



The Second Annual  
HealthGrades  
Bariatric Surgery Trends  
In American Hospitals Study

July 2007



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GUIDING AMERICA TO BETTER HEALTHCARE®

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HEALTHGRADES

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***Executive Summary***

Morbid obesity is recognized as a major public health problem in America that contributes to serious health risks. Bariatric surgery has been demonstrated to be a highly effective therapy to reduce the consequences of the serious health risks from morbid obesity, such as severe sleep apnea, heart disease and diabetes.<sup>1</sup> As a result, bariatric surgery has proliferated across the United States in recent years. A recent study by the Agency for Healthcare Research and Quality identified that from 1998 to 2004, the total number of bariatric surgeries increased nine-fold, from 13,386 to 121,055.<sup>2</sup>

Despite this explosive growth, bariatric surgery is not yet a regulated or credentialed surgical subspecialty. Although strict evidence-based quality indicators are emerging and being adopted by Centers of Excellence (COE), little comparative public information is available on hospital- or physician-specific bariatric surgery outcomes. While many bariatric surgery programs have excellent outcomes and positively change the lives and health of many people, bariatric surgeries performed by an inexperienced center or surgeon can have disastrous outcomes.

Since 1998, HealthGrades has studied and measured outcomes associated with a wide array of common inpatient procedures and diagnoses at the nation's 5,000 plus hospitals, and published the results of its annual research on the Web to assist consumers in choosing a hospital. In this second annual report, HealthGrades studied and measured the risk-adjusted in-hospital complication rate associated with bariatric surgery programs affiliated with hospitals in 19 states. In Part 1 of this *Second Annual HealthGrades Bariatric Surgery Trends in American Hospitals Study*, millions of all-payer discharges from 2003 through 2005 were analyzed. Risk-adjusted complication rates were calculated and hospitals were assigned a 1-star (poor), 3-star (as expected), or 5-star (best) quality rating for bariatric surgery. Individual hospital quality results from this study are available at [www.healthgrades.com](http://www.healthgrades.com).

This study and the first annual study<sup>3</sup> demonstrated that there was significant variation in in-hospital outcomes associated with bariatric surgery. This finding underscores that bariatric surgery, while the most beneficial intervention for morbid obesity, can carry significant risks, which can vary widely depending on the hospital. Thus, with the large increase in morbid obesity, there is enormous value and importance in making this type of quality information readily available to prospective patients who are deciding where to go for their medical treatments.

For the second part of this study, HealthGrades analyzed overall trends associated with bariatric surgery from 2003 through 2005 among 731 hospitals located in 19 states. The 19 states included in this study are:

Arizona	Maine	New Jersey	Pennsylvania	Virginia
California	Maryland	New York	Rhode Island	Washington
Florida	Massachusetts	North Carolina	Texas	Wisconsin
Iowa	Nevada	Oregon	Utah	

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## Executive Summary of Findings

Key findings of this study include:

- 1 Within the hospitals located in the 19 states studied, 166,410 bariatric surgery procedures were performed from 2003 to 2005. In last year's study, the growth rate in the number of surgeries increased by 45 percent in 2004 compared to 2002 (55,198 and 38,050, respectively). In this study, **the growth rate has remained relatively flat** between 2005 compared to 2003 (54,156 and 55,487 respectively).
  - Of the 731 hospitals that performed at least one case during the study period, 250 hospitals (34%) performed fewer than 30 cases during 2003 to 2005 or fewer than five cases in 2005, leaving 481 hospitals with adequate volume to receive a rating.
  - During 2003 to 2005, 81 percent of all patients had private insurance compared with only 13 percent who had Medicare or Medicaid.
  - During 2003 to 2005, almost four out of every 100 patients (3.66%) were self-pay, but this number continues to increase (a 62 percent growth from 2003 to 2005; 1,657 and 2,694, respectively).
  - Among the 19 states studied, almost half of all the procedures were performed in just four states—New York, Pennsylvania, Texas and Florida.
  - Nevada, Maryland and New York had the largest growth in number of procedures performed, with a third to two thirds more cases in 2005 compared to 2003.
- 2 As compared to last year's results, this year's findings show that there is a **trend away from traditional, more invasive gastric bypass to a less invasive laparoscopic procedure**. Over 70 percent of the bariatric surgeries done in 2005 were laparoscopic. Not surprisingly, on average, we found that laparoscopic procedures were associated with fewer in-hospital complications than traditional gastric bypass.
- 3 Large **quality gaps existed between the "best" and the "worst" hospitals** across the bariatric procedures studied.
  - Of the 481 hospitals that received a rating, 109 (22.7%) received a 5-star (best) rating; 257 (53.4%) received a 3-star (average) rating; 115 (23.9%) received a 1-star (worst) rating.
  - Five-star rated hospitals performed, on average, almost twice the number of procedures during the three-year study period compared to 1-star rated hospitals (533 and 293, respectively).
  - A typical patient undergoing a bariatric surgery procedure in a 5-star rated hospital would have, on average, a 64 percent lower chance of developing one or more major in-hospital complications compared to a 1-star rated hospital and a 41 percent lower chance of developing one or more major in-hospital complications compared to all study hospitals. The most common major complications include respiratory, bleeding, gastrointestinal and laceration complications.
  - Two hundred and fifty patients died in-hospital from complications of bariatric surgery during the study period. The average U.S. mortality rate during the study period was 0.15 percent, or 1.5 patients per 1,000. While the absolute overall mortality rate was low for most hospitals, the mortality rate in 5-star rated hospitals was almost half the rate of all other U.S. hospitals.
  - The average length of stay was 26 percent shorter in 5-star as compared to the 1-star rated hospitals.
- 4 If all hospitals performed at the level of a 5-star rated hospital, **5,902 out of the 166,410 patients could have potentially avoided one or more major in-hospital complications** from 2003 to 2005.

