Measurement of surgical wait times in a universal health care system

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Abstract

Introduction: Reported increases in surgical wait times for cancer have intensified the focus on this quality of health care indicator and have created a very public, concerted effort by providers to decrease wait times for cancer surgery in Ontario. Delays in access to health care are multifactorial and their measurement from existing administrative databases can lack pertinent detail. The purpose of our study was to use a real-time surgery-booking software program to examine surgical wait times at a single centre.

Methods: The real-time wait list management system Axcess.Rx has been used exclusively by the department of urology at the Kingston General Hospital to book all nonemergency surgery for 4 years. We reviewed the length of time from the decision to perform surgery to the actual date of surgery for patients in our group urological practice. Variables thought to be potentially important in predicting wait time were also collected, including the surgeon's assessment of urgency, the type of procedure (i.e., diagnostic, minor cancer, major cancer, minor benign, major benign), age and sex of the patient, inpatient versus outpatient status and year of surgery. Analysis was planned a priori to determine factors that affected wait time by using multivariate analysis to analyze variables that were significant in univariate analysis.

Results: There were 960 operations for cancer and 1654 for benign conditions performed during the evaluation period. The overall mean wait time was 36 days for cancer and 47 days for benign conditions, respectively. The mean wait time for cancer surgery reached a nadir in 2004 at 29.9 days and subsequently increased every year, reaching 56 days in 2007. In comparison, benign surgery reached a nadir wait time of 33.7 days in 2004 and in 2007 reached 74 days at our institution. Multivariate analysis revealed that the year of surgery was still a significant predictor of wait time. Urgency score, type of procedure and inpatient versus outpatient status were also predictive of wait time.

Conclusion: The application of a prospectively collected data set is an effective and important tool to measure and subsequently examine surgical wait times. This tool has been essential to the accurate assessment of the effect of resource allocation on wait times for priority and nonpriority surgical programs within a discipline. Such tools are necessary to more fully assess and follow wait times at an institution or across a region.

S urgical wait times have become a visible and contentious quality indicator in the universal health care systems of many nations. This important issue has had such influence that numerous surgical wait time initiatives have been formed[1-4] and specialty groups, as well as the federal government, have set "benchmarks" for wait times in Canada.[5]

Cancer has been prioritized in Ontario as 1 of the 5 surgical areas in which to increase access.[6] In the management of genitourinary diseases, wait times for both cancer and non-cancer surgery have demonstrated significant effects on outcomes. Unfortunately, there has been increasing evidence of significant delays in care to cancer surgery in Canada. A cohort of Ontario patients selected randomly from between 1990 and 1998 was analyzed and found to have increasing wait times for radical prostatectomy.[7]

Most wait time strategies tend to focus on the period of time from when the patient is pronounced "ready" for surgery to the actual surgery date.[8] Administrative databases measuring this 1 summary aspect have confirmed that the median surgical wait time increased for all cancer surgeries studied from 1993 to 2000 in Ontario.[9] Our objective was to examine the current wait times of the urological service at a single institution using prospectively collected data, and, in particular, any effects of priority programs on the wait times in general at this institution.

Methods

We based our study on data from real-time surgery-booking software at the Kingston General Hospital. This software has been used exclusively by our department to book all non-emergency surgery for several years. The data were entered by administrative staff, who received training on the software and used this program to schedule patients for the operating room. Demographic and surgical details of patients who underwent surgery were taken from the database housed by the software program Axcess.Rx (AdapCS.Canada). This research

project was approved by the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board.

We reviewed the length of time from the decision to perform surgery to the actual date of surgery for patients in our group urological practice. Variables thought to be potentially important in predicting wait time were also collected, including the surgeon's assessment of urgency (coded 1–5, with 1 being the most urgent), the surgical category (diagnostic, e.g., a patient with suspicious cytology; minor cancer, e.g., bladder cancer treated by transurethral resection; major cancer, e.g., laparoscopic nephrectomy; minor benign, e.g., hydrocele repair; major benign, e.g., ureteropelvic junction open repair; detailed further in Appendix 1), age and sex of the patient, inpatient versus outpatient status and year of surgery. Minor procedures were classified as outpatient or endoscopic procedures, whereas major procedures required hospital admission and invasive open or laparoscopic procedures. Diagnostic procedures were those procedures in which the operation was completed to determine pathology (e.g., cystoscopy and retrograde pyelogram, or ureteroscopy for suspicious cytology).

