



WORLD HEALTH ORGANIZATION
Prevention of Blindness and Deafness

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Preventing blindness in children

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WORLD HEALTH ORGANIZATION
PREVENTION OF BLINDNESS AND DEAFNESS
GENEVA, SWITZERLAND

INTERNATIONAL AGENCY
FOR THE PREVENTION OF BLINDNESS
HYDERABAD, INDIA

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INTRODUCTION

In March 1998, a two-day consultation on childhood blindness took place in London, at the request of the Task Force of nongovernmental developmental organizations in collaboration with WHO. The purpose of the meeting was to review the available data on childhood blindness and to prepare for the inclusion of a programme to control childhood blindness in the global initiative to eliminate avoidable blindness. The consultation concluded that WHO should be requested to convene an international workshop of experts to develop strategies for controlling childhood blindness in different parts of the world.

This workshop was convened at the LV Prasad Eye Institute, Hyderabad, from 13 to 17 April 1999. Dr Gullapalli N. Rao and Dr Clare Gilbert were elected as joint Chairpersons and Dr Madan Upadhyay and Dr David Yorston acted as Rapporteurs.

Childhood blindness is the second largest cause of blind-person years, following cataract. Globally, approximately 70 million blind person years are caused by childhood blindness. There are about 1.4 million blind children worldwide. Approximately 500 000 children become blind every year – approximately one every minute – and about half of them die within one or two years of becoming blind. Recent research on the economic cost of blindness indicates that blindness costs the community billions of dollars in lost productivity, caring for blind people, rehabilitation and special education. Approximately one-third of this cost is thought to be incurred by blindness in children.

A child's eye is not merely a smaller version of an adult eye, and the causes of childhood blindness are equally different from adult blindness. It follows that the strategies that are effective against adult blindness need to be modified in order to combat blindness in children. The purpose of this scientific meeting was to define strategies and to set clear goals that could lead to the elimination of avoidable childhood blindness by the year 2020.

Children are the most precious resource of families. Children represent the families' future and their hopes. A blind child is a tragedy for these families. A child whose blindness could have been prevented or cured is an even greater disaster.

REVIEW OF AVAILABLE DATA ON PREVALENCE, MAGNITUDE AND CAUSES

Definitions

A child is defined by UNICEF as an individual aged less than 16 years.

Blindness is defined as a corrected visual acuity of less than 3/60 in the better eye and severe visual impairment as a corrected visual acuity in the better eye of $< 6/60$ -3/60.

Prevalence of blindness in children

Limited data are available from developing countries from whole population surveys, disease-specific prevalence surveys and community-based rehabilitation programmes (CBR). In industrialized countries, there are data from registers of the blind and birth cohort studies. All sources probably underestimate the prevalence for a variety of reasons.

The prevalence of blindness in children is associated with under-5 mortality rates (U5MRs), being higher in poorer countries with high U5MRs. Using estimates based on U5MRs, the prevalence of blindness ranges from 0.3/1000 to 1.5/1000 children, being approximately one-tenth as frequent as blindness in whole populations. The prevalence is approximately 0.4/1000 children in high-

income regions, 0.7/1000 children in middle-income regions and 0.9/1000 children in low-income regions.

The overall prevalence of blindness in children is 0.75/1000 children.

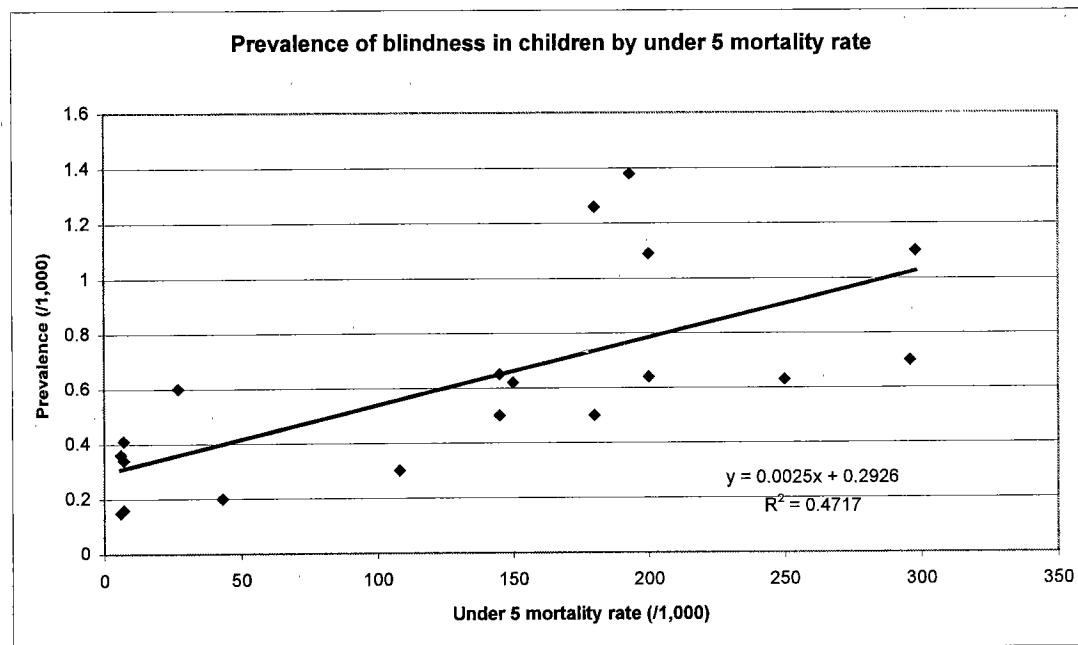


Fig. 1 Prevalence of childhood blindness by U5MRs

Incidence of blindness

There are few data on the incidence of blindness in children. Registers of the blind in Nordic countries suggest an incidence of 6-11/100 000 children/year.

It has been estimated that 500 000 children become blind each year (one every minute), but between 50% and 60% are thought to die within one to two years, mainly as a result of the condition causing blindness (e.g. vitamin A deficiency, measles, congenital rubella).

Magnitude of blindness

There are estimated to be 1 400 000 blind children worldwide, 73% of whom live in low-income countries.

Table 1. Distribution of blind children, by level of socioeconomic development

Region	Population aged < 16 years (millions)	Prevalence per 1000 children	Estimate of number of blind children	% of blind child population
EME	78	0.51	40 000	3
FSE	170	0.30	50 000	4
LAC	170	0.62	100 000	7
MEC	240	0.80	190 000	13
China	340	0.50	210 000	15
India	350	0.80	270 000	19
OAI	260	0.83	220 000	16
SSA	260	1.24	320 000	23
Total	1 868	0.78	1 400 000	100

Causes of blindness in children

The causes of blindness in children can be classified in two ways. The first uses a descriptive, anatomical classification which depends on the site in the eye most affected. The second, which is an etiological classification, is based on the time of onset of the insult leading to blindness (for example hereditary diseases, intrauterine factors, etc.). The anatomical classification is useful, as information can be collected on all children. The etiological classification is more useful for planning preventive measures, but reliable etiological information is more difficult to obtain.