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## **Methods Part 1:**

### **The Bariatric Surgery Hospital Quality Rating Methodology**

To help consumers evaluate and compare hospital performance, HealthGrades analyzed patient outcome data for all patients (all-payer data) provided by individual states for years 2003 through 2005. Ratings were based on HealthGrades' risk-adjusted methodology described in the *Multivariate Logistic Regression-Based Ratings* section of this report.

The purpose of risk adjustment is to obtain fair statistical comparisons between disparate populations or groups. Significant differences in demographic and clinical risk factors are found among patients treated in different hospitals. Risk adjustment of the data is needed to make accurate and valid comparisons of clinical outcomes at different hospitals.

### **Data Acquisition**

For the bariatric surgery hospital ratings, all-payer state data were used in those states where state data are available. For multivariate logistic regression-based ratings (see below), HealthGrades conducted a series of data quality checks to preserve the integrity of the ratings. Based on the results of these checks, we excluded a limited number of cases because they were inappropriate for inclusion in the database or miscoded.

Examples of excluded patient records were:

- Patients who left the hospital against medical advice or who were transferred to another acute care hospital.
- Patients who were still in the hospital when the claim was filed.
- Patients with an invalid gender.

### **Methodology for Rating Hospitals**

Fair and valid comparisons between hospital providers can be made only to the extent that the risk-adjustment methodology considers important differences in patient demographic and clinical characteristics. The risk-adjustment methodology used by HealthGrades defines risk factors as those clinical and demographic variables that influence patient outcomes in significant and systematic ways. Risk factors may include age, gender, specific procedure performed, and comorbid conditions such as hypertension, chronic renal failure, heart failure and diabetes. The methodology is disease-specific and outcome-specific. This means that individual risk models are constructed and tailored for each clinical condition or procedure using multivariate logistic regression.

### **Multivariate Logistic Regression-Based Ratings**

The initial analysis of the data utilized 19 states of all-payer data from 2003 through 2005. Bariatric surgery patients were identified by their ICD-9 principal procedure of a bariatric surgical procedure and a principal diagnosis of obesity/morbid obesity (see Table 1)—a definition previously described by Santry et al.<sup>4</sup> (Patients under the age of 18 years were excluded.)

For this population, potential risk factors and the outcome measures (complications) were then defined.

- 1 Potential risk factors were defined as all clinically relevant diagnoses occurring in more than 0.5 percent of the patients. In addition, patient demographic factors such as age and gender and the specific procedure performed

on the patient were also considered. Some diagnosis codes were merged together (e.g., primary and secondary pulmonary hypertension) to minimize the impact of coding variations.

- 2 Complications were identified using previous peer-reviewed research<sup>4,9</sup> and through input from clinical and coding experts.

In some cases an ICD-9 code can be either a risk or a complication. In these cases, a code is differentiated by the presence or absence of a 900 post-operative complication code. For example, in the case where a patient record contains "427.31 Atrial Fibrillation," that code is considered a risk if it occurs by itself and a complication if there is a corresponding "997.1 Cardiac Complications NEC" code also present in the patient record. Outcomes were binary, with documented major complications either present or not. Mortality is considered a major complication. Table 2 lists the major complications for bariatric surgery.

