Cataract surgery practice patterns worldwide: a survey

Tommaso Rossi, Mario R Romano, Danilo Iannetta, Vito Romano, Luca Gualdi, Isabella D’Agostino, Guido Ripandelli

ABSTRACT

Objective To report the results of a global survey on cataract practice patterns related to preoperative, intraoperative and postoperative care, surgical setting and personnel allocation.

Methods and analysis An online 28 questions survey was sent to 240 ophthalmologists asking to describe prevailing trends in their institutions across 38 countries and 5 continents. Questions inquired country, institution, surgical volume and setting, anaesthesia, preoperative and intraoperative examination and postsurgical care. Statistical analysis used crosstabs lambda statistics for non-parametric nominal variables. P value less than 0.05 was considered statistically significant.

Results 209/240 (87%) ophthalmologists responded: 38% representing public hospitals, 36% private practices and 26% academic sites; overall surgical volume was between 241 700 and 410 500 cataracts per year. There was a significant correlation between type of institution and surgical volume. Complete results available online (https://freeonlinesurveys.com/r/W6BeL2xy).

Conclusion Cataract surgery related patterns of perioperative care showed significant difference among respondents, regardless to type of institution, surgical volume and country. Many evidence-based procedures are unevenly practiced around the world and some widespread and expensive habits lack solid scientific evidence while consuming enormous amount of resources both monetary and human. There is a need to reach consensus and share evidence-based practice patterns.

INTRODUCTION

Cataract extraction is the most prevalent surgical procedure of all medical specialties with an estimated 3.7 million cases per year in the USA, 7 million in Europe and 20 million worldwide.1 2

Phacoemulsification with intraocular lens implant in the capsular bag is the standard of care, resulting in excellent anatomical and functional outcome and relatively low complication rate.3 Although the surgical procedure is very consistently performed worldwide, practice patterns related to patients’ preoperative and postoperative care, diagnostics, surgical setting, precautions and follow-up, greatly differ, according to countless variables including institutions and country regulations, insurance company requirements, payment agreements and even surgeons’ preferences and habits.4

Given the exceedingly high volume of cataract procedures worldwide, perioperative setting and organisation are at least as important as the technical quality of surgery itself, due to their impact on patients’ rehabilitation, satisfaction, healthcare organisation, expenditures as well as on the medico-legal burden. Defining and validating a golden standard of ‘perioperative’ care, diagnostics and surgical theatre setting, would greatly help deliver homogeneous, evidence-based healthcare services throughout the world. Even more importantly, this would increase appropriateness and efficiency while improving the management of risk inherent to surgical procedures, reducing the medico-legal burden and freeing a significant amount of resources.

Purpose of present paper is to report the results of a worldwide online survey conducted to highlight the preferred patterns of practice related to preoperative, intraoperative and postoperative setting and organisation around cataract surgery. The survey, far from being ‘omni-comprehensive’, is intended to offer a glimpse on shared practices as well as
notable distinctions in order to ignite discussion on the need for shared and validated procedures.

MATERIALS AND METHODS

Survey rationale and diffusion

An online survey consisting of 28 multiple choice questions reported in box 1 was sent to 240 leading ophthalmologists working in 240 different centres in 38 countries and five continents. All participants were contacted via email and previously instructed. Participants were recruited by the authors among colleagues previously contacted and willing to participate and also through a word-of-mouth mechanism. The Italian and Japanese Ophthalmological Society posted a call for participants to the survey thus enrolling more ophthalmologists than from any other participating country. The survey took approximately 20 min to complete and participants received no compensation.

Rationale behind questions was as follows: questions 1–3 described country of origin, type of institution and surgical volume. Questions 4–11 described the surgical theatre setting, number of ophthalmologists, nurses, anaesthesiologists, type of anaesthesia, safety precautions including venous access, continuous ECG and pressure monitoring.

Questions 12–19 evaluated preoperative diagnostics, infection prophylaxis and intraoperative material sterility and systemic management while questions 20–27 dealt with postsurgical care: patching, discharging and second eye surgery. The very last question touched one of the sensitive issues: whether the presence of an anaesthesiologist would be always desirable if cost were not an issue.

Data were gathered in .xls format for analysis and statistical purposes.

The survey was administered in English language and all participants were fluent in English. Question and answers are publicly available in online and online supplemental file (survey results final.pdf).

Patients were not involved in the study as practice patterns was the object.

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors and there are no competing interests to be disclosed.

Statistical analysis

Statistical analysis used Cramer-V and symmetric Lambda statistics of contingency tables on nominal variables. Multilevel structural equation modelling determined the difference between the surgical theatre setting with staff employed and the preoperative, intraoperative and postoperative diagnostics and prophylaxis in the five continents. P values less than 0.05 have been considered statistically significant.

