Outcomes of Bariatric Surgery Performed at Accredited vs Nonaccredited Centers

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BACKGROUND: In an effort to improve the quality of care in bariatric surgery, 2 accreditation programs based on volume have been initiated. The aim of this study was to analyze the perioperative outcomes of bariatric surgery performed at accredited vs nonaccredited centers.

STUDY DESIGN: Patient-level data obtained from the University HealthSystem Consortium for patients who underwent bariatric surgery for the treatment of morbid obesity between 2007 and 2009 were reviewed. Perioperative outcomes were analyzed according to accreditation status. The primary outcome was in-hospital mortality. Secondary outcomes included length of stay, 30-day readmission, overall complications, and cost. Comparisons of length of stay and cost were performed at the hospital-level data.

RESULTS: Of the 35,284 bariatric operations performed during the study period, 89.2% of cases were performed at 71 accredited centers; 10.8% of cases were performed at 43 nonaccredited centers. The rate of in-hospital mortality was significantly lower in accredited centers (0.06% vs 0.21%). Compared with nonaccredited centers, bariatric surgery performed at accredited centers was also associated with shorter length of stay (mean difference 0.3 days; 95% CI 0.16 to 0.44) and lower cost (mean difference, $3,758; 95% CI, $2,965 to $3,952). Post-hoc analyses based on procedural type and severity of illness suggested possible associations between center accreditation and improved in-hospital mortality in patients who underwent gastric bypass and patients with higher severity of illness; similarly, patients requiring prolonged ICU or hospital stay (≥7 days) had significantly lower in-hospital mortality within accredited centers.

CONCLUSIONS: Within the context of academic centers, accreditation status was associated with lower in-hospital mortality. The lower mortality rate associated with accredited centers may be attributed to their ability to recognize and rescue complications. (J Am Coll Surg 2012;215:467–474. © 2012 by the American College of Surgeons)

Over the past decade, the number of bariatric operations has exponentially increased after introduction of the laparoscopic approach to bariatric surgery.[1] With tremendous growth in the number of bariatric operations, safety and quality of bariatric surgery in the US were of concern.[2,3] The American Society for Metabolic and Bariatric Surgery (ASMBS) responded by initiating the centers of excellence concept in 2004, followed by creation of the American College of Surgeons (ACS) bariatric surgery center network in 2005. Both accreditation bodies developed structure and processes believed to represent quality care, and instituted a prospective database for collection of patient-level data.[4,5] The ASMBS developed the Bariatric Outcomes Longitudinal Database (BOLD); the ACS developed a bariatric-specific module based on the National Surgical Quality Improvement Project (NSQIP). In February 2006, the Centers for Medicare and Medicaid Services (CMS) expanded the national coverage for bariatric surgery for Medicare beneficiaries. Although the National Coverage Determination (NCD) expanded coverage for patients over the age of 65 years, it covers procedures only when performed at high-volume centers accredited either by the ASMBS or ACS.

The main advantage of participation in an accreditation program is the establishment of uniform structure and pro-

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Abbreviations and Acronyms

ACS = American College of Surgeons
ASMBS = American Society for Metabolic and Bariatric Surgery
O/E = observed-to-expected
UHC = University HealthSystem Consortium

cesses of care and collection of prospective data. Outcomes for individual centers can be compared with the national average. Centers with outliers in morbidity and mortality can be identified, and feedback may result in interventions to improve outcomes. However, disadvantages of an accreditation program include the extra expense incurred by the accreditation process and, more importantly, the potential for impeding access to care, particularly for patients living in rural regions.[6]

The aim of this study was to analyze perioperative outcomes of bariatric surgery performed at accredited vs nonaccredited bariatric surgery centers. We hypothesized that accreditation is associated with improved outcomes, specifically with respect to perioperative mortality. Because contemporary mortality associated with bariatric surgery is rare, a national clinical database was used to provide sufficient power for analysis. Additionally, a specific time period, between 2007 and 2009, was chosen because most center of excellence programs had been established by this time period, particularly in response to the 2006 Medicare National Coverage Determination for bariatric surgery that required Medicare beneficiaries to receive their bariatric surgical care at accredited centers.