**Table 1: Bariatric Surgery Cohort and Related ICD-9 Codes**

<b>Principal Procedures and Diagnoses – Inclusions:</b>
Procedure 44.31, 44.38, 44.39, 44.68, 44.93, 44.95, 45.51, or 45.91
Diagnosis 278.00, 278.01
<b>Procedures – Exclusions:</b>
44.5, 44.94, 44.96, 44.97
<b>Demographic – Exclusions:</b>
Patients under the age of 18 years

For a complete list of the over 400 diagnosis exclusion codes, please see the *Hospital Report Cards™ Bariatric Surgery Methodology* at [www.healthgrades.com](http://www.healthgrades.com).

**Table 2: Major Complications – Bariatric Surgery**

Major Complications – Bariatric Surgery	
<b>Respiratory Complications</b>	<b>Stroke</b>
31.1, 31.29, 480, 480.0, 480.1, 480.2, 480.3, 480.8, 480.9, 481, 482, 482.0, 482.1, 482.2, 482.3, 482.30, 482.31, 482.32, 482.39, 482.4, 482.40, 482.41, 482.49, 482.8, 482.81, 482.82, 482.83, 482.84, 482.89, 482.9, 483, 483.0, 483.1, 483.8, 484, 484.1, 484.3, 484.5, 484.6, 484.7, 484.8, 485, 486, 518.5, 518.81, 518.0, 997.3	431, 433.00, 433.01, 433.10, 433.11, 433.20, 433.21, 433.30, 433.31, 433.80, 433.81, 433.90, 433.91, 434.00, 434.01, 434.10, 434.11, 434.90, 434.91, 436, 437.1
<b>Cardiac Complications</b>	<b>Digestive System Complications</b>
427.0, 427.1, 427.41, 427.31, 427.89, 410.01, 410.11, 410.21, 410.31, 410.41, 410.51, 410.61, 410.71, 410.81, 410.91, 997.1	560.0, 560.1, 560.2, 560.30, 560.39, 560.81, 560.89, 560.9, 564.2, 578.9, 997.4, 998.6
<b>Urinary Complications/Acute Renal Failure</b>	<b>Hemorrhage/Surgical Wound Complications</b>
38.95, 39.95, 584.5, 584.8, 584.9, 599.0, 997.5	44.61, 54.12, 54.61, 54.91, 54.92, 99.04, 998.0, 998.11, 998.12, 998.2, 998.31, 998.32
<b>Splenic Injury</b>	<b>Post-Operative Infections</b>
41.2, 41.43, 41.5, 41.95	038.9, 038.0, 038.1, 038.10, 038.11, 038.19, 038.2, 038.3, 038.4, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038, 998.51, 998.59
<b>Pulmonary/Venous Embolism</b>	
415.11, 415.19, 453.8, 453.9	

For more details regarding the specific ICD-9 codes identified as complications, please see the *Hospital Report Cards™ Bariatric Surgery Methodology* at [www.HealthGrades.com](http://www.HealthGrades.com).

## Developing the HealthGrades Bariatric Surgery Ratings

Developing the HealthGrades Bariatric Surgery ratings involved four steps.

- 1 First, the predicted value (predicted complications) was obtained using a logistic regression model discussed in the next section.
- 2 Second, the predicted value was compared with the actual or observed number of complications. Only hospitals with at least 30 cases across three years of data and at least five cases in the most current year were included.
- 3 Third, a test was conducted to determine whether the difference between the predicted and actual values was statistically significant. This test was performed to make sure that differences were very unlikely to be caused by chance alone.
- 4 Fourth, a star rating was assigned based upon the outcome of the statistical test.

The following rating system was applied to the data for all procedures and diagnoses:

- ★★★★★ Best—Actual performance was better than predicted and the difference was statistically significant.
- ★★★ As Expected—Actual performance was not significantly different from what was predicted.
- ★ Poor—Actual performance was worse than predicted and the difference was statistically significant.

## Statistical Models

Using the list of potential risk factors described above, we used logistic regression to determine to what extent each potential risk factor was correlated with the quality measure (complications). A risk factor stayed in the model if it had an odds ratio greater than one (except clinically relevant procedures, cohort defining principal diagnoses, and some protective factors as documented in the medical literature were allowed to have an odds ratio less than one) and was also statistically significant ( $p < 0.05$ ).

Complications were *not* counted as risk factors as they were considered a result of care received during the admission. Table 3 lists several examples of risk factors for bariatric surgery. Risk factors are those diagnoses that are the most highly correlated with the outcomes studied (complications). The most highly correlated risk factors are not necessarily those with the highest volume.