Table 2. Estimates of the number of blind children, by cause

Anatomical classification		Etiological categories	
Retina	380 000	Unknown	560 000
Cornea	260 000	Hereditary	420 000
Whole globe	250 000	Childhood	280 000
Lens	190 000	Perinatal	100 000
Optic nerve	140 000	Intrauterine	40 000
Glaucoma	90 000		
Other	50 000		
Uvea	40 000		
Total	1 400 000	Total	1 400 000

Major causes of blindness in children and regional variation

There is marked regional variation in the major causes of blindness in children in different parts of the world. In the poor countries of the world, corneal scarring due to vitamin A deficiency, measles, ophthalmia neonatorum and the use of harmful traditional practices (TP) predominates. Globally, corneal scarring is the single commonest cause of blindness in children in schools for the blind. In middle-income countries, the commonest causes are retinal conditions, mainly hereditary retinal dystrophies and retinopathy of prematurity. Central nervous system disorders, due to a range of conditions, and retinal conditions are the commonest causes in high-income countries.

Table 3. Causes of blindness in children in schools for the blind
Anatomical classification (%)

	EME*	FSE	LAC	MEC	China	India	OAI	SSA
Globe	10	12	11	15	25	24	25	9
Cornea	1	2	8	8	4	28	23	31
Lens	8	11	7	20	19	11	16	9
Uvea	2	5	2	4	2	5	1	4
Retina	25	44	47	39	25	22	21	24
Optic nerve	25	15	12	7	14	6	7	10
Glaucoma	1	3	8	5	9	3	6	7
Other	28	8	5	2	2	1	1	6
Total	100	100	100	100	100	100	100	100

* Data from registers of the blind.

Table 4. Causes of blindness in children in schools for the blind
Etiological classification (%)

	EME*	FSE	LAC	MEC	China	India	OAI	SSA
Hereditary	45	18	22	54	31	26	25	24
Intrauterine	7	6	8	2	0	1	3	3
Perinatal	24	28	28	1	2	2	9	7
Childhood	10	5	10	6	14	29	17	31
Unknown	14	43	32	37	53	42	46	35
Total	100	100	100	100	100	100	100	100

*Data from registers of the blind.

Avoidable causes of blindness in children

Avoidable causes are those which are either entirely preventable, or where treatment can prevent blindness or restore sight (see below).

Table 5. Avoidable causes of childhood blindness

Preventable conditions	Treatable conditions
Corneal scarring due to: - vitamin A deficiency - measles infection - ophthalmia neonatorum - harmful traditional practices - infective corneal ulcers	Cataract Glaucoma Retinopathy of prematurity
Intrauterine factors: - rubella - toxoplasmosis - other teratogens such as alcohol	Uveitis Corneal disease (corneal ulcers and opacity)
Perinatal factors: - retinopathy of prematurity - birth hypoxia	
Hereditary diseases: - risk counselling for dominant disease	

Regional variation in avoidable causes

The relative importance of the different avoidable causes of blindness in children varies considerably from region to region. Estimates of the magnitude of avoidable blindness by region are given below.

Table 6. Regional variation in avoidable causes

High income Blind = 90 000		Middle income Blind = 290 000		Low income Blind = 1 020 000	
ROP	10% 9000	Cataract	15% 45 000	Corneal scar	20% 200 000
Teratogens	6% 5400	ROP	10% 29 000	Cataract	13% 133 000
Cataract	6% 5400	Glaucoma	6% 17 000	Glaucoma	6% 60 000
Glaucoma	2% 2000	Teratogens	4% 12 000	Optic atrophy*	6% 60 000
Total avoidable	24% 21 800	Total avoidable	35% 103 000	Total avoidable	45% 453 000

Overall, approximately 40% of blindness in children is avoidable. However, a significant proportion of the "unknown" causes certainly represent preventable conditions which cannot readily be diagnosed (for example congenital rubella syndrome). Forty per cent therefore represents a minimum estimate.

Trends in the major causes of childhood blindness

The major causes of blindness in children are largely determined by levels of socioeconomic development and health care provision. Causes of childhood blindness can vary over time in response to changing economic development and the introduction of health interventions. For example, ophthalmia neonatorum was a major cause in European countries at the turn of the century. Infectious causes were important in Saudi Arabia, but now hereditary diseases predominate. Retinopathy of prematurity was the single commonest cause of blindness in Europe during the 1950s, but now accounts for only 5-15%. Retinopathy of prematurity is becoming an important cause of blindness in middle-income countries as they introduce neonatal intensive care services. A reduction in corneal blindness has been documented in Asian and African countries, in response to improved measles immunization coverage rates. Due to the huge international efforts to combat vitamin A deficiency, keratomalacia is reported as being much less frequent in many countries which had a severe vitamin A deficiency problem (for example India).

It is likely that countries in transition (i.e. those in which the major causes of morbidity and mortality are changing from communicable to noncommunicable diseases) will develop patterns of blindness similar to those seen now in middle-income countries. Regions of the world in which economic development is in decline may witness a resurgence of causes due to diseases that were thought to be in the past.

CHILDHOOD BLINDNESS IN THE CONTEXT OF VISION 2020

In February 1999, WHO launched the global initiative for the elimination of avoidable blindness. Currently, there are 45 million blind people in the world, 90% of whom live in developing countries. Another 135 million suffer from some degree of visual impairment. Because of demographic changes and the world's steadily growing population, these figures will double during the next 20 years unless prompt action is taken. The aims of this initiative are:

- ▶ a focus on the major blinding diseases
- ▶ improved coordination of activities
- ▶ advocacy
- ▶ resource mobilization and fundraising

The five problems which are priorities for the first phase of VISION 2020 are:

- ▶ cataract
- ▶ trachoma
- ▶ childhood blindness
- ▶ onchocerciasis
- ▶ refractive errors

These diseases are responsible for 70% of all blindness and effective measures are available, at a reasonable cost, to cure or prevent the conditions.

VISION 2020 will be implemented through the following activities:

- ▶ Specific disease control measures
- ▶ Human resource development
- ▶ Development of appropriate technology and infrastructure

In the field of childhood blindness, it is suggested that the main priorities for action are:

- ▶ elimination of vitamin A deficiency
- ▶ treatment of congenital cataract, glaucoma, retinopathy of prematurity
- ▶ serious refractive errors

This will be achieved through:

- ▶ promotion of primary health care (PHC)
- ▶ developing specialist children's eye services, including surgery and low vision clinics
- ▶ school screening

The global initiative is focused on only a few conditions at present. As strategies are developed and implemented, the current leading causes of blindness will become relatively less important. When this happens, other diseases such as glaucoma or diabetic retinopathy may be included in the global initiative.

CORNEAL BLINDNESS

Corneal disease remains the leading cause of blindness among children. In Africa and Asia, up to 70% of childhood blindness is due to corneal disease. Corneal scarring related to vitamin A deficiency is probably the single largest cause of childhood blindness.

Prevention of corneal blindness in children requires an integrated effort by a large number of people:

- ▶ Ophthalmologists and other eye care workers
- ▶ Primary health care workers
- ▶ Community leaders and legislators
- ▶ Educators
- ▶ Traditional medical practitioners/healers
- ▶ Nutritionists

It is only through multisectoral collaboration that corneal blindness can be eliminated.

Causes and prevention of corneal blindness in children

Many of the causes of corneal blindness can be prevented by simple primary health care measures.

