

Lateral tarsorrhaphy is widely used because of its simplicity, but gives comparatively poor cosmetic and functional results. The loss of the temporal field of vision with a temporal tarsorrhaphy makes the surgery unpopular with patients. Good cosmetic and mechanical results, may be obtained by horizontal lid shortening (wedge excision), or tarsal strip procedures. This is the method of choice. Plastic surgeons often prefer more complicated temporalis muscle transfer surgery (TMT): cosmetic results can be excellent, but functional results – spontaneous regular blinking – are generally disappointing. TMT surgery requires extensive physiotherapy to learn the unnatural ‘blinking by chewing’ and, therefore, long admissions.

The principles of treatment of lagophthalmos are shown in Table 3.

Corneal hypo/anaesthesia may occur in combination with lagophthalmos. Complete corneal anaesthesia is rare, hypoaesthesia is more common. It may be the result of damage to the 1st and 2nd branches of the trigeminal nerve in Type 1 reaction, or to corneal nerve damage as a result of exposure. Corneal sensation may also be diminished in long-standing multibacillary leprosy, as a result of infiltration and secondary atrophy of the corneal nerves, or as a result of scleritis, with subsequent thinning of the sclera and damage to the ciliary nerves. Treatment is by eye health education and protective spectacles.

Eye Complications in Relation to Type II Reaction

Acute iritis in leprosy has the same clinical picture as iritis due to other causes. It is a well known, but not too

common complication. The treatment is the same as for iritis in general: energetic topical application of atropine sulphate 1%, steroid eye drops and steroid ointment at night. In case of secondary glaucoma, acetazolamide (Diamox) may be given for 2–3 days. Systemic steroids are usually not required unless there is a systemic Type II reaction as well, but in acute iritis, a direct relation to Type II reaction is often not clear. Acute iritis may still recur long after release from treatment.

Acute episcleritis and scleritis have a more obvious relation with Type II reaction. Episcleritis may precede a full Type II reaction and responds well to topical steroids. Severe bilateral scleritis, mostly in combination with anterior uveitis, may be seen in severe, persistent Type II reactions. Fortunately, such severe reactions have become rare. Apart from topical treatment, systemic Type II reaction treatment should be given. Severe scleritis may be unresponsive to treatment, and scleral thinning and staphyloma formation may develop. Hyperacute, often bilateral sclero-uveitis used to be the much feared cause of blindness before effective anti-leprosy treatment became available.

In the differential diagnosis of acute red eye in a leprosy patient, all other common conditions causing an acute red eye, should, of course, be considered.

Chronic or insidious iritis is confusing. There is a low grade ‘iritis’, with a few keratic precipitates and slight haziness (flare) in the anterior chamber. The ‘iritis’ is hardly influenced by therapy. There is little tendency to posterior synechiae formation, but the pupils become progressively smaller and resist dilatation with mydratics. The relationship with Type II is unclear. Chronic iritis may be the result of acute iritis which persists as a low grade inflammation. Alternatively, it might be due to ‘neuroparalytic iritis’ with iris atrophy (see below). Or, it may be a low grade chronic iritis as a separate entity. The final outcome is often a ‘pinpoint’ pupil. The condition is often bilateral. It is important to keep the pupil as active as possible and phenylephrine (2.5% to 5.0%) eye drops may be used. It is typically seen in MB patients with long standing leprosy and was more common in the past.

Eye Signs in Leprosy due to Infiltration and Secondary Atrophy

These lesions occur only in long-standing multibacillary leprosy and have become less common, due to early and effective MDT treatment.

A. Ocular Adnexae

- Madarosis of the eyebrows (loss of eyebrow hair) is a well recognised sign of leprosy. It occurs in multibacillary leprosy after at least 5–10 years of untreated disease. Loss or atrophy of the eyelashes may follow. Occasionally, eyebrow transplants are carried out surgically. Otherwise a brow pencil may help.

Table 3: Prevention and Treatment of Lagophthalmos

| | |
|---|--|
| Reactive facial patch surrounding the eye | <ul style="list-style-type: none"> • prednisolone (40mg/day) decreasing over 12 weeks |
| Lagophthalmos of <6 months duration | <ul style="list-style-type: none"> • prednisolone (40mg/day) decreasing over 12 weeks • blinking exercises • protective spectacles |
| Lagophthalmos of >6 months duration – no exposure keratitis – normal corneal sensation | <ul style="list-style-type: none"> • eye health education • protective spectacles and other protective measures • ‘think & blink’ habit |
| Lagophthalmos of >6 months duration – with exposure keratitis/ectropion/ or corneal anaesthesia | <p>Options:</p> <ul style="list-style-type: none"> • horizontal lid shortening (wedge excision) • tarsal strip procedure • permanent tarsorrhaphy • temporalis muscle transfer (TMT) |

- Dermatochalasis (excessive folds of skin of the upper eyelid) appears after lepromatous infiltration of the eyelid has subsided. This may lead to trichiasis of the upper eyelid and subsequent corneal damage. However, due to accompanying corneal hypoaesthesia, in combination with short and atrophic eyelashes, irritation may be minimal. Treatment is by surgical correction, if necessary.
- A blocked lacrimal sac can occur after leprosy inflammation of the nasal mucosa and nose collapse. This seems to happen more frequently in Asians than in Africans. Treatment is by dacryocystectomy – removal of the tear sac. Dacryocystorhinostomy, surgically creating a new passage for tears into the nose, is not suitable in this situation.

B. The Eye

- Lagophthalmos and corneal hypoaesthesia may develop gradually and bilaterally, as a late result of infiltration and secondary atrophy of the facial and corneal nerves.
- Limbal leproma is a painless, pink or yellowish nodule, usually located on the temporal side of the limbus. They may extend into the cornea. The pupil may be drawn towards the area of the leproma. Limbal lepromas are an important indication of dapsone drug resistance or relapse and occur in patients irregularly treated with dapsone monotherapy – as, for example, in areas with complete disruption of regular health services. They have become rare. Treatment by supervised multiple drug therapy should result in slow resolution. Displacement of the pupil is permanent. (Note: in episcleritis the nodule is acute, red and painful).
- Leprous keratitis (chalky corneal deposits) occurs in the upper outer quadrant of the cornea, usually in both eyes. Their presence is proof of corneal invasion by *M. leprae*. Leprous keratitis is asymptomatic and does not usually influence visual acuity.
- Iris pearls are rare, completely asymptomatic, but pathognomonic for leprosy. They appear as small white granules extruding from the iris stroma, and are formed of leprosy bacilli cast in chalk. They are proof of invasion of the anterior uvea by *M. leprae*. They remain for a period of time on the surface of the iris and then dislodge into the lower angle of the anterior chamber, where they are absorbed or may give rise to anterior synechiae.
- Iris atrophy and pinpoint pupils are typical manifestations of longstanding MB leprosy and result from invasion of the small autonomic nerves by *M. leprae*. The iris crypts flatten, the iris stroma becomes thin and the deep pigmented iris layer may become visible. Finally, full thickness holes may appear. The atrophy is most prominent in the dilator muscle, and as a result the pupil becomes very small ('pinpoint') and cannot be dilated, although there

are no posterior synechiae. The condition is usually bilateral and the patient may become night blind, due to the pinpoint pupils. In the first instance, every attempt should be made to achieve maximum dilatation of the pupils with phenylephrine 2.5–5%, followed by atropine, but this is often unsuccessful in advanced stages. If pupils are pinpoint and vision is poor in both eyes, a broad sector iridectomy may be carried out surgically, with a small radial cut in the iris sphincter at 6 o'clock, to prevent updrawing of the pupil. Due to friable iris tissue, it may be difficult to obtain a good grasp of the iris. This procedure can be combined with cataract extraction, if indicated. Enlarged pupils with a 'moth-eaten' appearance can also occur, due to progressive atrophy of the iris sphincter muscle.

- The ciliary body is probably the port of entry for *M. leprae* into the eye, from where the bacilli spread into the iris and cornea. Presbyopia in MB leprosy is said to occur at a relatively young age, due to atrophy of the ciliary muscle. The intraocular pressure tends to be low in the late stages of MB leprosy, due to atrophy of the ciliary body. However, chronic iritis with peripheral anterior synechiae may block the outflow of aqueous and counteract the low production.

C. Cataract and Glaucoma in Leprosy Patients

Disabled leprosy patients throughout the world often have difficulty in obtaining access to general health services and, thus, the prevalence of eye disease within the leprosy population tends to be high. It is estimated that 50% of blindness in leprosy is due to complications of the leprosy itself and the other 50% is due to conditions primarily unrelated to leprosy.

Age-related cataract is presently the single most important cause of blindness among leprosy patients. Cataract can also be steroid induced, as a result of prolonged treatment with prednisolone for reactions. In MB patients, acute or chronic iritis, iris atrophy and possibly low IOP, may be other risk factors for cataract formation. In age-related cataract, routine lens extraction can be performed, providing the patient is on regular anti-leprosy treatment and has been free of reactions during the previous 6 months, or has been released from treatment. IOLs are implanted with good results in leprosy patients with uncomplicated cataracts. Surgery for complicated cataract, with synechiae and poor dilatation, should be approached with caution. If the intraocular pressure is below 8mm Hg, phthisis bulbi can occur following surgery.

Every effort should be made to avoid infection during surgery. Lagophthalmos, ectropion and blocked sacs should be corrected first. However, a blind leprosy patient cannot protect himself from injuries and infected wounds. Patients with 'clean', granulating wounds on hands or feet should, therefore, be accepted for surgery, otherwise these patients may never qualify for operation.

Glaucoma may develop, secondary to acute iritis and scleritis. These eyes may become staphylomatous. In general, the intraocular pressure tends to be slightly lower than average in patients with long-standing lepromatous leprosy.

Management of Eye Problems in Leprosy

Examination of the eye in leprosy

The following are particularly important in the ocular examination of leprosy.

1. Measure the visual acuity in each eye (especially in those > 50 years).
2. Ask the patient to close his eyes gently (as in sleep), and also force-close his eyes. Look for lagophthalmos, weakness of the orbicularis oculi muscle and corneal exposure.
3. Observe if the patient blinks regularly. If in doubt, test corneal sensation with a wisp of cotton wool.
4. Examine the limbus for redness (ciliary reaction), indicating possibly iritis. (Note: prolonged use of a high dosage of clofazimine (Lamprene) for Type II reaction causes a dark discolouration of the skin and also an asymptomatic red discolouration of the conjunctiva and sclera. This should not be confused with intraocular inflammation).
5. If in doubt, dilate the pupil with a short acting mydriatic to look for synechiae, as evidence of acute or chronic iritis.

Eye health education

1. Patients with lagophthalmos, orbicularis oculi muscle weakness, or corneal anaesthesia should be taught to think and blink – consciously remembering to blink regularly. In the case of lagophthalmos, this can be combined with ‘blinking exercises’ (3x daily, 20x strong blinking), to reinforce the remaining orbicularis muscle fibres. Patients with established lagophthalmos should be checked at least once each year, and in the case of any acute complaints.
2. Any leprosy patient with a red eye or decreasing vision should see an eye specialist or trained medical worker urgently. This also applies after completion of MDT and release from control.
3. Patients on any treatment (systemic or topical) should be advised regarding the importance of their

treatment and the need for regular follow-up examinations.

Lagophthalmos

The management of lagophthalmos is summarised in Table 3.

Iritis/Scleritis

Immediate treatment with atropine and steroid eye drops should be given. In the case of secondary glaucoma, acetazolamide should temporarily be given.

Chronic iritis

Phenylephrine (2.5% to 5.0%) eye drops should be used to attempt dilatation of the pupil, followed by atropine.

Prevention of Blindness in Leprosy (Table 4)

Early MDT treatment of leprosy, proper treatment of reactions and prompt management of eye complications will prevent blindness and severe visual impairment in most patients. Routine cataract extractions can be performed without special precautions, if the patient is under treatment and has not recently experienced any reaction, or has been released from treatment.

Prevention of blindness in leprosy is the responsibility of both leprosy workers and eye care workers. It is highly recommended that prevention of blindness and outreach programmes include annual eye screening and surgery of leprosy patients in settlements and leprosaria, as part of their routine programme. Charity organisations and Service Clubs may be willing to provide extra funding for this.

Recommended Literature and Teaching Materials

Literature

Ocular manifestations in leprosy. Paul Courtright & Susan Lewallen. In: *The Epidemiology of Eye Disease*. Gordon J. Johnson, Darwin Minassian & Robert Weale (Eds.), Chapman & Hall.

Prevention of Blindness in Leprosy. Paul Courtright & Gordon J. Johnson (Eds.), ICEH, London, Free of charge.

Guide to Ocular Leprosy for Health Workers. A Training Manual for Eye Care in Leprosy. Paul Courtright & Susan Lewallen. TALMILEP, The Leprosy Mission, 80 Windmill Road, Brentford TW8 0QH, UK.

Training Health Workers to Recognise, Treat, Refer and Educate Patients about Ocular Leprosy. Paul Courtright & Susan Lewallen. TALMILEP, as above.

Posters

Leprosy – Eye Examination. Poster by Lepra, Fairfax House, Causton Road, Colchester, Essex, CO1 1PU, UK. Free of charge.

Slides/Text Series

‘Leprosy and the Eye’ (24 slides). Community Eye Health Slides /

Table 4: Prevention of Blindness in Leprosy

1. Early & effective anti-leprosy treatment.
2. Prompt treatment of Type I reaction in the face and of severe systemic Type II reactions.
3. Prompt treatment of any eye complication.
4. Clearance of the ‘backlog’ of cataract blind leprosy patients.
5. Close co-operation between leprosy & eye care services.

Text Series, No 9. International Resource Centre, International Centre for Eye Health, Department of Infectious & Tropical Diseases, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK. £15.00 plus postage.

Ocular Leprosy, Africa (24 slides)

Ocular Leprosy, Asia (24 slides)

INFOLEP, Netherlands Leprosy Relief, POB 95005, 1090 HA Amsterdam, Netherlands. Free of charge.

CD ROM

Leprosy. Topics in International Health, The Wellcome Trust. CABI Publishing, CAB International, Wallingford, Oxon, OX 10 8DE, UK. US \$ 195.

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Ocular Problems with HIV Infection and AIDS in Africa

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Introduction

HIV infection in Africa follows a distinct epidemiological pattern.^{1,2} Heterosexual activity is the main mode of transmission, and seropositivity is significantly associated with having multiple sexual partners, a history of sexually transmitted disease, and higher socioeconomic status.³ The sex ratio is 1:1. Two age-specific peaks of HIV seropositivity are present: one in children under five years and another in the age group 15–50 years. In many of the large urban centres of central and south-eastern Africa, seroprevalence among the latter age group is as high as 30%.⁴ The prevalence is lower in rural areas, but slowly rising there as well.

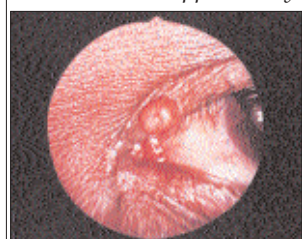
The frequency distribution of the various clinical disorders associated with HIV infection is different in tropical countries compared to industrialised nations. Few studies have tried to make comparisons, but it seems that the rate of progression from asymptomatic HIV infection to AIDS and death is much higher in Africans than in Americans.² The greatest burden of illness in developing countries occurs with patients in early HIV infection, before AIDS actually develops,⁵ while those infected with HIV in industrialised nations often remain relatively healthy until they actually develop clinical AIDS. This difference is probably due to better diagnosis and treatment available in industrialised nations. Most of the drugs used in the treatment of HIV infection and its complications are too expensive for use in developing countries, or are not available. From a public health standpoint it seems wiser to allocate the limited resources to educational campaigns, in order to prevent further spread of the epidemic.



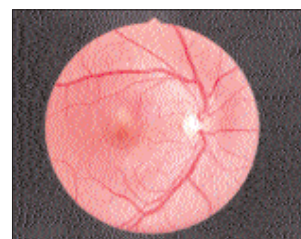
HIV-related retinopathy:
Cotton wool spots
Photo: Philippe Kestelyn



Herpes zoster ophthalmicus
Photo: Philippe Kestelyn



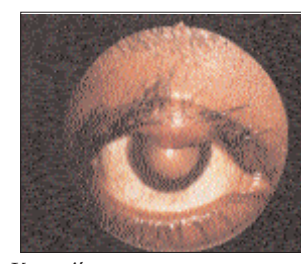
Molluscum contagiosum
Photo: Philippe Kestelyn



TB granuloma of the choroid
Photo: Philippe Kestelyn



Cytomegalovirus retinitis
Photo: Philippe Kestelyn



Kaposi's sarcoma
Photo: Philippe Kestelyn

Ocular Manifestations of HIV Infection

The ocular manifestations of HIV infection can be divided into the following categories:

1. **HIV-related retinopathy.**
2. **Non-opportunistic infections of the eye.**
3. **Opportunistic infections of the eye.**
4. **Tumour involvement.**
5. **Cutaneous hypersensitivity reactions.**
6. **Presence of HIV in the ocular structures.**
7. **Special features in infants and children.**

HIV-related Retinopathy

Cotton wool spots are the most common sign of HIV infection and these are seen in up to 50% of AIDS patients.⁶ These lesions are indistinguishable from those observed in diabetes, hypertension, anaemia, leukaemia, or collagen diseases. They are usually

located at the posterior pole and may disappear spontaneously in the course of a few weeks. There is an association between the presence of cotton wool spots and the degree of immune dysfunction.⁷

Dot haemorrhages, which may come and go, and can be isolated or with cotton wool spots, may be observed in 20–40% of AIDS patients.

Microaneurysms, telangiectasias and focal areas of non-perfusion are detected in most AIDS patients undergoing fluorescein angiography, and are thought to be a final common expression of vaso-occlusion.

Retinal perivasculitis may be observed in the peripheral fundus in the absence of infectious retinitis,⁸ and this may spread towards the posterior pole. The active inflammation is gradually replaced by residual sheathing.

From a practical point of view it is important to know that the above forms of non-infectious retinopathy do not interfere with vision and do not necessitate treatment.

2. Non-opportunistic Infections Associated with HIV Infection

Certain infectious diseases, whose natural history is well known in immunocompetent patients, will take on different characteristics or will occur with greater frequency in the HIV seropositive host.

2.1 Herpes zoster

The correlation between severe herpes zoster in young adults and HIV seropositivity is well established.⁹ Herpes zoster is a marker for HIV infection in Africa,¹⁰ with a high positive predictive value. The disease tends to run a more severe course in HIV positive patients in terms of corneal involvement¹¹ and post-herpetic pain. Severe scarring of the eyelids and the conjunctiva may lead to trichiasis, conjunctival surface disorders, or cicatricial ectropion with corneal exposure. Standard surgical treatment for these complications (trichiasis surgery, conjunctival flaps for corneal ulcers, skin grafts to repair cicatricial ectropion) may alleviate the patient's suffering and eventually save the anatomical integrity of the globe. Intravenous acyclovir (10 mg/kg every 8 hours) or oral acyclovir 800 mg x 5/day, an expensive drug rarely available for African patients, would probably prevent most of the serious complications we have observed.

2.2 Herpes simplex

A small series of AIDS patients with recurrent herpes simplex keratitis was described in the American literature.¹² These dendritic corneal ulcers tended to be peripheral (rather than central), resistant to therapy, and have a high recurrence rate. We have not noted these features in either Rwanda or Malawi.

2.3 Viral diseases of the eyelids

Both molluscum contagiosum¹³ and verrucae of the

eyelids are common cutaneous manifestations of HIV infection in the tropics. The former is very common in young children in Africa, but was rarely seen in adults before the AIDS era. Multiple verrucae around the eyelids is suggestive of HIV infection.

2.4 Syphilitic uveitis

There is speculation that syphilitic disease may progress more rapidly in HIV infected patients.¹⁴ Serological testing for syphilis should be performed on all HIV seropositive patients with ocular inflammation. Ocular manifestations of syphilis described in HIV seropositive patients include uveitis, retinitis and neuroretinitis, papillitis, optic neuritis and retrobulbar neuritis. Treatment is 12–24 million units of aqueous penicillin G IV per day, for 10–14 days.

2.5 Choroidal tuberculosis

There is an alarming rise in the prevalence of tuberculosis (TB) since the advent of the HIV/AIDS epidemic. In Rwanda, examination of 32 HIV positive patients with TB revealed 5 (15.6%), with ocular lesions due to TB, including disseminated choroiditis, phlyctenulosis, and solitary choroidal granulomas. In Malawi, however, one study of 68 HIV positive TB patients revealed only one with ocular disease which was probably TB related.¹⁵ A more recent study there also showed a low prevalence of TB related eye lesions; among 191 AIDS patients, 4 (2%) had choroidal granulomas consistent with TB (3 of these were known to have TB).¹⁶

3. Opportunistic infections

Infectious agents capable of producing intraocular infection in AIDS patients include *Cytomegalovirus*, *Cryptococcus neoformans*, *Pneumocystis carinii*, *Mycobacterium avium intracellulare*, *Toxoplasma gondii*, *Histoplasma capsulatum* and *Candida albicans*.

3.1 Cytomegalovirus

Cytomegalovirus (CMV) infection of the retina is by far the most common opportunistic infection of the eye, and the major cause of visual loss in AIDS patients in Europe and the United States, where it is reported in 26–46% of patients with AIDS. It is associated with profound immunodeficiency (CD4 count < 50/mm³). It is bilateral in 50% of cases and often starts at the posterior pole. The ophthalmological appearance is one of red haemorrhages and yellow necrotic tissue. It is relentlessly progressive and destroys the whole retina within 6 months. Both intravenous ganciclovir (60 mg/kg IV x 3/day for 2–3 weeks, then 5 mg/kg/day) and intravenous foscarnet (5 mg/kg IV x2/day for 2–3 weeks, then 90–120 mg/kg/day) are effective in retarding the progress of the disease but both have severe side effects (bone marrow toxicity and neutropenia with ganciclovir and nephrotoxicity with foscarnet). To be useful, therapy must be maintained for life.

The frequency of CMV retinitis in African AIDS patients seems to be much lower than in Europe or the United States.¹⁵ The shorter life expectancy of AIDS patients in developing countries probably reduces the period of profound immunodeficiency during which patients are most likely to develop *Cytomegalovirus* retinitis.

3.2 *Cryptococcal infection*

Cryptococcus neoformans is the most common life-threatening fungal pathogen and is significantly more common in African patients than in their Western counterparts, probably due to the high prevalence of *Cryptococcus neoformans* in the environment.¹⁷ The combination of low grade papilloedema and headaches in an HIV positive patient, even in the absence of fever and neck stiffness, should alert the ophthalmologist to the possibility of cryptococcal meningitis. In a study of 80 HIV positive patients with cryptococcal infection in Rwanda, papilloedema was observed in 26 (32.5%), visual loss in 7 (9%), sixth cranial nerve palsy in 7 (9%), and optic atrophy in 2 (2.5%). These findings are similar in patients with cryptococcal meningitis who are not infected with HIV. Actual invasion of the intraocular structures with *Cryptococcus neoformans* was an uncommon complication in Rwanda.¹⁸

4. Tumour involvement

Kaposi's sarcoma, B-cell lymphoma, and squamous cell carcinoma are the most common malignancies reported in association with HIV infection.

4.1 *Kaposi's sarcoma*

Kaposi's sarcoma has become a major cause of morbidity and mortality in HIV infected patients. In the United States, about 24% of all patients with AIDS have Kaposi's sarcoma. One study found that 20% of patients with systemic Kaposi's sarcoma have ocular involvement.¹⁹ Kaposi's sarcoma may develop on the eyelids, the conjunctiva, or rarely, within the orbit. On the eyelid it appears as deep purple-red nodules; the conjunctival lesions are bright red and resemble subconjunctival haemorrhages, but slit-lamp examination reveals their true nature. The lower fornix is more often affected than the upper. Radiation therapy is the treatment of choice; indications include cosmetically disturbing lesions and discomfort, or obstruction of vision from large lesions.

