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Outcome monitoring and efficient systems allow this hospital to provide high quality cataract surgery to nearly 50,000 patients per year, while costing patients less than US \$10 per eye. **NEPAL**

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Improving cataract services: better access, better outcomes, better value

A balanced approach to outcomes, output and outlay – together with strong partnerships – create cataract services that put patients at the centre and deliver better eye health for all.



David Yorston



Fatima Kyari



John Buchan

Although highly effective treatment for cataract has been available around the world for several decades, it remains the leading cause of avoidable blindness. It is completely unacceptable that millions of people are deprived of their right to sight due to a condition that can be cured with a safe, fast, and cost-efficient procedure.

The articles in this issue show that improvement doesn't only rely on new techniques, drugs, or equipment. Instead, improvement is also the result of a coordinated effort by everyone in the eye team to provide a patient-centred service.

The three pillars of combatting vision impairment due to cataract are:

- **Output** – the number of cataract operations performed, often expressed as the cataract surgical rate (the number of cataract operations per million population per year)
- **Outcome** – the results of cataract surgery, i.e., what percentage of eyes achieve good vision after a cataract operation, and the complication rate
- **Outlay** – how much an eye service needs to spend to provide cataract surgery (which will affect how much patients have to pay).

Improving cataract services means addressing all three of these. With a balanced approach to output, outcome, and outlay, it is possible to see major improvements in all three areas.



About this issue

Unoperated cataract remains the leading cause of blindness and moderate to severe visual impairment worldwide, affecting 94 million people globally. Addressing this urgent need requires a coordinated effort by everyone in the

eye team to provide a patient-centred service, increase access to cataract surgery, and improve visual outcomes after surgery. A balanced approach to outcome, output, and outlay – as well as a focus on partnerships – is key, and this issue of the journal offers some helpful pointers and examples.

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How can this be achieved?

The key element – as is evident in the articles in this issue – is partnership. First, partnership with **patients**. More work is needed to understand what matters to patients, so that we can ensure that cataract services are accessible and appropriate to our service users. It is worth considering how you could find out more about what matters to your cataract patients – the answers may surprise you. City Hospital, Nairobi already provides high quality services, but that didn't stop its leadership from asking patients how they could improve (page 4). The survey highlighted that patients wanted a telephone number to call if they had concerns, and that more patients than expected found the operation painful, prompting a review of their local anaesthesia policy.

The second partnership is with the **community**. There are numerous examples of engagement with the community in this issue of the journal, and in our previous issue on community engagement. These partnerships can involve working together to promote and publicise cataract services. Community partners may be community organisations, local government, businesses, media organisations, faith-based agencies, educational institutions, and patients who are happy with their cataract surgery. Partnerships can involve collaboration in the delivery of services – using a school as a venue for an outreach eye clinic during the weekend, for example. Members of the community can also be trained to identify cataract patients and to support follow-up care after cataract surgery. The greater the involvement of the local community, the more likely it is that patients will know about the services and trust their local eye care provider. Think about your clinic's links to the local community. Are there avenues of collaboration that you haven't explored? Are there strong local organisations that could help to promote or deliver cataract services? What about cost sharing models, such as health insurance?

The third partnership is with hospital **management**. In hospitals and eye clinics, in both high- and low-income countries, there needs to be a balance between income generation and cost-containment required by managers, and the scope of service provision by clinicians. This can sometimes lead to conflict: as clinicians, we want to provide the best possible services for everyone who needs them, regardless of the cost; however, managers have a responsibility to balance the books

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and to ensure that the clinic has enough funds to pay salaries at the end of the month. If we want to treat more patients (increase output), and obtain the best possible results (improve outcomes), we need to acknowledge that this will cost more (increased outlay), and we will need managers to approve the additional expenditure. Fortunately, all parties can achieve their goals. If the number of operations is increased, the unit cost per operation will decrease. This will bring in more profit that can be reinvested in improved services, or in subsidies for patients who would otherwise be unable to afford surgery. Increased outlay is therefore entirely compatible with greater financial sustainability.

The fourth partnership is with eye care **personnel** – the eye team. The most valuable resource an eye clinic has is its workforce, and

we need to ensure fair and transparent human resource policies in which all staff members contribute responsibly in their defined roles and are treated fairly and without favouritism. It takes time and effort to build this kind of partnership – one that is based on trust and understanding of the different but complementary needs and objectives of managers, support personnel, and clinicians. Have you ever spoken to the clinic's receptionist, or the hospital administrator, outside of a formal meeting in the workplace? If not, maybe it is time to start to build these partnerships.

We have a duty to reduce vision impairment caused by cataract, and this issue of the journal offers some pointers. If we keep in mind the essential messages of **partnership**, and balancing **output**, **outcome**, and **outlay**, then we will be successful.

Effective Cataract Surgical Coverage (eCSC): improving quality, output and access

Governments and international organisations, like the World Health Organization (WHO), need to be able to evaluate how well eye health services are doing in reducing avoidable blindness. In the past, they looked just at **quantity**: the number of people in a population who had undergone cataract surgery, using a measurement known as **Cataract Surgical Coverage (CSC)**.

This compared the number of people who had undergone cataract surgery to those who needed surgery (both operated and unoperated), and expressed this as a percentage. CSC did not measure the quality of surgery: how well the patients could see after their cataract operation.

To ensure that **quantity and quality** are both measured, ministries of health, WHO and other institutions increasingly want to know the **Effective Cataract Surgical Coverage (eCSC)**: the number of people who can now see well after cataract surgery, expressed as a percentage of those who needed surgery (both operated and unoperated).

In 2021, all WHO Member Countries agreed to a new global target: increasing eCSC by 30 percentage points by 2030.^{1,2} This target sets a new standard for the visual outcome of cataract surgery: a presenting visual acuity (PVA) of 6/12 or better, which is more difficult to achieve than the previous standard: PVA of 6/18 or better.¹

Increasing eCSC requires that eye units provide high quality surgery – which means routine measurement and reporting of surgical outcomes is now more important than ever. Recording who is coming for surgery is also vital so that we can ensure we are providing equitable access for all, including women and people with disabilities.

Providing people-centred cataract surgery, through outreach services and integration with existing health care services at primary level (as detailed in our recent issues on primary eye health care³ and community engagement⁴) will also help to improve patients' awareness and acceptance of surgery, as well as their ability to physically reach the services they need.

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Improving cataract services by asking patients for their feedback

Having a positive experience of cataract surgery makes patients more likely to recommend the service to others. Finding out what patients think is worthwhile, as it may result in low-cost improvements that can have a significant impact.



