

University of Massachusetts Medical School

eScholarship@UMMS

---

Open Access Articles

Open Access Publications by UMMS Authors

---

2019-06-14

## Shortened cataract surgery by standardisation of the perioperative protocol according to the Joint Commission International accreditation: a retrospective observational study

Yuichi Okumura  
*Juntendo University*

*Et al.*

Let us know how access to this document benefits you.

Follow this and additional works at: <https://escholarship.umassmed.edu/oapubs>



Part of the Eye Diseases Commons, Health and Medical Administration Commons, Health Services Administration Commons, Health Services Research Commons, Ophthalmology Commons, Surgery Commons, and the Surgical Procedures, Operative Commons

---

### Repository Citation

Okumura Y, Inomata T, Iwagami M, Eguchi A, Mizuno J, Shiang T, Kawasaki S, Shimada A, Inada E, Amano A, Murakami A. (2019). Shortened cataract surgery by standardisation of the perioperative protocol according to the Joint Commission International accreditation: a retrospective observational study. Open Access Articles. <https://doi.org/10.1136/bmjopen-2018-028656>. Retrieved from <https://escholarship.umassmed.edu/oapubs/3872>

Creative Commons License



This work is licensed under a [Creative Commons Attribution-Noncommercial 4.0 License](https://creativecommons.org/licenses/by-nc/4.0/)

This material is brought to you by eScholarship@UMMS. It has been accepted for inclusion in Open Access Articles by an authorized administrator of eScholarship@UMMS. For more information, please contact [Lisa.Palmer@umassmed.edu](mailto:Lisa.Palmer@umassmed.edu).

# BMJ Open Shortened cataract surgery by standardisation of the perioperative protocol according to the Joint Commission International accreditation: a retrospective observational study

Yuichi Okumura,<sup>1,2</sup> Takenori Inomata,<sup>2,3</sup> Masao Iwagami,<sup>4,5</sup> Atsuko Eguchi,<sup>6</sup> Ju Mizuno,<sup>7</sup> Tina Shiang,<sup>8</sup> Shiori Kawasaki,<sup>2,9</sup> Akie Shimada,<sup>2,9</sup> Eiichi Inada,<sup>7</sup> Atsushi Amano,<sup>2,9</sup> Akira Murakami<sup>3</sup>

**To cite:** Okumura Y, Inomata T, Iwagami M, *et al*. Shortened cataract surgery by standardisation of the perioperative protocol according to the Joint Commission International accreditation: a retrospective observational study. *BMJ Open* 2019;9:e028656. doi:10.1136/bmjopen-2018-028656

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2018-028656>).

Received 18 December 2018  
Revised 26 February 2019  
Accepted 24 May 2019



© Author(s) (or their employer(s)) 2019. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

**Correspondence to**  
Dr Takenori Inomata;  
[tinoma@juntendo.ac.jp](mailto:tinoma@juntendo.ac.jp)

## ABSTRACT

**Objectives** To investigate the impact of standardisation of the perioperative protocol based on the Joint Commission International (JCI) accreditation guidelines for operating time in cataract surgery.

**Design** Retrospective observational study.

**Setting** Single centre in Japan.

**Participants** Between March 2014 and June 2016, 3127 patients underwent cataract surgery under topical anaesthesia including 2581 and 546 patients before and after JCI accreditation, respectively.

**Primary and secondary outcomes** We compared three time periods, comprising the preprocedure/surgery time (pre-PT), PT and post-PT, and total PT (TPT) of cataract surgery between patients before and after JCI accreditation, by regression analysis adjusted for age, sex and cataract surgery-associated confounders.