4.2 *Lymphoma of the orbit*

Isolated case reports of this tumour in Western patients have been made. Although it occurs in Africa, it is our impression that it is not common.

4.3 *Squamous cell carcinoma of the conjunctiva*

There has been a striking increase in the number of patients with conjunctival neoplasms reported from Rwanda, Malawi, and Uganda. A case-control study in

Rwanda²⁰ demonstrated that HIV infection is a risk factor for the development of squamous cell dysplasia and neoplasia of the conjunctiva. Data available from Rwanda, Malawi, and Uganda indicate that approximately 75–80% of patients with these lesions are HIV positive.^{20,21} Since human papilloma virus (HPV) has been found in some squamous cell lesions in the cervix and conjunctiva, there is speculation that HIV plays a permissive role in allowing the oncogenic potential of HPV to be expressed. However, this is not likely to be the whole answer. Tests for HPV in 3 squamous cell carcinomas removed from the conjunctiva in Malawian patients were negative.²² A larger series from Uganda and Malawi demonstrated HPV in 7/20 (35%) of carcinomas there.²¹ For unknown reasons, conjunctival squamous cell lesions have always been more common in Africa than in Europe and North America. A co-factor such as ultraviolet light may act in concert with some viral infection to lead to carcinoma.

5. Neuro-ophthalmological manifestations

HIV infection may be associated with a large variety of neuro-ophthalmological manifestations, including optic nerve disease (oedema, inflammation or atrophy), retrobulbar neuritis, visual field defects, cortical blindness, pupillary defects and ocular motor nerve palsies. Most of these disorders are due to infectious lesions of the central nervous system. Neurosyphilis, cryptococcal meningitis, and central nervous system toxoplasmosis are the first pathogens to be suspected in such cases. Less frequent causes of neuro-ophthalmological manifestations are intracranial tumours and HIV encephalopathy.

6. Cutaneous hypersensitivity reactions

Stevens-Johnson syndrome is part of a spectrum of skin and generalised disease, due to a hypersensitivity reaction to various drugs or toxins. Sulfa drugs have been strongly implicated. A study in Kenya demonstrated that TB patients infected with HIV have an increased risk of developing hypersensitivity reactions when treated with thiacetazone.²³

The syndrome, which may be fatal in up to 50% of patients, begins with malaise, arthralgia, and fever, followed by a bullous rash including the mucous membranes of mouth, pharynx, and anogenital region. Severe mucopurulent conjunctivitis (often with keratitis) results in raw conjunctival surfaces which stick together, shortening or obliterating the fornices in a matter of days. The mucin producing goblet cells are destroyed and a severe dry eye results. About 75% of the patients admitted with Stevens-Johnson syndrome to the eye ward at the institution in Malawi were HIV positive. Of concern is the fact that many of these patients had taken Fansidar (sulfadoxine-pyrimethamine), the widely available drug – for fever which they assumed to be due to malaria, after which they developed Stevens-Johnson syndrome.

7. HIV in the eye

HIV has been isolated from tears, conjunctiva, cornea, aqueous humor, retinal vascular endothelium, and other ocular tissues.²⁴ Standard guidelines for dealing with infectious body fluids should be observed by ophthalmic workers. In areas where corneal transplantation is performed, it is imperative to rule out HIV infection in the donor.

The risk of HIV infection in an occupational setting seems small for ophthalmic care providers, and until now there are no confirmed cases of HIV seroconversion resulting from contact during eye examination or surgery.

8. Ocular manifestations of HIV infection in children

Literature on the ophthalmic manifestations of AIDS in children is still very limited. Cotton wool spots and CMV retinitis seem to be less common than in adults. Decreased lacrimation is a frequent finding, and is probably due to the same pathological process as the salivary gland enlargement which occurs in children with AIDS. Retinal perivasculitis in the peripheral vessels has been reported in 40% of a series of children with AIDS examined in Rwanda.^{8,25} The aetiology of this is not clear, but the clinical significance of this finding is probably minimal.

Summary

In summary, infection with HIV is associated with a number of ocular manifestations, and the frequency and importance of these varies between African countries and the industrialised nations. At the current time, herpes zoster ophthalmicus and squamous cell carcinoma of the conjunctiva are having the biggest impact on eye services in Africa, while CMV retinitis is most important in industrialised countries. There may be other, as yet unreported ocular manifestations of HIV/AIDS in Africa.

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Herpes Zoster Ophthalmicus in HIV/AIDS

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Herpes zoster is a common infection caused by the human herpes virus 3, the same virus that causes chickenpox. It is a member of herpes viridae, the same family as the herpes simplex virus, Epstein-Barr virus, and cytomegalovirus. Herpes zoster ophthalmicus occurs when a latent varicella zoster virus in the trigeminal ganglia involving the ophthalmic division of the nerve is reactivated. Of the three divisions of the fifth cranial nerve, the ophthalmic is involved 20 times more frequently than the other divisions.

Risk Factors

Risk factors include the following:

- Decreasing immuno-competence
- Increasing age.

Immune suppression may be due to the human immunovirus (HIV) infection, malignancy, systemic lupus erythematosus, and the use of immunosuppressive agents. HIV positive patients have a 15–25 times greater prevalence of zoster compared to the general population.¹ In the immuno-compromised patient, the dermatitis and ocular inflammatory disease are more prolonged and it is more difficult to prevent complications. Herpes zoster ophthalmicus may be the initial clinical manifestation of HIV infection.

The highest rise in prevalence, due to age, is in the fifth decade of life.

Extraocular Manifestations of Herpes Zoster Ophthalmicus

Infection and inflammation secondary to zoster can affect virtually all adnexal, ocular and orbital tissues.

Prodromal Stage

- Flu-like illness with fatigue, malaise, and low grade fever and chills that last up to one week before the rash over the forehead appears
- Pain: usually non-painful actions, like putting on a hat and combing hair may be very painful in about 60% of patients.



HZO showing the demarcation affecting one side of the face (picture on left). HZO causing upper eyelid cicatricial ectropion (upper right). HZO with severe corneal involvement (bottom right)

*Photos: Susan Lewallen
 Philippe Kestelyn (bottom right)*

Rash

- Erythematous macules appear along the involved dermatome
- Over several days these progress into papules and vesicles, and later pustules, which rupture and crust, taking several weeks to heal
- HIV positive patients may have a generalized vesicular rash and become very ill one to two weeks after the onset of the disease, resulting in very severe visual impairment.

Ocular Manifestations of Herpes Zoster Ophthalmicus

The skin manifestations of herpes zoster ophthalmicus strictly 'observes' the midline with involvement of one or more branches of the ophthalmic division of the trigeminal nerve, namely the supraorbital, lacrimal, and nasociliary branches. Because the nasociliary branch innervates the globe, the most serious ocular involvement develops if this branch is affected. Classically, involvement of the tip of the nose (Hutchinson's sign) has been thought to be a clinical predictor of ocular involvement.² It is important to note that patients with a positive Hutchinson's sign have twice the incidence of ocular involvement, but one third of patients without the sign develop ocular manifestations.

Eyelid

The eyelids are commonly involved in herpes zoster ophthalmicus.

- The majority of patients will have vesicular lesions on the eyelids that resolve with minimal scarring
- Patients may develop blepharitis. This can lead to secondary bacterial infection, eyelid scarring, marginal notching, loss of eyelashes, trichiasis and cicatricial entropion. Scarring and occlusion of the lacrimal puncta or canaliculi may occur
- Ptosis, secondary to oedema and inflammation may also occur.

Conjunctiva

Conjunctivitis is one of the most common complications of herpes zoster ophthalmicus. The conjunctiva is often injected and oedematous. This generally lasts for only one week. Secondary infection with *Staphylococcus aureus* may develop thereafter.

Sclera

Episcleritis or scleritis associated with herpes zoster may be either nodular or diffuse and can persist for months.

Cornea

Corneal complications occur in approximately 65% of cases with herpes zoster ophthalmicus.³ This can result in significant visual loss.

Symptoms are pain, photosensitivity and poor vision.

The clinical features of corneal disease in herpes zoster ophthalmicus may be due to:

- Direct viral infection.
- Antigen – antibody reactions.
- Delayed cell-mediated hypersensitivity reactions.
- Neurotrophic damage.

Table 1: Suggested Management Protocol

| Infection | Treatment |
|---|---|
| 'Shingles' | Acyclovir (Zovirax) 800mg orally five times daily for 7 to 10 days |
| Skin | Apply cool compresses |
| Blepharitis/ Conjunctivitis | Topical lubrication. Topical antibiotic |
| Epithelial keratitis | Debridement or none |
| Stromal keratitis | Topical steroids |
| Neurotrophic keratitis | Topical lubrication Topical antibiotics Tissue adhesives and protective contact lenses to prevent perforation |
| Uveitis | Topical steroids Oral steroids Oral acyclovir |
| Scleritis/ Episcleritis | Topical non-steroidal anti-inflammatory agents and/or steroids |
| Acute retinal necrosis/ Progressive outer retinal necrosis | IV acyclovir (1,500 mg per m ² per day divided into three doses) for 7 to 10 days, followed by oral acyclovir (800 mg orally five times daily) for 14 weeks |

Epithelial keratitis: The earliest manifestation of corneal involvement is punctate epithelial keratitis. Multiple, focal swollen lesions stain with fluorescein or rose bengal. These lesions contain live virus and may either resolve or progress into dendrites, presenting as early as one or two days after the initial rash, while dendrites often present after four to six days but can appear many weeks later. The dendrites appear as elevated plaques and consist of swollen epithelial cells. They form branching or 'medusa-like' patterns and have tapered ends in contrast to herpes simplex virus dendrites, which often have terminal bulbs. These dendrites also stain with fluorescein and rose bengal dyes. These epithelial lesions can lead to anterior stromal corneal infiltrates.

Stromal keratitis: This is an immune reaction to viral glycoprotein antigens deposited during the acute attack and possibly during late sub-clinical migration of the virus from the ganglion. Chronic stromal keratitis can lead to vascularization, corneal opacification, keratopathy, corneal thinning and astigmatism.

Uveal Tract

Anterior uveitis occurs frequently with herpes zoster ophthalmicus. The inflammation is generally mild and transient, frequently causing a mild elevation of intraocular pressure. Without timely and appropriate treatment the course of the disease may be prolonged and can lead to glaucoma and cataract.

Retina

The retinitis of herpes zoster ophthalmicus is often associated with anterior uveitis. It presents as necrotizing retinitis with haemorrhages and exudates, posterior vascular occlusions and optic neuritis. These lesions begin from the retinal periphery. The vision deteriorates rapidly as the disease progresses.

Post-herpetic neuralgia (PHN) and post-herpetic itch (PHI)

Pain and itching, late in the disease, are both acute and more common in HZO than in any other form of zoster. PHN is described as constant boring pain, sudden transient sharp pain, or pain elicited by usually non-painful stimuli. The mechanisms of PHN and PHI are not well understood but appear to be related to loss of peripheral sensory neurons.

Complications

1. Corneal neovascularization and scarring resulting in poor vision.
2. Neurotrophic ulcer with perforation.
3. Secondary bacterial or fungal infection.

4. Secondary glaucoma from uveitis or steroid treatment.
5. Necrotizing interstitial keratitis.
6. Post-herpetic neuralgia.
7. Vision loss from optic neuritis or chorioretinitis.

Management of Herpes Zoster Ophthalmicus

Herpes zoster ophthalmicus can be successfully managed by simultaneously combining systemic antivirals and tricyclic antidepressants to inhibit the infectious - inflammatory component and the pain. Antiviral agents may decrease the severity and duration of symptoms, if given early in the course of the illness.

Oral acyclovir therapy for herpes zoster ophthalmicus is found to:

- Reduce viral shedding from vesicular skin lesions
- Decrease systemic dissemination of virus
- Reduce the incidence and severity of the most common ocular complications such as dendritic keratitis, stromal keratitis and uveitis.⁴

Antibiotics should be used if secondary bacterial infection of the vesicles has occurred. Unfortunately, oral acyclovir has little effect on the incidence, severity, or duration of post-herpetic neuralgia.

Steroid eye drops may be helpful for HZO, but they can be disastrous for herpes simplex keratitis (Table 1). If secondary impetigo is present, a suitable anti-staphylococcal antibiotic should be given, and the

patient should be considered for hospital admission because of facial cellulitis. If a patient complains of severe pain at any point at or beyond the appearance of crusted vesicles, assume that post-herpetic neuralgia has developed. It requires aggressive management. Narcotic analgesics may be used. Capsaicin cream may be applied topically to the affected areas six hourly.

Tricyclic antidepressants (e.g., amitriptyline) are often helpful in post-herpetic neuralgia; they should be initiated at low doses and increased as appropriate.

Conclusion

Patients and the general population should be instructed regarding the importance of early presentation and careful compliance in treatment as well as the importance of regular follow-up. One obstacle that confronts eye care workers in the developing world is the cost of the drugs which affects compliance, as the patients are poor.

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Squamous Cell Carcinoma in HIV/AIDS

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Epidemiology

Since the 1980s, the number of patients presenting with squamous cell carcinoma of the conjunctiva has been increasing exponentially.^{1,2} In ophthalmic outpatient clinics in Harare, at least two of every one hundred patients have squamous cell carcinoma. The patients vary in age from eighteen to sixty years with the majority between twenty and forty years. Both males and females are affected. Often, the squamous cell carcinoma of the conjunctiva may be the only manifestation in an otherwise healthy looking adult. A large number of ill-looking patients may also present with the conjunctival carcinoma, in addition to other stigmata of immuno-suppression, such as dryness and increased pigmentation of the skin of the face. Some patients have molluscum contagiosum lesions on the lids and forehead.

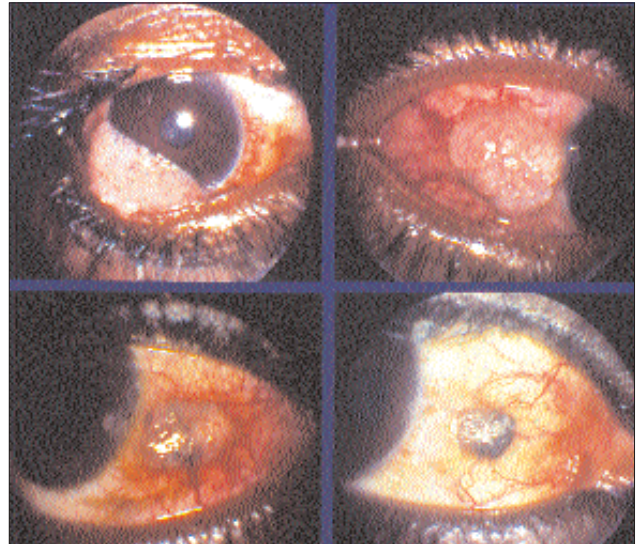
Pathogenesis

The exact cause of squamous cell carcinoma is not known, but the human papilloma virus (HPV) has been implicated. Polymerase chain reaction tests have turned positive in patients with squamous cell carcinoma. It is suggested that the immuno-suppression results in co-infection with the papilloma virus. The immuno-suppression causes reduction in the effectiveness of the immune surveillance system resulting in growth of the tumour.

Clinical Presentation

Symptoms and Signs

The majority of patients complain of a growth in the eye. They may describe a whitish growth which is progressively increasing in size. Often patients experience a foreign body or pricking sensation. In some cases they complain of a red, painful eye. Patients with recurrent squamous cell carcinoma invariably complain of a deep and severe pain around the eye. The pain can be so severe that the patients request enucleation despite good vision. The type of carcinoma seen in our patients is very aggressive.³



Examples of squamous cell carcinoma of the conjunctiva
Photos: Philippe Kestelyn

Examination

On examination, these patients have a growth located on the nasal conjunctiva near the limbus or mid-way between the limbus and the caruncle. Typically, the lesion is gelatinous, greyish white on the surface of what appears to be a pingueculum or pterygium. The growths vary in size from 2–3mm, and cover the nasal one third of the cornea. The bigger lesions appear necrotic. While most of these lesions slough off the cornea, some are embedded to underlying sclera. Recurrent tumours tend to be diffuse. We often see tumours invading 2–3mm into the cornea, from 7 o'clock to 10 o'clock. The lateral conjunctiva can be affected, but this is rare.

Differential Diagnosis

- Pingueculum
- Pterygium
- Foreign body
- Carcinoma in situ
- Kaposi's sarcoma
- Lymphoma.

In the initial stages, the carcinoma can easily be confused with pingueculum or pterygium. Where HIV is prevalent, it is advised to excise completely suspicious lesions, for biopsy. Carcinoma in situ invariably progresses to squamous cell carcinoma of

the conjunctiva. Kaposi's sarcoma tends to be darker and highly vascularised. In our population, these lesions are more likely to be located on the lids, as opposed to the conjunctiva. Lymphoma of the conjunctiva is less common but is typically salmon pink in colour. We perform excision biopsy in all these lesions.

Diagnosis

This is determined by excision biopsy.

Pathology

Histology of these growths typically shows the following features:

- Squamous cell proliferation
- Dyskeratosis
- Acanthosis
- Stromal invasion
- Concentric collection of epithelial and spindle cells.

Management

We strongly recommend excision of any obvious or suspicious lesions after the first visit. Some of these lesions can grow very rapidly. It is important to excise with a margin of at least 2mm of normal looking conjunctiva, as well as remove as much of the base of the tumour as possible. In our experience, most recurrences appear to arise from inadequate removal of the tumour embedded in sclera.

Enucleation is performed routinely in our clinics for recurrent squamous cell carcinoma. This has to be performed on patients who have had several excision biopsies. The bulk of our rural patients are often lost

to follow-up, only to present with recurrent tumour which has extensively spread to the fornices.

For those patients where tumour has spread to the fornices and lids, exenteration is the procedure of choice.

Radiotherapy does not appear to be of any help in the management of these patients. Despite local application of radiotherapy to the tumour bed, post-operatively, we have still experienced recurrences.

Chemotherapy, in the form of mitomycin application to the tumour bed, has been suggested to reduce recurrence. We are awaiting our initial results. (See 'Abstracts' on page 44 – Editor).

Conclusion

In sub-Saharan Africa, squamous cell carcinoma of the conjunctiva has become a highly significant and blinding condition. Recurrences of the tumour following surgery are becoming more frequent. Tumour development in one eye, following enucleation of the fellow eye for recurrent carcinoma, presents an emotionally difficult challenge for both patient and surgeon. We can only hope, in the short term, that increasing availability of anti-retroviral drugs may reduce the incidence of this disease.

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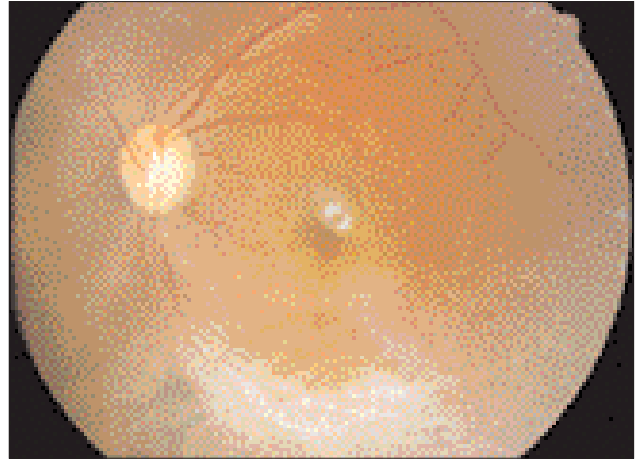
Managing CMV Retinitis in the Developing World

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Introduction

Cytomegalovirus retinitis (CMVR) is a major opportunistic complication of the acquired immune deficiency syndrome (AIDS). In the developed world, prior to the availability of highly active anti-retroviral therapy (HAART), it was estimated that about 30% of patients with AIDS would develop CMVR during their lifetime. However, since the introduction of HAART, the incidence of CMVR has declined significantly in these countries. By far the most valuable intervention in the treatment of CMVR is the treatment of the underlying HIV disease with HAART. HAART is unfortunately not widely available in the developing world and it is here that the AIDS epidemic is continuing to grow. Sub-Saharan Africa leads the world with 25.3 million infected individuals with South-east Asia (5.8 million cases) the next area of concern. In South Africa alone there are an estimated 5 million people living with HIV/AIDS, most of whom are not receiving HAART.

It has been considered that the rate of CMVR is lower in Africa than in the United States, possibly related to the fact that, lacking effective therapy, patients in Africa may not live long enough to develop the very



CMV retinitis

Photo: Linda Visser

low CD4 cell counts (<50/cu.mm) that are associated with the development of CMV disease.^{1,2} Over the last 4 years we have, however, witnessed a steady increase in the number of patients presenting to our clinic with CMVR. This increase may be due partly to better management of tuberculosis and prophylaxis for *Pneumocystis carinii* pneumonia (PCP), which has meant longer survival of patients and lower CD4 cell counts, and partly to a greater awareness of the disease with earlier referral.

In 1996, when the first few cases of CMVR started presenting to our clinics, we were faced with a dilemma. How could we afford to treat this disease when numbers started to increase? The first few patients were treated with systemic ganciclovir (GCV), but the results were poor and the cost very high. The only option was repeated intravitreal injections of GCV as, theoretically, up to 250 patients could be treated with a single vial of GCV. The aim was preservation of vision, and patients understood that they would not be protected against systemic CMV disease or involvement of the other eye at a later stage. We have been treating all our CMVR patients in this manner since then. All their case notes were recently reviewed.

Patients and Methods

All patients presenting to our clinics with CMVR since April 1996 were treated with intravitreal GCV injections. Two patients were given oral GCV for a short period, but returned to intravitreal injections when both showed progression of their disease. The reasons for non-treatment were (a) patient refusal,

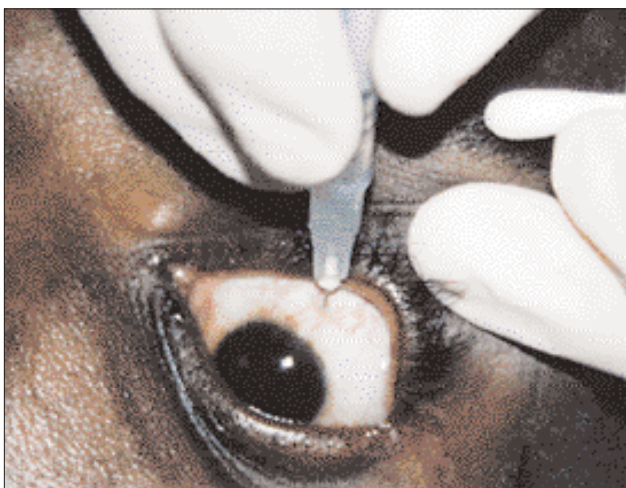


Fig.1: The injection is given 4mm posterior to the limbus

Photo: Linda Visser

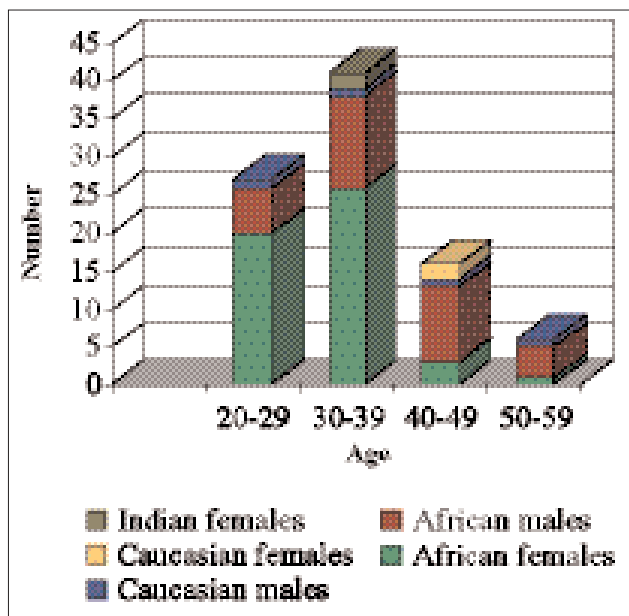


Fig. 2: Patient demographics

(b) no potential for vision and (c) less than 3 clock hours of disease in zone III only (anterior to the equator). This last group was carefully watched and treatment initiated if the disease progressed into zone II, or extended beyond 3 clock hours in zone III, as the risk of retinal detachment significantly increases if more than 25% of the peripheral retina is involved.

