Round Table

Cataract blindness – challenges for the 21st century

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Cataract prevalence increases with age. As the world's population ages, cataract-induced visual dysfunction and blindness is on the increase. This is a significant global problem. The challenges are to prevent or delay cataract formation, and treat that which does occur.

Genetic and environmental factors contribute to cataract formation. However, reducing ocular exposure to UV-B radiation and stopping smoking are the only interventions that can reduce factors that affect the risk of cataract. The cure for cataract is surgery, but this is not equally available to all, and the surgery which is available does not produce equal outcomes.

Readily available surgical services capable of delivering good vision rehabilitation must be acceptable and accessible to all in need, no matter what their circumstances. To establish and sustain these services requires comprehensive strategies that go beyond a narrow focus on surgical technique. There must be changes in government priorities, population education, and an integrated approach to surgical and management training. This approach must include supply of start-up capital equipment, establishment of surgical audit, resupply of consumables, and cost-recovery mechanisms. Considerable innovation is required. Nowhere is this more evident than in the pursuit of secure funding for ongoing services.

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Mots clés: Cataracte/étiologie/prévention et contrôle; Extraction cataracte/normes/économie; Vieillissement; Accessibilité service santé; Gestion ressources santé; Cristallin artificiel/ressources et distribution (*source: INSERM*).

Palabras clave: Catarata/etiología/prevención y control; Extracción de catarata/normas/economía; Envejecimiento; Accesibilidad a los servicios de salud; Asignación de recursos para la atención de salud; Lentes intraoculares/provisión y distribución (*fuente: BIREME*).

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Introduction

Cataract was a significant global problem at the beginning of the last century, but not widely recognized as such. Today, it is a greater problem, the significance of which is better understood. The challenge is to deal with it so that it is no longer a problem at the beginning of the next century.

Increasing age is associated with an increasing prevalence of cataract. Data from Australia show that this prevalence doubles with each decade of age after 40 years, so that everyone in their nineties is affected (*1*). Similar data come from population-based studies in other economically developed parts of the world (*2–5*).

The prevalence of cataract also increases with age in developing countries, although it often occurs earlier in life, and there is more of it. For example, in an Indian study, visually significant cataract occurred 14 years earlier than in a comparable study in the United States (*6, 7*). The age-adjusted prevalence of cataract in India was three times that of the US, with 82% of Indians of 75 to 83 years old having visually significant cataract or aphakia, compared to 46% (senile lens changes associated with a visual acuity of 6/9 and worse, or a history of cataract extraction) of those aged 75 to 85 years in the US (*6, 7*).

Over the next 20 years, it is estimated that the world's population will increase by about one third (*8*). This growth will occur predominantly in developing areas. During the same period, the number of people over 65 years of age will more than double (*8*). This "greying" of the population will occur in both developing and developed countries.

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If nothing else alters, these demographic changes will lead to a doubling in the amount of cataract, visual morbidity, and need for cataract surgery. The current 20 million people with severely reduced vision of 3/60 or worse as a result of cataract will have swelled to 40 million by the year 2020 (*8*). The challenge we face is to prevent this from occurring by delaying the development of cataract and by providing ready access to cataract surgery for all those who need it.

Prevention

Although many cross-sectional studies of risk factors for cataract have now been made (*9*), and the results of some longitudinal studies are available (*10, 11*), our understanding of age-related cataract etiology is incomplete. Secondary cataract is much less common and can occur after trauma, intraocular inflammation, exposure to ionizing radiation and other events.

The most exciting recent developments in cataract epidemiology have been the identification of a strong genetic component. Twin studies in the United Kingdom suggest that approximately half of nuclear and two thirds of cortical cataract can be accounted for by hereditary factors (*12, 13*). Dominant genes have been implicated for cortical cataract and additive genetic effects for nuclear. These findings are generally consistent with those from population-based studies (*14–16*). However, at this stage, nothing can be done to alter an individual's genetic makeup in relation to cataract.

"Age" in this context almost certainly represents the cumulative effect of the complex interaction of exposure to many factors over time that contribute to the development of cataract. Some of these factors are known, others are not yet identified or confirmed. Important risk factors for age-related cataract include exposure to ultraviolet-B (UV-B) radiation (*2, 5, 16–18*), the presence of diabetes (*9, 25*), and the use of therapeutic drugs such as corticosteroids (*28–30*), and recreational drugs such as nicotine (*3, 4, 31*) and alcohol (*4, 32, 33*). The occurrence of severe diarrhoea and dehydration have been suggested by some studies (*26, 27*), but not by others (*20*). The role of dietary antioxidant vitamins is unclear and often contradictory (*19, 21–24*).

