Final Report on Costs of and Quality of Life after Bariatric Surgery in a Michigan Medicaid Population

By

PI: Joseph C. Gardiner, PhD
Zhehui Luo, PhD
Jeff Gauvin, MD
Carole Slomski, MD
David Weismantel, MD, MS
Kathleen Oberst, RN, MS

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Abstract: A sustained increase in the prevalence of obesity over the past two decades has heightened awareness among health care providers of obesity's contribution to chronicity and health care costs. Surgical interventions as a means to treat the severely obese (BMI≥40 kg/m^2) have steadily increased in Michigan. However, long-term treatment outcomes and costs are not well researched. We propose a retrospective review of all Michigan Association of Health Plan members and fee-for-service Medicaid beneficiaries undergoing bariatric surgery between 10/1/03 – 9/30/04, to assess changes in health status and health care utilization before and after the surgical intervention.

Project Update: The project has been completed using available administrative data provided through the Michigan Data Warehouse and the Registrar's Office of Vital Statistics.

INTRODUCTION

Obesity is a national concern with nearly 1/3 of the adult population, over 60 million persons, classified as obese with a body mass index>30 kg/m2 according to the Center for Health Statistics' National Health and Nutrition Examination Survey conducted between 1999-2002. This represents a sixteen percent increase over the rate published during 1994. Findings of the survey indicate more women than men are obese and among women, the highest prevalence occurs in non-Hispanic black women with nearly 50% obese. According to the American Obesity Association, obesity is the second leading cause of preventable death in the U.S. Obesity prevalence is higher in those with fewer years of formal education. Nearly one-quarter of Michigan residents are classified as obese. Studies are beginning to evaluate the relationship between socioeconomic status and obesity. The Center for Health Equity and Research and Promotion reports generally inverse relationships between income and obesity among women of various races. Black and Hispanic men however, are found to experience a positive relationship between income and weight.

Studies of bariatric surgical procedures indicate that although patients are at increased risk for any surgical procedure due to obesity, most patients experience satisfactory results. A review of the Nationwide Inpatient Sample conducted by Santry and colleagues (2005) reported low in-patient mortality rates, on the order of less than one percent. This data source included admissions for bariatric surgery from 1998-2002. Rates of surgical and pulmonary complications approached 10%. The authors express concern however that over three-quarters of patients contained within their sample each year were privately insured and between 1/3 to over fifty percent were from zip code areas with highest annual income.

With a growing demand for bariatric surgery and coverage for the surgery granted by Medicaid, it becomes imperative to understand the cost and utilization patterns of patients undergoing the surgery. Surgical interventions as a means to treat the morbidly obese (body mass index≥40 kg/m2) have steadily increased in the Michigan Medicaid population. However, long-term treatment outcomes and costs are not well researched. The available literature generally finds this population underrepresented in studies.

METHODS

We carried out a retrospective review of all Medicaid fee-for-service (FFS) and managed care (MC) beneficiaries who had a bariatric surgery between 10/1/03 – 9/30/04. Our source of data was the Michigan Department of Community Health (MDCH) Medicaid claims and encounters. The MDCH warehouse was accessed on 11/3/2006. FFS paid claims, MC encounters, and Medicaid beneficiary eligibility data were pulled on that day. The database contains inpatient, outpatient, prescription drug claims or encounters for 550 beneficiaries who had stomach related procedures on 10/1/2003 or later. This "wide net" approach allows us to look at any service received by any beneficiary who had a bariatric procedure regardless of whether though FFS or MC. We linked the data to beneficiary's monthly eligibility history from 4/1/2002 to 7/31/2006. Each patient's death certificate was used to examine mortality and cause of death attributable to obesity. The study was approved by the institutional review boards at Michigan State University and MDCH.

The claim and encounter files contained diagnosis codes (International Classification of Diagnosis, 9th Revision, Clinical Modification ICD-9_CM), procedure codes (Current Procedural Terminology CPT-4), prescription drug (National Drug Codes, NDC), provider specialty and amounts charged and approved.