**Results** The main outcomes were pre-PT, PT, post-PT and TPT. Pre-PT (19.8±10.5 vs 13.9±8.5 min,  $p<0.001$ ) and post-PT (3.5±4.6 vs 2.6±2.1 min,  $p<0.001$ ) significantly decreased after JCI accreditation, while PT did not significantly change (16.8±6.7 vs 16.2±6.3 min,  $p=0.065$ ). Consequently, TPT decreased on average by 7.3 min per person after JCI accreditation (40.1±13.4 vs 32.8±10.9 min,  $p<0.001$ ). After adjusting for confounders, pre-PT ( $\beta=-5.82$  min, 95% CI -6.75 to -4.88), PT ( $\beta=-0.76$  min, 95% CI -1.34 to -1.71), post-PT ( $\beta=-0.85$  min, 95% CI -1.24 to -0.45) and TPT ( $\beta=-7.43$  min, 95% CI -8.61 to -6.24) were significantly shortened after JCI accreditation.

**Conclusion** Perioperative protocol standardisation, based on JCI accreditation, shortened TPT in cataract surgery under local anaesthesia.

## INTRODUCTION

Cataract surgery is the most common intra-ocular surgery<sup>1</sup>; worldwide population ageing has resulted in substantial growth of the number of patients eligible for cataract surgery.<sup>2</sup> Cataract surgery is one of the most cost-effective surgical interventions<sup>3,4</sup> and is

## Strengths and limitations of this study

- To our knowledge, this is the first study to investigate the impact of standardisation of the perioperative protocol for cataract surgery on operating room efficiency by comparing relevant time periods in the operating room for patients who underwent cataract surgery before and after Joint Commission International accreditation (JCI).
- This is the only study to have investigated the pre-procedure/surgery time, procedure/surgery time, postprocedure/surgery time and total procedure/surgery time of cataract surgery between patients before and after JCI accreditation.
- The main limitation is that this study was conducted at a single university hospital; therefore, the generalisability of our findings may be limited.
- Another limitation inherent to this study was that the impact of surgeon level and/or clinical experience of the surgeons and nurses was not analysed.

important for hospital financial management as a profitable operating theatre.<sup>5</sup> Therefore, it is essential to continuously review surgical techniques and practices regarding efficiency, decreasing costs and increasing safety in order to produce more reliable results for patients.

Cataract surgery is generally recognised as a safe and highly reproducible surgery. However, the recent focus on healthcare errors and safety supports performing cataract surgery from a patient safety perspective.<sup>6</sup> The Joint Commission International (JCI) advocates for maintenance of patient safety, continuous improvement of the quality of practice and accrediting healthcare organisations in compliance with standards.<sup>7</sup> The JCI requires continuous quality improvement

for international patient safety goals (IPSGs), which are important issues concerning patient safety. The IPSGs help to confirm correct patient identification, encourage effective communication between patients and medical staff, improve the safety of high-alert medication administration and ensure safe surgeries (correct surgical site, procedures and patient for the surgery).<sup>8</sup> JCI accreditation is expected to improve patient safety associated with surgical operations; however, there is concern that these changes may impair efficiency by prolonging operating room time with an excessive focus on patient safety. Previous studies have reported improved medication management during JCI accreditation<sup>7,9</sup>; however, there has been no study regarding the impact of IPSG procedures on operating room efficiency under topical anaesthesia with a large number of cases over a short period of time.<sup>10</sup>

In this study, we examined the impact of the standardisation of the perioperative protocol for cataract surgery on operating room efficiency by comparing relevant time periods, while maintaining the quality of patient care.

## METHODS

### Study design

We conducted a retrospective observational study between March 2014 and June 2016 at Juntendo University Hospital. The requirement for written informed consent was waived due to the retrospective observational nature of the study; patients could exclude themselves by using the opt-out method on our hospital website.

### JCI accreditation

The Joint Commission is a US-based non-profit tax-exempt 501(c) organisation that accredits US healthcare organisations and programmes. Its international branch, named JCI, was established in 1998; JCI accredits medical services worldwide. Juntendo University Hospital was accredited by the JCI on 12 December 2015. For JCI accreditation, inspectors from the JCI visit and evaluate

