Postoperative Health Services Use Before and After Implementation of a Provincial Bariatric Surgery Program in Ontario, Canada

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BACKGROUND: In 2009, the Ontario Bariatric Network (OBN) was established to address the exploding demand for bariatric surgery services funded outside Canada. The impact of outsourcing bariatric surgery, which can lack appropriate follow-up, remains unexplored. Our study objective was to compare postoperative hospital services use among Ontario residents who received bariatric surgery before and after implementation of the OBN.

METHODS: A population-based, before-and-after study using administrative data held at the Institute for Clinical Evaluative Sciences was conducted. All Ontario residents who underwent funded, first-time bariatric surgery were included in the study. Patients who received bariatric surgery within the 3-year period after (2010-2012) establishment of the OBN were compared to patients before (2007-2009). The primary outcome was hospital services use in Ontario within one year following surgery.

RESULTS: A total of 5,617 and 6,896 patients received bariatric surgery before and after the OBN, respectively. After adjustment, implementation of the OBN was associated with fewer postoperative hospital services (rate ratio [RR] 0.83, 95% CI 0.78 to 0.89, P<0.001), less intensive care (RR 0.53, 95% CI 0.35 to 0.81, P=0.003) and lower 1-year mortality (odds ratio [OR] 0.44, 95% CI 0.23 to 0.82, P=0.01). No statistically significant differences were found in hospitalization or reoperation rates. The physician assessment rate was significantly higher after the OBN (RR 3.50, 95% CI 3.19 to 3.84, P<0.001).

CONCLUSION: The implementation of a comprehensive and multidisciplinary provincial program to replace outsourcing bariatric surgical services was associated with

less postoperative hospital services use for Ontario residents undergoing bariatric surgery.

INTRODUCTION

The demand for weight loss procedures has grown significantly in recent years. In the late 1980's, there were 5,000 bariatric procedures performed worldwide, however this number grew to 350,000 by 2009 with 63% of the procedures performed in North America.[1, 2] Before 2009, bariatric surgery was not a widely available service in Canada, despite its growing popularity worldwide. Canadian hospitals are typically funded by global budgets and clinical programs such as bariatric surgery—that require additional hospital resources like new multidisciplinary allied health teams and purchase of new capital equipment—rarely gain traction unless they are supported by incremental revenue streams. The average wait period for bariatric surgery was close to five years, among the longest of any surgically treated condition in Canada.[3] As a result, Canadians began turning to private centres offering uninsured procedures or travelling out-of-country (OOC) for treatment as medical tourists.[4]

Initially, the Ontario Ministry of Health and Long-Term Care (MOHLTC), which funds health services in Ontario, denied coverage for OOC bariatric services since bariatric operations such as the Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) were insured, publicly-available health services in Ontario.[5] However, patients appealed successfully to the Ontario Health Services Appeal and Review Board, claiming that the long wait time for bariatric surgery made it functionally inaccessible.[6] As a result, the Ontario MOHLTC classified bariatric surgery as an eligible OOC Health Service in 2005 and established contracts with bariatric centres across the United States for OOC referrals.[7] Within a few years, over 1,660 OOC applications for bariatric surgery were granted annually, at a cost of over 50 million dollars.[8] The increasing cost

of OOC services and perceptions that follow-up care was poor, prompted the MOHLTC to create the Ontario Bariatric Network (OBN)—a network of Centers of Excellence for bariatric surgery in Ontario—in 2009.[8]

Before the existence of the OBN, there was minimal surgical, medical, dietary or psychological supervision for Ontario residents who received bariatric surgery in the United States.[5] The lack of follow-up care could have delayed the diagnosis and treatment of postoperative complications, leading to unnecessary hospitalizations or emergency room visits. We sought to evaluate the impact of the OBN on postoperative hospital services utilization and clinical outcomes among Ontario residents who received bariatric surgery.

METHODS

Study Design and Setting

We conducted a retrospective, before-and-after study using administrative data held at the Institute for Clinical Evaluate Sciences (ICES) in Ontario, Canada. The study population consisted of Ontario residents who received a bariatric surgical procedure funded by the MOHLTC between January 1, 2007 and July 31, 2012. We compared the one-year postoperative health services utilization during two 3-year periods, before and after establishment of the OBN.