The procedure was performed in the outpatient clinic after written, informed consent was obtained. The GCV was reconstituted to a concentration of 25mg/ml using normal saline solution. A drop of local anaesthetic was instilled into the lower fornix, after which the eye was rinsed with a 5% povidone-iodine solution. A cotton-tipped applicator, soaked in local anaesthetic, was then held to the conjunctiva at the site of injection for 1 to 2 minutes. Using an insulin (1ml) syringe with a 30G needle, 2mg (0.08ml) of the GCV solution was injected into the vitreous, 4 mm posterior to the limbus superiorly (Figure 1). For the first 2 to 3 weeks, the patients returned bi-weekly for injections and, thereafter, on a weekly basis. (Further information is given in the 'boxed' appendix at the end of this article).

Results

Between April 1996 and April 2003, 90 patients (123 eyes) were treated. A total of 1566 injections were given – 175 between April 1996 and December 1999 and 1391 between January 2000 and April 2003, clearly illustrating the rapid increase in numbers of patients presenting with CMVR over the last 3 years. All the patients were HIV positive. Only 15 patients were on anti-retroviral therapy at some point during their treatment (16.6%) and 30 patients (33.3%) were on cotrimoxazole prophylaxis for PCP. Tuberculosis was the most common other opportunistic infection in our patients, with 51 patients (56.6%) either concomitantly

or previously infected. Patient demographics are shown in Figure 2.

The highest incidence was seen in African females between the ages of 20 and 39 years. Most patients (75%) had bilateral disease at presentation. Of the 22 patients who presented with unilateral disease, only 2 (9%) developed CMVR in the contralateral eye after treatment had been initiated. To our knowledge, no patient developed systemic CMV disease.

Using only those eyes that had received 6 or more injections, the presenting visual acuity (VA) was compared to the final noted VA. The VA improved in 42 eyes (51%), remained unchanged in a further 12 (15%) and deteriorated in 28 (34%). In those eyes where the VA deteriorated, 23% lost 3 or fewer lines and only 11% lost 4 or more lines.

Progression, which is defined as the movement of disease by 750 microns over a 750 micron front or the development of a new lesion, did not occur when patients attended regularly for their injections. It was, however, seen in 10 patients:

- 4 patients had missed more than 3 consecutive injections due to illness
- 4 patients had been put on fortnightly injections and progressed after an average of 8 weeks
- 2 patients progressed while on oral treatment only.

Complications

1. Five *vitreous haemorrhages*, 3 of which were insignificant, cleared spontaneously within 2 weeks and were likely to have been the direct result of the injection. The other 2 haemorrhages were more severe, but occurred in patients who had retinal new vessels. One diabetic patient, who had new vessels at the disc had to have pan-retinal photocoagulation. The vessels regressed, the haemorrhage cleared spontaneously and did not recur after further injections. The other patient had peripheral new vessels following chorioretinitis/retinal vasculitis of unknown cause (though TB was suspected). As the haemorrhage was dense, the patient had a vitrectomy and sector retinal photocoagulation.
2. There were 6 *cataracts* in 5 patients, 4 of whom were over 45 years of age and were on HAART and thus had chronic uveitis. The other cataract was found in the patient who had had a vitrectomy for vitreous haemorrhage. None were caused by direct injury to the lens during injection.
3. One patient sustained a small *hyphaema* due to an iris root injury when she jerked her head away just as the injection was about to be given – it was her first injection. The hyphaema cleared within a day and she has been much more compliant since then.
4. As mentioned, 4 patients who were on HAART developed *chronic uveitis* – possibly related to immune recovery.
5. There were 3 *retinal detachments* (RDs), but all

occurred within 3 weeks of presentation in patients with more than 50% of the retina involved (high risk for RD). No RDs were seen once the retina started to scar down.

6. Sadly, we had 4 cases of *endophthalmitis*, 3 of which occurred on the same day.

Discussion

CMVR is increasing in South Africa, possibly due to better management of patients and prophylaxis for other opportunistic diseases. HAART, which is becoming available to more people, is by far the most valuable weapon in our fight against CMVR. Systemic anti-CMV drugs are very expensive, have many side effects and are generally not as effective as local therapy. The GCV implant is too expensive and fomivirsen is not readily available. Repeated intravitreal injections of GCV have been shown to be very effective, relatively safe and extremely affordable. The only drawback is that it is time-consuming and labour-intensive. Some would argue that local therapy alone does not offer protection against contralateral eye or systemic involvement. However, our figure of 9% subsequent infection compares well with the GCV-FOS trial done in America prior to HAART, which showed a 17% risk of fellow eye disease in patients on either systemic GCV or foscarnet.³

A retrospective review of 648 cases of CMVR seen at Johns Hopkins University School of Medicine, Baltimore, showed the one year cumulative incidence of loss of 3, 6 and 10 lines of VA in their patients to be 42%, 30% and 23% respectively.⁴ Many of these patients had been on HAART. In our study, 23% of patients lost 3 or fewer lines of VA and only 11% lost more than 3 lines and very few patients were on HAART. HAART did not seem to make a difference to the visual outcome, but what was of great importance to the patients was the fact that, for those on HAART, GCV injections could be discontinued once immunity was re-established.

If HAART became more readily available and a cheaper GCV implant could be produced for the developing world, our problems might be something of the past. However, until such time we will continue to treat our patients in this manner.

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Intravitreal Injection of GCV

1. Method of Preparation and Injection of GCV:

- One vial of ganciclovir (500mg) is reconstituted with 10 ml normal saline to a concentration of 50mg/ml. This is further diluted with normal saline (1:1) to a concentration of 25mg/ml (2mg/0.08ml)
- The injection is given with the patient lying down
- Fornices are rinsed with povidone-iodine solution
- Topical anaesthetic drops are applied
- A cotton-tipped applicator, soaked in topical anaesthetic, is held to the conjunctiva at the injection site for 1–2 minutes
- The injection is given 4mm behind the limbus superiorly with the patient looking down
- A 1ml syringe with a 30G(0.3x13mm) removable needle is used.

2. Price and Storage:

- One vial of ganciclovir (Cymevene, manufactured by Roche) costs between \$20 and \$30. We perform approximately 20 injections with 1 vial (\$1 per injection), but theoretically 250 injections can be done (8c per injection)
- Depending on the concentration of the ganciclovir, it has been reported to remain stable in a normal saline solution for between 12 hours (at 50mg/ml) and 35 days (at 5mg/ml). At 25mg/ml it seems to be stable for at least 72 hours
- The manufacturer recommends that diluted solutions be kept refrigerated at 2–8 degrees Celsius and discarded after 24 hours as sterility cannot be guaranteed. We however discard the vial after 72 hours in order to use only 1 vial per week, as patients receive 2 injections per week during induction of treatment (2 weeks).

3. Exclusion Criteria*

- No recoverable vision
- Less than 3 clock hours of disease in zone III
- No fundal view
- Patients not prepared or able to come for regular injections.

(* External eye disease, e.g., blepharitis is not an exclusion criterium, though this should be treated and the patient carefully watched.)

4. Safeguards and Training:

- The injection is only given by myself or an ophthalmic registrar/medical officer. I do not think that it should be given by someone who does not know the anatomy of the eye well
- I have taught a number of registrars and medical officers how to do the injections. It is fairly simple and anyone who has done any ocular surgery will be able to do it.

Linda Visser

REFRACTIVE ERRORS AND LOW VISION

The Role of Optometry in VISION 2020

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The global initiative, VISION 2020: The Right to Sight, established by the World Health Organization (WHO) and the International Agency for the Prevention of Blindness, has created valuable and effective collaborations of organisations involved in a wide range of eye care and community healthcare activities aimed at the elimination of avoidable blindness and impaired vision.

VISION 2020's major priorities are cataract; trachoma; onchocerciasis; childhood blindness, and refractive error and low vision. These have been selected not only because of the burden of blindness that they represent but, also, because of the feasibility and affordability of interventions to prevent and treat these conditions.

It is only recently that uncorrected refractive error has achieved prominence as a major cause of functional blindness and significantly impaired vision, as a result of landmark population-based studies in adults, children and in post-cataract patients.

Apart from individuals who have taken an active role in the elimination of diseases such as onchocerciasis or have been in cataract teams, optometrists have had little opportunity to take part in the front line elimination of four of the major, preventable blindness-producing conditions targeted



Vision restored!

Photo: Pak Sang Lee

by VISION 2020. The realisation of the impact of uncorrected refractive error has provided the opportunity for optometry to play a major part in alleviating vision loss for those most in need.

The need to mobilise optometry to deal with uncorrected refractive error has been accompanied by the possibility of better integration of optometry into prevention of blindness in general, with some major benefits in areas such as:

- Teaching eye care personnel, especially in refraction and low vision care.
- Providing screening and vision care services at secondary and tertiary levels.
- Detection and management of potentially blinding diseases such as cataract, diabetes and glaucoma.
- Research into the understanding of global eye care needs and solutions, especially in vision correction and vision care service delivery.
- Building economic and logistical models of self-sustainable eye care.

The Impact of Uncorrected Refractive Error

Visually disabling refractive error affects a significant proportion of the global population, occurring in both genders, in all ages and in all ethnic groups.

The most common cause of visual impairment, and the second leading cause of treatable blindness,¹ uncorrected refractive error has severe social and economic effects on individuals and communities, restricting educational and employment opportunities of otherwise healthy people. The duration of the effect is also significant – refractive error can account for twice as many blind-person-years compared to cataract, due to the earlier age of onset.²

The need is very great for both children and adults. Studies have shown that refractive error in children causes up to 62.5% of blindness ($\leq 6/60$ in the better eye) – in Chile,³ 22% in Nepal,⁴ 77% in urban India,⁵ and 75% in China.⁶ For visual impairment in children ($\leq 6/12$ in the better eye), refractive error is responsible for 55% in Chile, 86% in Nepal, 93% in China, 70% in rural India,⁷ and 83% in urban India.⁵ What is also disturbing is the amount of this refractive error that is uncorrected on presentation – 46% in Chile, 92% in Nepal, 58% in China, 86% in rural India. The burden even reaches to developed countries, with uncorrected refractive error causing 25% of all blindness ($<6/60$) in an Australian adult population, and 56% of visual impairment ($<6/12$).⁸

The burden of refractive error is set to grow alarmingly due to an increase in myopia in both the developed and developing world – especially in urbanised East Asians, such as the Chinese populations in Hong Kong, Singapore and Taiwan.^{9–11}

Refractive Error and VISION 2020

The impact and importance of uncorrected refractive error has now been recognised by VISION 2020. WHO established a Refractive Error Working Group (REWG) as part of global VISION 2020 activities, in recognition of this important facet of international eyecare. The REWG is now developing international strategic plans and policies to eliminate uncorrected refractive error.

Optometry's Role in Correcting Refractive Error

The good news is that while refractive error is amongst the most common causes of blindness and visual impairment, it is also the easiest to 'cure'. Refractive error can be simply diagnosed, measured and corrected, and the provision of spectacles is an extremely cost-effective intervention, providing immediate correction of the problem.

Throughout the world, optometry has been the major provider of vision correction, but usually from a private practice setting. Public health optometry has not reached the communities that are in most need, in any organised way. Despite this, on their own initiative, thousands of private optometrists worldwide have



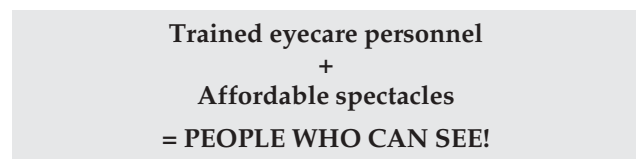
Eye examination by an ICEE optometrist in a remote location in East Timor

Photo: Brien Holden

regularly visited communities in need, to provide vision care and dispense spectacles. The opportunity now is for optometry to develop a concerted effort to create local capacity in these communities through service delivery, in collaboration with its partners in VISION 2020, by creating human resources and by helping to develop the infrastructure needed – the three cornerstones of the VISION 2020 programme.

What is Needed?

The way to eliminate uncorrected refractive error is through the development of all these aspects of a self-sustaining system, including personnel to provide eye care services; and spectacles, to correct vision.



In most developed countries the optometrist to population ratio is approximately 1:10,000. However, in developing countries the ratio is 1:600,000, and much worse in many rural areas – up to millions of people per optometrist. This lack of practitioners is the main reason for high rates of vision problems due to uncorrected refractive error in developing countries. The 'blindness' rate in many developing countries, especially in Africa, is 7 times higher, than in developed countries at 1.4%.

In order to deliver good quality eye care to countries where the need is greatest, there needs to be a steady but substantial increase in the number of eye care personnel trained in refraction and vision correction. The current desperate situation in many countries cannot wait for advanced optometry to develop, but requires optometry to take a major role in training mid-level personnel in refractive care. Whether it is the

world's newest country, East Timor, or Ethiopia with its 70 million people, both without any optometrists, interim measures using nurse-refractionists or ophthalmic or optometric technicians that refract are essential.

Many make the issue of refraction and vision correction too simple. Why not just use subjective trial and error? The main reason is that it does not work. Children accommodate, myopia is overcorrected, and hyperopia is undercorrected. The second reason is that both adults and children will not wear spectacles that hurt their ears, look strange or 'strain their eyes' – even if they are free. It is a waste of time, resources and money to do it the wrong way! Doing it the right way means an accurate refraction (by a refractionist using either a retinoscope or refractometer) and the correct ISO/ANSI standard spectacles that are comfortable and attractive. Affordable spectacles can be provided easily through mass-distribution of 'ready-made' spectacles and the establishment of low-cost local laboratories for 'tailor-made' spectacles.

International optometry and opticianry have important roles to play in this task. Traditionally, these groups have been primarily involved in the private sector, generally looking after wealthier people in the community. But progressive leadership in optometry sees an ever-increasing role in the development of training and continuing education programmes for all levels of available eye care personnel; in the establishment of infrastructure; in the development of effective models and programmes; in the delivery of eye care services to meet community needs, and in the funding needed for the provision of training and low cost spectacles.

Optometry as Part of the Eyecare Team

In the first Planning Meeting of the Informal Group on Refractive Error, the participants endorsed 'the inclusion of the correction of visually disabling refractive error as a component of the Global Initiative for the Elimination of Avoidable Blindness – VISION 2020: The Right to Sight', and 'emphasised the need to deliver refraction services as an integral part of general health care systems and comprehensive eye care'.¹²

The need for glasses is also a public eye health opportunity not to be missed. Refractive care provides excellent access to the population for screening of more serious eye problems, such as cataract and diabetes. Primary care screening by optometrists and eye care workers, with optometrists taking care of the more immediate interventions required, and referral for more 'complicated' care, is 'classical' health care delivery.

One effective current model, developed by the LV Prasad Eye Institute in Hyderabad, India, for the efficient and cost-effective delivery of eye care is a community eye care 'team'. For every 1,000,000 people the team has:



Bifocal spectacles make a difference in Jamaica

Photo: Murray McGavin

- 1 ophthalmologist.
- 4 optometrists.
- 8 eye care workers.
- 8 ophthalmic assistants.
- 16 ophthalmic nurses.

The Role of Research

As the previous statistics show, there is a significant problem to be faced in addressing uncorrected refractive error. But understanding the scope of the problem, and most importantly, planning how to solve it, requires much more information than these simple numbers. Adequate prevalence data are necessary to determine the regions, population groups and age cohorts most in need of intervention, and, also, to provide the basis from which interventions in the future can be evaluated.

As part of the front line of the eye care team, optometry has a role to play in research – as diverse as the aetiology of the epidemic of myopia in East Asia, to collecting the data needed to design effective eye care interventions – both in refractive error and for other eye care needs. Optometry can significantly contribute to the understanding of:

- Worldwide blindness and impaired vision – the burden and its effects.
- Health care planning.
- Service delivery.
- Outcomes of intervention.

Refractive Error Study In Children

A series of studies around the world have begun to fill in the gaps in our knowledge of the burden of blindness and impaired vision in children caused by refractive error. The studies address the variation of refractive error with age, gender, race and geographic region, the extent to which it is being corrected, and how the prevalence is changing over time. The

Refractive Error Studies in Children (RESC) have so far been conducted in Nepal, China, Chile and India, using population-based, cross-sectional sampling, consistent definitions and a common methodology. ICEE is currently conducting the RESC study in KwaZulu Natal, South Africa, in conjunction with the National Eye Institute and WHO, and sponsored by CBM International, Sight Savers International and ICEE. At the completion of the African study, data will have been collected on approximately 30,000 children worldwide.

Self-Sustainability, Refractive Error and Optometry

Two other important contributions that optometry and the optical industry can make to the worldwide fight to eliminate avoidable blindness and impaired vision due to refractive error are:

- Developing the logistics and economics of self-sustaining eye care at the community and institutional levels.
- Mobilising worldwide resources to develop models and create the educational and delivery infrastructure for refractive and general vision care.

First, optometry and opticians need to pass on knowledge of the logistics, supply systems and economic management, that is done so well in private practice, to public health programmes. Thus, spectacle supply can effectively fund more expensive or intensive needs, such as low vision and cataract surgery. An important part of practical and cost-effective eye care systems to communities in need is the understanding that it does not make sense to bring 50% of the population that require refractive services into a hospital setting for refractive care. It makes much more sense to screen, refract and supply spectacles and vision care (including the detection and treatment of minor problems and referral of those with more serious problems) at the community level. Optometry can make a major contribution in supporting eye care at this more convenient and cost-effective level.

Second, the global spectacle industry and optometrists and ophthalmologists who serve the private sector probably generate total revenues of over

\$100 billion. It would be a powerful statement of professional and corporate responsibility if 0.1% of this amount found its way back to help those most in need.

Conclusion

It should not be necessary for any child to struggle in school, to learn with an uncorrected refractive error. Nor should any older person be called upon to spend thirty or forty years without glasses – reading or sewing or managing a job. Optometry and the optical industry, in its broadest sense, should be able to find the financial resources to give this simplest gift of sight.

Preventable blindness is one of our most tragic and wasteful global problems. Optometry is an essential part of the team that will eliminate this tragedy, by understanding global eye care needs and delivering effective and sustainable vision care to people in need, thereby ensuring their fundamental right to sight.

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Strategies for Correcting Uncorrected Refractive Errors: The Challenge of providing Spectacles in the Developing World

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Visually disabling refractive error (RE) affects a significant proportion of the global population, occurring in both genders and all ages and ethnic groups. Yet we are only now beginning to realise the size and impact of this global health problem. RE is one of the most common causes of visual impairment, and the second leading cause of treatable blindness.¹ It has severe social and economic effects on individuals and communities, restricting the educational and employment opportunities of otherwise healthy people. The duration of the effect is also significant, as RE has been found to account for twice as many blind-person-years compared to cataract due to the earlier age of onset.²

The statistics are staggering. Studies have shown that in children, RE causes up to 62.5% of blindness in Chile,³ 22% in Nepal,⁴ 77% in urban India,⁵ and 75% in China.⁶ For visual impairment in children, RE is responsible for 55% in Chile, 86% in Nepal, 93% in



Donated spectacles

Photo: Murray McGavin

China, 70% in rural India,⁷ and 83% in urban India.⁵ The burden even reaches to developed countries, with uncorrected RE causing 25% of all blindness (<3/60) in an Australian adult population.⁸

In an eye with refractive error (or ametropia), parallel rays of light fail to converge to a sharp focus on the retina. For the patient, this means that their vision is blurred. The error is 'correctable' if a sharp focus can be achieved with the aid of vision correction devices, such as spectacles or contact lenses. Yet many people with refractive error are not aware that there is a cure for their compromised vision, have no-one to provide treatment, or cannot afford the appliances they need.

The way to eliminate global uncorrected refractive error is through the development of all aspects of a self-sustaining system, including human resources to provide eye care services, and spectacles to correct vision.

VISION 2020 and the Refractive Error Working Group

VISION 2020: The Right to Sight is a concerted worldwide effort designed to eliminate avoidable

blindness by the year 2020. Established by an alliance of the World Health Organization (WHO), the International Agency for the Prevention of Blindness (IAPB), and the Partnership Committee of the International Non-Governmental Development Organisations, the programme seeks to enable all parties and organisations involved in combating blindness to work in a focused and co-ordinated way.

In February 2000, ICEE made a proposal to the WHO and the IAPB for the establishment of a Refractive Error Working Group (REWG), to be part of the global VISION 2020 activities, in recognition of this important aspect of international eye care. The REWG is now developing international strategic plans and policies to eliminate uncorrected RE. The group is also helping to decide what research is required and in which regions, in order to have adequate data to make an estimate of blindness and impaired vision due to RE.

As the previous statistics show, there is a significant problem to be faced in addressing uncorrected RE. But understanding the scope of the problem, and most importantly planning how to solve it, requires much more information than these simple numbers.

A series of studies around the world aim to provide information on the variation of RE – with age, gender, race and geographic region, the extent to which it is being corrected, and how the prevalence is changing over time. The Refractive Error Studies in Children (RESC) have so far been conducted in Nepal, China, Chile and India. ICEE is currently conducting the RESC study in KwaZulu Natal, South Africa in conjunction with the National Eye Institute and WHO.

The study investigates the prevalence of RE and visual impairment in children 5–15 years old. Approximately 6000 children will be targeted in the study, which will use a mobile eye care team and regional eye clinics to reach communities. At the completion of the African study, data will have been collected on approximately 30,000 children worldwide. This data will be vital to determining the regions, population and age groups most in need of intervention, and will also form the basis from which interventions in the future can be evaluated.



Recording the spectacle lens powers using the focimeter

Photo: Murray McGavin

Low or No Cost Spectacles

A crucial element of the effective delivery of refractive eye care services is the provision of affordable vision correction devices. While there are a number of options for vision correction (e.g., contact lenses, refractive surgery, etc.), spectacles are the simplest and most inexpensive option. However, in many areas of the world, spectacles are either not available, or too expensive. While having adequately trained practitioners is essential to providing refraction and eye care to communities, this care must be supported with the devices needed to restore sight.

The challenge now is to develop ways of supplying good quality spectacles to communities in need. While there are many schemes which involve spectacle supply (for example, collecting used glasses for distribution to developing countries), for any system to be truly effective, it must be sustainable and long term.

The issues in the provision of spectacles are:

- Quality.
- Supply (ready-made or prescription).
- Distribution.
- Cost.
- Acceptance.

1. Quality

The spectacles need to be of the highest possible quality, including lenses which adhere to ISO standards of power, prism, and power variation; frames which are sturdy and with a metal hinge; and a complete pair of spectacles which are lightweight and attractive. Quality of lenses and frames are critical for effective use, especially by children.

In recent studies of spectacle wearers in India, comfort and attractiveness were significant factors in determining wear patterns.

2. Supply

In providing spectacles to patients, there is a choice between ready-made and prescription devices. Ready-mades are convenient for the refractionist and patient, and can be used for spherical distance prescription, and reading glasses – where the spherical power difference is less than 0.50D and the cylindrical power less than 0.75D. However, there are issues of cost, availability, quality, re-supply, and applicability.

Prescription spectacles will be needed for approximately 30% of the patient population depending on the criteria used.