Table 7. Causes and prevention of corneal blindness in children

Major causes	Primary prevention	Secondary prevention
Vitamin A deficiency	Measles immunization Vitamin A supplementation Nutrition education	Treatment of xerophthalmia with vitamin A
Measles	Measles immunization	Vitamin A treatment for children with measles Careful eye examination for all children with measles Treatment of corneal ulcers in any child with measles
Traditional practices	Education of traditional practitioners/ healers Accessible, affordable, high-quality primary eye care	Treatment with intensive antimicrobial therapy of ulcers associated with traditional practices
Ophthalmia neonatorum	Cleaning eyes of newborn children Povidone iodine prophylaxis	Intensive, appropriate and rapid treatment of neonates with conjunctivitis
Herpes simplex keratitis	Malaria prophylaxis	Prompt recognition and treatment with antivirals
Other corneal infections	Avoid trauma	Prompt and appropriate treatment

Tertiary prevention requires a corneal transplant (penetrating keratoplasty). This can be very successful in older children with corneal dystrophies and non-vascularized corneal scars. However, the majority of children blinded by corneal scarring are not good candidates for a corneal transplant, as the prognosis for the graft is poor in very young children and in eyes with vascular scars, anterior synechiae and other associated abnormalities.

Currently, the supply of donor tissue is insufficient to provide grafts for the patients who would most benefit. Locally organized eye banks, provided they maintain high standards of care, can be an important source of donor tissue for corneal grafting in children. In a few cases, optical iridectomy may prove useful.

Measles immunization

Since 1990, global immunization coverage with measles vaccine has been sustained at 80%, preventing an estimated 90 million cases and 1.5 million deaths per year. However, an estimated one million deaths due to measles still occur every year, half of them in Africa. There is a need to improve measles immunization coverage, particularly in poor rural areas.

Measles immunization is receiving more attention and heightened political interest. Currently, 113 countries have set a target of measles elimination. These countries will be intensifying surveillance, with investigation of cases, specimen collection and laboratory investigations.

Primary health care and corneal blindness

Corneal blindness is closely linked to low socioeconomic status. The provision of basic necessities, such as:

- ▶ adequate food
- ▶ clean water supply
- ▶ basic primary health care, including immunization
- ▶ education

will greatly reduce the incidence of blinding corneal disease.

Primary health care has made a great contribution to preventing corneal blindness in children, and this contribution is insufficiently recognized. Prevention of childhood blindness should be an explicit aim of PHC programmes.

Treatment of active corneal diseases relies on the availability of effective, accessible and affordable primary eye care. Ideally, this should be an integral part of primary health care. With prompt treatment, severe corneal scarring can often be avoided.

Vitamin A supplementation

Vitamin A deficiency is a major contributor to childhood morbidity and mortality. As defined by its clinical and subclinical forms, vitamin A deficiency exists in 75 countries and affects an estimated 3 million schoolchildren. In 1994, WHO adopted a policy of integrating administration of vitamin A into national immunization programmes. This policy promotes vitamin A supplementation in:

- ▶ routine immunization services
- ▶ supplementary immunization activities (national immunization days and other mass campaigns)
- ▶ measles case-management

During 1997-1998, 47 countries administered vitamin A supplements during national immunization days. These serve as a vehicle for administering one dose per year, yet children should receive a dose every six months, and this may require conducting another mass campaign annually.

CONGENITAL CATARACT

Etiology

There are an estimated 130 000 children blind from congenital cataract or aphakia. In many cases, the cause of the cataract cannot be determined. The main preventable causes of congenital cataract are the following:

Congenital rubella

An estimated 238 000 children in developing countries are born with congenital rubella syndrome (CRS) every year. The number blind from CSR cataracts is unknown. In a hospital-based study in southern India, 25% of infantile cataracts were associated with congenital rubella. The frequency of congenital rubella will vary in different parts of the world, depending on disease transmission and immunization policies.

Currently, 78 countries, including more than one-quarter of all developing countries, use rubella vaccine on a national basis. Countries have shown increasing enthusiasm for rubella immunization. USA and the English-speaking countries of the Caribbean have set targets to eliminate CRS and rubella by the year 2000. Rubella immunization of women of childbearing age is the top priority for preventing CRS in all countries. Countries that have achieved 80% measles vaccination coverage for infants should incorporate rubella immunization into the routine childhood immunization programmes, as long as high coverage can be sustained.

Genetic

Some cases of congenital cataract might be avoided by genetic counselling. However, there are major cultural barriers to this in many communities.

Management of cataract in children

Children with cataract do not present themselves. The cataract must first be recognized by someone else – usually a member of the child's family, sometimes a teacher or a trained health worker.

Cataract in children is very different from cataract in adults. The surgery is more complex, and the postoperative follow-up care is much more demanding.

Children are not born with normal vision, they have to learn to see by using their eyes constantly during the first few months of life. In order to do this, there must be a clear image focused on the macula of the child's retina. If this does not happen, the child's vision will not develop normally. In an adult, surgery for cataract is not urgent, and correction of the aphakia may be carried out at leisure. In young children, both the surgery and full visual rehabilitation are urgent.

Children's eyes behave differently from adult eyes. Severe intraocular inflammation is more common. If the posterior capsule is left intact, it will invariably become opaque. The eye is growing until the child is two years old, which leads to frequent changes in the refractive state of the eye.

Correction of aphakia

Because a focused image on the retina is essential to visual development, merely removing the cataract will not restore vision. Full correction of the aphakia, as soon as possible after surgery, is essential. Currently there are three methods which are used to correct aphakia in children:

Spectacles

Safe and inexpensive. Easy to change the power. However, they can be lost or broken. Children may not wear them for cultural or cosmetic reasons.

Contact lenses

Expensive. Provide good quality of vision. Easy to change the power. However, they require intensive follow-up and meticulous care to avoid severe corneal infections. They may get lost.

Intraocular lenses

Inexpensive. Cannot get lost or broken. Impossible to change the power as the child's refraction changes. Use in children under two years of age is controversial. Further evaluation is required.

At present, there is no conclusive evidence to suggest that one method of correction is better than another. There is a consensus that an intraocular lens is the best form of correction for older children, but the minimum age for a lens implant must be left to the individual ophthalmologist to decide.

What is certain is that any correction of aphakia is better than none and that full correction of aphakia should be carried out as soon as possible after the cataract is removed.

When should surgery be done?

Surgery should be carried out as soon as possible after the development of a visually disabling lens opacity. Early recognition, early intervention and early rehabilitation will all increase the probability of a good visual outcome.

What surgery should be done?

Lenectomy, combined with posterior capsulectomy and anterior vitrectomy, guarantees a clear visual axis with one operation. Extracapsular extraction/aspiration will leave the posterior capsule intact and almost invariably requires secondary capsulotomy.

Who should do the surgery?

Not all ophthalmologists should do congenital cataract surgery. The surgery should be performed by an ophthalmologist with an interest in childhood blindness and who has the skills and commitment necessary to supervise the child until visual development is complete.

The parents of the affected child are an essential part of the eye care team. They should be fully involved in their child's treatment and follow-up.

Where should surgery be done?

Congenital cataract surgery should be carried out in specialist centres that have the necessary staff and facilities. These include paediatric anaesthesia, an automated vitreous cutting machine and good refraction and low vision services.

RETINOPATHY OF PREMATURITY

Definition

Retinopathy of prematurity (ROP) occurs in pre-term babies because the normal process of vascularization of the peripheral retina is not complete at the time of birth. The developing vasculature is sensitive to biochemical changes (such as blood gas levels) which can lead to the formation of abnormal blood vessels in the back of the eye. These blood vessels can leak and bleed, and abnormal scar tissue causes the retina to detach.