RESULTS

The complete survey results are public and accessible online at the above URL. Overall response rate was 209/240 (87.08%) from 38 countries (figure 1). The survey represented all types and sizes of institutions: 38%

Box 1  Survey questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Please enter the state where your institution is located.</td>
<td></td>
</tr>
<tr>
<td>2. Type of institution.</td>
<td></td>
</tr>
<tr>
<td>Private practice.</td>
<td></td>
</tr>
<tr>
<td>Academic.</td>
<td></td>
</tr>
<tr>
<td>Public hospital NHS.</td>
<td></td>
</tr>
<tr>
<td>3. How many cataract surgeries per year are performed in your institution?</td>
<td>&lt;500 per year.</td>
</tr>
<tr>
<td>Between 500 and 1000 per year.</td>
<td></td>
</tr>
<tr>
<td>Between 1000 and 2000 per year.</td>
<td></td>
</tr>
<tr>
<td>Over 2000 per year.</td>
<td></td>
</tr>
<tr>
<td>4. How many ophthalmic surgeons (MDs) are present at the same time in the OR during cataract surgery?</td>
<td>Only one, the surgeon.</td>
</tr>
<tr>
<td>Two surgeons.</td>
<td></td>
</tr>
<tr>
<td>One surgeon and one resident.</td>
<td></td>
</tr>
<tr>
<td>5. How many nurses are present at the same time in the OR during cataract surgery?</td>
<td>No nurses, the surgeon is alone.</td>
</tr>
<tr>
<td>One circulating nurse.</td>
<td></td>
</tr>
<tr>
<td>One scrub nurse.</td>
<td></td>
</tr>
<tr>
<td>One scrub and one circulating nurse.</td>
<td></td>
</tr>
<tr>
<td>Resident/fellow as a scrub nurse alone.</td>
<td></td>
</tr>
<tr>
<td>Resident/fellow and a circulating nurse.</td>
<td></td>
</tr>
<tr>
<td>6. Type of anaesthesia for uncomplicated routine cases.</td>
<td></td>
</tr>
<tr>
<td>&gt;90% topical.</td>
<td></td>
</tr>
<tr>
<td>75% topical 25% peribulbar.</td>
<td></td>
</tr>
<tr>
<td>50% topical 50% peribulbar.</td>
<td></td>
</tr>
<tr>
<td>10% topical 90% peribulbar.</td>
<td></td>
</tr>
<tr>
<td>7. Is there an anaesthesiologist?</td>
<td></td>
</tr>
<tr>
<td>Dedicated MD present in the OR during all surgery.</td>
<td></td>
</tr>
<tr>
<td>Dedicated nurse anaesthesiologist present in the OR during all surgery.</td>
<td></td>
</tr>
<tr>
<td>MD available for sedation on demand in the operating group.</td>
<td></td>
</tr>
<tr>
<td>MD available only for emergency.</td>
<td></td>
</tr>
<tr>
<td>8. Sedation.</td>
<td></td>
</tr>
<tr>
<td>None &gt;90%.</td>
<td></td>
</tr>
<tr>
<td>Benzodiazepines &gt;90% of cases.</td>
<td></td>
</tr>
<tr>
<td>Benzodiazepine 50% of cases.</td>
<td></td>
</tr>
<tr>
<td>Benzodiazepine 25% of cases.</td>
<td></td>
</tr>
<tr>
<td>Opioids &gt;75% of cases.</td>
<td></td>
</tr>
<tr>
<td>Opioids 50% of cases.</td>
<td></td>
</tr>
<tr>
<td>Opioids 25% of cases.</td>
<td></td>
</tr>
<tr>
<td>9. Does the patient have a vascular access during routine cataract surgery?</td>
<td>100% of patients.</td>
</tr>
<tr>
<td>Only if deemed necessary: about 75%.</td>
<td></td>
</tr>
<tr>
<td>Only of deemed necessary: about 50%.</td>
<td></td>
</tr>
<tr>
<td>Never.</td>
<td></td>
</tr>
</tbody>
</table>

Continued
Box 1 Continued

10. Does the patient have continuous ECG monitoring during routine cataract surgery?
100% of cases.
No, never.
Only in deemed necessary, roughly 75% of cases.
Only if deemed necessary, roughly 50% of cases.
Only in deemed necessary, roughly 25% of cases.
Only in deemed necessary, roughly 5% of cases.

11. Does the patient have continuous blood pressure monitoring during routine cataract surgery?
100% of cases.
No, never.
Only in deemed necessary, roughly 75% of cases.
Only if deemed necessary, roughly 50% of cases.
Only in deemed necessary, roughly 25% of cases.
Only in deemed necessary, roughly 5% of cases.

12. Pre-op ocular diagnostics ROUTINELY used.
Optic biometry.
Ultrasound biometry.
Endothelial microscopy.
Corneal topography.
Macular OCT.
Potential Acuity Meter.

13. Preoperative testing.
Topical antibiotics.
No pre-op therapy.
Topical NSAIDs.
Topical antiseptics.
Systemic antibiotics.

14. Use of anticoagulants/antiaggregants.
Leave as it is.
Discontinue before surgery.
Substitute with LMW heparin.
Ask patient’s GP.