Innovative ways of producing prescription spectacles are being investigated. It is anticipated that with a simple system, there will be minimal need for full laboratory set-up and highly trained technicians to provide custom-made prescription spectacles.

3. Distribution

While spectacles may be readily available in urban areas, the system must ensure that vision correction devices are also available for patients living in rural and remote areas. It is, therefore, necessary to look at every level of distribution:

- National / Provincial.
- Regional.
- District.
- Community.

Ready-mades can be made available at the community level, while prescription lenses would require a dispensing laboratory within the district, and a technician within the community to fit lenses to frames.

Various delivery models have been devised for the delivery of eyecare and vision correction, e.g., the 'Franchise Model', where potential practitioners are selected, training and provided with spectacle sets. The franchise guidelines could include:

- Minimum number of eye examinations to be provided in schools and villages
- Low cost spectacles
- Upgrading of the franchisee's training and involvement.

4. Cost

It is anticipated that the establishment of a self-sustaining system of supply of low cost spectacles will provide funds that can be directed to other programmes, such as education or research. However, funds will be required from existing funding schemes, charities, industry and/or government subsidy – particularly in the early stages of this scheme.

5. Acceptance

In some communities there are cultural issues regarding acceptance of spectacles, while in other communities wearing spectacles are considered attractive. Public education is the key to acceptance.

Conclusion

Avoidable blindness and low vision can restrict



A selection of 'designer frames' in Jamaica

Photo: Murray McGavin

progress in education, particularly literacy; limit motor development in children; affect mobility; limit career opportunities, and restrict access to information. It is a burden on the community and social and income generating services. By correcting uncorrected refractive error, we can dramatically improve the quality of life and access to education for many people.

Available and affordable spectacles are a major part of this aim. The issues of quality, supply, distribution, cost and acceptance all need to be examined. Then, the best possible plans and programmes can be developed, which will deliver vision to communities in need.

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Vision Testing for Refractive Errors in Schools

'Screening' Programmes in Schools

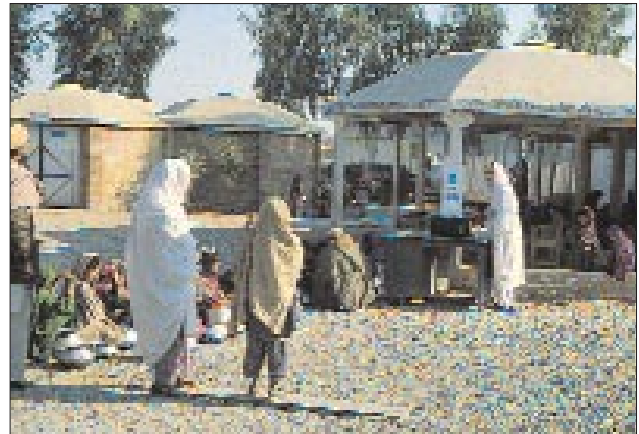
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Uncorrected refractive errors are an important cause of visual impairment in many countries. In developing countries, however, it is often difficult to provide an efficient refraction service for a variety of reasons. The proportion of children who are blind or visually impaired, due to refractive errors, can be used to assess the level of development of eye care services in a country.

Vision testing in children is the process of detecting vision problems, and is undertaken to improve prognosis and reduce disability. The word 'screening' has a very precise meaning in public health¹ and there are clearly defined criteria which should apply before any screening programme is established. (*When considering the detection of refractive errors and other causes of visual impairment in older children, the term 'screening' does not really apply – 'vision testing' is perhaps a better term).

Assessment of Need

There are few data available on the prevalence and types of refractive errors in children in developing countries, but in the USA the prevalence of vision problems is estimated to be 5–10%, while the prevalence of amblyopia is 1–5% in children.² In a study in India, 5.1% of children in schools had a visual acuity of < 6/12 in the better eye.³ In Botswana, a survey of children in schools and in the community showed that 1.5% of children aged 5–15 years had a visual acuity of <6/18 in the better eye due to refractive errors, 78% of whom had a refractive error of less than +/- 2.00D (diopetre sphere) spherical equivalent.⁴ At least 2000 children / million population have refractive errors greater than -1.00D in both eyes. These are the children who should be the focus of attention in any school vision testing programme.



Vision testing of children in Pakistan

Photo: Murray McGavin

Different age groups of children have different problems and needs (Figure 1):

Planning a Vision Testing Programme for Children

There are several questions which need to be addressed and answered when planning a vision testing programme for children. The most important is to decide the aim of the programme. Others include:

- At what age will children be tested?
- Where will vision testing be done?
- What method of visual acuity measurement will be used?

Fig. 1: Age Groups and Specific Needs

| Age group | Specific needs |
|-------------------------------------|---|
| Pre-school age <6 years | <ul style="list-style-type: none"> • Significant refractive errors are uncommon • Undetected and untreated refractive errors, eye disease and strabismus can lead to amblyopia |
| Early school age 6–11 years | <ul style="list-style-type: none"> • Age at which myopia starts to develop • Undetected refractive errors which developed at a younger age are still present • Treatment of amblyopia is probably too late |
| Late school age 12 years & older | <ul style="list-style-type: none"> • Myopia progresses and then stabilises⁵ • Undetected refractive errors which developed at a younger age are still present |

- What level of visual acuity will be used to identify children who need further examination/refraction?
- Who will measure the vision?
- Where will the follow up examinations and refraction be performed?
- Who will do this?
- How will services be provided for children who need them?
- How will the programme be monitored and evaluated? (see Figure 2).

Aim of Vision Testing Programme

Before establishing a vision testing programme, it is important to consider the aim of the programme. If the aim is to detect and treat conditions that may lead to amblyopia (i.e., refractive errors, eye disease causing visual impairment, and strabismus) the programme must focus on pre-school age children. This approach presents considerable challenges, as examining young children and measuring their visual acuity or refractive errors is difficult, particularly in a non-clinical setting. Another difficulty is that in many countries there is no readily identifiable ‘catchment’ population of pre-school age children, which adds logistical difficulties. For all these reasons, formal pre-school screening programmes are not established in many industrialised countries.

If the aim is to detect and treat ‘significant’ uncorrected refractive errors and eye conditions causing visual impairment, older children can be targeted. Again, consideration has to be given to the age at testing – testing only 6–7 year olds in primary school will increase the proportion of children examined (as school attendance rates at this age are high in most countries), but will be too young to detect myopia of puberty. If vision testing is undertaken to detect myopia in 12–14 year olds, those with early



Follow-up of vision testing by refraction

Photo: Murray McGavin

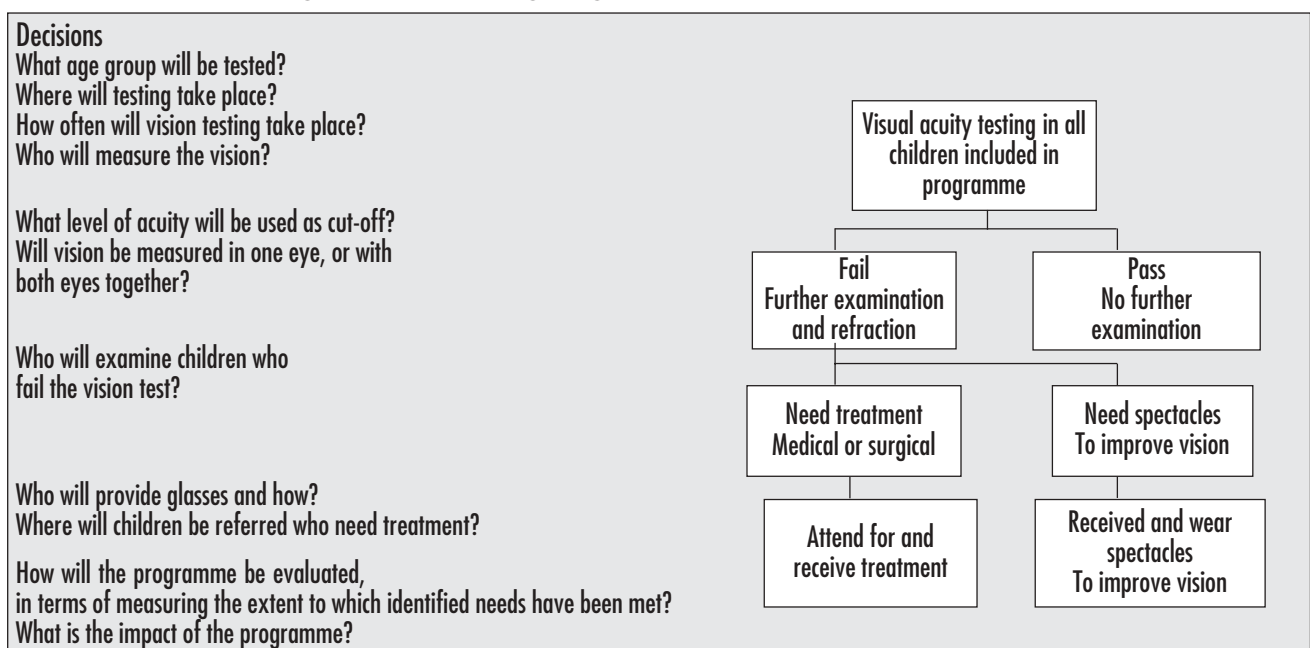
onset refractive errors will have many years of poor vision, and may have dropped out of school for this reason.

The frequency of vision testing needs to be linked to the availability of resources. If conditions are favourable, children should be screened once during the primary school years (6–11 years) and once during early adolescence (12–14 years). This is the ideal for developing countries. However, if resources are limited, it is best to start in early adolescence – because most children would have manifested their myopia by that time, children of this age readily comply with vision testing, and because more are likely to wear spectacles when prescribed.

Testing Vision: How and Who?

The initial test of visual acuity identifies children who are ‘abnormal’ and who need to be refracted and examined in more detail. Decisions need to be made whether to measure vision in each eye separately, or

Fig. 2: Vision Testing Programmes: Decisions and Flow Chart



with both eyes open. The level of acuity that denotes 'failure' also has to be decided. If the level of acuity is too high (i.e., less than 6/9 in one or both eyes), a very high proportion of children will 'fail', many of whom would not need or benefit from glasses. If the level is set too low (i.e., <6/60 in the better eye), only those with severe visual impairment will be detected. In India, a cut off of < 6/9 in either eye is used to define abnormal vision. Children failing this test are referred to an ophthalmic assistant for refraction. In this programme more than 60% of the prescriptions were < 1.00D (dioptre sphere)⁶ and it is not known how many of these children continue to use spectacles in the long term. To increase the cost effectiveness of a school vision testing programme, it is probably wise to use <6/12 in the better eye to determine 'abnormal vision'. The visual cut off level is also dictated by the compliance of populations with spectacle use.

The method of vision testing needs to be valid (Figure 3). In other words, the test should identify those children who will benefit from treatment (i.e., spectacles). The test should not refer too many children who cannot benefit from treatment (false positives), as this will cause anxiety in the families and overload the available services. Also, the test should not miss children who need spectacles (false negatives).

The balance between sensitivity and specificity is important. If a programme uses a visual acuity cut off < 6/6 in either eye, the test would have a very high sensitivity, as all the 'visually impaired' would be identified by the test. However, there would be many false positives, and a large number of normal children would be referred for diagnostic work up.

If < 6/12 in the better eye is used as the cut off for normal vision, the sensitivity would be lower than if <6/6 was the cut off, as some children who may need spectacles would pass the vision test. The positive predictive value would be higher, indicating that most of the children referred would indeed be found to have refractive errors, with some having loss of vision from other causes.

Trained eye workers (i.e., ophthalmic paramedics, opticians or ophthalmologists) should not undertake the initial testing, as it is not a good use of their time. Whoever does the vision testing in schools needs to be trained. In India, school teachers have been identified for this purpose – in other programmes community volunteers have been used successfully. In India, preference is given to female teachers who wear spectacles themselves, as they have heightened awareness of the problems of refractive errors.⁵ After one day's training, the teachers are provided with a vision testing kit.

Vision Testing in Schools

Once the training is complete, the vision testing can start. It is preferable to complete the screening during the period when children do not have any examinations. The procedure for testing should be explained – a big cut-out of an E can be shown to the child, and the directions of the limbs of the E explained. If the child already wears glasses, vision should be recorded with the spectacles. As children can memorise the Snellen chart quickly, a card with 4 E optotypes of the same size is preferable. Children should not stand too close together, as they also tend to 'help' each other!

Good lighting is important and testing can be done outdoors. The vision should be immediately recorded for each child, and a list made of all the children who fail vision testing, to ensure that all those who need further assessment are correctly referred.

Examination and Refraction

All children who 'fail' the initial vision test must be examined and refracted, and the cause of their problem identified. This can either be done by ophthalmic staff who go to the school and set up a temporary dark room, or by referring children to a nearby eye department or optician. Mechanisms for refraction and examination must be set up before

embarking on vision testing, as the programme will fail if children are tested and there is no referral system. Parents should be involved so they can participate in the process.

Service Provision

Services should be provided for all children who need spectacles or eye treatment. Good quality, low cost spectacles should be available for the parents to buy. Many families are happy to purchase a pair of spectacles if they consider it to be important. In India, a contract is drawn up with a local optician who is

Fig 3. Validity of Screening Tests

| | | Need for Spectacles ('Significant' Refractive Error) | |
|------------------------------------|------|---|---|
| | | Present | Absent |
| Result of Vision Testing in School | Fail | A Children who need spectacles correctly identified (true positives) | B Normal children labelled as abnormal by test (false positives) |
| | Pass | C Children who need spectacles but pass the vision tests (false negatives) | D Normal children correctly identified (true negatives) |
| Sensitivity = A / A+C | | Positive predictive value = A / A+B | |
| Specificity = D / B+D | | Negative predictive value = D / C+D | |

willing to provide spectacles at a competitive price. The students do not pay anything to the optician, as the costs are covered by the programme. In some instances arrangements are also made for the optician to deliver spectacles to the schools.

Follow-up of Children

Once a child has been diagnosed, he/she should be re-examined at intervals of 1–2 years by the optometrist / ophthalmologist. This is particularly important for myopic children, as their myopia might progress.

Monitoring, Evaluation and Impact

School vision testing programmes do not end with the provision of spectacles, as it is important to evaluate the benefit of the programme. This can be done by determining the proportion of children screened who needed spectacles, the number prescribed glasses who actually wear them, and the number of children whose vision has been improved as a result of the programme. Evaluating the impact of the programme is more difficult, as this would involve making an assessment of the wider educational, social and economic benefits resulting from improved vision in school children. The impact will be low if only mild refractive errors are corrected.⁷

Vision testing programmes in schools not only help the children but also help communities, as awareness about good vision is increased amongst teachers and parents. Teachers and parents should be taught to look for symptoms and signs which indicate refractive errors. They can observe if children hold books unusually close to their eyes, sit close to the TV, rub

their eyes frequently, or twist or tilt their heads to favour one eye.

Summary

In conclusion, school vision testing programmes are simple to conduct, need minimal resources, greatly benefit children with significant refractive errors, and have an impact on concerned communities by increasing their knowledge of vision disorders and how to manage them. However, they need careful planning and resourcing. More information is required from different populations as to what level of visual acuity should be considered as 'abnormal'. This will result in appropriate identification of children who will wear and benefit from spectacles.

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Case Finding for Refractive Errors: Assessment of Refractive Error and Visual Impairment in Children

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The World Health Organization informal planning meeting, in July 2000, clearly indicated that detailed comparisons of refractive error prevalence across study reports are generally not possible because of different measurement methods and definitions.¹ Further, because most studies are carried out using samples of unknown representativeness, interpretation of the findings in a population-based context has problems.

RESC Studies

An exception to this difficulty is a series of population-based surveys of refractive error and associated visual impairment in school-age children, conducted in five different geographic regions using a common protocol – the Refractive Error Survey in Children (RESC).² These RESC surveys, which began in 1998, were carried out in a rural district in eastern Nepal;³ a rural county outside of Beijing, China;⁴ an urban area of Santiago, Chile;⁵ a rural district near Hyderabad in southern India;⁶ and an urban area of New Delhi in northern India.⁷ A sixth survey is currently being carried out in Durban, South Africa. Others are planned.

In each survey, population-based samples of approximately 5000 children, aged 5 to 15 years, were obtained through cluster sampling. Clusters were defined in rural areas using village boundaries, while in urban areas community blocks or wards were used. The sample size was designed to obtain reasonably accurate prevalence estimates at age- and sex-specific levels.

Clinical Measurements

Enumeration of children within the randomly selected clusters in each study was followed by clinical



Better vision with spectacles for this child in Uganda

Photo: Murray McGavin

examination at one or more sites within the community. The examination included measurement of distance visual acuity using an illuminated LogMAR 'E' chart, near and distant, ocular motility evaluation with a cover/uncover test, cycloplegic dilatation with cyclopentolate, streak retinoscopy, autorefraction with a handheld Retinomax K-Plus, subjective refraction for those with unaided visual impairment, and slit – lamp and direct ophthalmoscope examination of the lens, vitreous, and fundus. A principal cause of visual impairment was recorded by the examining ophthalmologist for each eye with visual acuity of 6/12 or worse.

Comparative Findings

Uncorrected visual acuity < 6/18 in the better eye ranged from 0.46% to 3.25% (Figure 1). With presenting vision – aided vision for those wearing

glasses – the prevalence of visual acuity < 6/18 in the better eye ranged from 0.42% in Nepal to 1.79% in China. With best corrected visual acuity, visual impairment was substantially reduced, ranging from 0.09% in China to 0.28% in rural India. The difference between presenting and uncorrected vision reflects the amount of refractive error that is already corrected, while the difference between presenting and best corrected vision indicates the extent to which uncorrected refractive error remains as a vision disabling problem. The prevalence of visual impairment with best refractive correction represents the degree of

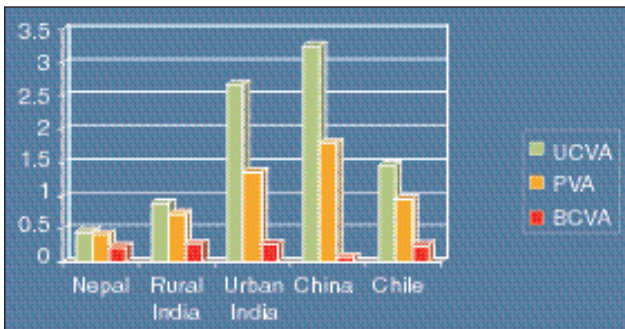


Fig. 1: Percentage prevalence of visual acuity < 6/18 in the better eye.
 UCVA: uncorrected visual acuity
 PVA: presenting visual acuity
 BCVA: best corrected visual acuity

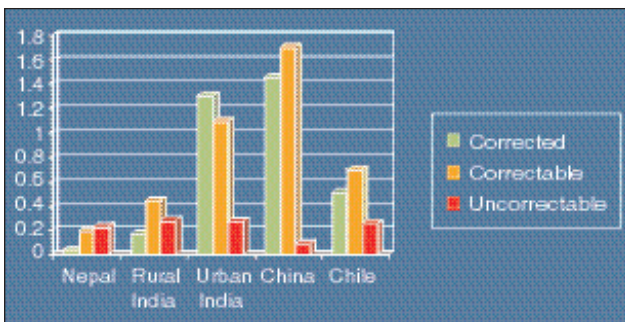


Fig. 2: Percentage prevalence of visual impairment < 6/18 in the better eye. Corrected: already corrected visual impairment. Correctable: uncorrected, but correctable visual impairment. Uncorrectable: uncorrectable visual impairment.

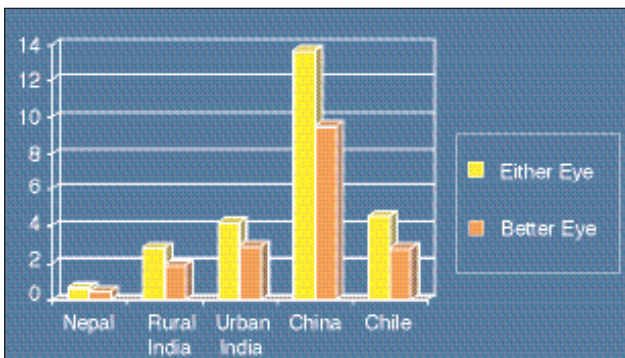


Fig. 3: Percentage prevalence of myopia: > -1.00 spherical equivalent dioptres in either eye (worse eye) and better eye as measured with cycloplegic autorefraction.



Recording visual acuity in Zanzibar

Photo: Murray McGavin

vision loss attributable to causes other than refractive error.

Although some of the refractive error underlying clinically significant visual impairment was found to have been already corrected with spectacles, an essentially equal amount of *correctable* refractive error remained uncorrected (Figure 2). This was the case in all five study areas, which were generally representative of lower and lower middle class populations in each country.

Refractive error in this age group was usually due to myopia with a relatively high prevalence among Chinese children (Figure 3). Although the relationship between uncorrected visual acuity and refractive error was not a precise one, among those with a relatively high prevalence of visual impairment, correspondingly high amounts of refractive error were found, as expected. The prevalence of hyperopia (hypermetropia: + 3.00 spherical equivalent dioptres or more in either eye) was found to be particularly high in Chile, 5.55%, and was accompanied by comparatively high levels of astigmatism as well (data not shown). Further information regarding the age- and sex-specific prevalence of both myopia and hyperopia is available in the original reports.²⁻⁷

Conclusion

These comparative studies illustrate that the prevalence of myopia and hyperopia varies considerably across geographic regions. They also illustrate that visual impairment, which in this age group is almost entirely because of correctable refractive error, will vary in a corresponding fashion. Unfortunately, it appears that approximately half of the visual impairment associated with easily corrected refractive error remains uncorrected – at least among school-age children in lower and lower middle class populations. To the extent that these data represent children across different geographic and ethnic origins, as well as different cultural settings, reduced vision because of uncorrected refractive error is an important public health problem. Cost-effective

strategies are needed to eliminate uncorrected refractive error as a cause of disabling visual impairment, particularly during the formative years of children.

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Case Finding in the Clinic: Refractive Errors

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The detection of refractive errors includes effective screening programmes in the school or community. However, the lack of human and other resources often prevent such programmes from occurring. Therefore, patients with many conditions, both refractive and non-refractive, present at clinics. The separation of these patients into refractive and non-refractive conditions is important in the good organisation of eye care clinics, as members of the eye clinic team can then carry out their different duties more effectively.

General Considerations

Refractive error can be detected through the routine examination of patients who present to clinics, or through vision screening of the population at large.¹ An added component is the screening of patients in the clinic setting and combining this with the eye examination. This process will thus incorporate a case history, visual acuity, pinhole visual acuity, retinoscopy and a subjective examination.

Complaints of frontal headaches, poor concentration in school, inappropriate viewing distances, presence of tropias (eye-turns), tilting of the head (high cylinders), and 'squinting'/peering are indicators of refractive error. The pinhole occluder assists in determining the best visual acuity possible with a refractive correction. History combined with visual acuity tests and visual acuity through the pinhole, should enable the clinician to determine if refractive error is the cause of the patient's problem.²

Retinoscopy is an effective tool in determining the presence of refractive error in adults. Retinoscopy with cycloplegia is the most appropriate method of determining refractive error in children, given the accommodative status of children.³

A subjective refraction should include a binocular balancing technique and a full eye examination to detect other ocular abnormalities.

Detecting Refractive Cases

Patients referred from a screening programme

If the vision screening programme is known to have been established through proper protocols and training of staff, then the patients should be accepted in the clinic on the basis of the preliminary findings and a full refractive examination conducted. However, many screening programmes are incomplete, only using visual acuities and not a pinhole or +2.00D lens to detect latent hyperopia (hypermetropia). Such patients should be managed in a similar way to the self-presenting patients.

