



Original Article

Rates and reasons for emergency department presentations of patients wait-listed for public bariatric surgery in Tasmania, Australia

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ABSTRACT

Background: Demand for bariatric surgery in the public hospital setting in Australia is high with prolonged wait-list times. Policy-makers need to consider the consequences of expanding public bariatric surgery including on emergency department (ED) presentations.

Aims: To describe and evaluate public ED presentation rates and reasons for presenting in a cohort of patients wait-listed for public surgery.

Methods: All Tasmanians placed on the public wait-list for primary bariatric surgery in 2008–2013 were identified using administrative datasets along with their ED presentations in 2000–2014. The presentations were assigned to one of three periods: before wait-list placement, whilst on the wait-list, and after wait-list removal for publicly-funded surgery or drop-out. A negative binomial mixed-effects regression model was used to derive ED presentation incidence rate ratios (IRR) to compare observation periods and patient groups.

Results: 652 wait-listed patients had 5149 public ED presentations. 178 patients had publicly-funded bariatric surgery – all as laparoscopically adjustable gastric banding (LAGB). Overall, ED presentation rates did not change significantly post-surgery compared with the waiting period (IRR 1.19, 95%CI 0.90–1.56). Presentation rates significantly increased for digestive system (IRR 2.02, 95%CI 1.19–3.45) and psychiatric diseases (IRR 4.85, 95%CI 1.06–22.26) after surgery. The likelihood of being admitted from the ED significantly increased after surgery (31.7%–38.9%, $p < 0.05$).

Conclusion: ED presentations were common for patients wait-listed for public bariatric surgery and rates did not decrease over an average of three years post-LAGB. The likelihood of being admitted to the hospital from the ED increased after surgery.

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Introduction

Bariatric surgery is currently the most effective treatment for resistant obesity and obesity-related diseases and is recommended for patients with severe obesity or obesity-related comorbidities and type 2 diabetes (T2DM) [1]. Its cost-effectiveness, however, remains unclear. Some studies have shown economic benefits, with reductions in healthcare costs, whereas others have demon-

strated increased total costs in operated groups [2–4]. Studies have reported on patient cohorts with different health insurance status and in different healthcare systems [5], making comparisons difficult.

This uncertainty remains for not only healthcare costs but also the utilisation of healthcare facilities including through hospital admissions and emergency department (ED) presentations. Our study of hospital admissions in the Tasmanian public system demonstrated that admission rates did not decrease during three years of follow-up post-surgery and even significantly increased in the first two years, with a decreasing trend thereafter (unpublished data). Some studies have demonstrated that in-hospital service use decreased post-operation [6], especially for certain comorbidities [7,8], whereas other authors have suggested that surgery increased in-hospital demands and acute presentations, especially in the

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first 30 days after the operation or during short-term follow-up [9].

It is unclear from the available literature whether bariatric surgery significantly influences rates and reasons for presentations to emergency departments in the long-term. During a 4-year follow-up of 174 obese patients in Brazil, emergency service use after bariatric surgery was not higher than in a non-operated obese population [10]. Nevertheless, in the majority of studies, including a longitudinal analysis of administrative data focused on short-term outcomes and re-presentations [11], post-operative emergency department presentation rates after Roux-en-Y gastric bypass (RYGB) [12] or a mix of procedures (RYGB, duodenal switch, gastric plication) [13] increased compared with the pre-operative period and were more likely to be surgery-related. In a UK hospital, operated patients presented to emergency departments with surgery-related complications up to two years post-surgery [14].

ED presentations post-surgery do not necessarily indicate post-operative complications and are often referred to as undifferentiated abdominal pain, nausea or vomiting [15,16] that may reflect difficulties in adjusting to lifestyle and dietary changes after surgery [17]. Such presentations, even if not leading to hospital admissions, still utilise public healthcare resources. ED presentations that lead to hospital admission increase resource use even more. The likelihood of being admitted after presentation to the ED differs greatly among studies (32.5–85%), depending on the type of bariatric procedure, whether the procedure was performed in the same hospital, whether the centre was compliant with optimal practice policies, and overall bariatric centre complication rates [15,18,19].