The statistical model was checked for validity and finalized. The final model was highly significant, with a C-statistic of 0.646. This model was then used to estimate the probability of a complication for each patient in the cohort. Patients were then aggregated for each hospital to obtain the predicted number of complications for each hospital. Statistical significance tests were performed to identify, by hospital, whether the actual and predicted rates were significantly different.

**Table 3: Top Five Diagnosis Risk Factors – Bariatric Surgery**

Diag 285.9	ANEMIA, UNSPECIFIED
Diag 518.0	PULMONARY COLLAPSE (must occur without code 997.3 Respiratory Complication, NEC)
Diag 428.0	CONGESTIVE HEART FAILURE, UNSPECIFIED
Diag V64.41	CONVERT LAP PROCEDURE TO OPEN
Diag 493.20	CHRONIC OBSTRUCTIVE ASTHMA

### ***Limitations of the Data Models***

It must be understood that while these models may be valuable in identifying hospitals that perform better than others, one should not use this information alone to determine the quality of care provided at each hospital. The models are limited by the following factors:

- Cases may have been coded incorrectly or incompletely by the hospital.
- The models can only account for risk factors that are coded into the billing data—if a particular risk factor was not coded into the billing data, such as a patient’s socioeconomic status and health behavior, then it was not accounted for with these models.
- Although Health Grades, Inc. has taken steps to carefully compile these data using its methodology, no techniques are infallible, and therefore some information may be missing, outdated or incorrect.

Please note that a high ranking for a particular hospital is not a recommendation or endorsement by Health Grades, Inc. of a particular hospital; it means that the data associated with a particular hospital has met the foregoing qualifications. Only individual patients can decide whether a particular hospital is suited for their unique needs.

Also note that if more than one hospital reported to CMS under a single provider ID, HealthGrades analyzed patient outcome data for those hospitals as a single unit. Throughout this document, therefore, “hospital” refers to one hospital or a group of hospitals reporting under a single provider ID.

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## **Results Part 1: Hospital Bariatric Surgery Ratings**

HealthGrades' ratings of 481 hospitals, based on *The Second Annual HealthGrades Bariatric Surgery Trends in American Hospitals Study*, can be found at [www.healthgrades.com](http://www.healthgrades.com).

For bariatric surgery,

- 109 hospitals (22.7%) stand out as “best” performers (5-star rated)
- 257 hospitals (53.4%) were rated as “as expected” performers (3-star rated)
- 115 hospitals (23.9%) were rated as “poor” performers (1-star rated)

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## **Results Part 2: Bariatric Surgery Trends**

The purpose of the second part of the study was to evaluate trends in bariatric surgery in hospitals located within the 19 states that provide all-payer data. In Part 1, the actual (observed) and predicted (expected) in-hospital complication rates associated with various bariatric surgery procedures were calculated and aggregated for each hospital.

In Part 2, procedure type and volume, payer type, and observed mortality rates were also evaluated for trends. Overall performance comparisons between 5-, 3- and 1-star rated hospitals were compared using observed-to-expected ratios (O/E ratios).

- An **O/E ratio of less than one** means that the patient population measured had **fewer complications** than expected.
- An **O/E of greater than one** means that the patient population measured had **more complications** than expected.

Within the hospitals located in the 19 states studied:

- In total, 166,410 bariatric surgery procedures were performed in 731 hospitals from 2003 through 2005 (Table 4a).
- Nearly half (47.77%) of all the procedures were performed in just four states—New York, Pennsylvania, Texas and Florida (Table 6).
- Nevada, Maryland and New York had the largest growth (range: 31.90% to 65.15%) in number of procedures performed, resulting in 36.64 percent more cases in 2005 compared to 2003 (Table 6).



Of the 731 hospitals that performed at least one bariatric surgery procedure in 2003 through 2005:

- Thirty-four (34.2) percent (n=250) performed fewer than 30 cases during the study period or fewer than five in 2005, and did not receive a 1-, 3- or 5-star rating (Table 4a).
- The remaining 481 hospitals performed more than 30 cases during the study period and had five or more cases in 2005 and received a star rating (Table 4a).
- Eighty-one (81.17) percent of patients had private insurance compared with 12.82 percent who had Medicare or Medicaid. However, Medicare and Medicaid-based procedural volume grew by 5.02 percent while private insurance-based procedural volume declined 6.52 percent (Table 5).
- Almost four out of 100 patients (3.66%) were self-pay—a 62.58-percent increase in 2005 compared to 2003 (2,694 and 1,657, respectively) (Table 5).
- Growth in the number of procedures performed from 2003 through 2005 across the 19 states varied widely, from a decline of 51.29 percent in Iowa to an increase of 65.15 percent in Nevada. However, as an aggregate, average growth associated with bariatric surgery across the 19 states declined by 2.40 percent (from 55,487 to 54,156) (Table 6).