Speaking to patients outside City Eye Hospital. KENYA

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Cataract is the leading cause of blindness globally. The VISION 2020 programme prioritised increasing the number of cataract operations performed and improving service coverage. More recently, the World Health Organization (WHO) World Report on Vision emphasised integrated people-centered eye care.¹ Among the ten key messages of The Lancet Global Health Commission on Global Eye Health was that high quality eye health services are not always delivered.²

Why does quality matter?

One of the top five challenges in eye health today is improving cataract surgery services: their quality, equity and access.³ WHO defines quality of care as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and describes good quality services as effective, safe, people-centered, timely, equitable, integrated, and efficient.⁴

Good quality services attract more patients, which is vital for improving demand for, and uptake of, cataract services – which is important if we are to address the surgical backlog in many countries.

But how can we improve? Monitoring clinical outcomes is an important first step. If you are already doing this, the next step is to look at patients' experience and how that can be improved.

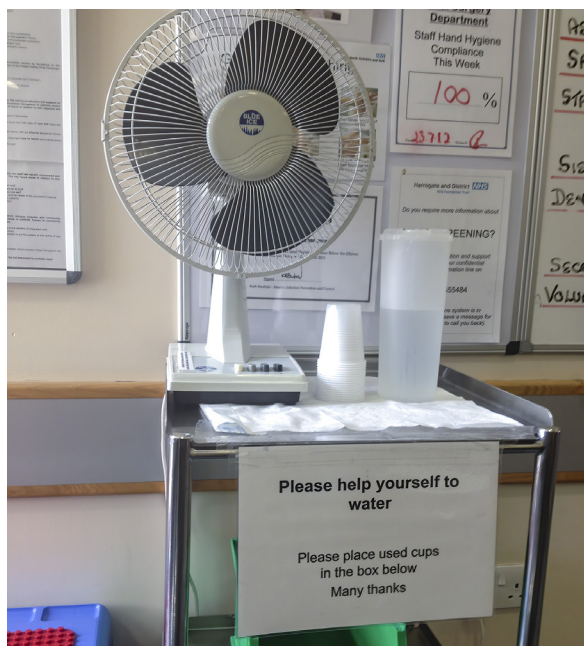
The case study below, although imperfect, shows that speaking to patients can highlight improvements that can be made at low cost while still significantly improving patients' experiences. Ideally such surveys should be repeated annually so that improvements can be tracked.

Case study: Learning from our patients

City Eye Hospital is a busy day surgery centre in the city of Nairobi, Kenya that sees around 200 patients every day. Most cataract operations are done by phacoemulsification under topical anaesthesia. In 2022, we decided to find out more about our patients' experience of the service, with the aim of finding out how our service could be improved.

Because we were short on staff time, we looked at questions researchers in other countries had asked their patients about their experience before, during and after cataract surgery⁵ and created a patient satisfaction questionnaire that we thought would be reasonably relevant in our setting. Our aim was not to produce published research, but rather to inform ourselves about how we could improve.

Over three days in June 2022, a customer service staff member asked patients waiting in different areas in the hospital whether they were willing to be interviewed. If a patient agreed, and had received cataract surgery within the previous month, the staff member asked them to rate, on a scale of 1 to 5, how satisfied they were with a set of statements about their care (see panel). The statements included aspects of care



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Providing drinking water is a simple way of improving patients' experience of an eye service.

UK

Questionnaire: aspects of care before, during, and after surgery

We selected the following questions as being relevant to our patients and our service. Patients were asked to rate each item using a 5-point Likert scale:

1 (very dissatisfied), **2** (dissatisfied)
3 (neutral), **4** (satisfied), **5** (very satisfied)

Before surgery

- Easy to come to the clinic (directions)
- The waiting time before opening a file/card
- The waiting time before seeing the doctor
- Access to food and drinks while waiting
- Friendliness of staff members
- Easy access for people with disabilities

- Ease of movement for someone who cannot see well
- Privacy in the consultation room
- Doctor explained what the problem was (cataract) in a way I could understand
- Doctor took enough time with me (not rushed)
- Provided written information about cataract surgery
- Told me the cost of surgery beforehand
- Gave me a date for surgery
- Answered my questions
- Reminded me of the surgery appointment date
- Accessible by phone if I had questions

During surgery

- Waiting time before going into the operating room Surgical procedure was explained to me
- I found the staff helpful
- Pain during surgery

After surgery

- Do's & Don'ts after surgery clearly explained
- Could see better after surgery
- Use of eye drops was clearly explained
- Gave me a number to call in case of emergency

before surgery, on the day of surgery, and after surgery. A total of 62 patients completed the questionnaire over the three days.

Patients who were 'satisfied' or 'very satisfied' were graded as being happy with the service and those who were 'unsatisfied' or 'very unsatisfied' were graded as being unhappy with the service.

Patients were happy about most aspects of the service, and no-one was 'very dissatisfied' with any aspect, which was encouraging. All were happy that they could see after surgery: 77% were very satisfied and 23% were satisfied.

However, we were keen to find out what aspects patients were less satisfied with, as that showed where we could make improvements.

The results show that the patients' main source of dissatisfaction is not their clinical care. Patients were unsatisfied with the following:

- A lack of provision of a cataract surgery brochure before surgery that they or a family member could read (86%)
- Pain during surgery (58%)
- Lack of accessibility by phone if they had questions before surgery (54%)
- Long waiting times in the queue to open a file (22%), to see the doctor (22%) and when waiting for your turn on the day of surgery (23%).

Only pain management required a change in clinical practice. One possible solution would be to train nurses to give sub-Tenon's blocks prior to surgery, and we are currently investigating this.

We have also addressed patients' dissatisfaction with the absence of a contact number – we now give them a number to call if they have concerns before or after surgery. Shortening waiting times and providing written information about cataract surgery are more difficult to address, but we are looking at ways this can be done.

Lessons for the future

Although we used a five-point scale, very few of the responses were in the middle (neutral), as we would normally expect. This suggests that having a staff

member administer the questionnaire may have influenced patients' responses. For example, patients may have been worried that a negative response could influence the care they receive in future. We could improve on this next time by asking someone to help who is independent of the hospital, and is perceived as being independent, to administer it.

Another limitation of our approach is that we chose the questions based on what we thought was important at the time, which might not reflect all of the concerns our patients have. It is possible we could have addressed this by adding an open-ended question at the end, to find out what else patients think we should have asked about. In future, we could also ask someone experienced in qualitative research to speak to smaller groups of patients first, to find out what is important to them, and then use the results when drawing up the questionnaire.

Although our results cannot be generalised to other clinics, or used to compare the patient satisfaction in this eye hospital with the results from other eye units, we plan to repeat key questions in 12 months' time to check whether the changes we made have led to better patient satisfaction.