Insurance status also influences the risk of presentation to the ED post bariatric surgery with patients with private insurance presenting less often in a study from the United States [18]. In Australia, most bariatric procedures are performed in the private sector (88% according to the data captured by the Australian Bariatric Surgery Registry in 2017) [20], although more than 400,000 uninsured Australians may be eligible for bariatric surgery [21]. In this setting, policy-makers need to consider the range of resources required for the treatment of bariatric patients in the publicly funded health system. We hypothesised that the rates and reasons for ED presentations would increase while waiting for bariatric surgery and after receiving it. This study aimed to describe and compare the frequency, reasons and outcomes of public hospital ED presentations for all patients wait-listed for bariatric surgery in the Tasmanian public sector over a ten-year period, according to their wait-list status and outcome.

Materials and methods

This is a retrospective state-wide cohort study of public ED presentations during the period 2000–2014 of all patients appearing on the public wait-list for bariatric surgery in the sampling period 2008–2013.

Tasmania has three main public hospitals and a number of additional small inpatient facilities. All public bariatric surgery in Tasmania is conducted in two public hospitals. All patients waiting for public bariatric surgery in Tasmania during 2008–2013 were identified using three administrative databases (multiple databases were used due to the migration of data to new systems over time and due to structural changes within the Department of Health). All databases used certain repetitive time points called “census dates”, ranging from monthly to annually (depending on the database used) to represent patients’ progress on the wait-list and to ensure that patients remained on the wait-list. To achieve this, patients received annual letters in response to which they had to confirm whether they still required and wished to receive surgery. Patients

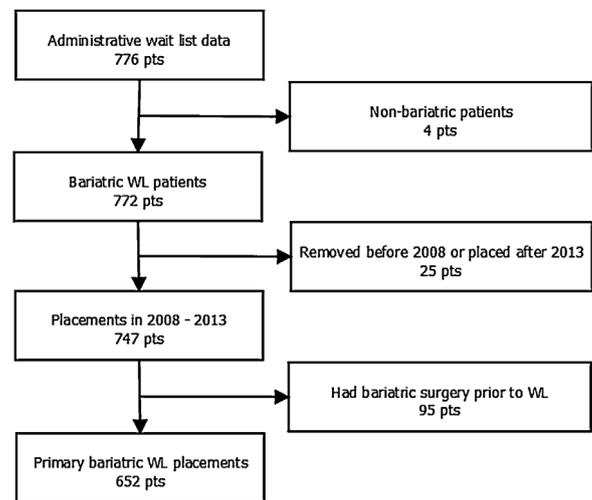


Fig 1. Patient selection flowchart.

were placed on the wait-list after a surgical consultation following a GP referral when conservative treatment was considered ineffective. There were no mandatory requirements for patients to achieve and/or maintain certain weight loss or otherwise demonstrate compliance after being placed on the wait-list. Patients were removed from the wait-list after undergoing surgery, after submitting a response letter indicating that they did not want or did not require surgery, or after not engaging in correspondence.

We identified 776 patients appearing on wait-lists for bariatric surgery in the selected timeframe. Data on ED presentations in 2000–2014 were extracted from an administrative database. These data included ED presentation dates, ICD-10 diagnostic codes, and urgency related group major diagnostic block categories (URG MDB), and outcomes (admission or discharge).

Additional manual data extraction from digital medical records was performed for all the patients identified to ascertain hospital admissions in all inpatient facilities in 2006–2014, to obtain bariatric surgery type and whether it was primary or revisional, and to extract anthropometric data where available. After this process, 124 patients were excluded: 4 were identified as being on the wait-list for non-bariatric surgery, for 25 patients the wait-list dates were outside the study timeframe (removed before 2008 or placed after 2013), and 95 patients had had previous bariatric surgery.

In total, 652 patients were included as wait-listed for primary bariatric surgery in Tasmania in 2008–2013 (Fig. 1). Patients waiting for bariatric surgery were divided into three groups depending on the waiting outcome: (1) removed from the wait-list after undergoing a bariatric procedure (operated), (2) removed from the wait-list without a publicly-funded operation (dropped-out), and (3) those who were still waiting for surgery by the end of 2014, or had disappeared from the wait-list without being actively removed for any stated reason.

All ED presentations were assigned to one of the periods in relation to wait-list placement and removal dates: (1) prior to being placed on the wait-list (pre-WL), (2) while on the wait-list (WL), (3) after removal from the wait-list for bariatric surgery or for other reasons (post-WL). Patients who disappeared from the wait-list without a record of being removed were followed up to their last census date (regular discrete time-points in the wait-list records) of being present on the wait-list. In total, 5,149 ED presentations were identified within the study period for the included patients.

