Surgeon Volumes and Selected Patient Outcomes in Cataract Surgery

A Population-Based Analysis

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Objective: To study the association of annual surgeon volume of cataract procedures with the risk of postoperative adverse events.

Design: We used population-based administrative health records to conduct a retrospective cohort study from 2001 through 2003.

Participants: The number of surgeons who performed more than 50 cataract surgeries annually ranged from 231 to 243 over the 3 years. There were 284 797 cataract surgeries in patients older than 20 years performed at 70 hospitals or eye surgery centers in the province of Ontario, Canada.

Methods: We calculated cataract surgery volume for each surgeon and tested for the presence of a volume–outcome association. We used generalized estimating equations to account for the effect of clustering of patients according to individual surgeons and to adjust estimates for the potential confounding effects of patient age and gender.

Main Outcome Measures: We used a composite outcome of postoperative adverse events from cataract surgery that included billing claims for vitrectomy, vitreous aspiration or injection of medication, vitreous air or fluid exchange, and dislocated lens extraction performed by any ophthalmologist between 1 and 14 days after cataract surgery. These procedures are surrogate markers for the outcomes of retinal detachment, lost lens or lens fragment, and suspected endophthalmitis.

Results: In each year, fewer than 1 in 200 patients experienced an adverse event (range, 0.33%–0.41%). Surgeons performing 50 to 250 cataract surgeries per year had an adverse event rate of 0.8%. Surgeons performing 251 to 500 cataract surgeries per year had an adverse event rate of 0.4% and an adjusted odds ratio of postoperative adverse events of 0.52 (95% confidence interval [CI], 0.39–0.69) compared with surgeons performing 50 to 250 procedures per year. Surgeons performing 501 to 1000 cataract surgeries per year had an adverse event rate of 0.2% and an adjusted odds ratio of 0.31 (95% CI, 0.22–0.43), and surgeons performing more than 1000 cataract surgeries per year had an adverse event rate of 0.1% and an adjusted odds ratio of 0.14 (95% CI, 0.09–0.23).

Conclusions: Selected adverse event rates for surgeons performing more than 50 cataract surgeries per year are low. There is a volume-outcomes relationship for cataract surgery, and this relationship persists even for very high-volume surgeons. *Ophthalmology 2007;114:405–410 © 2007 by the American Academy of Ophthalmology.*

Volume-outcome studies have found that surgeons who perform more procedures have better patient outcomes than surgeons who perform fewer procedures.[1] In these studies, the definition of high-volume surgeons varies considerably, depending on the type of procedure, the distribution of cases across surgeons and hospitals, and the definition of high volume.[2] For example, one study showed that the number of surgeries performed by surgeons in the highest volume

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category for pancreatic resection was 4 or more procedures per year, whereas 162 procedures per year was considered high volume for coronary artery bypass grafting.[3] Some researchers and health policy advocacy organizations have sought to identify a minimum threshold number of surgeries performed per year to obtain a high level of proficiency and to provide optimal patient outcomes.[4,5]

There are few volume-outcomes studies in the field of ophthalmology compared with other surgical specialties, despite the relatively large surgical volume.[6,7] These studies involved relatively few surgeons, sites, and patients. Population-based administrative health records encompass a large sample of patients, surgeons, and hospitals. Access to these records provided us with the opportunity to study the association of surgeon volume of cataract procedures with the risk of surrogate markers for important postoperative adverse events within the first 2 weeks after cataract surgery. Our hypothesis was that there was a volume-outcomes effect in cataract surgery similar to that of other surgical procedures.

