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Visit the online version of this article at *www.cuaj.ca* as of June 15 for supplemental tables.

Abstract

Introduction: The ability of academic (teaching) hospitals to offer the same level of efficiency as non-teaching hospitals in a publicly funded healthcare system is unknown. Our objective was to compare the operative duration of general urology procedures between teaching and non-teaching hospitals.

Methods: We used administrative data from the province of Ontario to conduct a retrospective cohort study of all adults who underwent a specified elective urology procedure (2002–2013). Primary outcome was duration of surgical procedure. Primary exposure was hospital type (academic or non-teaching). Negative binomial regression was used to adjust relative time estimates for age, comorbidity, obesity, anesthetic, and surgeon and hospital case volume.

Results: 114 225 procedures were included (circumcision n=12 280; hydrocelectomy n=7221; open radical prostatectomy n=22 951; transurethral prostatectomy n=56 066; or mid-urethral sling n=15 707). These procedures were performed in an academic hospital in 14.8%, 13.3%, 28.6%, 17.1%, and 21.3% of cases, respectively. The mean operative duration across all procedures was higher in academic centres; the additional operative time ranged from 8.3 minutes (circumcision) to 29.2 minutes (radical prostatectomy). In adjusted analysis, patients treated in academic hospitals were still found to have procedures that were significantly longer (by 10–21%). These results were similar in sensitivity analyses that accounted for the potential effect of more complex patients being referred to tertiary academic centres.

Conclusions: Five common general urology operations take significantly longer to perform in academic hospitals. The reason for this may be due to the combined effect of teaching students and residents or due to inherent systematic inefficiencies within large academic hospitals.

Introduction

Canadians place a significant value on maintaining a high-quality, publicly accessible healthcare system. However, sustaining this system is challenging, as healthcare costs are rising faster than inflation.[1] The majority of Canadian hospitals are funded by an annual fixed global budget, which tends to promote rationing of health services, increased wait times, and provides no incentive for productivity and efficiency.[2] These issues have led to the implementation of alternative funding models, such as activity-based funding ("bundled reimbursement" or "quality-based funding").[3] For surgeons, this model has significant implications: if a hospital receives a single fixed payment for a specific service (such as joint replacement), then the hospital and surgeon must provide this service efficiently and economically in order to avoid losing money and potentially not being able to offer this procedure.

This funding shift has significant potential implications for academic hospitals. While non-teaching-based hospitals exist primarily to deliver patient care, academic hospitals have the additional demands of clinical research and the training and education of medical and nursing students, allied health professionals, and postgraduate physicians (interns, residents, and fellows). The inclusion of medical residents in surgical procedures performed in the U.S. has been shown to increase the risk of a prolonged operation for specific urological procedures (such as laparoscopic urological oncology procedures[4] and transurethral surgery[5]), as well as in other surgical specialities (such as gynecology[6] and general surgery[7]). The increase in operative duration associated with training future medical professionals inherently increases the operating room cost of procedures at academic hospitals and is not currently accounted for in many activity-based funding models. Even small increases in operative time are significant, as each minute of operating room time has been calculated to cost between $10 and $40 in Canada.[8]

To our knowledge, the investigation of the actual magnitude of impact that medical education has on the operating room efficiency of urologists has not been quantified in a publically funded healthcare system. The primary objective of this study was to compare the operative time of five general urology procedures when they were performed in academic hospitals as compared to non-teaching hospitals.

Methods

Study design and setting

This study was conducted at the Institute for Clinical Evaluative Sciences (ICES). We performed a population-based, retrospective cohort study of all adult patients who underwent one of five general urological procedures between April 2002 and March 2013 in the province of Ontario (population of approximately 13 million people, with universal healthcare). Study approval was granted through the Research Ethics Board at Sunnybrook Hospital (Toronto, ON).

Data sources

The Canadian Institute for Health Information's Discharge Abstract Database and Same Day Surgery (CIHI-DAD/SDS) databases capture all diagnostic and procedural information for patients who are admitted to hospital or who undergo an inpatient or outpatient surgical procedure. The Ontario Health Insurance Plan (OHIP) database captures all health claims for physician services. The ICES Physician Database (IPDB) contains physician characteristics. The Registered Persons Database (RPDB) captures demographic data on all individual Ontarians. These datasets were linked using unique, encoded identifiers and analyzed at the ICES Western site. Previous studies have demonstrated that these data sources are reliable and valid.[9-11]

Patient population

We identified patients who had both a relevant Canadian Classification of Health Intervention (CCI) code and a matching OHIP billing code for one of the following five procedures: circumcision, hydrocelectomy, open radical prostectomy, transurethral prostectomy, or mid-urethral sling. As the OHIP fee code for a mid-urethral sling was only introduced in the fall of 2007, we restricted the mid-urethral sling cohort to Oct 2007–March 2013.