After descriptive analysis, characteristics of those who underwent surgery were compared with those who did not, using independent sample t tests and χ^2 tests. The analysis was planned a priori to identify factors associated with wait time by using multivariate analysis to analyze variables that were significant in univariate analysis. The wait time data were adjusted to take unavailable days into account. The associations between wait time and the independent variables listed above were tested using nonparametric statistics, as the wait time data were skewed. The associations between the number of cancellations and the independent variables were also assessed with nonparametric statistics. The wait time data were log-transformed for the multivariate linear regression, which was completed by using a manual approach to sequentially remove variables that did not contribute significantly to the model. No linear regression was done for the number of cancellations, as most of the patients had no cancellations, prohibiting log-transformation of these data. SPSS version 14.0 for Windows (SPSS, Inc.) was used for all analyses.

Results

The mean age of patients was 59 (range 0.5–97) years and 79.4% were male. From 2003 to June 2007, 2614 procedures were completed with 960 procedures done for malignancy (36.7%). Of the 2614 patients who underwent surgery, 9.8% (257 patients) had had their scheduled surgery cancelled at least once (range 1–6). Inpatient procedures had shorter wait times as compared with outpatient procedures (43 v. 56 d, $p < 0.001$).

Analysis of patients who underwent surgery versus those who never received surgery revealed no statistically significant differences in sex ($p = 0.99$). The difference in urgency score approached significance, with more urgent cases more likely to result in surgery ($p = 0.07$). Cancer status ($p = 0.003$), patient age ($p = 0.016$) and surgical category ($p = 0.005$) had significant differences between those who had surgery versus those who did not. Table 1 presents the mean and median wait times for the 5 surgical categories.

Owing to the skewed distribution of waiting times, nonparametric statistical tests (Mann–Whitney U, Kruskal–Wallis and Spearman rank correlation) were employed to determine significant differences between groups. On univariate analysis, wait times were not significantly associated with sex ($p = 0.79$). Inpatient status ($p < 0.001$), cancer status ($p < 0.001$), urgency ($p < 0.001$), year of surgery ($p < 0.001$) and surgical category ($p < 0.001$) were all significantly associated with the outcome of wait time to surgery.

For the numerical variables of age and urgency, correlations with wait time were explored. Spearman rank correlation determined a positive correlation of 0.273 ($p < 0.001$) between urgency and wait time. Age was negatively correlated with wait time (–0.066, $p = 0.001$). Age and urgency were also associated, with a correlation of –0.323 ($p < 0.001$).

Table 1. Wait times by surgical category

Surgical category (n)	Wait time, d	
	Mean (95% CI)	Median
Diagnostic procedures (381)	45.9 (41.3–50.5)	30
Benign, minor (1198)	46.7 (44.4–49.1)	38
Benign, major (184)	64.3 (55.3–73.3)	47
Cancer, minor (470)	33.2 (30.8–35.6)	28
Cancer, major (381)	44.3 (40.8–47.7)	38
Total (2614)	45.1 (43.5–46.6)	35
CI = confidence interval.		

Multivariate linear regression was completed to determine the presence or absence of confounders and the predictive value of the model. For the categorical variables, the year 2003 and the diagnostic procedures were used as reference categories. Cancer status ($p = 0.38$) and age ($p = 0.12$) were sequentially removed from the model, as they were not significant. The multivariate model using the untransformed data was similar to the one using the transformed data, so the untransformed model is presented in Table 2 for ease of interpretation. Interaction between year of surgery and cancer status was also tested but was not significant ($p = 0.26$). On average, outpatients waited close to 6 days longer than inpatients did. As the urgency score decreased, the length of wait increased by an average of 14.1 days. Compared with the year 2003, 2004 had shorter wait times, and 2006 and 2007 saw longer wait times, as shown in Figure 1. As compared with the diagnostic category, the major benign and the major cancer categories had longer wait times.

The proportion of surgery done for benign indications as opposed to cancer remained relatively stable during the years of study (range 35%–41%) as shown in Figure 1. The wait time did, however, increase significantly for both benign and cancerous surgeries. Figure 2 shows the increase in wait time for urological procedures stratified by cancerous versus noncancerous indications. The wait time was shortest in 2004 at 34 days for benign conditions and 29 days for cancerous conditions. The year 2007 (results up to June) has by far the longest wait times with 75 days (95% confidence interval [CI] 49–57) for benign procedures and 56 days (95% CI 67–82) for cancer surgery. The second longest wait times are from 2006 (54 and 40 days, respectively, for benign v. cancer surgery).