Patients and Methods

We identified patients 20 years of age and older who underwent cataract surgery using the Ontario Health Insurance Plan physician claims database for the period between April 1, 2001, and March 31, 2004 (we categorized data according to the Ontario fiscal year, which begins on April 1). The province of Ontario has a universal insurance program that covers all 12 million residents. Billing outside of the program is not permitted; thus, data can be considered population based. The database has excellent reliability for procedure performance.[8]

We identified individual ophthalmologists using their physician specialty code and their unique billing identifiers. We calculated each surgeon's annual cataract surgery volume based on the number of claims submitted for each fiscal year. We selected only those ophthalmologists performing more than 50 (approximately 1 per week) cataract surgeries in 1 year for inclusion in the analysis. By excluding those surgeons performing an extremely low number of procedures, we sought to minimize the possibility of misclassification bias. As a result, we excluded 1746 of the total of 286 543 (0.6%) procedures over the study period. Ophthalmologists performing more than 50 cataract surgeries in 1 year then were linked with their respective patients to comprise the cohort for analysis.

Adverse Events

We used a composite outcome of selected postoperative adverse events from cataract surgery. We identified physician billing claims for specific procedures that were defined as the adverse events: vitrectomy, dislocated lens extraction (with vitrectomy), air or fluid exchange (with vitrectomy), and vitreous aspiration or injection of medication performed by any ophthalmologist between 1 and 14 days after a cataract surgery. We used these procedures, performed within 2 weeks of cataract surgery, as surrogate markers for occurrences of retinal detachment, lost lens or lens fragment, and suspected endophthalmitis. A maximum of 1 adverse event was assigned to an individual cataract surgery, regardless of the actual number of subsequent procedures.

We divided the adverse events into those not specific for endophthalmitis (nonendophthalmitis, which included retinal detachment and lost lens or lens fragments) and those specific for suspected endophthalmitis (suspected endophthalmitis). The nonendophthalmitis adverse event of retinal detachment or lost lens/lens fragments was defined as vitrectomy with air or fluid exchange, plus vitrectomy with dislocated lens extraction. The adverse event of suspected endophthalmitis was defined as all remaining vitrectomies plus all vitreous aspirations or injections.

Statistical Analysis

We calculated cataract surgery volume for each surgeon in each of the 3 fiscal years studied. We first tested for the presence of a volume-outcome association by modeling volume as a continuous variable. We then divided the annual procedure volume into 4 categories that were identified a priori: (1) 50 to 250 procedures; (2) 251 to 500 procedures; (3) 501 to 1000 procedures; and (4) more than 1000 procedures. We defined the annual volume as the number of procedures performed by a surgeon during the same fiscal year that the procedure was performed. We also performed analyses over the entire 3-year study period by pooling all the data. We used generalized estimating equations to fit the models, to account for the effect of clustering of patients within individual surgeons, and to adjust estimates for the potential confounding effects of patient age and gender.[9] We used generalized estimating equations instead of conventional logistic regression models because it is likely that patients are not distributed randomly among surgeons, and observations may not be independent. The relation of cataract surgery volume to adverse event rates was expressed as the odds ratio and 95% confidence intervals (CIs). All reported *P* values are 2 sided. Analyses were performed with SAS software version 9.1 (SAS Institute, Cary, NC).

The study was approved by the ethics committee of the Sunnybrook and Women's College Health Sciences Centre and followed data confidentiality and privacy guidelines of the Institute for Clinical Evaluative Sciences.

Results

The number of cataract surgery procedures in Ontario increased from 89 556 in 2001 to 99 333 in 2003 (Table 1). Between 231 and 243 ophthalmologists performed 50 or more cataract operations in Ontario between 2001 and 2003. Surgery was performed at 70 hospitals or eye surgery centers. Almost half of the patients were

Table 1. Characteristics of Cataract Surgery Procedures by Fiscal Year

	2001/2002	2002/2003	2003/2004
Number of procedures	89 556	95 908	99 333
Number of surgeons*	240	231	243
Median surgeon volume (interquartile range)	353 (314)	391 (285)	392 (289)
Age category (%)			
20–64	17.7	17.8	18.2
65–74	32.6	32.7	32.4
75–84	41.0	41.1	41.1
85+	8.8	8.4	8.3
% Female	60.5	60.0	60.0
Adverse events† (%)	0.4	0.3	0.3

*Surgeons performing fewer than 50 cataract surgeries per year were excluded.
†Adverse event included vitrectomy, vitreous aspiration, or injection of medication performed by any ophthalmologist between 1 and 14 days after cataract surgery.