Data Sources

Data sources included the following: Ministry of Health and Long-term Care Out-of-Country Service (MOHLTC-OOC) database; Ontario Health Insurance Plan (OHIP) physician claims database; Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD); National Ambulatory Care Reporting System (NACRS); and Registered Persons Database (RPDB). The MOHLTC-OOC database collected data on type, date and location of surgery for all Ontario residents who received OOC bariatric surgery funded by MOHLTC. The OHIP database provided details on all claims paid by OHIP to physicians including physician assessments, critical care services, and operative procedures. The CIHI-DAD contained information on the dates of hospitalizations and length of stay at acute care facilities in Ontario for all residents. The NACRS database captured information on emergency department visits and the RPDB provided demographic and vital status information on Ontario health cardholders.

Implementation of the Ontario Bariatric Network

The Ontario Bariatric Network was established on April 1, 2009. The program defined eligibility criteria for bariatric surgery, established surgical and perioperative care standards, and centralized referrals to one of four provincial Bariatric Centers of Excellence (COEs). This program provided a chronic disease management model suitable for bariatric patients by recognizing the complexity and multidisciplinary issues surrounding obesity and its comorbidities.[9] Once established, the province effectively stopped funding patients to receive OOC bariatric surgery.

Patient Selection

OOC surgery recipients were identified using the MOHLTC-OOC database and in-province recipients were identified using specific OHIP fee codes for bariatric surgery (RYGB or SG). For patients with more than one bariatric procedure during the study period, only the first operation was selected. Patients who underwent private or uninsured bariatric procedures were not included. Cohort selection was based on the date of surgery. To determine an estimate of the program's effect, patients in the three years after program implementation (2010 to 2012) were compared to the patients in the prior three years (2007-2009). Although, the OBN was established on April 1st, 2009, OBN-funded procedures did not start until January 1st, 2010.[8] The follow-up period for each patient started from the discharge date of the principal operation and ended 365 days after the date of surgery. The discharge date was unavailable for OOC surgery patients because we lacked records for hospitalizations occurring outside Ontario. The follow-up period for OOC patients therefore started at the time of return to Ontario, ensuring that the effective follow-up time was similar for both groups.

Outcome Measures

The primary outcome of our study was the number of days where Ontario hospital services were used, which was a composite count of the number of emergency room visits and the total number of days admitted to hospital. Secondary outcomes included the number of days requiring care in an intensive care unit (ICU) and ventilatory support, as measured using per diem physician fee codes for critical care and ventilatory care.[10] All primary care physician or specialist assessments were identified based on physician

billing codes. Postoperative reoperations were identified using procedure fee codes for abscess drainage, bowel obstruction, bowel resection, and feeding tube placement. We also measured death within 30 days and one year of surgery.

Statistical Analysis

We compared the baseline patient characteristics between the two cohorts using t-tests and chi-square tests as appropriate. Negative binomial (NB) regression was used to estimate the effect of the OBN on the rate of health services use after adjusting for potentially confounding variables. Logistic regression was used to estimate the effect of the OBN on 30-day and 1-year mortality after accounting for baseline covariates. Models included the following independent variables: age, sex, household income quintile in neighborhood of residence (an ecologic measure of socioeconomic status), rurality (rural vs. urban residence), type of bariatric procedure (RYGB vs. other), and the Johns Hopkins Adjusted Clinical Groups (ACG) comorbidity score.[11, 12] All variables were chosen *a priori* based on clinical relevance. No evidence of multicollinearity was detected based on a variance inflation factor threshold of four.[13] Although, there were a high number of zero counts in our outcome data, the assumptions of model fit were satisfied using a conventional NB model with no improvement in model fit using a zero-inflated NB model. Negative binomial regression results were presented as rate ratios (RR) and logistic regression results as odds ratios (OR) with corresponding 95% confidence intervals (CI). P-values less than 0.05 were considered statistically significant. A sensitivity analysis was also performed using only in-province hospitals outside the OBN to compare one-year postoperative health services utilization before and after 2010. Analyses were conducted using SAS v9.3 for UNIX (SAS Institute Inc, Cary, NC). The

study protocol was approved by the research ethics board of Sunnybrook Health Sciences Centre, University Health Network and the University of Toronto.