Patients not screened/self-presenting

Primary Level

Adults

All patients should be tested using a Snellen acuity test (E Chart) at distance. Those with <6/6 vision should then be further tested with a pinhole test. Should the vision improve to 6/6 then the patient is classified as having a refractive error. Those patients with no improvement to 6/6 with a pinhole, are classified as non-refractive and referred to a secondary level for a full eye examination.

Patients with a Refractive Error

1. Adults over 45 years of age

The Refractive Error Working Group (REWG)¹ recommends that patients with a distance acuity of 6/18 or better (binocularly) should be provided with reading glasses for near. Patients with a visual acuity less than 6/18 should be referred to the secondary level for a refraction.

Patients with specific occupational demands may also need to be referred to the secondary level for a full eye examination.

2. Adults less than 45 years of age

These patients will fall into the early presbyope or pre-presbyope category.

Should there be no occupational demands, patients with 6/18 or better (binocularly) need not be referred for a refraction while those with occupational demands should be referred to the secondary level for a full eye examination. Patients with 6/18 and better but with

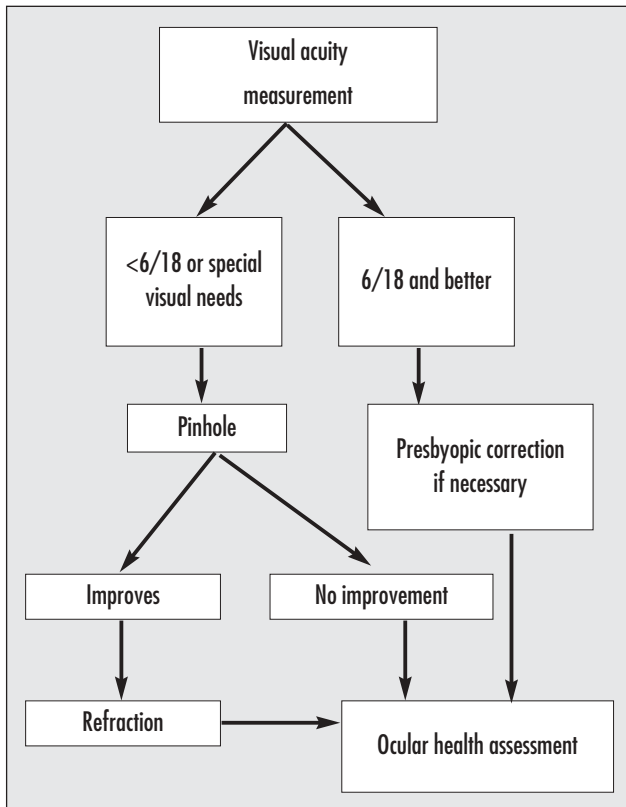


Fig. 1: Screening Adults in an Eye Clinic

near occupational visual demands should be dispensed presbyopic glasses ('readers').

3. Children

The REWG recommends that children be referred for refraction should they have a binocular visual acuity less than 6/12.³ They should be referred to the secondary level for a full eye examination (including a cycloplegic refraction).

Secondary Level

Many patients present directly to the secondary level clinics, a consequence of which is an unnecessary increase in patient numbers.

Ancillary personnel (clinic assistants) should screen patients and determine the appropriate management – prior to seeing the Eye Care Practitioner (ECP) – utilising:

- Snellen acuity (E Chart).
- Pinhole test for those with <6/6.
- History – to determine age and symptoms.
- Visual acuity with a +2.00 D lens for children.

Who is Referred for Refraction?

1. Adults

- All patients failing the Snellen acuity test, improving to 6/6 with the pinhole test but with less than 6/18 binocularly (Figure 1).

- Patients complaining of headaches and with decreased visual acuity that is improved with a pinhole.
- Patients with occupational and special needs experiencing better visual acuity with the pinhole.
- Patients who are presbyopic.

2. Children

- All children failing the Snellen test (<6/12 binocularly) (Figure 2) but improving with the pinhole test.
- Children with better than 6/12 vision but with no blurring of vision with a +2.00D lens.
- Children who present with symptoms consistent with refractive error.
- Children with tropias.

Screening: False Referrals

Given the percentage of false referrals, children referred for ocular disease evaluation should be referred from the ECP for refraction should no ocular disease be detected.

Malingers

Malingering could indicate behavioural and other problems or just a desire to wear spectacles and be like parents or friends.

Children failing the Snellen test and showing no improvement in visual acuity could, in fact, be malingers. Retinoscopy, with cycloplegia, is the best method to determine if a refractive condition exists.

The REWG recommends that children be considered myopic or hyperopic based on the following criteria:³

- Myopia: $\leq -0.50D$
- Hyperopia: $\geq +2.00D$

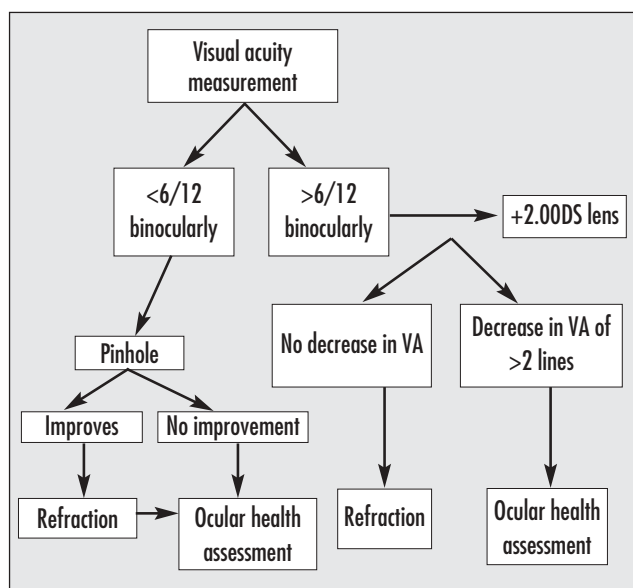


Fig. 2: Screening Children in an Eye Clinic

Tests for malingering may also use the following techniques:

- Put plano lenses into the trial frame and observe any improvement.
- Move the child closer to the chart and then take visual acuity. No improvement indicates malingering.

General Comments

Children with binocular vision of 6/12 or better, with a visual acuity difference between the two eyes of more than two lines on the chart, should be referred for a refraction as amblyopia is a consideration.

If patient numbers are low, the screening protocol could be applied for all patients attending the hospital or clinic, not just the eye clinic patients.

Conclusion

There is great variation in the availability of resources from region to region and country to country. Should the appropriate resources exist then consideration should be given to the 'lowering' of the referral criteria.

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Guidelines for Setting Up a Child Based Low Vision Programme for Children

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Introduction

Blindness and low vision are major causes of morbidity and have profound effects on the quality of life for many people. They bar the mobility and economic well-being of individuals, as well as their families. Childhood blindness (CBL) is one of the challenges faced by the world generally and developing countries in particular. In developed countries, certain mechanisms for normal schooling and socio-economic rehabilitation of visually impaired children exist. However, in developing countries due to scarce resources and traditional taboos, these children are rarely able to attend 'normal' educational institutions. Vision 2020: The Right to Sight, has recognised CBL and low vision and refraction as important strategic themes for the control of avoidable blindness.

Clinical Definition

A person with low vision is one who has impairment of visual function even after treatment and/or standard refractive correction, and has an acuity of less than 6/18 to light perception or a visual field less than ten degrees from the point of fixation, but who uses (or is potentially able to use) vision for the planning and execution of a task.¹

Functional Definition

In 1989, Anne Corn defined low vision as 'a level of vision that, with standard correction, hinders an individual in the planning and/or execution of a task,



Using a stand magnifier for near vision

Photo: Lynne Ager

but which permits enhancement of the functional vision through the use of optical or non-optical devices, environmental modifications and/or techniques'. Natalie Barraga, in 1983, designated children with low vision as those who have limitations in distance, but are able to see objects and materials within a few inches, or at a maximum of a few feet away.

There is now an increasing acceptance of a behavioural function, rather than a medical basis, for low vision. However, children in developing countries are rarely encouraged to develop the use of residual vision and its existence is often ignored by medical and education staff. The challenge for us is to recognise ways to enable partially sighted children to benefit from their residual vision through the provision of appropriate services, materials and devices.

This paper attempts to provide some guidelines on how a child based low vision programme could be set up in a developing country.

Ten Logical Steps to Developing a Child Based Low Vision Programme

Step 1: Establish a Need

The need can be established using direct or anecdotal evidence. This may be in the form of census surveys that give the proportion of children under 15 years, national prevalence of blindness surveys, surveys of

schools for the blind, blind registry's, and regional estimates of prevalence of childhood blindness. The mean global prevalence of childhood blindness/severe visual impairment (BI/SVI) is 0.75/1000 and the prevalence of low vision is about twice that number.² While establishing a need at national level, it is also helpful to determine the magnitude at the provincial and district levels, where appropriate.

Step 2: Situation Analysis of Available Infrastructure, Human Resources and Technology

The next step in the sequence of planning is to conduct a situation analysis of the available infrastructure (eye care services, education institutions, social welfare services, and organisations for the blind). Human resources available for service delivery to the visually impaired at tertiary level (ophthalmologists, optometrists, special education/resource/itinerant teachers and orthoptists), at secondary level (ophthalmic medical assistants, nurses, refractionists, teachers, orientation and mobility instructors) and at primary level (community based rehabilitation workers, community health workers and social workers) and appropriate technology opportunities available, i.e., current level of optical services and its capacity to produce assorted low vision devices. The situation analysis should also identify what current legislation/laws ensure the rights of disabled persons and how they can be utilised effectively.

The situation analysis will identify the most suitable cadres on whom the service can be based (at the tertiary, secondary and primary levels). The review of the infrastructure will determine where the services will be based, to ensure maximum utilisation. An analysis of the technology available will help in determining what can be produced/procured locally and what will be needed from external sources.

Step 3: Gap Analysis of Available Resources

As a precursor to a low vision programme, a concept will have to be developed that outlines what is available and what needs to be achieved over a certain period of time, and the difference between these would be the gap analysis. This could be in the form of training that needs to be imparted to existing cadres to be able to perform a low vision assessment,³ prescribe low vision devices (LVDs) or manufacture low cost LVDs.^{4,5} It may also involve determining means and ways to utilise existing infrastructure, e.g., space in an eye department for a low vision clinic optimally.

Step 4: Develop a Plan for Low Vision with Short, Medium and Long Term

Objectives

The situation analysis and the gap analysis together will form the basis for development of a plan for low vision services for children. Usually, this forms part of a more comprehensive low vision programme. It is useful to define short, medium and long term

objectives. Examples of short term objectives could be training of core cadres in low vision, awareness workshops for eye care professionals, adding on a low vision component on existing training programmes, e.g., paramedics and teachers, and standardising curriculae to incorporate low vision. Medium term objectives may include establishment of low vision clinics, networking of service providers, and development/enhancement of the local capacity to produce LVDs. In the long term, the low vision concept and component should be fully integrated into a national comprehensive eye care programme with an incremental increase in the quality and coverage of service.

Step 5: Identify and Mobilise Resources

Even though the main emphasis on developing a low vision programme remains the optimal and effective utilisation of existing resources, nevertheless, some external support will still be required in the form of training of national focal/resource persons in low vision and setting up of low vision clinics (supply of equipment). The different components of the plan (short, medium and long term) should be costed and funding sought from the government, non-governmental organisations, community based and service organisations and commercial enterprises willing to support programmes for disabled persons.

Step 6: Pilot the Programme in a Defined Setting or Area

As in most new programmes, it is advantageous to first pilot the plan in a defined setting or area to test the concepts proposed and identify deficiencies. The piloting phase could conceivably be done by identifying a district that has a secondary level eye unit, availability of optical services and an educational institution willing to participate in this programme. Access to a tertiary eye department and existence of an on-going community based rehabilitation programme in the area are definite added advantages.

Step 7: Develop Local Expertise for Production of Assessment Materials and LVDs

Simple optical and non-optical low vision devices and assessment materials can be produced in most countries where basic optical services exist. The assessment materials can be developed using a desk top computer with a laser printer. A semi-skilled technician with basic optical knowledge can be trained in a short time to produce low vision devices. Most of the materials involved in the production of low vision devices are usually available locally and may include PVC pipes and optical lenses. The issue of non-availability of optical lenses in higher power and aberrations associated with these lenses can be overcome by combining 2 or 3 low powered lenses to produce a higher power system.

Step 8: Network with Other Service Providers of Visually Impaired

The role of low vision service as a bridge between medical, educational and rehabilitative services has been recognised. The low vision centre in the district can act as a referral point for the child to access other services that may be required, e.g., orientation and mobility training, early intervention, and peer support groups. One way in which this could be brought about is to hold networking meetings between the different service providers and develop a consensus on the modality for detection of the visually impaired child in the community, referral to a low vision clinic for assessment and prescription of LVDs, appropriate placement in school, access to statutory benefits and elimination of blocks to eye care.

Step 9: Replicate the Pilot Model by Integration into the National Vision 2020 Programme

The lessons learned from the piloting phase can then be employed to develop a larger programme within the framework of a national Vision 2020 programme. This will ensure its lateral integration with other eye care related activities, remove the need to set up a vertical programme, and promote its long term sustainability.

Step 10: Maintain the Dynamic Character of the Programme and Increase Coverage

The low vision programme, thus developed as part of a national comprehensive eye care plan should be dynamic in character with an ability to absorb changes in technology, move towards sustainability and have included within it a mechanism for reporting, monitoring and evaluation. The goal should be to increase the coverage of the service and continually improve its quality.

Conclusion

Most specialties in ophthalmology are costly to develop and require specially trained people and sophisticated equipment. Low vision as a specialty is one area that can easily be initiated in any ophthalmic,

educational or optometric set-up with a minimum of investment and training. Most of the devices used for assessment can be produced locally using indigenously available materials and appropriate technology. The use of simple magnifiers can help children pursue education in normal stream schools and improve their quality.

Each country can identify its own relevant existing human resources and train them in a short period of time to provide low vision care in a school, hospital or clinic setting. Standard manuals on production of inexpensive low vision devices can be utilised to make these devices. As experience is gained, and with some input from external sources, a cost effective and sustainable low vision service can be developed. It would be preferable to plan the development of any such service so that it is capable of fitting in the ongoing national health, educational and social welfare programmes. This will not only ensure its sustainability and cost containment but also its early acceptability and implementation.

In developing countries, it is neither practical nor economical to establish separate low vision programmes for adults and children. Often it is more realistic to develop low vision services for both children and adults. Furthermore, where specialised tertiary centres exist (e.g., tertiary teaching eye departments with established specialty clinics, institutes of child health), the possibility of establishing 'Early Intervention' clinics/centres for very young children and infants with severe impairment should be explored.

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Optical Services for Visually Impaired Children

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An estimated 1 in 250 children are visually impaired as a result of eye disease. Some of these children have nearly normal vision, some are totally blind, but the majority fall into a broad range between these two points. Children are said to have 'low vision' or 'partial sight' when they have: (a) a corrected visual acuity in the better eye of $<6/18$ to 'perception of light' (or a visual field of less than 10 degrees); and (b) the ability to use their residual vision to orientate themselves or to perform tasks.¹ They are identified at eye clinics, school screening programmes, community based rehabilitation (CBR) programmes, or special schools for the visually impaired.

The education, employment prospects, independence and quality of life of a child with low vision can all be improved by enhancing vision. Optical devices



Accurate refraction and spectacle correction help many children with low vision

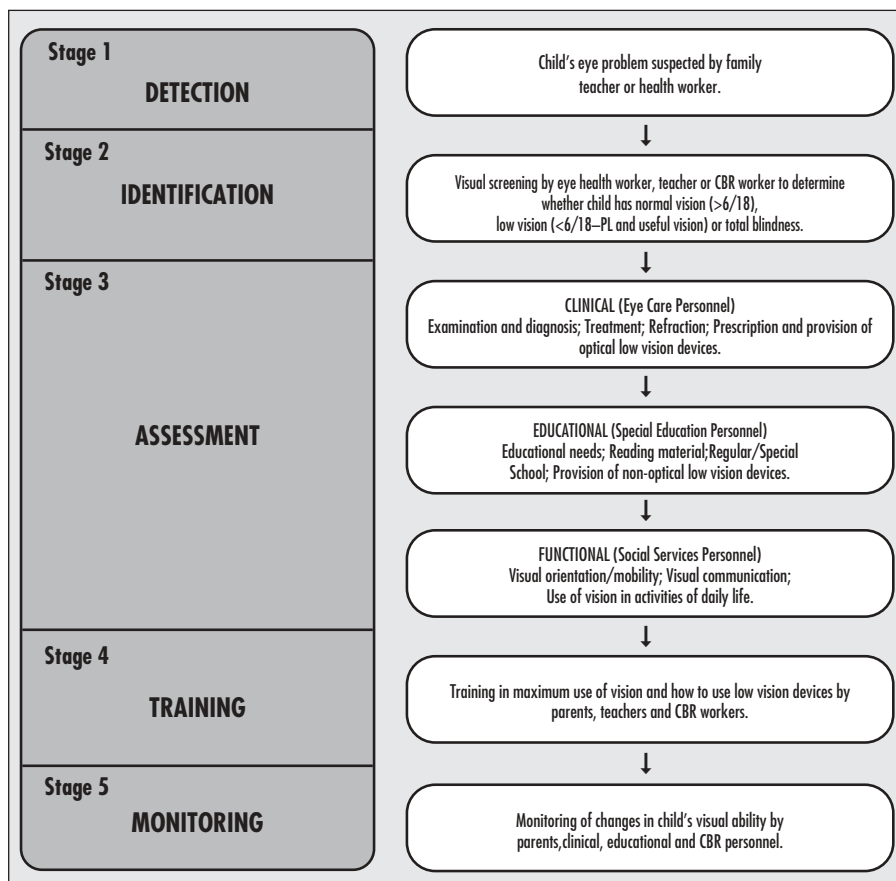
Photo: Murray McGavin

(spectacles, magnifiers and telescopes) play a key role in achieving this. Studies carried out in East Africa,² South America³ and West Africa⁴ indicate that approximately half of children who have low vision show an improvement in distance and/or near visual acuity, with the help of spectacles, a magnifier or both. The majority of magnifiers are prescribed for children who have a visual acuity in the better eye of $<6/60$ to $1/60$.^{3,4}

The Role of Optical Services in the Management of Children with Low Vision

The management of children with low vision requires co-operation between the child, his/her family and eye care educational and social personnel. There are five stages in the management of children with low vision (Figure 1). Eye care personnel are primarily involved in the assessment and monitoring stages, which include: a) visual acuity measurement (distance and near); b) eye examination, diagnosis and prognosis; c) surgical and/or medical treatment and, d) the provision of optical services.

Fig.1: Stages in the Management of Children with Low Vision



Sight is a key source of stimulus during a child's development, and so children with low vision should be motivated to make the maximum use of their residual vision. This can be done using both non-optical and optical methods.

Enhancing Vision using Non-optical Methods

- Move CLOSER, e.g., use an angled reading desk
- Use COLOUR to show objects more clearly
- Use CONTRAST, e.g., eat white rice off a coloured plate
- Pay attention to LIGHTING, e.g., sit near a window in class
- Make objects LARGER, e.g., write with larger letters
- Use a LINE-GUIDE, such as a ruler, when reading and writing.

Enhancing Vision using Optical Devices

Optical devices play a key role in enhancing vision and reducing visual disability in children with low vision. They include: standard prescription spectacles; optical low vision devices for distance vision; and optical low vision devices for near vision.

(a) *Standard prescription spectacles:* It is important to ensure that children with low vision are refracted and provided with any spectacles they require. Work in West Africa indicates that at least 30% of children with low vision need spectacles.⁴ Refraction should always be carried out before a magnification assessment.

(b) *Optical low vision devices for distance vision:* Distance vision magnification requires a telescopic lens system. Telescopes are expensive and have limited applications. It is often more practical for a child to sit near the front of class to see the backboard than to use a telescope.

(c) *Optical low vision devices for near vision:* An optical low vision device for near vision uses one or more lenses placed between the eye and an object, to alter the retinal image size of the object. This makes the object larger and easier to see. The minimum dioptric power of a device used in this way is +4.00D. These devices are inexpensive and have a wide range of applications. They play a vital role in giving children with low vision access to print and illustrations in standard textbooks.

Prescribing Magnifiers for Near Vision

The *power* of magnifier prescribed for a child is determined by the child's visual requirements, recorded near visual acuity and measured working distance. They are prescribed, starting with low power magnifiers and then progressing to higher powers. The higher the power, the smaller the area of visual field seen through the magnifier. More words in a sentence can be viewed through a +10D magnifier than through a +20D magnifier. The power of the magnifier



Aphakic spectacle corrections after congenital cataract surgery for two Romanian children

Photo: Clare Gilbert

prescribed should be the maximum power which enables the child to perform the task required, but not above requirements, so that maximum visual field is maintained. Moving the eye closer to the lens of a hand-held or stand magnifier also increases the field of view. In West Africa, 71% of magnifiers prescribed were low power magnifiers (under +25D).⁴ These were prescribed more frequently for those with a visual acuity of 3/60 or better. High power magnifiers (over +25D) were prescribed in 29% of cases, and were mainly prescribed for those with a visual acuity of less than 3/60.

To determine the appropriate *type* of magnifier, it is important to assess the child's personality, co-ordination, motivation and task aims. The same magnification can be provided using different mounting systems and working distances. Optical devices for near vision include: hand-held magnifiers (illuminated or non-illuminated); stand magnifiers (illuminated or non-illuminated); spectacle mounted magnifiers (e.g., high plus spectacle lenses, hyperocular lenses); and spectacle mounted telescopic units. The most widely available optical low vision devices for near vision are non-illuminated hand-held magnifiers, non-illuminated stand magnifiers, and high plus spectacle lenses. Advantages and disadvantages of these three types of magnifier are indicated in Table 1.

There are many benefits in providing magnifiers to children with low vision. The magnifiers encourage children to use their low vision to the full, thereby increasing visual stimulus and helping the children's development. The magnifiers promote literacy by increasing access to printed material for educational purposes and private reading. It is also more cost effective to provide children with optical devices enabling them to use standard books, than to provide large print books which are expensive and heavy to carry.

There are some limitations in providing magnifiers. Using a magnifier may make a child's visual disability more noticeable, causing the child to feel different from other children. The human and financial resources available to provide the magnifiers may be limited. The child needs to be taught carefully how to use the magnifier, as the restricted field of view can

Table 1: Practical Differences Between Magnifiers

| | Hand-Held Magnifiers | Stand Magnifiers | High Plus Spectacle Lenses |
|----------------------|---|---|--|
| Uses | <ul style="list-style-type: none"> • reading • looking at pictures • writing • identifying money • inspecting small objects | <ul style="list-style-type: none"> • reading • looking at pictures | <ul style="list-style-type: none"> • reading • writing • looking at pictures • close range |
| Advantages | <ul style="list-style-type: none"> • easy to carry around • available from low to medium power • inexpensive to make • can be used at any position or angle | <ul style="list-style-type: none"> • has a fixed, stable working distance • easy to use • available in low, medium, or high power | <ul style="list-style-type: none"> • range of magnification • both hands free • readily available |
| Disadvantages | <ul style="list-style-type: none"> • difficult to keep appropriate distance • one hand occupied • difficult to hold steady | <ul style="list-style-type: none"> • one hand occupied • not useful for writing • bulky to carry around • need flat working surface | <ul style="list-style-type: none"> • exact reading distance important • heavy to wear |

prevent a child from perceiving the overall pattern of words, or sentences, on a page.

Supply of Magnifiers

Low power magnifiers can be made easily, using locally available materials. An optical workshop in Nairobi, Kenya developed a design using mounts made from plastic drain-pipe tubing. These are now used world-wide, as they are inexpensive (approx. \$6 each) and robust. Hand-held and stand magnifiers can be made in a range of powers, from +8D to +28D. Instructions for making these are available from Christoffel Blindenmission, Nibelungenstrasse 124, D-64625 Bensheim, Germany. Higher power magnifiers can be imported from Combined Optical Industries Limited (COIL), UK or Eschenbach, Germany. These are made from lightweight, plastic aspheric lenses, and cost between \$6 (low power hand-held magnifier) and \$34 (high power stand magnifier). They range in power from +8D to +76D.