We used the following CPT-4 codes to find patients who had bariatric surgery between 10/1/2003 and 9/30/2005: 43842, 43843, 43846, 43847; 43644, 43645, 43659, 43770, 43845, S2082 and S2085. We excluded patients who had only revision code 43848 or unspecific code 43999. We also excluded bariatric surgery with primary diagnosis code for stomach or intestinal cancer (ICD-9 CM codes: 150.0x-159.9x or *in situ* 230.1x-230.9.)

The total stomach related surgical procedures performed since 10/1/2003 was 795 with 226 in FFS and 569 in MC groups. Some patients had repeated procedures. We use the first surgery as the index surgery and restricted patient age to be 18 and above. The resulting sample size was 460 (159 FFS and 301 MC on the day of surgery). We originally proposed to study the beneficiaries who had the surgery between 10/1/2003 and 9/30/2004 to allow 18 months data to be collected before and after the surgery. The number of patients available was quite small with 54 in FFS and 87 in MC. Notice, between 10/1/2004 and 9/30/2005 the number of beneficiaries undergone the surgery increased to 68 in FFS and 153 in MC. This second group of patients would have 12 months of data after surgery to be collected by November 2006 when the data was accessed although the last three months may be incomplete due to delay in claim turnover. To increase the sample size under study, we focused comparisons between FFS and MC for the two-year period 10/1/2003 and 9/30/2005 (N=362), as opposed to the proposed study period. The expansion of the original sample was approved by the institutional review boards. Figure 1 displays the flow of the volumes of bariatric surgeries since 10/1/2003, Figure 2 shows unique beneficiaries' index surgery occurrence time, and Table 1 shows the basic demographic characteristics of the 362 beneficiaries who had surgery in this period. One FFS patient had colon cancer and two MC patients had malignant intestinal cancer. They were excluded from further study. The final sample size is 359 (FFS=121, MC=238).

Figure 1 Surgery Volumes

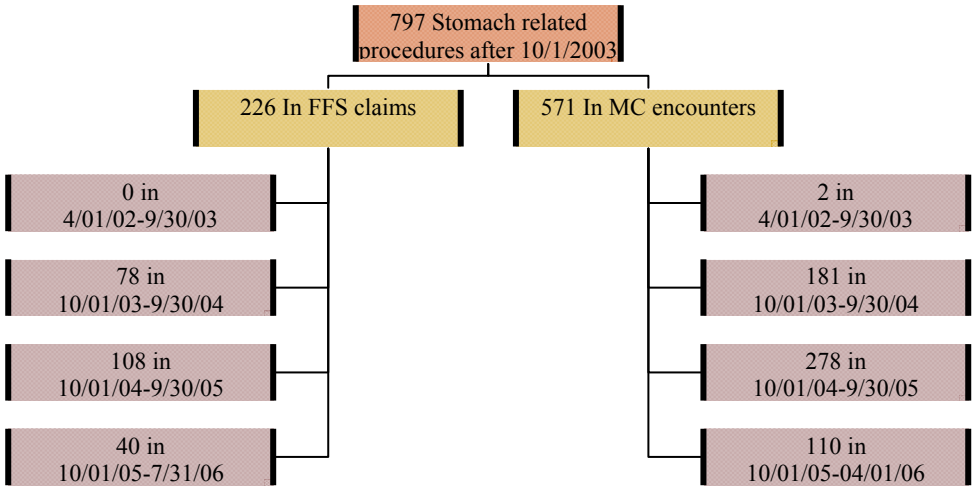
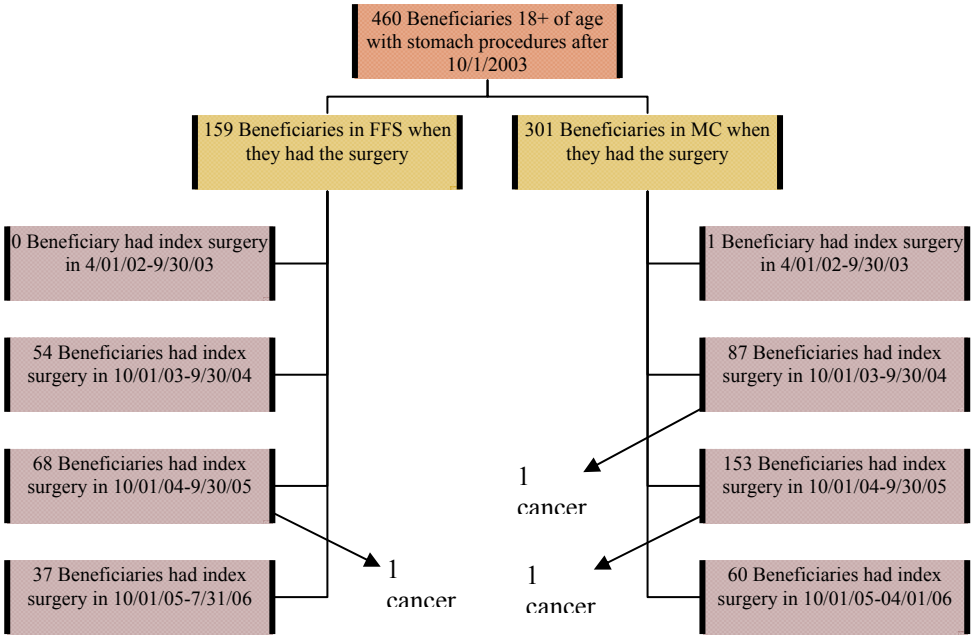