Of the 189 596 patients initially considered for inclusion, we excluded patients who had missing or invalid information (missing institution number, invalid demographic information, n=440), were treated at a pediatric hospital, or in the Kingston area (n=2727, due to historically inconsistent OHIP billing in that region), were <18 years of age (n=19 206), or were from outside Ontario (n=64). We also excluded emergency (n=8753) and after-hours (n=2578) procedures, repeat procedures (using a minimum 10-year lookback window, n=10 078), procedures performed by surgeons other than urologists or gynecologists (n=1150), and those without an anesthesiologist present (n=2974) or an anesthetic billing record from the same day (n=9382). Patients who had a simultaneous additional procedure (n=17 855) were also excluded; however, select, commonly occurring concurrent procedures were permitted and adjusted for in the multivariable analysis.

Primary outcome and exposure

The primary outcome was surgical duration. This was determined using a previously validated algorithm (with a correlation of r=0.94 with medical records), which calculates the duration of an operative procedure based on anesthesia OHIP billing records.[12] Time units are billed in 15-minute increments and encompass the time period from which the patient enters the operating room to the time the patient is transferred to the post-surgical recovery unit. Our prespecified hypothesis was that surgery would take longer in academic centres.

The primary exposure was surgery carried out in an academic hospital (defined as a hospital with full-time medical school and residency training programs, and a primary affiliation with a medical school). This included specific hospitals in Hamilton (McMaster University), London (Western University), Ottawa (Ottawa University), and Toronto (University of Toronto). Kingston (Queens University) was excluded due to their alternative funding model for physicians.

Covariates

Measured patient covariates include age, socioeconomic status (based on income quintiles), rural residence,[13] morbid obesity (body mass index >45), and number of family physician visits in the year prior to the procedure. Expected healthcare use (as a marker of comorbidity) was measured using the Johns Hopkins University Adjusted Case Groups® case-mix system Resource Utilization Bands (RUB); this system classifies all inpatient and outpatient healthcare visits based on disease severity and chronicity.[14] RUBs were classified as low (RUB=0–3), moderate (RUB=4), or high (RUB=5). Procedure covariates included year, type of anesthesia (general anesthesia (GA), spinal/epidural, other), and the yearly volume of the specific procedure at the hospital (determined from CIHI-DAD/SDS). Physician covariates from the IPDB included age, gender, specialty, and surgeon yearly procedure volume (calculated using OHIP records).

Statistical analysis

Mean and standard deviation are used to report our primary outcome and continuous variable covariates. Baseline characteristics of each procedure were compared between academic and non-teaching hospitals using standardized differences (SD). SD provide a better indication of clinically meaningful differences than p values when study samples are large (SD greater than 10% is considered potentially significant).[15]

The primary analysis was a negative binomial regression model with generalized estimated equations to account for the shared variance of patients clustered within surgeons, who in turn were clustered within hospitals (SAS 9.3, SAS institute, Cary, NC, U.S.). Unadjusted and adjusted (for patient age, comorbidity score, morbid obesity, year of surgery, anesthesia type, physician age, gender, yearly hospital and surgeon volume, and specific concurrent procedures) models are presented and time ratios (representing the relative change in surgical duration), 95% confidence intervals, and p values are reported ($p<0.05$ was considered significant).

Two additional sensitivity analyses were conducted to assess for a referral bias. First, we restricted our analysis to patients with low comorbidity (RUB 0–3). Second, we restricted our analysis to patients who presented to their expected admitting hospital, based on data from the Ontario Multispecialty Network database.[16]