15. Preoperative prophylaxis.
Topical antibiotics.
No pre-op therapy.
Topical NSAIDs.
Topical antiseptics.
Systemic antibiotics.

100% of cases.
Most cases.
Never.

17. Intra-op endophthalmitis prophylaxis at the end of surgery.
No prophylaxis.
Intracameral cefuroxime.
Other intracameral drug.
Conjunctival sac povidone iodine.
Conjunctival antibiotics.

18. Mark all materials changed with a sterile one after EACH and EVERY routine cataract surgery.
Pump cassette.

All tubings.
Phaco handpiece.
Phaco tip.
BSS bottle.
Phaco tray draping.

Surgeon prescribes drugs.
Anaesthesiologist prescribes drugs.
Nurse administers drugs based on predetermined protocol.

None.
For a few hours.
At night for few days.
For a few days H24.

None.
No social activities/work 5 days.
No social activities/work 12 days.
No social activities/work >15 days.

22. Post-op therapy.
None.
Topical antibiotics + topical NSAIDs.
Topical NSAIDs alone.
Topical antibiotics alone.
Systemic antibiotics + topical.

23. Second eye.
At patient’s will.
Same day.
Within 7 days.
Within 15 days.
Within a month.
Within 3 months.

24. Length of stay within the premises of the Surgical Centre AFTER surgery for monitoring reason.
Few minutes.
At least 1 hour.
At least 2 hours.
At least 3 hours.

25. Who discharges the patient from surgical centre after surgery?
The surgeon.
A nurse based on surgeon written order.
A second ophthalmologist.
The patient is free to leave whenever comfortable.

26. Post-op visit schedule is approximately.
Days 1, 7, 30.
Days 7, 30.
Days 30.

27. Who sees the patient post routine cataract surgery?
Always same surgeon.
Any ophthalmologist on duty in the day of control visit.
Referring ophthalmologist.
public hospitals, 36% private practices and 26% academic sites; 40% of them with a surgical volume greater than 2000 and 40% between 1000 and 2000 per year for overall surgical volume between 241700 and 410500 cataracts per year. There was a significant correlation between type of institution and surgical volume (p<0.05): public hospitals had larger surgical volume.

Preoperative systemic testing varied considerably among respondents (figure 2): 52% of involved institutions had mandatory preoperative ECG and blood testing, in 126/209 (60%) centres was the ophthalmologist who interviewed patient on his/her systemic conditions while in 57/209 institutions an anaesthesiologist briefed the patient. In such all such cases, patients also underwent ECG and blood tests. Interestingly, 13/203 centres (6%) did not ask for any pre-op testing, neither interviewed the patient, while 65/209 (31%) required the patient to fill a questionnaire and 34/209 (16%) had the general practitioner doing it. Neither institution type nor surgical volume had an impact on systemic pre-op testing (table 1).

Antiplatelet aggregation drugs and anticoagulants were left untouched in 75% of cases and discontinued in 12% while pre-op topical prophylaxis was performed in 71% of interviewed institutions while the remainder 29% did not. Fifty-four per cent or responders used antibiotics, 29% non-steroid anti-inflammatory drugs (NSAIDs), 29% antiseptics and multiple choices were common: 6.9% used three products; 21% two drugs, 68% only one drug. Institutions requiring one drug only prescribed: 61/85 (71.7%) antibiotics, 15/85 (17.6%) antiseptic drugs alone, 9/85 (10.6%) NSAIDs (figure 3).

Preoperative ocular diagnostics varied considerably (figure 4): 87% performed optic biometry, 28% ultrasound biometry, 55% endothelial microscopy, 47% Optical Coherence Tomography (OCT), 30% corneal topography. Interestingly, 26/209 (12.4%) performed ultrasonic biometry as the only pre-op diagnostics; 2.9% of responders performed all six tests, 7.8% performed five tests, 13.3% four tests, 27.5% three tests, 29.5% two tests and 18.7% only one test. Institution type but
not surgical volume significantly influenced this choice: 38% of private practices performed four or more tests versus 20% academic centres and 11% of public hospitals (table 1).

Surgeon was alone in the operating room (OR) in 45% of cases, assisted by a resident in 29% or second house-staff surgeon in 26%; the type of institution significantly influenced the number of surgeons (table 1): private practitioners were more likely to operate alone (74% of centres vs 13% academic and 42% public hospitals) while the surgical volume did not correlate to the number of surgeons present in the OR.