The results of studies currently under way on the effectiveness of antioxidant vitamin supplements (*34–36*) are awaited with interest. Until they or other studies prove otherwise, the only known effective ways to reduce the risk of cataract seem to be to reduce ocular UV-B radiation exposure, and to stop smoking (*37*). Australian data indicated a population-attributable risk for smoking and nuclear cataract of 17%, and a risk of 10% for UV-B exposure and cortical cataract (*38*). Given the overall prevalences of the different cataract types, this gives a 14% combined population risk for "cataract" attributable to smoking and UV-B exposure. This would translate into a retardation of the median age for cataract from 70 to 80 years. In some industrialized countries, a combination of legislation and public health education has proved effective in reducing smoking and exposure to sun (*39, 40*). In industrialized countries the challenge is now to eliminate smoking and make UV-B irradiation avoidance the norm in all leisure and work activities. If this were to be achieved, then cataract could be halved (*41*).

A far greater challenge will be to accomplish this in developing countries. These are often in regions with high incident light, and have populations dependent on outdoor agrarian activities, weak legislative capacity with little consumer protection, and little or no anti-smoking education and promotion. In addition, there are many more immediate imperatives for the daily survival of their people. Prospects are poor.

People with diabetes have an increased risk of cortical and posterior subcapsular cataract (*9, 16, 25*) and are also more likely to have early cataract surgery. These associations will assume greater importance as diabetes continues to increase in both developing and industrialized areas. The challenge is to design and deliver widespread public health initiatives aimed at dietary and physical activity education and behaviour change to control this epidemic of diabetes.

In the United States, a high body mass index increased the risk of developing posterior subcapsular cataract (*42*). At the other end of the spectrum of community and individual wealth, studies in India have shown that severe protein-calorie malnutrition is more common in people with cataract (*6*). In addition, cataract has been linked to severe diarrhoea and cholera (*26, 27*). One of the many problems that have to be solved here is inequity of resource and opportunity distribution, both within and between countries (*43*).

As our understanding of the cellular and molecular changes associated with cataract formation becomes refined, the possibility increases of delaying its onset. Initial hopes for the protective use of aspirin have not been substantiated (*32, 44*). To date, perhaps with the exception of the antioxidant vitamins A, C, and E (*19*), no other serious protective pharmaceutical contender has emerged. The challenges do not end with the identification and trial of an effective preventive drug. Depending on its formulation, mass supply and distribution would need to be organized along the lines of oncherciasis treatment in endemic areas, or perhaps fluoridation of drinking-water.

The benefits of cataract prevention are obvious, but unfortunately, the likelihood of achieving it is remote. However, a delay of 10 years in the onset of cataract would, with today's criteria for surgical intervention, halve the number needing surgery. In Australia, where the median age for developing cataract is in the eighth decade, this reduction would be achieved with only a 14% delay in the onset rate (*41*). The challenges of cataract research, influencing government policy and modifying the behaviour of the public are therefore worth taking up.

Treatment

The cure for cataract is surgery. However, this surgery is not equally available to all, and where it is available it does not produce equal outcomes. Decisions have to be made, according to the prevailing circumstances, about how much cataract is enough to warrant surgery, who should have that surgery, how it should be performed and delivered, and how it should be paid for.

How much cataract is enough to warrant surgery?

In the strictest sense, "blindness" as a "total lack of sight" has never been the criterion for cataract surgery. Indeed, it has been a contraindication. Instead, the criterion has been an "extreme loss of function" as a result of reduced vision, characterized by an inability for self-care. Usually this is measured against the arbitrary scale of "visual acuity". "Legal blindness", with financial benefits, was first specified by the 1935 Social Security Act in the United States (*45*). This approximated a definition of blindness as the vision at which intracapsular cataract extraction would be considered, and the vision with the resultant uncorrected aphakia.