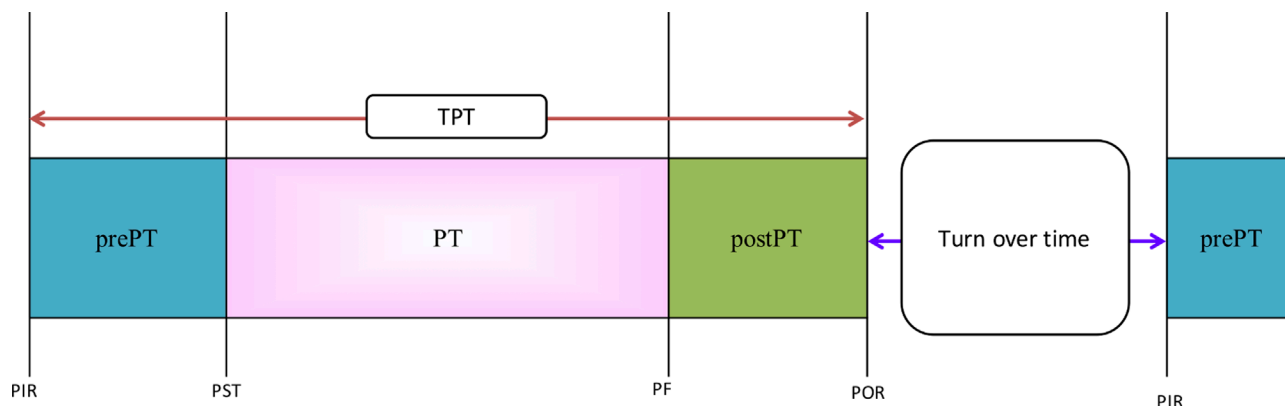
hospitals to observe hospital operations, conduct interviews and review medical documentation in order to determine whether hospitals meet compliance standards set forth by the JCI. The goal of JCI accreditation is to evaluate care, standardise hospital processes, provide education and promote quality improvement for the surveyed organisations.

### Study period and participants

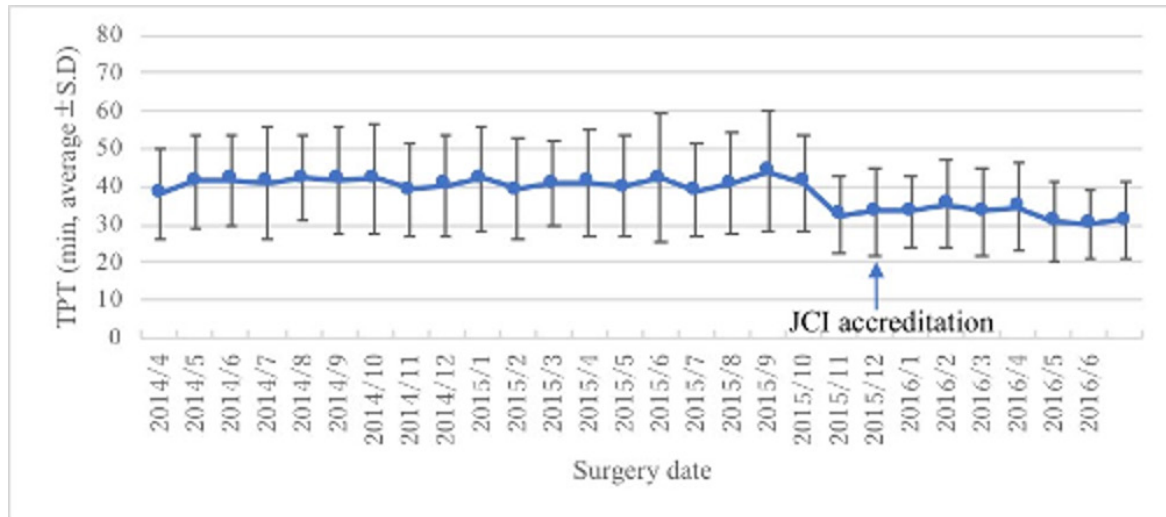
We identified patients who underwent cataract surgeries (phacoemulsification with intraocular lens implantation) under topical anaesthesia in Juntendo University Hospital between March 2014 and June 2016. We excluded combined cases, such as cataract extraction with trabeculectomy or anterior vitrectomy, to fairly compare operation times. Patients were divided into the two groups: a group before and a group after JCI accreditation.

