Routine monitoring of visual outcome of cataract surgery. Part 1: Development of an instrument

H Limburg, A Foster, C Gilbert, G J Johnson, M Kyndt

Aim: To develop a system for routine monitoring of visual outcome after cataract surgery.
Methods: Staff from eight eye centres in Asia and Africa defined the data collection form and report formats to be used for monitoring visual outcome after cataract surgery. Several operational research questions were raised and methods developed to address them. The system was field tested for 6 months and the operational studies undertaken. The system was finalised based upon the experience gained.

Findings: Two different systems for data collection were developed: a manual paper tally system and a computer system (cataract surgery record forms (CSRF)). Both systems report on operative complications; the proportion with good outcome (can see 6/18) and poor outcome (cannot see 6/60); and causes of poor outcome. Data are collected at discharge and at specified time intervals at follow up. Both systems were well accepted.

Conclusion: The major problem in field testing was data entry errors in centres using the computerised system. Routine monitoring of cataract outcome should be used by individual surgeons or centres to follow trends in their own results over time, and not to compare surgeons, in an atmosphere of trust and support.

Cataract blindness is a major public health problem. As a result of population growth and ageing the number of people blind as a result of cataract is calculated to double in the next 20 years if services are not increased and improved. Cataract surgery has been demonstrated to be one of the most cost effective health interventions. The cost effectiveness is related to short operation time, the potential for high volume, high success rates, and the low cost of consumables. However, when success rates are low, cost effectiveness is reduced. Recent clinical trials have demonstrated that cataract surgery can provide a good visual outcome (presenting visual acuity of 6/18 or better) in 90% of more of operated eyes. However, these trials usually exclude individuals with ocular co-morbidity, and are usually undertaken in tertiary institutions by highly trained surgeons. In contrast, population based surveys and rapid assessments conducted over the past decade, have shown that of all eyes operated for cataract, 21–53% had a presenting visual acuity of less than 6/60 (poor outcome). A significant cause of poor outcome is uncorrected aphakia due to loss or breakage of spectacles. However, even in eyes receiving an intraocular lens (IOL) poor outcome is reported in 5–15%.

Outcome data from population based surveys may not do justice to recent improvements in surgical techniques, but they may well reflect what the public perceives, influencing their expectations of regaining sight if they have surgery. Several studies have demonstrated that fear of not regaining sight and fear for the operation are important barriers which prevent patients coming for surgery. It is therefore imperative that, besides increasing the number of operations, the outcome of cataract operations should also be improved. If the causes of poor outcome are known through monitoring then it should be possible to address these causes and improve the results of surgery. This article describes a multicentre study to develop a simple instrument for monitoring cataract outcome in low and middle income settings. The goal is a system that can be used in a range of circumstances from non-ophthalmologists operating in remote rural areas to experienced ophthalmologists operating in training institutions.

The word “discharge” in this article is used as “discharge from inpatient care following cataract surgery.” The phrase “follow up visits” is used to indicate outpatient assessment at least 1 week after surgery.

In case of day care surgery, the postoperative assessment at the first or second postoperative day should be used as the “discharge” assessment. In many countries, follow up is poor, but all patients will have an assessment at discharge.

METHODS
Development of recording forms
In March 2000 eye surgeons from eight centres in Africa and Asia participated in a workshop to define the essential data needed to monitor results of cataract surgery. The centres were selected to represent a range of service providers—that is, outreach surgical services in rural Africa; district level eye units in Africa and Asia; and well equipped tertiary level training institutions in Africa and Asia. The output of these centres varied from 300 to 10 000 cataract operations per year (table 1).

It was agreed to focus on uncomplicated age related cataract, and to exclude from the monitoring process people younger than 40 years, those with traumatic cataract, and those having cataract surgery combined with another procedure. Drafts of a simple manual system (manual cataract surgical record form, MCSRF), and of a more detailed recording form for data entry and analysis (computerised cataract surgical record form, CCSRF) were developed by the participants over 2 days. Over the following 3 months a
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The first study was set up to determine whether results
have a good outcome. All these concerns were
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settings where not all patients return for routine follow up. In
value of recording visual acuity within 1–2 days of surgery in
about (1) the workload entailed in recording information for
participants met again in 2001 to evaluate the results
and finalise the instrument based upon the experience
database was created for data entry, and software written for
automated analysis of data.