Classification

ROP can be classified according to the region of the retina affected (Zones 1, 2 and 3), the stage of disease (Stages I-V) and other features:

- ▶ "Plus" disease, which denotes breakdown of blood retinal barriers.
- ▶ Threshold disease, which is defined as five continuous clock hours, or a total of eight hours, of Stage III "plus" disease.
- ▶ Cicatricial disease, from scarring, which causes traction and distortion of the retina. Stage V causes blindness due to retinal detachment.

Natural history of ROP

The early stages of ROP (Stages I and II) usually are not seen until six to seven weeks after birth. Spontaneous regression occurs in the majority of babies, but in some the disease progresses to Stage III. If "plus" disease is also present, around 50% of babies will progress to Stage IV (subtotal retinal detachment) or Stage V (total retinal detachment).

A large multicentre study of cryotherapy treatment for eyes with threshold disease, undertaken in USA, showed that peripheral retinal ablation was effective at preventing an unfavourable outcome in almost 50% of eyes. Currently, retinal ablation may be carried out either with cryotherapy or with a laser mounted on a binocular indirect ophthalmoscope.

Complex vitreoretinal surgery has been undertaken for eyes with Stage IV or V disease, but this has been shown to give disappointing visual results.

Regional variations in ROP

Established market economies

The "first epidemic" occurred in the West during the 1940s and 1950s and was the single commonest cause of blindness in many industrialized countries. During the "first epidemic", babies with birth weights over 1500 g were also affected. The cause was probably too much oxygen administered to babies in incubators. Industrialized countries are witnessing a "second epidemic" of blindness in children due to ROP, which had been thought to be a disease of the past. The re-emergence of the condition has come about as a result of better intensive neonatal care, with improvements in the survival of extremely premature, low-birth-weight babies. In these countries, only babies with birth weights of less than 1250 g tend to be affected by advanced disease.

Middle-income countries

There is evidence that ROP is an increasingly important cause of blindness in middle-income countries, including former Socialist economies. Blind school studies in these countries show that the proportion of blindness due to ROP ranges from 0 to 60% (mean for Latin American countries: 25%).

The birth weight of children blind from ROP in these countries shows a much wider range than in high-economy countries (600-2240 g).

During the "first epidemic", the main risk factors for ROP were supplemental oxygen given to pre-term babies which was unmonitored. The current risk factors in the West are currently extreme prematurity and low birth weight. Middle-income countries seem to have a mixture of these risk factors.

Prevention of ROP

As the advanced stages of ROP are not amenable to surgical treatment, emphasis needs to be on prevention. Primary prevention would entail preventing pre-term birth and excellent intensive neonatal care of premature, low-birth-weight babies, including blood gas monitoring and control.

Secondary prevention requires the development of screening programmes to identify babies needing peripheral retinal ablation, i.e. those with Stage III "plus" threshold disease. Examining the peripheral retina in very small babies in neonatal intensive care units is a specialized skill and should be carried out by ophthalmologists who have received training in the procedure.

Follow-up studies have shown premature babies to be at increased risk of refractive errors, amblyopia and strabismus. All babies included in a screening programme for ROP should also be followed up to identify and manage these other ocular problems.

REFRACTIVE ERRORS AND SCREENING

See also the Report of the Informal Planning Meeting on the Elimination of Avoidable Visual Disability due to Refractive Errors (Unpublished document WHO/PBL/00.79)

Impact of refractive errors

Visual impairment (vision less than 6/18 but not blind) is common in children. There is a wide variation in the frequency of this problem, depending on ethnic and other factors. In southern India, 3% of schoolchildren have visual impairment. In China, it is thought that the prevalence is much higher. Overall, it is estimated that 2-10% of children may have significant refractive error (defined as a refractive error where the child is likely to wear the prescribed spectacles regularly).

Visual impairment can have a significant impact on a child's life. In particular, it may interfere with his/her education. This in turn may lead to lower earnings, reduced employment opportunities and social stigmatization.

The major cause of visual impairment is refractive error. In 95% of visually impaired children, the provision of spectacles improves their vision to within normal limits.

Screening for refractive errors

Because visual impairment is a common condition with significant socioeconomic costs, and treatment is simple, effective and inexpensive, a screening programme is appropriate. However, no screening should take place unless the following are available:

- ▶ Personnel trained in refraction and the prescription of glasses
- ▶ Adequate provision for treatment of any abnormalities discovered

Who should do it?

Initial screening may be carried out by a teacher, a nurse or any other trained person. A high level of ophthalmic expertise is not required. Children found to have visual impairment should be examined by a primary eye care provider, who should be appropriately trained in refraction. Spectacles should be provided to all children who need them.

When should it be done?

There is no single time at which it is possible to screen for all childhood eye problems. Initially, screening for refractive error and visual impairment should be started between the ages of 11 and 13. This could be extended later to younger age groups, depending on available resources.

Vision screening is not a one-time activity but a continuous process.

Where should it be done?

Initial screening should be done at school. When this has been accomplished, screening may be extended to children who do not attend school.

What should be done?

All screening tests represent compromises between sensitivity (too many false positives) and specificity (too many false negatives). It is important to keep the initial screening test very simple, so that it can be administered by teachers or nurses. The ability to see 6/12 with both eyes open constitutes a simple and reproducible screening test. This test will not pick up unilateral loss of vision, nor will it find patients with mild refractive errors. However, significant refractive errors, for which spectacle wear is likely to be acceptable by the child, will be identified.

LOW VISION SERVICES**Definition**

"A person with low vision is one who has impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception, or a visual field of less than 10° from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task." [Management of low vision in children (Unpublished document WHO/PBL/93.27)]

Anyone who has vision has the potential to use that vision, but may need training in order to use the vision efficiently. Few children with low vision have access to low vision care. One reason is the lack of knowledge, among both health care professionals and the community, of the need for and benefits from low vision services.

Objectives of low vision care

- ▶ To minimize the extent to which low vision restricts children's participation in activities normal for children of that age in the community in which they live.
- ▶ Tests appropriate to the child's age and culture should be available in order to assess vision.
- ▶ Distance, near and functional vision should be assessed in addition to assessing the impact of visual impairment on the daily activities of the child.
- ▶ Low vision services should be integrated into eye care services at primary, secondary and tertiary levels.
- ▶ Training in low vision should be included in the basic training of all eye care professionals. Postgraduate training programmes should be available in selected countries.

- ▶ Low-cost, high-quality low vision devices must be available in sufficient quantities to meet the requirements of all children who need them.
- ▶ To ensure that all children with low vision are referred to early intervention rehabilitation services and receive appropriate education – preferably in an integrated programme.

Primary, secondary and tertiary low vision services

Primary

At the primary level, children with low vision should be identified and referred for assessment and possible treatment – which may include refraction, prescription of low vision devices and planning a low vision rehabilitation programme. Basic rehabilitation can be provided through CBR or integrated educational programmes.

Secondary

Secondary-level low vision care can be provided within an eye unit in a hospital; or in an educational or rehabilitation resource centre, by eye care personnel and a multiskilled worker. After refraction, low-power magnifiers for near work may be prescribed. Depending on assessment of functional vision and educational or rehabilitation needs, the device should be provided by a multiskilled teacher or rehabilitation worker.

Tertiary

Many children can be served well by secondary-level low vision services, but

- ▶ very young children
- ▶ children with severe ocular abnormalities or multiple disabilities
- ▶ low vision children who need complex or high-powered low vision devices

will require specialized care that is likely to be available only at tertiary specialist centres.

