The impact of the Ontario quality-based procedures funding model on radical prostatectomy outcomes

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ABSTRACT

Introduction: In 2015, radical prostatectomy (RP) in Ontario transitioned to the quality-based procedures (QBP) funding model, which assigns disbursement from surgical quality indicator (QI) outcome performance. The objective of this study was to assess the QBP QI outcomes before and after implementation of the QBP funding model for RP, and to determine whether changes seen were attributable to the QBP model.
Methods: We conducted a population-based, retrospective cohort study including all men who underwent RP for prostate cancer in Ontario from 2010–2019. We used administrative data from Ontario's health databases to gather surgical and QI outcome data. Our primary outcomes were the five measurable QBP QIs outlined by the province. We performed a pre- and post-intervention comparison, in addition to an interrupted-time series (ITS) analysis.
Results: Two of the five QIs improved after implementation of the QBP model (complication rate: 11.89% vs. 9.96%, p<0.001; proportion meeting length of stay target: 78.11% vs. 86.84%, p<0.001). ITS analysis revealed that there was no difference in trend in either outcome between pre- and post-implementation periods (p=0.913 and p=0.249, respectively). Two QIs were worse in the post-implementation period (unplanned visit rate: 23.45% vs. 25%, p=0.015; proportion meeting Wait 2 target: 94.39% vs. 92.88%, p<0.001). ITS revealed a significant trend changes post-implementation (p=0.260 and p=0.272, respectively). There was no difference in reoperation rate (2.84% vs. 2.45%, p=0.107).
Conclusions: The QBP model for RP corresponds with mixed QI changes, but further analysis suggests that these changes were pre-existing trends and not attributable to the model.

INTRODUCTION

Ontario's single payer healthcare system balances health outcomes against cost effectiveness as priorities in cancer care.[1] In 2012, Ontario began shifting away from traditional lump-sum payments to hospital and health groups, and instead towards an Activity-Based Funding (ABF) model for annual payment of various health services.[2] In tying health outcomes to funding share, the idea is that heath care teams may be further encouraged to deliver higher quality care. Unveiled as Ontario's Quality-Based Procedures (QBP) program, specific outcomes of interest named Quality-Indicators (QIs) for a range of surgical procedures are to be tracked by the province to measure performance that will determine funding share.[3]

While there is merit to the idea of such funding models improving outcomes, the evidence is not clear. Studies of these models has shown difficulties with implementation, and selection of QI outcomes that precisely reflect quality is controversial. This has led some to suggest that blended funding models are preferred.[4]

To date, Li et al. (2020) published the only study evaluating the efficacy of Ontario's QBP model. They employed an interrupted time series assessing the QBP funding model impact on its early targeted hospitalizations and procedures: pneumonia, hip fracture surgical repair, congestive heart failure, and prostate cancer surgery (radical prostatectomy).[5] Their study examined a range of conditions, so their outcomes were limited to length of stay, re-admission rate, and mortality. For radical prostatectomy, they found a worsening in length of stay, but no change in mortality or re-admission.

For radical prostatectomy (RP), the QBP was implemented in fiscal year (FY) 2015-2016 and highlights additional QIs not covered by Li et al. (2020). Additionally, patient and surgical factors that affect outcomes must be worked into any analysis before drawing conclusions on the QBP efficacy; patient age, obesity, surgeon volume, and surgical approach are some that have been described.[6–8] RP can be done via perineal approach (PRP), retropubic approach (RRP), laparoscopic approach (LRP), and robotic-assisted approach (RARP); each has its own expected length of stay and other outcome rates, and each approach has varied in popularity over the years. Thus, any comprehensive analysis of RP outcomes should account for these approaches. As some surgical centres will undoubtably lose funding share with the introduction of QBP, it is important that a comprehensive study assessing the impact of the QBP funding model on the outlined QI outcomes.

The purpose of this study was to examine the QBP QI outcomes pre- and post-implementation of the QBP funding model in FY 2015-2016 for RP, and to further characterize whether any changes were specifically attributable to the QBP funding model.