Cancellations were significant at 9.8%, with the remaining 2357 (90.2%) having no cancellations. An additional 207 (7.9%) cancelled once, with an additional 36 (1.4%), 8 (0.3%), 4 (0.2%), 1 (0.0%) and 1 (0.0%) cancelling 2, 3, 4, 5 and 6 times, respectively. Table 3 contains the results of the univariate analysis for number of cancellations for all categorical variables. The correlation between age and number of cancellations was poor (Spearman rank correlation = 0.008, $p = 0.68$). The median value for all groups examined was equal to zero, so only the mean value and the 95% CI are presented. Regression analyses were not completed owing to the skewed nature of the data and the inability to log-transform the data because of the large number of zero values.

Table 2. Multivariate linear regression model for number of days waited*

Variable	Unstandardized coefficients (95% CI)		p value
Constant	2.5	(–5.6 to 10.5)	0.55
In- or outpatient†	4.1	(0.2 to 8.0)	0.041
Year‡			
2004	–11.6	(–16.9 to –6.3)	< 0.001
2005	0.3	(–5.1 to 5.7)	0.93
2006	5.8	(0.7 to 10.9)	0.025
2007	21.5	(15.5 to 27.5)	< 0.001
Surgical category§			
Benign, minor	–1.7	(–6.6 to 3.1)	0.49
Benign, major	16.2	(8.9 to 23.5)	< 0.001
Cancer, minor	–1.7	(–7.6 to 4.1)	0.56
Cancer, major	11.6	(5.4 to 17.8)	< 0.001
Urgency¶	14.1	(12.1 to 16.0)	< 0.001

CI = confidence interval
*Model summary: F = 47.7, $p < 0.001$, adjusted r^2 = 0.17.
†Inpatients were coded as "0" in the model and outpatients as "1."
‡Reference = 2003.
§Reference = diagnostic.
¶Urgency was scored by the surgeon from 1 to 5, with 1 being the most urgent.
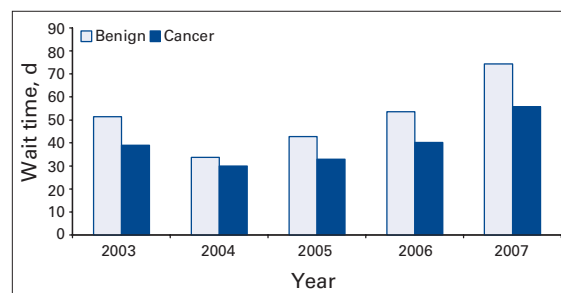

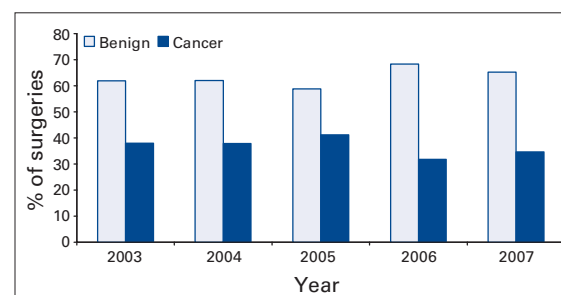**Fig. 1.** Wait time in days for benign and cancerous indications, by year.

Fig. 2. Percent of surgeries for benign and cancerous indications, by year.

Discussion

Surgical wait times have become a frequently targeted barometer of the quality of our medical care, as prolonged wait times have been associated with poorer outcomes in several surgical procedures. Taking genitourinary surgery as an example, prolonged wait times have been shown to have significant effects on patients' psychosocial well-being.[10] Despite some controversy,[11,12] studies have also demonstrated a deleterious effect of prolonged wait times on the outcomes of both prostate[13] and bladder cancer.[14,15]

There is growing evidence that wait times for cancer treatment are increasing in Canada, particu-

