Wait Times in a Bariatric Surgery Program: A Retrospective Review and Analysis of Operational Factors

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Conception and design: Diamant, Milner, Sockalingam, Okrainec, Jackson, Quereshy. Acquisition of data: Diamant, Quereshy. Analysis and interpretation of data: Diamant, Milner, Cleghorn, Quereshy. Drafting of the manuscript: Diamant, Cleghorn. Critical revision of the manuscript for important intellectual content: Milner, Sockalingam, Okrainec, Jackson, Quereshy. All authors approved the final version of the manuscript to be published, and agreed to act as guarantors of the work.

Previous Presentation: This research has not been previously published; however preliminary results were presented at the INFORMS Annual Meeting in 2013.

Funding: This study was funded by the Ontario Academic Health Science Centres Innovation Fund. The funder had no involvement in the study or its publication.

Conflicts of Interest: Diamant has nothing to disclose. Dr. Milner has nothing to disclose. Cleghorn has nothing to disclose. Dr. Sockalingam has nothing to disclose. Dr. Jackson has nothing to disclose. Dr. Okrainec reports grants from Covidien, personal fees from Covidien, outside the submitted work. Dr. Quereshy reports grants from Ontario Ministry of Health and Long-Term Care, during the conduct of the study.

Word Count: 2400

Abstract

Background: Increasing rates of obesity has led to growing demand for bariatric surgery. This has implications for wait times, particularly in publicly-funded programs. This study examines the impact of patient and operational factors on wait times in a multidisciplinary bariatric surgery program.

Methods: A retrospective study of 1682 patients referred to a large tertiary care centre for bariatric surgery between June 2008 and July 2011 was conducted. Patient characteristics, dates of clinical assessments, and records describing operational changes were collected. Univariable analysis and multivariable log-linear and parametric time-to-event regressions were performed to determine whether patient and operational covariates are associated with the wait time for bariatric surgery (i.e. length of preoperative evaluation).

Results: Patients with active substance use (β=0.3482, p=0.024), and individuals who entered the program in more recent operational periods (β=0.2028, p<0.001), were shown to have longer wait times in both a univariable and multivariable analysis. Additionally, the median time-to-surgery has increased over three discrete operational periods (characterized by specific programmatic changes relating to scheduling and staffing levels, as well as varying referral rates and defined surgical targets); p<0.001.

Interpretation: This study demonstrates that certain patients that can be identified at referral are at risk for longer wait times. We also find that previous operational decisions have significantly increased the wait time in the program since its inception. Careful consideration must be devoted

to process-level decision-making for multi-stage bariatric surgical programs, as managerial and procedural changes can affect timely access to treatment.

Introduction

Obesity is a global epidemic that places substantial burden on individuals and healthcare systems. In Canada, the public health agency reports that nearly a quarter of Canadians are obese (body mass index [BMI] > 30 kg/m^2) at a direct cost of up to $7.1 billion per year.[1] In the United States, more than one-third of all adults are obese, an increase of over 10% since 1999,[2] and as much as $147 billion in annual medical spending (10% of all medical expenditures) can be attributed to obesity[3]. It is projected that by 2030, there will be 65 million more obese adults in the United States, increasing health spending by $48–66 billion per year.[4] Obesity is associated with a reduction in quality of life and decreased life expectancy,[5,6] and is linked to an increased incidence of diseases such as coronary heart disease,[7,8] diabetes,[9,10] and certain types of cancers[11].

