



HEALTHGRADES® Hospital Report Card™ Bariatric Surgery Methodology 2012 (2008-2010 Data)

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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.¹ As a result, bariatric surgery has proliferated across the United States in recent years.

To help consumers evaluate and compare hospital performance in bariatric surgery, HealthGrades analyzed patient outcome data for all patients (all-payer data, inpatient only) provided by 19 individual states for years 2008 through 2010. Ratings were based on HealthGrades' risk-adjustment methodology, and the HealthGrades ratings are available on the Internet at www.healthgrades.com.

The purpose of risk adjustment is to obtain fair statistical comparisons among 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. These data were chosen because they represent virtually all discharges (all ages) for the associated states; however, patient volumes may differ due to data masking by state agencies to protect patient privacy. The data represent three years of discharges. The 19 states evaluated were as follows:

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

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.

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.
- Patients with an invalid age.

Multivariate Logistic Regression-Based Ratings

The initial analysis of the data utilized 19 states of all-payer data from 2008 through 2010. 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 *Appendix A*). Patients under the age of 18 were excluded.

For this population, potential risk factors and the outcome measure (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^{2,3} 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. *Appendix B* lists the major complications for bariatric surgery.

Developing 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 one 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. 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. (See *Appendix C* for the Top Five Diagnosis/Procedure Risk Factors.)

The statistical model was checked for validity and finalized. The final model was highly significant, with a C-statistic of 0.675. 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.

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 HealthGrades 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 HealthGrades 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 outcomes 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.

References

- 1 Buchwald, H. et al., Bariatric Surgery: A Systematic Review and Meta-Analysis. JAMA. 2004; 92: 1724–1737.
- 2 Santry HP, Gillen DL, Lauderdale DS. Trends in bariatric surgical procedures. JAMA. 2005; 294: 1909-1917.
- 3 Nguyen NT, Paya M, Stevens CM, et al. The relationship between hospital volume and outcome in Bariatric surgery at academic medical centers. Ann of Surg. 2004; 240(4): 586-594.

Appendix A. Patient Cohorts and Related ICD-9-CM Codes

Bariatric Surgery

Inclusions

Principal Procedures: 44.31, 44.38, 44.39, 44.68 or 44.95; OR 43.89 and 45.51 and 45.91 - one of the three must be in the primary position

Principal Diagnoses: 278.00, 278.01

Exclusions

Procedures: 44.5, 44.94, 44.96, 44.97

Diagnoses: (Primary or Secondary): 042, 141.9, 150.0, 150.1, 150.2, 150.3, 150.4, 150.5, 150.8, 150.9, 151.0, 151.1, 151.2, 151.3, 151.4, 151.5, 151.6, 151.8, 151.9, 152.0, 152.1, 152.2, 152.3, 152.8, 152.9, 153.0, 153.1, 153.2, 153.3, 153.4, 153.5, 153.6, 153.7, 153.8, 153.9, 154.0, 154.1, 154.2, 154.3, 154.8, 155.0, 155.1, 155.2, 156.0, 156.1, 156.2, 156.8, 156.9, 157.0, 157.1, 157.2, 157.3, 157.4, 157.8, 157.9, 158.0, 158.8, 158.9, 159.0, 159.1, 159.8, 159.9, 161.9, 162.9, 171.5, 171.8, 195.0, 195.2, 196.0, 196.1, 196.2, 196.3, 196.5, 196.6, 196.8, 196.9, 197.0, 197.1, 197.2, 197.3, 197.4, 197.5, 197.6, 197.7, 197.8, 198.0, 198.1, 198.2, 198.3, 198.4, 198.5, 198.6, 198.7, 198.81, 198.82, 198.89, 199.0, 200.00, 200.03, 200.08, 202.00, 202.01, 202.03, 202.05, 202.80, 202.83, 203.00, 203.02, 203.12, 203.80, 203.82, 204.02, 204.12, 204.22, 204.82, 204.92, 205.02, 205.10, 205.12, 205.22, 205.82, 205.92, 206.02, 206.12, 206.22, 206.82, 206.92, 207.02, 207.12, 207.22, 207.82, 208.02, 208.12, 208.22, 208.82, 208.92, 211.1, 211.2, 211.3, 211.5, 211.6, 211.8, 211.9, 214.3, 215.5, 228.04, 228.1, 230.2, 230.7, 230.9, 235.2, 235.4, 235.5, 238.1, 239.0, 239.2, 239.8, 530.83, 530.84, 530.85, 530.86, 530.87, 531.00, 531.01, 531.10, 531.11, 531.20, 531.21, 531.31, 531.40, 531.41, 531.50, 531.51, 531.60, 531.61, 531.71, 531.91, 532.00, 532.01, 532.10, 532.11, 532.20, 532.21, 532.31, 532.40, 532.41, 532.50, 532.51, 532.60, 532.61, 532.71, 532.91, 533.00, 533.01, 533.10, 533.11, 533.20, 533.21, 533.31, 533.40, 533.41, 533.50, 533.51, 533.60, 533.61, 533.71, 533.91, 534.00, 534.01, 534.10, 534.11, 534.20, 534.21, 534.31, 534.40, 534.41, 534.50, 534.51, 534.60, 534.61, 534.71, 534.91, 535.0, 535.00, 535.01, 535.1, 535.10, 535.11, 535.20, 535.21, 535.30, 535.31, 535.40, 535.41, 535.50, 535.51, 535.60, 535.61, 536.0, 536.1, 536.2, 536.3, 536.40, 536.41, 536.42, 536.49, 536.8, 536.9, 537.0, 537.1, 537.2, 537.3, 537.4, 537.5, 537.6, 537.81, 537.82, 537.83, 537.84, 537.89, 537.9, 555.0, 555.1, 555.2, 555.9, 558.1, 558.2, 558.3, 558.9, 562.02, 562.03, 564.81, 564.89, 564.9, 569.5, 569.81, 569.82, 569.83, 569.84, 569.85, 569.86, 569.89, 569.9, 751.0, 751.1, 751.2, 751.3, 751.4, 751.5, 751.60, 751.61, 751.62, 751.69, 751.7, 751.8, 751.9, 996.8, 996.80, 996.81, 996.82, 996.83, 996.84, 996.85, 996.86, 996.87, 996.89, V42.0, V42.1, V42.4, V42.6, V42.7, V42.81, V42.82, V42.83, V42.84, V42.89, V42.9