RESULTS

Patient Population

Overall, 5,617 and 6,896 patients had surgery before and after implementation of the OBN, respectively. The groups were generally comparable with respect to demographic and clinical characteristics (Table 1). There were small but statistically significant differences in age and rurality. Furthermore, difference in ACG comorbidity score was statistically significant but the histogram distribution of scores was quite similar (data not shown). Women made up approximately 82% of the patient population. More than 80% of patients in both groups resided in an urban location at the time of surgery. In addition, the distribution of neighbourhood income quintile was similar across groups. The proportion of RYGB operations was lower after the OBN was implemented (93.1% vs. 95.8%, P<.001). Before program implementation, 78.1% of bariatric surgery was performed OOC with approval by Ontario's MOH. All OOC surgeries were preformed in the United States. OOC surgery dropped to only 6.8% after program implementation and likely represented patients already accepted for OOC services.

There was a sharp decline in OOC cases after the implementation of the OBN in 2009, associated with a corresponding increase in cases performed at OBN centres (Figure 1). The very small number of bariatric cases performed in Ontario hospitals outside the OBN remained unchanged throughout the study period.

Health Services Utilization and Mortality

The proportion of patients who required at least one day of hospital services before the OBN was 54.0% compared to 50.1% after the OBN (P=0.001) (Table 2). The proportion of patients requiring at least one postoperative hospitalization before and after the OBN was 26.8% and 28.4%, respectively (P=0.01). The mean number of days spent in hospital during the year after surgery was 9.3 days before and 6.8 days after (mean difference 2.5 days, 95% CI 1.2 to 3.8). In both groups, just over 2% of patients were admitted to an ICU and approximately 1% required ventilator support. However, the mean number of days in the ICU among persons requiring an ICU stay was 11.1 before and 4.4 after (mean difference 6.7 days, 95% CI 3.1 to 10.3). While 7.6% of patients before the OBN underwent a physician assessment within one year following surgery, 32.2% of patients were assessed after the OBN was in place (P<.001). There was no statistical difference in 30-day mortality (0.2% vs. 0.1%, P=0.36), but the 1-year mortality was 0.5% and 0.2% in the before and after group, respectively (P=0.03).

The adjusted risk of hospital services use was 0.83 (95% CI 0.78 to 0.89; P <.001) after program implementation, representing a 17% reduction in the rate of hospital services (Table 3). There was also a significant decrease in the adjusted mean number of days admitted to an ICU (RR 0.53, 95% CI 0.35 to 0.81; P=0.003) and on ventilator support (RR 0.37, 95% CI 0.19 to 0.71; P=0.003). There was no statistical difference in the rate of hospitalization or reoperation. The rate of physician assessments was almost 3.5 times higher after the OBN was introduced (95% CI 3.19 to 3.84; P<.001). The 1-year mortality was significantly lower after program implementation (adjusted OR 0.44, 95% CI 0.23 to 0.82; P=0.01). The sensitivity analysis restricted to in-province hospitals outside the

OBN revealed no significant differences with the exception of the physician assessment rate when one-year postoperative health services use were compared before and after 2010.

DISCUSSION

In this study of 12,513 patients, bariatric surgery at a regionalized bariatric program was associated with less postoperative hospital and critical care services, along with a lower 1-year mortality. We found no evidence of reduced hospitalization or reoperation rates. The physician assessment rate was significantly higher after implementation of the OBN, presumably due to the program's model of care, which included intensive medical follow-up.

There is limited literature evaluating the impact of bariatric COE with respect to postoperative health services utilization. Previous studies have focused mainly on evaluating differences in clinical outcomes between bariatric COEs and non-COEs. Accreditation of COEs has been emphasized in the United States, based primarily on hospital volume and access to a dedicated multidisciplinary bariatric team.[14] An evaluation of clinical outcomes 18 months before and after the Center for Medicare and Medicaid Services (CMS) restricted bariatric surgery to COE revealed the policy decision was associated with improved outcomes.[15] Patients who underwent bariatric surgery after the CMS decision had significantly shorter length of hospital stay and a lower overall complication rate, but not significantly lower mortality.[15] A recent study by Morton et al using Nationwide Inpatient Sample data also showed that centre accreditation improves bariatric surgery outcomes.[16] Other large population-based

studies found no significant association between COE designation and clinical outcomes.[17, 18] Among Medicare patients undergoing bariatric surgery, there was no significant difference in the rates of complications and reoperation between COE and non-COE hospitals.[19]

Our study differs with respect to the comparison group, which was composed primarily of patients who received surgery out of country, and who may have experienced difficulty finding local physicians to provide follow-up care. This lack of continuity of care was unique to our study population, and could explain the higher use of hospital services in the group having OOC surgery.