Previous articles

How Aravind Eye Care System assessed patient satisfaction and improved uptake of eye care by 15% by providing a better patient experience

<https://www.cehjournal.org/article/patients-perspective-an-important-factor-in-assessing-patient-satisfaction/>

Practical tips on how to provide a positive patient experience:

<https://www.cehjournal.org/article/improving-the-patients-experience/>

Different ways to find out what patients think about our services & what the challenges are (including a great case study from KCMC):

<https://www.cehjournal.org/article/understanding-what-patients-think-about-eye-care-and-our-services/>

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Measuring cataract outcomes

Measuring the outcomes of cataract surgery can drive improvement and patient satisfaction. But is visual acuity measurement the only way?

Cataract surgery can be a frightening prospect for many patients. Hearing from others in their community who are happy with the results can have a significant impact and increase the overall uptake of cataract surgery in that community. To achieve this, we need to deliver cataract services that are successful in the opinion of the most important people: the patients. But how can we know whether our patients are happy, and what matters to them?

A patient-centred approach has two components:

- 1 Patients' **experience** of the cataract service before, during and after surgery. This can include comfort/pain, cleanliness, communication, and many other aspects of care. We cover this in more detail in another article in this issue.
- 2 The **visual outcome** of surgery, which surgeons need to know so they can check their surgery is of good quality. This will be the main focus of this article.

Visual outcome

The success or failure of cataract surgery has traditionally been assessed by measuring a patient's presenting visual acuity after surgery.

Visual acuity is an essential benchmark for the quality of cataract surgery. We should all aspire to meet the WHO's new recommendation that 80% of eyes operated on should have a presenting visual acuity of 6/12 or better after surgery.¹ In fact, by measuring and publicly reporting the visual acuity outcomes of cataract surgery, the United Kingdom's National Health Service was able to significantly improve outcomes by introducing a National Ophthalmology Database Cataract Audit in 2014. Likewise, tools such as the free BOOST cataract app (<https://boostcataract.org>) allow surgeons in low- or middle-income settings to monitor cataract outcomes and receive feedback without incurring additional costs.² Publishing these data publicly can improve outcomes and boost public confidence – which in turn improves the uptake of cataract surgery.³

In most low-income settings, patients tend to come for surgery when their cataract is already advanced. For them, a presenting visual acuity outcome of better or equal to 6/12 (the new World Health Organization benchmark) is highly satisfactory.

However, in high-income settings, the excellent visual acuity outcomes of cataract surgery, combined with the availability and affordability of surgery, has led to early uptake of services. For example, at least a third of patients undergoing cataract surgery in the UK have pre-operative visual acuity of 6/12. For them, visual acuity is a less useful indicator of the success of surgery.³

Visual acuity is usually measured by asking patients to read black letters on a white background at six metres – a task that few patients ever need to do in real life. Patients with higher pre-operative visual acuity will be more interested in their visual function: how the operation has improved their ability to do everyday



A cataract patient carrying out her daily tasks with ease after a successful operation. INDIA

tasks such as cooking, reading, or driving. Distance visual acuity alone, therefore, is not a perfect measure of success for, as it doesn't tell us much about the patient's perspective – how they perceive their own vision and visual function, and the impact on their quality of life.

Patient-reported outcome measures (PROMs) are a potential solution to this dilemma.⁴ PROMs are short questionnaires given to patients before and after surgery to ask about their own perception of their vision and the impact of their vision on their quality of life; this is expressed as a numerical score.

Although perception of vision and quality of life are subjective (i.e., individual to each patient), PROM questions are developed through a robust process of research, testing, and mathematical analysis, which means that the scores produced when the questionnaire is administered before and after surgery can provide a reliable measurement of the improvement experienced by each patient. Creating PROMs requires the input of patients during development to ensure they consider patients' visual needs, which will vary depending on factors such as patients' level of literacy or the need to be able to drive. PROMs put patients' perception of their own vision at the centre. This encourages clinicians to listen to patients and helps them to understand how patients' vision impacts their quality of life, which in turn permits health care professionals to develop services that meet the needs and expectations of patients – a very desirable outcome.

The importance of monitoring quality

Faced with a high prevalence of cataract blindness, increasing the quantity of surgery is often essential. However, this needs to be accompanied by monitoring the quality of what is being done.

For further reading on outcome monitoring see <https://bit.ly/CEHJ-cat>

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High-volume cataract surgery in Lahan, Nepal

The efficient, team-based approach to cataract surgery practiced at Sagarmatha Choudhary Eye Hospital increases output and reduces outlay by ensuring that everyone's time is used efficiently – thereby making surgery more affordable.



The patient on the left is being prepared for surgery while the surgeon is busy with the patient on the right. **NEPAL**

Sagarmatha Choudhary Eye Hospital (SCEH) is a 450-bed hospital in eastern Nepal, in the terai (lowlands) region near the border with India. It served more than 48,000 cataract patients in 2021: 60% from Nepal and 40% from India. During the peak season, 300–400 cataract operations take place every day, six to seven days a week. On average, surgeons perform 60–70 cataract operations per day, or up to 100 operations in a 12-hour shift during the peak season.

The hospital routinely monitors the outcomes of surgery in order to improve quality and improve standards, which has enabled it to develop an excellent reputation. Most patients believe the surgery offered is affordable. Manual small-incision cataract surgery costs 1,200 Nepalese rupees per eye (less than US \$10), which is approximately 10% of the monthly minimum wage in both Nepal and the neighbouring Indian state of Bihar. As a result, SCEH no longer actively promotes its cataract surgery services in Nepal, because there is no perceived need to do so. In India, however, there are cataract motivators in the community who recruit patients and help them by arranging bus travel to the hospital.

How is high output achieved?

The whole process is highly organised; every staff member, from surgeon to security guard, is clear about their role in the patient journey.

Each surgeon works between two operating tables simultaneously. By the time a surgeon has removed the first patient's cataractous lens and tied the conjunctival suture, the next patient, on the adjacent table, is ready for their lens to be removed.

Surgeons use the 'Fishhook' surgical technique¹ to deliver the nucleus, and the entire procedure takes just 3–4 minutes to perform on the fully prepared patient.

Clinical and surgical team

The clinical team consists of two general consultant (senior) ophthalmologists and five consultant ophthalmologists who are also subspecialists: a paediatric ophthalmologist, a cornea subspecialist, a glaucoma subspecialist, and two retina subspecialists. All the subspecialists split their days between cataract surgery and their own subspecialty.

There are also seven anterior segment fellows: recently graduated ophthalmologists from Nepal who are at different stages of a rigorous 2-year in-house training programme in cataract surgery (see panel).

Ophthalmic assistants at SCEH have an extended role. They perform a detailed eye examination of each patient and take an ocular and systemic history. The level of difficulty of the operation and the likelihood of complications are then discussed with the senior supervising surgeon, who decides which patients to assign to which trainees, based on their level of experience. This approach ensures high quality and fewer complications.