Empirically, the quality of vision afforded by aphakic correction does not warrant cataract surgery at a threshold better than 6/60 or 3/60. In industrialized countries, this threshold persisted during the introduction of intraocular lens implantation. However, as the surgery has become consistently safer, with predictably good vision rehabilitation, often without the need for spectacle correction at all, this threshold has decreased. Also, there have been increasing social and economic imperatives to lower the threshold. For example, a driving licence is now considered essential for many, even those retired (*46*). This requires vision of the order of 6/12. The shift from a largely unskilled workforce with lesser vision demands, increasing emphasis on leisure pursuits, and greater expectations concerning quality of life, including for the retired, have all contributed to a demand for sustained good vision. There is also the accumulating evidence of increased mortality and morbidity associated with vision reduction (*47*).

The threshold for cataract surgery in many industrialized countries is now 6/9 or less (*1, 11, 48, 49*). This has resulted in a substantial increase in numbers receiving surgery in these countries over the last 20 years. Threefold to fourfold increases in a decade have been reported from the United States, Sweden (*48, 50*), the United Kingdom (*51*) and Australia (*52*). Cataract surgery now accounts for more than half the ophthalmic procedures in some areas, and in several countries it is the most common elective surgery (*52, 53*). In recent years, corneal refractive procedures have caused increased public scrutiny of vision and its correction. The pursuit of uncorrected "super-vision" of better than 6/6 is on the rise. This may translate to an even greater demand for cataract and clear lens extraction in developed countries.

In developing countries, the intracapsular cataract extraction threshold has largely persisted, because where surgery is available, this is the technique most frequently used. As extracapsular cataract extraction with intraocular lens implantation becomes more common (*43*), the threshold will be reduced. This will have huge implications for the number of operations that need to be done.

Who should have cataract surgery?

With a descending threshold for cataract surgery, criteria must be set as to when this procedure is really required. The decision has implications for the planning, delivery, financing, and accessibility of cataract surgical services. It is obviously impractical to declare a single surgical threshold for "cataract blindness" that would be appropriate and acceptable to all, or even a majority, of individuals and communities. We have to assume there is a distribution of levels of visual impairment (*54*), and define a particular threshold as "blind and requiring surgery", depending on the prevailing social and economic situation.

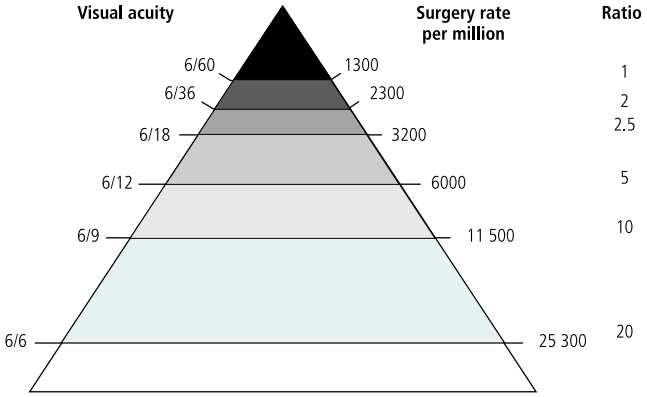
Definition of such a threshold for a given community needs more than just a visual acuity determination. The daily visual needs of members of that community need to be identified and the functional implications of disability assessed (*54*). Questionnaires such as the VF-14 can be useful (*49*). An assessment of the level of disability that family and community will tolerate in its members also should be evaluated. For example: what level of disability prevents a person from making their usual contribution to their family and community? At what level is another family member required to leave economically active work and provide support? At what level is a community prepared, where there is a pension system, to support a visually disabled person? All of these types of information may be expected to lower the final threshold.

According to Australian data (*1*), and just using visual acuity as the indicator, the number of cataract operations needed increases 2.5 times as the threshold changes from < 6/60 to < 6/24, and increases fivefold if it goes to < 6/12 (Fig. 1). In developing countries the increase would probably be more.

On the other hand, the level of disability at which a government or insurer is prepared to pay for intervention is likely to raise the final threshold. The reality of economic rationing is that, except when patients pay for their own surgery or are subsidized by other paying patients, limited resources will limit the total number of surgeries financed. This rationing is likely to be reflected in a paucity of surgical facilities, staff and consumables.

In rich and poor countries alike, services may be rationed by making them unaffordable or inaccessible. Rationing also occurs with the use of the "surgical waiting list". For example, in England

Fig. 1. **The relation between surgical threshold visual acuity and the cataract surgery rate required to deal with the prevalence of surgically significant cataract**



Source: **Taylor HR**: Cataract: how much surgery do we have to do? *British Journal of Ophthalmology*, 2000, **84**: 1–2.