### Outcome measures

In Juntendo University Hospital, surgeons and nurses are required to computationally record the timing of the following events: the patient entered the surgical room, the surgery started and ended, and the patient was discharged from the surgical room. As performed in our previous studies,<sup>11–15</sup> we first defined total procedure/surgery time (TPT) as the duration between patient entrance to and discharge from the operating room. Then, we divided TPT into three specific time periods (figure 1): pre-PT, PT and post-PT. Pre-PT was defined as the time elapsed in minutes between patient entry to the operating room (patient in room) and the attachment of monitors, such as an ECG and blood pressure gauge, and sign in. PT was defined as the time elapsed in minutes between the start and end of surgery (the procedure/surgery start time to the procedure/surgery finish time (PF), respectively). Post-PT was defined as the time elapsed in minutes between PF and the time that the patient exited the room (patient out of room).



**Figure 1** Glossary of time periods in the operating room under local anaesthesia. Time periods were divided into three intervals. Pre-PT, preprocedure/surgery time; PT, procedure/surgery time; post-PT, post procedure/surgery time; TPT, total procedure/surgery time; PIR, patient in room; PST, procedure/surgery start time; PF, procedure/surgery finish; POR, patient out of room.



**Figure 2** Post hoc descriptive analysis of the monthly change in TPT. The monthly average and SD of TPT during the study period (between March 2014 and June 2016). JCI, Joint Commission International; TPT, total procedure/surgery time.

### Analysis

Patient characteristics were compared between patients who underwent cataract surgery before and after JCI accreditation, by using the unpaired t-test for age, best-corrected visual acuity (BCVA), and intraocular pressure (IOP) and the  $\chi^2$  test for sex and the prevalence of complications associated with cataract surgery. We collected information on the complications associated with cataract surgery including posterior capsule rupture, Zonule of Zinn rupture, dropped nucleus, iris prolapse, continuous curvilinear capsulorrhexis incomplete and capsule tear.

First, we crudely compared pre-PT, PT, post-PT and TPT between patients before and after JCI accreditation by using the unpaired t-test. Then, we conducted adjusted analyses with multivariable regression models, adjusting for age, sex, BCVA, IOP and complications associated with cataract surgery. Multicollinearity was investigated to determine which variables were to be included in the adjusted analyses. This was achieved by examining the bivariate correlations between all variables and calculating the variance inflation factors (VIF). VIF values

greater than 2.5 are often considered to indicate multicollinearity.<sup>16</sup> Sensitivity analysis was conducted using only the right eye of each patient.

Finally, as a post hoc descriptive analysis to detect the overall temporal trend during the study period, we plotted the monthly averages of pre-PT, PT, post-PT (online supplementary figure 1A–C) and TPT (figure 2).

All data were analysed with STATA V.15 (StataCorp).

### Patient and public involvement

No patients were involved in the research design and conception of this research study.

## RESULTS

### Characteristics of patients

A total of 3127 patients (mean age, 71.6 years old (IQR, 66–79 years); male sex, 44.1%) underwent cataract surgery under local anaesthesia at Juntendo University Hospital. Although the age and sex distributions were similar, BCVA and IOP were slightly, but significantly,

**Table 1** Patient characteristics

Variables	Before JCI n=2581	After JCI n=546	P value	Total n=3127
Age, years (SD)	71.6 (10.3)	71.9 (10.6)	0.477	71.6 (10.3)
Sex, no (%)				
Men	1138 (44.1)	242 (44.3)	0.925	1380 (44.1)
Women	1443 (55.9)	304 (55.7)		1747 (55.9)
BCVA, LogMAR (SD)	0.34 (0.3)	0.37 (0.4)	0.040*	0.35 (0.3)
IOP, mm Hg (SD)	14.0 (3.1)	14.3 (3.2)	0.015*	14.0 (3.1)
Complication, yes (%)	72 (2.8)	18 (3.3)	0.483	90 (2.4)

\*P<0.05.