Table 2. Cataract Surgery Procedures by Surgeon Volume and Fiscal Year

	2001/2002				2002/2003				2003/2004			
	50–250	*251–500*	*501–1000*	*>1000*	*50–250*	*251–500*	*501–1000*	*>1000*	*50–250*	*251–500*	*501–1000*	*>1000*
Number of procedures	12 600	36 797	33 574	6585	9162	40 477	38 160	8109	8602	41 924	39 897	8910
Number of surgeons	85	97	53	5	60	106	59	6	64	111	61	7
Age category (%)												
20–64	21.2	17.5	16.8	16.3	20.4	17.7	17.3	17.8	22.8	18	17.6	17.9
65–74	33.9	32.3	32.4	33.4	33.8	32.7	32.4	32.5	32.5	32.4	32.0	34.6
75–84	36.8	41.2	42.1	41.8	38.2	40.9	41.8	42.7	37.3	41.3	42.0	40.3
85+	8.2	9.1	8.8	8.4	7.7	8.8	8.5	7.0	7.1	8.3	8.6	7.3
% Female	59.3	60.9	60.4	61.9	59.2	60.2	59.8	60.7	58.1	60.1	60.3	59.6
Adverse events* (%)	0.9	0.5	0.2	0.1	0.7	0.4	0.2	0.1	0.8	0.4	0.2	0.1

*Adverse event included vitrectomy, vitreous aspiration, or injection of medication performed by any ophthalmologist between 1 and 14 days after cataract surgery.

aged 75 years or older, and approximately 60% were women. In each year, fewer than 1 in 200 patients experienced an adverse event of vitrectomy, vitreous aspiration, or injection of medication (range, 0.3%–0.4%).

In each year of the study, the most common annual surgical volume category was 251 to 500 procedures (Table 2). The distribution of surgeon volume, patient age, and patient gender was similar over the 3 years of the study. The rate of adverse events was inversely related to surgeon volume in each of the study years. In 2003, surgeons who performed 50 to 250 procedures annually had an adverse event rate of 0.8%, as compared with 0.4% for surgeons who performed 251 to 500 procedures, 0.2% for surgeons who performed 501 to 1000 procedures, and 0.1% for surgeons who performed more than 1000 procedures annually.

In each study year, there was a statistically significant linear relationship between volume and outcome ($P<0.001$). This association between the volume of cataract surgeries performed by a surgeon and the surgeon's adverse event rate for 2003/2004 is presented in Figure 1. The figure was truncated at 900 procedures per year to protect the anonymity of the high-volume surgeons. The results of the unadjusted and adjusted regression models are summarized in Table 3. In these analyses, data from all 3 study years were pooled. There was a consistent and statistically significant association between procedure volume and risk of adverse events. Surgeons performing 50 to 250 cataract surgeries had an adverse event rate of 0.8%. Surgeons performing 251 to 500 cataract surgeries per year had an adverse event rate of 0.4% and an adjusted odds ratio of postoperative adverse events of 0.52 (95% CI, 0.39–0.69) compared with surgeons performing 50 to 250 procedures per year. Surgeons performing 501 to 1000 cataract surgeries per year had an adverse event rate of 0.2% and an adjusted odds ratio of 0.31 (95% CI, 0.22–0.43), and surgeons