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and Wales there is an estimated cataract backlog of 2.4 million people with visual impairment (<6/12) due to cataract (*55*). About 160 000 cataract operations are performed each year, with an annual increase of about 7%. However, with 1.1 million new cases expected over 5 years, death will remove almost as many people from the cataract backlog as are removed by completed surgery.

Once the surgical threshold has been established, the task is to establish widespread access to services capable of delivering the necessary vision rehabilitation.

Access to treatment

Without trivializing the remaining challenges for industrialized countries in this regard, it has to be recognized that the real challenges here are in the developing ones.

Where there is wealth, it is a maldistribution of surgeons and facilities, outmoded and inefficient work practices, personal greed, indifferent professionalism, and budgetary constraints that combine to limit equitable access to cataract surgery. However, in a largely open society with high literacy rates, a free press, an informed public, and organized professional and special interest groups, the quality and use of cataract services are likely to be improved by vigilance, debate and compromise.

In developing countries there are many more solid barriers to the availability of, access to, and uptake of cataract surgery. It is these that we must identify, scrutinize and overcome. Although the desire to do this may be present, generally, the impetus and resources to initiate it will not come from within these countries, but elsewhere.

The vast majority of cataract patients in developing countries live in rural areas, while hospitals and surgical facilities are frequently in the cities and larger towns. In practice, generally, these facilities are accessible only to people living in their immediate vicinity. But even where such facilities are available, there is often a lack of instruments and other equipment, exacerbated by poor maintenance, with medications and other consumables in short supply.

Overall, there are not enough cataract surgeons. In the continent of Africa, for example, there are 500 or so ophthalmologists, about 1:1 000 000 population. A considerable number of these are in private practice, unavailable to the general population (*56*). Low government salaries, and conflicts of interest between private and public practice, diminish the efficiency of government-employed physicians (*57*), who also usually live and work in urban settings. They are often underutilized, with a low surgical output per surgeon. Even if working well, their surgical output is usually insufficient to meet the actual need or the potential demand. For example, Indian surgeons, on average, do between 400 and 900 cataract surgeries per year, depending on whether they are in public or private practice (*58*). Also, inefficient use is made of non-ophthalmologists for routine aspects of vision care, often because the majority of paramedical personnel and general doctors have only superficial knowledge of eye conditions. Nor are they widely used as cataract surgeons, an obvious and achievable solution to the problem of insufficient trained practitioners (*57, 59, 60*).

Where cataract surgical services are made available, patients may not make use of them. For example, when rural Kenyans (*61*) were offered free intracapsular cataract extraction, only 70% agreed to the surgery, and in a Nepalese study (*62*), even when offered transport and free surgery, the use rate was below 60%.

Poor uptake of services may be because patients do not know or believe that cataract is curable. Potential patients may also be unaware of the possibility of an operation, or of the availability of a particular surgical service. Or, they may have no previous experience of successful cataract surgery. Large numbers of people who are irreversibly blind because of surgical complications, or functionally blind with uncorrected aphakia, may be deterrents to accessing available services. Also, aphakic spectacles may be regarded as the brand of a cripple. Poor outcomes, whether due to poor patient selection or poor surgery, can erode trust and contribute to a facility's bad reputation.

There may also be misconceptions about cataract surgery, such as still waiting for the cataract to mature when intraocular lens implantation is possible earlier. Or, there may be fatalism about blindness. Practices of traditional medicine are often associated with religious beliefs and mystification. Belief in magical cures influences a population's attitude towards modern health practices and treatments, including cataract surgery. Frequently, it is difficult to provide better information for potential patients and dispel discouraging misinformation.

Even where these obstacles do not prevent surgery, the monetary and other costs of services may

be beyond the reach of community, family, or individual resources. These cost impediments may include the distance to such services, lack of transport, having no one to act as escort and carer, and seasonal work demands on partially sighted patients and their families.