P values were calculated by using an unpaired t-test for age, BCVA and IOP, and by using the  $\chi^2$  test for sex and complications. BCVA, best-corrected visual acuity; IOP, intraocular pressure; JCI, Joint Commission International.

**Table 2** Operation time intervals

Time periods, min (SD)	Before JCI	After JCI	P value	Total
	n=2581	n=546		n=3127
Preprocedure/surgery time	19.8 (10.5)	13.9 (8.3)	<0.001***	18.7 (10.4)
Procedure/surgery time	16.8 (6.7)	16.2 (6.3)	0.065	16.7 (6.6)
Postprocedure/surgery time	3.5 (4.6)	2.6 (2.1)	<0.001***	3.4 (4.3)
Total procedure/surgery time	40.1 (13.4)	32.8 (10.9)	<0.001***	38.8 (13.2)

\*\*\*P<0.001.

P values were calculated by using an unpaired t-test.

JCI, Joint Commission International.

worse after JCI accreditation (table 1). The complication rate of cataract surgery did not significantly differ between the groups (online supplementary table 1).

### Crude analysis

Table 2 compares time periods in the operating room between groups before and after JCI accreditation. The pre-PT (19.8±10.5 min vs 13.9±8.3 min, before vs after JCI, respectively, p<0.001) and post-PT (3.5±4.6 min vs 2.6±2.1 min, p<0.001) were significantly reduced after JCI accreditation. However, the PT was not significantly different between before and after JCI accreditation (16.8±6.7 min vs 16.2±6.3 min, p=0.065). Consequently, TPT was significantly reduced by an average of 7.3 min per patient after JCI accreditation (40.1±13.4 min vs 32.8±10.9 min, before vs after JCI, respectively, p<0.001).

### Adjusted analysis

After adjusting for age, sex, BCVA, IOP and complications associated with cataract surgery in multivariable regression analysis, pre-PT ( $\beta$ =−5.82 min, 95% CI −6.75 to −4.88, p<0.001), PT ( $\beta$ =−0.76 min, 95% CI −1.34 to −1.71, p=0.011), post-PT ( $\beta$ =−0.85 min, 95% CI −1.24 to −0.45, p<0.001) and TPT ( $\beta$ =−7.43 min, 95% CI −8.61 to −6.24, p<0.001) were significantly shortened after JCI accreditation (table 3A–D). No severe multicollinearity was observed in the adjusted analysis (online supplementary table 2). Sensitivity analysis using only the right eye of each patient showed similar results with those presented in table 3 (online supplementary table 3).

### Post hoc descriptive analysis of monthly changes in TPT

The monthly average of TPT considerably changed since October 2015, approximately 2 months before the JCI accreditation (12 December 2015) (figure 2). The results of pre-PT, PT and post-PT are shown in online supplementary figure 1.

## DISCUSSION

Cataract surgery is an established minimally invasive and efficient surgical procedure.<sup>17</sup> However, because of rising medical expenses and lack of healthcare workers caused by the ageing society,<sup>10 18</sup> it is necessary to perform cataract surgery efficiently while maintaining quality of care.<sup>14</sup> Therefore, it is important to analyse the efficiency

of services to ensure effective use of finite medical resources.<sup>19</sup> We explored the effect of standardisation of perioperative protocols in cataract surgery by using the transition to JCI accreditation.