Results

We identified a total of 114 225 people who met our study inclusion criteria (circumcision n=12 280; hydrocelectomy n=7221; open radical prostatectomy n=22 951; transurethral prostatectomy n=56 066; or mid-urethral sling n=15 707). These procedures were performed at an academic hospital in 14.8%, 13.3%, 28.6%, 17.1%, and 21.3%, respectively. The use of pelvic lymphadenectomy during radical prostatectomy was slightly more prevalent in non-teaching hospitals (91.2% vs. 87.9%, SD 0.11). Among women receiving a mid-urethral sling, 57.6% were done by gynecologists and 42.4% were done by urologists. Selected baseline characteristics of the patients and surgeons involved in these procedures are shown in Table 1. In general, patient characteristics were similar between those undergoing procedures at an academic hospital compared to a non-teaching hospital, with a larger proportion of rural patients attending a non-teaching hospital. Patients at academic hospitals were more likely to have general anesthesia (GA) for a radical prostatectomy and less likely to have GA for a mid-urethral sling. Surgeons at academic hospitals tended to perform more radical prostatectomies and mid-urethral slings compared to those operating in non-teaching hospitals (who conversely performed more circumcisions, hydrocelectomies, and transurethral prostectomies). Academic hospitals tended to have a lower yearly volume of hydrocelectomies and circumcisions and a higher volume of mid-urethral slings and radical prostatectomies.

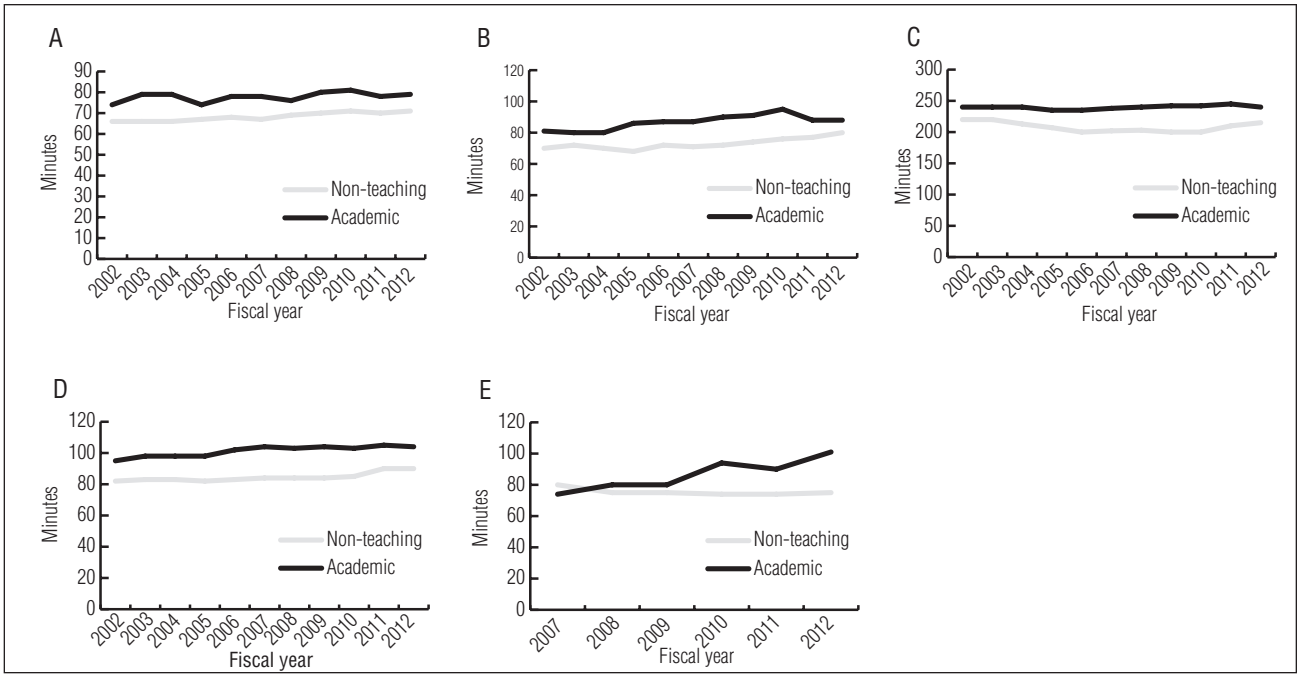

Fig. 1. Duration of general urological procedures by hospital type between 2002 and 2012: ***(A)*** Circumcision; ***(B)*** Hydrocelectomy; ***(C)*** Open radical prostatectomy; ***(D)*** Transurethral prostatectomy; ***(E)*** Mid-urethral sling.

In all cases, the unadjusted operative time was longer for procedures done in academic hospitals compared to non-teaching hospitals (Fig. 1). The mean additional time (over the entire study period) that was required in academic hospitals to carry out these procedures was: circumcision 8.3 minutes (95% CI 7.2–9.4); hydrocelectomy 12.8 minutes (95% CI 11.0–14.6); radical prostatectomy 29.2 minutes (95% CI 27.6–30.8); transurethral prostatectomy 16.6 minutes (95% CI 15.9–17.4); and mid-urethral sling 14.1 minutes (95% CI 12.6–15.6).