METHODS

Study design and data sources

We conducted a population-based retrospective cohort study including all men who underwent radical prostatectomy for prostate cancer in the province of Ontario, Canada (population approximately 14.4 million in 2018) from April 1, 2010 to March 31, 2019.[9] We excluded non-Ontario residents, men who were less than 18 or greater than 75 years old, did not have a confirmed diagnosis of prostate cancer within 5 years of surgery, had a non-urologist listed as surgeon, or who had a history of total or radical cystectomy, renal transplant, abdominal perineal resection or other bowel resection, any patient who had received pelvic radiation within the last 10 years, and if we were unable to identify a billing record associated with the procedure.

All Ontario residents have access to universal health care through the Ontario Health Insurance Plan (OHIP), with all insured services captured in administratively-linked databases. Patient demographic data was obtained using the Registered Persons Database (RPDB); comorbidity, patient characteristic, and initial cohort and complication data was obtained using the Discharge Abstract Database (DAD) and Same Day Surgery (SDS) databases; prostate cancer diagnosis was confirmed using Ontario Cancer Registry (OCR); surgeon data, reoperation data, obesity demographics, and identification of concurrent procedures was obtained using the OHIP database; pelvic radiation history was captured using the Cancer Activity Level Reporting database (ALR); some demographic data was gathered using three ICES derived cohort databases (ODD, HYPER, COPD). These datasets were linked using encoded identifiers and analyzed at ICES Western. ICES is a prescribed entity under section 45 of Ontario's Personal Health Information Protection Act. Consequently, informed consent and approval from a Research Ethics Board were not required for this study.

Outcome definitions

The QBP QIs that were measurable with our administrative databases were the outcomes of interest. This includes 30-day composite complication rate, 30- and 90-day mortality, 30-day re-operation rate, 30-day unplanned visit rate, proportion meeting Wait 2 target time, and proportion meeting length of stay target. Components and codes of the composite complication outcome are included in the appendices, and were chosen based on what comparable studies had included, and what was available to us. Wait 2 target time was approximated by the time between consultation with the surgeon and the surgery index date. The length of stay target time in Ontario is outlined in the QBP handbook; for perineal and retropubic approaches the target is 3 days, and for laparoscopic and robotic approaches the target is 2 days.

Baseline variables

Patient age, comorbidity information (including obesity with BMI ≥40, diabetes, hypertension, chronic obstructive pulmonary disease, and composite Charlson Index score), centre of surgery (academic vs community), neighbourhood income quintile, surgical approach, surgeon volume, and centre volume were obtained. The comorbidities were obtained using a lookback to the start of the derived datasets, and 3-year look back window for obesity. As BMI is not captured by administratively-linked datasets, we identified obesity using the OHIP obesity premium code for billing surgical procedures, where patients with BMI ≥40 qualify. For surgeon volume and centre volume, we identified thresholds for high and low volume surgeons and centres independently, as there is no standard threshold in the literature. To define high volume surgeons, we tallied each surgeon's case volume in each year, identified the number of cases required to define a 90th percentile case-volume surgeon in each year (range: 36-22 cases/year), and then chose the lower end of that range and applied it to all years to standardize the case threshold. This procedure preserved the original case volume data and ensured that some high-volume surgeons are not mischaracterized in the low volume group in some years. The same procedure was applied to define high volume centre (65 cases/year).

Analysis

We compared baseline characteristics for men who underwent RP either before or after the intervention using standardized differences (SD). For large cohorts, SDs have been shown to better reflect clinically important differences than p-values obtained by independent samples t-test.[10] With this method, we used SD ≥20% as a clinically meaningful indicator of between group difference, as differences up to this threshold are still considered to be small. To compare before and after implementation of the QBP funding model, we used a FY 2015-2016 as a one year implementation period, and compared baselines in the pre- (FY 2010-2015) and post-implementation (FY 2016-2019) periods. The purpose of defining an implementation period and excluding it from analysis is to account for the realities associated with overhauling a funding model, and the expectation that surgical centres will not adopt changes immediately. Baseline characteristics were compared using one-way ANOVA, Kruskal-Wallis, Chi-square, and Cochran-Armitage trend tests as appropriate. Outcomes were compared using unadjusted and adjusted logistic regression.