**Table 1** Survey questions when type of institution and surgical volume are considered independent variables

<table>
<thead>
<tr>
<th>Question</th>
<th>Type of institution</th>
<th>Surgical volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Type of Institution</td>
<td>–</td>
<td>λ 0.07 p=0.163</td>
</tr>
<tr>
<td>3. How many cataract surgeries per year are performed in your institution?</td>
<td>λ 0.07 p=0.163</td>
<td>–</td>
</tr>
<tr>
<td>4. How many ophthalmic surgeons (MDs) are present at the same time in the OR during cataract surgery?</td>
<td>λ 0.29 p&lt;0.001</td>
<td>λ 0.07 p=0.298</td>
</tr>
<tr>
<td>7. Is there an anaesthesiologist?</td>
<td>λ 0.07 p=0.265</td>
<td>λ 0.06 p=0.259</td>
</tr>
<tr>
<td>9. Does the patient have a vascular access during routine cataract surgery?</td>
<td>λ 0.13 p=0.046</td>
<td>λ 0.00 p=1</td>
</tr>
<tr>
<td>10. Does the patient have continuous ECG monitoring during routine cataract surgery?</td>
<td>λ 0.08 p=0.184</td>
<td>λ 0.00 p=1</td>
</tr>
<tr>
<td>11. Does the patient have continuous blood pressure monitoring during routine cataract surgery?</td>
<td>λ 0.04 p=0.176</td>
<td>λ 0.00 p=1</td>
</tr>
<tr>
<td>12. No. of pre-op ocular diagnostics ROUTINELY used</td>
<td>λ 0.15 p=0.02</td>
<td>λ 0.06 p=0.069</td>
</tr>
<tr>
<td>13. No. of preoperative systemic testing</td>
<td>λ 0.04 p=0.081</td>
<td>λ 0.03 p=0.266</td>
</tr>
<tr>
<td>15. No. of preoperative prophylactic drugs</td>
<td>λ 0.01 p=0.788</td>
<td>λ 0.01 p=0.316</td>
</tr>
<tr>
<td>18. No. of materials changed with a sterile one after EACH and EVERY routine cataract surgery</td>
<td>λ 0.19 p=0.001</td>
<td>λ 0.04 p=0.204</td>
</tr>
<tr>
<td>24. Length of stay within the premises of the Surgical Centre AFTER surgery for monitoring reason</td>
<td>λ 0.09 p=0.167</td>
<td>λ 0.02 p=0.296</td>
</tr>
<tr>
<td>25. Who discharges the patient from surgical centre after surgery?</td>
<td>λ 0.09 p=0.025</td>
<td>λ 0.02 p=0.284</td>
</tr>
<tr>
<td>26. Post-op visit schedule is approximately</td>
<td>λ 0.06 p=0.416</td>
<td>λ 0.01 p=0.316</td>
</tr>
<tr>
<td>27. Who sees the patient post routine cataract surgery?</td>
<td>λ 0.21 p&lt;0.001</td>
<td>λ 0.1 p=0.1</td>
</tr>
<tr>
<td>28. If cost were NOT an issue, would you like a dedicated anaesthesiologist?</td>
<td>λ 0.08 p=0.007</td>
<td>λ 0.02 p=0.250</td>
</tr>
</tbody>
</table>

Bold values represent statistically significant difference among questionnaire answers (p<0.05).

OR, operating room.
Two nurses (one scrub and one circulating) were present in 78% of cases, only one circulating nurse in 11%. A dedicated anaesthesiologist was present in the OR throughout surgery only in 30% of cases, available for sedation in 29% or on call within the premises of the hospital for emergency only, in 31% while 10% relied on a nurse anaesthesiologist (a professional that does not exist in many countries) although if cost were not an issue, 51% of responders would like a dedicated anaesthesiologist (see complete results online). Type of institution but not surgical volume (table 1) influenced significantly the wish for a dedicated anaesthesiologist: 24% of private practices, 20% of academics and 7% of hospitals felt it was not necessary while respectively 47%, 39% and 60% disagreed.

Topical anaesthesia was used in more than 90% routine, uncomplicated cases in 81% of responding centres. Sixty-nine per cent of respondents used no sedation in over 90% of their cases, while 15% used benzodiazepines in over 90% of their patients and 10% only in 50%. The presence of a dedicated anaesthesiologist influenced the use of sedation ($\lambda$ 0.08; $p=0.004$) but not the type of anaesthesia or the amount of preoperative systemic testing.

A vascular access was routinely placed in 60% of centres (type of institution influenced significantly vascular access, being more frequent in public hospitals: 76% versus 64% in academic centres and 40% of private practices; $p<0.01$; table 1). Sixty-nine per cent of responders placed continuous ECG monitoring and 81% pressure monitoring.

The use of povidone iodine before surgery was 95% while at the end of surgery 59% injected cefuroxime in the anterior chamber (AC), 12% injected other drugs in the AC, 34% instilled povidone in the conjunctival sac, 23% antibiotics and 13% did not use any drug at all.

Surgical material sterility management and the exchange of used materials after every single procedure showed great variability (figure 5): 92% changed the phaco tip, 80% the handpiece, 71% phaco tray draping, 69% the entire tubing set and only 53% all six items. Type of institution significantly impacted on this issue: 30% of private practices, 71% of academic centres and 87% of hospitals changed five or more materials after each and every surgery (table 1).