Table 3. Univariate analysis of number of cancellations

Variable (n)	Mean no. of cancellations (95% CI)		p value*
Sex			0.61
Male (2076)	0.13	(0.11–0.14)	
Female (538)	0.13	(0.09–0.16)	
Patient status			0.11
Inpatient (1701)	0.11	(0.09–0.13)	
Outpatient (670)	0.19	(0.15–0.22)	
Cancer status			0.45
No cancer (1654)	0.15	(0.13–0.17)	
Cancer† (960)	0.09	(0.07–0.11)	
Year			
2003 (366)	0.01	(0.00–0.01)	< 0.001
2004 (496)	0.02	(0.01–0.04)	
2005 (718)	0.08	(0.06–0.10)	
2006 (720)	0.18	(0.15–0.22)	
2007 (314)	0.40	(0.31–0.50)	
Urgency code‡			
1 (143)	0.06	(0.02–0.09)	0.020
2 (1014)	0.12	(0.10–0.15)	
3 (987)	0.12	(0.09–0.14)	
4 (335)	0.16	(0.10–0.22)	
5 (135)	0.21	(0.12–0.31)	
Surgical category			< 0.001
Diagnostic procedures (381)	0.23	(0.17–0.30)	
Benign, minor (1198)	0.12	(0.09–0.14)	
Benign, major (184)	0.15	(0.08–0.21)	
Cancer, minor (470)	0.11	(0.08–0.15)	
Cancer, major (381)	0.06	(0.03–0.08)	

CI = confidence interval.
*P values are based on nonparametric tests (Mann–Whitney and Kruskal–Wallis).
†Those with a cancer flag (960) do not equal those identified as "Cancer, minor" and "Cancer, major" (851) since the flag is based on the presurgical impression.
‡1 = most urgent.

larly for urological cancers.[7,16] As a result independent councils charged with monitoring the quality of health care and guiding change have emerged, but their work is unfortunately impeded by a lack of reliable and detailed data.[17,18] The study of wait times in particular is plagued in many instances by bias or incomplete information. A prospective analysis of wait time data by surgeons was completed at cancer centres in Ontario and found that response bias and noncompletion of data forms was a problem, as only 72% of surgeries were tracked.[19] Administrative data using detailed records still renders some patients with a paucity of information about care points despite rigorous retrospective study.[20] Both these methods of study do not consider the effect that prioritizing a program (such as cancer care) can have on the wait times for other surgeries.

Our evaluation of a real-time booking software to report on wait times is, to our knowledge, the first to consider other important and broad-ranging variables for analysis, such as type of surgery, benign versus cancerous indication, patient age and sex, admission postsurgery to hospital, urgency and cancellation data. Assessing wait times with this tool, we have confirmed a significant recent trend of prolonged wait times for urological diseases. Steady increases in surgical wait times have resulted in an average wait time of 56 days for cancer and 74 days for benign conditions. These progressively increasing wait times are concerning, especially for the cancer cases, and are longer than national and international recommendations[1–4] of 2–4 weeks for oncologic surgery.

Improving access to cancer surgery is one of the Wait Times Information Strategy's 5 priority programs,[21] yet the effect was not observed at our centre. Possible reasons for this phenomenon include an increase in the technical complexity of oncologic cases (e.g., laparoscopic partial nephrectomy v. open partial nephrectomy) leading to longer operative times for the same oncologic outcome, a relatively static distribution of surgery time for urological surgery at our centre, and a multifaceted issue of resource allocation for the operating room and ancillary services required, such as post-operative anesthesia unit access. Overall, the demographic shift upwards in age leads to the principle of increased demand for services without a concomitant increase in supply of surgical time.

Evaluation with this prospective, real-time

booking software has afforded significant insight into wait times. Our final model determined factors that appeared to decrease wait time, including surgeon's assessment of higher urgency, inpatient status and earlier year of surgery. Confirming results from other studies in universal health care systems,[22,23] it is apparent that significant triaging of patients occurs at our institution. Examination of the results stratified by the priority program (cancer surgery) displays a predilection for cancer cases to be performed ahead of benign indications. In fact, cancer status was undoubtedly factored into the urgency scoring of cases, and once urgency was accounted for, cancer status was no longer significant in multivariate analysis. Similar results were found for patient age, with younger patients triaged as more urgent cases.

The surgical time available to urological service did not change over time, but the absolute number of surgical cases did vary over the years of study. Although we detected a recent, and concerning, 9.8% cancellation rate, other variables such as the increase in technically advanced surgeries and changes in surgical personnel likely explain some of the variance in the case completion rate. However, the aging demographic in Ontario, as well as increasing detection and surgical management of many urological diseases has likely resulted in an increased demand and is a major factor in prolongation of wait times.

Our study does have limitations. It is retrospective (although the software was designed and implemented specifically to track wait times and data was entered prospectively), the pathological outcomes of patients stratified by wait time are not presented, and there are likely biases in data entry with regard to surgical decision to treat. However, the bias is likely to actually underestimate the wait time, as operative room paperwork is received by staff after the decision to treat is made. This implies that the date entered in the software program, if not entered as the correct date, would be 1 to a few days later. Furthermore, the summary measurement of surgical wait time from decision-making to surgery is limiting in the overall depiction of access to care issues.