Given the effectiveness of bariatric surgery for severe obesity[12,13] and rising demand for surgical intervention, in 2009, the Ontario Ministry of Health and Long-Term Care invested $75 million to increase the number of surgeries performed in the province from 244 to 1,470 per year by 2012.[14] Four "Bariatric Centres of Excellence" were established that deliver care based on a multidisciplinary, multi-stage pre-surgical assessment process in order to appropriately identify suitable candidates for surgery.[15] However, this model of care has led to prolonged preoperative evaluation, resulting in wait times that far exceed the provincially-mandated target of 365 days from referral to surgery. In contrast to previous survey-based research on wait times for bariatric surgery,[16-18] this study quantifies how patient characteristics and operational factors contribute to excessive wait times in a large bariatric surgery program. Operational factors may include

administrative decisions relating to scheduling, staffing levels, and available resources, in addition to varying referral rates and defined surgical targets.

Methods

Study Design, Setting and Participants

This study was a retrospective review of 1682 patients referred for bariatric surgery at a large tertiary care centre in Toronto, Ontario between June 1, 2008 and July 31, 2011. As a multidisciplinary, multi-stage program, the preoperative evaluation includes medical, dietary, and psychological assessments, as well as a social work and surgical consultation before patients are eligible for surgery.[15] All referred individuals had a BMI > 40 kg/m^2 or BMI > 35 kg/m^2 with at least one obesity-related comorbidity. All patients in the study underwent bariatric surgery or withdrew from the program by August 2013.

Operational Periods

Several procedural changes took place during the study period. We distinguished between three operational periods, characterized by four managerial and administrative changes (related to staffing levels, referral rate, surgical target, and internal procedures), since many of these interventions occurred at once. The first period corresponds to early program performance (baseline levels), while the third period represents the most recent operational landscape.

In each period since the program's inception, staffing levels and the physical space reserved for assessments increased. The referral rate, which represents the average number of weekly

referrals by primary care physicians, increased in Period 2 as compared to Period 1, but remained fixed in Period 3. The surgical target represents the maximum allowable number of surgeries that can be performed annually as set by the provincial government. This target increased from 180 surgeries in Period 1 to 300 surgeries in Period 2, although it was decreased to 270 surgeries in Period 3. Finally, two internal procedures underwent transition during the study period. First, appointment scheduling in Period 2 began to include patients who had surgery and required on-going follow-up. Second, in Period 3, a formal removal process was initiated for patients who failed to attend three scheduled assessments.

Data Collection & Outcome Measures

Patient characteristics (height, weight, BMI) including demographic information (age, gender, postal code), possible exclusion criteria for surgery (substance use including smoking, alcohol, and drug use), and the dates of each assessment including surgery were collected from the referral document and electronic patient records. Data were linked to operational records describing procedural changes. The referral dates for 5 patients and the physical charts for 13 patients were missing, and therefore they were excluded from the analysis.

The primary outcome was the overall wait time for bariatric surgery. This includes patients who completed all preoperative assessments and underwent bariatric surgery. We also examined the total wait time given a patient attended an orientation session, therefore focusing on patients who demonstrated a willingness to participate in the program. Patients who attended orientation but did not undergo surgery were censored as of their last appointment date.

Statistical Analysis

Data analysis was performed using the R programming environment.[19] A random forest technique was used to impute missing data.[20] Baseline patient characteristics were compared using Mann-Whitney U or Kruskal-Wallis test, where appropriate. Multivariable regression was used to determine the association between patient and operational covariates and total wait time for: i) all patients who reached bariatric surgery (log-linear model), and ii) all patients who attended orientation but who did not necessarily undergo surgery (parametric time-to-event model). Departures from linearity were assessed by plotting a locally weighted scatter plot curve through the martingale residuals. The appropriateness of the regression models were tested by performing a global validation of model assumptions, a variance inflation test for multicollinearity, a Breusch-Pagan test for heteroskedasticity, and a Q-Q plot of the residuals for normality. A 95% confidence interval was used to assess statistical significance.

The study protocol was approved by the institutional Research Ethics Board.

Results

Univariable Analysis

Of the 1664 patients included in the study, 724 underwent surgery with a mean and median wait time of 440 (SD = 198) and 445 days, respectively. Wait times ranged from 3 months to 4 years. The majority of referred patients (74%) and those who reached surgery (81%) were female. The average age at referral was 48 years (SD = 11.3), and few patients were referred with active substance use (42). The median patient distance to the hospital was 48.2 km (range 1 – 550 km).