SCEH also employs eye health workers (EHWs) who are trained to perform pre-operative checks and prepare patients for surgery. This includes giving the peribulbar block, applying the bridle suture (superior rectus muscle traction suture), placing the speculum, performing peritomy (opening the conjunctiva), and cauterising the highly vascular scleral tissue.

Managing quality

Every three months, cataract operations are audited and staff present and discuss difficult/challenging cases to improve practice.

If a surgeon or trainee surgeon encounters complications, a senior surgeon will step in if needed. The surgeon responsible is asked to follow the patient's progress closely and give a presentation that includes a discussion of the complication and how it could have been avoided and/or better managed (this can include reviewing video recordings). The trainee surgeon may then be supported with closer supervision if needed.

Cataract surgical outcome is measured on the first day after surgery, at the end of the first month after surgery, and at the three-month follow-up visit. At the one-month follow-up, more than 60% of all cataract patients have uncorrected visual acuity of 6/18 or better.

Outlay

Ordering consumables in bulk (made possible due to the high volume of surgery) helps to keep the costs down. Most surgical instruments are sterilised and re-used, e.g., keratome and crescent blades (typically can be used for five cases), Simcoe cannulas (cleaned then steam sterilised and reused).

The greatest saving in terms of outlay is due to the efficiency with which patients move through the eye care system. The systems developed at SCEH, such as training eye health workers to prepare patients and give anesthesia, and setting up the operating theatre so one patient is being prepared while the surgeon is still operating on another patient, reduce the time the patient is in theatre, which means that everyone's time is used more efficiently. This reduces the overhead costs per patient and therefore the overall outlay, which supports SCEH to offer surgery at an affordable price.

Sustainability

SCEH has a separate outpatient department for patients



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on higher incomes and offers a range of eye services, including phacoemulsification cataract surgery. Income from this department subsidises low-income patients. SCEH also benefits from donor agencies who support the costs of equipment, human resource development, and surgical consumables.

Supporting women

Even though women and girls in Nepal have a greater burden of blindness than men and boys, they are less likely to visit eye hospitals, for a variety of reasons.² SCEH monitors uptake of cataract services separately for male and female patients, and has put in place measures to make the facilities female friendly, for example by offering separate registration counters, queues and toilets for men and women, an enclosed breastfeeding space, and a female counsellor for female patients. At present, around 3% more cataract operations are performed in women than in men.

The authors would like to thank Astrid Leck and Elmien Wolvaardt for their contributions to this article.

An eye health worker (EHW) giving a peribulbar block a few minutes before taking the patient to the operating table. A sterile eye pad is kept over the eye and the patient is asked to apply gentle pressure with the palm of his hand. Eye movement and pressure is checked before sending the patient for surgery. NEPAL

Cataract surgery training

Cataract surgery trainees, known as anterior segment fellows, undergo a rigorous two-year training programme.

Candidates must be ophthalmologists registered with Nepal's Medical Council and undergo a written exam and interview at SCEH before being considered for the programme. The successful candidates must also pass the SCEH protocol exam before being eligible to examine patients in the outpatient department (OPD).

Surgical training starts after one month of OPD exposure. Training

begins with two days of observing surgery in the operating theatre, followed by a week of suturing practice in the wet lab. After that, the trainee surgeons perform skin suturing, under supervision, in adult dacryocystorhinostomy patients. Once confident in skin suturing, they are given opportunities to perform supervised corneal suturing in adult patients with corneal or corneoscleral injury who have minimal visual potential.

Once hand-eye coordination is well established, and fellows are comfortable handling ocular

injury surgery independently, they are given selected cataract surgery cases.

Cataract surgery training is started systematically. Fellows are trained in each step under supervision, for a period of one month. After evaluation by the supervisor/mentor, they are eligible to perform independent cataract surgery. Complications are managed by the supervisor/mentor initially, and complication management is gradually handed over to the trainees, depending upon their individual performance.

For more information, visit www.erec-p.org/sagarmatha

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Using a quality improvement process to improve cataract outcomes

Ongoing monitoring and a systematic approach to quality improvement can improve outcomes for patients.

The Aravind Eye Care System (AECS) has an annual output of over 300,000 cataract operations a year through its network of 14 hospitals. More than 60% of all operations are subsidised or at no cost to the patient, and they are performed using the manual small-incision cataract surgery (MSICS) technique.

Thanks to advances in surgical techniques and intraocular lens (IOL) technology, cataract surgery can now restore sight and address refractive error. Given that many patients may not have access to spectacles, or be able to afford them, it is important to achieve a good presenting visual acuity after surgery. In recognition of recent evidence about the impact of mild vision impairment (visual acuity of $<6/12$ to $6/18$) on the everyday functioning of individuals,^{1,2} the World Health Organization now recommends a threshold for presenting visual acuity after cataract surgery of $6/12$ or better.³

As part of Aravind's ongoing cataract quality improvement strategy, we set out to address postoperative presenting visual acuity by testing a different approach to biometry. Biometry is the process of taking measurements of the eye to predict the power of IOL that would be needed by each patient. Accurate prediction of IOL power is one of the major factors that determines presenting visual acuity after cataract surgery. The accuracy of a biometry service is measured by recording the percentage of patients for whom the difference between the target refraction (estimated during biometry) and the refraction achieved after surgery falls within a specified range of prediction error; this is expressed as a spherical equivalent, in dioptres (D).

Our quality improvement process includes these steps:

- 1 Identify the problem (ask: what needs to change?) and gather baseline data on outcomes/outputs before changes are made
- 2 Set standards based on agreed benchmarks
- 3 Decide on the methods or equipment needed to make an improvement
- 4 Introduce changes and train personnel
- 5 Measure impact
- 6 Gather data to drive a process of ongoing improvement.

Identifying the problem and gathering baseline data

Until 2012, IOL power was calculated using contact or applanation ultrasound biometry methods as this is easy and quick to perform, especially in high-volume services (Figure 1). However, because this method involves direct contact with the cornea, compression of the cornea is possible, which can cause reading errors.

Aravind uses an electronic medical record-keeping system called CatQA to monitor and continually improve outcomes and processes. When we analysed the CatQA data from our hospitals, we found that just 40.4% of the patients who had undergone ultrasound biometry and MSICS had a prediction error within $\pm 0.5D$, and 85% had a prediction error within $1.0D$.