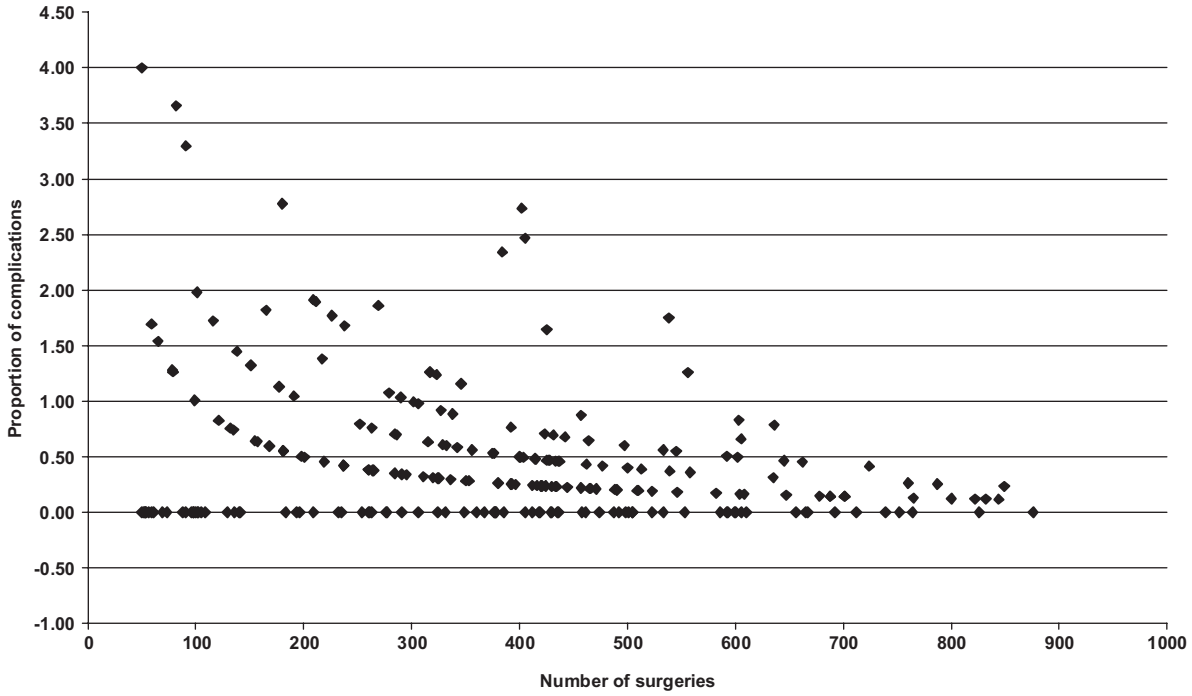

Figure 1. Scatterplot showing the proportion of complications by the volume of cataract surgery of each surgeon, fiscal year 2003/2004. Complications include codes for treatment of retinal detachment, lost lens or lens fragment, and suspected endophthalmitis. The number of surgeries per year was truncated at 900 to protect the identity of individual surgeons.

Table 3. Effect of Surgeon Cataract Procedure Volume on Risk of Combined Adverse Events, 2001 through 2003*

Mean Annual Cataract Surgery Volume	Odds Ratios (95% Confidence Intervals)	
	Unadjusted	*Adjusted*†
50–250	1	1
251–500	0.52 (0.45–0.61)	0.52 (0.39–0.69)
501–1000	0.31 (0.26–0.37)	0.31 (0.22–0.43)
>1000	0.14 (0.10–0.22)	0.14 (0.09–0.23)

Models account for the clustering of patients within surgeons.
*Adverse event included vitrectomy, vitreous aspiration, or injection of medication performed by any ophthalmologist between 1 and 14 days after cataract surgery.
†Adjusted for patient age and gender.

performing more than 1000 cataract surgeries per year had an adverse event rate of 0.1% and an adjusted odds ratio of 0.14 (95% CI, 0.09–0.23).

