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The Use, Safety and Cost of Bariatric Surgery Before and After Medicare's National Coverage Decision

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Abstract

Objective—To determine the impact of the Centers for Medicare and Medicaid Services' (CMS) bariatric surgery national coverage decision (NCD) on the use, safety, and cost of care CMS beneficiaries.

Background—In February 2006, the CMS issued a NCD restricting reimbursement for bariatric surgery to accredited centers and including coverage for laparoscopic adjustable gastric band (LAGB).

Methods—A pre/postinterrupted time-series cohort study using nationwide Medicare data (2004–2008) evaluating rates of bariatric procedures/100,000 enrollees, 90-day mortality, readmission rate and payments.

Results—Forty-seven thousand thirty patients underwent procedures at 928 sites pre-NCD and 662 post-NCD. The procedure rate/100,000 patients dropped after the NCD to 17.8 (from 21.9 in 2005) increasing to 23.8 and 29.1 in 2007 and 2008, respectively. Open roux-en-y gastric bypass (ORYGB) and laparoscopic roux-en-y gastric bypass (LRYGB) were common pre-NCD (56.0% ORYGB, 35.5% LRYGB) changing post-NCD with LAGB inclusion (12.8% ORYGB, 48.7% LRYGB, 36.7% LAGB). 90-day mortality pre-NCD was 1.5% (1.8% ORYGB, 1.1% LRYGB) and post-NCD was 0.7% (1.7% ORYGB, 0.8% LRYGB, 0.3% LAGB; $P < 0.001$). The 90-day rates of readmission decreased post-NCD (19.9% to 15.4%), reoperation (3.2% to 2.1%) and payments (\$24,363 to \$19,746; P for all < 0.001). Differences in outcome and cost were largely explained by a shift in procedure type and patient characteristics.

Conclusions—The NCD was associated with a temporary reduction in procedure rate and a shift in types of procedures and patients undergoing bariatric surgery. It was associated with a significant decrease in the risk of death, complications, readmissions, and per patient payments.

Bariatric surgery helps patients achieve weight loss, reduces the burden of comorbid conditions^{1–6} and improves survival.^{7–9} Although recent prospective studies^{10,11} have

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described the safety of the procedures, data from 1996 to 2002 demonstrated that the short-term risk of death from bariatric surgery among higher-risk Medicare patients was 2%, 5-fold greater than prior case series had suggested.¹² This report coincided with lay reports of safety events after gastric bypass surgery,^{13,14} and the suspension or closure of clinical programs due to safety concerns.

To address safety concerns, the availability of less invasive procedures and to resolve variability in coverage across states, the Centers for Medicare and Medicaid Services (CMS) completed a national coverage decision (NCD) for bariatric surgery. On February 21, 2006, CMS released the NCD (CAG-00250R¹⁵) which immediately limited coverage of bariatric surgery to procedures performed at facilities that were accredited by either the American College of Surgeons (ACS) or the American Society for Metabolic and Bariatric Surgery (ASMBS).^{16,17} Both accreditation programs include hospital and surgeon procedural volume criteria, and a group of system and practitioner requirements including surveillance of procedural outcomes. The NCD also expanded coverage to the laparoscopic adjustable band (LAGB) procedure, a less invasive procedure approved a few years earlier by the FDA, along with laparoscopic and open roux-en-y gastric bypass (RYGB) and the less commonly performed laparoscopic and open biliopancreatic diversion with duodenal switch. Although the NCD restricted coverage to accredited bariatric centers, most centers were not accredited at the time of the NCD. At the time of the NCD there were concerns that the policy would restrict access to care (CMS recognized 36 unique centers as having accreditation pre-NCD).^{15,18}

A comparison of the period before and after the NCD provides a natural experiment to evaluate its impact on access to bariatric surgery, adverse outcomes and associated healthcare costs. The aim of this study was to assess the nationwide impact of the NCD on use patterns of bariatric surgery, 90-day mortality and readmission rates, and per patient payments pre- and post-NCD.

METHODS

Data Sources and Setting

This study was approved by the University of Washington Institutional Review Board. A pre- and post-NCD cohort study design was used. CMS data (January 1, 2004 through December 31, 2008) were obtained through the Research Data Assistance Center (ResDAC, Minneapolis). Data included Part A (ICD9 procedure, diagnostic codes, payments for inpatient and skilled nursing facilities), Part B (payments and claims for professional fees in all settings), and enrollment databases (vital status and death dates obtained from the Social Security Administration and the Railroad Retirement Board).