In our multivariable model, all five general urology procedures continued to take significantly longer in academic hospitals compared to non-teaching hospitals (Table 2). The increased time required for these procedures in academic hospitals compared to non-teaching hospitals varied from 10–21% (Fig. 2A). Morbid obesity was associated with a prolonged operative time in all procedures. All procedures except radical prostatectomy were significantly longer with the use of epidural/spinal anesthesia and increased surgeon volume significantly reduced operative time for circumcision, hydrocelectomy, and radical prostatectomy. In our two preplanned sensitivity analyses, the significantly

Table 1. Baseline characteristics (counts and proportions, or means and standard deviations are reported)

	Circumcision		Hydrocelectomy		Open radical prostatectomy		Transurethral prostatectomy		Mid-urethral sling	
	Non-teaching	Academic	Non-teaching	Academic	Non-teaching	Academic	Non-teaching	Academic	Non-teaching	Academic
Number of procedures (%)	10 461 (85.2%)	1819 (14.8%)	6257 (86.7%)	964 (13.3%)	16 386 (71.4%)	6565 (28.6%)	46 468 (82.9%)	9598 (17.1%)	12 353 (78.6%)	3354 (21.4%)
Patient characteristics										
Age	47.5 (20.4)	45.5 (19.9)*	54.8 (16.1)	54.8 (15.9)	62.0 (6.4)	61.6 (6.6)	71.5 (9.2)	70.8 (9.3)	53.1 (11.8)	53.5 (11.2)
Number of primary care visits	6.1 (6.3)	5.3 (6.4)*	5.7 (5.5)	5.4 (6.1)	6.3 (4.7)	5.9 (5.0)	8.4 (7.0)	7.5 (7.2)*	6.6 (6.5)	6.3 (7.0)
RUB										
Low	6774 (64.8%)	1227 (67.5%)	3835 (61.3%)	531 (55.1%)*	5555 (33.9%)	2166 (33.0%)	14 821 (31.9%)	2864 (29.8%)	6459 (52.3%)	1781 (53.1%)
Moderate	2204 (21.1%)	339 (18.6%)	1436 (23.0%)	231 (24.0%)	6545 (39.9%)	2533 (38.6%)	15 365 (33.1%)	3038 (31.7%)	4393 (35.6%)	1165 (34.7%)
High	1483 (14.2%)	253 (13.9%)	986 (15.8%)	202 (21.0%)*	4286 (26.2%)	1866 (28.4%)	16 282 (35.0%)	3696 (38.5%)	1501 (12.2%)	408 (12.2%)
Morbid obesity	93 (0.9%)	14 (0.8%)	39 (0.6%)	N<6 (<0.6%)	47 (0.3%)	38 (0.6%)	102 (0.2%)	20 (0.2%)	310 (2.5%)	51 (1.5%)
Socio-economic group										
Lowest two quintiles	4186 (40.0%)	778 (42.8%)	2334 (37.3%)	369 (38.3%)	5302 (32.4%)	1789 (27.3%)*	18 003 (38.7%)	3657 (38.1%)	4294 (34.8%)	1127 (33.6%)
Highest two quintiles	4028 (38.5%)	678 (37.3%)	2601 (41.6%)	372 (38.6%)	7728 (47.2%)	3518 (53.6%)*	18 902 (40.7%)	4161 (43.4%)	5427 (43.9%)	1582 (47.2%)
Rural residence (%)	1289 (12.3%)	109 (6.0%)**	923 (14.8%)	63 (6.5%)**	2597 (15.8%)	860 (13.1%)	7214 (15.5%)	760 (7.9%)**	2553 (20.7%)	322 (9.6%)**
Anesthetic type										
General	8877 (84.9%)	1524 (83.8%)	5182 (82.8%)	819 (85.0%)	12 761 (77.9%)	5790 (88.2%)**	15 888 (34.2%)	3859 (40.2%)*	9376 (75.9%)	1757 (52.4%)**
Epidural/spinal	737 (7.0%)	99 (5.4%)	596 (9.5%)	75 (7.8%)	3610 (22.0%)	764 (11.6%)**	29 359 (63.2%)	5422 (56.5%)*	1593 (12.9%)	480 (14.3%)
Other	847 (8.1%)	196 (10.8%)	479 (7.7%)	70 (7.3%)	15 (0.1%)	11 (0.2%)	1221 (2.6%)	317 (3.3%)	1384 (11.2%)	1117 (33.3%)**
Surgeon & hospital characteristics										
Surgeon age	50.5 (10.8)	49.5 (9.8)*	48.7 (10.3)	47.8 (9.7)	46.6 (9.5)	47.7 (8.6)*	50.2 (10.4)	49.7 (9.1)	48.4 (8.4)	48.8 (8.2)
Surgeon yearly volume	10.7 (5.5)	8.6 (5.4)**	6.7 (3.4)	4.9 (3.0)**	21.5 (12.5)	49.3 (35.6)**	41.7 (23.1)	31.3 (20.9)**	35.2 (32.6)	52.0 (38.6)**
Hospital yearly volume	28.1 (19.9)	21.8 (10.6)**	16.1 (9.6)	11.5 (5.2)**	51.1 (26.3)	121.8 (66.6)**	108.4 (57.0)	107.2 (56.3)	69.0 (43.1)	127.2 (79.4)**