Strategies for improving the utilisation rate of the surgical room are to increase the occupancy of the operating room by increasing the number of surgeries or to increase the economic efficiency by reducing the size of the operating room in accordance with the current number of surgeries. To increase the number of surgeries, it is important to shorten TPT and interval time between individual operations; reducing perioperative time (pre-PT and post-PT) would lead to shortening of TPT. In our previous study,<sup>11</sup> we investigated the impact of JCI accreditation with patients who underwent surgery under general anaesthesia in all departments and showed that the patient safety and operating room efficiency can be compatible. In the case of cataract surgery, because there is a short time between patient entry to and exit from the operating room, it is necessary to perform patient confirmation, prepare for surgery and record the operation while caring for the patient, all within the short surgical time. Therefore, recording is frequently performed between high-priority tasks, and the recording time must be divided and dispersed. We showed that pre-PT and post-PT were shortened by the standardisation of the perioperative protocol at the point of entry to the operating room; Juntendo University Hospital has implemented surgical record sheets (invasive procedure safety checklist) in their electronic medical records to ensure adherence to IPSP standards (online supplementary table 4). In surgeries that involve a large number of cases in a short period of time, such as cataract surgeries, standardisation of records and tasks is important for increasing the efficiency of the operating room. A previous study reported that clarification of the group goal was effective for improving efficiency,<sup>20</sup> indicating that the standardisation of perioperative protocols in Juntendo University Hospital has shortened the perioperative time by streamlining the process. Here, we revealed that, for a surgical procedure that cannot be shortened further, such as cataract surgery, improvement of non-surgical portions, such as preparation of surgery and communication among medical personnel,

**Table 3** Adjusted operation time intervals

<b>A</b>				
Pre-PT	Coefficient	SE	P value	95% CI
JCI accreditation, yes	-5.823	0.480	<0.001***	-6.765 to -4.882
Sex, women (vs men)	0.497	0.370	0.179	-0.228 to 1.221
Age, years	-0.026	0.018	0.144	-0.061 to 0.009
BCVA, LogMAR	-0.542	0.579	0.349	-1.678 to 0.593
IOP, mm Hg	-0.026	0.058	0.659	-0.140 to 0.089
Complication, yes	-0.338	1.084	0.755	-2.463 to 1.788
<b>B</b>				
<b>PT</b>				
JCI accreditation, yes	-0.756	0.299	0.011*	-1.342 to -0.171
Sex, women (vs men)	-0.547	0.230	0.017	-0.997 to -0.096
Age, years	0.033	0.011	0.003**	0.011 to 0.055
BCVA, LogMAR	3.042	0.360	<0.001***	2.336 to 3.748
IOP, mm Hg	0.004	0.036	0.908	-0.067 to 0.075
Complication, yes	10.278	0.674	<0.001***	8.956 to 11.599
<b>C</b>				
<b>Post-PT</b>				
JCI accreditation, yes	-0.847	0.201	<0.001***	-1.241 to -0.454
Sex, women (vs men)	0.258	0.155	0.095	-0.045 to 0.561
Age, years	-0.005	0.007	0.487	-0.020 to 0.009
BCVA, LogMAR	-0.224	0.242	0.355	-0.699 to 0.251
IOP, mm Hg	-0.018	0.024	0.473	-0.065 to 0.030
Complication, yes	0.353	0.453	0.437	-0.536 to 1.242
<b>D</b>				
<b>TPT</b>				
JCI accreditation, yes	-7.427	0.605	<0.001***	-8.613 to -6.240
Sex, women (vs men)	0.208	0.466	0.655	-0.705 to 1.121
Age, years	0.002	0.022	0.937	-0.042 to 0.046
BCVA, LogMAR	2.275	0.730	0.002**	0.844 to 3.706
IOP, mm Hg	-0.039	0.074	0.595	-0.183 to 0.105
Complication, yes	10.293	1.366	<0.001***	7.615 to 12.971

\*P<0.05, \*\*P<0.01, \*\*\*P<0.001.

Complications associated with cataract surgery included posterior capsule rupture, Zonule of Zinn rupture, dropped nucleus, iris prolapse, continuous curvilinear capsulorrhexis incomplete and capsule tear.

P values were calculated by using an unpaired t-test.

BCVA, best-corrected visual acuity; IOP, intraocular pressure; JCI, Joint Commission International; pre-PT, preprocedure/surgery time; PT, procedure/surgical time; post-PT, postprocedure/surgery time; TPT, total procedure/surgery time.

is important for shortening the utilisation time of the operating room.