Cohort Selection

Subjects were CMS enrollees (January 1, 2004 through December 31, 2008) who had a diagnosis of morbid obesity (ICD-9 codes 278.01 and V85.3–V85.4) with a standard set of current procedural terminology (CPT) codes in the physician/carrier file that describe bariatric surgery (Supplemental Digital Content 1, available at: <http://links.lww.com/SLA/>

A175, which lists exact coding used for bariatric surgery). This selection scheme parallels that of two prior bariatric studies using CMS data.^{10,12}

Data Specification

Patient covariates include age at time of bariatric surgery, sex, race, and health status. Health status was classified using the Deyo modification¹⁹ of the Charlson comorbidity index (categorized 0–3, with 3 or more indicating greatest comorbidity), calculated for each patient based on ICD9 diagnostic codes from all records within 6 months before the operation. Hospital and ambulatory surgical technical service claims were used to identify the number of unique sites performing bariatric surgeries. Less than 10% of bariatric procedures were not matched to a corresponding site (10.2% in the pre-NCD and 8.8% in the post-NCD era).

Adverse outcomes included death, reoperation or readmission within 90 days of surgery (Supplemental Digital Content 2, available at: <http://links.lww.com/SLA/A176>, which lists exact coding used to identify reoperations). Readmission to a hospital within 90 days was defined as a procedure-related rehospitalization. Total payments within 90 days of the procedure were defined as the sum of the amounts paid by Medicare, the beneficiary through coinsurance and deductibles, and other payers for institutional (hospital inpatient, hospital outpatient, skilled nursing facility, home health care, and hospice care) and noninstitutional (physician, laboratory, durable medical equipment) care. All payments were adjusted to 2008 dollars using the component of the Consumer Price Index.²⁰ Patients who had their bariatric procedure in the last quarter of 2008 were excluded from analyses of 90-day readmission, reoperation, and payments as these patients had less than 90 days of claim follow-up.

Statistical Analysis

A priori we determined that to detect a 25% reduction in 90-day mortality post-NCD (the least important clinically significant difference) would require at least 14,849 subjects (based on a pre- NCD mortality rate of ~2%, power 0.9, $\alpha = 0.05$). The predicted pre-NCD rate was 2% based on a prior study.¹²

Patient characteristics were summarized using frequency distributions for categorical variables, and means and standard deviations for continuous variables stratified by NCD status of the bariatric center when the operation was performed. Descriptive statistics were produced for primary and secondary outcomes by NCD status and type of bariatric operation. *P*-values for the differences between groups were obtained using the student's *t*-test for continuous variables and the Pearson chi-square statistic or Fisher's exact test for categorical variables.

Temporal trends in bariatric procedures and mortality were evaluated by quarter. Procedures/100,000 CMS enrollees, numbers of unique surgeons and sites performing bariatric procedures were calculated. The 90-day mortality, readmission and reoperation rates were calculated pre- and post-NCD and across procedure types. Sensitivity analyses were conducted to explore changing rates of use and outcome among enrollees of fee-for-service separate from CMS Health Maintenance Organization (HMO) status and to include

and exclude data from the first months of 2006 to account for potential anticipatory changes and lag time for NCD impact. Including data from the first months of 2006 had no impact on the adjusted analysis and were included only in the descriptive analysis. Including HMO and partial FFS enrollment had no impact on the bivariate analyses and were not explored in the time-series analyses.

To estimate the impact of the NCD on outcomes, we used logistic regression models with interrupted time-series to account for changes independent of other temporal trends.^{21–23} We estimated the model using patient-level data. The model included the following terms to estimate mortality rates: pre-NCD rates, post-NCD rates, and monthly trend. To assess the contribution of procedure type, sex, age, and Charlson comorbidity index to changes in mortality rate, an augmented model included these covariates. We used a linear regression with interrupted time-series model to evaluate the impact of NCD on costs.