Figure 1 A biometrist performs contact (applanation) ultrasound biometry. **INDIA**



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Figure 2 A biometrist performs immersion ultrasound biometry. **INDIA**



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Setting standards

We decided to base our standards for the accuracy of biometry on the benchmark set by the UK's National Health Service (NHS): a prediction error within ± 0.5 D in 60% of patients, and within ± 1.0 D in 90% of patients.⁴

Finding the methods or equipment needed to make an improvement

There is good evidence⁵ that immersion ultrasound biometry performs better than contact ultrasound biometry and can be used in all cataract types (although optical biometry performs better than ultrasound overall, it doesn't work in advanced cataract – which is more typical in low-income settings such as ours).

Based on this evidence, and our available human and financial resources, we took the decision to convert from applanation ultrasound biometry to immersion ultrasound biometry in all 14 eye hospitals.

Introducing changes gradually

Immersion biometry was implemented between 2013 and 2018, in just a few hospitals at a time, by first upgrading the equipment and then retraining the staff members who perform biometry. Training was structured and staff were closely monitored. By the end of 2018, all 14 hospitals were performing immersion ultrasound biometry (Figure 2).

Measuring impact

To measure impact, we collected data about the accuracy of IOL power prediction a year after introducing immersion ultrasound biometry and again in 2021. The impact of the change was evident when we compared this with the baseline data from 2012 (Table 1).

Table 1 Patients seen in a 12-month period with prediction error within ± 0.5 D and 1.0 D (the benchmarks are 60% within 0.5 D and 90% within 1.0 D)

	Prediction error within ± 0.5 D	Prediction error within ± 1.0 D
Contact biometry (2012)	46,278 (40.4 %)	97,410 (85.0 %)
Immersion biometry 1 year after it was introduced	84,036 (54.6 %)	147,758 (96.0 %)
Immersion biometry (March 2022)	71,871 (67.7%)	101,874 (96.0%)

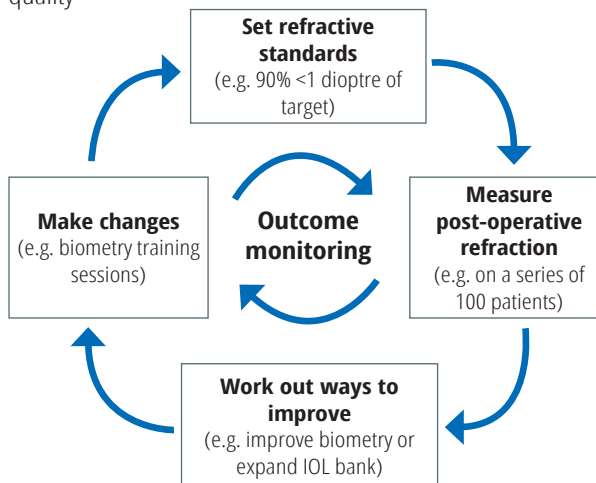
Following the adoption of immersion ultrasound procedure across all 14 hospitals, we found that, of the 153,868 patients who had undergone immersion biometry, 54.6% now had a prediction error within ± 0.5 D (up from 40.4%) and 96.0% had a prediction error within ± 1.0 D (up from 85%).

Ongoing data gathering and evaluation

We continued to routinely monitor the prediction error and make improvements where needed. (Figure 3), using a process of outcome monitoring and quality improvement.

Other opportunities for quality improvement, including using better IOL calculation formulae and offering staff members further biometry training, were responsible for some of the additional improvements seen between 2019 and 2021 (Table 1).

Figure 3 Continuous monitoring of outcomes to improve quality



In 2021, despite carrying out fewer operations, on more advanced cataracts (due to the COVID-19 pandemic), we significantly exceeded the NHS benchmarks with 68.2% and 94.9% of patients within the ± 0.5 D and ± 1.0 D prediction error, respectively (Table 1).

There was a corresponding improvement in the proportion of patients achieving better postoperative visual acuity once we started using immersion biometry. The proportion of patients who had uncorrected postoperative visual acuity of 6/18 or better improved from 63.0% in 2012 to 83.9% in 2021 (Table 2). Similarly, the proportion of patients with uncorrected visual acuity of 6/12 and better increased from 31.0% in 2012 to 59.8% in 2021 (Table 2).

To conclude, this process of patient-centred quality improvement promoted patient safety, treatment effectiveness, and efficient use of resources. The constant monitoring of outcomes provided the information necessary to continuously improve, refining the quality processes in ways that were often not expensive (e.g., using better IOL calculation formulae). The first step in the process is identifying where opportunities exist to improve, which will be different for each institution.

We would encourage everyone involved in cataract surgical service provision to be in this constant quality improvement cycle, as this helps to achieve the best outcomes for patients, irrespective of the volume of cataract surgery.

Table 2 Patients seen in a 12-month period with uncorrected visual acuity (UCVA) of 6/18 or better and 6/12 or better, before and after adopting the immersion biometry technique.

	Number (and percentage) of patients achieving UCVA of 6/18 or better	Number (and percentage) of patients achieving UCVA of 6/12 or better
Contact biometry (2012)	114,560 (63.0%)	34,936 (31.0%)
Immersion biometry (2021)	89,560 (84.4%)	61,587 (58.0%)

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Reducing the costs per patient by increasing the volume of cataract surgery

When eye units increase their cataract output, a small increase in the outlay (for consumables and IOLs) can drastically increase income and/or reduce costs for patients.

Cataract is the leading cause of avoidable blindness worldwide.¹ Since the burden of cataract blindness is greatest in the communities who are least able to afford eye care, cost is a major barrier to patients accessing cataract surgery.²⁻⁴ The financial barriers to patients accessing cataract surgery may be greater in rural areas, as additional travel, accommodation, and food costs are often incurred.⁵ Lack of access to cataract surgery can be financially devastating, often resulting in reduced economic potential because of vision impairment.⁶ Thus, designing more accessible and affordable cataract services is essential for tackling inequalities and overcoming poverty.

The aim of this article is to discuss high-volume cataract surgery as a strategy for lowering the cost of cataract surgery per patient. High-volume cataract surgery does not have an absolute definition, but is often considered as a service that carries out significantly more cataract operations than centres in the surrounding area.⁷

Cataract surgery costs can be divided into the costs of **consumables** (such as intraocular lenses, medication, anaesthetics, and disposables) and the costs of **infrastructure and salaries** (Figure 1).⁷ Each cataract operation uses approximately the same amount of consumables, therefore the yearly cost of consumables varies in line with the number of cataract operations performed in that year.

The cost of **infrastructure and salaries** is typically larger than the costs of **consumables** and must be paid regardless of the number of cataract operations performed each year. Examples of **infrastructure and salary** costs include staff salaries, equipment, cleaning, and building maintenance.