ED presentation rates were calculated as presentations per 100 person-years. The reasons for presentations were determined using URG MDB (where available) in the administrative data. In calculating the ED presentation rates, we accounted for possible increased

Table 1
Patient characteristics (statistically significant differences between operated and dropped-out groups are highlighted in bold).

	Operated ^a (n = 178)	Dropped-out ^b (n = 236)	Waiting ^c (n = 238)	Total (n = 652)
Age at time of WL placement, years (SD)	42.9 ± 11.1	46.6 ± 12.6	43.9 ± 12.0	44.6 ± 12.1
Males, % (n)	24 (43/178)	31 (73/236)	26 (62/238)	27 (178/652)
Aboriginal or Torres Strait Islander origin, % (n)	6.3 (9/143)	10.6 (23/217)	6.5 (8/124)	7.4 (40/484)
Weight at time of WL placement (n), kg	125.1 ± 29.7 (25)	122.1 ± 19.5 (29)	137.6 ± 36.8 (29)	128.4 ± 30.0 (83)
BMI at time of WL placement (n)	44.0 ± 7.6 (16)	45.3 ± 6.8 (16)	45.6 ± 8.8 (19)	45.0 ± 7.7 (51)
Weight at time of WL removal (n), kg	139.8 ± 29.8 (89)	118.1 ± 25.5 (39)	n/a	133.2 ± 30.2 (128)
BMI at time of WL removal (n)	49.6 ± 9.4 (89)	44.1 ± 8.6 (22)	n/a	48.6 ± 9.4 (111)
Average waiting time, years	4.1 ± 2.8	4.5 ± 2.4	4.4 ± 2.6	4.4 ± 2.6
Observation time prior to WL placement, years	7.2 ± 2.7	7.3 ± 2.3	7.5 ± 2.5	7.4 ± 2.5
Observation time during WL period, years	4.1 ± 2.8	4.5 ± 2.4	4.4 ± 2.6	4.4 ± 2.6
Observation time after removal from WL, years	3.2 ± 1.8	2.5 ± 1.4	n/a	2.8 ± 1.6
Total observation time, years	14.5 ± 0.4	14.1 ± 1.3	11.9 ± 3.0	13.4 ± 2.3

^a Patients who had bariatric surgery.

^b Patients removed from the wait-list without operation.

^c Patients remaining on the wait-list or with unknown wait-list status at the end of the study period. Those with the unknown status accounted only for their known waiting time.

presentation rates immediately after surgery and excluded 30 ED presentations within 30 days of a bariatric operation. We also excluded eight presentations when patients were dead on arrival to the ED.

A negative binomial mixed-effects regression model of ED presentations was used to compare follow-up periods and patient groups, including an interaction term between these two variables. Mixed-effects regression with a random intercept for a participant was used because each participant had more than one (non-independent) observation period. Incidence rate ratios (IRR) were estimated by including an offset in the model – log of days at risk for each period – and the model was adjusted for sex and age at the beginning of each period. Deviance residuals were checked to ensure model fit. Adjusted incidence rate ratios were compared between periods (using the wait-list period as reference) and groups (using the operated group as reference). A similar model was used for annual incidence rate comparisons, with each year before and after removal from the wait-list being a separate period. IRRs were reported with 95% confidence intervals (CI).

Differences between patient characteristics in the operated and dropped-out groups were compared using the *t*-test and the χ^2 test. ED presentation outcomes as proportions admitted to hospital were compared between the operated and dropped-out groups and consecutive periods (before wait-list placement, while waiting and after surgery or drop-out) using the χ^2 test. *P*-values less than 0.05 were considered statistically significant. Statistical analysis was performed using Stata 14.2 software.

Results

Of 652 patients waiting for primary public bariatric surgery in 2008–2013, 178 (27.3%) were operated on, 236 (36.2%) were removed from the wait-list without publicly-funded bariatric surgery, and 238 (36.5%) were still waiting or disappeared from the wait-list and were followed to their last census date.

Publicly operated patients were, on average, younger when placed on the wait-list than those who dropped-out (42.9 ± 11.1 vs 46.6 ± 12.6 years, *p* < 0.01). There were no significant differences in the proportions of males or Aboriginal patients between the groups. Incomplete hospital medical records prevented comparison of patients' weights and BMIs upon wait-list placement or removal. The average total observation period was 13.4 ± 2.3 years and the average follow-up time was 2.8 ± 1.6 years after being removed from the wait-list following public surgery or dropping-out without a publicly-funded operation. The operated group had longer observation time post-WL removal than the dropped-out group, in which 21 patients were removed due to death and did not have a post-removal observation period (Table 1).