*Standardized difference between non-teaching and academic hospital for specified procedure is between 0.10–0.20; **Standardized difference between non-teaching and academic hospital for specified procedure is >0.20; n<6: Specific number of patients not reported due to privacy regulations.

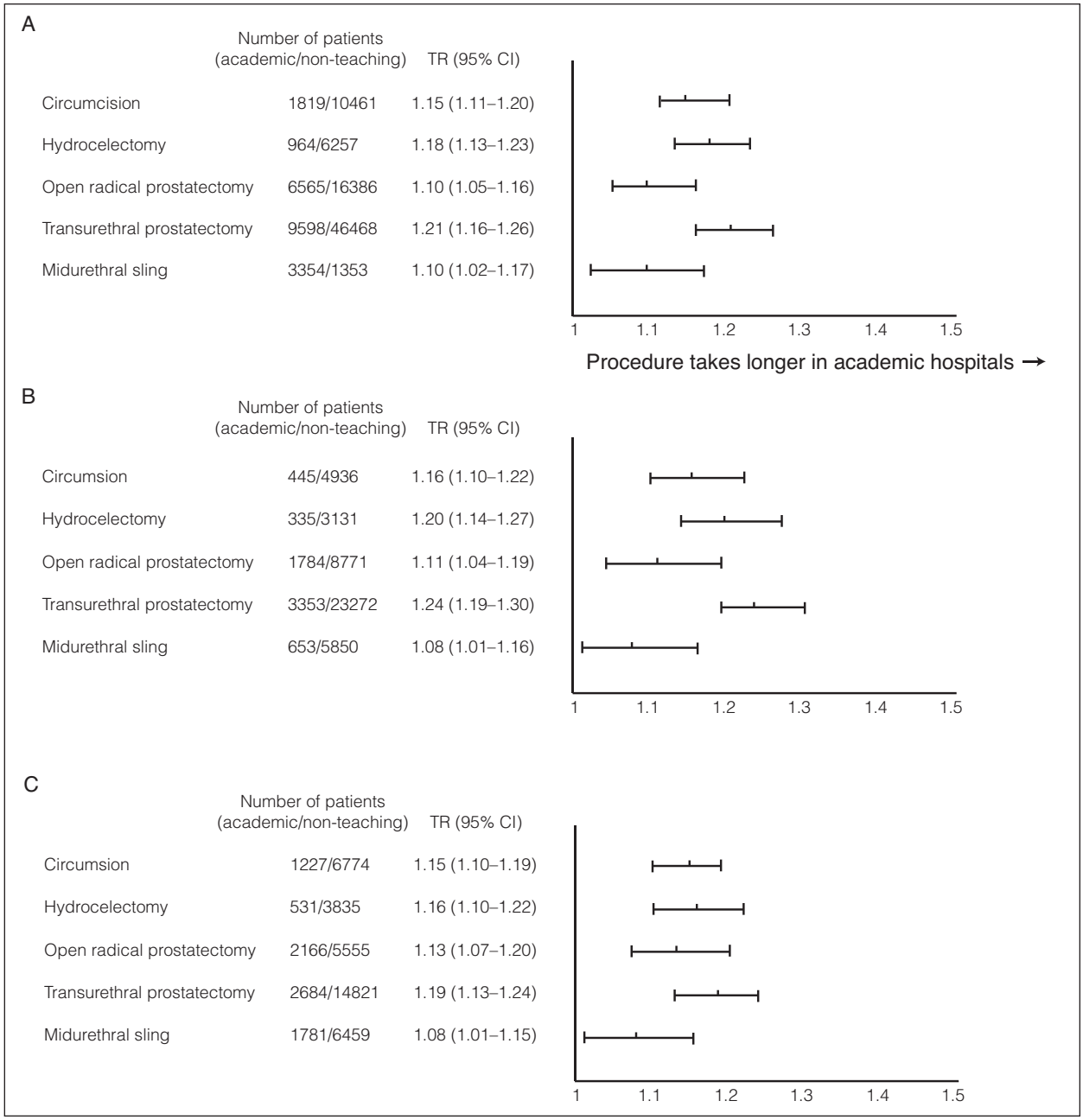

Fig. 2. Forest plot showing time ratio (95% CI) for each of the urological procedures studied. The time ratio (TR) is interpreted as the proportion of extra time required for the procedure in an academic hospital compared to a non-teaching hospital: ***(A)*** Primary adjusted analysis; ***(B)*** Sensitivity analysis restricted to patients operated on at their expected hospital based on residency; ***(C)*** Sensitivity analysis restricted to patients with low comorbidity. The number of patients included from non-teaching hospitals and academic hospitals is included for each procedure.

prolonged operative time observed in academic hospitals across all our procedures persisted (Figs. 2B, C).

Discussion

We demonstrated that the operative time for common urological procedures is significantly longer in academic centres as opposed to non-teaching hospitals. This difference translated to 8–17 additional minutes for shorter operations (circumcision, hydrocelectomy, transurethral prostatectomy, and mid-urethral sling), or 10–21% additional operative time. Similarly, a more complex procedure (radical prostatectomy) took an additional 29 minutes, or 10% longer. As expected, we found that morbid obesity and epidural or spinal anesthetic also significantly prolonged operative procedures. In general, patient comorbidities, surgeon characteristics, and hospital and surgeon volume had only a small magnitude of effect on the duration of the urological

Table 2. Multivariable model assessing the impact of non-teaching vs. academic hospital on operative duration. Results are time ratios (95% confidence intervals). A time ratio >1 represents a variable increasing the operative time

	Circumcision	Hydrocelectomy	Open radical prostatectomy	Transurethral prostatectomy	Mid-urethral sling
Patient characteristics					