**Table 4a: Bariatric Surgery Trends Across U.S. Hospitals (2003 - 2005)**

Hospital Bariatric Surgery Star Rating	Number of Hospitals	Average Patient Age (Years)	Average Volume (2003-2005)	Inhospital Unadjusted Mortality Rate	Pvalue (Mortality Compared to U.S.)
1-Star	115	42.62	293	0.20%	< 0.001
3-Star	257	42.61	262	0.14%	NS
5-Star	109	42.28	533	0.08%	< 0.001
U.S. Average*	731	42.03	331	0.15%	-

\*U.S. average includes all hospitals (rated and not rated).

**Table 4b: Bariatric Surgery Trends Across U.S. Hospitals (2003 - 2005)**

Hospital Bariatric Surgery Star Rating	Observed Inhospital Complication Rate	Expected Inhospital Complication Rate	Observed to Expected Complication Ratio	Pvalue (O:E Compared to U.S.)	Average Length of Stay (Days)
1-Star	16.07%	9.75%	1.65	< 0.001	3.45
3-Star	9.16%	9.34%	0.98	NS	3.03
5-Star	5.60%	9.43%	0.59	< 0.001	2.57
U.S. Average*	9.50%	9.50%	1.00	-	2.95
Relative difference between 5-star compared to 1-star	65.15%	3.28%	64.24%	< 0.001	25.66%
Relative difference between 5-star and the U.S. Average*	41.05%	0.74%	41.00%	< 0.001	12.88%

\*U.S. average includes all hospitals (rated and not rated).

**Table 5: Bariatric Surgery Hospital Volume Trends by Payer and Year (2003 - 2005)**

Payer	2003	2004	2005	2003-2005	% of Total Cases 2003-2005	% Change from 2003 to 2005
Blue Cross	10,076	13,418	10,271	33,765	20.29%	1.94%
Blue Cross HMO	3,075	817	3,891	7,783	4.68%	26.54%
Champus	949	905	1,289	3,143	1.89%	35.83%
Fee-For-Service	13,971	13,991	6,627	34,589	20.79%	(52.57%)
HMO	11,186	9,218	11,850	32,254	19.38%	5.94%
HMO/PPO	1,119	1,577	1,417	4,113	2.47%	26.63%
Medicaid	3,380	1,409	1,439	6,228	3.74%	(57.43%)
Medicaid Risk	784	847	1,897	3,528	2.12%	141.96%
Medicare	3,046	3,738	4,200	10,984	6.60%	37.89%
Medicare Risk	247	76	274	597	0.36%	10.93%
Other	1,451	1,280	220	2,951	1.77%	(84.84%)
Other Government	782	1,014	817	2,613	1.57%	4.48%
PPO	3,468	6,244	6,776	16,488	9.91%	95.39%
Self-pay	1,657	1,733	2,694	6,084	3.66%	62.58%
Unknown	253	481	470	1,204	0.72%	85.77%
Worker's Compensation	43	19	24	86	0.05%	(44.19%)
<b>All</b>	<b>55,487</b>	<b>56,767</b>	<b>54,156</b>	<b>166,410</b>	<b>100.00%</b>	<b>(2.40%)</b>

**Table 6: Bariatric Surgery Hospital Volume Trends by State and Year (2003 - 2005)**

State	2003	2004	2005	2003-2005	% of Total Cases (2003-2005)	% Change from 2003 to 2005
Arizona	2,279	2,167	1,745	6,191	3.72%	(23.43%)
California	4,785	5,346	5,437	15,568	9.36%	13.63%
Florida	6,799	6,414	4,487	17,700	10.64%	(34.01%)
Iowa	1,556	1,041	758	3,355	2.02%	(51.29%)
Maine	482	575	551	1,608	0.97%	14.32%
Maryland	1,133	1,495	1,669	4,297	2.58%	47.31%
Massachusetts	2,640	2,904	2,735	8,279	4.98%	3.60%
Nevada	637	678	1,052	2,367	1.42%	65.15%
New Jersey	3,883	3,759	3,604	11,246	6.76%	(7.19%)
New York	6,382	7,246	8,418	22,046	13.25%	31.90%
North Carolina	2,642	2,605	2,437	7,684	4.62%	(7.76%)
Oregon	841	722	741	2,304	1.38%	(11.89%)
Pennsylvania	6,361	7,090	6,712	20,163	12.12%	5.52%
Rhode Island	333	303	263	899	0.54%	(21.02%)
Texas	6,308	6,506	6,773	19,587	11.77%	7.37%
Utah	1,011	783	781	2,575	1.55%	(22.75%)
Virginia	4,247	3,927	3,166	11,340	6.81%	(25.45%)
Washington	1,482	1,301	1,344	4,127	2.48%	(9.31%)
Wisconsin	1,686	1,905	1,483	5,074	3.05%	(12.04%)
<b>All</b>	<b>55,487</b>	<b>56,767</b>	<b>54,156</b>	<b>166,410</b>	<b>100.00%</b>	<b>(2.40%)</b>