Table 2
Public hospital ED presentation rates (unadjusted) per 100 person-years.

Wait-list status	Pre wait-list	On wait-list	Post wait-list	Total
Operated	40.3	59.2	73.6	53.0
Dropped out	61.5	61.2	73.3	63.3
Waiting	48.7	72.7	n/a	57.6
Total	51.1	65.0	73.6	58.4

Table 3
Adjusted^a ED presentation incidence rate ratios (IRR) with 95% confidence intervals.

Wait-list status	Period		
	Pre wait-list	On wait-list	Post wait-list
IRR between groups			
Operated	1	1	1
Dropped-out	1.32 (0.96–1.81)	1.26 (0.91–1.76)	1.17 (0.83–1.67)
Waiting	1.07 (0.78–1.46)	1.23 (0.88–1.71)	n/a
IRR between periods			
Operated	0.69 (0.54–0.91)	1	1.19 (0.90–1.56)
Dropped out	0.73 (0.59–0.91)	1	1.10 (0.87–1.41)
Waiting	0.61 (0.48–0.76)	1	n/a

Statistically significant differences are highlighted in bold.

^a Adjusted for age, sex and non-independent observation periods.

109 of 178 patients were operated in public hospitals. We were able to identify the procedure performed for all of them, which was laparoscopic adjustable gastric banding (LAGB). For the 69 patients who were outsourced to the private hospitals using public funding, we did not have access to medical records for their surgery admission with the procedure details. However, all outsourced publicly funded bariatric procedures were performed by a single surgeon, who confirmed that LAGB was the only type of procedure performed for these patients. This is also supported by the Medicare Benefit Schedule data for the types of procedures that were performed in the private sector in the state during the study period, with 98.9% of procedures being LAGB.

ED presentation rates

Among all wait-listed patients, 86.2% presented to the ED at least once, with no significant difference between operated-on and dropped-out patients. Unadjusted ED presentation rates are presented in Table 2.

Prior to being placed on the wait-list, patients in all groups had significantly lower ED presentation rates compared with the wait-list period (Table 3). There were no significant differences in ED presentation rates between groups in any period.



Fig. 2. Trends in ED presentation rates by years relative to the time of wait-list removal (represented as 0).

Table 4

Proportion of ED presentations admitted to hospital or transferred to another hospital (excluding presentations within 30 days post bariatric surgery).^a

Wait-list status	Period		
	Pre wait-list % (n)	On wait-list % (n)	Post wait-list % (n)
Operated	25.5 (131)	31.7 (140)	38.9 (162)
Dropped-out	30.4 (324)	39.4 (255)	44.3 (174)
Waiting	20.8 (181)	26.3 (201)	n/a
Total	26.0 (636)	32.2 (596)	41.5 (336)

^a Statistically significant differences between operated and dropped-out groups are highlighted in bold, statistically significant differences between consecutive periods within groups are underlined.

When comparing the annual ED presentation rates in the year preceding surgery (reference period) and annually postoperatively (Fig. 2), we observed initially increasing rates in the first two years postoperatively with a peak in the ED presentations in the second year (IRR 1.54, 95%CI 1.01–2.36) and a subsequent decrease after that period (IRR 1.24, 95%CI 0.77–2.00).

ED episode outcomes

The proportion of patients admitted to hospital after presenting to the ED increased for all patient groups over the successive periods of follow-up (pre-, during and post-wait-list) (Table 4). There was no statistically significant difference between groups in the likelihood of being admitted following presentation to the ED prior to being placed on the wait-list. During the waiting period, ED presentations in the operated group resulted in fewer admissions compared with the dropped-out patients (31.7% vs 39.4%, $p < 0.05$). After the bariatric operation, however, the likelihood of being admitted following ED presentation increased significantly to 38.9%, $p < 0.05$.

Reasons for ED presentations

While ED presentations in the first 30 days post-surgery were not included in the rate calculation given the inevitable increase due to immediate postoperative complications, we looked at the reasons for these early ED presentations (Table 5), of which 18 (60%) could be attributed to postoperative complications.