Field testing recording forms
In June and July 2000, the principal investigator (HL) visited
each centre that elected to evaluate the CCSRF. The objectives
of the study were explained to all the staff, giving details of
how to complete the recording form. The data entry software
was installed, and a local data operator trained. After the visit
further assistance was provided through email, if required.
One centre decided after a few months to use the manual
system only because they did not have any dedicated staff for
data entry.

Each centre recorded patients having cataract surgery
between June and December 2000. Follow up of patients
continued into 2001. Data were regularly sent by email to the
principal investigator for consistency checks and, in case of
doubt, compared with the original case sheets. Contacts
between the principal investigator and the centres were
limited intentionally, in order to explore what problems the
centres encountered and how they solved them.

Issues raised
During discussion at the workshop concerns were raised
about (1) the workload entailed in recording information for
all operated patients in high volume settings, and (2) the
value of recording visual acuity within 1–2 days of surgery in
settings where not all patients return for routine follow up. In
some countries patients with poor results do not return to the
place of surgery, but seek advice from other clinicians. It is
not, therefore, possible to assume that those who do not
return have a good outcome. All these concerns were
developed into operational research studies, which were
undertaken by the centres over the ensuing 6 months.

Operational research studies
The following operational research studies were undertaken:

- The first study was set up to determine whether results
  obtained using the two systems were comparable. Four
centres agreed to collect data on the same patients using
both systems.

- The second study was set up as a means of addressing the
  workload issue, by determining whether the findings in a
randomly selected sample of 20% of patients having
cataract surgery gave similar findings to all patients
having cataract surgery. In four centres a random sample
of 20% was selected at the time of surgery, by drawing a
marble from a black bag in the operating theatre which
contained five marbles, one of which was a different
colour from the others. The recording form was only
completed if the marble with a different colour was
selected.

To address issues of follow up, two studies were under-
taken.

- Five centres agreed to trace patients who failed to return
  for follow up and measure their visual acuity in their
  home. Visual acuities in those who did return for follow up
  were compared with those who did not.

- In a second study analysis was limited to patients with
  complete follow up data to compare visual acuity at
discharge with visual acuity at various periods after
surgery, to evaluate changes in visual acuity over time.
Data from six centres were used for this purpose.

The participants met again in 2001 to evaluate the results
and finalise the instrument based upon the experience
gained.

RESULTS
Cataract surgery record forms
Versions of the manual and the computerised cataract
surgery records used in the pilot studies are shown in
figures 1 and 2. In each form the number of parameters has
been limited to those identified as being essential. The
following World Health Organization4 (table 2) definitions
were used for the operated eye:

- Presenting vision: visual acuity with available correction, if
  any

- Best corrected vision: visual acuity with best possible
  correction

- Good outcome: can see VA 6/18

- Borderline outcome: cannot see 6/18, but can see 6/60

- Poor outcome: cannot see 6/60.

Causes of poor visual outcome following surgery can be
recoded as follows:

- Selection: due to pre-existing concurrent eye disease

- Surgery: due to intraoperative or immediate postoperative
  complications

- Spectacles: due to inadequate optical correction

- Sequelae: due to late postoperative complications.

Software accompanying the CCSRF
Two computer packages were developed for the CCSRF—one
is programmed in Epi-Info 6.0415 and runs under MS-DOS
and Windows, the other is in Visual FoxPro 6.0 and runs in
Windows only. The software generates reports selected
through a menu. The user can select all records for analysis,
or use filters to select a particular year, surgical centre, or
surgeon. Reports can also be produced in chronological order
by date of operation, giving the results from 100 consecutive
cases, allowing the user to follow trends over time with