Figure 2 Indexed Surgery Volumes for 18+ years of age



As can be seen in Table 1, the MC group had younger patients, higher fraction of female and black beneficiaries as compared to the FFS group. The majority of FFS

beneficiaries were also covered by Medicare. This indicates that most of these beneficiaries were older and might qualify for Medicaid due to disability. Medicare claims data were not available for inclusion into our analyses.

Table 1 Basic Characteristic of the Medicaid Beneficiaries Who Had Bariatric Surgery in 10/1/2003 and 9/30/2005.

		FFS (N=121)	MC (N=238)	Total (N=359)	P-value
Age	**Mean (SD)**	47.04 (9.69)	39.73 (9.04)	42.19 (9.88)	<0.001
	[Min, Median, Max]	[28, 46, 68]	[20, 39, 65]	[20, 41, 68]	
Gender	**% Female**	79.3	92.0	87.3	0.002
Race	**% White**	81.0	76.5	78.0	
	% Black	12.4	21.0	18.1	
	% Other	6.6	2.5	3.9	0.027
Level of care at index surgery	**%Standard**	84.2	n/a	28.2	
	%LTC	7.5	n/a	2.5	
	%Exempt from MCEP	8.3	n/a	2.8	
	%Managed Care	n/a	100	66.5	n/a
Other Insurance	**%No other**	15.8	96.6	69.6	
	%Medicare	82.5	2.5	29.3	
	%Private HMO	1.67	0.84	1.1	
Prior eligible months	**Mean (SD)**	11.01(7.74)	12.13 (6.58)	11.75(7.01)	0.147

SURGICAL PROCEDURES

We identified four major types of bariatric surgeries by the CPT codes: (1) Roux-en-Y gastric bypass and other types of gastric bypass and malabsorptive procedures such as long limb bypass and bilopancreatic diversion (43846, 43847, 43845); (2) laparoscopy, surgical gastric restrictive procedure (43659; 43644, 43645 new CPT codes effective 1/1/05); (3) vertical or non-vertical gastric banding or gastroplasty without gastric bypass (43842, 43843);

and (4) laparoscopic placement of an adjustable gastric balloon band of a silicone implant (43770, HCPCS S2082, adjustment of band diameter S2083, S2085).

The laparoscopic Roux-en-Y gastric bypass procedure is indicated in the literature to result in more short-term weight loss than laparoscopic adjustable gastric banding, but the latter has fewer postoperative complications and a lower death rate. In the first period between 10/1/2003-9/30/2004, both the FFS and MC bariatric surgeries were dominantly the Roux-en-Y gastric bypass procedures (61% and 87%). In the second period between 10/1/2004-9/30/2005, increasingly more laparoscopic procedures were performed in FFS (47%) and MC (54%). We might expect better postoperative outcomes in the later period as compared to the early period.

The vertical banded gastoplasty was only performed in two patients in the FFS group. It was found to have long-term complications and small weight loss and often necessitate repeated operations. We will focus on the comparison between open bypass (43846, 43847) and laparoscopic procedures (43659, 43644, 43645, (including Roux-en-Y gastric bypass)). Each approach has its own unique risks and complications.