Training courses and curricula should be developed. These can be incorporated into basic training of eye care personnel.

STRATEGIES FOR THE CONTROL OF CHILDHOOD BLINDNESS

Primary-level services

The essential elements of primary health care are of paramount importance for the control of blindness in children, particularly for the prevention of conditions causing corneal scarring and for the early identification of children needing intervention.

Primary health care strategies

HEALTH PROMOTION – INFORMATION, EDUCATION AND COMMUNICATION (IEC)

Target groups:

- Mothers and women of childbearing age
- Teachers
- Religious and other community leaders

The community in general

Health education messages should include the following:

- Breastfeeding can prevent eye disease and blindness
- A diet rich in vitamin A foods can prevent blindness
- Immunization against measles can prevent blindness
- Good hygiene and facial cleanliness can prevent eye disease
- Avoid using harmful traditional practices which can damage the eyes
- If a child has an eye or visual problem, seek medical advice

DIAGNOSIS, TREATMENT AND REFERRAL OF COMMON EYE DISEASES

The following conditions can be recognized and treated at the primary level and referred when indicated:

- Ophthalmia neonatorum
- Xerophthalmia
- Measles
- Acute "red eyes"
- Trauma

INTERVENTIONS THROUGH MATERNAL AND CHILD HEALTH CLINICS

MCH can provide the following to control childhood blindness:

- Antenatal care, with low-dose vitamin A supplementation
- Vitamin A supplementation to women after delivery and to children [WHO/UNICEF/IVACG/HKI. Vitamin A supplements: A guide to their use in the treatment and prevention of vitamin A deficiency, 3rd ed. (In press)]
- Child-spacing
- Measles immunization
- Identification and treatment of sexually transmitted diseases and ocular prophylaxis in the newborn to prevent ophthalmia neonatorum

ESSENTIAL DRUGS

- Vitamin A capsules/syrup
- Topical antibiotics without steroid
- Topical preparations for prophylaxis of ophthalmia neonatorum (i.e. tetracycline ointment, povidone iodine drops, silver nitrate solution)

Cataract

HEALTH PROMOTION – INFORMATION, EDUCATION AND COMMUNICATION (IEC)

Target groups:

- Mothers and other family members
- PHC workers
- MCH workers
- Midwives
- Traditional birth attendants
- Family practitioners

Teachers

Health education messages should include the following:

Cataract can affect babies and children and is not a disease just of the elderly
 Early identification and referral for intervention are important
 Rubella immunization can prevent some cataracts

IMMUNIZATION

Rubella immunization

MATERNAL AND CHILD HEALTH

Monitoring of compliance and follow-up

IDENTIFICATION AND REFERRAL

Primary-level health workers

Retinopathy of prematurity

MATERNAL AND CHILD HEALTH

Good antenatal care to prevent pre-term birth

HEALTH PROMOTION – INFORMATION, EDUCATION AND COMMUNICATION (IEC)

Target groups:

Women of childbearing age
 Family
 Teachers
 PHC/MCH workers
 Family practitioners

Health education messages should include the following:

Pre-term birth can lead to blindness from retinopathy of prematurity (ROP)
 Pre-term births are more likely in early teenage pregnancies
 Pre-term birth can follow injudicious elective Caesarean section and so increase the risk of ROP

Refractive errors

HEALTH PROMOTION – INFORMATION, EDUCATION AND COMMUNICATION (IEC)

Target groups:

Mothers
 Others who care for children
 Teachers
 PHC/MCH workers
 Family practitioners

Health education messages should include the following:

Early intervention is important
Children of any age who have a significant refractive error can benefit from wearing glasses

RECOGNITION AND REFERRAL

Vision screening and appropriate referral
Refraction services

Low vision services

HEALTH PROMOTION – INFORMATION, EDUCATION AND COMMUNICATION (IEC)

Target groups:

Mothers and others who care for children
Teachers
PHC/MCH workers
Family practitioners

Health education messages should include the following:

Early intervention is important
Children of any age who have a significant refractive error can benefit from wearing glasses
Children with low vision benefit from specialist care, including the use of special equipment and materials
The use of vision should be encouraged

RECOGNITION AND REFERRAL

Vision screening and appropriate referral
Low vision care through community-based rehabilitation and education

Table 8. Role of primary health care in the control of childhood blindness

	Vitamin A deficiency	Harmful TP	Ophthalmia neonatorum	Measles	Other corneal	Cataract	ROP	Refractive errors	Low vision care
Health education	+++	+++	+++	+++	+++	+++	+++	+++	+++
Maternal and child health	+++	+	+++	+++	+++	++	+++	-	-
Water/sanitation	+++	-	-	-	+++	-	-	-	-
Food/nutrition	+++	-	-	++	-	-	-	-	-
Immunization	+++	-	-	+++	-	+++	-	-	-
Control of locally endemic diseases	+++	-	-	-	+++	-	-	-	-
Treatment of common diseases	+++	+	+++	+++	+++	+	-	+++	+
Essential drugs	+++	+	+++	+++	+++	-	-	-	-

Secondary-level services

The role of the secondary level in the control of childhood blindness includes prevention, diagnosis, disease management and/or referral, and follow-up; human resource development; health education; management; documentation.

Corneal blindness

PREVENTION/MANAGEMENT OF EXTERNAL EYE INFECTIONS, CORNEAL SCARS AND CORNEAL OPACITY

- Ocular prophylaxis/treatment of ophthalmia neonatorum
- Diagnosis and appropriate treatment of corneal ulcers and external eye infections
- Coordination with EPI immunization programmes
- Referral for assessment of nutritional status
- Referral of selected cases for sight-restoring surgery (i.e. optical iridectomy, penetrating keratoplasty)

HUMAN RESOURCE DEVELOPMENT

- Training and support of primary-level health workers and traditional healers
- Training of trainers for the primary level

HEALTH EDUCATION

- Development and production of health education materials for use at secondary and primary levels

MANAGEMENT

- Eye donation unit

Cataract

EYE CARE SERVICES

- Coordination with rubella immunization programme
- Assessment and prompt referral of young children with cataract
- Assessment and surgical management of children with cataract
- Long-term follow-up with management of refractive errors, amblyopia, strabismus
- Visual rehabilitation

HEALTH EDUCATION

- Of mothers and families of the need for optical correction and long-term follow-up

HUMAN RESOURCE DEVELOPMENT

- Training and support of primary-level health workers
- Training of trainers for primary-level personnel

RESEARCH

- Good documentation to evaluate outcomes

Retinopathy of prematurity

HEALTH EDUCATION

Increase awareness among obstetricians, neonatologists and paediatricians

Refractive errors

EYE CARE SERVICES

Detection and management of children with significant refractive errors
Detection and referral of children with complex refractive errors

HUMAN RESOURCE DEVELOPMENT

Training of teachers and other workers at primary level in vision screening

HEALTH EDUCATION

Children at any age who have a need can benefit from wearing glasses

MANAGEMENT

Ensure supplies of low-cost spectacles with paediatric frames

Low vision

EYE CARE SERVICES

Evaluation of vision and assessment of need for low vision care
Prescription of spectacles, simple optical and non-optical low vision devices
Assessment and referral of complex cases
Training in use of vision, equipment and techniques for independent function

HEALTH EDUCATION

Of parents/teachers about the potential benefits of low vision care

MANAGEMENT

Ensure supplies of low-cost low vision devices

Tertiary-level services

At the tertiary level, important activities for the control of childhood blindness include the provision of specialized eye care services, human resource development, planning and research. Services need to be integrated with those at the secondary and primary levels. There should be close collaboration with other specialties providing services for children, for example paediatricians, neonatologists, geneticists.