Postoperative care was administered as follows: patients were discharged from surgical centre after at least an hour in 49% of cases, a few minutes after surgery in 36% mostly by a nurse on written orders by the surgeon (59%) or by the surgeon him/herself (15%) with topical antibiotics and anti-inflammatory drugs in 89% or responses with a return visit schedule of 1, 7, 30 days in 87% of cases, done by the surgeon in 40% of cases and any ophthalmologist on duty in 53% of cases. Patching was ordered for a few hours in 48% of cases, at night for a few days in 25% of responses while 23% did not recommend any patching. Restrictions also varied: 51% precluded social activity and work for 5 days while 43% did not recommend any.

Postoperative care is influenced by institution type but not surgical volume (table 1).

Second eye surgery schedule ranged from 7 days to 3 months with most centres allowing the patients to decide anytime (33%). Only 5% scheduled same day bilateral surgery.

**DISCUSSION**

Cataract surgery is the most prevalent surgery of all medical fields, very consistently performed throughout the world with high rehabilitation rate. While the surgical technique is extremely standardised, preoperative, intraoperative and postoperative procedures greatly vary according to surgeons’ preferences, institution and country regulations.

Our survey represents a snapshot of this extremely variegated scenario: despite the existence of guidelines and scientific evidence, there seems to be little consensus on many key issues, strengthening the need for the definition of a ‘best practice’, given the gigantic caseload, the number of stakeholders and the economic and medico-legal implications.

Although the questionnaire topics regarded numerous aspects of cataract surgery process, our discussion will focus on costs and safety.

A single surgeon is present in 40% of ORs and 30% use a resident as second surgeon; there is a dedicated anaesthesiologist only in 30% of cases, while is available for sedation on demand in 29% and reachable only for emergency in another 31%. Two nurses are present in 77% of ORs.

The copresence of two surgeons, mandatory in some countries (eg, Italy) and recommended in other specialities, may questionably increase safety and certainly cost: assuming a 20 min uncomplicated surgery, medical staff cost per surgery varies from US$46 for a single surgeon and available anaesthesiologist, to US$120 for two surgeons and a dedicated anaesthesiologist (table 2), translating into 1.2 million physician hours or 132 million dollars in the USA (assuming US$110 average cost per hour) and about twice as much in Europe! It all doubles for a dedicated anaesthesiologist.
Intraoperative monitoring also returns inconsistent data: vascular access is routinely placed only in 60% of centres, ECG in 69%, ECG and continuous pressure measurement in 81%. There clearly is a need for a univocal recommendation in the interest of safety although venous access itself can be a matter of controversy as oral sedation has been proved to be at least as effective as intravenous10 and accurate patient selection could limit its use to those more likely to require pharmacological treatment. In any case, a vascular access has very limited impact on cost but is potentially life-saving and continuous monitoring of a patient with no vascular access is almost of no use since intravenous drugs cannot be quickly administered on need.

The amount of preoperative ocular diagnostics is even more variable: 40% do four or more tests and 20% only one. The difference of cost and healthcare personnel time is striking: assuming an average US$35 per each diagnostic test, the delta between a single biometry test (mandatory) and the entire panel of six mentioned tests, is US$175 per surgery or 647 million in the USA and twice as much in Europe without even considering medical staff adjunctive time costs that certainly exceed 1 hour per surgery (another US$110 per surgery).

Routine preoperative medical tests requested by 50% of survey responders have been often alleged unnecessary11–13 and replaced with preoperative assessment by a physician with or without the help of self-administered questionnaires14 as was the case in our survey. It should be noted that both raise direct and indirect costs: a basic panel of blood exams has an average cost of US$25 and ECG US$30 (US$55 per surgery) plus at least 30 min of personnel time adding another US$55 per procedure,15 while physical assessment and interview would require at least 20 min of a physician (US$110/3=US$36.6 per surgery). A summary of cost and scientific support for the most sensitive issues touched by our survey is reported in table 2.

Anaesthesiologists raise multiple issues: safety, costs and also comfort: while only 30% of interviewed surgeons have a dedicated one, 51% would like one and form the patients’ perspective, the possibility of some form of sedation is certainly desirable. Indications for sedation represent a key issue with regard to the presence of an anaesthesiologist: for some patients (and surgeons) sedation is just a ‘plus’ to live better the surgical experience16 while in other cases a good sedation makes the difference between being able to perform surgery without complications or not.

Provided safety is guaranteed, institutions may decide differently: a private practice may wish to offer sedation for a better ‘surgical experience’ and attract anxious patients while high volume hospitals may elect to use a single anaesthesiologist to cover multiple contiguous ORs at the same time.