RESULTS

Characteristics of the Patients and Procedures by Pre- and Post-NCD era

A total of 47,030 CMS patients underwent bariatric procedures between January 1, 2004 to December 31, 2008 (Table 1). The rates of bariatric procedures (Fig. 1) increased from 15.0 procedures/100,000 CMS enrollees in 2004 to 21.9/100,000 in 2005, then decreased to 17.8/100,000 in 2006 and increased thereafter to 23.8/100,000 and 29.1/100,000 in 2007 and 2008, respectively. There was a significant increase in the mean age of those undergoing procedures from pre-NCD to post-NCD (51.0 ± 11.1 years vs. 54.0 ± 11.7 years, $p < 0.001$), whereas the nonage entitlement beneficiary group (ie, medically disabled or renal failure and under age 65) decreased from 85.7% to 73.8% in the post-NCD era ($p < 0.001$). The mean comorbidity index of bariatric cases increased slightly post-NCD (0.91 to 0.96, $p < 0.001$) and those with comorbidity scores ≥ 3 increased post-NCD (5.9% vs. 7.4%, $p < 0.001$). The most common procedures in the entire study period were laparoscopic roux-en-y gastric bypass (LRYGB, 43.9%), open roux-en-y gastric bypass (ORYGB, 28.5%), and LAGB (23.8%). There was a significant change in the type of gastric bypass surgery performed from ORYGB to LRYGB between the pre-NCD era (61.2% open and 38.8% laparoscopic) and post-NCD era (20.8% open and 79.2% laparoscopic). There was a substantial increase in LAGB procedures in the post-NCD period (0% pre-NCD and 36.7% of all operations post-NCD). The numbers of sites and surgeons performing surgery decreased (absolute reductions of 48.6% and 47.8%, respectively) after the NCD and did not recover to reach pre-NCD levels (Fig. 2).

Survival, Complications, and Cost for Pre- and Post-NCD Era

Outcomes improved after the NCD (Table 2). The 90-day mortality rate pre-NCD was 1.5% (1.8% ORYGB, 1.1% LRYGB) and post-NCD was 0.7% (1.7% ORYGB, 0.8% LRYGB, 0.3% LAGB) ($p < 0.001$). After controlling for time trends (Fig. 3), the estimated pre-NCD 90-day mortality rate was 1.7% falling to 1.3% after the NCD (reduction in relative risk of 22.9%, $p = 0.05$). Reoperative complications pre-NCD occurred in 3.2% (3.5% for ORYGB and 3.2% LRYGB) and post-NCD in 2.1% (5.6% ORYGB 2.5% LRYGB and 0.3% AGB) ($p < 0.001$). The 90-day readmission rates were 19.9% and 15.4% before and after the NCD,

respectively ($p<0.001$). The rate of readmission pre-NCD was 22.1% for ORYGB and 18.0% for LRYGB, and 23.6% for ORYGB and 17.3% for LRYGB post-NCD (Table 2). The average 90-day payments per case were \$23,653 ($\pm 26,027$) pre- and \$19,171 ($\pm 20,808$) post-NCD ($p<0.001$).

The unadjusted impact of the NCD on the rate of 90-day deaths was a reduction of 0.65% ($p<0.01$). After controlling for covariates (age, sex, body mass index, and comorbidity index) and time trends this effect persisted, but the magnitude of the impact was lower-0.36% ($p = .03$). After controlling for the change in procedure type, the observed reduction in mortality rate was no longer significant-0.21% ($p = 0.18$). The magnitude of the effect of procedure shift on mortality rate and other outcomes is difficult to distinguish from other variables that are likely to be correlated with procedure selection.

DISCUSSION

CMS' NCD for bariatric surgery allowed coverage for a lower risk, less expensive procedure (LAGB) and limited procedures to centers meeting standard criteria as assessed by one of two surgeon-led organizations [ACS and ASMBS]. We evaluated the impact of the NCD on the use of surgery, adverse outcomes and costs and identified a transient decrease in the rate of procedure use along with a significant reduction in the number of sites and surgeons performing these procedures. We also found a significant drop in the relative rates of 90-day mortality (-49.7%), reoperative complications (-34.5%), readmissions (-22.7%) and payments per patient (-19.0%).