Corneal blindness

SPECIALIZED EYE CARE SERVICES

Prompt and appropriate management of corneal ulcers
Sight-restoring surgery and follow-up of selected cases with corneal opacity (i.e. optical iridectomy, corneal graft)
Microbiology services
Low vision services

HUMAN RESOURCE DEVELOPMENT

Training of ophthalmologists and trainers of trainers in management of corneal ulcers
Training of ophthalmologists in keratoplasty
Training of those providing optical correction and visual rehabilitation

PLANNING

Multisectoral collaboration
Eye banking and linkages
Legislation concerning preventive measures, for example seat belts, fireworks

RESEARCH NEEDS

Epidemiological research
Clinical research, for example role and outcome of keratoplasty

Cataract

SPECIALIZED EYE CARE

Diagnosis and assessment, with surgical and optical management of cataract and any complications
Optical correction, visual rehabilitation and long-term follow-up
Counselling

HUMAN RESOURCE DEVELOPMENT

Training of ophthalmologists in the management of paediatric cataract
Training for those providing optical services and visual rehabilitation
Training of secondary and primary health workers in the detection of cataract
Training of paediatric ophthalmology teams (ophthalmologist/anaesthetist and ophthalmic nurse)

PLANNING

Referral systems for expedited care
Mobilization of resources for care and development
Public and professional awareness education
Training for all levels

RESEARCH NEEDS

- Epidemiological research
- Clinical outcome studies (possibly multicentre)
- Clinical trials (possibly multicentre)

Retinopathy of prematurity

SPECIALIZED EYE CARE

- Screening pre-term, low-birth-weight babies for ROP needing treatment
- Diagnosis and treatment of threshold disease
- Counselling
- Optical and low vision services, with visual rehabilitation
- Rehabilitation for the totally blind child
- Long-term follow-up of low-birth-weight babies

HUMAN RESOURCE DEVELOPMENT

- Training of ophthalmologists in indirect ophthalmoscopy, the recognition of ROP and treatment of threshold disease
- Training of support personnel

PLANNING

- Coordination of multidisciplinary care
- Identification of care provider to ensure responsibility for follow-up
- Documentation and audit
- Increase awareness
- Promote good antenatal care

RESEARCH NEEDS

- Research into risk factors, incidence, screening guidelines, and indications and outcome of treatment in different settings
- Blind school studies repeated over time to evaluate impact of screening programme

Refractive errors

SPECIALIZED EYE CARE

- Management of complex refractive errors

HUMAN RESOURCE DEVELOPMENT

- Training in refraction

PLANNING

- Policy planning for optical services
- Screening policy
- Provision of high-quality glasses with paediatric frames at affordable cost

RESEARCH NEEDS

Epidemiological – magnitude and distribution
 Screening – methodology, target population, outcomes
 Safe, shatterproof glasses for children

Low vision**SPECIALIZED EYE CARE**

Assessment, provision and training in the use of low vision devices (simple and complex) and non-optical interventions, with follow-up
 Support to those responsible for children with low vision
 Specialized rehabilitation training provided by a multidisciplinary team

HUMAN RESOURCE DEVELOPMENT

Training of low vision rehabilitation personnel
 Training for those providing low vision services at secondary and primary levels
 Increase awareness among those providing eye care to children

PLANNING

Development of low vision services
 Resource mobilization
 Provision of good-quality, affordable low vision devices (LVDs)
 Support to services at the primary and secondary levels
 Assessment and monitoring of service
 Technology transfer for local/regional production of LVDs

RESEARCH NEEDS

Epidemiological research for needs assessment: magnitude
 Low vision technology
 Operational research: assessment of training curriculum and methods
 Evaluation of methods and impact on quality of life

HUMAN RESOURCE DEVELOPMENT

Low-income countries suffer from a severe shortage of eye care personnel. This is most extreme in sub-Saharan Africa. Even in middle-income countries in which there are, in theory, sufficient human resources, there may be a shortage of the specialist skills needed to combat childhood blindness (for example screening for retinopathy of prematurity). Unless this lack of human resources is redressed, it will be extremely difficult to eliminate the avoidable causes of childhood blindness.

Definition

Human resource development encompasses much more than simply training eye health workers. It should include the following:

- ▶ Training
- ▶ Equipping

- ▶ Supplying
- ▶ Motivating
- ▶ Supporting
- ▶ Developing

In some countries, personnel costs consume the major part of the health care budget. This means that insufficient resources are available to provide the necessary equipment and supplies to enable trained eye care workers to provide an adequate level of service for patients. When planning human resource development, it is essential to consider these factors and to ensure that everyone who is trained will be adequately supported.

There are four cadres of health workers who are of particular importance in reducing the prevalence of avoidable childhood blindness:

- ▶ Paediatric-oriented ophthalmologist
- ▶ Low vision worker
- ▶ Refractionist
- ▶ Primary health care worker

Paediatric-oriented ophthalmologist

In most low-income countries, there are very few ophthalmologists with specific training in childhood eye disease. Paediatric-oriented ophthalmologists are defined on the basis of their skills and interests, rather than on the basis of having completed postgraduate subspecialty training in paediatric ophthalmology. Paediatric-oriented ophthalmologists are qualified ophthalmologists with an interest in, and understanding of, children's visual development. They should have the requisite skills to enable them to deliver a high standard of children's eye care. The minimum requirement is one per 10 million population. In low- and middle-income countries, the bulk of their practice will be routine adult ophthalmology; however, they will also take a special interest in the prevention of childhood blindness.

Low vision personnel

In most countries there are very few, if any, health workers who specialize in the delivery of low vision services to children. This task involves refraction, prescription of low vision devices and low vision training, assessment of vision in young children, treatment of amblyopia, and visual stimulation. To fulfil this role, a low vision worker must be a multiskilled individual, combining some of the abilities of an orthoptist, a refractionist and a low vision therapist. The minimum requirement is one per 5 million population. Few training programmes for low vision personnel exist, and the development of training curricula and infrastructure is a high priority for the elimination of avoidable childhood blindness.

Refractionist

Refractive error is an important cause of visual impairment in children. Although some countries have sufficient people trained to provide optical devices for the correction of refractive error, others – particularly low-income countries – have very few people with the requisite skills. The global initiative for the elimination of avoidable blindness has set a target of one refractionist per 100 000 population by 2010. This should be sufficient to meet the needs of children as well as adults. It should be noted that the term "refractionist" will mean different people in different situations. In high-income countries, refraction will usually be carried out by an optometrist, with a minimum of three years' training. In low-income countries, refraction may be performed by an ophthalmic assistant or a nurse who has received special training in the identification of refractive

errors and the prescription of glasses. Development of a standard basic curriculum, together with the supply of basic requirements, is necessary to meet this target.

Primary health care worker

Primary health care workers have played a vital role in the prevention of childhood blindness. A wide variety of individuals, groups and organizations are available in all countries of the world who can and do play a crucial role in the control of childhood blindness. Through the provision of immunization, health education, maternal and child health care, and early identification and referral of blinding eye diseases, they have helped to reduce the incidence of corneal scarring and blindness due to treatable ophthalmic disorders. However, many primary health care workers are unaware of their contribution to the elimination of avoidable childhood blindness. All primary health care workers should receive training in the causes and prevention of childhood blindness at the primary level. Training in primary eye care is required by some cadres; others need only to be made aware of the part they are already playing.