When analyzed separately, the results were similar for all 3 adverse event categories and followed the general pattern of the overall analysis (Table 4). For 2001 through 2003, surgeons performing 251 to 500 cataract surgeries per year had an adjusted odds ratio of lost lens or lens fragment adverse events of 0.45 (95% CI, 0.30–0.70) compared with surgeons performing 50 to 250 procedures per year. Surgeons performing 501 to 1000 cataract surgeries per year had an adjusted odds ratio of 0.22 (95% CI, 0.12–0.40), and surgeons performing more than 1000 cataract surgeries per year had an adjusted odds ratio of 0.08 (95% CI, 0.03–0.21). For retinal detachment adverse events, surgeons performing 251 to 500 cataract surgeries per year had an adjusted odds ratio of lost lens or lens fragment adverse events of 0.36 (95% CI, 0.21–0.61) compared with surgeons performing 50 to 250 per year. Surgeons performing 501 to 1000 cataract surgeries per year had an adjusted odds ratio of 0.16 (95% CI, 0.09–0.28), and surgeons performing more than 1000 cataract surgeries per year had an adjusted odds ratio of 0.13 (95% CI, 0.05–0.38). For suspected endophthalmitis adverse events, the adjusted odds ratio was 0.63 (95% CI, 0.45–0.90) for the surgeons performing 251 to 500 surgeries compared with the surgeons performing 50 to 250 procedures, 0.46 (95% CI, 0.32–0.66) for the surgeons performing 501 to 1000 procedures, and 0.22 (95% CI, 0.12–0.41) for those surgeons performing more than 1000 surgeries.

Discussion

We examined all cataract surgeries performed in the province of Ontario over a 3-year period. The overall adverse event rate, defined as relevant procedures performed by any ophthalmologist between 1 and 14 days after cataract surgery, was less than 0.5% in each year. The adverse event rate was inversely related to the annual volume of cataract surgery procedures performed by a surgeon. Separation of the adverse events into those specific to suspected endophthalmitis and those not specific to suspected endophthalmitis resulted in a similar effect.

Previous studies have examined the association of surgeon procedure volume on outcomes of cataract surgery. Habib et al[6] evaluated only intraoperative complication rates of 16 975 cases performed by 6 surgeons over 6 years at 1 hospital and found strong evidence of a decrease in complication rates with an increase in surgical volume. Schein et al[7] evaluated 772 cases performed by 75 surgeons in 3 cities and found that the rates of intraoperative, perioperative, and 4-month postoperative adverse events and the improvement in visual acuity did not differ either by surgical technique (phacoemulsification or extracapsular cataract extraction) or volume stratum. Venkatesh et al[10] evaluated outcomes of 593 cataract surgeries performed by 3 high-volume surgeons (defined as 80 surgeries per day) on 6 randomly selected high-volume days in a developing country. With 94% of patients obtaining a best-corrected visual acuity after surgery of 6/18 or better and 98% experiencing no intraoperative complications, the authors concluded that high-volume cataract surgery using appropriate techniques and standardized protocols does not compromise quality of outcomes.

One of the strengths of our findings is that our patient sample is consecutive and population based. It includes a large number of surgeons, patients, and hospitals. This allowed us to capture adverse events of patients who sought follow-up treatment from their surgeon as well as the adverse events of those patients who sought follow-up treatment from other ophthalmologists. This is important because specialized care frequently is required for some of the postoperative ad-

Table 4. Effect of Surgeon Cataract Procedure Volume on Risk of Adverse Events Presented Separately*

Mean Annual Cataract Surgery Volume	Lost Lens/Lens Fragments (N = 509)†		Retinal Detachment (N = 137)†		Suspected Endophthalmitis (N = 535)	
	Odds Ratios (95% Confidence Intervals)		Odds Ratios (95% Confidence Intervals)		Odds Ratios (95% Confidence Intervals)	
	Unadjusted	*Adjusted*‡	*Unadjusted*	*Adjusted*†	*Unadjusted*	*Adjusted*†
50–250	1	1	1	1	1	1
251–500	0.46 (0.37–0.57)	0.45 (0.30–0.70)	0.36 (0.24–0.53)	0.36 (0.21–0.61)	0.63 (0.50–0.81)	0.63 (0.45–0.90)
501–1000	0.23 (0.18–0.30)	0.22 (0.12–0.40)	0.15 (0.09–0.26)	0.16 (0.09–0.28)	0.46 (0.35–0.59)	0.46 (0.32–0.66)
>1000	0.08 (0.04–0.17)	0.08 (0.03–0.21)	0.13 (0.05–0.37)	0.13 (0.05–0.38)	0.22 (0.13–0.38)	0.22 (0.12–0.41)