Additionally, we revealed that PT itself is shortened after JCI accreditation (table 3C), indicating that the thorough standardisation of the perioperative protocol positively influenced the preparation process for surgery and communication among medical staff, resulting in shortened PT. Our results showed that TPT decreased by an average of 7.3 min per patient. Since the average cataract operation time in our hospital is 16.7 min, shortening

of cataract operation time by 7.3 min corresponds to a 43.7% reduction in the average cataract operation time; if we performed three cataract surgeries, the time saved would allow for one additional surgery. In addition, since the number of complications did not change before and after the JCI accreditation, standardisation of the perioperative protocol did not impair patient safety, while improving efficiency in operating room use. In this study, cataract surgery was selected to eliminate to the greatest possible extent the effect of different types of surgery,

but it is probable that improving the preparation process and the communication among medical staff by standardisation of the preoperative protocol would also be effective for shortening the operation time in other types of ophthalmic surgery including vitreous and glaucoma surgeries.

Since IPGS measures may have affected clinical practice gradually, simply comparing surgical time intervals before and after JCI accreditation cannot accurately determine the effect of introducing JCI standards. Therefore, we conducted a trend analysis, as shown in figure 2; notably, time intervals sharply declined in advance of the accreditation date. This indicates that the continuous standardisation of IPGSs in Juntendo University Hospital was gradually introduced during preparation for the JCI accreditation, implying that the focus of the medical staff changed within a few months. Fostering IPGSs in the effort for the JCI accreditation increased efficiency of cataract operation time and added value to our hospital as a profit centre.

There were several limitations in this study. First, since this study was conducted at a single university hospital, the generalisability of our findings may be limited. Depending on the size of a hospital and its current practice, the impact of standardisation on the perioperative protocol for cataract surgery may differ. Second, we did not assess the influence of the surgeon level and/or clinical experience of the surgeons and nurses. However, based on the number of complications, we suspect that the influence of individual surgeon level and job experience on operation time did not substantially change between before and after the JCI accreditation. In addition, time is required to train surgeons and medical professionals, whereas standardisation of the perioperative protocol can be introduced with little time investment.

In conclusion, we investigated the impact of JCI accreditation and implementation of standardised procedures on time periods in the operating room. Pre-PT and post-PT were significantly shortened; thus, TPT was significantly reduced after implementing IPGSs. Therefore, we conclude that the improvement of patient safety by standardisation of the preoperative protocols can also improve the efficiency of surgery under topical anaesthesia.

#### Author affiliations

<sup>1</sup>Department of Ophthalmology, Juntendo University Graduate School of Medicine, Bunkyo-ku, Tokyo, Japan

<sup>2</sup>Department of Strategic Operating Room Management and Improvement, Juntendo University Faculty of Medicine, Bunkyo-ku, Tokyo, Japan

<sup>3</sup>Department of Ophthalmology, Juntendo University Faculty of Medicine, Bunkyo-ku, Tokyo, Japan

<sup>4</sup>Department of Non-Communicable Disease Epidemiology, London School of Hygiene and Tropical Medicine, London, UK

<sup>5</sup>Department of Health Services Research, Faculty of Medicine, University of Tsukuba, Tsukuba, Ibaraki, Japan

<sup>6</sup>Department of Hospital Administration, Juntendo University Graduate School of Medicine, Bunkyo-ku, Tokyo, Japan

<sup>7</sup>Department of Anesthesia and Pain Medicine, Juntendo University Faculty of Medicine, Bunkyo-ku, Tokyo, Japan

<sup>8</sup>Department of Radiology, University of Massachusetts Medical School, Worcester, Massachusetts, USA

<sup>9</sup>Department of Cardiovascular Surgery, Juntendo University Faculty of Medicine, Bunkyo-ku, Tokyo, Japan

**Acknowledgements** The authors thank the colleagues working at Juntendo University Hospital, Department of Surgery and Ophthalmology.

**Contributors** YO: performance of the research, data collection, data analysis and writing of the paper. TI: performance of the research, research design, data analysis and writing of the paper. MI: research design, data analysis and writing of the paper. AE: data collection, data analysis. JM: research design, data analysis. TS: writing of the paper. SK: data collection, data analysis. AS: data collection, writing of the paper. EI and AA: research design, writing of the paper. AM: research design, writing of the paper. All authors reviewed the manuscript.