Training in PEC should be task-oriented, with acquisition of appropriate skills. The necessary knowledge and attitudes need to be imparted. Training in PEC for the control of blindness in children should form part of a general curriculum in PEC and should be embedded and integrated within PHC and eye care services.

Human resource development at the primary level

Primary level activities

HEALTH PROMOTION AND EDUCATION

Examples of health messages:

- Breastfeeding
- Balanced nutrition
- Compliance to immunization
- Hygiene and sanitation
- Signs of eye problems/visual loss and need for referral
- Avoidance of use of traditional practices
- Cleanliness
- Prevention of ocular trauma

SPECIFIC DISEASE PREVENTION

Examples of activities:

- Immunization
- Vitamin A supplementation for mothers and young children
- Ocular prophylaxis for ophthalmic neonatorum

CLINICAL ACTIVITIES

- Recognition and treatment
- Recognition, treatment and referral
- Recognition and referral

ADMINISTRATION

Record-keeping
 Reporting
 Ensuring essential drugs and availability of supply
 Implementation

Awareness for the control of childhood blindness

Information on local eye care service availability
 Health promotion education (see above)

Table 9. Cadres and groups involved in integrated primary eye care

	Trained in PEC	Awareness
Globally available	Primary health centre workers, including EPI staff MCH workers Community health workers	Teachers Religious leaders Community leaders
Regionally available	1. Family practitioners 2. Midwives 3. Traditional birth attendants 4. CBR workers 5. Traditional healers	1. Refractionists 2. Volunteers, local NGOs, other service organizations 3. Other programme staff

Training in primary eye care

Childhood blindness should be included in training in general primary eye care.

Place of training:	Eye units where cases can be used for demonstration Schools for the blind
Trainers:	Secondary-level staff who have been trained in PEC for the control of childhood blindness
Methods:	Didactic lectures, demonstrations, role play, problem-solving
Materials:	Manuals, slides, video
Supplies:	Manual for reference PEC kit (visual acuity chart, torch, pinhole) Health education materials (for example WHO/EPI posters)
Motivation:	Career development plans Feedback on cases referred Continuing medical education Support from secondary level. Promotion of success stories Use of media to promote preventive measures Ambassador for childhood blindness
Cost:	Relatively little cost will be incurred to integrate childhood blindness training within general prevention of blindness training.

Sustainability: Consideration should be given to the career path of personnel at the primary level, to enhance sustainability of service provision through an increased level of commitment.

Secondary level

There is a standard list of medical and surgical equipment for a district eye unit. This should be available at secondary-level eye clinics. This equipment should be sufficient to meet the needs of their role in prevention of childhood blindness.

It is particularly important that the secondary-level unit have at least one person who can refract children and prescribe glasses. The refractionist will also need access to an adequate supply of glasses and appropriately sized children's frames.

The health personnel must be well informed about the causes of childhood blindness and should know which conditions to refer and which may be treated at the secondary level. Where anaesthetic facilities are available, it may be appropriate for secondary-level clinics to carry out surgery for uncomplicated ocular trauma in children, or for cataract in children over 10 years old. However, it is not necessary to establish paediatric anaesthesia facilities at all secondary-level clinics purely for the treatment of childhood blindness.

Secondary-level clinics are often responsible for supervising primary health care. If primary health care workers are going to be effective in preventing childhood blindness, it is important that their supervision and training give attention to this aspect of their work. This may be implemented through secondary-level clinics.

Tertiary level

The specialist unit, or "childhood sight centre", will normally be a part of a large eye clinic. It is assumed that this clinic will have managers, technicians, pharmacists, etc. Only those cadres who are specifically concerned with prevention of childhood blindness have been included in this analysis.

Personnel and equipment have been grouped according to what is absolutely essential – the basic minimum for a specialist centre, what is useful and what would be ideal. Moving from the basic minimum to an ideal unit should allow both for an increase in the quantity of work done as well as for an improvement in the quality.

**Table 10. Children's sight centre
Resources needed for 10 million population**

I. Human

	Essential	Useful	Ideal
1. Paediatric-oriented ophthalmologist	1	2	3
2. Multiskilled OMA (low vision, refraction, orthoptics)	2	-	-
3. Refractionist	2	2	4
4. Orthoptist	1	2	4
5. Low vision specialist	1	1	2
6. Paediatrician/neonatologist (part-time)	1	1	1
7. Paediatric anaesthesia	1	2	2
8. Paediatric nurse	1	4	8
9. Operating room assistant	2	4	8

A paediatric-oriented ophthalmologist is a trained ophthalmologist with an interest in, and the necessary skills for, diagnosis and treatment of childhood eye diseases.

II. Equipment

	Approximate unit cost (US\$)	Essential	Useful	Ideal
1. Operating microscope (co-axial)	10 000	1	2	4
2. Laser (diode – indirect)	30 000	1	2	2
3. Cryo, with paediatric probes	10 000	1	1	1
4. Electrodiagnostic equipment	25 000	-	1	1
5. Vitrectomy machine	20 000	1	2	2
6. CT/MRI (access to)		-	1	1
7. Low vision equipment	5 000	1	1	1
8. Automated visual fields	5 000	-	1	1
9. Pre-verbal vision test	500	4	6	8
10. Paediatric anaesthesia equipment	10 000	1	1	1
11. Indirect ophthalmoscope	1 500	3	4	6
12. Slit lamp – portable	2 000	1	1	2
13. Colour vision test	200	1	1	1
14. A-scan ultrasound	5 000	1	1	2
15. B-scan ultrasound	10 000	1	1	2
16. Keratometer – hand-held	3 000	1	2	2
17. Refractometer	3 000	-	-	1
18. Tonometer – Perkins/Tonopen	3 000	1	2	2
19. YAG laser	15 000	-	1	1

- NOTE:**
1. This list assumes that the standard equipment of a district eye hospital will be available.
 2. Some additional special instruments for paediatric cataract, glaucoma and other operations may be needed, depending on the type of surgery carried out at the centre, for example goniotomy knife.
 3. A- and B-scans are often sold as one combined instrument, which is less expensive than buying both machines separately.
 4. All prices given are very approximate and usually represent the upper limit of a range of likely prices. In most cases, it will be possible to obtain equivalent equipment at a lower cost.
 5. The facility must be user-friendly – that is, it should be designed to cater to the needs of mothers and children. This will require different adaptations in different socioeconomic situations. However, in all circumstances the clinic environment should make visually impaired children and their mothers feel welcome and comfortable.

RESEARCH PRIORITIES

The following areas were identified as research priorities for prevention of childhood blindness.