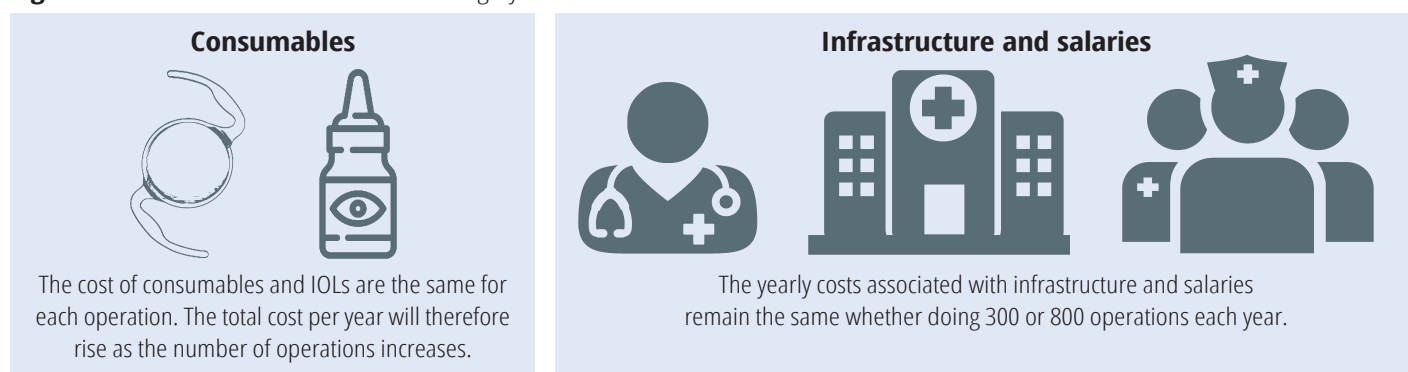
Although increasing the yearly number of cataract operations (the cataract volume, or output) will increase the total yearly cost of consumables, the cost of infrastructure and salaries remains fixed. By carrying out more operations per year, the infrastructure and salary costs – which can make up the bulk of the total cost of surgery in smaller centres – is therefore shared between more patients, **bringing down the cost per patient** for an individual cataract operation. Increasing the cataract volume also enables further reductions in the cost per operation through taking advantage of ‘economies of scale’ such as bulk purchasing of consumables: by buying a large number of items at once, lower prices could be negotiated, further reducing the cost per operation.

Growing your surgical output

A key assumption of high-volume cataract surgery is that most cataract services have unused capacity. Estimates of East African cataract services suggest that, although surgeons currently perform fewer than 300 operations each per year, they could perform 500 to 800 per year if improvements were made to management systems.⁸ This would have to be matched by increasing the number of patients who come for surgery, as detailed elsewhere in this issue and the previous issue on community engagement. Since staff salaries are a major fixed cost, optimising the number of operations performed per surgical day by theatre teams is an effective strategy for reducing the cost per eye.^{8,9}

Figure 3 is also based on our hypothetical example, and shows how the cost per operation reduces as the number of cataract operations per year increases. Table 1 shows how the costs per operation is calculated for 500 and 800 operations, respectively.

Figure 1 The costs associated with cataract surgery



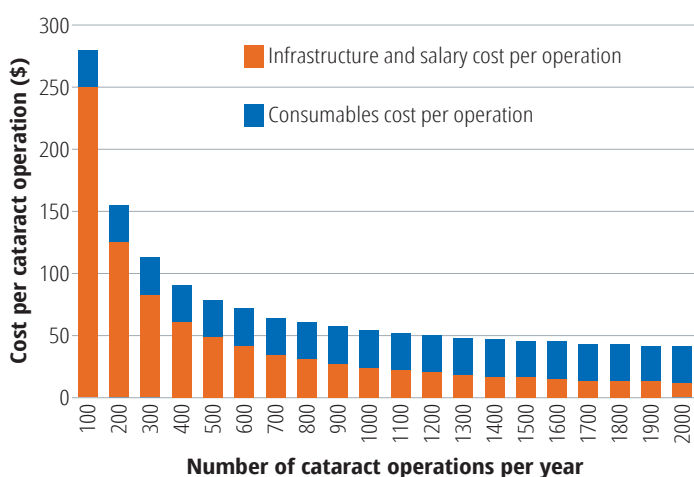
Hypothetical example: a cataract service with an annual output of either 500 or 800 operations

Here is a hypothetical example of a cataract service where the yearly infrastructure and salary cost is \$25,000 per year, and the cost of consumables for one cataract operation is approximately \$30. The **total cost** of **one** cataract operation can be calculated by dividing the total yearly cost of infrastructure and salaries (\$25,000) by the number of operations per year, then adding the consumables cost (see the formula in Figure 2).

Figure 2 Calculating the cost of one cataract operation

$$\begin{aligned} \text{Total cost of one cataract operation} &= \left(\frac{\text{Total yearly infrastructure and salary cost}}{\text{Number of operations per year}} \right) + (\text{consumables cost for one operation}) \\ &= \left(\frac{\text{US \$25,000}}{\text{Number of operations}} \right) + \text{US \$30} \end{aligned}$$

Figure 3 Changes in the cost of a single cataract operation as the number of operations per year increases



operation.

- If the annual cataract volume is 800 cataract operations per year, the outlay is \$61.25 per operation (\$30 for consumables + \$31.25 for infrastructure and salaries). If the hospital charges \$85 for cataract surgery, it makes a profit of \$23.75 from each operation.

Table 2 shows the outlay and profit on an annual basis for a surgical volume of 500 and 800 operations per year. For 500 operations per year, the annual profit is \$2,500, and for 800 operations per year, the profit is \$19,000 per year.

Increasing the cataract output by 300 operations per year requires an additional outlay of \$9,000 to cover the cost of the IOLs and consumables. But this is more than made up for by the increase in income from £2,500 to £19,000: an increase of £16,500.

Table 2 Annual cost, income and profit of a cataract service performing either 500 or 800 operations per year

Annual cataract volume	500 operations per year	800 operations per year
Consumables cost (annual)	\$15,000	\$24,000
Infrastructure and salary costs (annual)	\$25,000	\$25,000
Total outlay	\$40,000	\$49,000
Total income @ \$85 per operation	\$85 x 500 = \$42,500	\$85 x 800 = \$68,000
Total profit	\$2,500	\$19,000

Table 1 Cost per cataract operation for an annual cataract volume (operations per year) of 500 and 800, respectively

Annual cataract volume	500 operations per year	800 operations per year
Consumables cost per operation	\$30	\$30
Infrastructure and salary costs per operation	\$25,000 ÷ 500 = \$50	\$25,000 ÷ 800 = \$31.25
Total outlay per operation	\$80	\$61.25

Taking the examples in Table 1, for 500 and 800 operations per year, we can work out the costs (or outlay) and profit per operation. Say the hospital charges patients \$85 per cataract operation:

- If the annual cataract volume is 500 cataract operations per year, the outlay is \$80 per operation (\$30 for consumables + \$50 for infrastructure and salaries). If the hospital charges \$85 for cataract surgery, it makes a profit of \$5 from each

Additional profits generated by increasing the number of cataract operations could be used to subsidise patients who would otherwise struggle to afford surgery, or could be reinvested in services to make them more sustainable.