Case Studies

In West Africa, 291 students with low vision were identified at eye clinics, special schools for the visually impaired, integration programmes and CBR programmes during 1995/6. All received an initial visual assessment, including distance and near visual acuity measurement, refraction, magnification assessment and a quantitative measure of their level of functional vision. The functional vision tests included orientation, activities of daily life, ability to recognise pictures and reading speed. A follow-up assessment was received by 139 students. At first assessment, 44%

(128/291) of the students showed an increase in distance or near visual acuity with an optical device. Potential to read normal print (N10 or better), with or without the help of spectacles and/or a magnifier, was shown by 55% (159/291) of students. Those who benefited were provided with optical devices, and all the children with low vision received non-optical low vision devices and educational support. At follow-up assessment six months later, 63% (88/139) of students with low vision showed a further improvement in their distance visual acuity, near visual acuity and/or their functional vision. In special schools for the visually impaired in Ghana, 46% of students with low vision showed an improvement in reading and/or writing at their follow-up assessment.

These figures indicate that correctly prescribed optical devices can be of significant benefit to the child with low vision and, therefore, the provision of optical services should be an integral part of any low vision service.

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HUMAN RESOURCE DEVELOPMENT

• HEALTH EDUCATION

Human Resource Development VISION 2020: The Right to Sight

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The major goal of VISION 2020: The Right to Sight is to make high quality eye care services available, accessible and affordable to all, through a sustainable delivery system. One of the key pre-requisites is the development of adequate, appropriate human resources. An analysis of current practices reveals problems related to number, quality of training, distribution and utilisation of various categories of eye care personnel. Fundamentally, most eye care delivery services in developing countries lack appropriate human resource planning.

Human resources are required for primary, secondary and tertiary levels of eye care, to provide the medical/technical, management/administrative and community eye health services. This is best carried out by an 'eye care team'. Some of the services can best be achieved by integrating them into general health care systems in various communities.

For effective eye care delivery to under-served populations, we have evolved a comprehensive model, initially covering a population of 500,000. Table 1 illustrates the human resource structure for these centres and the benefits of the team approach.

The team has one ophthalmologist supported by optometrists, ophthalmic technicians and ophthalmic nurses, biomedical and maintenance technicians, a management group and a support services group.

All the training is provided at the L V Prasad Eye Institute (LVPEI), or by its staff at the centre concerned. After training, close monitoring of performance is maintained for two years by LVPEI. This model typically provides outpatient services to 12,000 to 15,000 outpatients, and 1500 to 1700 intraocular surgical procedures, with about 60% absolutely free of cost. It further provides complete door-to-door screening of about 300,000 of the population, with 90%



Teaching and educational materials are vital for human resource development

Photo: Murray McGavin

to 100% community-based rehabilitation of the incurably blind, and better than 100% cost recovery by the third year. This output can be doubled by a subsequent 30% increase in staff over three years. This model demands the following:

- Close linkage with a training / tertiary care centre.
- Linkage with the local community.
- Good infrastructure.
- High quality training of all personnel.
- Prompt and high quality service.

All members of the staff, with the likely exception of the ophthalmologist, should be selected from the local community.

The demand for different categories of personnel varies across regions. Unfortunately, there is a tremendous shortage of all eye care professionals globally, the problem being most acute for categories other than ophthalmologists. Most countries either have very poor or no infrastructure for such training, leading to a disproportionate number of ophthalmologists. In such circumstances, ophthalmologists perform tasks that do not require their level of training.

In general, the following factors need attention for

Table 1: Human Resource Structure and Activities of a Model Team

| Category | Number | Functions | Qualifications |
|-------------------------------|--------|--|---|
| Ophthalmologist | 1 | Medical & surgical care | Residency +comprehensive ophthalmology fellowship |
| Optometrists | 2 | Initial evaluation, refraction, tonometry, A-scan, visual fields, etc. and patient instruction | 2–4 years training (post-class 12) |
| Ophthalmic Technicians | 2–3 | Community screening, CBR & linkage with primary health care | 1–2 years training (post-class 12) |
| Ophthalmic Nurses | 6 | Operating rooms and inpatient wards | 1 year training (post-class 10) |
| Management Group:* | | | |
| • Administrator | 1 | Overall administration | 1 year training (post-college degree) |
| • Accounts/Stores | 1 | Accounts and inventory management | 1 year training (post-class 12) |
| • Medical Records | 1 | Maintenance of medical records | 1 year training (post-class 12) |
| • Patient Counsellors | 3 | Outpatient registration, inpatient and surgical counselling | 1 year training (post-class 12) |
| Maintenance Technician | 1 | Repair and maintenance of equipment and building | 1 year training (post-class 10; basic technical training) |
| Support services: * | 8–10 | All support services as identified | 1 month training or as required |
| • Patient Support | | | |
| • Housekeeping | | | |
| • Security | | | |
| • Transport | | | |

* In the initial states of a hospital development, the above members of management and support services groups can be smaller

human resource development for eye care in most developing countries.

Development of a uniform 'basic minimum' curriculum for residency training of ophthalmologists.

1. A larger number of training programmes, to enhance the skills of already qualified professionals. This will go a long way in improving the quality of care. India is an example.
2. Design of an appropriate matrix of human resource requirements for the different systems of eye care delivery.
3. Pilot projects should be carried out to find a solution to the problems of under-utilisation and unequal distribution of ophthalmologists.
4. Improve or develop infrastructure of acceptable standards. Develop guidelines to ensure basic minimal standards.
5. Increase the availability and accessibility of educational materials. Many excellent resources are available, such as those of the American Academy of Ophthalmology, which should be adapted globally with appropriate modifications. The International Resource Centre at the London School of Hygiene and Tropical Medicine, provides teaching and educational materials, including the *Journal of Community Eye Health*. Six other resource centres are being developed over the next 3 years in India (LVPEI), Pakistan, Tanzania, South Africa, Nigeria and Colombia.
6. Development of a global network of training centres with exchange of knowledge through electronic conferences, discussions, consultations and educational materials.
7. Development of a large number of training programmes for all categories of eye care professionals.
8. Career advancement mechanisms should be explored and created for all categories of health care workers that will help stabilisation of the eye care work force.
9. Institution of monitoring and evaluation mechanisms, followed by implementation of recommendations.
10. The ultimate aim is also to provide a well trained ophthalmic technician – to provide a comprehensive eye care service through a (small) vision centre for every 50,000 population in the world. This certainly demands a major effort to develop training programmes throughout the world.

VISION 2020: The Right to Sight is a plan to intensify global efforts to eliminate needless blindness. Human resource development is vital to the successful execution of this plan. The resources are available, but the mechanisms to exploit them should be put in place.

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Health Education: A Key to Community Eye Health – But Where are the Locksmiths?

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It is estimated that up to 80% of blindness is avoidable. The role of professionals in reducing this alarming figure is important. However, to be successful, strategies to prevent or cure blindness should centre on the role that affected individuals and communities can play. Their willingness to take up services, their belief that preventive activities are worthwhile, and their participation in changing the conditions which contribute to blindness are crucial components of any prevention of blindness endeavour.

Communication and Education

Communication and education are the keys to linking professionals with communities. This is widely acknowledged. But how is it achieved? Compared with the volume of reports describing intervention and service programmes, relatively little is documented about the role of health education and promotion in eye care. Reasons for this could be:

- (a) because those doing it are too busy to write about it
- (b) it is not happening at all, or
- (c) because what is done amounts to little more than 'health talks', and is therefore not considered worthy of report. Another possibility is that those responsible for health education in eye care are included too late in the programme design. As a result, health education is seen only as the key to open a one way channel of communication, to inform communities about services or solutions already decided upon. The frustrating results of such limited approaches are also unlikely to merit report. It is hoped that this article will broaden the understanding of what health education is, and can achieve, in the prevention of blindness – thereby encouraging more innovation and reporting on successes and failures. If health education is to provide the key to community eye health, we need to consider carefully the doors which it is expected to open and the skills needed to fashion the appropriate keys.

To some readers, this focus on health education may seem somewhat late. Since its launch in 1988, only two articles dealing specifically with health education have been featured in the *Journal of Community Eye Health*. In Issue No.1, Ranjana Mehra and Angela Reidy reported on a project in Raipur District of Madhya Pradesh (India), which evaluated the effectiveness of teaching mothers how to prevent childhood blindness. More recently, in Issue No. 9, Harjinder Chana wrote about blindness prevention and schools, outlining a project in Mutare, Zimbabwe, which builds on the UNICEF proposition that the education system is the developing world's broadest channel for disseminating health knowledge and developing health attitudes and practices. In this current issue, Anne Erpelding and Elliot Marseille provide a detailed account of how social marketing principles were applied to sell the concept of eye health in rural Nepal – with particular emphasis on the promotion of service utilisation, especially cataract surgery. The article provides an example of a health education campaign targeted for a specific purpose and a specific population, fashioning culturally appropriate 'keys'. It describes how the programme included an understanding of how cataract is understood and experienced locally; how the concept of 'marketing mix' was applied, by blending mass communication with traditional media; how it utilised the infrastructure of eye centres, and how research was undertaken to evaluate the effectiveness of the programme.

Decisions about how best to approach education need to be part of project planning from the start. What is required is not just good persuasive communicators, but consideration of the options and links which could be made: links to facilitate two way communication between programme personnel and the populations they work with; links to strengthen community networks; links with organisations and wider social policy. This suggests a broad view of health education, recognising the significant change which has led to the preferred term *health promotion*. In this territory, fierce debates occur between those who support the idea that achieving health depends on individual lifestyle change and those who believe that social and structural changes are fundamental and should be the goal of health promotion. It is perhaps most helpful to see these positions as a range of possible approaches, selection of which depends on purposes and circum-

stances, rather than on philosophical commitments.

Prevention of blindness provides special challenges and illustrates well the diversity of approaches necessary. For example, the challenge of how to encourage people to be screened for glaucoma would require very different treatment to that of promoting agricultural development as a strategy to prevent blindness from vitamin A deficiency in children.

What are some of the specific activities which should form part of this health education process? Four are briefly outlined here:

- Qualitative research.
- Strengthening community networks.
- Communication strategies.
- Advocacy.

Qualitative Research

Project personnel need to understand the context in which eye problems occur. This is best learnt from the communities themselves and there is increasing interest in the 'insiders' views of health and health education activities. Qualitative research is well suited to providing such insights (Manderson and Aaby, 1992; Aubel and Mansour, 1989; Kahn and Manderson, 1992; Brieger WR and Kendall, 1992). For this reason, skills in qualitative methods are increasingly being included in the training of health educators, and greater use is being made of multi-disciplinary teams (McLeroy et al, 1988) which include sociologists and anthropologists. In relation to eye problems, such insights could help to address some of the very difficult problems in eye health education: poor uptake of services, the use of harmful traditional medicines and face washing in water-scarce areas where trachoma is a problem. Each of these problems has multiple determinants, which need to be understood and analysed before meaningful educational approaches can be developed.

Strengthening Community Networks

It has been argued (Green and Raeburn, 1990; Burdine and McLeroy, 1992) that the goals of health education should also include changes in the capacity of individuals, networks, organisations, and communities to address health problems. Changes in problem solving ability, labelled as capacity building, could contribute to the prevention of blindness from diseases such as trachoma or vitamin A deficiency – which, for long term control, require improvements in socio-economic status and community organisation. A strategy which adopts this approach may not be recognised as 'health education' by one conditioned to see only the traditional health lecture as educational. However, activating communities for health promotion has stimulated considerable interest recently and provides specific challenges both in terms of methodology and measurement, or evaluation (Bjaras, Hagland and Rifkin 1991; Wickizer T M 1993).

Communication Strategies

This would include all activities designed to facilitate information flow to and from targeted populations. The range extends from mass media, appropriate for promoting uptake of cataract services or vitamin A capsule and ivermectin distribution, to inter-personal and small group approaches, more suitable perhaps for communicating with ante-natal mothers.

Advocacy

A broader health promotion approach looks beyond individual behaviour change to influencing the wider context in which ill health occurs. Promotion of eye health can, therefore, also include strategies to influence policy makers and to empower populations to address structural and social factors.

What does this range of approaches mean for prevention of blindness education? It opens up a host of possible issues and activities which can guide and enrich the health education process. Health education should never be seen as the turning of a single key – rather, it involves finding out about the nature of a wide variety of locks – and knowing how to make appropriate keys. The fight against global blindness should engage those who are able to assess the special needs of each problem and population, select appropriate educational activities which ensure the two way flow of information and understanding, and also connect different people and agencies who can contribute to the solution. In many places this could already be happening. The submission of articles that describe specific health education activities, however small, attempting to address specific problems in specific contexts, are to be encouraged. In other words, while we may know something about the keys, we are unsure of the nature of the locks in different social and cultural settings, and we are eager to find out if there are any talented locksmiths out there!

Health Education: A Key to Community Eye Health – But Where are the Locksmiths?

Postscript to the article in the *Journal of Community Eye Health* 1993, Volume 6, Issue No.12

Since publication of this article in 1993, there have been encouraging examples of greater attention to education and communication in prevention of blindness programmes. Further articles in the *Journal of Community Eye Health* have emphasised the importance of this topic,¹ and the Journal has published a number of articles which illustrate varied and innovative approaches to communication and education.

Attention to the perceptions and experience of intended beneficiaries of education and services is demonstrated by a project in Mumbai, Western India. This project was based on innovative dietary educa-

tion following a careful study of food preferences amongst young slum-dwelling children.² Donoghue's examination of why people do not use eye services draws on a number of studies which have looked at poor utilisation of services from the viewpoint of individuals with the eye problem – not of professionals.³ A number of studies documented elsewhere have shown the increasing value given to understanding cultural context and community perceptions, in relation to the mass treatment of onchocerciasis.^{4,5,6}

The importance of strengthening community networks as a health education strategy is illustrated in projects which take their starting point as the community – such as Sutter and Maphorogo's description of the 20+ year old Care Group project in South Africa and its impact on trachoma and wider health consciousness.⁷ Other recent experiences show the value of active community participation in the delivery of services, such as the Community-Directed Treatment with Ivermectin approach, adopted by the Onchocerciasis Control Programme (OCP) and the African Programme for Onchocerciasis Control (APOC).

We also see an increasing range of communication strategies, from individual counselling, such as patient counsellors to increase the uptake of cataract surgeries in India, to mass media approaches, such as the International Trachoma Initiative's field-based communications strategy in Tanzania. Such advances are encouraging. However, we must continue to stress

the crucial role of education and communication and the importance of 'tailoring' approaches to specific problems and communities. This takes time, patience, creative individuals and the backing of senior policy makers and managers, to ensure appropriate recognition and support for the efforts of health educators in the global fight against blindness.

Victoria Francis, May 2002

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INFRASTRUCTURE DEVELOPMENT • APPROPRIATE TECHNOLOGY

VISION 2020: The Right to Sight – National Prevention of Blindness Programmes

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The goal of VISION 2020: The Right to Sight can be achieved only through action at the national level, in accordance with the dictum, 'Plan Globally, Act Locally'.

One of the critical functions of the World Health Organization's Programme for the Prevention of Blindness, under its mandate of providing technical cooperation to Member countries, has been to assist in the establishment of national programmes and committees for the prevention of blindness. To date, there are over 100 such national programmes/committees/focal points, in countries where blindness is a public health problem. These are in various stages of development and activity. While political will and the commitment of ministries of health is an important determinant of how well these function, professional groups and non-governmental organisations can also play a major role – as demonstrated by the importance of advocacy.

Despite varying efforts, often hampered by resource constraints, there has been a deterioration in the blindness situation in some countries, because of population growth and ageing and the paucity of eye care services where they are needed most.

VISION 2020 represents a unique opportunity to revitalise and strengthen existing programmes/committees, and to create new ones where they are lacking.

There is a need to translate global and regional strategies into nationally applicable activities, through defining national plans of action – focusing preferably



Waiting for an eye examination at the health centre. Somalia, in former years

Photo: Murray McGavin

on the most peripheral level possible, perhaps the district level. Such plans of action should fit the situation in which activities would be implemented.

Prior to planning, a situation analysis would be necessary, as well as a detailed needs assessment, taking into account:

- the epidemiological situation, ideally through population-based surveys or 'rapid assessment' techniques, or appropriately extrapolating from available data
- human resources, in terms of numbers and cadres (including the private sector), geographical distribution and 'quality' (i.e., the need for re-training)
- infrastructure, in terms of quantity, quality and distribution.

This will facilitate the setting of priorities based on: unmet needs; the magnitude of the disease burden; and the feasibility and cost-effectiveness of interventions. Relevant and realistic targets need to be set, indicators defined and data recording and reporting systems put in place. As far as possible, data should be

collected at district level or other defined areas, to measure and ensure equity in service delivery.

Given the time frame of VISION 2020, it would be useful to have a five-year plan of action, in the first instance, with subsequent more detailed annual plans of work, to enable monitoring and evaluation.

Finally, VISION 2020 must not be considered a vertical programme with a limited time frame. The national programme plan should be an integral part of the health delivery system, work towards long-term sustainability and address, among others, the key issues of quality and equity.

WHO, the International Agency for the Prevention of Blindness (IAPB) and its constituents, working in partnership, need to support Member countries in the

development and implementation of their national plans.

These plans should be as decentralised as possible in order to reflect the actual level of implementation of the different activities. The empowering of local communities is another essential aspect that should not be overlooked. Lessons learned from community-directed treatment programmes, in the case of onchocerciasis control, have demonstrated how much can be achieved even in the most underserved areas when all those concerned join hands and work together.

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National Prevention of Blindness Programmes

David Yorston FRCS FRCOphth

David Yorston responds to questions (Q) on National Prevention of Blindness Programmes, providing answers (A) based on his experience in Africa and elsewhere. Dr Yorston (Christian Blind Mission International: CBMI) was formerly Ophthalmologist at Kikuyu Eye Unit, Kenya, and is now practising at Moorfields Eye Hospital, London

Q: Are National Programmes relevant to VISION 2020?

A: A key part of VISION 2020 is devolving decision making and planning to district level – the idea of planning services for units of one million people. Generally, when we have tried to plan for larger populations, we have not been successful. This has led some people to question whether national prevention of blindness programmes have any role in VISION 2020. Well managed national programmes can play a major part in implementing VISION 2020. However, ineffective programmes risk becoming irrelevant, as the focus of activity will inevitably shift to the districts.

Q: What should National Programmes focus on?

A: The main task of a national prevention of blindness programme should be to provide a framework for VISION 2020 at the district level. Globally, VISION 2020 is successful because it has pooled experience and expertise from many sources, and we have all agreed to pursue some clearly defined goals, rather than independently pursuing our own priorities. In the same way, at national level, a multitude of isolated, independent programmes will not be the most efficient way to eliminate avoidable blindness. A national programme can help by providing guidelines in response to a variety of questions – for example:

- How should we monitor cataract outcomes?
- Which districts should have the highest priority for full implementation of SAFE?
- What is the minimum standard of equipment and supplies for district eye clinics?
- All of these issues are best decided at national level.

Secondly, national programmes are vital for human resource development. They must advise the government about the numbers and cadres of eye workers that are needed, how they should be trained, and what they should do. Again, this must be done at national level. It would be unacceptable if ophthalmic assistants were permitted to do cataract surgery in one



Planning an eye care programme

Photo: Pak Sang Lee

district, but not in another. The programme should ensure that eye workers are not only trained, but also empowered – that is:

- They are suitably equipped and supplied.
- They have a realistic job description.
- They have authority to plan their work within the limits of the job description.
- They receive continuing medical education.

Finally, national programmes should act as channels of communication. They should be constantly sharing good ideas, spreading the message that avoidable blindness can be defeated, encouraging the best programmes, and helping the rest to improve. An effective national programme will ensure that there is no such thing as an isolated eye worker.

Q: Who are the key players in National Programmes?

A: National prevention of blindness programmes are usually planned and run by prevention of blindness committees (PBC). Ideally, all groups contributing to prevention of blindness should be represented on the PBC.

- **Ministry of Health**

An effective prevention of blindness programme needs official government support. The MoH representative should be sufficiently senior to act as an effective advocate for prevention of blindness within the Ministry. They should have the authority to make decisions that will affect prevention of blindness. It can be very frustrating to spend long

periods formulating plans and proposals, only to have them ignored by the MoH.

- **Eye care professionals**

These should include not only ophthalmologists, but also para-medical eye workers, optometrists, eye nurses, and orthoptists. All of us are involved in prevention of blindness, and we all have different insights and priorities. An effective programme will make good use of all these differing skills.

- **INGDO**

The international non-government development organisations usually provide the funds for prevention of blindness in developing countries. Sadly, INGDO's may be viewed solely as a source of cash! Major INGDO's, such as Sight Savers International, and CBMI, have many years of experience of prevention of blindness programmes in many different countries. This expertise is at least as important as their money. The ideal is partnership, in which the PBC and the INGDO sit together and plan how the INGDO can contribute most effectively.

- **Service clubs**

In some countries, service clubs such as Lions and Rotary, make a major contribution to prevention of blindness. Sometimes this can lead to problems, as service club eye clinics may take place outside the framework of the national programme. The best way to handle this is not to ban eye camps (which is usually impossible!) but to include the service clubs in the national programme, by involving them in the development of eye services.

- **Major institutions**

Major teaching institutions, and other successful centres of excellence, should be represented on the PBC. Other programmes may be able to learn from their experience, and decisions about human resource development will have important implications for their training programmes.

- **Patients' representative**

Few PBC have any lay representatives, which is a pity. We need to be reminded that we are not dealing with a million cataracts, but with a million people and their families, every one of whom is

experiencing different problems because of their visual disability.

- **Other expertise / celebrities**

The main obstacles to prevention of blindness are not technical or clinical, but are due to failures in management and administration. More skilled managers and business people should be appointed to PBCs, not because they are interested in prevention of blindness, but because they know how to manage a large enterprise successfully and profitably.

We need advocates who will raise awareness of prevention of blindness. This is most likely to be achieved by involving a local celebrity – a sporting personality, a film star or entertainer, or a traditional leader.

In general, we should be more imaginative and appoint people to national PBC's who would not normally sit on MoH committees.

Q: What are the problems facing National Programmes?

A: Sometimes national programmes try to do the wrong things. The primary focus for implementation of VISION 2020 is at the district level. National programmes cannot micro-manage individual district eye care teams. The national PBC has to give the guidelines to the districts and then let them do the work.

Secondly, national programmes are often perceived as being remote and out of touch. One of the most important tasks of the national programme is to promote networking and sharing of ideas. If this is done effectively, then the national programme will be close to every eye worker.

Finally, prevention of blindness on a national scale is bound to be a political issue. Sadly, care for blind people is frequently hampered by rivalry between different eye care professions, government departments, and NGO's. It has been said that if we spent as much energy fighting blindness as we expend on fighting each other, we could achieve the goals of VISION 2020 by 2015! We must bury past differences, and work together for a common programme. National programmes which can do that effectively will make a huge contribution to eradicating avoidable blindness.

The Importance of Affordable Eye Care

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Introduction

The Global Initiative for the Elimination of Avoidable Blindness (VISION 2020: The Right to Sight) sets a major challenge requiring a significant increase in the provision and uptake of eye care services. If the increasing trend in blindness is to be reversed, then access to eye care services needs to be made more widely available. One of the most significant barriers to accessing these services, is affordability. The shrinking economies of many of the world's poorest countries is placing increasing pressure on health care budgets that are already severely over stretched. Competing demands from life threatening diseases such as AIDS, malaria, and TB are pushing eye health services further down the agenda list of public health priorities. Simultaneously, the increasing cost of health care is forcing many governments to reform the structure of their health delivery systems. Many are choosing to introduce cost recovery mechanisms, as a means of controlling the overall rising costs of providing health care services.