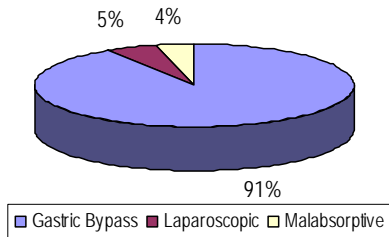
Ninety-seven and a half percent of all bariatric surgeries performed from 2003 through 2005 in the 19 states studied were gastric bypass or laparoscopic procedures (Table 8). While gastric bypass procedures make up the majority of bariatric surgeries, the volume of laparoscopic surgeries is growing (Graphic 1).

Twenty-eight percent of all bariatric surgeries studied during 2003-2005 were laparoscopic as compared to only 5.3 percent in 2002-2004 (Graph 1). As compared to last year's results, this year's findings show that there is a trend away from traditional, more invasive gastric bypass to a less invasive laparoscopic procedure. Not surprisingly, on average, we found that laparoscopic procedures were associated with fewer in-hospital complications than traditional gastric bypass, and this difference was most notable for 1-star rated hospitals (Table 8). Over 70 percent of the procedures performed in 2005 were laparoscopic (Table 9).

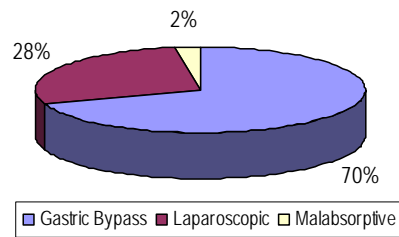
Substantial variation in volume, mortality, average length of stay and risk-adjusted in-hospital complications across hospitals was noted. Five-star rated hospitals had, on average, significantly higher total volume during the three-year study period compared to 3-star and 1-star rated hospitals (533 vs. 262, and 293, respectively) (Table 4a). We found the average U.S. mortality rate during the study period was very low (0.15%, or 1.5 patients per 1,000), and was low across different star-rating performance categories. Although absolute rates were very low, 5-star rated hospitals had a 46.67 percent lower unadjusted in-hospital mortality rate (0.08%) compared to the U.S. average (0.15%) and a 60.00 percent lower unadjusted in-hospital mortality rate compared to 1-star rated hospitals (0.20%) (Table 4a).

## Graph 1: Rates of Various Bariatric Surgical Procedures

**Graph 1a:**  
Rates of Various Bariatric Surgical Procedures  
in 17 States (2002-2004)<sup>3</sup>  
n=147,022



**Graph 1b:**  
Rates of Various Bariatric Surgical Procedures  
in 19 States (2003-2005)  
n=166,410



See Table 8 for details

Although little variation in absolute in-hospital mortality rates was observed, highly variable unadjusted and adjusted in-hospital complications were noted across hospitals. The average complication rate associated with the inpatient bariatric surgical procedures performed in the 19 states studied from 2003 through 2005 was 9.50 percent (Table 4b and 8). The most commonly occurring in-hospital complications are shown in Table 7. Most were pulmonary, gastrointestinal, laceration and bleeding complications.

**Table 7: Top Five In-hospital Complications Associated with Bariatric Surgery (2003 – 2005)**

Description	% of All Patients
Surgical Complication of Respiratory System	1.45
Surgical Complication of Gastrointestinal System	1.28
Post-operative Pulmonary Insufficiency	1.19
Hemorrhage Complicating Procedure	1.14
Accidental Operative Laceration	1.08

While the overall in-hospital complication rate across all bariatric surgeries studied in 19 states from 2003 through 2005 was 9.5 percent, 5-star rated hospitals had significantly lower than expected in-hospital complication rates across the various bariatric procedure types. This finding was also associated with significantly lower observed complication rates and significantly better risk-adjusted outcomes. Five-star hospitals were 65.15 percent and 64.24 percent lower ( $P < 0.001$ ), respectively, compared to 1-star rated hospitals and 41.05 percent and 41.00 percent lower ( $P < 0.001$ ), respectively, compared to the U.S. average (Tables 4a, 4b, and 8).