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Addressing the gender-specific barriers to cataract surgical services for women: evidence from Nepal

Implementing gender-responsive strategies and reducing the cost of eye care are necessary to improve women's access to eye care services.

The burden of vision impairment and blindness is borne disproportionately by women around the world.¹ In Nepal, the age-adjusted prevalence of bilateral blindness (presenting visual acuity <3/60 in the better eye) is 2.4% in women and 2.1% in men.² Despite this, fewer women than men come to eye hospitals; they are more likely to visit rural outreach clinics where services are limited.³ A 2010 policy brief on eye care equity in Nepal highlighted that gender disparity in eye care is persistent, profound, and pervasive.⁴

To better understand the barriers women faced, Tilganga Institute of Ophthalmology carried out formative research in 2016 which concluded that the cost of eye care services and the lack of female-friendly care were the major barriers. This was supported by qualitative exit interviews with women about the specific changes that would make eye health facilities more female-friendly for them.

Based on these findings, Tilganga Institute of Ophthalmology, with support from the Fred Hollows Foundation (FHF), conducted a pragmatic trial of strategies to promote access to eye care for women in remote and marginalised areas in five districts of eastern and far-western Nepal, including the hill regions and the *terai* (lowlands). The strategies were delivered through two intervention packages, from 2018 to 2020.

The first intervention package focused on the delivery of a set of strategies that collectively sought to address the 'awareness' and 'acceptability' dimensions of access, by enhancing women's experience of care and their awareness of services. This included:

- making eye health facilities female-friendly by setting up separate queues and toilets for men and women, as well as an enclosed breastfeeding space
- appointing a focal person to deal with gender issues within each hospital
- mobilising and training female community health volunteers to carry out eye health promotion and referral
- training technical and health personnel at eye care facilities
- hosting women-focused eye health awareness events in selected community eye care centres
- promoting eye health through mothers' groups
- distributing information, education, and communication (IEC) materials
- reaching out through mass media campaigns on local FM radio services
- conducting outreach programmes.

The second intervention package focused on the additional benefits associated with reducing the non-medical, out-of-pocket costs associated with eye care, thereby addressing the 'affordability' dimension of

access. This included:

- free eye treatment and free surgery for low-income and marginalised female patients referred by female community health volunteers, as well as for women referred at outreach camps in all intervention districts
- financial support for travel, food, and accommodation for the patients and for one family member accompanying each patient.

Data were collected at baseline (before the packages were implemented) and at the end of the study period, using a mixed method approach at the level of service providers and the community. The quantitative results were analysed using the difference-in-differences method, which compared the changes observed at the intervention sites with that of the control. The results were further supported by qualitative findings that were transcribed, reviewed, and analysed manually by identifying themes and categories.

After one year of the intervention, it was observed that – in the intervention sites – awareness-raising activities for women increased their knowledge about cataract. The work of female community health volunteers at the community level also led to an increase in women's self-reported autonomy in decision-making about accessing eye health care, and women cited female community health volunteers as a preferred source of eye health information. Most importantly, travel barriers decreased after intervention, with the provision of financial support to cover the travel costs of accessing eye care. However, the interventions could not increase women's access to cataract surgery at distant tertiary eye hospitals, with women citing household responsibilities as the main barrier. Instead, there was a surge of female service seekers in the outreach camps that were closer to their homes.

Based on the findings from the trial, the following measures could be adopted by eye health service providers to reduce the gender disparity in eye care access in other parts of Nepal and in countries with rural, marginalised populations, and where women have to depend on their male counterparts for decision-making.

At the institutional level

- In all eye hospitals, there should be a dedicated team for gender and eye health programmes led by a gender focal person with specific terms of reference. The overall responsibilities of the focal person would be to ensure the delivery of gender-responsive services, support policies to enhance gender equality, arrange periodic training for staff on gender issues, and so on.
- There should be periodic reviews of the needs and expectations of female patients, by conducting exit interviews and assessing the uptake of

clinical services (including cataract surgery) by female patients.

- Periodic review of the records of female patients (regular patients, as well as those referred by female community health volunteers and via outreach camps), including those of women from marginalised groups, can provide useful feedback to hospital management teams. Disaggregated data by gender, ethnicity, and area can be used to monitor interventions and reduce disparities in eye care access and delivery.
- Regular communication should be established with community clinics in the catchment areas to collect information regarding women's use of eye care services, including difficulties faced while providing eye services to female patients.

Eye care providers should provide regular updates about women's eye health needs, expectations, issues, and challenges.

At the community level

- Regular communication should be established with local governments and local health

facilities to promote community-based eye health programmes and strengthen the referral mechanism in collaboration with local female community health volunteers (where available) and other stakeholders.

- The integration of cataract referral programmes with other local health programmes, where appropriate and feasible, can reduce staff effort, increase coordination, reduce the time spent on programme activities, and possibly increase the coverage area.

At national level

In Nepal, there is a strong structural network of primary health care centres across all the administrative units. This study showed that women could be reached and encouraged to use eye care services through the community. Thus, integrating eye care services into existing primary health care programmes will increase the availability of eye care at the grassroots level, to which women have easier access.

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CASE STUDY: INDIA



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Improving cataract output in India: a joined-up approach

Improvements in outreach, demand generation, training, and quality control yielded a 15-fold increase in cataract output in just over a decade at Sitapur Eye Hospital.

Sitapur Eye Hospital was set up in 1927 in Sitapur, in the Indian state of Uttar Pradesh. The hospital began cataract services in 1935,¹ providing much-needed community eye care for many decades. However, there followed a period of decline in eye care services, with the hospital's cataract output reducing to just 2,000 operations per year in 2009. The hospital's extensive buildings also degraded over time.

The prevalence of cataract in Uttar Pradesh is high because of poor access to surgery.² High quality, high-volume eye care centres are therefore needed, and Sitapur Eye Hospital (SEH), with its large physical infrastructure and recognisable brand value, had the potential to increase its cataract output to better meet the eye care needs of the population.

A team was formed in 2009 to do just that. They found that the key challenges were as follows:

- a shortage of eye care personnel with the right level of skills in the right areas
- a lack of systems to monitor and improve quality
- not enough patients coming in for surgery
- a lack of proper counselling for patients needing surgery, and a lack of effective tracking of patients, e.g., by sending follow-up reminders
- a lack of outreach activities
- a shortage of funds
- staff attitudes that compromised patient care.

Over the next 13 years, these challenges were addressed

through improvements in the following areas.