Table 1 Profile of participating centres

<table>
<thead>
<tr>
<th>Centre</th>
<th>Description</th>
<th>Region</th>
<th>No of eye surgeons</th>
<th>Cataract operations/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eye department, teaching hospital, urban</td>
<td>Africa</td>
<td>5</td>
<td>1000</td>
</tr>
<tr>
<td>2</td>
<td>Ophthalmic department, general hospital, urban</td>
<td>Africa</td>
<td>5</td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>Eye hospital, teaching, urban</td>
<td>Asia</td>
<td>40</td>
<td>8000</td>
</tr>
<tr>
<td>4</td>
<td>Voluntary eye unit, rural</td>
<td>Asia</td>
<td>3</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td>Voluntary eye hospital, urban</td>
<td>Asia</td>
<td>21</td>
<td>10 000</td>
</tr>
<tr>
<td>6</td>
<td>Voluntary eye hospital, rural</td>
<td>Asia</td>
<td>12</td>
<td>9000</td>
</tr>
<tr>
<td>7</td>
<td>Eye department, general hospital, rural</td>
<td>Africa</td>
<td>3</td>
<td>500</td>
</tr>
<tr>
<td>8</td>
<td>Outreach programme, rural district</td>
<td>Africa</td>
<td>3</td>
<td>900</td>
</tr>
</tbody>
</table>
meaningful percentages. Data can also be generated by month and year depending on local volume and requirements. The reports produce tables on:

(1) operative complications: total and type of complication
(2) percentage of good, borderline or poor outcome at discharge
(3) causes of poor outcome (VA < 6/60) at discharge
(4) good, borderline or poor outcome at 4 weeks or more postoperatively
(5) cause of poor outcome (VA < 6/60) at 4 weeks or more postoperatively.

Information by age and sex; first and second eyes; existing ocular pathology; surgeon and place of surgery can also be accessed.

Operational research studies
(a) Comparison of MCSRF with CCSRF
One centre discontinued CCSRF in favour of the MCSRF. The other three centres used the computer system first and the manual system later as an addition. However, the data in the two systems differed considerably, with more data entry errors in the manual system. Motivation to correct the MCSRF was low because of the extra work.

(b) Comparison of a randomly selected sample with the whole study population
Three centres were unable to take a random sample for a variety of reasons. In the other study centre 122 patients were selected by “the marble in the bag” system, out of the total of 454 cases operated on (27%). There were no significant differences in outcome between the two groups.

(c) Comparison of findings in those attending follow up with non-attenders
Different centres had different findings. Centre 1 compared 117 non-attenders visited at home at least 6 months after surgery with 133 cases who returned for the first and/or second and third follow up visit. At more than 6 months postoperatively, the outcome data for the non-attenders did not differ significantly from the data for those who did attend.

Centre 6 reported that 69% of the traced patients had good visual outcome while only 33% of those who came voluntarily had good vision. However, the postoperative periods in the two groups differed. Similarly, centre 8 reported that follow up cases traced at home had better visual outcomes than those attending for follow up. In this case, the traced group was examined at a mean of 67 days after surgery compared with a mean of 24 days in the self reporting group. Differences in outcome could, therefore, be attributed to the longer postoperative period in patients traced in their homes. Centre 5 managed almost 100% follow up and, hence, no comparison was possible. Centre 7 could not conduct home visits because of civil unrest. In summary therefore, one centre had evidence that those returning for follow up are representative of the total, but this finding could not be substantiated in the other participating centres.

(d) Change in visual acuity between that at discharge and at 8–25 weeks after surgery
Presenting visual acuity data at discharge as well as at 8–25 weeks follow up were available for analysis on 2819 eyes that had received a variety of different surgical procedures at the various centres. Overall, the proportion with good vision increased from 30.8% at discharge to 68.5%, while the

### Table 2: WHO target guidelines on the visual outcome of cataract surgery

<table>
<thead>
<tr>
<th>Postoperative acuity</th>
<th>Available correction</th>
<th>Best corrected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>6/6–6/18</td>
<td>&gt;80%</td>
</tr>
<tr>
<td>Borderline</td>
<td>&lt;6/18–6/60</td>
<td>&lt;15%</td>
</tr>
<tr>
<td>Poor</td>
<td>&lt;6/60</td>
<td>&lt;5%</td>
</tr>
</tbody>
</table>

Figure 1 (A) The manual cataract surgery record form: page A, for use at discharge. (B) The manual cataract surgery record form: page B, for use >4 weeks postoperatively.
proportion with poor outcome fell from 17.5% to 5.1% (table 3). There was, therefore, a very significant improvement in results from discharge to 8–25 weeks follow up time.