Preoperative prophylaxis is another area of variability: 54% use topical antibiotics despite most literature proving this does not reduce either intraoperative ocular surface

### Table 2 Perioperative practice patterns and projected costs

<table>
<thead>
<tr>
<th>Issue</th>
<th>Cost per surgery (US$)</th>
<th>US cost (3.7 million cases) US$ (million)</th>
<th>EU cost (7 million cases) US$ (million)</th>
<th>Evidence-based impact on safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single surgeon</td>
<td>37</td>
<td>135.6</td>
<td>256.6</td>
<td>+</td>
</tr>
<tr>
<td>Two surgeons</td>
<td>73</td>
<td>271.3</td>
<td>513.3</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>37</td>
<td>135.6</td>
<td>256.6</td>
<td>+</td>
</tr>
<tr>
<td>‘On call’ anaesthesiologist</td>
<td>9</td>
<td>34.2</td>
<td>64.7</td>
<td></td>
</tr>
<tr>
<td>Dedicated anaesthesiologist</td>
<td>37</td>
<td>136.9</td>
<td>259</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>28</td>
<td>102.7</td>
<td>194.2</td>
<td>+/-</td>
</tr>
<tr>
<td>Intra-op monitoring all inclusive</td>
<td>1</td>
<td>3.7</td>
<td>7</td>
<td>+++</td>
</tr>
<tr>
<td>Pre-op ocular diagnostics: single test</td>
<td>35</td>
<td>129.5</td>
<td>245</td>
<td></td>
</tr>
<tr>
<td>Pre-op ocular diagnostics: four tests</td>
<td>140</td>
<td>518</td>
<td>980</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>105</td>
<td>388.5</td>
<td>735</td>
<td>–</td>
</tr>
<tr>
<td>Pre-op systemic testing: physician assessment</td>
<td>37</td>
<td>135.6</td>
<td>256.6</td>
<td></td>
</tr>
<tr>
<td>Pre-op systemic testing: ECG+blood testing</td>
<td>55</td>
<td>203.5</td>
<td>385</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>18</td>
<td>67.8</td>
<td>128.3</td>
<td>+/-</td>
</tr>
<tr>
<td>Pre-op therapy: topical antibiotic</td>
<td>20</td>
<td>74</td>
<td>140</td>
<td>+/-</td>
</tr>
<tr>
<td>Pre-op therapy: topical NSAID</td>
<td>20</td>
<td>74</td>
<td>140</td>
<td>+</td>
</tr>
<tr>
<td>Intra-op prophylaxis: povidone+antibiotic AC</td>
<td>11</td>
<td>40.7</td>
<td>77</td>
<td>+++</td>
</tr>
<tr>
<td>Phaco pac sterile all inclusive</td>
<td>70</td>
<td>259</td>
<td>490</td>
<td>+++</td>
</tr>
</tbody>
</table>

Bold value signify 0.05 p level.
AC, anterior chamber; NSAID, non-steroid anti-inflammatory drug.
bacterial count\textsuperscript{17} or the risk of endophthalmitis\textsuperscript{18,19} especially if cefuroxime\textsuperscript{20} or moxifloxacin\textsuperscript{21} is administered in the AC at the end of surgery. This issue has several implications: while patients’ safety does not seem to improve, drug cost (assuming US$20 per vial)\textsuperscript{22} is 74 million dollars in the USA (and 140 million in Europe) with the only potential effect of increasing bacterial resistance.

NSAIDs improve mydriasis\textsuperscript{23} and reduce inflammation\textsuperscript{24} while their prophylactic role in preventing cystoid macular oedema is controversial and has been demonstrated only in diabetic patients.\textsuperscript{25,26} About one-third (28\%) of survey responders do use it (95\% of responders do it routinely) and intracameral antibiotic\textsuperscript{2} (71\%). It is surprising that 29\% do not use intracameral antibiotics despite the existence of data from a well-designed multicentre study\textsuperscript{28} and evidence on other molecules\textsuperscript{29,30} allowing a drastic endophthalmitis risk reduction at low cost (table 2).

Surgical materials exchange after each and every surgery also yielded surprising responses: 92\% change phaco tip, 80\% handpiece, 71\% phaco tray draping, 69\% all tubing, 66\% pump cassette and 53\% Balanced Salt Solution (BSS) bottle. These results raise concern since there is no question that the first four issues contaminate during surgery\textsuperscript{31} and most likely even the cassette and BSS bottle despite filters, valves and a pressure gradient. Recommend exchanging all phaco materials with disposable sterile pack, as indicated by manufacturers forbidding a second use, costs about US$70\textsuperscript{32} and has an obvious impact on safety at a reasonable cost. Reusable or partially reusable tubing and cassettes allow a reduction of costs adding some sterility expenses.

Post-surgery patient management also yielded somewhat contrasting results with minimal or no impact on costs and uncertain effect on safety: 36\% dismiss patients a few minutes after surgery while 64\% keep them for at least an hour; 43\% do not limit social activities in any way while 51\% do so for 5 days.

Regardless to institutions and countries, survey results suggest the following practice pattern as the most prevalent although with notable distinctions: half patients undergo blood testing and ECG, virtually all are instructed to keep their antiplatelet aggregation drugs and more than half receive preoperative antibiotic topical prophylaxis. Povidone iodine and intra-cameral cefuroxime endophthalmitis prophylaxis are very widespread while surgery is mostly performed by a single surgeon sometimes assisted by training doctor, one scrub and one circulating nurse, under topical anaesthesia with an anaesthesiologist on call for emergency only. The phaco tip is changed for every surgery in most cases and a vascular access is obtained in 60\% of patients with continuous ECG monitoring and brachial pressure monitoring in 70\%.