Using the 5-star observed-to-expected complications ratio as a benchmark of performance, **5,902 out of the 166,410 patients who had procedures in 19 states could have potentially avoided one or more major in-hospital complications** from 2003 to 2005 if all hospitals performed at the level of a 5-star rated hospital.

**Table 8: Bariatric Surgery Hospital Outcomes by Procedure Type**

ICD-9 Procedure Code	Procedure Type	Star Rating	Case Volume	Observed Inhospital Complication Rate	Expected Inhospital Complication Rate	Observed-to-Expected Ratio	95% CI (O/E Ratio)	Relative Difference of 5-star Compared to 1-star	Relative Difference of 5-star Compared to 3-star	Number of Patients with Potentially Avoidable Inhospital Complications (as Compared to 5-star)
<b>Gastric Bypass</b>										
44.31	High Gastric Bypass	1	11,799	16.37%	10.02%	1.63	1.58 - 1.69	61.34%	35.71%	1,936
		3	21,281	9.87%	10.08%	0.98	0.94 - 1.02			
		5	21,162	6.03%	9.58%	0.63	0.59 - 0.67			
		U.S.*	58,462	9.99%	9.93%	1.01	0.98 - 1.03			
44.39	Other Gastroenterostomy	1	12,214	18.42%	11.22%	1.64	1.59 - 1.69	65.24%	41.23%	2,479
		3	24,099	10.28%	10.60%	0.97	0.93 - 1.01			
		5	18,900	6.23%	10.88%	0.57	0.53 - 0.61			
		U.S.*	57,246	10.91%	10.85%	1.01	0.98 - 1.03			
<b>Laparoscopic</b>										
44.38	Laparoscopic Gastroenterostomy	1	7,488	12.71%	7.68%	1.66	1.58 - 1.73	62.65%	36.73%	1,068
		3	16,892	7.64%	7.78%	0.98	0.93 - 1.03			
		5	13,522	4.78%	7.70%	0.62	0.56 - 0.68			
		U.S.*	38,493	7.66%	7.73%	0.99	0.96 - 1.02			
44.68	Laparoscopic Gastroplasty	1	180	10.56%	4.13%	2.55	1.86 - 3.25	67.84%	31.09%	29
		3	1,014	5.03%	4.21%	1.19	0.90 - 1.49			
		5	682	4.25%	5.18%	0.82	0.50 - 1.14			
		U.S.*	1,901	5.26%	4.55%	1.16	0.95 - 1.36			
44.95	Laparoscopic Gastric Restrictive Procedure	1	867	5.19%	3.84%	1.35	1.02 - 1.68	76.30%	52.94%	75
		3	3,028	2.58%	3.77%	0.68	0.50 - 0.86			
		5	2,162	1.20%	3.71%	0.32	0.11 - 0.54			
		U.S.*	6,242	2.52%	3.77%	0.67	0.54 - 0.79			

**Table 8: Bariatric Surgery Hospital Outcomes by Procedure Type (continued)**

ICD-9 Procedure Code	Procedure Type	Star Rating	Case Volume	Observed Inhospital Complication Rate	Expected Inhospital Complication Rate	Observed-to-Expected Ratio	95% CI (O/E Ratio)	Relative Difference of 5-star Compared to 1-star	Relative Difference of 5-star Compared to 3-star	Number of Patients with Potentially Avoidable Inhospital Complications (as Compared to 5-star)
<b>Malabsorptive</b>										
45.51	Isolation of Segment of Small Intestine	1	50	20.00%	16.65%	1.20	0.60 - 1.81	100.00%	100.00%	13
		3	21	14.29%	13.78%	1.04	-0.02 - 2.10			
		5	7	0%	19.35%	0	-1.50 - 1.48			
		U.S.*	91	14.29%	15.81%	0.90	0.44 - 1.37			
45.91	Small-to-Small Intestinal Anastomosis	1	1,152	18.84%	9.88%	1.91	1.74 - 2.08	79.58%	72.92%	302
		3	1,119	16.00%	11.11%	1.44	1.28 - 1.60			
		5	1,634	5.69%	14.42%	0.39	0.28 - 0.51			
		U.S.*	3,974	12.73%	12.17%	1.05	0.97 - 1.13			
<b>Other</b>										
44.93	Insert Gastric Bubble	1	0	NA	NA	NA	NA	NA	NA	NA
		3	1	100.00%	3.41%	29.30	NA			
		5	0	NA	NA	NA	NA			
		U.S.*	1	100.00%	3.41%	29.30	NA			
<b>All Bariatric Surgery Procedures</b>		1	33,750	16.07%	9.75%	1.65	1.62 - 1.68	64.24%	39.80%	5,902
		3	67,455	9.16%	9.34%	0.98	0.96 - 1.00			
		5	58,069	5.60%	9.43%	0.59	0.57 - 0.62			
		U.S.*	166,410	9.50%	9.50%	1.00	0.99 - 1.01			