**Funding** This study was supported by Hogy Medical, Inc.

**Competing interests** Yes, there are competing interests for one or more authors and I have provided a Competing Interests statement in my manuscript.

**Patient consent for publication** Obtained.

**Ethics approval** This study was approved by the Institutional Review Board and Medical Ethics Committee of Juntendo University Hospital (approval number: 16-153) and was conducted in accordance with the tenets of the Declaration of Helsinki.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data sharing statement** The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

#### REFERENCES

- Spalton D, Koch D. The constant evolution of cataract surgery. *BMJ* 2000;321:1304.
- Hatch WV, Campbell EL, Bell CM, *et al*. Projecting the growth of cataract surgery during the next 25 years. *Arch Ophthalmol* 2012;130:1479-81.
- Foster A, Gilbert C, Johnson G. Changing patterns in global blindness: 1988-2008. *Community Eye Health* 2008;21:37-9.
- Eye Care Comparative Effectiveness Research Team (ECCERT). Cost-effectiveness of cataract surgery in Japan. *Jpn J Ophthalmol* 2011;55:333-42.
- Abbott T, White SM, Pandit JJ. Factors affecting the profitability of surgical procedures under 'Payment by Results'. *Anaesthesia* 2011;66:283-92.
- Kelly SP, Astbury NJ. Patient safety in cataract surgery. *Eye* 2006;20:275-82.
- Wang HF, Jin JF, Feng XQ, *et al*. Quality improvements in decreasing medication administration errors made by nursing staff in an academic medical center hospital: a trend analysis during the journey to Joint Commission International accreditation and in the post-accreditation era. *Ther Clin Risk Manag* 2015;11:393-406.
- Joint Commission International. International Patient Safety Goals. 2017 <http://www.jointcommissioninternational.org/improve/international-patient-safety-goals/> (Accessed 15 Jul 2017).
- Fang X, Zhu LL, Pan SD, *et al*. Safe medication management and use of narcotics in a joint commission international-accredited academic medical center hospital in the people's Republic of China. *Ther Clin Risk Manag* 2016;12:535-44.
- McGinnis SL, Moore J. The impact of the aging population on the health workforce in the United States-summary of key findings. *Cah Social Demogr Med* 2006;46:193-220.
- Inomata T, Mizuno J, Iwagami M, *et al*. The impact of Joint Commission International accreditation on time periods in the operating room: A retrospective observational study. *PLoS One* 2018;13:e0204301.
- Glossary of times used for scheduling and monitoring of diagnostic and therapeutic procedures. *Aorn J* 1997;66:601-6.



13. Mazzei WJ. Operating room start times and turnover times in a university hospital. *J Clin Anesth* 1994;6:405–8.
14. Overdyk FJ, Harvey SC, Fishman RL, *et al.* Successful strategies for improving operating room efficiency at academic institutions. *Anesth Analg* 1998;86:896–906.
15. Hsiao KC, Machaidze Z, Pattaras JG. Time management in the operating room: an analysis of the dedicated minimally invasive surgery suite. *JSLs* 2004;8:300–3.
16. Allison PD. *Multiple Regression: A Primer*. Thousand Oaks: CA: Pine Forge Press, 1999.
17. Singh K, Misbah A, Saluja P, *et al.* Review of manual small-incision cataract surgery. *Indian J Ophthalmol* 2017;65:1281–8.
18. Sasaki T, Izawa M, Okada Y. Current trends in health insurance systems: OECD Countries vs. Japan. *Neurol Med Chir* 2015;55:267–75.
19. Denton B, Viapiano J, Vogl A. Optimization of surgery sequencing and scheduling decisions under uncertainty. *Health Care Manag Sci* 2007;10:13–24.
20. Kang JM, Padmanabhan SP, Schallhorn J, *et al.* Improved utilization of operating room time for trainee cataract surgery in a public hospital setting. *J Cataract Refract Surg* 2018;44:186–9.