Table 2 displays the number of individuals having these three kinds of surgeries in the period between 10/1/2003 and 9/30/2005. The majority of FFS patients had laparoscopic procedures and the MC patients were more likely to have Roux-en-Y gastric bypass and other types of gastric bypass and malabsorptive procedures. The CPT code interpretation was derived from the AMA coding system. Refer to Appendix A for additional details.

Table 2 Observed Surgical Procedures of the Medicaid Beneficiaries Who Had Index Bariatric Surgery in 10/1/2003 and 9/30/2005

Types	Observed CPT	FFS (N=121)	MC (N=238)
Open Bypass	43846	50 (41.3%)	130 (54.6%)
	43847	4 (3.3%)	16 (6.7%)
Laparoscopic Bypass	43659	40 (33.1%)	61 (25.6%)
	43644	25 (20.7%)	24 (10.1%)
	43645	0 (0%)	7 (2.9%)
Banding	43843	2 (1.7%)	0 (0%)

Over the first year of the study period, both FFS and MC patients were more likely to undergo open bypass procedures versus laparoscopic bypass procedures (see Table 2a), although MC patients had higher percent of bypass surgeries. With the advancement of the laparoscopic procedures, in the second year of the study FFS and MC patients were equally like to have laparoscopic procedures (see Table 2b).

Table 2a Observed Surgical Procedures of the Medicaid Beneficiaries Who Had Index Bariatric Surgery in 10/1/2003 and 9/30/2004

Types	Observed CPT	FFS (N=54)	MC (N=86)
Open Bypass	43846	33 (61.1%)	67 (77.9%)
	43847	0 (0%)	9 (10.5%)
Laparoscopic Bypass	43659	21 (38.9%)	10 (11.6%)
	43644	0 (0%)	0 (0%)
	43645	0 (0%)	0 (0%)
Banding	43843	0 (0%)	0 (0%)

Table 2b Observed Surgical Procedures of the Medicaid Beneficiaries Who Had Index Bariatric Surgery in 10/1/2004 and 9/30/2005

Types	Observed CPT	FFS (N=67)	MC (N=152)
Open Bypass	43846	29 (43.3%)	63 (41.5%)
	43847	4 (6.0%)	7 (4.6%)
Laparoscopic Bypass	43659	7 (10.5%)	51 (33.6%)
	43644	25 (37.3%)	24 (15.8%)
	43645	0 (0%)	7 (4.6%)
Banding	43843	2 (3.0%)	0 (0%)

COMORBID CONDITIONS COMPARISON

Obesity-related comorbid conditions are difficult to manage unless patients can lose a significant amount of weight. Two major comorbid conditions for obese patients are diabetes and hypertension. We used the following ICD-9 codes to identify, before and after the surgery for all patients, diabetes: 250, 2500-1, 2508, 25000-93, and hypertension: 4011, 4019, 4010, 64200-64205, 40200, 40210, 40290, 40300, 40310, 40390, 40400, 40410, 40490, 40501, 40509, 40511, 40519, 40591, 40599, 64210-24, and 64270-64294.

The MC population was relatively healthier before the surgery (Table 3). The prevalence of diabetes among patients who had bariatric surgery was 57% in the FFS group and 47% in the MC group 365 days prior the surgery (p-value=0.074). The prevalence of hypertension was 80% in the FFS group and 69% in the MC group (p-value=0.024). After the surgery both groups of patients on average experienced reduction in diabetes and hypertension based upon visits for these conditions. The prevalence of diabetes reduced to 51% in FFS and 40% in MC in 365 days post surgery (p-value=0.041). The prevalence of hypertension reduced to 66% and 54% in FFS and MC respectively (p-value=0.030).