This was an observational study based on administrative data and as a result, there are some limitations. We relied on coded administrative health data and the validity of bariatric surgery codes has not been specifically evaluated. However, the Ontario Schedule of Benefits does include specific fee codes for bariatric surgery and procedure codes in Ontario health data are generally very reliable.[20, 21] Our data sources did not have information on weight loss and resolution of comorbid conditions, which did not allow us to comment on the effectiveness of surgery. Given our six-year study duration, temporal factors improving surgical care over time, such as the wider application of laparoscopic surgery, may have attributed to the program's effect. Due to the lack of a Canadian bariatric control cohort outside Ontario, it was not possible to completely isolate the effect of the OBN from temporal trends. To test this potential secular trend, we performed a sensitivity analysis of in-province centres outside of OBN and found no difference in the use of hospital services. Selection bias was also mitigated in our study by including both OOC and in-province surgery recipients in our control group, since

bariatric patients accepted for OOC services may have been systematically different from patients who received surgery in Ontario.

A major concern with “medical tourism” for bariatric surgery is the lack of continuity in care to monitor postoperative complications and nutritional deficiencies. The importance of follow-up care is further evident by the fact that bariatric surgery has long-term effects, with weight reduction and correlated changes in comorbidities continuing for months or even years after the procedure.[22] Unlike other types of surgical procedures, the successful long-term treatment of morbid obesity and its associated comorbidities requires a lifelong surgical, medical, psychological, and dietary care.[22] Dedicated bariatric programs based on best practices and clinical standards of care can ensure that patients consistently receive the safest and most effective care possible.[23] As well, the opportunity to address concerns and complications in an outpatient setting can also translate to a reduced need for hospital services. Our findings support the position statement by the American Society of Metabolic and Bariatric Surgery (ASMBS) on global bariatric healthcare, which discourages the “referral across international borders or long distances for patients requesting bariatric surgery if a high-quality bariatric program is available locally”.[24]

In conclusion, we found that a comprehensive and multidisciplinary provincial bariatric program provided an improved model of care when compared to outsourcing bariatric surgical services by reducing the use of postoperative health services. Future research should include an economic evaluation to determine the costs and benefits of this policy decision.

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Table 1. Characteristics of the Ontario Bariatric Surgery Cohort before and after program implementation

Characteristics	Before OBN (n = 5,617)	After OBN (n = 6,896)	Difference[b] (95% CI)	P value
Age (years) Mean [SD]	43.3 [10.3]	44.8 [10.4]	1.5 (1.2, 1.9)	<.001[c]
Sex Female	4551 (81.5)	5633 (81.8)	0.3% (-1.1%, 1.7%)	0.68[d]
ACG Comorbidity Score ≤2 3 4 5	 135 (2.4) 3256 (58.0) 1633 (29.1) 593 (10.6)	 101 (1.5) 4039 (58.6) 2076 (30.1) 680 (9.9)	-	<.001[d]
Rural residence[e]	971 (17.3)	1078 (15.6)	-1.7% (-3.0%, -0.4%)	0.01[d]
Neighbourhood Income Quintile[f] 1 2 3 4 5	 1308 (23.4) 1272 (22.8) 1136 (20.3) 1040 (18.6) 832 (14.9)	 1597 (23.2) 1590 (23.1) 1421 (20.7) 1321 (19.2) 949 (13.8)	-	0.47[d]
Procedure RYGB	5378 (95.8)	6423 (93.1)	-2.6% (-3.4%, -1.8%)	<.001[d]
Centre location In-province OBN Other Out-of-country	 1164 (20.7) 69 (1.2) 4384 (78.1)	 6216 (90.1) 212 (3.1) 467 (6.8)	-	<.001[d]

Abbreviations: OBN, Ontario Bariatric Network; CI, Confidence Interval; RYGB, Roux-en-Y Gastric Bypass; ACG, Adjusted Clinical Group

[a] Data reported as Number (%) unless otherwise indicated

[b] Differences are reported in percent with exception of age where mean difference is reported

[c] p-value given for t test

[d] p-value given for Chi-square test

[e] Rural residence defined as a community size of less than 10,000 population

[f] Income quintile determined based on linking residential postal code to its corresponding dissemination area and then calculating the average income per person in the area. Areas are then ranked and divided into quintiles.