Models account for the clustering of patients within surgeons.
*Adverse events included vitrectomy, vitreous aspiration, or injection of medication performed by any ophthalmologist between 1 and 14 days after cataract surgery.
†There were 65 cases over the 3 years with both retinal detachment and lost lens or lens fragment.
‡Adjusted for patient age and gender.

verse outcomes of cataract surgery. Another strength relates to the consistent and robust effect of surgeon volume demonstrated in the volume-outcome analysis. Although some may contend that extremely high-volume ophthalmologists may be operating on a disproportionate number of uncomplicated patients or that low-volume surgeons may be operating on a disproportionate number of more complicated cases, the effect of surgery volume was consistent across all 4 of the volume groupings.

Because vitrectomy, vitreous aspiration, and injection of medications are performed for suspected endophthalmitis as well as proven cases of endophthalmitis, our data likely overestimate its true incidence. However, these procedures should still be considered adverse clinical events because they are unanticipated occurrences related to a previous procedure and would be interpreted as negative experiences by patients. Moreover, the nature of the diagnoses minimizes the possibility of detection bias—where one group is more likely to have the complication diagnosed than another group—because the events are not subtle and usually present fairly quickly after the procedure. Further, our observed adverse event rate is comparable with a combination of the estimates for postoperative endophthalmitis and lost lens or lens fragment rates from previous studies.[11–15]

Our study has several limitations. First, we used administrative health data, which lack clinical information for detailed case-mix adjustment. Adjusting for the difficulty of the cataract surgery using clinical records may account for some of the differences in patient outcomes between low- and high-volume surgeons.[16] However, our analysis did account for patient age and gender, which is also important for adjustment of surgical complexity. Second, complications resulting from surgical resident cases at teaching hospitals are ascribed to the staff physician. Although this may play a small role, most of the care provided to patients in the province occurs outside of academic institutions. A large number of the academic surgeons would have to be concentrated in the lower surgical volume categories for this to impact our overall findings and conclusions significantly. Further, our data demonstrate that the volume-outcome effect persists throughout all levels of surgeon volume. Moreover, previous work in other surgical procedures has shown that volume-outcomes effects still persist at academic centers and that teaching status may even be associated with better patient outcomes.[17,18] Third, we did not measure the potential effect of hospital or surgical facility volume on patient outcome, and differences in endophthalmitis incidence across surgical centers have been found.[19,20] Fourth, we did not measure the clinical effectiveness of cataract surgery, such as visual acuity or visual function. Fifth, we included only surgeons who performed 50 or more procedures per year, so conclusions about lower-volume surgeons cannot be made. Sixth, it is possible that the adverse events are linked to the eye that did not have cataract surgery, because our analysis does not identify the eye undergoing the procedure. It would be extraordinarily rare to require such care for an unoperated eye within 2 weeks of surgery on the contralateral eye. Seventh, our estimates of selected adverse events were made by counting procedures that were surrogate markers for the outcomes of retinal detachment, lost lens or lens fragment, and suspected endophthalmitis. These estimates are susceptible to all limitations inherent in the use of surrogate markers. Finally, it should be emphasized that our findings reflect relative differences and that cataract surgery is usually well tolerated and free of complications. For example, even the grouping with the lowest-volume surgeons had an adverse event rate of less than 1% in each year of the study. We believe it is unlikely that any of these limitations would affect our analyses to such an extent as to invalidate our principal findings that the risk of adverse events decreases with increasing surgical volumes.

Our population-based analysis of the risk of selected adverse events after cataract surgery found that patients operated on by surgeons with high annual procedure volumes had a lower risk of adverse events than patients operated on by surgeons with lower annual volumes. This effect occurred throughout the spectrum of measured surgical volumes, was present when the adverse events were analyzed separately, and was not explained on the basis of variations in patient age or gender. Professional organizations may consider formulating recommendations about the appropriate number of cataract surgeries required for surgeons to maintain a high level of proficiency.