According to the analysis by URG MDB, the most common cause for ED presentation for the overall study period was circulatory

Table 5

Principal diagnoses (ICD-10AM) of ED presentations (n = 30) within 30 days of the primary bariatric surgery.

Principal diagnosis description	Number of presentations	Percentage presentations
Unspecified complication of the procedure	5	16.7
Wound infection following a procedure	2	6.7
Lobar pneumonia	2	6.7
Other and unspecified abdominal pain	2	6.7
Attention to surgical dressings and sutures	1	3.3
Disruption of operation wound	1	3.3
Embolism and thrombosis of unspecified vein	1	3.3
Postprocedural disorder of digestive system, unspecified	1	3.3
Surgical follow-up care unspecified	1	3.3
Hypoglycaemia	1	3.3
Acute stress reaction	1	3.3
Bronchitis not specified	1	3.3
Cervicalgia	1	3.3
Follow-up examination after unspecified treatment	1	3.3
Hordeolum	1	3.3
Open wound to finger(s)	1	3.3
Other specified abnormal uterine or vaginal bleeding	1	3.3
Other specified disorder of teeth and support structures	1	3.3
Other inflammatory disorders of penis	1	3.3
Procedure not done, patient declined	1	3.3
Superficial injury of forearm	1	3.3
Syncope and collapse	1	3.3
No ICD-10 code	1	3.3

system illnesses (7.2 presentations per 100 person-years), and the presentation rate for this cause did not differ significantly between the waiting and post-waiting periods following surgery or drop-out.

When the presentation rates during the wait-list time were compared with those during the postoperative period for the operated group, there was a significant increase in rates of presentations for digestive system illnesses (IRR 2.02, 95%CI 1.19–3.45).

The dropped-out patients tended to have a higher rate of psychiatric presentations than the operated group initially (pre-wait-list IRR 4.17, 95%CI 0.97–17.91) and while on the wait-list (IRR 4.03, 95%CI 0.82–19.70). When comparing periods, for the operated patients ED presentation rates for psychiatric illnesses increased significantly after the surgery (IRR 4.85, 95%CI 1.06–22.26).

Table 6
Adjusted^a ED presentation incidence rate ratios (IRR) with 95% confidence intervals for the most common (≥ 100 presentations) urgency related group major diagnostic blocks (URG MDB) excluding presentations within 30 days post bariatric surgery.

URG MDB	Wait-list status	Absolute numbers for the total period		Periods		
		Presentations	Patients	Pre wait-list	On wait-list	Post wait-list
Circulatory system illness	Operated	172	53	0.37 (0.21–0.64)	1	0.80 (0.47–1.37)
	Dropped-out	273	104	0.56 (0.37–0.86)	1	0.98 (0.62–1.55)
	Waiting	162	75	0.43 (0.27–0.68)	1	n/a
Injuries	Operated	159	65	0.33 (0.20–0.57)	1	1.00 (0.59–1.70)
	Dropped-out	208	80	0.48 (0.32–0.73)	1	0.95 (0.59–1.53)
	Waiting	184	81	0.47 (0.31–0.71)	1	n/a
Other presentation (not specified)	Operated	131	67	0.30 (0.16–0.55)	1	1.33 (0.77–2.31)
	Dropped-out	174	69	0.78 (0.47–1.32)	1	1.61 (0.92–2.82)
	Waiting	164	58	0.42 (0.25–0.70)	1	n/a
Digestive system illness	Operated	138	63	0.39 (0.22–0.71)	1	2.02 (1.19–3.45)
	Dropped-out	168	85	0.57 (0.36–0.90)	1	1.03 (0.60–1.75)
	Waiting	116	61	0.25 (0.15–0.42)	1	n/a
Neurological system illness	Operated	114	51	0.33 (0.18–0.64)	1	0.62 (0.32–1.19)
	Dropped-out	167	62	0.63 (0.37–1.08)	1	1.31 (0.73–2.37)
	Waiting	103	55	0.32 (0.18–0.55)	1	n/a
Respiratory system illness	Operated	52	28	0.34 (0.14–0.83)	1	1.00 (0.43–2.32)
	Dropped-out	129	54	0.73 (0.40–1.32)	1	1.53 (0.79–2.97)
	Waiting	154	54	0.37 (0.22–0.65)	1	n/a
System infection	Operated	81	29	0.40 (0.16–0.99)	1	1.13 (0.47–2.71)
	Dropped-out	146	59	0.53 (0.28–1.01)	1	1.28 (0.63–2.59)
	Waiting	79	45	0.30 (0.15–0.61)	1	n/a
Psychiatric illness	Operated	31	16	0.68 (0.13–3.64)	1	4.85 (1.06–22.26)
	Dropped-out	97	27	0.70 (0.26–1.93)	1	0.84 (0.27–2.59)
	Waiting	42	16	1.19 (0.33–4.33)	1	n/a
Urological system illness	Operated	45	18	0.33 (0.08–1.27)	1	1.56 (0.49–4.92)
	Dropped-out	50	28	0.36 (0.14–0.93)	1	0.89 (0.33–2.37)
	Waiting	39	26	0.65 (0.27–1.55)	1	n/a
Hepatobiliary system illness	Operated	37	21	1.09 (0.33–3.56)	1	1.05 (0.25–4.24)
	Dropped-out	35	15	0.84 (0.25–2.84)	1	1.16 (0.27–4.92)
	Waiting	36	14	0.41 (0.13–1.34)	1	n/a
Musculoskeletal/connective tissue system illness	Operated	19	14	0.54 (0.16–1.84)	1	0.91 (0.25–3.31)
	Dropped-out	48	33	1.26 (0.53–2.94)	1	1.50 (0.57–3.95)
	Waiting	37	24	0.25 (0.11–0.60)	1	n/a

