

Prevention of Blindness

Forecasting cataract blindness – and planning to combat it

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Cataract intervention programmes may not give the expected results if trends in their outputs and rapid demographic changes are ignored. Computer simulation models make it possible to take these factors into account. On the basis of experience gained in India the present article discusses the information required for such models and the questions they can answer.

As the population and the average life expectancy at birth have increased in India the number of people at risk for senile cataract has also grown. Fig. 1 shows the results of a survey on cataract blindness conducted by the Indian Council for Medical Research in 1971 and of another conducted by the National Programme for the Control of Blindness in collaboration with WHO in 1986, together with the numbers of cataract operations performed in the country between 1981 and 1993. It is clear that there were too few operations during this period to reduce the prevalence of the condition.

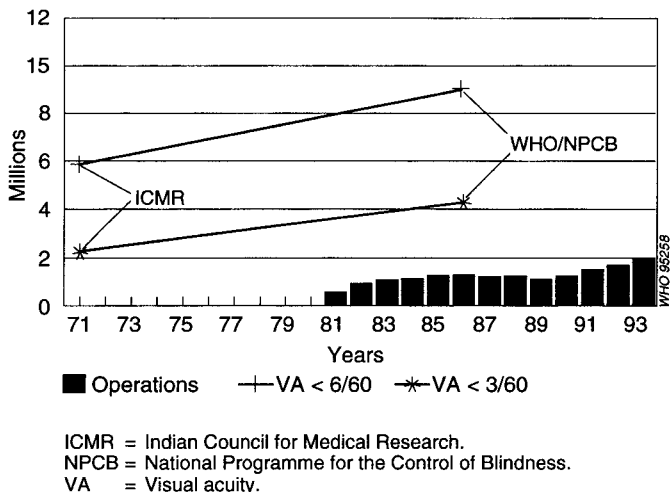
In order to tackle the problem effectively it is necessary to answer the following questions.

- What is the expected rate of increase in cataract blindness?

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- In order to reduce the prevalence of cataract blindness how many people should have their eyesight restored annually?
- How many cataract operations have to be performed each year in order to achieve this? What would the load be if both eyes were operated on, and what would it be if only one were operated on? How long would it be before the prevalence of cataract blindness declined?
- What contribution could be made by cataract surgery with intraocular lenses in patients whose visual acuity is better than 3/60 and who are therefore not defined as blind? What effect could such preventive surgery have on incidence?
- Given the present manpower and infrastructure, and assuming the availability of funds, what would be the maximum capacity for cataract surgery per year?
- What increase in manpower and infrastructure would be needed so that surgical capacity would be sufficient for the desired rate of progress to be achieved? What would be the differences in requirements for man-

Fig. 1
Cataract blindness in India: prevalence and operations



power and infrastructure between intracapsular cataract extraction with spectacles and extracapsular cataract extraction with intraocular lenses?

- Would a shift towards intraocular lens surgery lead only to an increase in the number of operations or would it also bring about a reduction in blindness? This type of surgery is more expensive and time-consuming but also motivates more people to come forward for treatment.
- What would be the most effective strategy for controlling cataract blindness, given the constraints on funds, manpower and infrastructure?

Simulation model

A prototype cataract blindness macrosimulation model has been developed with a view to achieving realistic, accurate and result-oriented planning. The formula on which the model is based relates the number of persons blind because of cataract at the end of any particular year to the numbers of new cases,

persons with cataract blindness who died, and persons whose sight was restored during this year, and to the number of persons blind because of cataract at the end of the previous year.

The number of cataract-blind persons in each five-year age group over 40 years is calculated from the formula for each year. Part of the formula can be used to calculate the increase in cataract blindness, which is mainly determined by demographic trends and the incidence of the condition. An intervention that reduced the incidence would affect this part of the formula. The remaining part calculates how many blind persons become sighted and are thus removed from the prevalence total; this is determined by the absolute number of cataract operations and, to a greater degree, by the sight restoration rate.

The number of operations planned and the estimated sight restoration rate for each of the coming 16 years are entered in the simulation model. The sight restoration rate depends strongly on the strategies and policies of the

cataract control programme, the quality of surgery, and the selection of cases for treatment. The visual acuity chosen as an indication for surgery, and the decision as to whether sight should be restored in one or both eyes, may be of marginal importance to individuals whereas the implications for the total surgical workload are enormous. By varying the number of operations and the sight restoration rate the effect of different targets and programme policies can be simulated.