Table 3 Diabetes and Hypertension before and after the Surgery of the Medicaid Beneficiaries Who Had Bariatric Surgery in 10/1/2003 and 9/30/2005

	365 Days Before or on the Index Surgery Date			365 Days Post the Index Surgery Date		
	FFS (N=121)	**MC (N=238)**	**p-value**	**FFS (N=121)**	**MC (N=238)**	**p-value**
Diabetes	69 (57%)	112 (47%)	0.074	62 (51%)	95 (40%)	0.041
Hypertension	97 (80%)	164 (69%)	0.024	80 (66%)	129 (54%)	0.030
	180 Days Before or on the Index Surgery Date			**180 Days Post the Index Surgery Date**		
Diabetes	68 (56%)	109 (46%)	0.062	53 (44%)	91 (38%)	0.301
Hypertension	93 (77%)	155 (65%)	0.031	67 (55%)	119 (50%)	0.336

The prevalence of diabetes among patients who had bariatric surgery was 56% in the FFS group and 46% in the MC group 180 days prior the surgery (p-value=0.062). The prevalence of hypertension was 77% in the FFS group and 65% in the MC group (p-value=0.031). After the surgery the prevalence of diabetes reduced to 44% in FFS and 38% in MC in 365 days post surgery (p-value=0.301). The prevalence of hypertension reduced to 55% and 50% in FFS and MC respectively (p-value=0.336).

MC group had more reduction in diabetes ((112-95)/112=15.2% reduction in MC versus (69-62)/69=10.1% reduction in FFS) in 365 days post surgery. MC group also had higher reduction in hypertension ((164-129)/164=21.3%) as compared with the FFS group ((97-80)/97=17.5%) in 365 days. However, MC group had less reduction in diabetes ((109-91)/109=16.5% reduction in MC versus (68-53)/68=22.1% reduction in FFS) in 180 days post surgery. MC group also had less reduction in hypertension ((155-119)/155=23.2%) as compared with the FFS group ((93-67)/93=28.0%) in 180 days. These rates of reduction of diabetes and hypertension are much lower than those reported in literature.

Assuming weight loss and alleviation of comorbid diabetes and hypertension are positively correlated, we can infer that the FFS group had more significant weight loss in the short term (180 days after surgery) and the MC group had more weight loss in the long term (365 days). We didn't have authorization to access to patients' medical records to examine actual weight loss.

POSTSURGICAL COMPLICATIONS

We identified twelve postoperative complications specifically related to bariatric surgeries. These twelve complications were identified from a meta-analysis of bariatrics literature. We first compared the 30-day and 180-day post-surgical complication rates between the FFS and MC beneficiaries. Secondly, we compared the 30-day and 180-day complication rates between two types of surgical procedures.

Table 4 indicates in the 30 days post surgery (including the surgery day), FFS patients had less complications overall as compared to MC patients (33.5% vs. 49.1%, p=0.014). The FFS group complication rate was comparable to that reported among privately insured population (Encinosa et al. 2006). The specific complications that led to high overall rate in the MC group were (1) dumping, vomiting, diarrhea, etc. (27%) and (2) deep vein thrombosis, pulmonary embolism (21%). Small in absolute number, reported abdominal hernia in the FFS group was 5 whereas in the MC group there was no abdominal hernia. The other complications did not differ between the two groups. The 180-day outcomes exhibit the same pattern although the overall complication rates were not significantly different from each other.

Table 4 Number of Beneficiaries with Post-surgical Complications between FFS and MC groups

	30 Days Post the Index Surgery Date			180 Days Post the Index Surgery		
	FFS (N=121)	**MC (N=238)**	**p-value**	**FFS (N=121)**	**MC (N=238)**	**p-value**
Anastomosis	0 (0%)	6 (3%)	0.101*	2 (2%)	24 (11%)	0.002*
Marginal ulcer	1 (1%)	2 (1%)	1.000*	5 (4%)	8 (3%)	0.768*
Abdominal hernia	5 (4%)	8 (3%)	0.768*	6 (5%)	9 (4%)	0.587*
Dumping, vomiting, diarrhea etc.	21 (17%)	64 (27%)	0.045	42 (35%)	94 (40%)	0.377
Hemorrhage	6 (5%)	12 (4%)	1.000	7 (6%)	15 (6%)	0.847
Wound Dehiscence	0 (0%)	0 (0%)	n/a	0 (0%)	0 (0%)	n/a
Infection and Sepsis	10 (8%)	25 (9%)	0.424	12 (10%)	31 (13%)	0.391
Deep vein thrombosis/pulmonary embolism	6 (5%)	49 (21%)	<0.001*	9 (7%)	51 (22%)	0.001
Respiratory Failure	6 (5%)	5 (2%)	0.193*	7 (6%)	7 (3%)	0.248*
Pneumonia	4 (3%)	18 (8%)	0.109*	5 (4%)	18 (8%)	0.259*
Postoperative acute myocardial infarction	0 (0%)	1 (%)	1.000*	0 (0%)	1 (0.4%)	1.000*
Postoperative stroke	0 (0%)	0 (0%)	n/a	0 (0%)	1 (0.4%)	1.000*
Any complication	43 (36%)	121 (49%)	0.014	65 (54%)	152 (61%)	0.218

*Fisher's exact test was used.