Age (per 10 years increase)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.01 (1.01–1.02)*	1.01 (1.01–1.01)*
RUB (reference=low)					
Moderate	1.00 (0.99–1.01)	1.00 (0.99–1.01)	1.01 1.00–1.01)*	0.98 (0.97–0.99)*	1.01 (1.01–1.02)*
High	1.01 (1.00–1.02)*	1.01 (1.00–1.03)	1.01 (1.00–1.01)*	0.97 (0.97–0.98)*	1.03 (1.02–1.04)*
Morbid obesity	1.07 (1.03–1.12)*	1.13 (1.05–1.22)*	1.11 (1.07–1.15)*	1.09 (1.04–-1.14)*	1.09 (1.07–1.11)*
Anesthetic type (reference=GA)					
Epidural/spinal	1.06 (1.04–1.08)*	1.07 (1.05–1.10)*	1.01 (1.00–1.02)	1.01 (1.00–1.02)*	1.07 (1.05–-1.08)*
Other	1.01 (0.99–1.03)	1.01 (0.99–1.03)	0.99 (0.95–1.02)	1.01 (0.99–1.02)	1.01 (1.00–1.03)
Surgeon & hospital characteristics					
Surgeon age (per 10-year increase)	0.98 (0.97–0.99)*	0.99 (0.98–1.00)	0.98 (0.96–1.01)	1.01(0.99–1.02)	0.98 (0.96–1.01)
Surgeon yearly volume (per 10 additional procedures)	0.98 (0.97–0.99)*	0.97 (0.94–0.99)*	0.99 (0.99–1.00)*	1.00 (0.99–1.00)	1.00 (0.99–1.00)
Hospital volume	0.99 (0.98–1.00)*	0.98 (0.97–1.00)*	1.00 (1.00–1.01)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Academic hospital (reference= non-teaching hospital)	1.15(1.11–1.20)*	1.18 (1.13–1.23)*	1.10 (1.05–1.16)*	1.21 (1.16–1.26)*	1.10 (1.02–1.17)*

*p<0.05

Model was also adjusted for year of cohort entry, and specific concurrent procedures outlined in the methods (data shown in eTable 4; online at *www.cuaj.ca*). In all cases of concurrent procedures, the operative duration was significantly longer. Model was also adjusted for surgeon gender; the data is not shown in accordance with privacy regulations due to the small number of female urologists.

procedures we assessed. Assigning an average value of $10 per minute of operating time (which accounts for the fixed, non-consumable costs, such as nursing salary, utilities, and equipment depreciation[8]), the additional cost of carrying out these five procedures in our select cohort during the study period (above that required if they were done in non-teaching hospitals) was $4.25 million dollars. This is significant in a publically funded healthcare system, where the use of operating room time is >95% and tax payers cover the costs of any inefficiencies in the operating room.