The following parameters are necessary.

- **Age-related prevalence of cataract blindness (visual acuity < 3/60).** The data, usually obtainable from national blindness surveys, are required at the start of the model.
- **Age-related incidence of cataract blindness (visual acuity < 3/60).** A study in the Raipur District of India provided this information (1). It can also be estimated from age-related prevalence rates (2). For the purposes of the present model the incidence figures for Raipur District were adjusted by means of a factor making the age-specific prevalence rates for Raipur at par with those for India as a whole.

The following assumptions were made:

- the incidence of cataract blindness would remain constant for the next 16 years;
- the age-related incidence of cataract blindness in persons aged under 40 years was negligible;
- the proportion of cataract operations performed in persons aged under 40 years was negligible and did not affect incidence among older persons.

An estimate of the number of new cases in any particular year is obtained by multiplying the age-related cumulative incidence by the population at risk for every five-year age group in that year.

- **Data on age composition of the population, population growth, aging trends and age-related mortality rates.** These data are available in India. Future demographic trends can be estimated from past trends or calculated by

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means of specific models. Any alternative demographic scenario can be entered in the model. The population at risk, used in the formula, is that of people aged 40 years and above minus persons already blind from cataract at the beginning of the year under consideration and persons who had been operated on by the end of the previous year. There is evidence of elevated mortality among people who are blind as a result of cataract or who have been operated on for the condition (3, 4). In Central India the mortality rate for such persons is 2.2 times higher than for sighted persons, and this has been put into the prototype simulation model.

- **Number of cataract operations performed annually and percentages leading to restoration of sight.** Successful operations, in which visual acuity > 6/18 is achieved, account for 80–96% of those performed. The number of operations is an indicator of workload but does not measure the impact of operations on the number of cataract-blind persons. A more sensitive indicator of this impact is the number of persons whose eyesight is restored. It has to be borne in mind that persons blind in only one eye are operated on, and that operations performed on people with cataract and a visual acuity better than 3/60 do not reduce the backlog of cases directly, since these people

are not classified as being blind; such operations may, however, reduce future incidence.

Data from eye camps suggest that about 70% of the operations are in bilaterally cataract-blind patients and 30% in patients who had previously been operated in the other eye. Persons who are blind in one eye are seldom operated on in these camps. With an average success rate of 90% this would give a sight restoration rate of 63%.

Future trends

If the number of cataract operations performed in India remained at two million a year, if the sight restoration rate continued at 63%, and if the assumptions made in the model are correct, the country would probably have at least 25 million persons blind from cataract, i.e. with visual acuity < 3/60 in the better eye, by 2011 (Fig. 2).

The utilization of infrastructure, beds and manpower is currently less than 40%;

approximately 8000 ophthalmologists each perform 250 cataract operations a year on average, but many are not performing any surgery and most are concentrated in the larger cities. It is considered that the present infrastructure in India would allow a doubling of the number of operations performed annually.

Assuming a yearly increase of 10% in the number of cataract operations until four million are being performed annually as from the year 2000, and sight restoration rates of 45%, 63% or 80% maintained from 1995 until 2011, the effects of different policies and strategies on the future prevalence of cataract blindness can be simulated (Fig. 3).

A strategy in which both eyes were operated on would restore eyesight in some 45% of treated patients; with a continuation of the present arrangements the sight restoration rate would remain about 63%; if priority were given in case-finding and surgery to first eyes the rate would be 80% or more. These projections are based on the assumption that

Fig. 2
Future trends in cataract blindness with 2 million operations a year and sight restoration rate of 63%