DISCUSSION

Two major problems were experienced during the pilot study. The first concerned the flow of CCSRFs through the hospital. Data are collected up to discharge while the patient is in hospital and then the CSRF goes to the computer operator for data entry. Afterwards it is returned to the outpatient department where patients are seen for review and again back for data entry. This cycle has to be repeated for subsequent visits. This requires strict logistic procedures and timely data entry.

The second problem was frequent data entry errors as data entry was not always done by trained, designated staff. In

<table>
<thead>
<tr>
<th>Type</th>
<th>No</th>
<th>Good outcome [6/6–6/18]</th>
<th>Poor outcome [-6/60]</th>
</tr>
</thead>
<tbody>
<tr>
<td>At discharge</td>
<td></td>
<td>At 8–25 week follow up</td>
<td>At discharge</td>
</tr>
<tr>
<td>All eyes</td>
<td>2819</td>
<td>30.8</td>
<td>68.5</td>
</tr>
</tbody>
</table>

Table 3  Presenting visual acuity at discharge and at 8–25 weeks following surgery
order to reduce this problem consistency checks were later incorporated into the software.

The operational research questions posed at the beginning of the study could only be partly answered. Centres could manage either the paper manual system or the computer system, but using both for comparison was found too time consuming. Patients seen at follow up in one centre were representative of all operated eyes in that centre, but this could not be substantiated in other centres. This is an important question which should be investigated further. Efforts to monitor outcome in a randomly selected sample of all operated cases caused much confusion. Only one centre could demonstrate no significant differences in outcome at any postoperative period between the two groups, although the sample was 27% of all operated cases, suggesting that the randomisation process had not been reliable (that is, 20% should have been selected). The consensus was that monitoring all operated cases rather than a random sample was less confusing and not much extra work. Centres with a large output might consider monitoring every other month, or during the first week of each month. However, the risk is that work attitudes may differ during monitoring periods and thereby affect outcome. Lastly, as anticipated, visual acuity at discharge did not accurately reflect visual acuity at 8–25 weeks after surgery. There was an improvement in good outcome from 30.8% to 68.5% of operated eyes and a decrease in poor outcome from 17.5% to 5.1%. The surgical technique used in most centres was extracapsular cataract extraction (ECCE) with IOL surgery, and only one of the centres was performing phacoemulsification. As small incision cataract surgery gains acceptance in developing countries it is anticipated that visual rehabilitation will be quicker than is currently the case following ECCE. Under these circumstances it seems likely that visual acuity at discharge will more closely relate to the final visual acuity, and so become more reliable for monitoring.

The monitoring system presented here follows the guidelines formulated by the WHO on visual outcome after cataract surgery (table 2). It is primarily intended for use in low and possibly middle income countries where gains from regular monitoring of outcome are expected to be greatest. Early in 2003 a CD-ROM with installation files for the manual monitoring and computer monitoring packages was distributed to another 20 eye centres for further testing. Based on their feedback and recommendations optional fields on preoperative and postoperative refraction, targeted postoperative spherical equivalent, biometry, and surgical details were added. The number of complications was expanded and a faster method for data entry was incorporated. An additional report on surgical details was added. In December 2003, this updated version was sent to the same 20 centres and a few new ones. Figure 2 shows the latest version of the CCSR.

For all cases with poor outcome a cause should be identified. This helps the surgeon decide whether current practices need modification to improve results. It is important to keep surgical causes of poor outcome or inadequate optical correction to a minimum. The proportion of cases with poor outcome due to pre-existing eye disease can also be reduced, by not operating on cataract patients with known pathology. However, these patients should not be denied surgery if there is the prospect of an improvement in functional vision; these patients should be informed of the likely outcome. When late postoperative complications, such as posterior capsule opaci-

**REFERENCES**


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A CD-ROM with installation files can be ordered from: International Resource Centre for the Prevention of Blindness, International Centre for Eye Health, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK. Tel: +44 20 7938 8168; email: sue.stevens@lshtm.ac.uk; or download the installation files at www.jceh.co.uk

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