Our results are generally consistent with the existing literature on resident involvement and operative times. The majority of the prior literature is based on data from the National Surgical Quality Improvement Program (NSQIP) in the U.S. The involvement of residents (including junior, senior, and chief residents) significantly increased the risk of an operative time >75th percentile for minimally invasive partial and radical nephrectomies, as well minimally invasive radical prostatectomy.[4] Similarly, there was a two-fold higher chance of a prolonged operative time (defined as >75% percentile) when urology residents were involved with transurethral surgery.[5] Among basic general surgery procedures (laparoscopic cholecystectomy or appendectomy, or open inguinal hernia repair, all of which tended to take approximately an hour), skin-to-skin operative time increased by 12–20 minutes with the involvement of both junior or senior residents, compared to the attending surgeon operating alone.[7]

It is essential for academic urologists and anesthesiologist to continue to balance the priorities of resident education and hands-on learning opportunities with the efficient and responsible use of publicly funded healthcare resources, such as operating room time. In addition to resource implications, previous studies have demonstrated an increased risk in complications, such as surgical site infections, among certain surgical procedures when they are significantly prolonged.[17] This potential risk is balanced by studies suggesting that, in general, patients do not have worse outcomes if residents are involved in their surgical procedure.[18] The unique responsibilities and contributions of teaching hospitals should be recognized by funding bodies and activity-based funding should account for the increased operative time associated with training the next generation of medical professionals.

Our study has several unique features that add to the existing literature. First, the operations we studied were chosen due to their infrequent need to refer to a tertiary care academic centre. It is likely that some of the previously studied procedures were prone to a significant referral bias and cases with increased complexity would not be adequately captured within administrative data. Our two sensitivity analyses, which attempt to adjust for referral bias, demonstrated results consistent with our primary analysis. Second, we captured the entire duration of the operative process. While a comparable operative speed may be achieved by a surgeon with and without a trainee, the effect of other components of the academic hospital operating room (such as anesthesia residents or operating room nurses in training) also need to be taken into account, as ultimately this time is attributed to the surgeon's procedure. Third, we adjusted

our estimates for several potential variables outside of patient comorbidities, such as surgeon experience and hospital volumes. Finally, these results are from a publically funded healthcare system, which may be subject to different financial pressures and potential inefficiencies than the NSQIP hospitals.

The limitations of our study also need to be acknowledged. We could not actually determine which specific trainees were involved with individual cases. This concern is minimized by a long-standing priority among all urology residency programs to ensure operative cases are attended by a resident or fellow and, if anything, the lack of trainee participation in an academic centre should bias the time ratios towards 1.0. This also means it is impossible to separate out the effects of medical students, nurses in training, anesthesiologists, urologists, and general systematic differences in preoperative, operative, and postoperative care and patient flow that is inherent in large academic hospitals. Our results are based on the single payer, publically funded Canadian healthcare system, and may not be generalizable to hospitals that use different funding models. Misclassification or residual confounding is always a possibility with an observational study and, despite the fact the procedures are generally straightforward, it is possible there were unadjusted systematic differences between patients being treated at academic vs. non-teaching centres.

Conclusion

A variety of general urological surgical procedures take 10–21% longer to complete in academic hospitals as opposed to non-teaching hospitals. It is likely that the involvement of various healthcare trainees plays a significant role in this effect and it should be taken into account when developing activity-based funding models.

Competing interests: Dr. Welk has received grant funding from Astellas. The remaining authors declare no competing personal or financial interests.

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eTable 1. STROBE checklist for cohort studies

	Item No.	Recommendation	Page no.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Abstract, methods
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract
Introduction			
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	Methods, primary outcome and exposure
Methods			
Study design	4	Present key elements of study design early in the paper	Methods, study design and setting
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods, study design and setting, primary exposure
Participants	6	(a) Cohort study — Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of followup	Methods
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods, primary outcome and exposure, eTable 2
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods, data sources, eTable 2
Bias	9	Describe any efforts to address potential sources of bias	Methods, statistical analysis
Study size	10	Explain how the study size was arrived at	Methods, (population-based study)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods, primary outcome and exposure, covariates
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Methods, statistical analysis
		(b) Describe any methods used to examine subgroups and interactions	None
		(c) Explain how missing data were addressed	Methods
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed	NA
		(e) Describe any sensitivity analyses	Methods, statistical analysis