Appendix B. Major Complications

Independent complications are conditions that are clearly hospital-acquired or by the coding definition are defined as post-operative. For 2008 or later these conditions were not counted as complications if the POA indicator was "Yes" or "Clinically Undetermined."

Bariatric Surgery – Independent Complications

038.0	STREPTOCOCCAL SEPTICEMIA	482.1	PSEUDOMONAL PNEUMONIA
038.10	STAPH SEPTICEMIA NOS	482.2	H. INFLUENZAE PNEUMONIA
038.11	MSSA SEPTICEMIA	482.30	STREP PNEUMONIA NOS
038.12	MRSA SEPTICEMIA	482.31	GROUP A STREP PNEUMONIA
038.19	STAPH SEPTICEMIA NEC	482.32	GROUP B STREP PNEUMONIA
038.2	PNEUMOCOCCAL SEPTICEMIA	482.39	STREP PNEUMONIA NEC
038.3	ANAEROBIC SEPTICEMIA	482.40	STAPH PNEUMONIA NOS
038.40	GRAM-NEG SEPTICEMIA NOS	482.41	MSSA PNEUMONIA
038.41	H. INFLUENZAE SEPTICEMIA	482.42	MRSA PNEUMONIA
038.42	E. COLI SEPTICEMIA	482.49	STAPH PNEUMONIA NEC
038.43	PSEUDOMONAS SEPTICEMIA	482.81	PNEUMONIA D/T ANAEROBES
038.44	SERRATIA SEPTICEMIA	482.82	E. COLI PNEUMONIA
038.49	GRAM-NEG SEPTICEMIA NEC	482.83	GRAM-NEG PNEUMONIA NEC
038.8	SEPTICEMIA NEC	482.84	LEGIONNAIRES' DISEASE
038.9	SEPTICEMIA NOS	482.89	BACTERIAL PNEUMONIA NEC
410.01	ANTEROLAT AMI-INITIAL	482.9	BACTERIAL PNEUMONIA NOS
410.11	ANT AMI NEC-INITIAL	483.0	M. PNEUMONIAE PNEUMONIA
410.21	INFEROLAT AMI-INITIAL	483.1	CHLAMYDIAL PNEUMONIA
410.31	INFEROPST AMI-INITIAL	483.8	PNEUMONIA D/T ORG NEC
410.41	INF AMI NEC-INITIAL	484.3	PNEUMONIA IN WHOOP COUGH
410.51	LAT AMI NEC-INITIAL	485	BRONCHOPNEUMONIA ORG NOS
410.61	POSTERIOR AMI-INITIAL	486	PNEUMONIA ORGANISM NOS
410.71	SUBEND INFARCT-INITIAL	518.5	PI FOLLOW TRAUMA & SURG
410.81	AMI NEC-INITIAL EPISODE	518.51	AC RESP FAIL TRAUM/SURG
410.91	AMI NOS-INITIAL EPISODE	518.52	PI NEC FOLLOW TRAUM/SURG
415.11	IATRO PULM EMBOL/INFARCT	518.53	A&C RESP FAIL TRAUM/SURG
415.12	SEPTIC PULMON EMBOLISM	518.7	TRALI
427.1	PVT	518.81	AC RESPIRATORY FAILURE
427.41	VENTRICULAR FIBRILLATION	539.01	INF D/T GASTR BAND PX
431	INTRACEREBRAL HEMORRHAGE	539.09	GASTR BAND PX COMP NEC