The referral BMI of 83 patients was missing, and we employed a non-parametric multiple imputation procedure to estimate the appropriate values. The out-of-bag error estimate was 3.6%.

In Table 1, we report several univariable comparisons of the wait time for surgery based on patient characteristics and operational period. We found no difference in the length of the preoperative assessment among patients based on age ($\chi^2 = 3.148$, df = 3, p = 0.101), BMI ($\chi^2 = 6.538$, df = 4, p = 0.162), and distance from the hospital ($\chi^2 = 6.256$, df = 6, p = 0.395). However, subsequent analysis indicated that the median distance to hospital for patients who attended multiple assessments in one day was 30 km farther than the distance for patients who did not have such assessment schedules (W = 36780.6, $p < 0.001$). Males (W = 36433.5, p = 0.039), individuals with active substance use (W = 1596.5, p = 0.009), and patients who attended an orientation session in Period 2 (W = 44809, $p < 0.001$), experienced a longer overall wait time. Patients who had surgery in Period 3 spent more time in the program than in any other period ($\chi^2 = 160.8$, df = 2, $p < 0.001$).

Multivariable Analysis

The results of a log-linear regression of wait time on covariates known at referral are presented in Table 2. Only patients who underwent bariatric surgery were included in this analysis. Patients with active substance use ($\beta = 0.3482$, p = 0.024), and individuals who attended orientation in Period 2 ($\beta = 0.2028$, $p < 0.001$), spent more time in the program. A multivariable time-to-event regression for patients who attended an orientation session is presented in Table 3. Again, patients with active substance use ($\beta = 1.489$, p = 0.024), and individuals who attended orientation in Period 2 ($\beta = 1.279$, $p < 0.001$), spent more time in the program.

Additional multivariable analysis using power-transformed regression was conducted to explore how covariates affected the wait time between two contiguous preoperative asessments. Several regression models were estimated, and while they are not presented here, they confirm the results presented above. Specifically, active substance use and operational period were statistically significant in all models. Wait times increased with operational period and showed a worsening trend. Additionally, the time between referral and orientation was slightly reduced for males and older patients, while inter-station time increased with the logarithm of distance from the hospital in the early stages of the program only.

The wait time between specific assessment stations is presented in Table 4. The highlighted cells represent the expected sequence of appointments as determined by program directors. Although this is the modal pathway, many patients deviated from this sequence of care.

Interpretation

This study serves to understand barriers to care by quantitatively examining patient and operational factors that contribute to excessive wait times in a publicly-funded bariatric surgery program. We show that specific patient profiles and programmatic changes are associated with longer wait times. Patients spent on average 75 days longer in the program than the government-mandated target (365 days) for bariatric surgery. While 46% of that time was spent between referral and orientation, 71% of all patient transitions between assessments took longer than 30 days.

Substance use was associated with longer preoperative evaluation and was shown to independently predict overall wait time. This may be explained by the three-month abstinence requirement before patients can attend further preoperative assessments, or the six-month abstinence requirement before patients can have surgery. Despite active substance use being an exclusion criterion for referral, more stringent practices may need to be adopted that would allow programs to refuse admittance to patients with uncontrolled substance dependencies. This would help relieve system congestion and potentially reduce the wait time for patients identified as ideal surgical candidates. However, restrictions at the provincial level may limit the autonomy programs and individual providers have in deciding which patients should not be considered for surgery based on efficacy and safety concerns.