Articles in this Issue focus primarily on the supply issues of service delivery, looking particularly at how increasing operational and manufacturing efficiencies can reduce costs to an affordable level. But to place affordability within the reach of ordinary people, their families and the communities in which they live, we also need to understand the demand issues which place additional cost burdens that do not allow access to eye care.

The costs are many and complex and the intention of this article is to explore what these might be (direct and indirect), and to offer some suggestions as to what might be done in order to make eye care more affordable to those who can least afford it.

Direct Costs

In an effort to provide sustainable services, many public and NGO health care providers throughout the world are increasingly moving towards the introduction of user fees. However, in reaching out to poor and marginalised communities, the effects of



Waiting for eye care in Uganda

Photo: Murray McGavin

these strategies are widely believed to have negative outcomes on both utilisation and equality in service uptake. A number of barrier studies (conducted primarily in India) have found that direct costs, such as those for transport, treatment, surgery, drugs, glasses and optical devices, like IOLs, etc. act as major deterrents for those who can least afford them. When these are removed, for example in offering free surgery, transport and food, not surprisingly there has been an increased uptake of services.¹ However, these same studies have also shown that the removal of these costs alone is still not enough to encourage full service utilisation. In fact, one study in particular in India demonstrated that the provision of highly subsidised fees had little impact on improved uptake of services.²

Calculating the cost impact of direct fees in real terms for the individuals concerned, is not an easy task. An affordability study carried out in Jamaica provides an enlightening approach to calculating what these costs might possibly be. Using national income data, the average daily income was calculated at the 30th, 60th and 90th percentile. The study then calculated how many days an average worker, at each percentile point, would need to work, in order to afford a simple eye examination and an average pair of prescription glasses. The study showed that those on average income at the 60th percentile would need to work over 52 days in order to afford the necessary fees. This contrasted dramatically with 3.4 days in the USA for the same percentile level.³

Whilst the removal of treatment fees or the introduction of subsidies may improve the problem, the issues of affordability are far more complex. To increase the uptake of services, we also need to examine and understand the nature and social context of indirect cost barriers.

Indirect Costs

The nature of indirect costs will very much depend on circumstances, but they will relate to the cost of time, effort and disturbance of daily activity for both the individual concerned and importantly, their families. In a Participatory Rural Appraisal study carried out in India, 40% of respondents quoted such indirect costs, as the major reason for non-attendance. Here, the main reasons given for not accessing services, were a) the cost of lost income to attend treatment for both the individual and their accompanying carer and b) concerns about the length of recovery time.⁴ This is particularly interesting because the recovery time for cataract surgery (which, if performed early, is only a matter of a few days with ECCE and an IOL implant), is more likely to be affected by associated complications arising from late presentation. As the onset of cataract is painless and is characterised by a slow decline in vision, the pressure of affordability delays the decision to come forward early, thus increasing the risks of complications and, consequently, lengthening the time of recovery and cost to the individual and their families.

Another study in Uganda recorded reasons such as 'too busy' to be a major deterrent for accessing services.⁵ Here the issue is one of 'opportunity cost' where in a typically rural subsistence community, the meeting of basic living needs, such as food production to feed the family, override all other concerns (like the gradual clouding of vision), which are regarded as non-essential.

Once vision deteriorates to a point where daily functions can no longer be performed, the sufferer soon becomes completely dependent on other family members for sustained well-being. Even at this point, where the problem has become obvious, barrier studies have shown that people still may not present – for such reasons as 'no one to accompany them' or 'family opposition'. There is no doubt that in many very poor communities, the opportunity cost of a family member accompanying a blind relative to hospital, may be too great a price to pay, if the lost time is at the expense of providing the family with basic needs such as food. Elderly people suffering from cataract blindness frequently have little say over how the family resources are utilised and, in this respect, 'family opposition' may well be an expression of discrimination, where the family concludes that investment of minimal resources on an ageing relative is of little value, when weighed against other competing demands.

As we have seen, the issues of affordability are many and complex and whilst barrier studies show a remarkable similarity of results, it is also true that there will be variation in cost deterrents, depending upon the circumstances of specific situations. The challenge is to design a delivery system that is sensitive and responsive to these cost barriers, in order to make eye care more affordable.

Making Eye Care More Affordable

Making eye care more affordable to those who can least afford it, requires specific strategies that target the root causes of both direct and indirect cost barriers. Such strategies might include the following;

Reducing the burden of direct costs

- Promote community based screening and treatment – extend the reach of services into the community and reduce the burden of travel costs for patients
- Provide financial support for transport and food – encourage those who are particularly poor to come forward for surgery, by offering incentives that reduce the cost burden
- Introduce a user fee structure that does not deny affordable access – implement a cross subsidy pricing structure (to include free service where necessary), where wealthier patients pay more to subsidise poor patients, through the offering of value added services (e.g., private rooms)
- Reduce unit cost of service provision – increase operational efficiency and volume of output (e.g., number of operations)
- Reduce the need for repeated visits – create a 'one stop' referral and/or treatment service, to reduce the burden of unnecessary travel and time costs for patients
- Mobilise community resources – encourage communities themselves to support the treatment of poor patients out of their own resources.

Reducing the burden of indirect costs

- Raise awareness about the cost of blindness – motivate people to come forward early, by advertising the cost of blindness compared to the cost of treatment
- Promote ECCE with IOL surgery – the use of this surgery dramatically reduces patient recovery time, compared to ICCE with aphakic correction
- Identify and train community eye health carers – working closely with the community, identify motivated 'carers' to assist, by accompanying patients coming forward for surgery/treatment
- Introduce demand management strategies – structure service management to meet the variations of seasonal peaks in demand, to reduce patient waiting time.

There is little doubt that affordability significantly limits the reach of many eye care programmes. If Vision 2020 (The Right to Sight) is to achieve its very worthwhile goals, greater efforts are needed to reduce the costs of access, particularly in the design of service provision, so that eye care can truly become an accessible right for all.

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Cost Containment in Eye Care

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Voluntary eye hospitals committed to serving the community must recognise the reality of increasing costs due to inflation, advancements in medical technology and changing expectations of staff and patients. However, these costs are often not matched by the patients’ paying capacity. While increasing income, through increased user fees or donations, are options to become financially viable, this article will focus on cost containment.

Conditions for Effective Cost Control

Though cost containment tends to be driven by the systems in the organisation, certain organisational conditions have to be in place for them to be effective. The leadership has a strong role in this. The organisational leadership must be within the eye care system and be available to the organisation whenever required – as opposed to hospitals run by Government or Religious Organisations, where the leadership is often outside the hospital system and not readily available. Delayed

Table 1: Factors Contributing to Cost Containment¹

| Parameters | Factors Affecting Cost |
|--|--|
| 1. Leadership and Attitude | <ul style="list-style-type: none"> Concerned about cost Instituting a culture of cost consciousness Being available for timely decisions Viewing the patient as a partner in the healing process |
| 2. Increasing the Uptake of Eye Care Services | <ul style="list-style-type: none"> Forecasting and planning for expected workload Reducing fluctuations in workload Utilisation of community resources |
| 3. Human Resources | <ul style="list-style-type: none"> Job description Workload variations versus manpower planning Recruitment and selection Employee retention |
| 4. Building and Infrastructure | <ul style="list-style-type: none"> Appropriate size and design Appropriate building technology and material Flexible and functional building design Durability and ease of maintenance |
| 5. Supplies, Instruments and Equipment | <ul style="list-style-type: none"> Group purchasing Inventory management Models easy to repair and service Appropriate technology Preventive maintenance |
| 6. Systems and Procedures | <ul style="list-style-type: none"> Standardisation Periodic review to eliminate unnecessary systems Level of control over finances, purchases and personnel |

or inappropriate decisions tend to increase costs and inefficiency. It is also important that the leadership promotes a culture of cost consciousness.

Standard clinical and administrative protocols are necessary to review the present practices and institute measures of cost containment, without affecting quality, productivity or patient satisfaction. Table 1 lists the various factors that influence costs.

Definitions Relating to Cost

| | |
|------------------------|--|
| Capital Cost: | Cost of land, building, major equipment, etc. |
| Fixed Cost: | Costs that have to be incurred regardless of the level of activity. e.g., salaries, interest, depreciation, annual maintenance contracts, etc. |
| Variable Cost: | Costs that vary directly with the level of activity. e.g., cost of sutures, IOLs, medicines, etc. |
| Recurring Cost: | Sum of fixed and variable costs also referred to as ‘operating costs’ or ‘running expenses’ |
| Unit Cost: | Recurring cost (fixed cost+ variable cost) per unit of service |
| Marginal Cost: | Additional cost in an ongoing production/service set up to produce one more unit of service or commodity (variable cost ÷ units of service). |

Note: Several cost items tend to have, within them, elements of fixed and variable costs. e.g., electricity, housekeeping.

The ‘unit cost’ of Cataract Surgery can be expressed as:

$$\frac{\text{Fixed cost apportioned to cataract surgery}}{\text{No. of cataract surgeries}} + \text{Consumables cost per surgery}$$

The ‘marginal cost’ of cataract surgery = consumables cost per surgery

Variable Costs

The variable costs are mostly made up of clinical consumables, stationary, etc. Cost savings in this area require good inventory management and group purchasing, for better prices for established quality standards. Good materials management, to reduce wastage in storage and pilferage, will again reduce the variable costs.

However, reviewing the clinical protocols and eliminating investigations, procedures and medications that do not contribute to quality, productivity, outcome or patient comfort, can result in greater reductions in variable costs. Setting up a good clinical information system is necessary for making such evidence based decisions.

Fixed Costs²

In health care organisations, the fixed cost could account for as much as 70% of the total recurring expenditure, and hence deserves the most attention. Investments in infrastructure, size of the facility and

staffing are the major determinants of fixed costs. Leasing out a part of the building, reducing staff or better negotiations of maintenance or salary contracts, could be some of the options to reduce fixed costs, but the main focus in cost containment must be more on the optimum utilisation of the infrastructure – thus reducing the unit cost of service, by reducing the fixed cost component within it. This is particularly relevant, since in most areas the provision of eye care is far below the required levels. This focus will lead to continuous efficiency improvements, resulting in sustained cost containment and more of the community being served. Seasonal variations in patient load leads to under utilisation in low seasons and thereby affects the costs. Salaries constitute the major proportion of fixed costs. Thus, the staff utilisation pattern, especially that of the ophthalmologists, has a direct impact on costs. The factor that has the most impact on 'unit fixed cost' is productivity. A simplified exercise,³ given in Table 2, illustrates that, as productivity increases to match capacity, the unit fixed cost reduces to a fourth and the total cost comes down to almost a third.

Table 2: Resources, Performances and Expenditures

| Consider an Eye Hospital with the following Resources, Performance and Expenditures: | | | | | |
|---|---|--|--|----------------------------------|--------------------------|
| A. Resources: | | | | | |
| <u>Facilities:</u> | | | <u>Staff:</u> | | |
| Beds | : | 50 | Ophthalmologists | : | 2 |
| Equipped Operating Theatre | : | 1 | Paramedics | : | 9 |
| IOL surgery sets | : | 2 | Housekeeping staff | : | 6 |
| | | | Office & Security staff | : | 6 |
| <u>Capacity of the Above Resource</u> | : | | | | |
| • From bed capacity perspective | : | 4,000 surgeries assuming 80 surgeries per bed (average stay of 3 days) | | | |
| • From the staff perspective | : | 2,000 surgeries, assuming 1,000 surgeries per surgeon | | | |
| B. Annual Performance: | | | | | |
| Out-patient visits | : | 20,000 | Cataract/IOL Surgery | : | 500 |
| Admissions | : | 600 | Other Surgeries | : | 50 |
| C. Annual Expenditure (Based on costs in India expressed in US\$): | | | | | |
| <u>Fixed Costs:</u> | | | <u>Variable Costs (for cataract surgery only):</u> | | |
| Salaries | : | 35,200 | Sutures, Drugs, etc. | : | 2,660 |
| Electricity | : | 1,330 | IOLs (450 @ \$6 per IOL) | : | 2,700 |
| Maintenance | : | 1,250 | Instruments replacement | : | 750 |
| Other fixed costs | : | 2,220 | Stationery | : | 230 |
| | | | Other variable costs | : | 660 |
| Total Fixed Costs | : | 40,000 | Total Variable Costs | : | 7,000 |
| D. Unit Cost per Cataract Surgery (All figures in US\$): | | | | | |
| Assuming that 80% of fixed costs are incurred in providing cataract surgery, cost per surgery for the current output, for 1,000 surgeries and at capacity of 2,000 surgeries will workout as follows: | | | | | |
| Number of Cataract Surgeries | | Total Fixed Cost(US\$) | Unit Fixed Cost (US-\$) | Unit Variable Cost (US\$) | Total Cost (US\$) |
| (current) 500 | | 32,000 | 64 | 14 | 78 |
| 1000 | | 32,000 | 32 | 14 | 46 |
| 2000 | | 32,000 | 16 | 14 | 30 |



The joy of sight

Photo: Murray McGavin

Cost Containment Strategies

- **Daily planning:** In addition to long range or annual planning, it is essential to plan for the next day and ensure that all resources/supplies are organised and all concerned staff are informed. The patient load, availability of staff and requirement of supplies can be determined with a high level of reliability the previous day. Emergency procurements and delays in service delivery, resulting in longer length of stay, increase the cost.
- **Clinical process:** A patient protocol based on an integrated path for diagnosis, investigations, admission, surgery and follow-up would substantially reduce delays and associated costs.
- **Personnel costs:** Hospital is a labour intensive organisation. Staff salaries constitute a major percentage of the total operating expenditure. Hence, it is important that salary packages are designed keeping this in view. Incentives linked to surgeries adversely affect the cost reductions that come from increased productivity.
- **Appropriate use of human resources:** Since salaries are a major element of the fixed costs, it requires special attention. The ophthalmologists' time is both expensive and in limited supply. Delegating routine, repetitive and measurement related clinical tasks to well trained ophthalmic technicians can significantly increase the productivity of the ophthalmologists.
- **Work culture:** Developing a positive work culture reduces bureaucracy, promoting teamwork and a commitment to patient care. All of these have a very direct impact on costs.
- **Local production of consumables:**⁴ Many housekeeping supplies, bandages, cotton pads, swabs, etc. can be produced locally (if less expensive

than buying them). This also gives an opportunity to use the clinical staff when there is low patient care activity.

- **Managing seasonal variations:**⁵ Productivity is governed by the patient load, which tends to have seasonal and also daily fluctuations. Hence, it is necessary to find ways to ensure uniform demand – and when this is not possible, staff training, vacation time for staff or developmental activities as appropriate, can be scheduled.
- **Community participation in outreach:** One resource that is hardly used, when compared to its potential, is the community. In many programmes, the hospital staff does the publicity, arranging a campsite, and necessary furniture, etc. All these activities can easily be done by the community, and in all cases done better, often at no cost to the hospital. When the community comes in as equal partners, the camp attendance also goes up. The community can also provide volunteers and facilitate many other activities.
- **Other Strategies:** These include developing in-house competence for instruments/equipment maintenance, instituting appropriate recycling systems for waste products, regular review of cost data and administrative systems, like daily review of revenues and expenditures, control over expenses through formal procedures for approval, and independent audit of all internal records and processes.

Role of Hospital Administrator⁶

The above principles and strategies need to be translated into action and systems appropriate to local settings, and put into day-to-day practice. These systems require periodic review and changes, arising out of new developments, changes in the infrastructure, staffing, patient complaints and suggestions. It requires a person who can pay constant attention and be responsible for this. This must be one of the key responsibilities of the hospital administrator or manager. The administrator needs to work closely with clinical staff to reduce the length of stay, eliminate unnecessary investigations, drugs and therapies, and bring about economies in the use of supplies, facilities and human resources. He or she has to devote enough time and attention to planning for services and facilities, and scheduling of staff and patients for optimum utilisation of resources, to enable cost containment. For this function to be effective, it is necessary that this be carried out by a person well experienced, or formally trained in hospital management, who ideally does not have a dual clinical role.

Conclusion

Cost containment is a continuous organisational process. It is a complex interaction of technical,

organisational and human factors, which need committed leadership, right attitude of staff and a systems approach. Higher expenses per surgery do not necessarily mean higher quality. Hospitals that provide quality service, with large volume relative to their size, tend to have lower unit costs through better systems. On the whole, cost containment should be viewed as one of the strategies to enhance the efficiency, and thus the effectiveness of eye care programmes.

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Financial Sustainability in Eye Care

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Background

If eye care programmes are to provide quality eye care services to communities in the long term, it is imperative, particularly in developing countries, that they become financially sustainable within a reasonable period of time.¹ Modalities of sustainability have to be introduced from the very beginning of any eye care programme, for it to benefit the community in the long term.

The L V Prasad Eye Institute (LVPEI), a not-for-profit, tertiary eye care hospital in Hyderabad, India, has been involved in setting up a permanent infrastructure for eye care in underserved rural areas.²⁻⁵ Details of this infrastructure, which includes rural eye care centres and community programmes, have been described elsewhere.⁴ It was anticipated that this infrastructure would address the barriers to eye care services – relating to accessibility, availability and



All patients are counselled and assessed

Photo: B R Shamanna

affordability of the services. This resulted in the setting up of the first rural satellite eye care centre, the Bhosle Gopal Rao Patel Eye Centre at Mudhol village, in the poor district of Adilabad in the southern Indian state of Andhra Pradesh. The successful and self-sustaining functioning of this centre, prompted LVPEI to develop other rural eye care centres in Andhra Pradesh, which are well on their way to becoming financially self-sustainable. In this article we describe the systems that made Bhosle Gopal Rao Patel Eye Centre (BGRPEC) financially self-sustainable.

Bhosle Gopal Rao Patel Eye Centre (BGRPEC)

Staff

A total of 25 staff, including one ophthalmologist, work at this centre. Most of the staff were drawn from their local communities, and were trained for varying periods of time at LVPEI. During the training period, area-specific jobs were assigned to individual staff, and the emphasis was on hands-on training. On completion of the training, they were recruited as employees of the rural eye care centre, with performance-related increments and promotion.

Service Provision

At this centre, standard secondary level eye care services are provided with reasonable facilities and equipment, while adhering to the highest quality standards. The services provided include refraction, detailed dilated eye examination, medical treatment, and operations – such as cataract surgery with an intraocular lens, glaucoma surgery, lid surgery, and lacrimal duct surgery. The systems and staffing of the eye care centre currently allows for examination of

12,000–18,000 out-patients and 1,200–1,800 operations in a year. The overall infrastructural design, with the necessary additional staffing of BGRPEC, has the capacity to provide for a maximum of 40,000 out-patients and 5,000 operations in a year.

The charter of this centre calls for the provision of 50% of all services free of cost to the economically underprivileged in society, with the remaining 50% on payment of charges by those who can afford to pay. The patients are triaged into paying and non-paying categories for eye care service delivery, based on their socio-economic status. This is assessed by an experienced eye care person, or counsellor. For patients who are advised to undergo surgery, the counsellor further assesses the total paying capacity of these patients by assessing the total family income. This includes assessment by reference to a ration card, provided by the government to families whose monthly income is below a certain level. Surgical services for paying patients are offered within a system where the only difference lies in the facility of accommodation – where type and quality of surgical services provided remains the same. The non-paying patients who are advised to have surgery are offered the same surgery at no cost to them. In addition to the medical and surgical services, optical and pharmacy shops are an integral part of this centre. A cafeteria is also available catering for the needs of the patients and staff alike.

Capital Investment

Local and international non-governmental organisations and local philanthropists helped LVPEI to set up this rural eye care centre to reach a population of 500,000 which is spread over 3 districts in the two states of Andhra Pradesh and Maharashtra. The capital investment towards setting up this centre was in the region of Rs. 81.3 lakhs (US\$ 189,000), details of which are shown in Table 1.

Financial Self-sustainability

Since its beginning, the service delivery figures for BGRPEC have shown an increase in the number of out-patients seen and operations performed. While the ratio of paying to non-paying out-patients was 50:50

Table 1. Initial Investment for Capital Items at BGRPEC, Mudhol

| Item | Amount in Lakhs of Indian Rupees (Thousands of US\$)* | |
|------------------------|---|----------------|
| Land & Development | 1.75 | (4.0) |
| Buildings | 61.17 | (142) |
| Generator | 2.54 | (5.9) |
| Air conditioner | 0.52 | (1.2) |
| Furniture and fixtures | 5.04 | (11.7) |
| Equipment | 10.11 | (23.4) |
| Kitchen equipment | 0.17 | (0.4) |
| Total | 81.30 | (188.6) |

*1 US\$ = Rs. 43.20

Fig. 1: Out-patients seen at BGRPEC, Mudhol, 1997 to 1999

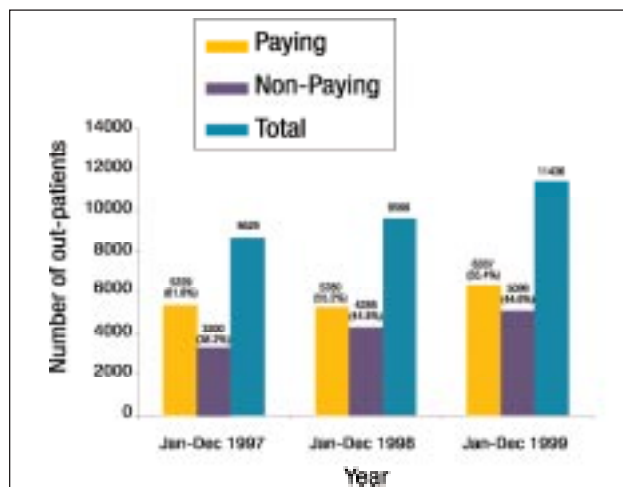
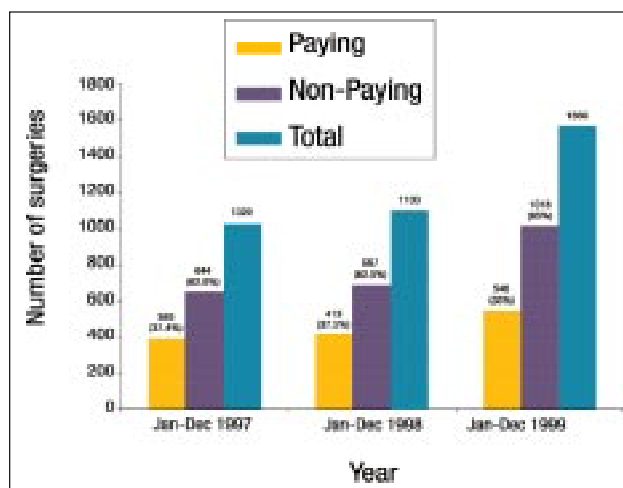


Fig. 2: Surgeries performed at BGRPEC, Mudhol from 1997 to 1999



(Figure 1), the operations maintained a ratio of 35:65 respectively (Figure 2). Average cost-recovery per month, for monthly income and expenditure, was used as a measure of assessing financial sustainability over every 6 months period. Cost-recovery was calculated as a ratio of income divided by the expenditure and was expressed as a percentage. Standard formats that are used at BGRPEC for recording income and expenditure each month provided the basis for calculating cost-recovery. Recurrent grants received and depreciation on capital and equipment were not included in these calculations, as they are calculated on a yearly basis in our system.

Income resulted from the eye care services provided, sales from optical services and pharmacy, from the cafeteria, and interest on bank deposit. The surgical services and sales from the optical and pharmacy shops were the major sources of income. Expenditure related to salaries of personnel, purchase of medical consumables, optical and pharmacy shop purchases, payment of electricity and other bills, cafeteria, and office expenses.