Systems, infrastructure, training, and quality

Improvements have included the installation of better equipment, training of ophthalmic personnel, renovation of the operation theatre, and putting in place better systems flow and processes. Information and hospital management system (IHMS) software was installed to electronically record the demographic and clinic data of patients. Outpatient processes were streamlined. All clinical and administrative protocols were also aligned to the country's standard operating procedures; these were strictly followed and monitored to avoid any medical errors, such as cluster endophthalmitis. The visual outcomes of cataract surgery were assessed using Cataract Quality Metrics, a benchmarking software programme. Infrastructure and quality improvement is a continual process now, which is built into our organisational culture.

The academic/training programmes that we now offer includes a Bachelor of Optometry degree, a Masters in Ophthalmology degree (with an annual intake of 15 students), clinical fellowships in ophthalmology and optometry, and training courses for ophthalmologists, optometrists, and ophthalmic assistants.

Collaborations

Organisations such as Aravind Eye Care System,

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Sightsavers India, CBM, and Orbis, as well as the Indian government – through health schemes like the national programme for control of blindness and visual impairment, ‘Rashtriya Bal Swasthya Karyakram’ (a national programme to protect and promote the health of children) – are collaborating with us to improve service quality, offer training, and improve service delivery; they are also providing financial support.

Increasing patients’ access to surgery

Sitapur Eye Hospital conducts comprehensive eye care outreach camps where we identify cataract patients in rural and low-income communities. Everyone selected for cataract surgery at the camps is offered free eye surgery, spectacles, medicines, transport, and food. During the COVID-19 pandemic, door-to-door screening and mobile van-based services were created to reach the community. For non-surgical eye conditions, twenty well-equipped vision centres have also been established in eight districts; these enable communities to have easier access to eye care in their local neighbourhoods.

Finances

Initially, Sitapur Eye Hospital’s chief medical officer, who is responsible for teaching and administration, helped to generate income by performing phacoemulsification using premium lenses, glaucoma surgery, and paediatric surgery. This subsidised the cost of providing care to patients who would otherwise be unable to afford surgery.

Finances now come from multiple sources. Sitapur Eye Hospital has set up a three-tier paying system for patients: paid services for

those who can afford to pay in full, subsidised services for those unable to pay the full fees, and free treatment for those unable to pay at all. The ratio of paying to free patients is 30:70. The hospital also receives funding from non-governmental organisations (which support their special outreach activities), via government reimbursements and medical insurance, and from the sale of spectacles and medicines. All of this has enabled us to become financially self-sustaining.

Results

As a result of these efforts, Sitapur Eye Hospital has increased its output from 2,000 cataract operations in 2009 to 31,000 operations in 2021, with no episodes of cluster endophthalmitis and 74.8% of patients achieving corrected visual acuity of 6/18 or better. We operate on 700 to 800 children for cataract annually and attend to all sub-specialty cases. According to the demographic data collected using our IHMS, the male-to-female ratio of cataract patients is 50:50. Because of our outreach services, eye care is now reaching more villages, which is improving access to services for women, children, and disabled people, on their doorstep.

Looking to the future

The Sitapur Eye Hospital model is a self-sustainable one, both financially and in terms of human resource needs. Infrastructure and quality improvement is now a continual process, built into our organisational culture. The aim is to perform 100,000 cataract operations annually by 2030, to continue to provide equitable eye care for all, to develop specialties in ophthalmology, and to upgrade training and research facilities on an ongoing basis.

Picture quiz



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A 65-year-old man complains of gradually decreasing vision for the last two years. He has always been myopic, but recently his myopia has got worse, and he has had to change his spectacles twice in twelve months. He has been a heavy smoker for many years and has type 2 diabetes and hypertension. He is taking tablets for diabetes and raised blood pressure but is not on any other treatment. There is no other past ocular or medical history. His unaided vision is 6/60, but (in the eye in the photo) this improves to 6/18 with a pinhole.

ANSWERS

1. c. Progressive nuclear sclerosis increases the refractive index of the lens in a fairly regular symmetrical fashion, producing a myopic shift. In cortical lens opacities, the changes in refractive index will be more localised, so the refractive changes would tend to be towards astigmatism. As he is 65 years old, the eye is no longer growing. We would also not expect there to be progressive keratoconus at this age.

2. a and b. Diabetes and smoking are known risk factors for cataract. Smoking is particularly associated with nuclear cataract, as seen in this photo. Steroids and uveitis can cause cataract, however, he is not on steroids at present, and there is no evidence or history of previous uveitis. Glaucoma has no direct causative relationship with cataract formation, and there is no history of this.

3. c. To improve his presenting vision from the current level of 6/60, a cataract operation is likely to be the best option. Some benefit might be gained from new spectacles, but this would be his third pair in the past year, so this would only be a reasonable option if he was very unwell and unlikely to live much longer, or if he was unwilling or unable to undergo cataract surgery safely (or has to wait more than 6 months for surgery). Stopping smoking and improving his diabetes management would not reverse the cataract changes he already has in that eye, but may slow cataract progression in the other eye, and would have wider health benefits for him.

Question 1

Why is his myopia getting worse? (Select one)

- ☐ a. His eye is growing longer
- ☐ b. He has keratoconus
- ☐ c. He has a nuclear cataract

Question 2

What do you think has caused/exacerbated this problem? (Select all that are correct)

- ☐ a. Diabetes
- ☐ b. Smoking
- ☐ c. Steroid treatment
- ☐ d. Uveitis
- ☐ e. Glaucoma

Question 3

How would you help this man improve his vision?

- ☐ a. Encourage him to stop smoking and improve the management of his diabetes
- ☐ b. Prescribe new, stronger spectacles
- ☐ c. Refer for cataract surgery

Key community eye health messages

There are three key dimensions to a cataract service:



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- **Cataract output.** How many surgeries are being done and how can the number be increased? Which groups of people are accessing services and which are not?
- **Cataract outcome.** What percentage of patients achieve good vision after surgery? What is the complication rate? How can outcomes, patient satisfaction, and quality of service be improved?
- **Cataract outlay.** How much does it cost to perform each operation and how much do patients pay? How can services be made affordable?

The quality of cataract surgeries can be measured from three standpoints:



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- **Physiological.** What is the change in visual acuity before and after surgery?
- **Functional.** What activities are patients able to do before and after surgery?
- **Psychological.** How satisfied are patients with the surgery?

Improving the uptake of cataract services calls for the following:



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- Identifying people with visual impairment due to cataract through outreach, education, and mobile clinics
- Motivating people to come for treatment by allaying their fears and anxieties, ensuring a high quality of care, and providing comfortable and convenient facilities
- Reducing barriers by keeping fees affordable, reducing long wait times, and minimising transport costs, travel time, and loss of wages.