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 health[1] 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 (dioptre 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.

Different age groups of children have different problems and needs (Fig. 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?
- 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? (Fig.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 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 (6-11years) 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 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

Fig. 1: Age Groups and Specific Needs

Age group	Specific needs
Pre-school age <6 years	• Significant refractive errors are uncommon • Undetected and untreated refractive errors, eye disease and strabismus can lead to amblyopia
Early school age 6–11 years	• 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	• Myopia progresses and then stabilises[5] • Undetected refractive errors which developed at a younger age are still present

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 (Fig. 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 of children in Pakistan

Photo: Murray McGavin

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 the children can be referred to a nearby eye department or optician. Mechanisms for refraction and examination must be set up before embarking on vision testing – if children are tested and there is no referral system, the programme will fail. Parents should be involved so they can participate in the process.

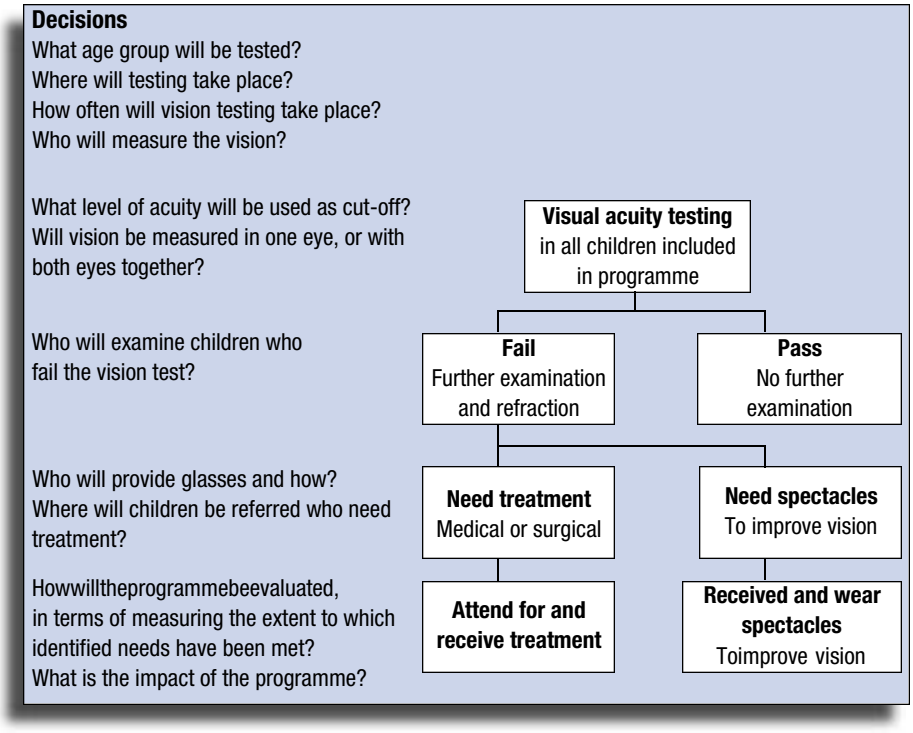
Service Provision

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 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.

Fig. 2: Vision Testing Programmes : Decisions and Flow Chart



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.

Follow-up of vision testing by refraction

Photo: Murray McGavin

Fig 3. Validity of Screening Tests

Result of Vision Testing in School		Need for Spectacles ('Significant' Refractive Error) Present	Need for Spectacles ('Significant' Refractive Error) Absent
	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 Normalchildrencorrectly identified (true negatives)

Sensitivity = A / A+C
Specificity = D / B+D
Positive predictive value = A / A+B
Negative predictive value = D / C+D

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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Sir John Wilson

Sir John Wilson, who died at the age of 80 in November 1999, was a towering international figure in the blindness prevention movement for 50 years. His work had a profound impact on the lives of millions of people. One of his main concerns was to bring eye care within reach of poor communities.

Blinded himself at the age of 12 by an accident in a school chemistry laboratory, the young John Wilson fought back with courage and determination and went on to gain a double first at Oxford University.

In 1950 he founded Sight Savers International – formerly known as the Royal Commonwealth Society for the Blind. He led the organisation for more than 30 years, during which time one of his great strengths was his genius for innovation. He was involved in establishing some of the essential elements of today's eye care services in developing countries. These included mobile outreach programmes and thetrainingofophthalmicparamedics.Sight Savers also funded early research into the little understood disease of onchocerciasis. Training schemes for blind people in rural areas proved that they could farm as successfully as their sighted neighbours.

Sir John was also instrumental in revealing the scale of world blindness - the first conservative estimate at over 15 million people – and he set about stimulating the global collaboration which was essential to tackle human suffering on such a scale. He played a key role in establishing the International Agency for the Prevention of Blindness (IAPB) and was its first President.

Sir John retired from Sight Savers in 1983, but maintained close links with the organisation. The pace of his life did not slacken. He founded the IMPACT movement, a global initiative to prevent major causes of disability, and his international travel schedule continued up to the time of his death.

Pat Midwinter
Sight Savers International