The safety of bariatric surgery seems to be improving over time. While our group previously reported a 30-day mortality rate of 2.2% for the CMS population using data from 1996 to 2002,¹² within a few years the rate had dropped to 1.3%.¹⁰ Nationwide in-hospital mortality for all patients of all insurance types dropped 75% between 2001 to 2002 and 2005 to 2006.²⁴ More recently, the LABS consortium found a 30-day mortality rate of 0.3% in its cohort of nearly 5000 patients.¹¹ Improved safety has been attributed to surgeon and team skill development, laparoscopic approaches, patient selection, and shift to higher volume centers.^{10,25} In our study, adjusted analyses that accounted for temporal trends, sex, age, changes in procedure types and comorbidity index, found that reductions in 90-day mortality were largely accounted for by a shift to lower risk procedures and a change in patient characteristics (an increased proportion were Medicare-eligible related to age ≥ 65 years with fewer patients who were Medicare-eligible related to disability [age <65]) and not necessarily the result of a shift to accredited centers.

To meet the NCD requirements of a level 1 center, a center would have to be a full service hospital with a Joint Commission-/American Osteopathic Association-/state-approval, an existing bariatric surgery service for more than one year before application, a record of at least 125 primary bariatric operations within the past year, surgeon case volume requirements and the existence of key staff including two or more bariatric surgeons, a director of bariatric surgery, and a bariatric surgery coordinator. Further, these accrediting bodies require site visits to demonstrate compliance with evolving standards and reporting of clinical data and outcomes based on either National Surgical Quality Improvement

Program for ACS or Bariatric Outcomes Longitudinal Database for ASMBS. Although unrecognized by CMS and ASMBS, ACS also designates level 2 centers that are lower volume centers with requirement of at least 25 bariatric operations annually with at least one experienced bariatric surgeon. Level 2 centers are not approved for operations on high-risk patients (age ≥ 60 , BMI ≥ 55 for males and 60 for females, and presence of either cardiac or pulmonary comorbidities). Volume has been linked to improved outcomes in bariatric surgery and the NCD likely redirected CMS beneficiaries and physicians from lower volume centers to higher volume accredited centers. However, we found that most of NCD's impact on outcomes was from a shift in procedure types-specifically, the broader use of the safer LAGB procedure.^{26,27} The changing risk profile of patients undergoing bariatric surgery also seems to have impacted mortality differences. The proportion of disabled patients decreased post-NCD (85.8% disabled pre-NCD to 74.0% post-NCD) while those ≥ 65 years of age increased. These changes may have contributed to improvements in outcomes as recent evidence demonstrates that disability is strongly associated with complications and death after bariatric surgery.¹¹ The impact of advancing age on outcome has been less consistently identified.^{11,12} Although we could not determine the reason for this shift in risk of the patient population, it may have been related to the availability and attractions of the less invasive LAGB procedure to older patients as well as surgeon/center changes in selection criteria given the increased scrutiny of adverse events associated with the accreditation process. Another consequence of the NCD was a decrease in payments related to bariatric surgery. Payments within 90-days after bariatric surgery decreased by 19.0% at a time when overall national healthcare costs increased by 6.1% annually.²⁸ ORYGB consistently was the most expensive operation (overall average payment of \$24,751) and the most common procedure performed in the pre-NCD era compared to operations such as LRYGB (overall average payment of \$20,948) and LAGB (overall average payment of \$15,368), which became the two most common procedures in the post-NCD era. The overall declining payments fostered by the NCD seem to be related to this shift to less expensive and less complicated procedures.

One concern about the NCD was that accreditation-based coverage might decrease access to care.^{18,29} We found that the number of sites and surgeons delivering bariatric care in the first year after the NCD decreased by nearly half, but within 2 years the bariatric case volume/100,000 CMS enrollees returned to projected volume (based on the trend of 2 pre-NCD years). Concerns about access to care may be central to time-critical interventions like trauma care but may be less relevant for complex elective care where safety considerations predominate and comprehensive care delivery systems are required. Ascertaining the more global impact of the NCD related to reduced access to care is challenging because this study could not assess deaths and complications due to decreased use of bariatric surgery during those 2 years and obesity remains a leading source of preventable disease.³⁰