Our results clearly indicate an overall global inconsistency of most cataract practices deeply impacting costs and most likely generating diverse levels of patients’ security. It is surprising that surgical volume did not impact significantly in any inquired matter, as opposed to institution type, in other words hospital, academic and private practices do not seem to converge to an overlapping workflow organisation even when dealing with comparable surgical volumes as if it were impossible (or there if were no interest) in establishing a shared ‘best practice’ (table 1).

Given the exceedingly high number of patients involved, reaching consensus on validated and shared golden standard seems advantageous if not mandatory and would produce a manifold impact on healthcare: improve safety, rationalise cost and free consistent monetary and human resources.

The limitations of present study are numerous and include the unequal response rate from different Countries and the extremely limited number of responders per country, in many instances only one. Nonetheless responses cover a vast number of surgical procedures well distributed among all types of institutions and the wide variability of reported behaviours is indeed the most interesting result and could only have increased with more responders. We therefore believe those pitfalls scarcely impact what is regarded as the main outcome: disclose an extreme practice variability.

Scientific and professional societies hold the responsibility for deploying evidence-based standard of care and encourage consistent, diffuse application. An international committee promoted by large scientific societies would be desirable.

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REFERENCES


1 Please enter the state where your institution is located

Italy
TOWNSVILLE
Italy
Abidjan
Italy
Rome
United Kingdom
Italy
Spain
Poland
Canada
Italy
THESALONIKI
Belgium
uK
Italy
Russia
Russia
Russia
British Columbia, Canada
Mexico
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Italy
Tamilnadu, India
Napoli, Italy
Milan Italy
Italy
Bologna
Italy
Riga, Latvia
Japan
Italy
Italy
Leipzig, Germany
JAPAN
Focus eye clinic
Japan
Japan
MELBOURNE Australia
BRAZIL
Japan
2 Type of Institution (choose one)

- **36% (73)** Private Practice
- **26% (53)** Academic
- **38% (76)** Public Hospital NHS
- **10.21** Standard Deviation

3 How many cataract surgeries per year are performed in your Institution? (choose one)

- **13% (27)** < 500 per year
- **19% (38)** between 500 and 1000 per year
- **28% (58)** between 1000 and 2000 per year
- **40% (81)** over 2000 per year

4 How many ophthalmic surgeons (MDs) are present at the same time in the OR during cataract surgery? (choose one)

- **46% (94)** only one, the surgeon
- **27% (56)** two surgeons
- **30% (61)** one surgeon and one resident

- **202** Responses
- **204** Responses
- **211** Responses
5. How many nurses are present at the same time in the OR during cataract surgery? (choose one)

- 1% (2) no nurses, the surgeon is alone
- 12% (24) one circulating nurse
- 3% (7) one scrub nurse
- 78% (159) one scrub and one circulating nurse

205 Responses

6. Type of anesthesia for uncomplicated routine cases (choose one)

- 80% (164) > 90% topical
- 5% (11) 50% topical 50% peribulbar
- 8% (17) 75% topical 25% peribulbar

204 Responses

7. Is there an anesthesiologist? (Choose one)

- 30% (61) dedicated MD present in the OR during all surgery
- 10% (21) dedicated nurse anesthesiologist present in the OR during all surgery
- 29% (59) MD available only for sedation or demand in the operating group
- 31% (62) MD available only for emergency

203 Responses
8. Sedation (may choose more than one)

- 69% (190) of cases: no sedation
- 15% (31) of cases: benzodiazepines
- 9% (19) of cases: benzodiazepine 50% of cases
- 6% (13) of cases: benzodiazepine 25% of cases

1% (3) of cases: opioids > 75% of cases
2% (4) of cases: opioids 50% of cases
0% (1) of cases: opioids 25% of cases

210 Responses

9. Does the patient have a vascular access during routine cataract surgery? (choose one)

- 60% (123) of patients: 100% of patients
- 3% (6) of patients: only if deemed necessary about 75%
- 3% (7) of patients: only if deemed necessary about 50%
- 10% (20) of patients: only of deemed necessary about 25%
- 24% (49) of patients: never

43.84
Standard Deviation

205 Responses
10. Does the patient have continuous ECG monitoring during routine cataract surgery? (choose one)

- 69% (140) 100% of cases
- 3% (7) only deemed necessary, roughly 75% of cases
- 2% (4) only if deemed necessary, roughly 50% of cases
- 7% (14) only deemed necessary, roughly 25% of cases
- 11% (23) no, never

Standard Deviation: 47.93
Responses: 202

11. Does the patient have continuous blood pressure monitoring during routine cataract surgery? (choose One)

- 81% (164) 100% of cases
- 2% (4) only deemed necessary, roughly 75% of cases
- 0% (1) only if deemed necessary, roughly 50% of cases
- 4% (9) only deemed necessary, roughly 25% of cases
- 6% (13) no, never