Living farther away from the bariatric centre did not lead to increased overall wait times for individual patients. Although distance may affect the time between appointments (inter-station time), patients who live far from the hospital tend to cluster their appointments (i.e., schedule multiple assessments consecutively on a single day) and make fewer trips. This finding is supported by current evidence which indicates that distance is not a barrier to care in this setting.[21]

Operational period, as characterized by specific managerial and procedural changes, influenced wait times. Patients who had surgery in Period 3 spent more time in the program than in any other period. This suggests that process-level decision-making that guided operational practices were insufficient at coping with increases in demand. Specifically, during Period 3, the number

of available weekly appointments reached maximum capacity, and patients who had already underwent bariatric surgery were being scheduled for post-surgical follow-ups at several assessment stations. As a result, as the number of surgeries increased, so too did the number of patients needing follow-up appointments, and therefore increasing numbers of pre-surgical patients met with a smaller pool of appointment openings. This operational roadblock may explain why the surgical target was not met in Period 2 despite an increase in the referral rate, and why the Ministry of Health lowered the target in Period 3. Finally, changes in internal operating procedures, specifically initiation of a formal removal process for no-show patients, may have also contributed to poorer operational performance.

Our analysis has revealed three areas of improvement. First, certain patients (e.g. males) should be identified early on, and program administrators may want to develop customized care plans that address their specific needs. Second, the current exclusion criteria for surgery may be too lenient, in particular those criteria that relate to substance use. Patients presenting with substance use spend more time in the program, and since they are less likely to undergo bariatric surgery,[21] should be identified at the time of referral. This would facilitate earlier behavioural modification (e.g. smoking cessation), and delay premature entry into an already resource-constrained system. Third, previous operational interventions have been inefficient at decreasing wait times. Given that the program receives limited funding, novel scheduling techniques need to be introduced. For instance, preferential scheduling practices could be used to prioritize patients at low-risk for long wait times and non-completion. These patients would be fast-tracked through the program while more resources are directed towards patients requiring intensive evaluation. We are currently investigating how to dynamically schedule patients to assessments in order to increase

healthcare provider utilization, as well as the optimal proportion of new versus follow-up appointment slots to reserve. Other interventions can also be implemented to improve performance, such as group assessments,[22,23] and enhanced triaging of patients. For instance, if relevant medical and psychosocial information is collected at referral, patients can be directed to assessments that best address any potential clinical issues early in their sequence of care. Better triaging enables early treatment, interventions, and relevant diagnostic tests (e.g. blood work, sleep study) to be performed even while patients undergo other assessments. This would decrease the time spent waiting later in the program when patients are closer to surgery, and could also reduce late patient attrition.

This study represents the experience of a Canadian institution and a bariatric program operating within a public funding model. It was limited to retrospective data, and does not take into account information that was learned by providers at pre-surgical assessments. It has implications for other types of multidisciplinary programs across different clinical specialities that involve longitudinal assessment of patients in a complex system (e.g. transplant and oncology), although direct application of these findings may be limited.

This study expands current understanding of wait times in multidisciplinary, multi-stage outpatient centres. To date, this is the largest series exploring predictors of wait times in a bariatric surgery program. We found that the time patients spent in the program did not depend on BMI, and was generally insensitive to age, gender, and distance from the bariatric centre. However, active substance use was associated with longer wait times on multivariable analysis. We also show that process-level changes are associated with worsening wait times: that is, since

the program was established, the wait time has steadily increased despite several operational interventions. This is a problematic trend that could impact timely patient access to treatment. Future research will identify triaging techniques and scheduling practices that improve wait times within this unique clinical setting.

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Table 1. Univariable, non-parametric statistical testing of differences in time-to-surgery.[a] Only patients who reached bariatric surgery were included in the analysis (n = 724).