We expected that some of these outcomes may be trending towards improvement or worsening over time, independent of the implementation of the QBP funding model. To detect this, we designed an interrupted time series model for each outcome, comparing the trend in the pre- and post-implementation periods. We used monthly windows as our time measure, and monthly events for each outcome. As we expected no loss of generality (no anticipated causes for major fluctuation in the monthly outcomes), we selected a Poisson regression to compare the trend lines pre- and post-implementation.

RESULTS

Our initial cohort consisted of 24 099 subjects. After applying exclusions criteria, 2771 were excluded leaving us with a final cohort of 22 118 (**Error! Reference source not found.**). Of these, 12 922 were classified within the pre-intervention period, 2260 were in the implementation period, and 6936 were in the post-intervention period.

Baseline characteristics are shown in **Error! Reference source not found.**. Differences between pre- and post-intervention based on SD ≥0.2 were seen in age (mean 62.49 vs 63.29), Stage II disease (54.9% vs 43.2%), retropubic approach (71.7% vs 57.9%), and robotic approach (16.9% vs 34.0%).

The QBP QI outcomes are shown in **Error! Reference source not found.** with a between the comparison pre- and post-intervention periods. 30- and 90-day mortality were not included in the table, as the 30-day mortality in the post-intervention window was not reportable (small number). There was an overall 0.14% 30-day mortality in the entire study period, and no difference for 30-day or 90-day mortality between pre- and post-intervention (p=0.527 and p=0.500 respectively). There was a significant improvement for 30-day composite complication rate (11.89% vs 9.96%; OR 0.820, CI 0.746-0.902, p<0.001), and non-significant trend to improvement for 30-day re-operation rate (2.84% vs 2.45%; OR 0.860 CI 0.715-1.033; p=0.1074). The outcomes meeting statistical significance that worsened were 30-day unplanned visit rate (23.45% vs 25.00%; OR 1.088, CI 1.017-1.165; p=0.0147), and proportion meeting Wait 2 target (94.39% vs 92.88%; OR 0.775, CI 0.689-0.872; p< 0.001). Proportion meeting length of stay target (78.11% vs 86.84%; OR 1.849 CI 1.705-2.005; p< 0.001) was statistically significantly improved, and this was true when further sub-grouped by open approach (77.67% vs 84.5%; OR 1.567, CI 1.424-1.725; p< 0.001) and minimally-invasive approach (79.42% vs 90.55%; OR 2.482, CI 2.126-2.898; p<0.001). The mean length of stay also decreased (2.82 days [SD 2.03] vs 2.28 [SD 1.94]) by 0.54 days.

The interrupted time series analysis was completed for each of the QBP QIs and is shown in **Error! Reference source not found.**. The estimate slope change after intervention for each of the outcomes did not reach statistical significance: 30-day complication rate (p=0.913), 30-day re-operation rate (p=0.984), 30-day unplanned visit rate (p=0.260), proportion meeting Wait 2 target (p=0.272), proportion meeting LOS target (p=0.249). The interrupted time series data table is included in the Appendices.

DISCUSSION

This study demonstrated mixed effects on QBP QIs after implementation of the QBP funding model. The main finding of support was the improved 30-day complication rate, and improved proportion meeting LOS target. The latter was true even after accounting for surgical approach. However, there was a deleterious effect on 30-day unplanned visit rate, and proportion meeting Wait 2 time between pre- and post-implementation periods. Our interrupted time series analysis showed that for all the outcomes, none demonstrated a significant change in trend post-implementation of the QBP funding model. This could suggest that the differences seen in the 30-day complication rate, 30-day unplanned visit rate, proportion meeting the Wait 2 target, and proportion meeting LOS target over the study period may not be reflective of impact by the funding model, but rather longstanding trends related to other extraneous factors.