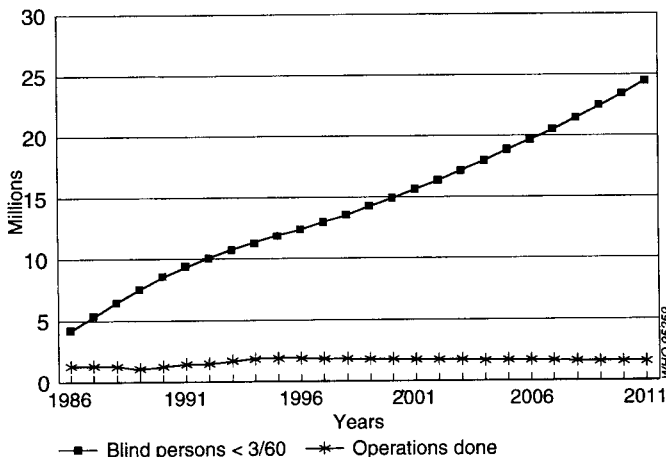
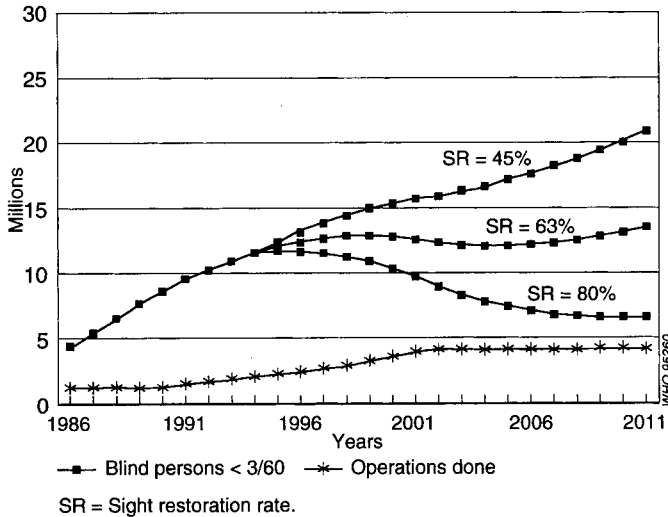


Fig. 3
Simulation of effects of different policies and strategies on future prevalence of cataract blindness



all operations are performed on bilaterally blind persons with a visual acuity < 3/60 in the better eye.

In India only 30% of patients who are bilaterally blind because of cataract receive surgical treatment; all the others remain blind for the rest of their lives. Given the present manpower and infrastructure it is realistic to consider that up to four million cataract operations could be performed annually. The simulation model described in the present article indicates that this number of operations, together with a strategy aimed at alleviating the disability caused by blindness, could bring cataract blindness under control in the country.

Additional inputs would be needed in order to expand the capacity of cataract surgery beyond four million operations a year, and efforts are being made in this direction. How-

ever, it is just as important to select efficient and effective policies and strategies, addressing the selection of patients, the type of surgical intervention, and the place where it is carried out.

Until now the effect of operational policies and strategies has only been measurable several years after their implementation, and comparison with possible outcomes of alternative approaches has not been feasible. An accurate simulation model, however, allows the impacts of different strategies to be anticipated and enables planners and policy-makers to choose the most effective strategy for reducing cataract blindness.

The creation of an accurate model requires:

- more data on the incidence of cataract blindness;
- annual updates of demographic data and estimates of future population growth and aging trends;

- systematic collection and analysis of pre-operative and post-operative data on patients, allowing calculation of realistic sight restoration rates;
- regular assessments of cataract blindness in persons aged 40 years and above;
- cost studies on different strategies for the delivery of cataract surgery, and use of a simulation model to indicate which are the most cost-efficient;
- information on the maximum capacity of different surgery delivery systems for intra-capsular cataract extraction plus spectacles and extracapsular cataract extraction plus intraocular lenses. ■

Acknowledgement

The authors are grateful to Professor J.D.F. Habbema, Department of Public Health, WHO Collaborating Centre for Research on Inequalities in Health, Erasmus University, Rotterdam, Netherlands, for his comments.

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User charges help share the load

Governments are increasingly asking their peoples to pay for services or drugs, or both. If user charges are well designed and affordable, they can have a positive impact on the availability and rational use of drugs. But to achieve this, the community has to be involved in decisions about the management and use of funds and the level of fees, and in making sure that the system is equitable and protects vulnerable groups. Such schemes should not allow the government to abdicate its responsibility to provide and fund health services.

- *Implementation of the global malaria control strategy. Report of a WHO Study Group on the Implementation of the Global Plan of Action for Malaria Control 1993–2000.* Geneva, World Health Organization, 1993: p. 14 (WHO Technical Report Series, No. 839).