Other procedures have been subject to restrictions of coverage aimed at improving safety. Cardiac surgery reimbursement is linked to participation in an outcomes registry (Society of Thoracic Surgery database).³¹ Coverage for the implantation of internal cardiac defibrillators and carotid stents have been limited to selected patient populations and the requirement of registry participation.^{32,33} CMS also limited coverage of lung volume reduction surgery to centers that were involved in a randomized trial of its efficacy and

transplant centers.³⁴ While these coverage-limiting mechanisms seem to be effective, NCDs also exert their effect on the healthcare systems through the adoption by other insurers. Concurrent with the NCD several insurers (eg, Cigna, Blue Cross/Blue Shield) developed or adopted accreditation programs akin to the NCD criteria³⁵ and broadened coverage to include adjustable banding. It is unclear why the shift to accredited centers alone did not seem to have an independent impact on outcome. Increasingly, investigators have questioned whether outcomes at accredited centers are actually better than those at nonaccredited centers.^{29,36} We could not compare our study findings to outcomes among CMS beneficiaries at nonaccredited hospitals because of the nature of the NCD, but this study raises the issue of whether other accreditation-based NCDs (without the similar inclusion of a less invasive procedure) will have a similar effect on outcomes.

There are other limitations to this study. CMS beneficiaries include patients over the age of 65 and disabled patients under the age of 65, both groups previously recognized as higher risk.¹² The generalizability of these findings may be limited to these groups, but because of their increased risk, this may be an optimal cohort to study the potential of payer-based initiatives around safety. By one estimate CMS pays for only 6% of bariatric procedures nationwide,³⁷ so this experience may not broadly reflect changes in the care being delivered to the general population. In some states, CMS beneficiaries represent 25% of the total population of bariatric surgery patients,³⁸ so these findings may be more relevant for those regions or at centers that treat more CMS beneficiaries. In a recent study evaluating the impact of the CMS NCD across one such system, the University HealthSystem Consortium (UHC) found no statistical difference in in-hospital mortality (0.28% 18 months pre-NCD to 0.20% 18 months post-NCD) and a small decrease in complications (12% vs. 10%) among Medicare and Medicaid patients.³⁹ The UHC study did not reflect the nationwide impact of the NCD because it included only academic medical centers (expected to have had larger case volumes pre-NCD), excluded outpatient LAGB procedures and could not account for death after discharge. Our study was limited because we could not determine if centers performing surgery after the NCD were actually accredited, but the risk of not being reimbursed likely compelled centers to perform surgery on CMS beneficiaries only if they were accredited. Both ASMBS and ACS allow for accreditation of more than one bariatric surgery site within a center designation. As of January 1, 2009 CMS recognized 403 accredited centers, but an accredited center therefore may include more than one clinical site.¹⁵ While our study used “site codes” that were linked to claims we could not determine whether these sites reflected unique, accredited centers. For this reason the decline of unique facilities performing bariatric operations after the NCD (Fig. 2) may not reflect an accurate count of sites performing the procedures and the impact of the NCD on patient access to bariatric centers. We could not account for changes in important patient characteristics such as body mass index or other variables that may have influenced the patient risk profile. Analytically, while interrupted time series has been used to distinguish the effect of policy decision from underlying temporal trends,^{21–23} this study could not account for all other changing factors distinct from the NCD. This analysis is also limited by characteristics of the dataset. While the observed changes in adverse outcomes and cost seemed to be linked most significantly to a shift in procedures rather than a shift in patient or center characteristics, the observational nature of the dataset precludes cause and effect statements.

The effect of procedure shift on mortality rate and other outcomes is likely difficult to distinguish from other variables that are likely to be correlated with procedure selection. Finally, while safety and costs are important domains of outcome, they are not the only ones and bariatric surgery is an intervention with a lifelong impact. It remains to be determined if the shift to the LAGB is resulting in durable weight loss and improvements in comorbid conditions and in European series as many as 29.5% of patients with an LAGB have it removed within a mean follow-up period of 5±3 years.⁴⁰ Balancing short-term risk and cost with longer-term effectiveness is an essential component of strategic clinical decision making.

In conclusion, the CMS bariatric surgery NCD was associated with a temporary reduction in case volume, a near halving of the 90-day mortality rate, significant decreases in serious complications and readmissions, and a 19% reduction in 90-day payer expenses per patient. The impact of the NCD on safety and cost in the CMS population seems to be accounted for mostly by shifts in procedure types and patient characteristics rather than in shifts of patients to accredited centers alone. This NCD highlights the power that payers have to influence quality, safety and costs as well as the limits of accreditation-based coverage.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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FIGURE 1.

Bariatric operations per 100,000 CMS enrollees by quarter, Medicare 2004 to 2008.

FIGURE 2.