In contrast to our findings, Li et al. (2020) describe an increase in length of stay by 0.33 days in the post-intervention period, and found no significant difference in their 30-day unplanned visit rate outcome.[5] There are two important methodological differences that may explain the discrepant findings. Firstly, Li et al (2020) examined the mean length of stay, which is different than our outcome of proportion meeting length of stay target. The QBP QI of interest is in fact the proportion meeting target that will be used to determine performance, in order to account for surgical approach. Nevertheless, we identified that given the increasing adoption of RARP, the mean length of stay decreased – this remains in contrast with their findings. Secondly, their narrower window of evaluation (FY 2010-2017) shortened their post-intervention window; this exclusion of FY 2018-2019 diminishes the influence of RARP on the data given its adoption continues to rise in later years. Another working group evaluating trends in robotic surgery in Ontario published findings that there was a decrease in total and minor 90-day adverse event rate with RARP compared to open approaches, which would be consistent with our findings of a lower 30-day complication rate in the post-intervention period coinciding with double the proportion of robotic case load in that time period.[11]

Strengths and limitations

A strength of our study methodology is the use of an implementation window, as comparing outcomes after a pragmatic delay allows for a clearer detection of true differences that may exist. Our interrupted time series regression model also provided important context on the trend of changes to more accurately depict effects of the QBP model on outcomes.

One of this study's limitations is with regards to the shorter post-intervention time window. The 30-day re-operation rate trended towards statistical significance, but did not meet it, and perhaps it would have reached significance with a larger sample post-intervention. However, given that the trend in complication rate did not appreciably change post-intervention, it suggests that any change is less likely to be attributable to the new funding model. Our group has done a dedicated study examining the factors affecting 30-day complication rate that is being published separately and accounts for confounders and the nature of these complications.

Another limitation is related to our data sourcing, as administrative data is not collected for research purposes. As such, many complications are not easily captured. One example is urinary tract infections, which would be likely underestimated as our administrative databases would only identify those diagnosed in health or hospital facilities. Any that were found in the outpatient setting would not be identified, so the true complication rate is likely higher than our figures suggest. Nevertheless, since the data codes were consistent throughout the study period, and our study was comparing outcomes within the study period and over time, this is a smaller limitation.

Some outcomes are not precisely measured with administrative data either. For Wait 2 period (defined as the length between decision-to-operate date and surgery date), we cannot know the exact date that the decision was made, so we approximated it by using the first visit with the urologist who did the RP. Using this methodology, our Wait times were likely overestimated, and the real proportion meeting the target time is possibly even better than we measured. Re-operation rate was measured to include any surgery within 30 days of the procedure, so some unrelated procedures may have been included and our measurement may overestimate the real rate that patients experience. Future studies should utilize more recent data as it becomes available in order to create a larger post-intervention window. This was a nonmodifiable factor for our study, but would strengthen the findings if our methodology is repeated.

CONCLUSIONS

After implementation of the QBP funding model in Ontario, there has been an improved complication rate and post-operative length of stay for patients who have had a radical prostatectomy. There has been a concurrent small worsening in surgical wait time and patient volume who require re-admission or re-presentation to the emergency department within 30 days. However, further analyses in this study suggest that these were pre-existing trends that were not altered after implementation of the model. Future study should examine a longer post-intervention window of data to assess the effects of the funding model on 30-day complication rate and re-operation rate specifically, with strict adjustment for confounding factors.

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FIGURES AND TABLES

Figure 1. Interrupted time series comparison of pre- and post-intervention (A) 30-day composite complication rate; (B) 30-day re-operation rate; (C) 30-day unplanned visit rate; (D) proportion meeting Wait 2 target; and (E) proportion meeting length of stay (LOS) target. CI: confidence interval.