Table 2. One-year postoperative health services utilization before and after program implementation[a]

Outcomes	Before OBN (n = 5,617)	After OBN (n = 6,896)	Difference[b] (95% CI)	P value
Any hospital services[c]	3033 (54.0)	3510 (50.1)	-3% (-4.9%, -1.3%)	<.001[d]
Number of days requiring hospital services among persons with ≥ 1 day Mean [SD	5.7 [14.1]	4.8 [9.5]	-0.8 (-1.4, -0.2)	<.001[e]
Any emergency room visit	2778 (49.5)	3244 (47.0)	-2.6% (-4.4%, -0.8%)	0.007[d]
Number of emergency visits among persons with ≥ 1 visit Mean [SD]	2.5 [2.7]	2.3 [2.3]	-0.2 (-0.3, -0.1)	<.001[e]
Any hospitalization	1504 (26.8)	1960 (28.4)	1.7% (0.7%, 3.2%)	0.04[d]
Number of hospitalizations among persons with ≥ 1 hospitalization Mean [SD]	1.7 [1.4]	1.7 [1.3]	0.02 (-0.08, 0.11)	0.99[e]
Number of days in hospital Mean [SD]	9.3 [21.0]	6.8 [12.6]	-2.5 (-3.8, -1.2)	<.001[e]
Any intensive care stay	120 (2.1)	164 (2.4)	0.2% (-0.3%, 0.8%)	0.37[d]
Number of days in ICU among persons requiring an ICU stay Mean [SD]	11.1 [20.8]	4.4 [9.4]	-6.7 (-10.3, -3.1,)	<.001[e]
Any ventilatory support	61 (1.1)	71 (1.0)	-0.06% (-0.4%, 0.3%)	0.76[d]
Number of ventilated days among persons requiring ventilation Mean [SD]	13.1 [24.2]	4.3 [6.2]	-8.8 (-14.7, -2.8,)	<.001[e]
Any physician assessment	429 (7.6)	2218 (32.2)	24.5% (23.2%, 25.8%)	<.001[d]
Number of physician assessments among persons with ≥ 1 visit Mean [SD]	1.5 [1.5]	1.2 [0.7]	-0.3 (-0.4, -0.2)	<.001[e]
Reoperation	144 (2.6)	300 (4.4)	1.8% (1.2%, 2.4%)	<.001[d]
Number of reoperations among persons with ≥ 1 reoperation Mean [SD]	2.0 [1.6]	1.3 [0.7]	-0.6 (-0.8, -0.4)	<.001[e]
30-day mortality	11 (0.2)	9 (0.1)	-0.07% (-0.2%, 0.08%)	0.36[d]
1-year mortality	26 (0.5)	16 (0.2)	-0.2% (-0.4%, 0.02%)	0.03[d]

Abbreviations: OBN, Ontario Bariatric Network; CI, Confidence Interval; ICU, Intensive Care Unit; SD, Standard Deviation