Cornea

- ▶ Operations research on the best means of preventing corneal scarring through primary health care measures
- ▶ Outcomes of treatment for corneal disease
- ▶ Keratoplasty in childhood corneal blindness – indications, techniques and outcomes

Cataract

- ▶ Outcome of cataract surgery in children
- ▶ Etiology of childhood cataract
- ▶ Optimum aphakic correction for childhood cataract, particularly the role of IOLs in children in developing countries

Retinopathy of prematurity

- ▶ Epidemiological research as to which babies are at risk in developing countries
- ▶ Evaluation of the outcome of different treatment modalities and the timing of treatment

Low vision

- ▶ Operations research on delivery of low vision services
- ▶ Epidemiological data on the causes and prevalence of low vision in children
- ▶ Outcomes of low vision treatment in children

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

General

1. There are an estimated 1.4 million blind children in the world. This number is increasing and, if current trends are not reversed, the total will increase to 2 million by 2020.
2. Causes of childhood blindness vary according to region and socioeconomic development (see Table 11). However, at least 40% of childhood blindness is avoidable.
3. The main avoidable causes of childhood blindness and visual impairment are the following:
 - ▶ Corneal scar
 - ▶ Cataract
 - ▶ Retinopathy of prematurity
 - ▶ Uncorrected refractive error

Corneal blindness

4. Corneal scarring is still the leading cause of avoidable childhood blindness. The major causes of corneal scarring are the following:
 - ▶ Vitamin A deficiency
 - ▶ Measles
 - ▶ Ophthalmia neonatorum
 - ▶ Harmful traditional practices
 - ▶ Other corneal infections
5. These can be eliminated by simple primary health care measures, for example measles immunization, vitamin A supplementation, maternal and child health care, etc.

Cataract

6. Some cases of congenital cataract are due to congenital rubella syndrome. This can be prevented by rubella immunization.
7. Most congenital cataracts cannot be prevented. However, with prompt and expert treatment, sight can be restored.

Retinopathy of prematurity

8. Retinopathy of prematurity is an important and potentially avoidable cause of blindness in children which seems to be increasing in middle-income countries. In several countries, it is the leading cause of childhood blindness. Retinopathy of prematurity is likely to become a problem in urban centres of low-income countries as neonatal intensive care services are introduced.
9. Identifying and screening all babies at risk requires a specially trained ophthalmologist and a high level of coordination between paediatricians and ophthalmologists.

Refractive errors

10. A large number of children suffer from refractive errors. This has socioeconomic consequences, as it interferes with the children's education. Screening programmes which incorporate the provision of glasses for children with significant refractive error are a simple and effective means of eliminating this problem.
11. Correction of refractive errors is a critical and achievable goal of VISION 2020, provided a good basic structure exists at all levels of eye care delivery.

Low vision

12. Children whose vision is less than 6/18, despite optimum treatment, may require low vision services in order to allow them to maximize the use of their residual sight. Currently, very few of the children who would benefit from low vision care receive these services.

Integrated strategies to prevent childhood blindness

13. Primary, secondary and tertiary health care can all play a role in children's eye care. Their major roles can be summarized as follows:

Primary	Prevention of corneal scarring by measles immunization, nutrition/health education, etc. Early treatment of simple eye problems Prevention of congenital rubella through immunization Early identification and referral of children with sight-threatening disease
Secondary	Identification and treatment of refractive errors and external eye infections in children; referral of more complex problems
Tertiary	Specialized treatment and surgery for congenital cataracts, retinopathy of prematurity, corneal opacity, glaucoma, etc. Training of health workers in prevention of childhood blindness Provision of specialist low vision services Research

Human resources

14. Human resource development encompasses much more than training alone. It should include equipping, supplying, supporting, motivating and developing health workers.

RECOMMENDATIONS

1. A concerted and integrated effort by:
 - ▶ primary health care workers
 - ▶ community leaders and legislators
 - ▶ educators
 - ▶ traditional medical practitioners
 - ▶ nutritionists
 - ▶ ophthalmologists and other eye care workers

is needed to eliminate new cases of corneal scarring in children by 2020.
2. While preventive measures should take priority, the development of corneal transplantation services, along with standard eye banks, is important to help some children who are bilaterally blind from corneal opacity. In addition, some other children may be helped by optical iridectomy.
3. Congenital cataract surgery should be carried out in suitably equipped specialist centres by ophthalmologists with specific interest and skills in the management of cataract in young children. Immediate optical correction following surgery and long-term follow-up for visual rehabilitation are essential.
4. Countries which have intensive care services for pre-term, low-birth-weight babies, but do not have screening programmes for retinopathy of prematurity, should introduce screening programmes.
5. Refraction services should be established and expanded as an integral part of eye care services. Priorities for action include the development and manufacture of low-cost, high-quality spectacles and the training of refractionists.
6. The development of a standard basic curriculum, together with the supply of basic requirements, is necessary to meet this target. By 2010, there should be one trained and appropriately equipped refractionist for every 100 000 population.
7. There is a need for more paediatric-oriented ophthalmologists. These are qualified ophthalmologists with an interest in, and understanding of, children's visual development. They should have the requisite skills to enable them to deliver a high standard of children's eye care. The optimum requirement is one per 10 million population.
8. Paediatric ophthalmologists will work as part of a team, in a specialist centre. They should be supported by low vision services, optical and refraction services and paediatric anaesthesia services. They should have access to a specialist paediatrician.
9. More low vision personnel are needed. The ideal low vision therapist at a specialist centre, in a developing country, will be a multiskilled individual able to provide the following services: refraction, prescription of low vision devices and low vision training, assessment of vision in young children, treatment of amblyopia, visual stimulation. The optimum requirement is one per 5 million population.
10. Prevention of childhood blindness should be included in the curriculum for training of all primary health care workers in eye care.
11. There is a need for more research into the major causes of childhood blindness.

2020 TARGETS

Specific disease control measures

1. Reduce the global prevalence of childhood blindness from 0.75/1000 children to 0.4/1000 children.
2. Elimination of corneal scarring caused by vitamin A deficiency, measles and 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 a fundus examination by a trained observer six to seven weeks after birth. Cryo or laser treatment to be provided for all those with treatable disease.
6. All schoolchildren to receive a simple vision screening examination; glasses should be provided for all those with significant refractive error. This should be integrated into the school health programme.

Human resource development

7. Ensure that prevention of childhood blindness is an explicit aim of all primary health care programmes.
8. Ensure that all secondary-level eye clinics have facilities to provide appropriate spectacles for children with refractive errors.
9. Train one refractionist per 100 000 population by 2010.
10. Train at least one low vision therapist for every 20 million children by 2010 and for every 5 million by 2020.
11. Train one paediatric-oriented ophthalmologist for every 50 million population by 2010 and one per 10 million population by 2020.

Appropriate technology and infrastructure development

12. Development of low-cost, high-quality low vision devices which should be widely available, even in low-income countries.
13. Establish a network of specialist "childhood blindness" tertiary centres.

The above 2020 targets are based on the estimated current burden in a population of 10 million (see below).

Table 11. Estimates of the burden in a total population of 10 million

	Low income	Middle income	High income
No. of children Aged <16 years	4.5 million 45%	3.5 million 35%	2.5 million 25%
Prevalence			
Blindness	1/1000	0.7/1000	0.4/1000
Low vision*	3/1000	2/1000	1/1000
Refractive errors	1%	1%	1%
Blindness incidence*	25/100 000/year	16/100 000/year	8/100 000/year
Numbers affected			
Blind	4 500	2 450	1 000
Low vision*	13 500	7 000	2 500
Refractive errors	45 000	35 000	25 000
New blind	1 125	560	200
Main avoidable causes	1. Corneal scar 2. Cataract(3. Glaucoma 4. Optic atrophy	1. Cataract 2. ROP 3. Glaucoma 4. Teratogens	1. ROP 2. Teratogens 3. Cataract 4. Glaucoma

* Estimates.

* * *