The international ophthalmic community has largely concentrated on the technicalities of cataract surgery in developing areas. During the last 15 years, much effort has been directed to identifying the best operative procedure. There was controversy, even though the answers were often already known from experience in developed countries, but extracapsular cataract extraction with posterior chamber lens implantation (*63, 64*) is now widely accepted as the procedure of choice (*58, 65–69*). It is recommended because its results are better than those obtained with the alternatives (*70–72*). Also, equipment such as the robust, affordable, portable microscope and YAG laser produced by the Fred Hollows Foundation in collaboration with Australian industry, are now available.

The question of quality

Much of what has happened in the last 15 years has been driven by the relatively easily met need to achieve increased surgical output, rather than by a regard for vision outcome and rehabilitation. Concern about the audit of outcome and quality assurance is relatively recent. This has revealed that despite all the attention to cataract surgical detail, postoperative vision results are less positive than anticipated, and complication rates are greater. For example, assessment of urban Indian surgery (*73*) showed 21% of patients had a very poor outcome (presenting visual acuity of worse than 6/60), with another 35% having poor outcome (6/18 to 6/60). In neighbouring Nepal, 21% are still blind postoperatively with presenting visual acuity of <6/60 in both eyes. However, this improves to 7% with best correction (*74, 75*). Opacification of the posterior capsule can occur, but it rarely causes blindness (*76*). More effort needs to be directed to improving the quality of cataract surgery (*74, 77*), through improvement in areas such as case selection and postoperative care, rather than just concentrating on surgical technique and volume.

The surgical act plays only a small part in the cure of cataract. It must be supported by a whole gamut of linked activities: training and ongoing development for surgeons, nurses and administrators; equipment purchase, maintenance, and replacement; the ordering and supply of consumables; cost recovery with patient cross-subsidization so the very poor have equitable access; improving management capability and commitment; planning; and fostering recipient ownership. Integration and coordination of all these activities, as well as many others, are required for a successful sustainable cataract intervention (*78*). In India, the effective work of the Aravind Hospital system is testimony to this (*79*, *80*).

The work of the Fred Hollows Foundation in cataract-related projects in Africa and Asia is a further example (*59, 78*). The integrated approach to cataract surgery offered by the Foundation varies according to local circumstances, but may consist of surgical and management training, supply of start-up capital equipment, and help in setting up surgical audit, consumables resupply, and cost recovery mechanisms (*43, 59*).

It is only through an integrated approach that the challenge of creating widespread access to surgical services capable of delivering good quality vision rehabilitation will be met. Then we must ensure that those without the personal resources to afford choice of service can access these services. Generally it is those most in need who are least able to influence community politics and who suffer most from unjust choices.

Paying for treatment

The industrialized world is fiscally challenged by an apparently insatiable demand for medical technology and services. Whether under the guise of "managed care", priority listing of interventions or some other system, attempts to control expenditure will continue to incite public and professional debate. From this debate, a position of compromise and common good is expected to arise. In developing countries, political elites are under much more pressure to allocate severely limited resources to priorities other than cataract services. Unless patients pay for their own surgery and subsidize that of those who cannot afford it, widespread surgery will not be sustained.

An alternative approach is to develop a direct link between cataract services and revenue-generating industry (*43*). Such an arrangement should involve the most modern technologies in value-adding industries (*81*). This will accelerate economic development, finance services for those unable to afford them, and greatly reduce dependence on government funding. The challenge of such development may seem beyond the interest or influence of ophthalmologists (*82*), but in fact this is not the case. Consider an example: the manufacture of intraocular lenses (*83*).

Observations of pharmaceutical production in the worst of circumstances in Eritrea, a country then at war, showed that intraocular lens manufacture was possible (*83*). The Fred Hollows Foundation has acted on this and similar information to establish manufacturing facilities in both Eritrea and Nepal (*84*). Each is run by a local management board and staff. Research and development have led to the incorporation of technology that is more sophisticated than that used in comparable Western production. Now, as these commercial enterprises move into profit, ownership is being transferred to indigenous organizations. Individuals and their communities have directly benefited from these lens factories — through education, salary, and an affordable intraocular lens for local use. Major

advantages also come with the export of the internationally certified intraocular lenses produced, and the foreign exchange this generates.