433.00	BASIL ART OCCL S INFARCT	539.81	INF D/T BARIATRIC PX NEC
433.01	BASIL ART OCCL W INFARCT	539.89	COMP NEC D/T BAR PX NEC
433.10	CAROTID OCCL S INFARCT	560.0	INTUSSUSCEPTION
433.11	CAROTID OCCL W INFARCT	560.1	PARALYTIC ILEUS
433.20	VERT ART OCCL S INFARCT	560.2	INTESTINAL VOLVULUS
433.21	VERT ART OCCL W INFARCT	560.30	IMPACTION INTESTINE NOS
433.30	MULT PREC OCCL S INFARCT	560.39	INTESTINE IMPACTION NEC
433.31	MULT PREC OCCL W INFARCT	560.89	INTESTINAL OBSTR NEC
433.80	PREC OCCL NEC S INFARCT	560.9	INTESTINAL OBSTR NOS
433.81	PREC OCCL NEC W INFARCT	578.9	GI HEMORRHAGE NOS
433.90	PREC OCCL NOS S INFARCT	584.5	AC KF W TUBULAR NEPHR
433.91	PREC OCCL NOS W INFARCT	584.8	ACUTE KIDNEY FAILURE NEC
434.00	CEREB THROMB W/O INFARCT	584.9	ACUTE KIDNEY FAILURE NOS
434.01	CEREB THROMB W INFARCT	599.0	URINARY TRACT INF NOS
434.10	CEREBRAL EMBOL S INFARCT	997.1	SURG COMP-HEART
434.11	CEREBRAL EMBOL W INFARCT	997.3	SURG COMP-RESP NEC
434.90	CEREB ART OCCL S INFARCT	997.31	VENT ASSOC PNEUMONIA
434.91	CEREB ART OCCL W INFARCT	997.32	POSTPX ASP PNEUMONIA
436	ACUTE ILL-DEFINED CVD	997.39	OTH SURG COMP-RESP
437.1	AC CEREBROVASC INSUF NOS	997.4	SURG COMP-DIGESTIVE
449	SEPTIC ARTERIAL EMBOLISM	997.5	SURG COMP-URINARY NEC
453.8	AC VEN THROMB OTH VEIN	998.0	POSTOPERATIVE SHOCK
453.82	AC DVT UPPER EXTREMITY	998.00	POSTOP SHOCK NOS
453.83	AC VEN THROMB UE NOS	998.01	POSTOP CARDIOGENIC SHOCK
453.84	AC VEN THROMB AX VEIN	998.02	POSTOP SEPTIC SHOCK
453.85	AC VEN THROMB SCL VEIN	998.09	POSTOP SHOCK NEC
453.86	AC VEN THROMB INT JV	998.11	HEMORRHAGE COMP PX
453.87	AC VEN THROMB THOR NEC	998.12	HEMATOMA COMPLICATING PX
453.89	AC VEN THROMB NEC	998.2	ACCIDENTAL OP LACERATION
453.9	VENOUS THROMBOSIS NOS	998.30	DISRUPTION WOUND NOS
481	PNEUMOCOCCAL PNEUMONIA	998.31	DISRUPT INTERNAL OP WND
482.0	K. PNEUMONIAE PNEUMONIA	998.32	DISRUPT EXTERNAL OP WND
998.51	INFECTED POSTOP SEROMA	31.29	OTHER PERM TRACHEOSTOMY
998.59	POSTOP INFECTION NEC	38.95	VENOUS CATH FOR RD
998.6	PERSIST POSTOP FISTULA	39.95	HEMODIALYSIS