[a] Data reported as Number (%) unless otherwise indicated

[b] Differences are reported in percent with exception of mean differences

[c] Hospital services = total number of emergency room visits + days in hospital

[d] Based on a Chi-square test

[e] Based on a t test

Table 3. Summary of unadjusted and adjusted estimates of study outcomes

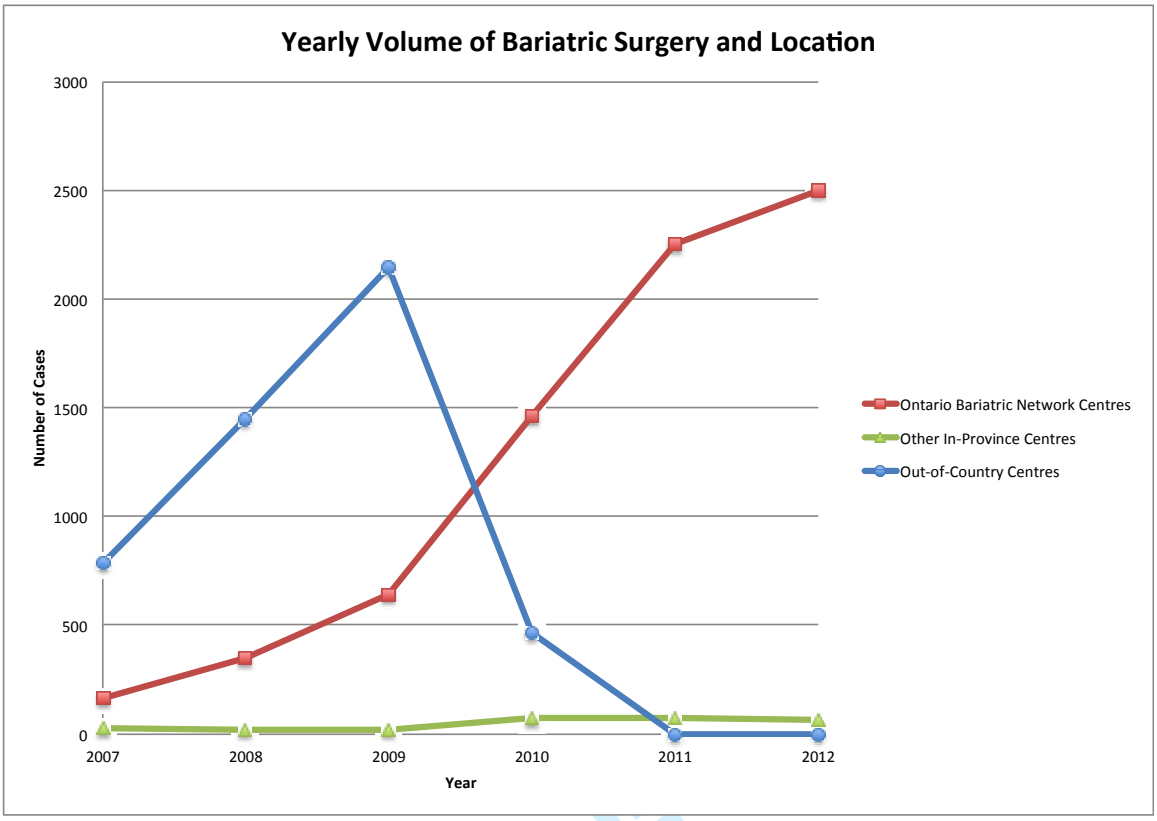
Outcomes	Unadjusted RR (95% CI)	P value	Adjusted[a] RR (95% CI)	P value
Hospital services	0.78 (0.72, 0.84)	<.001	0.83 (0.78, 0.89)	<.001
ER visits	0.88 (0.83, 0.93)	<.001	0.92 (0.87, 0.97)	0.004
Days in hospital	0.76 (0.66, 0.87)	<.001	0.80 (0.70, 0.92)	<.001
Hospitalizations	1.07 (0.99, 1.15)	0.07	1.05 (0.98, 1.13)	0.16
Intensive care stay	0.44 (0.29, 0.67)	<.001	0.53 (0.35, 0.81)	0.003
Ventilatory support	0.31 (0.17, 0.58)	<.001	0.37 (0.19, 0.71)	0.003
Physician visits	3.49 (3.19, 3.83)	<.001	3.50 (3.19, 3.84)	<.001
Reoperations	1.16 (0.93, 1.45)	0.20	1.15 (0.92, 1.44)	0.22
	Unadjusted OR (95% CI)	**P value**	**Adjusted[b] OR (95% CI)**	**P value**
30-day mortality	0.67 (0.28, 1.61)	0.37	0.62 (0.26, 1.50)	0.29
1-year mortality	0.50 (0.27, 0.93)	0.03	0.44 (0.23, 0.82)	0.01

Abbreviations: RR, Rate Ratio; OR, Odds Ratio; ER, Emergency Room

[a] Adjusted variables included age, sex, procedure, rurality, income quintile, and comorbidity score

[b] Adjusted variables included age and sex

Figure 1: Annual summary of bariatric surgeries based on centre location



Author and Study Information

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