Statistically significant differences are highlighted in bold.

^a Adjusted for age, sex and non-independent observation periods.

Details of the presentation rates by the most common URG MDB are summarised in [Table 6](#).

Discussion

We found that rates of ED presentations increased after the wait-list placement (as expected for patients referred for surgical treatment of obesity compared with the earlier period when they did not require it), and that ED presentation rates did not decrease after publicly funded bariatric surgery performed as LAGB even after excluding presentations within 30 days of surgery. Studies comparing postoperative resource utilisation for up to four years after various bariatric procedures, such as LAGB, RYGB and sleeve gastrectomy, also found no decrease in ED visits [6,10].

While there was a peak of presentations within 2 years after the surgery and an increase in presentations for certain conditions after the surgery, overall postoperative ED presentation rates were not higher compared with the dropped-out group.

Two studies with three months follow-up of all ED presentations post-RYGB or various procedures reported an increased number of conditions related to the surgery itself, e.g. post-operative complications [15,17]. Supporting this notion, an increase in gastrointestinal presentations was also found in some other studies

as a post-procedure complication, with abdominal pain being one of the most common reasons for ED presentation in the short-term [12,22]. Our study also revealed a significant increase in presentations for gastrointestinal illnesses within several years after bariatric surgery.

Some studies have reported that patients present with mental health disorders more often after bariatric surgery than before [23,24], and, in our study, a significant increase in presentations for psychiatric illnesses occurred in the publicly-operated group after the surgery. Compared with the operated group, the dropped-out group tended to have higher presentation rates for psychiatric conditions both before and while waiting.

Patients who had bariatric surgery were more likely to be admitted from the ED after surgery than before surgery. Their post-operative admission rate of 38.9% is similar to the admission rate of 34.9% in the study by Telem, although the latter study examined short-term presentations only after different types of bariatric procedures (LAGB, RYGB, sleeve gastrectomy) [18]. No studies known to us have compared the pre- and post-operative likelihood of admission. It is not clear whether the prevalence of conditions requiring admission during ED visits increased, whether medical practitioners were more inclined to admit postoperative patients, or whether this increase simply reflects an overall trend of greater severity of health conditions over time.

Some economic evaluations show that costs eventually decrease a few years after surgery [2], although not immediately in the first years [5]. Our findings of non-decreasing rates of ED presentations and an increased likelihood of admission from the ED after bariatric surgery suggest that the policy of performing publicly funded bariatric surgery as LAGB did not reduce the burden on the public hospital system in Tasmania. However, further analysis is required to determine the economic impact for public hospitals as this study was looking at service use rather than overall costs. Costs of ED presentations comprise only a fraction of total costs for the public system which include hospital admissions, inpatient time, outpatient costs and, particularly relevant to bariatric surgery, costs of revisional procedures.

This study should not be interpreted as a comparison of operated patients with non-operated patients, but rather as a comparison of patients who had publicly funded surgery with those who dropped-out from the public wait-list, even if they went on to have privately-funded surgery, either self-funded or through private insurance. The study aimed to inform public payers of wait-list patient pathways and their impacts on hospital services use.