Bariatric Surgery – Independent Complications

999.31	INFECT NEC & NOS D/T CVC	41.2	SPLENOTOMY
999.32	BLOODSTREAM INF D/T CVC	41.43	PARTIAL SPLENECTOMY
999.34	AC INF POST TRANSFUSION	41.5	TOTAL SPLENECTOMY
999.39	INFECT COMP MED CARE NEC	41.95	REPAIR OF SPLEEN
999.80	TRANSFUSION REACTION NOS	44.61	SUTURE GASTRIC LAC
999.83	HTR INCOMPATIBILITY NOS	54.12	REOPEN RECENT LAP SITE
999.84	AHTR INCOMPATIBILITY NOS	54.61	RECLOSE POSTOP DISRUPT
999.85	DHTR INCOMPATIBILITY NOS	54.91	PERC ABD DRAINAGE
31.1	TEMPORARY TRACHEOSTOMY	54.92	RMVL FB PERITON CAVITY

Bariatric Surgery - Dependent Complications

Dependent complications are conditions that must either have the POA indicator set to "No", or if the POA indicator is set to "Unknown" or is missing, there must also be the listed 900 post-operative complication code present in the patient record.

Must occur with 997.1 Cardiac Complications, Not Elsewhere Classified

427.0	PSVT	428.31	ACUTE DIASTOLIC HF
427.31	ATRIAL FIBRILLATION	428.33	AC & CHR DIASTOLIC HF
427.89	OTH CARDIAC DYSRHYTHMIAS	428.41	AC SYS & DIASTOLIC HF
428.21	ACUTE SYSTOLIC HF	428.43	AC SYS & DIASTOLIC HF
428.23	AC & CHR SYSTOLIC HF		

Must occur with 997.3 Respiratory Complications or 997.39 Other Respiratory Complications

415.19	PULMON EMBOL/INFARCT NEC	518.0	PULMONARY COLLAPSE
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Must occur with 997.4 Digestive System Complication

560.81	INTESTINAL ADHES W OBSTR
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Appendix C: Top Five Risk Factors

ICD-9 Diagnosis or Procedure Code	Description
Proc 44.69	OTHER REPAIR OF STOMACH
Proc 44.39	OTHER GASTROENTEROSTOMY WITHOUT GASTRECTOMY
Proc 44.31	HIGH GASTRIC BYPASS
Proc 518.0	PULMONARY COLLAPSE
Diag v64.41	LAPAROSCOPIC SURGICAL PROCEDURE CONVERTED TO OPEN PROCEDURE

Appendix D. Summary of Changes 2011 Bariatric Ratings

Change	Rationale
Included new complication codes:	These are new ICD9 Codes as of October 2011.
518.51 Acute Respiratory Failure Following Trauma And Surgery	
518.52 Other Pulmonary Insufficiency, Not Elsewhere Classified, Following Trauma And Surgery	
518.53 Acute And Chronic Respiratory Failure Following Trauma And Surgery	
539.01 Infection Due To Gastric Band Procedure	
539.09 Other Complications Of Gastric Band Procedure	
539.81 Infection Due To Other Bariatric Procedure	
539.89 Other Complications Of Other Bariatric Procedure	

Appendix E. Policy on Hospital Ratings and Awards Removal

HealthGrades rates the nation's nearly 5,000 hospitals using several data sources including data submitted by hospitals to the Centers for Medicare and Medicaid Services (CMS), All-payer data submitted by hospitals to their States, and HCAHPS data.

Regardless of the data set utilized, HealthGrades ratings are not voluntary and our objective ratings methodology is applied to every hospital in the same manner.

On rare occasions, HealthGrades identifies new information that impacts its assessment of a hospital. HealthGrades' policy is to remove certain hospitals' ratings and/or awards from its website in the following situations:

- A revocation of a hospital's Medicare license by CMS
- Federal indictment of a hospital for Medicare fraud
- Egregious issues with the integrity of data submitted by a hospital to CMS or to the state in which the hospital resides

In these rare circumstances, the hospital's CEO will be notified in writing of the reason for the ratings removal. The ratings and awards are removed at the discretion of HealthGrades based on which ratings and awards are impacted by the erroneous data and/or fraudulent activities.

Under **no circumstances** will HealthGrades accept data directly from a hospital, nor will HealthGrades manipulate or change a hospital's rating or data in any way. It is the hospital's responsibility to resubmit the data to CMS or to its state. To have a hospital's ratings re-posted, HealthGrades must receive corrected data directly from CMS or from the state during its annual ratings update.

Rankings and Awards

Using the HealthGrades star ratings, hospitals are rank ordered nationally to determine Specialty Excellence Awards™ and within their state for overall service lines and service line subspecialties. Ranking is done on an annual basis. In the case that a hospital's ratings are removed, it is HealthGrades policy NOT to re-rank hospitals. No hospital shall move up or down at the time when a hospital's ratings are removed. Rankings are conducted annually.