		Median Time-to-Surgery	*p*-value
Gender	Male	446	-
	Female	409	0.039*
Substance Use	Yes	557	-
	No	413	0.009*
BMI (kg/m^2)	35−39	418	-
	40−49	412	-
	50−59	414	-
	60+	444	0.101
Age (years)	19−29	414	-
	30−39	404	-
	40−49	410	-
	50−59	415	-
	60+	473	0.162
Distance (km)	0−25	405	-
	25−50	417	-
	50−100	422	-
	100−200	438	-
	200−300	398	-
	300−400	450	-
	400−500	418	-
	500+	474	0.395
Orientation Period	1	369	-
	2	432	< 0.001*
Surgical Period	1	373	-
	2	381	-
	3	608	< 0.001*

BMI, body mass index

[a] The Mann-Whitney U test (Kruskal-Wallis test) was used to determine whether two (three or more) populations spent a similar amount of time in the program.

* $p < 0.05$ was considered statistically significant.

Table 2. Multivariable analysis of differences in wait time for patients who reached bariatric surgery (n = 724).[a]

Covariates[b]	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	5.8133	0.0904	64.32	0.0000
Substance Use	0.3482	0.1534	2.27	0.0235*
Age	-0.0001	0.0016	-0.08	0.9354
BMI (kg/m^2)				
(40–49)	-0.0363	0.0600	-0.60	0.5457
(50–59)	-0.0063	0.0653	-0.10	0.9228
(60+)	-0.0049	0.0795	-0.06	0.9512
Male	0.0643	0.0436	1.47	0.1408
Log(Distance)	0.0109	0.0122	0.89	0.3724
Orientation Period 2	0.2028	0.0373	5.44	<0.001*

BMI, body mass index

[a] Log-linear regression.

[b] Baseline covariate values: females, no substance use, 19 years of age, BMI between 35–39 kg/m^2, live within a few kilometres of the bariatric centre, and attended orientation in Period 1.

* $p < 0.05$ was considered statistically significant.

Table 3. Multivariable analysis of differences in wait time for patients who attended orientation (n = 1385).[a]

		Estimate	2.5 % CI	97.5 % CI	Pr(>|t|)
Distribution Parameters	Mean	421.55	359.54	494.25	<0.001
	SD	1.612	1.575	1.651	0.002
Covariates[b]	Substance Use	1.489	1.144	1.937	0.024*
	Age	1.001	0.998	1.004	0.818
	BMI (kg/m^2)				
	(40–49)	0.927	0.834	1.030	0.053
	(50–59)	0.953	0.849	1.070	0.272
	(60+)	0.931	0.808	1.073	0.058
	Male	1.086	1.005	1.175	0.079
	Log(Distance)	0.983	0.962	1.050	0.071
	Orientation Period 2	1.279	1.194	1.370	<0.001*

BMI, body mass index; CI, confidence interval; SD, standard deviation

[a] Parametric time-to-event regression with log-normal hazards. Dependent variable is time-to-surgery. Patients who did not undergo bariatric surgery are censored at their last assessment date. Patients who did not attend orientation were excluded from the analysis.

[b] Baseline covariate values: females, no substance use, 19 years of age, BMI between 35–39 kg/m^2, live within a few kilometres of the bariatric centre, and attended orientation in Period 1.

* $p < 0.05$ was considered statistically significant.

Table 4. Mean (median) inter-station wait time (in days) for observed station transitions. Highlighted cells represent the standard path through the program.[a]

From\To	Orientation	Nursing	Social Work	Nutrition	Psychology	Surgical Consult	Surgery
Referral	203 (208)	-	-	-	-	-	-
Orientation	-	49 (33)	43 (18)	59 (5)	-	-	-
Nursing	-	-	19 (0)	19 (2)	24 (16)	50 (38)	-
Social Work	-	23 (13)	-	43 (30)	32 (20)	32 (24)	-
Nutrition	-	42 (35)	37 (28)	-	22 (10)	65 (43)	-
Psychology	-	18 (14)	47 (19)	45 (19)	-	61 (32)	68 (53)
Surgical Consult	-	-	52 (32)	61 (32)	40 (42)	-	66 (48)

[a] After referral, a patient proceeds through a series of preoperative assessments before undergoing bariatric surgery.