It will be obvious that not every developing country needs or wants an intraocular lens factory. However, even in the commercial context of a small medical discipline such as ophthalmology, the manufacturing and service opportunities are many, and include sutures, surgical instruments, other equipment, pharmaceuticals, education and information materials and other such supplies. The international ophthalmic community could contribute to this development process either by raising the capital for a commercial enterprise or by using products manufactured in such circumstances in its everyday work, provided they are of comparable quality to those made in the West. Where such products are not available, the collective purchasing power of ophthalmologists could be used to encourage producers in industrialized countries to enter suitably structured joint ventures in the developing world. Only with unconventional approaches such as these will cataract surgery be available in the long term to those who are at present the least able to get access to it and pay for it.

Conclusion

Cataract is a significant and increasing global problem. The challenges are to prevent or delay cataract formation, and cure that which does occur. Preventive interventions must be identified, perfected and delivered, through research, changes in government policy and legislation, and modification of community and individual behaviour.

Widespread surgical services capable of delivering good vision rehabilitation must be acceptable and accessible to all in need, no matter what their circumstances. To establish and sustain these services requires comprehensive strategies going well beyond a narrow focus on surgical technique. There must be changes in government priorities, population education, and, where missing, an integrated approach to surgical and management training, with supply of start-up capital equipment, and help in setting up surgical audit, consumables resupply and cost recovery mechanisms. Considerable innovation is required. Nowhere is this more evident than in the pursuit of secure funding for ongoing services. ■

Résumé

Cécité due à la cataracte – Les enjeux pour le XXI^{e} siècle

La prévalence de la cataracte augmente avec l'âge. A mesure que la population mondiale vieillit, les dysfonctionnements visuels et la cécité dus à la cataracte augmentent, ce qui représente un problème important partout dans le monde. Les enjeux consistent donc à prévenir ou à retarder l'apparition de la cataracte et à la traiter lorsqu'elle survient.

Des facteurs génétiques et environnementaux contribuent à l'apparition de la cataracte. Les seules interventions susceptibles de réduire les facteurs de risque consistent à diminuer l'exposition oculaire aux rayonnements UV-B et à cesser de fumer. La cataracte s'opère très bien, mais l'opération n'est pas à la portée de tous et les méthodes chirurgicales ne donnent pas les mêmes résultats partout.

Des services chirurgicaux capables de garantir une bonne récupération de la vision doivent être accessibles à tous ceux qui en ont besoin quelle que soit leur situation, et acceptables par tous. La mise en place durable de ces services suppose des stratégies complètes qui aillent au-delà des simples techniques chirurgicales. Il convient en effet aussi de modifier les priorités gouvernementales, d'éduquer la population et d'adopter une approche intégrée de la formation à la prise en charge et à la chirurgie.

Cette démarche doit comprendre la fourniture de matériel de base, l'établissement d'un contrôle sur le plan chirurgical, le réapprovisionnement en fournitures renouvelables et des mécanismes de récupération des coûts. Des innovations considérables s'imposent, particulièrement en ce qui concerne la recherche d'un financement durable des services.

Resumen

Ceguera por catarata: retos para el siglo XXI

La prevalencia de la catarata aumenta con la edad. A medida que envejece la población mundial, aumentan también los casos de disfunción visual y ceguera por catarata. Se trata de un problema mundial importante, que nos desafía a prevenir o retrasar la formación de cataratas y a tratar todos los casos que aparezcan.

A la formación de la catarata contribuyen factores tanto genéticos como ambientales. Sin embargo, la reducción de la exposición a la radiación UV-B y el abandono del tabaco son las únicas medidas que permiten reducir la influencia de factores que inciden en el riesgo de catarata. La curación se consigue sólo con tratamiento quirúrgico, pero no todo el mundo puede acceder a él, y las intervenciones quirúrgicas disponibles tienen resultados dispares.

Es necesario que todas las personas necesitadas, cualesquiera que sean sus circunstancias, puedan acceder fácilmente a servicios quirúrgicos aceptables, capaces de restablecer debidamente la vista. Para establecer y sostener estos servicios se requieren estrategias amplias que no se detengan en la simple técnica quirúrgica. Hay que introducir cambios en las

prioridades de la Administración y la educación de la población, y enfocar de forma integrada la capacitación en el manejo y el tratamiento quirúrgico de esta dolencia. Forman parte de ese enfoque el suministro de bienes de equipo iniciales, el establecimiento de sistema de control de las intervenciones quirúrgicas, la reposición del material fungible y los mecanismos de recuperación de costos. Se requiere para ello una innovación considerable, lo que resulta especialmente evidente a la hora de buscar fondos para los servicios en marcha.

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