Number of unique general surgeons performing and sites where bariatric operations took place, by quarter 2004 to 2008.

FIGURE 3.

Time series of 90-day mortality rates for the CMS beneficiaries undergoing bariatric surgery. Q denotes quarter, and the fitted trend lines show predicted values for segmented time-series regressions for pre-NCD and post-NCD periods (adjusted only for temporal trends). The shaded bar represent transitional quarter between policy period, not included in this analysis.

TABLE 1

Patient Characteristics

Characteristics	Pre-NCD (N = 17,127)			Post-NCD (N = 29,903)			Overall (N = 47,030)			P
	Mean	SD		Mean	SD		Mean	SD		
Age	51.0	±11.1		54.0	±11.7		52.9	±11.6		<0.001
	n	%		n	%		n	%		
Age category										<0.001
18-<22	26	0.15		33	0.11		59	0.13		
22-<35	1430	8.35		1963	6.57		3393	7.22		
35-<45	3441	20.10		4782	15.99		8223	17.49		
45-<55	5259	30.72		7424	24.83		12,683	26.97		
55-<65	4513	26.36		7854	26.27		12,367	26.30		
65 +	2451	14.32		7843	26.23		10,294	21.89		
Female	13,139	76.78		22,339	74.73		35,478	75.48		<0.001
Race or ethnic group										<0.001
White	13,754	80.34		24,338	81.40		38,092	81.01		
Black	2671	15.60		4255	14.23		6926	14.73		
Hispanic	362	2.11		600	2.01		962	2.05		
Other	285	1.66		522	1.75		807	1.72		
Unknown	48	0.28		184	0.62		232	0.49		
Type of operation										<0.001
ORYGB*	9583	55.95		3819	12.77		13,402	28.50		
LRYGB†	6081	35.51		14,561	48.69		20,642	43.89		
L AGB‡	244	1.42		10,960	36.65		11,204	23.82		
Other	1219	7.12		563	1.88		1782	3.79		
Charlson comorbidity index										<0.001
0	6757	39.45		11,420	38.19		18,177	38.65		
1	6631	38.72		11,675	39.04		18,306	38.92		
2	2737	15.98		4583	15.33		7320	15.56		
3 +	1002	5.85		2225	7.44		3227	6.86		

* Open roux-en-y gastric bypass.

[†] Laparoscopic roux-en-y gastric bypass.

[‡] Laparoscopic adjustable gastric band.

TABLE 2

Changes from Pre- and Post-NCD According to Surgical Procedure

	Pre-NCD (N = 17,127)		Post-NCD (N = 29,903)		Overall (N = 47,030)	
	n	%	n	%	n	P
90-day all cause mortality	248	1.45	217	0.73	465	0.99
ORYGB [*]	173	1.81	63	1.65	236	1.76
LRYGB [†]	64	1.05	111	0.76	175	0.85
L AGB [‡]	0	0	33	0.30	33	0.29
Other	11	0.90	10	1.78	21	1.18
90-day reoperative complications [§]	552	3.22	556	2.11	1108	2.55
ORYGB [*]	338	3.53	199	5.60	537	4.09
LRYGB [†]	196	3.22	324	2.52	520	2.74
L AGB [‡]	2	0.82	25	0.26	27	0.28
Other	16	1.31	8	1.61	24	1.40
90-day readmissions [§]	3405	19.88	4047	15.36	7452	17.14
ORYGB [*]	2114	22.06	840	23.63	2954	22.48
LRYGB [†]	1096	18.02	2220	17.26	3316	17.50
L AGB [‡]	28	11.48	875	9.27	903	9.33
Other	167	13.70	112	22.54	279	16.26
90-day payments (in 2008 dollars) [§]	23,653	26,027	19,171	20,808	20,936	23,109
ORYGB [*]	24,898	27,992	24,357	32,001	24,751	29,131
LRYGB [†]	22,515	23,304	20,207	19,890	20,948	21,073
L AGB [‡]	15,512	10,434	15,364	14,071	15,368	13,990
Other	21,179	24,296	27,545	32,778	23,023	27,171

^{*} Open roux-en-y gastric bypass.[†] Laparoscopic roux-en-y gastric bypass.[‡] Laparoscopic adjustable gastric band.

[§]Reported for bariatric patients January 1, 2004 to September 30, 2008 (n = 43,483).