The average monthly cost recovery for the operating



The quality and type of surgical services are the same for paying and non-paying patients

Photo: BR Shamanna

costs increased from 72.7% in the first half of 1997–98 to 104.3% in the last half of 1998–99 (Figure 3).

Achieving Financial Self-sustainability

BGRPEC was financially self-sustainable within 3 years of its beginning. This achievement can be attributed to the establishment of appropriate patient care systems, with equal emphases on medical and management systems, well-trained clinical and non-clinical staff working as a team, and the support of the local community.

A major factor on the clinical side, in achieving financial self-sustainability is the quality of eye care services provided by BGRPEC. The quality of service does not differ based on the capacity of the patient to pay for the service. In addition, to a large extent, BGRPEC is also able to address the barriers to eye care services relating to accessibility, availability and affordability of the services.

Optimum utilisation of staff, intelligent purchasing, use of consumables through bulk central purchase, and minimum wastage, are other factors that have contributed to financial sustainability. BGRPEC has also demonstrated that having strong links with local

social development organisations, encouraging community support with mobilisation, and political will, are as important in achieving financial sustainability as are systems within the centre itself.

Experience with BGRPEC has demonstrated:

1. The importance of good training for clinical and non-clinical staff.
2. The team approach to eye care.
3. Provision of good quality eye care services.
4. Community support can lead to financial self-sustainability.

Sustainable and optimally functional eye care systems would have to be an important element of any approach that hopes to substantially reduce blindness in India in the long-term.⁶

Acknowledgement

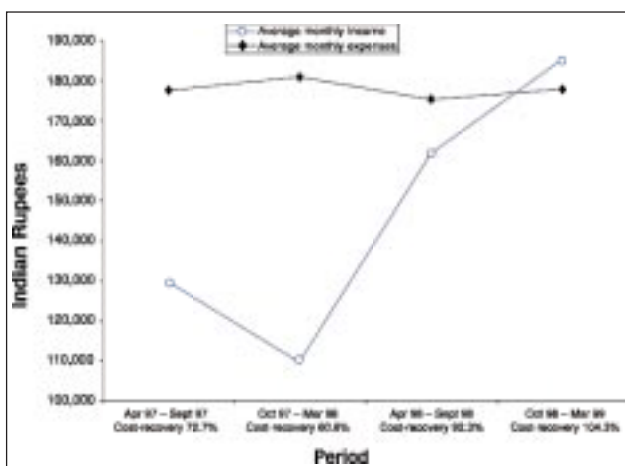
The contribution of V. Rajashekar is gratefully acknowledged in connection with various activities relating to the setting-up of this rural eye centre and the collection of the data presented.

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Fig. 3: Cost-recovery for BGRPEC, Mudhol for the Financial Years 1997–98 and 1998–99



THE BLIND AND VISUALLY IMPAIRED

How Eye Workers Can Help Newly Blind People

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8 a.m. The hospital day begins. Eighty people are queuing at the eye clinic. Eye workers, Mary and Gerard, know they'll be busy until late afternoon. First they must see the post-operative patients. Two older cataract patients have a very good outcome after surgery. A 9-year-old child operated on for congenital cataract has a doubtful result, and cannot see any hand movement. With outpatients beginning to knock at the door, Mary has to find something to say to this child's mother.

The woman asks whether she has to come back to the hospital, and when. What can Mary say? It is unlikely that the child will have any functional vision, even after some months. Mary has a few private words with Gerard. 'What should I do?' she asks. 'Tell the mother to go to a school for the blind', Gerard advises. Mary doubts if the child could get into that school. The mother looks very poor and the school has very few places. She decides to tell the mother to come back within a month for review. Mary now begins to see the outpatients.

11 a.m. The work goes well, it's a routine day. Two cataract patients arrive, who are booked for surgery next week. Gerard has a special case: a 35 year old man who became blind after falling on his head. The head wound itself isn't too bad, but probably brain damage has led to the blindness, which can't be cured. Now Gerard is unsure, and consults Mary. 'Do you know that man's village?' he asks. 'Can you tell these people that there is a big problem, and that there is nothing we can do?' But Mary feels that Gerard should explain the situation himself. The man is *his* patient!



Medical students experience blindness simulation through supervised role play

Photo: Sue Stevens

These are all too familiar situations in eye units in developing countries. Confronted with newly blind people, many eye workers are uneasy and have little or no useful information to communicate. They feel that if surgery has not been successful, there is not much hope left.

This article explains the task and potential contribution of eye workers faced with newly blind persons. For several reasons, eye workers can have an important impact on further rehabilitation. They are the people from whom families initially try to get help in terms of eye care. They may also be the first to assess objectively irreversible blindness. They are considered specialists, and they are at hand when families face this crisis. The eye workers' own attitudes to the crisis, and their well, or poorly informed responses may set people on the right or the wrong road. Families and newly blind persons may quickly sense whether eye workers are trying to avoid them, or are giving well informed and considered advice about the next steps to take.

Eye Workers, Referrals and Transfers

Eye workers will rarely be involved in formal rehabilitation or education itself. Their role will be to

refer or transfer the blind child or adult to a unit where services can be provided to improve their life and their self care skills. It is important to distinguish between referral and transfer. A *referral* means that the eye worker says, 'you could go to a school for the blind; they may be able to help you there'. A *transfer* means that the eye worker has accurate information about the school (or other service), about conditions of admission, and will even make an appointment. Transfers are more likely to lead to services being provided later on, so eye units should be encouraged to aim for *well-informed transfers*, rather than referrals.

When There is No Treatment: Can Low Vision Work Help?

If the visual impairment cannot be improved through any kind of treatment, the first question to ask should always be: 'Will low vision therapy, and consequently the provision of optical and/or non-optical low vision devices, improve the use of a patient's vision and, therefore, assist the patient to perform visual tasks more independently?'. It is essential for each eye unit to work together with a qualified low vision specialist, e.g., Vision Therapist/ Vision Support Teacher. Of all people with visual impairments (blind and low vision), only one third (30%) are totally blind. Without effective provision of low vision services, three quarters of them (75%)



Hospital staff must set a good example and be aware of the needs of the visually impaired

Photo: Sue Stevens

would be considered as functionally blind. It is, therefore, very important to transfer a patient to a low vision specialist whenever the best possible visual acuity is less than 6/18 (less than 0.3) in the better eye, and/or the visual field is less than 20° wide, measured from the point of fixation. If low vision services cannot improve the situation sufficiently, we have to consider additional systems of rehabilitation.

Fig. 1: Questionnaire

Name of Eye Unit
Address
Telephone Number

Dear Director,

Our eye unit, at, often comes across blind people. We are collecting information on rehabilitation and education services in this area, so that we can transfer people to an appropriate source of help. Kindly complete this questionnaire, and return it to us, or attach your information leaflet.

1. What type of services does your programme provide for blind people?
2. Which people are you able to help?
 Criteria for admission?
 – sex
 – age
 – vision (VA)
3. How long do the services take?
4. Is there an admission form?
5. At which time of the year does your programme take new entrants?
6. What should people bring with them when they come to your service provision?
7. What is the cost of your services that has to be paid by the family (total)?
8. How many people can you enlist per year?
9. Whom should we contact for admissions?
 Telephone number?
 Email?

Many thanks for returning this form to the Eye Unit (address above).

Which Services can be Provided to Newly Blind Persons?

1. Psychological care

Even though eye units cannot usually provide formal psychological care, they can at least avoid reinforcing

Fig. 2: Feedback Form

Feedback Form

Please return to: [Name of Eye Unit, Person Responsible, Address, Phone number]

Dear Director (of a Centre/School for the Blind),

We are sending..... who was a patient at our eye clinic. We have no further services that might improve the vision of this patient, so would like to transfer him/her to you. Please fill in this form, and return it to us.

We appreciate your efforts.

Yours, Signed [the Responsible Person for the Newly Blind].

1. Name of person transferred and assessed:
2. Are you able to assist this person?
3. Why (not)?
4. What type of services can you provide?
5. In case there are no services that your programme can provide, is there any other programme that could help this person?
6. Your name:
 Telephone number?
 Email?

the new blind person's doubts and fears. The aim should be to ensure that blind people are transferred speedily to one of the following specialist services (see 2 to 5 below), with an explanation of what support is available. The information, the transfer, and the services that may follow, will offer a positive perspective, which is psychologically very helpful at this stage.

2. Early childhood intervention

Children with congenital visual impairments need special training to support their physical development. As 80% of learning in a normally sighted child is acquired through vision (i.e., by imitation of seen behaviours/activities) the learning process in a visually impaired child has to be adapted. The child needs encouragement to learn body movements, while using other senses. In low vision, the child needs to gain awareness of visual stimuli and to learn how to respond to them. Find out whether there are community based rehabilitation programmes (CBR), or other programmes that would provide appropriate help if blind and low vision children are transferred to them.

3. Education in special schools or integrated systems

Most developing countries have one or more special schools for the blind, or annexes attached to regular primary schools, or an itinerant teacher programme supporting integrated education. Integrated systems assist the 'normalising' of life and opportunity for blind children, but the quality of education is often weak. Whatever the system, the aim will be to provide primary school education. Having completed primary school education, some children continue integrated education in a secondary school, but most children will return home and may then need one of the following services.

4. Functional rehabilitation by community based rehabilitation (CBR) programmes

Functional rehabilitation is provided at home and in the community by CBR programmes or by associations of the blind. They aim at increasing the activities blind

people can do at their homes and in the neighbourhood, focusing on what matters in that specific community, and at that specific stage of life.

5. Vocational rehabilitation by CBR programmes or by vocational training programmes

Vocational rehabilitation services aim at providing a livelihood to the blind person. It consists of skill training, possibly provision of a small loan, and often additional training in basic marketing skills.

Which Services are Available: How are they Accessible?

It is important for each eye unit to know which services are available in the region/country, and to have *accurate and sufficient information* about them. To obtain this information, the questionnaire (Figure 1) can be used.

Make Appointments and Ask for Feedback

Once the eye unit has collected this information about special schools, education and rehabilitation programmes that are available for blind people, a nurse or administrative person should be appointed as blind people's counsellor. Clinicians should transfer all newly blind patients to the counsellor. The counsellor would also co-operate with the different transfer service units. He/she should visit all these units regularly, and update the information gathered by the questionnaire. In caring for each newly blind person, the counsellor should contact the respective unit (if possible) by phone, make an appointment for the patient and ask for feedback after the visit.

A sample Feedback Form (Figure 2) can be sent along with the patient.

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Assisting the Blind and Visually Impaired: Guidelines for Eye Health Workers and Other Helpers

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Introduction

As eye health workers, we give much attention to learning and teaching the importance of health education and the prevention and treatment of eye disease. Despite our gained knowledge, sadly, our efforts are not always successful and we are presented with the responsibility and challenge of caring for people who have to cope with visual impairment, perhaps for the rest of their lives. We have to understand their difficulties, recognise their abilities and learn how to cooperate and communicate with them in a social, as well as hospital environment. It is often within the eye hospital itself that the lack in education of health workers, and their understanding of the assistance needs of blind and visually impaired patients, is all too evident.

Visually impaired and blind people come from all kinds of backgrounds. Some are clever, some are not so gifted. Many are elderly, some are young. They may be sportsmen and women, gardeners, farmers, chess players, teachers, typists, musicians, lawyers, housewives, computer programmers, physiotherapists, social workers, telephonists, parents . . .

Such people have many abilities and can achieve many things despite visual impairment or blindness, but there are times when they will appreciate and welcome practical assistance.

Meeting and Greeting (Figure 1)

There are some general points to remember, which are really common sense and a matter of courtesy:

- Always ask first before offering any help and do



Trying to be helpful – but the patient would have felt more supported if the helper had walked alongside him

Photo: Sue Stevens

not be offended if it is refused. Some people have had very bad experiences of what a sighted person thinks is being helpful!

- Be precise if giving instructions. Giving directions by pointing and saying, 'It is down there on the right', is not much help and very thoughtless.
- The use of a white cane does not necessarily mean that a person is totally blind.



Fig. 1

- In some countries a person is accompanied by a guide dog, but the animal must never be distracted. Often it is the animal who receives attention and the owner ignored! Together they usually make a good working team and rarely need extra help.
- Once into a conversation, never leave without saying you are doing so. Do not allow the blind person the embarrassment of talking into the air!

Approach and Attitude

- Always treat a blind person normally; speak first and introduce yourself.
- Shake hands but only if a hand is offered.
- It is also politeness to look at him/her during conversation and adopt the same level of position, e.g., sit or stand.
- Do not be afraid of using normal language and include words like 'look', 'see', 'read', remembering that blind and visually impaired people have exactly the same vocabulary as sighted people.
- Explain noises and silences and do not shout.
- Do not expect or invite others to speak for blind people. Do not be afraid to 'touch', but be sensitive to cultural differences.

Guiding (Figure 2)

- Always consider a person's age and any other disabilities.
- Never presume where the person wants to go. Ask for details of where and how he/she would like to be guided. It is not uncommon to see a person being propelled or steered, and at great speed! Go at their pace and, if there is space, walk side by side and always 'hand to arm'.
- If there is a guide dog, but extra help *is* needed, approach and walk on the other side. The animal has been trained to understand that he is still in charge and responsible!
- Give adequate room around obstacles and hazards and plenty of time for response if you need to say, "bend your head low to avoid this tree branch!"
- Describe any sudden changes in the environment. It is also very important to explain changes in ground surfaces, especially when moving into wide open spaces, e.g., fields.



Fig. 2

Walking in Single File or in Narrow Spaces (e.g., in shops, offices and busy crowded areas) (Figure 3)

- Tell your partner of the change in surroundings and then move your own guiding arm towards the middle of your own back.

- Your partner should automatically step in behind you, still holding your arm, and together you will be able to negotiate a narrow space.

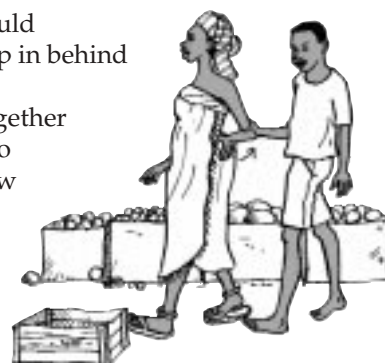


Fig. 3

Doorways (Figure 4)

- It is important to take this manoeuvre (movement) very slowly; it is not an easy one to master.
- Tell your partner if the door opens towards you or away from you.
- Go through the door with your partner on the hinge side.
- Open the door with your guiding arm; your partner should place his/her hand against the door to feel the handle.
- He/she should then follow you through and close the door behind both of you.



Fig. 4

Steps, Stairs and Slopes (Figure 5)

- Tell your partner whether the steps, stairs or slope go up or down. Going down is more difficult.
- Allow your partner plenty of time to hold the handrail securely and judge the first step carefully.
- Go one step ahead and take a slightly longer stride on the last step to allow your partner space.



Fig. 5

Kerbs and Roads (Figure 6)

- Never take risks!
- Tell your partner if you are approaching a 'kerb up' or 'kerb down' (the step onto or off a pavement/sidewalk) and pause slightly before taking the step.



Fig. 6

- Make sure you approach the kerb together – both facing, and at an equal distance from the kerb – taking extra care with rounded kerbs.
- Cross the road using the shortest distance and go straight across.
- Tell your partner if you are parting company after crossing the road and ensure they know which way they are facing.

Seating (Figure 7)

- Never propel or steer a blind or visually impaired person backwards into a seat!
- Guide your partner to the seat and explain what type it is – e.g., upright chair, low sofa, armchair, stool.
- Ask them to let go of your arm and place their hand on the back or the seat of the chair .
- This is sufficient help as your partner will now be able to judge the height of the seat and will be able to sit safely and at his/her own pace.



Fig. 7

Travelling (Figure 8)

- Tell your partner if he/she is getting into the back or the front seat of a car and whether it is facing left or right.
- Place your guiding hand on the door handle and allow him/her to slide his/her grip hand down your arm to the door handle.
- With his/her other hand, the car roof can be noted and your partner will lower his/her head appropriately.
- At the end of the journey, get out of the car before your partner and help them out.
- Tell them if there are wider than average gaps to cross. This is particularly important when travelling by train!
- Always lead your partner on and off public transport.
- In rural areas, extra help may be needed when you and your partner have to negotiate getting on and off unstable modes of transport, e.g., carts, boats, etc.



Fig. 8

- Remember your patient is at the hospital because they cannot see well – sadly, an often seemingly forgotten point, even by the more senior or so-called experienced staff members!
- Never be afraid to ask the patient's opinion about a situation specific to them and how they would like to be assisted.
- In the treatment room, always explain what you are going to do – and to which eye!
- When providing written information, make sure it is in a readable size and font and pass it to an attending sighted carer for future reference.
- An unaccompanied patient who may be unable to hear, as well as having sight problems, may benefit from taped information to take away and share with their family at home.

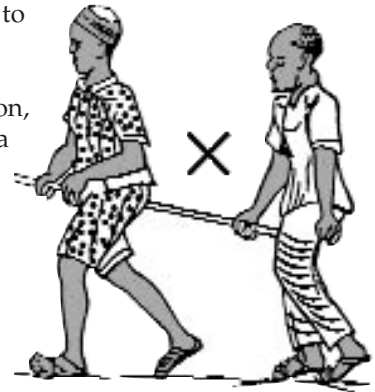


Fig. 9: 'Don't pull me!'

Eye health workers have a responsibility, and an important role, for teaching others about assistance to the visually impaired. But we must be seen to be practising what we teach. A community-based rehabilitation project in

Uganda, some years ago, used a very appropriate and challenging means of raising general awareness. They provided T-shirts for the project team members with illustrations and slogans which read, 'Don't pull me' (front – see Figure 9) and 'Walk with me' (back – see Figure 10). Can you think of similar activities, perhaps?

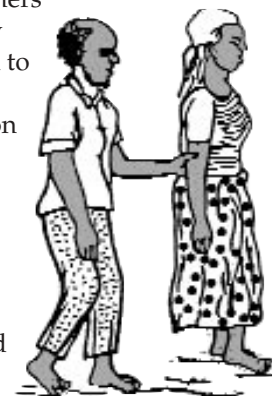


Fig. 10: 'Walk with me!'

Acknowledgments

- The Royal National Institute for the Blind, UK.
- Illustrations (Figs. 1 – 8) by Teresa Robertson.
- My thanks are also due to the visually impaired patients who have helped me to understand their needs and taught me how to help them.

☆ ☆ ☆

In the Eye Hospital

- The patient will expect eye health workers to know how to help them.
- Always apply all the principles mentioned above. Be extra gentle and take time.

LEARNING RESOURCES • OPHTHALMIC EQUIPMENT • SUPPLIERS • INGDOs

Learning Resources, Ophthalmic Equipment, Suppliers Contact Details, Non-governmental Organisations and other Useful Addresses

Sue Stevens RGN RM OND FETC
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International Resource Centre
London School of Hygiene and Tropical Medicine
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London
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BOOKS

The Actions and Uses of Ophthalmic Drugs

P H O'Connor-Davies
ISBN: 0-407-93272-9, paperback
from: Waterstones

Alexander's Care of the Patient in Surgery

M H Meeker, J C Rothrock
ISBN: 0323-00-1343, hardback
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M A Dobson
ISBN: 92-4-154228-4, paperback
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Basic Eye Care

Training Activities for Community Health Workers
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Care of the Ophthalmic Patient

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VIDEOS

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The Anterior Chamber IOL

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The Posterior Chamber IOL

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ECCE with IOL Implantation for Developing Countries

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REFERENCE PUBLICATIONS

Directory of Teaching and Information
 Resources for Blindness Prevention and
 Rehabilitation
 S Stevens
 Booklet
 from: ICEH

Trichiasis Surgery for Trachoma

(The Bilamellar Tarsal Rotation Procedure)
 M Reacher, A Foster, J Huber, B Bauer
 Ref. WHO/PBL/93.29, booklet
 From: WHO

Ophthalmic Operating Theatre Practice

A Manual for Developing Countries
 I.Cox, S.Stevens
 ISBN: 1-902541-08-1
 from: ICEH

Teaching and Assessing in Clinical Practice

C.M.Downie, P.Basford
 ISBN: 1-86166-108-8
 from: Waterstones

A Textbook of Clinical Ophthalmology

R Crick, P Khaw
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| COLARIS (Centro Oftalmológico Latinoamericano de Recursos Informáticos en Salud) | Apartado Aereo 3128 Urbanización el Bosque Autopista a Floridablanca Fundación Oftalmológica de Santander Bucaramanga Colombia fax: +57 97 679 8629 email: colaris@foscal.com.co | Information and teaching resources |
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Asian Eye Care (AEC)
 Christian Blind Mission International (CBMI)
 Association for Eye Care Development in Asia
 Christoffel Blindenmission e.V. (CBM)
 Prof. Junkerslaan 3
 Nibelungenstrasse 124
 1185 JL Amstelveen
 64625 Bensheim
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 fax: +31 20 441 4921
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Dana Center for Preventive Ophthalmology
 Fédération Internationale des Associations
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 Catholiques d'Aveugles (FIDACA)
 Johns Hopkins Hospital
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 fax: +33 1 60 89 49 46
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 email: fidaca@aol.com
 fax: +1 410 955 2542
 email: ncongdon@jhmi.edu

Foresight
 Foundation Dark & Light
 c/o Save Sight Institute
 PO Box 672
 Sydney Eye Hospital Campus
 3900 AR Veenendaal
 GPO Box 6337
 Netherlands
 Sydney
 fax: +31 318 561 577
 NSW 2001
 email: info@darkandlight.com
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 Foundation of the American Academy of Ophthalmology
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 USA
 web: www.hollows.com.au
 fax: +1-415 561 8533
 email: mlynskey@hollows.org
 email: wovaitt@aaio.org
 web: www.eyenet.org

Health for Humanity
 Helen Keller Worldwide (HKW)
 415 Linden Avenue, Suite B
 352 Park Ave South, 12th Floor
 Wilmette
 New York
 Illinois 60091
 NY 10010

USA
 USA
 fax: +1 847 425 7901
 fax: +1 212 532 6014
 email: mkhadem@northwestern.edu
 email: info@hkworld.org
 web: www.hkworld.org

HelpAge International
 International Eye Foundation (IEF)
 PO Box 32832
 10801 Connecticut Avenue
 London
 Kensington
 NI 92N
 MD 20895
 UK
 USA

fax: +44 20 7843 1840
 fax: +1 301 986 1876
 email: hai@helpage.org
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 InFOCUS
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International Centre for Eye Health (ICEH)
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International Eye Foundation (IEF)
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Joint Commission on Allied Health Personnel in Ophthalmology (JCAHPO)
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Lighthouse International
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Norwegian Association of the Blind and Partially Sighted (NABP)
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International Agency for the Prevention of Blindness (IAPB)
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web: www.iapb.org

International Council for Education of People with Visual Impairment (ICEVI)
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Operation Eyesight Universal (OEU)
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Royal National Institute for the Blind (RNIB)
105 Judd Street
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web: www.rnib.org.uk

Sight Savers International (SSI)
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 email: generalinformation@sightsavers.org
 web: www.sightsavers.org.uk

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World Health Organization (WHO)
 Prevention of Blindness and Deafness (PBD)
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 email: info@who.int

ORBIS International Inc.
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 web: www.orbis.org

Organizacion Nacional de Ciegos de España (ONCE)
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Seva Foundation
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Society for Blindness Prevention Overseas
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OTHER USEFUL ADDRESSES

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The Resource Centre holds books, videos, posters, brochures and patient information pamphlets on prevention of blindness topics. The hospital also runs courses in human resource development and in instrument maintenance.

Healthlink Worldwide
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A non-profit purchasing and supply organisation which will purchase and send goods to organisations involved in health care delivery.