Standard Deviation: 58.36
Responses: 203
12  pre-op ocular diagnostics ROUTINELY used: (may choose more than one)

- **Optic biometry**: 90% (182) respondents
- **Ultrasound biometry**: 29% (56) respondents
- **Endothelial microscopy**: 57% (115) respondents
- **Corneal topography**: 32% (64) respondents
- **Macular OCT**: 49% (97) respondents
- **Potential Acuity Meter**: 16% (32) respondents

550 Responses

13  Pre-operative testing (may choose more than one)

- **No pre-op screening**: 6% (13) respondents
- **Pre-op briefing with ophthalmologist**: 61% (126) respondents
- **Pre-op briefing with anaesthetologist**: 28% (57) respondents
- **ECG + blood testing**: 53% (108) respondents
- **Pre-op questionnaire filled by patient**: 32% (65) respondents
- **Pre-op questionnaire filled by General Practitioner**: 17% (34) respondents

403 Responses
14 Use of anti-coagulants / anti-aggregants (choose one)

- 75% (152) leave as it is
- 12% (24) discontinue before surgery
- 5% (11) substitute with LMW Heparin
- 12% (24) ask patient’s GP

211 Responses

15 Pre-operative prophylaxis (may choose more than one)

- 54% (116) topical antibiotics
- 29% (59) no pre-op therapy
- 29% (58) topical NSAIDs
- 25% (50) topical antiseptics

- 2% (5) systemic antibiotics

282 Responses
16  Povidone Iodine before surgery (choose one)

- 95% (193) 100% of cases
- 4% (8) most cases
- 1% (2) never

203 Responses

17  Intra-op endophthalmitis prophylaxis at the end of surgery (may choose more than one)

- 12% (25) no prophylaxis
- 59% (121) intracameral cefuroxime
- 12% (25) other intracameral drug
- 34% (69) conjunctival sac povidone iodine

23% (46) conjunctival antibiotics

285 Responses
18 Mark all materials changed with a sterile one after EACH and EVERY routine cataract surgery: (may choose more than one)

- 65% (132) pump cassette
- 68% (138) all tubings
- 80% (162) phaco handpiece
- 93% (188) phaco tip
- 52% (106) BSS bottle
- 70% (143) phaco tray draping
- 1% (2)

871 Responses

19 Management of intra-operative systemic pressure spikes / anxiety (choose one)

- 35% (72) surgeon prescribes drugs
- 53% (108) anesthesiologist prescribes drugs
- 15% (30) nurse administers drugs based on pre-determined protocol

210 Responses

20 Post-op patching (choose one)

- 22% (46) none
- 50% (102) for a few hours
- 24% (50) at night for few days
- 6% (12) for a few days H24

210 Responses
21 Post-op restrictions (Choose one)

- 43% (87) none
- 50% (102) no social activities / work 5 days
- 5% (10) no social activities / work 12 days
- 3% (6) no social activities / work >15 days

205 Responses

22 Post-op therapy (choose one)

- 0% (0) none
- 88% (175) topical antibiotics + topical NSAIDs
- 0% (0) topical NSAIDs alone
- 4% (8) topical Antibiotics alone

- 9% (18) systemic antibiotics + topical

201 Responses
Supplemental material

23 Second eye (choose one)

- 33% (68) at patient’s will
- 21% (42) within a month
- 11% (22) within 15 days
- 5% (10) same day
- 18% (36) within 7 days

217 Responses

24 Length of stay within the premises of the Surgical Centre AFTER surgery for monitoring reason (choose one)

- 36% (74) few minutes
- 49% (101) at least 1 hour
- 11% (23) at least 2 hours
- 3% (7) at least 3 hours

37.91 Standard Deviation

205 Responses

25 Who discharges the patient from surgical center after surgery? (choose one)

- 59% (118) a nurse based on surgeon written order
- 15% (30) the surgeon
- 15% (30) a second ophthalmologist
- 11% (21) the patient is free to leave whenever comfortable

39.58 Standard Deviation

109 Responses
26  post-op visit schedule is approximately (choose one)

- 87% (177) day 1, 7, 30
- 5% (11) day 7, 30
- 5% (11) day 30
- 2% (4) patient is instructed to call and make an appointment if he/she feels anything goes wrong

68.21 Standard Deviation 204 Responses

27  Who sees the patient post routine cataract surgery? (choose one)

- 40% (81) always same surgeon
- 52% (104) any ophthalmologist on duty in the day of control visit
- 4% (8) referring ophthalmologist
- 2% (4) optometrist
- 2% (4) nurse

43.34 Standard Deviation 201 Responses
28 if cost were NOT an issue would you like a dedicated anesthesiologist? (choose one)

- 51% (104) yes
- 17% (34) not necessary
- 18% (37) available for sedation in the same floor is enough
- 15% (30) available only for emergency is enough