Given that some reasons for ED presentations changed significantly after bariatric surgery, costs are also expected to change and require evaluation. Moreover, there could be cost drift from individuals to public healthcare. It has been argued that increased hospital resource use and even increased costs should not limit access to public bariatric surgery due to the expected health benefits and mortality reductions [25].

This study included all patients wait-listed for primary public bariatric surgery in Tasmania and provided a long observation period of 13 years on average, which is greater than the observation periods reported in other studies of ED presentations. The postoperative observation period of three years is similar or greater than those in other studies [12,15,17,18]. Outcomes for the operated group were compared with those of a similar population of patients who were eligible for surgery in the public hospital system (as defined by placement on the wait-list). Few studies of healthcare resource utilisation have had comparison groups closely resembling the treatment group, if they have been available at all [10].

Our study did not provide comparisons between bariatric surgery types because all the procedures were LAGB. In a study of 36,673 patients that compared ED presentation rates not resulting in admissions within 90 days post-surgery, and that included different types of bariatric procedures, LAGB was associated with lower ED presentation rates than sleeve gastrectomy or RYGB [15]. Similar results were shown in a study of ED presentations resulting in readmissions within 30 days for 130,007 patients [26]. In studies comparing sleeve gastrectomy and RYGB only, RYGB was associated with higher rates of ED presentations within one year in a study of 5701 patients [27] and in a Saudi study of 301 patients operated within a five-year period without details of average follow-up time [28]. However, most of these studies were comparing short-term follow-up data only, representing immediate post-surgical complications (and excluded for that reason from our study), and no conclusions on long-term emergency department presentations rates for different procedures could be drawn.

This study has certain important limitations. It encompasses the population of only a single state, with a small number of bariatric surgeons operating publicly and laparoscopic adjustable gastric banding as the most commonly performed procedure (in contrast to current national and world trends [29]). While multidisciplinary management and long-term follow-up are associated with better LAGB results [30–32], and long-term complication rates are typically higher for patients lost for follow-up [33], our study was not able to account for patients' adherence to postoperative follow-up.

We relied on Tasmanian administrative databases, and thus, patients who left Tasmania or had emergency presentations while in other areas were not captured. Presentations to private hospital emergency departments could also not be tracked. Due to the inferior quality of the hospital medical records, we were not able to examine the relationships of ED presentations with weight and BMI; however, it is usual for administrative databases not to have anthropometric data, and for studies based on administrative data not to report on such associations [9,18].

This study does not provide information on the impact of waiting time on public ED presentation rates. Future studies with a matched sample of individuals who are not wait-listed for surgery would help to differentiate between aging and waiting time contributions to ED presentation rates.

Conclusion

We conclude that (i) the overall ED presentation rate did not decrease after publicly funded laparoscopic adjustable gastric banding; (ii) overall ED presentation rates were similar following publicly-funded operations and drop-out from the wait-list; (iii) there were increases in specific ED presentation reasons after LAGB particularly for digestive system problems and psychiatric illnesses; and (iv) the likelihood of being admitted during an ED presentation increased after LAGB surgery.

The results of the study suggest that publicly funded bariatric surgery performed as laparoscopic adjustable gastric banding does not reduce the burden on the public healthcare system in terms of emergency department service use over an average of three years. Further economic analysis is required to quantify the cost implications.

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Ethical statement

This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent

For this type of study formal consent is not required.

Conflict of interests

Alison Venn reports grants from National Health & Medical Research Council, Australia, grants from Department of Health & Human Services, Tasmania, grants from Department of Premier & Cabinet, Tasmania, during the conduct of the study.

Martin Hensher reports that he was responsible for policy development and performance management of elective surgery and elective surgery waiting lists on behalf of the Tasmanian Department of Health and Human Services for much of the study period.

CRedit authorship contribution statement

Alexandr Kuzminov: Conceptualization, Methodology, Software, Formal analysis, Investigation, Data curation, Writing - original draft, Visualization. **Stephen Wilkinson:** Validation, Resources, Writing - review & editing. **Andrew J. Palmer:** Supervision, Visualization, Writing - review & editing. **Petr Otahal:**

Methodology, Software, Formal analysis, Writing - review & editing. **Martin Hensher**: Conceptualization, Resources, Writing - review & editing. **Alison J. Venn**: Conceptualization, Methodology, Supervision, Visualization, Writing - review & editing, Project administration, Funding acquisition.

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