Table 5 compares the post-surgical complications between open procedures (43846, 43847) and laparoscopic procedures (43659, 43644, 43645). The open procedures had much higher complication rates in the 30 days post surgery (including the surgery day). The overall complication rates were 55% in the open procedures versus 35% in the laparoscopic procedures (p-value<0.001). The open procedures resulted in higher complication rates in hemorrhage, infection and sepsis, and deep vein thrombosis/pulmonary embolism. In a longer period (180

days post surgery), the overall complication rate was still higher in the open procedures (67% in open procedures v. 54% in laparoscopic procedures, p=0.013). Specific complications with higher rates in the open procedure group included abdominal hernia, hemorrhage, infection and sepsis, and deep vein thrombosis/pulmonary embolism.

Table 5 Number of Beneficiaries with Post-surgical Complications between open versus laparoscopic surgeries

	30 Days Post the Index Surgery Date			180 Days Post the Index Surgery		
	Open (N=200)	**Laparoscopic (N=157)**	**p-value**	**Open (N=200)**	**Laparoscopic (N=157)**	**p-value**
Anastomosis	3 (2%)	3 (2%)	1.000*	10 (5%)	16 (11%)	0.061
Marginal ulcer	3 (2%)	0 (0%)	0.259*	10 (5%)	3 (2%)	0.158*
Abdominal hernia	10 (5%)	3 (2%)	0.158*	12 (6%)	3 (2%)	0.065*
Dumping, vomiting, diarrhea etc.	46 (23%)	39 (25%)	0.685	73 (37%)	63 (40%)	0.484
Hemorrhage	15 (8%)	3 (2%)	0.026*	18 (9%)	4 (3%)	0.014*
Wound Dehiscence	0 (0%)	0 (0%)	n.a.	0 (0%)	0 (0%)	n.a.
Infection and Sepsis	25 (13%)	10 (6%)	0.053	32 (16%)	11 (7%)	0.010
Deep vein thrombosis/pulmonary embolism	52 (26%)	3 (2%)	<0.001*	54 (27%)	6 (4%)	<0.001
Respiratory Failure	8 (5%)	3 (2%)	0.359*	9 (5%)	5 (3%)	0.593*
Pneumonia	13 (6.5%)	9 (6%)	0.765	14 (7%)	9 (6%)	0.628
Postoperative acute myocardial infarction	0 (0%)	1 (1%)	0.440	0 (0%)	1 (%)	0.440
Postoperative stroke	0 (0%)	0 (0%)	n.a.	1 (1%)	0 (0%)	1.000*
Any complication	109 (55%)	55 (35%)	<0.001	133 (67%)	84 (54%)	0.013

*Fisher's exact test was used. The row totals do not add up to the row totals in Table 4 because 2 patients were excluded as their surgery codes did not belong to the surgery codes we considered here.

UTILIZATION COMPARISON

There was more detailed data in the FFS claims compared to the MC encounter data. From here forward we focus on only the FFS patients and compare their health care utilization before and after the surgery in office visits, ED visits, hospitalization and selected medication use by surgical approach (open vs. laparoscopic). Due to small numbers, the two patients undergoing the banding procedure were omitted from further analysis. ED visits were identified using the emergency condition code in the FFS claims (this may overestimate the ED use). Office visits were identified by the following CPT codes: 99201, 99202, 99203, 99204, 99212, 99213, 99214, 99215, 99241, 99243, 99244, 99245, 99313, 99354, 99385, 99386, 99387, 99394, 99396, 99397, 99402, 99403, 99404, 99412, 99499, 99242, 99395, 90862.