eTable 1 (cont'd). STROBE checklist for cohort studies			
	Item No.	**Recommendation**	**Page no.**
Methods (cont'd)			
Participants	13	(a) Report numbers of individuals at each stage of study — e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Methods
		(b) Give reasons for non-participation at each stage	Methods
		(c) Consider use of a flow diagram	
Descriptive data	14	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	Results, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	NA
		(c) Cohort study — Summarize followup time (e.g., average and total amount)	NA
Outcome data	15	Cohort study — Report numbers of outcome events or summary measures over time	NA
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results, Table 2
		(b) Report category boundaries when continuous variables were categorized	Results standard deviation
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Results Time ratios (analogous to relative risk)
Other analyses	17	Report other analyses done — e.g., analyses of subgroups and interactions, and sensitivity analyses	Figs. 2B, C
Discussion			
Key results	18	Summarize key results with reference to study objectives	Discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion
Generalizability	21	Discuss the generalisability (external validity) of the study results	Discussion
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Acknowledgements

eTable 2. Coding elements used to identify the specified urologic procedures. Both a physician billing code (OHIP) and a matching hospital procedure code (CIHI-DAD/SDS) had to be present

Urology procedure	OHIP code	CCI code
Midurethral sling	S815	1.PL.74.CR-XX-N
		1.PL.74.AL-XX-N
		1.PL.74.AF-XX-N
		1.PL.74.LA-XX-N
		1.PL.74.DA-XX-N
Transurethral prostatectomy	S655	1.QT.59.BA-GX
		1.QT.59.BA-AG
		1.QT.87.BA
		1.QT.87.BA-AG
		1.QT.87.BA-AK
		1.QT.87.BA-GX
Hydrocelectomy	S611	1.QH.80.LA
		1.QH.87.LA
		1.QH.87.LB
Circumcision	S573	1.QD.89.LA
		1.QD.89.LA-FF
		1.QD.72.LA
		1.QD.89.WJ
Open radical prostatectomy	S651	1.QT.91.PB
		1.QT.91.PK

CCI: Canadian Classification of Health Intervention; CIHI-DAD/SDS: Canadian Institute for Health Information's Discharge Abstract Database and Same Day Surgery; OHIP: Ontario Health Insurance Plan.

eTable 3. Yearly procedure volumes

Procedure	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Circumcision	1035	1081	1083	1028	1039	1042	1115	1297	1210	1130	1220	12 280
Hydrocelectomy	653	612	644	625	627	626	658	660	682	695	739	7221
Open radical prostatectomy	1944	1859	2095	2327	2239	2322	2124	2098	2120	2170	1653	22 951
Transurethral prostatectomy	4787	4835	5327	5420	4993	4883	5083	5145	5013	5183	5397	56 066
Mid-urethral sling	0	0	0	0	0	319	2433	3123	3219	3589	3024	15 707

eTable 4. Frequency of concurrent procedures (non-teaching versus academic), and the adjusted time ratio (TR) with 95% confidence interval

Index procedure	Concurrent procedure	Frequency (Non-teaching vs. academic)	Adjusted time ratio as a result of the concurrent procedure
Circumcision	Chordee/Peyronie's repair	5.6% vs. 3.3%*	1.08 (1.05–1.11)
Hydrocelectomy	Concurrent spermatocele repair	24.9% vs. 10.5%**	1.06 (1.04–1.07)
Open radical prostatectomy	Pelvic lymphadenectomy	91.2% vs. 87.9%*	1.06 (1.03–1.08)
Transurethral prostatectomy	Removal of bladder stone	1.5% vs. 1.1%	1.09 (1.07–1.12)
	Cystolithopaxy	6.3% vs. 6.8%	1.22 (1.20–1.23)
	Prostate biopsy	2.3% vs. 1.6%*	1.09 (1.06–1.12)
Mid-urethral sling	Anterior or posterior repair	8.6% vs. 11.5%*	1.30 (1.26–1.34)
	Anterior and posterior repair	3.1% vs. 4.4%	1.60 (1.56–1.64)
	Repair of enterocele	1.9% vs. 6.7%**	1.76 (1.70–1.81)
	Hysterectomy with prolapse repair	1.5% vs. 3.8%*	2.44 (2.31–2.59)

*Standardized difference between non-teaching and academic hospital for specified procedure is 0.10–0.20; **Standardized difference between non-teaching and academic hospital for specified procedure is >0.20.