\*U.S. includes aggregate performance of all hospitals (rated or unrated) that performed one or more bariatric surgery cases during the study period within the 19 states studied.

**Table 9: Frequency of Bariatric Surgery Codes by Year**

ICD-9 Procedure Code	Procedure Type	2003	2004	2005	Total
<b>Gastric Bypass</b>					
44.31	High Gastric Bypass	41,124	13,637	3,701	58,462
44.39	Other Gastroenterostomy	12,192	33,726	11,328	57,246
<b>Laparoscopic</b>					
44.38*	Laparoscopic Gastroenterostomy	0	6,817	31,676	38,493
44.68*	Laparoscopic Gastroplasty	0	308	1,593	1,901
44.95*	Laparoscopic Gastric Restrictive Procedure	0	926	5,316	6,242
<b>Malabsorptive</b>					
45.51	Isolation of Segment of Small Intestine	58	28	5	91
45.91	Small-to-Small Intestinal Anastomosis	2,112	1,325	537	3,974
<b>Other</b>					
44.93	Insert Gastric Bubble	1	0	0	1

\*Codes 44.38, 44.68, and 44.95 became effective October 1, 2004.

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## Discussion

This second annual study of an adult all-payer population undergoing bariatric surgery in hospitals in 19 states from 2003 through 2005 found that bariatric surgery has rapidly proliferated over the years, but in most recent years, is starting to level off. Bariatric surgery is an effective treatment for preventing the numerous complications of morbid obesity and our findings suggest it is relatively safe and associated with low mortality, consistent with other recent studies.<sup>5,6</sup> However, while generally safe, this study finds that the variation in outcomes among the hospitals studied is significant and this variation can impose significant risk to the patient.

Assuming all hospitals in the 19 states studied could perform at the level of the top-performing hospitals **5,902 patients could have potentially avoided one or more major in-hospital complications associated with bariatric surgery**. Similar to our study last year, we found that on average, almost one in 10 patients will develop one or more major in-hospital complications associated with a bariatric surgery hospitalization.

Although the rate of growth in total bariatric surgery volume has slowed since 2003 in the 19 states studied, self-pay and managed care patients continued to be a fast growing population choosing bariatric surgery. Approximately 40 percent of all cases in the 19 states studied were self-pay or managed care patients. This finding underscores the increasing acceptance by physicians, patients and payers that the benefits of surgery, with its associated improvement or resolution of obesity-related comorbidities, such as diabetes and heart disease, outweigh its associated costs (\$30,000).<sup>7</sup>

Although controversial in other types of surgeries, we found that **higher volume was associated with better outcomes in bariatric surgery**. This finding is consistent with other previous studies<sup>8,9</sup> and the American College of Surgeons<sup>10</sup> recommendations on hospital and surgeon bariatric surgery volume. This study found that top-performing hospitals had, on average, almost twice the annual volume as bottom-performing hospitals (178 cases vs. 98 cases per year, respectively).

While we found growth in number of procedures has slowed since 2003, we also identified a significant shift from more traditional, invasive types of surgeries to less invasive, laparoscopic procedures. Considering the well-documented explosion of both morbid obesity and its most effective treatment, we would expect to see continued growth, especially propelled by the less invasive surgical procedures that we found to be associated with lower complications across all hospital star-rating performance categories.

*The Second Annual Bariatric Surgery Trends in American Hospitals Study* evaluated and identified national outcomes trends in 19 states. In this follow-up study, we found that bariatric surgery while relatively safe, can have significant risks and the potential for these adverse outcomes varies by hospital. This variation in in-hospital outcomes and volume among the hospitals studied was significant and continues to persist. This key finding should underscore the importance of appropriate patient selection, hospital and physician expertise, and patient and family access to hospital- and surgeon-specific volume and outcomes for informed decision making.



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