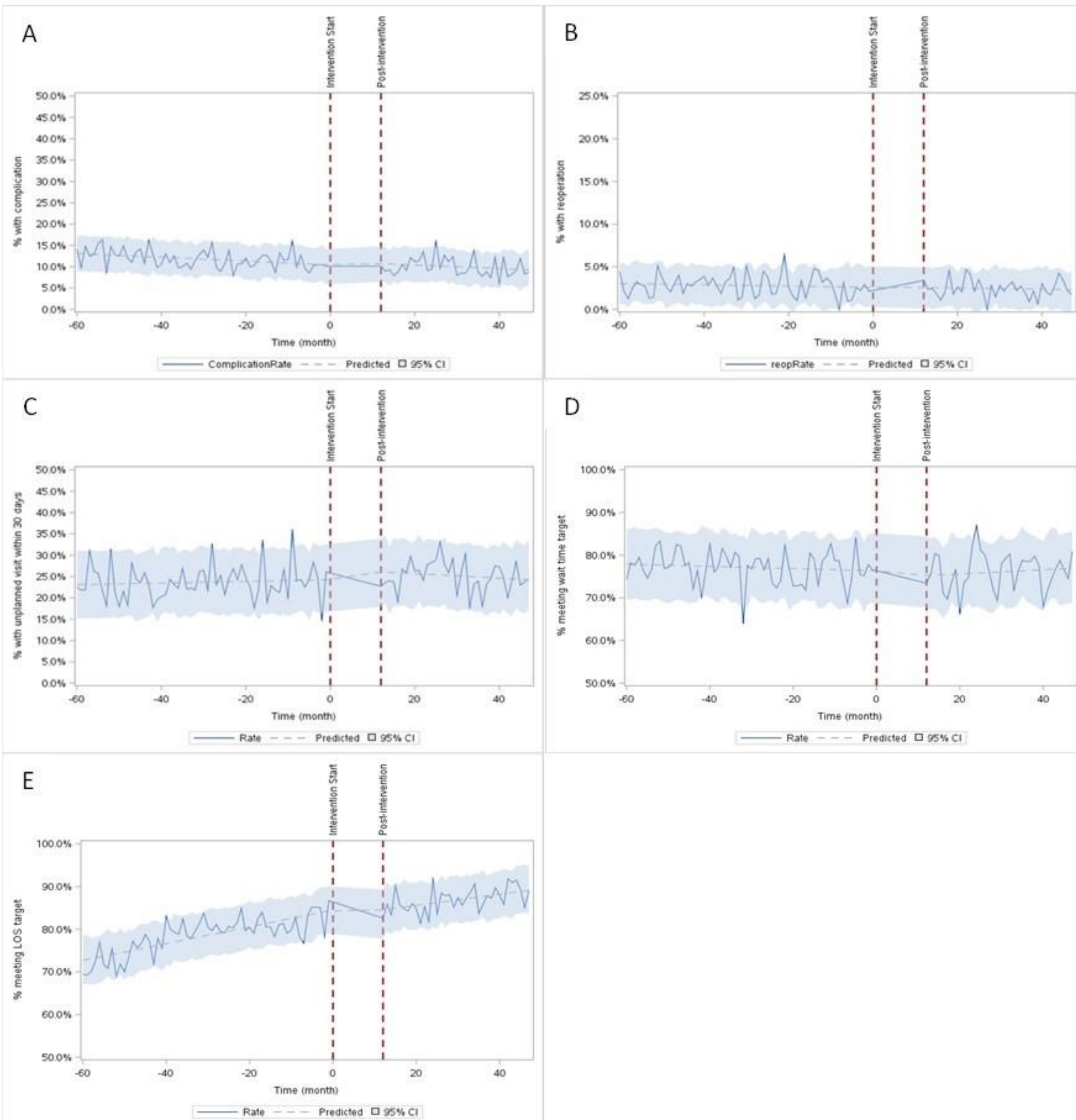

Table 1. Cohort build

Exclusion criteria	**Number excluded**	**Number included**
Initial Cohort	N/A	24 099
Data cleaning	15	24 084
Non-Ontario resident	6	24 078
Age <18 or >75 years	311	23 767
No cancer within 5 years of index	790	22 977
No matching OHIP record	1,366	22 401
Total/radical cystectomy	113	22 288
Pelvic radiation therapy	133	22 155
Renal transplant	7	22 148
Concurrent procedure/Not by a urologist	30	22 118
TOTAL	**2771**	**22 118**