As shown in Table 6, within each surgical group, there was no difference in ED and office visits before and after the surgery. However, the two surgical groups clearly had different prior distributions of ED and office visits. In particular, those who went through the laparoscopic surgeries had higher ED visits than those who went through open surgeries 180 days before the index surgery; however, the former group had lower ED visits than the latter group in 180 days after the index surgery. The former group had higher number of office visits both before and after the index surgery as compared to the latter group.

We also looked at the total number of prescription drug fills and insulin uses between the two surgical groups using the NDC codes. The available data did not permit further analyses of other drug categories.

Table 6 Utilizations before and after the surgery in FFS patients by procedures (N=119)

	180 days before surgery (including the day of surgery)			180 days after surgery		
	Open (N=54)	**Laparoscopic (N=65)**	**p-value**	**Open (N=54)**	**Laparoscopic (N=65)**	**p-value**
Emergency visit (yes)	33 (61%)	19 (35%)	<0.001	45 (69%)	47 (72%)	0.153
#Emergency visits (SD)	9.4 (9.8)	33.5 (86.3)	0.2418	25.4 (29.0)	24.6 (44.3)	0.9201
Office visit (yes)	46 (85%)	47 (87%)	0.091	49 (91%)	60 (92%)	1.000
#Office visits (SD)	4.8 (3.2)	5.3 (2.7)	0.4243	9.6 (7.9)	10.0 (8.1)	0.7933
Use of insulin (yes)	7 (13%)	4 (7%)	0.222*	7 (13%)	4 (7%)	0.222
# prescription fills (SD)	4.9 (2.5)	3.8 (1.7)	0.4622	6 (3.7)	6 (3..6)	1.000

Note: t-test with unequal variances for continuous variables and chi-square test for proportion were used respectively. *Fisher's exact test was used when cell size is less than 5.

COST COMPARISON

A recent AHRQ research brief found that "that from 1998 to 2003, the total number of bariatric surgeries increased by more than 740 percent from 13,386 to 112,435. In 2003, privately insured patients accounted for 82 percent of surgeries. Medicare, Medicaid, and self-pay accounted for 6, 5, and 3 percent of surgeries, respectively, with the remaining 3 percent of surgeries paid for by other payers." The national estimate of mean cost per bariatric surgery in 2002 paid by Medicaid was $15,051, an increase of 17% from the mean cost per surgery in 1998, the highest percent change among all payers. Combining the amount paid by Medicare, Medicaid and patients themselves through co-insurance, deductible and copayment, the average total costs for all bariatric surgeries in 10/1/2003-9/30/2005 is $13,930 (sd=$11,192). The open procedures are more expensive ($17,583) and the laparoscopic procedures are relatively cheaper ($10,895).

Table 7 Surgical costs in FFS patients by procedures (N=119)

	Open (N=54)	Laparoscopic (N=65)	All procedures (N=119)
Total amount paid	$17,582.7 (14371.5)	$10,895.4 (6270.2)	$13,930 (11192.4)

MORTALITY

We matched our cases with the vital records death certificate data. Among the 359 subjects, two died within 90 days of surgery (cause of death: disorder of the lung and thoracic aortic aneurysm without mention of rupture respectively) and two died within 180 days (cause of death: respiratory failure and hepatic failure respectively) for an overall mortality rate of 1.1%. Three of the four death occurred to MC patients. The mortality rate of these patients is somewhat higher than has been reported elsewhere (0.2%).

DISCUSSION AND LIMITATION

Our analyses were conducted relying on administrative claims data provided by the MDCH Medicaid Program. Consistent with other findings, more women than men had this surgery and patients were mostly Caucasian. We note the large proportion of FFS members who were dually insured through Medicare that may represent a unique cohort of members at increased risk although 75% of the mortality occurred in the MC subgroup.

Variation in surgical approach was noted for the first year of interest between MC and FFS subgroups yet the laparoscopic approach gained predominance during the second year. This coincides with broader efforts to reduce open procedures for a variety of conditions. Laparoscopic procedures are generally associated with fewer complications and faster recovery. These data indicate that overall surgical complications among those having laparoscopic were less than those undergoing open procedures for short and longer periods post-operatively.