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References

1. Halm EA, Lee C, Chassin MR. Is volume related to outcome in health care? A systematic review and methodologic critique of the literature. Ann Intern Med 2002;137:511–20.
2. Institute for Clinical Evaluative Sciences. Analysis of current research related to the impact of low-volume procedures/surgery and care on outcomes of care. Ottawa: Canadian Institute for Health Information; 2005. Available at: http://secure.cihi.ca/en/downloads/Lit_Review2005_e.pdf. Accessed October 11, 2006.
3. Birkmeyer JD, Stukel TA, Siewers AE, et al. Surgeon volume and operative mortality in the United States. N Engl J Med 2003; 349:2117–27.
4. Shahian DM, Normand SL. The volume-outcome relationship: from Luft to Leapfrog. Ann Thorac Surg 2003;75:1048–58.
5. Birkmeyer JD, Dimick JB. Potential benefits of the new Leapfrog standards: effect of process and outcomes measures. Surgery 2004;135:569–75.
6. Habib M, Mandal K, Bunce CV, Fraser SG. The relation of volume with outcome in phacoemulsification surgery. Br J Ophthalmol 2004;88:643–6.
7. Schein OD, Steinberg EP, Javitt JC, et al. Variation in cataract surgery practice and clinical outcomes. Ophthalmology 1994; 101:1142–52.
8. Williams JI, Young W. A summary of studies on the quality of health care administrative databases in Canada. In: Goel V, Williams JI, Anderson GM, et al, eds. Patterns of Health Care in Ontario. The ICES Practice Atlas. 2nd ed. Ottawa: Canadian Medical Association; 1996:339-45. Available at: http://www.ices.on.ca/file/Practice2-appendix.pdf. Accessed October 11, 2006.
9. Zeger SL, Liang KY, Albert PS. Models for longitudinal data: a generalized estimating equation approach. Biometrics 1988; 44:1049–60.
10. Venkatesh R, Muralikrishnan R, Balent LC, et al. Outcomes of high volume cataract surgeries in a developing country. Br J Ophthalmol 2005;89:1079–83.

11. Lundstrom M, Stenevi U, Thorburn W. The Swedish National Cataract Register: a 9-year review. Acta Ophthalmol Scand 2002;80:248–57.
12. Wong TY, Chee SP. The epidemiology of acute endophthalmitis after cataract surgery in an Asian population. Ophthalmology 2004;111:699–705.
13. Riley AF, Malik TY, Grupcheva CN, et al. The Auckland Cataract Study: co-morbidity, surgical techniques, and clinical outcomes in a public hospital service. Br J Ophthalmol 2002; 86:185–90.
14. Norregaard JC, Bernth-Petersen P, Bellan L, et al. Intraoperative clinical practice and risk of early complications after cataract extraction in the United States, Canada, Denmark, and Spain. Ophthalmology 1999;106:42–8.
15. Desai P, Minassian DC, Reidy A. National cataract surgery survey 1997–8: a report of the results of the clinical outcomes. Br J Ophthalmol 1999;83:1336–40.
16. Habib MS, Bunce CV, Fraser SG. The role of case mix in the relation of volume and outcome in phacoemulsification. Br J Ophthalmol 2005;89:1143–6.
17. Nguyen NT, Paya M, Stevens CM, et al. The relationship between hospital volume and outcome in bariatric surgery at academic medical centers. Ann Surg 2004;240:586–93.
18. Ko CY, Chang JT, Chaudhry S, Kominski G. Are high-volume surgeons and hospitals the most important predictors of in-hospital outcome for colon cancer resection? Surgery 2002;132:268–73.
19. Li J, Morlet N, Ng JQ, et al, Team EPSWA. Significant nonsurgical risk factors for endophthalmitis after cataract surgery: EPSWA fourth report. Invest Ophthalmol Vis Sci 2004;45:1321–8.
20. Morlet N, Li J, Semmens J, et al. The Endophthalmitis Population Study of Western Australia (EPSWA): first report. Br J Ophthalmol 2003;87:574–6.