Table 2. Baseline variables

Variable	**Value**	**Overall cohort**	**Pre-intervention period**	**Post-intervention period**	**Pre vs. post-intervention periods**
		FY 2010–2019 N=22 118	**FYs 2010–2015 n=12 922**	**FYs 2016–2019 n=6936**	**SD**
Age	Mean (SD)	62.49±6.44	62.04±6.45	63.29±6.29	0.2
	Median	63 (58–67)	63 (58–67)	64 (59–68)	0.19
Morbid obesity	Yes	2.0%	1.7%	2.2%	0.03
Diabetes	Yes	16.6%	16.0%	17.4%	0.04
Hypertension	Yes	52.1%	52.0%	52.0%	0
COPD	Yes	12.7%	12.1%	13.6%	0.04
Charlson comorbidity score	Mean (SD)	0.11±0.48	1.09±1.50	1.27±1.63	0.12
	Median	0 (0–0)	0 (0–2)	1 (0–2)	0.11
	0	94.8%	94.8%	95.0%	0.01
	1	1.2%	1.3%	0.9%	0.04

	2	2.6%	2.5%	2.7%	0.01
	≥3	1.4%	1.4%	1.4%	0
Center of surgery	Academic	44.1%	43.8%	44.6%	0.02
	Community	55.9%	56.2%	55.4%	0.02
Stage	1	8.8%	7.6%	10.7%	0.11
	2	50.4%	54.9%	43.2%	0.24
	3	31.5%	30.2%	34.2%	0.08
	4	3.7%	3.0%	4.6%	0.08
	Missing/ Unknown	5.6%	4.2%	7.4%	0.13
Income quintiles	Quintile 1	13.3%	13.3%	13.5%	0.01
	Quintile 2	18.2%	17.9%	18.7%	0.02
	Quintile 3	19.9%	19.6%	19.7%	0
	Quintile 4	22.3%	22.7%	21.8%	0.02
	Quintile 5	26.1%	26.4%	26.0%	0.01
	Missing	0.2%	0.3%	0.2%	0.02
Surgical approach	Open perineal	3.3%	3.3%	3.5%	0.01
	Retropubic	66.3%	71.7%	57.9%	0.29
	Laparoscopic	6.7%	8.1%	4.6%	0.15
	Robotic	23.7%	16.9%	34.0%	0.4
Surgeon volume	Mean (SD)	39.99 ± 40.63	38.80 ± 35.77	41.52 ± 46.41	0.07
	Median (IQR)	22 (13-52)	23 (14-54)	21 (12-52)	0.07
	High volume	52.0%	54.1%	49.1%	0.1
Institution volume	Mean (SD)	106.42 ± 86.52	104.60 ± 84.25	108.99 ± 88.70	0.05
	Median (IQR)	65 (38-183)	70 (40-173)	62 (36-199)	0.03
	High volume	49.8%	51.8%	48.8%	0.06

Table 3. QBP QI outcomes comparison pre- and post-intervention

Outcome	**Overall**	**Pre-intervention**	**Post-intervention**	**Pre- vs. post-intervention**	
		FYs 2010–2015	**FYs 2016–2018**	**Odds ratio (95% CI)**	**p**
		n=12 922	**n=,936**		
Composite complication rate	10.57%	11.89%	9.96%	0.820 (0.746–0.902)	<0.001
30-day reoperation rate	2.69%	2.84%	2.45%	0.860 (0.715–1.033)	0.1074
30-day unplanned visit rate	23.80%	23.45%	25.00%	1.088 (1.017–1.165)	0.0147
Proportion meeting Wait 2 target	93.76%	94.39%	92.88%	0.775 (0.689–0.872)	<0.001
Proportion meeting length of stay target	81.53%	78.11%	86.84%	1.849 (1.705–2.005)	<0.001
Open approach	80.16%	77.67%	84.5%	1.567 (1.424–1.725)	<0.001
Minimally invasive approach	84.68%	79.42%	90.55%	2.482 (2.126–2.898)	<0.001

CI: confidence interval.