The strength of our study is the detailed description of variables associated with prolonged surgical wait times for urological surgery. Despite government initiatives to decrease wait times for cancer surgery, our wait times for urological oncology have steadily increased. It is apparent from our local experience that simplistically applied financial incentives are not sufficient to decrease wait times without more detailed examination of the origins of prolonged surgical wait times on a departmental, institutional or regional basis. Furthermore, it is apparent from the triaging described in our study that there is a need to closely evaluate resource allocation to priority programs, ensuring that any effects on nonpriority surgery are minimized.

Conclusion

Our institution's real-time surgical booking software is an excellent tool for tracking surgical wait times and subsequently examining resource allocation. We recommend that health care units at the departmental, institutional and regional level require more of the detailed information collection afforded by real-time, prospectively collected data in order to improve the complex problem of prolonged surgical wait times in a universal health care system.

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Appendix 1. Classification of operative procedures (part 1 of 2)

Diagnostic procedures
- Diagnostic procedures can have cancer flag "yes"
- Diagnosis should not be "urolithiasis"

Minor
- Biopsy, bladder
- Biopsy, penis
- Biopsy, prostate needle
- Biopsy, renal
- Biopsy, testis
- Cystoscopy
- Cystoscopy laser lithotripsy
- Ureteroscopy
- Cystoscopy ureteroscopy, flexible/rigid
- Cystoscopy with retrogrades

Benign conditions
- Cancer flag must be "no," except for diagnostic procedures and resection, prostate transurethral

Major
- Bladder suspension, 4 corner
- Burch procedure
- Burch suspension, open
- Suspension, bladder neck
- Sling, pubovaginal

Minor
- Repair tension-free vaginal tape
- Vaginal wall sling

Bladder stone
  Minor
  - Cystolithopaxy
  Major
  - Cystolithotomy, open

Benign prostatic hyperplasia
  Minor
  - Resection, prostate transurethral
  - Cystoscopy insertion, UroLume (American Medical Systems, Inc.)
  Major
  - Prostatectomy, simple

Stricture disease
  Minor
  - Visual internal urethrotomy
  - Incision, bladder neck contracture
  - Resection, bladder neck transurethral
  - Cystoscopy urethral dilatation

Phimosis
  Minor
  - Circumcision
  - Dorsal slit

Kidney stone
  Major
  - Percutaneous laser lithotripsy
  - Nephrolithotomy, percutaneous
  - Percutaneous nephroscopy

Stone disease
  - For stone disease diagnosis should be "urolithiasis," otherwise procedure category should be "diagnostic" for the 4 codes below
  Minor
  - Cystoscopy laser lithotripsy
  - Ureteroscopy
  - Cystoscopy ureteroscopy, flexible/rigid
  - Cystoscopy with retrogrades

Continued on next page

Appendix 1. Classification of operative procedures (part 2 of 2)

Benign conditions cont'd
Elective procedures
  Minor
- Vasectomy
- Varicocelectomy, single

  Major
- Vasovasostomy

Scrotal surgery
  Minor
- Hydrocelectomy
- Spermatocelectomy
- Epididymectomy

Other
- If cancer flag is "no" and not diagnostic

Cancer operations
- Cancer flag must be "yes" for these to be cancer operations, i.e., nephrectomy may be for benign reason and therefore should be excluded

Bladder cancer
  Minor
- Resection, bladder tumour transurethral
- Resection, bladder tumour transurethral, recheck

  Major
- Cystectomy, radical
- Cystectomy with ileal conduit
- Cystectomy, partial

Testis cancer
  Minor
- Orchidectomy, unilateral
- Orchidectomy, radical

  Major
- Lymphadenectomy, retroperitoneal

Kidney cancer
  Major
- Nephrectomy
- Nephrectomy, laparoscopic
- Nephrectomy, partial
- Nephrectomy, radical

Upper tract transitional cell carcinoma
  Major
- Nephroureterectomy
- Nephroureterectomy, laparoscopic

Prostate cancer
  Major
- Prostatectomy, radical
- Prostatectomy, retropubic

Penile cancer
  Major
- Penectomy

"Other"
- If cancer flag is "yes," not categorized as diagnostic, and not in above list

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