Efforts to obtain clinical data from medical records or prior authorization processes were not productive. The reliance on administrative data may be a contributing factor to the lower reduction in diabetes and hypertension in these data compared to the literature. Had clinical data been available, changes in blood pressure readings or blood sugar levels may have identified improvement in these conditions.

Variation in complication rates were noted between FFS and MC subgroups in the first year of the study with MC beneficiaries experiencing greater complications. This pattern contradicted expectations since MC patients were presumed to be a healthier cohort based upon identification of comorbid conditions (e.g. diabetes and hypertension). The discrepancy in complication rates did not surface during the second year's review. Further analysis revealed the MC cohort experienced fewer laparoscopic procedures during the first year of analysis and the rate of lap procedures increased during year 2. This suggests that the complication rate was related to the type of procedure and this pattern of fewer complications in laparoscopic procedures reflects conventional knowledge. We confirmed this pattern by evaluating complications by procedure type rather than beneficiary type and corroborated more complications among recipients of open procedures. Patient-level differences may also contribute to the increased complication rates associated with open procedures. Not all patients are eligible to undergo laparoscopic procedures. These patients may have additional comorbid conditions that preclude this approach. It is reasonable to presume then these less healthy patients would be at higher risk for complications or adverse events.

General health care utilization was found not to vary significantly between FFS patients having open or laparoscopic procedures with the exception of ED use before surgery. Patients undergoing open procedures had greater ED use before surgery. This may reflect a patient pool

that had additional comorbid conditions or were less healthy overall and as previously mentioned, possibly not suitable for the laparoscopic tactic.

Costs associated with the surgical approaches favor the laparoscopic method. Open procedures had higher costs. This may result from multiple factors including the increased demand for inpatient resources on an open procedure as well as the increased risk of complications. We would not advocate that cost be sole criteria on which to recommend a surgical approach at the expense of clinical judgment.

The mortality of our patients is somewhat higher than that reported by other studies, 1.1% compared to 0.2%. Three of the four mortalities occurred in the MC subgroup. Two of the three MC mortalities occurred in patients who underwent open procedures which have been noted to have potentially more complications.

Our study describes the experience of a cohort of Medicaid beneficiaries undergoing bariatric surgery for obesity between 10/1/2003 – 9/30/2005. Our analyses were conducted using only administrative data provided by the MDCH Medicaid claims warehouse. Known limitations of administrative data sources include lack of clinical measures (e.g. weight, blood pressure readings or laboratory results), lack of complete documentation of all comorbid conditions and omission of services not considered billable. Analyses conducted for this study were restricted to those that were possible with the available data. For this reason, we were unable to describe overall weight loss experienced or improvements in blood pressure readings or blood sugar levels that would have been anticipated. Assuming weight loss and reduction of comorbid diabetes and hypertension (as measured by the identification of visits with these diagnosis codes) are positively correlated, we might infer that these patients did lose weight subsequent to the surgical procedure.

Based on the descriptive elements contained in this report, it would appear reasonable to have bariatric surgery as one of several treatment options for obese patients. Of the surgical approaches, it would appear that laparoscopic procedures might offer some benefit over open procedures in terms of reduced complications. However, final determination of appropriateness of any surgical procedure must be made with physician consultation considering the characteristics and health care condition(s) of each patient on an individual basis.

ACKNOWLEDGEMENT

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Appendix A Coding Convention:

The following CPT code interpretation is derived from AMA coding system.

43846. Gastric restrictive procedure, with gastric bypass for morbid obesity; with short limb (150 cm or less) Roux-en-Y gastroenterostomy Medicare Payment Non-Facility $1675.71; Facility$1675.71.
43847. Gastric restrictive procedure, with gastric bypass for morbid obesity; with small intestine reconstruction to limit absorption $1861.73; $1861.73
43659. Unlisted laparoscopy procedure, stomach $0.00; $0.00
43644. Laparoscopy, surgical, gastric restrictive procedure; with gastric bypass and Roux-en-Y gastroenterostomy (roux limb 150 cm or less) *****$1870.25; $1870.25
43645. Laparoscopy, surgical, gastric restrictive procedure; with gastric bypass and small intestine reconstruction to limit absorption $2025.43; $2025.43
Source: https://catalog.ama-assn.org/Catalog/cpt/cpt_search.jsp

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