METHODS

Database

The University HealthSystem Consortium (UHC) is an alliance of 114 academic medical centers and 255 of their affiliated hospitals, representing approximately 90% of the nation's nonprofit academic medical centers. Criteria for membership within the UHC include any nonfederal teaching hospital or health system that has a documented affiliation agreement with a medical school accredited by the Liaison Committee on Medical Education and is either under common ownership with a medical school or has a reputation for excellence in service, teaching, and research as determined at the discretion of the UHC Member Board of Directors. The UHC database is an administrative, clinical, and financial database that provides benchmark measures on the use of health care resources for the purpose of comparative data analysis between institutions. The UHC database is a collection of patient-level discharge abstract data of all operations performed by each institution. The data are acquired by clinical coders from each academic health center and affiliate community hospitals. The UHC database contains discharge information on in-patient hospital stay including patient characteristics, length of stay, 30-day readmission, overall and specific postoperative morbidity, in-hospital mortality, and in-patient care costs. In addition, UHC uses the Refined Diagnosis Related Group (RDRG) methodology to assign a level of severity by grouping patients based on the severity and complexity of the secondary diagnoses (comorbidities and complications). The severity class is grouped as minor, moderate, major, or extreme. For example, comorbidities such as diabetes would be categorized as moderate severity and recent myocardial infarction as extreme severity. This study is compliant with the Health Information Portability and Accountability Act because there was no personal information available within the database. Approval for the use of the UHC data in this study was obtained from the Institutional Review Board of the University of California, Irvine Medical Center and the UHC.

Data analysis and outcomes

We analyzed the UHC database for discharge data on all patients who underwent open or laparoscopic Roux-en-Y gastric bypass, laparoscopic adjustable gastric banding, or laparoscopic gastroplasty for the treatment of morbid obesity between October 1, 2007 and December 31, 2009. All hospitalizations during which any of the above bariatric procedures were performed for treatment of morbid obesity were identified using appropriate diagnosis and procedural codes as specified by the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). We used the principal ICD-9 diagnosis codes for obesity and morbid obesity (278.0, 278.01, and 278.00), which included a subcategory of obesity and a subclassification of morbid obesity. The principal ICD-9 procedure codes for open Roux-en-Y gastric bypass were 44.31 and 44.39, which included a subcategory of gastroenterostomy without gastrectomy and a subclassification of high gastric bypass. The principal ICD-9 procedure code for laparoscopic Roux-en-Y gastric bypass was 44.38, which included a subcategory of gastroenterostomy without gastrectomy and a subclassification of laparoscopic gastroenterostomy. The principal ICD-9 procedure code for laparoscopic adjustable gastric banding was 44.95. The principal ICD-9 procedure code for laparoscopic gastroplasty was 44.68. There was no ICD-9 code for laparoscopic cases that were converted to open cases. Patients undergoing emergent procedures were excluded.

Accredited centers were identified from the Centers for Medicare and Medicaid Services website (www.cms.hhs.gov/MedicareApprovedFacilitie/BSF/List.asp) based on each institution's unique Medicare provider number. This list was also cross referenced with the list on the ACS website and the

Surgical Review Corporation website. The ACS accredited centers include both large and small facilities (level 1 and level 2) and both were included within the accredited centers grouping.

The primary outcome of interest was in-hospital mortality, which corresponds to whether a patient died before being discharged. So in-hospital mortality rate refers to the percentage of patients who died before being discharged from the hospital. The UHC database has no information available on death occurring after discharge, even if the death occurred within 30 days from the date of surgery.

The observed-to-expected (O/E) mortality ratio represents a ratio of observed mortality divided by the "expected" mortality, as calculated by the UHC based on risk adjustment methodology, which involves selection of a patient population to serve as the basis of the model, use of multiple regression techniques to predict probability of mortality based on the normative patient population, and assignment of probability of mortality to every patient in the database. A set of key acute variables defined by ICD-9-CM secondary diagnosis codes that have been identified as being strongly associated with mortality are used when coded as being present on admission. These secondary diagnosis codes were used in conjunction with other common variables such as age and sex to calculate the expected mortality. For the UHC logistic regression mortality models, goodness of fit tests were run to determine how well the model predicted the outcomes across different levels of risk. An O/E ratio less than 1 represents mortality lower than expected and a ratio greater than 1 represents mortality higher than expected, where by expected we mean according the UHC risk model that takes into account patient-level chart information. The O/E statistic estimates how the observed mortality differs from the expected mortality based on the UHC risk model.

Using the O/E statistic and the overall mortality rate, we estimated the "risk-adjusted" mortality rate, which represents the mortality we would expect to observe for a random sample of patients from the population of interest based on information from the UHC risk model and the observed mortality rates for accredited centers and nonaccredited centers. This risk-adjusted mortality rate statistic is another measure to compare mortality, taking into account the different patient risk profiles between the 2 groups.

Secondary outcomes included length of stay, 30-day readmission, ICU stay, overall complications, and cost. Length of stay was defined as the period from the index procedure to hospital discharge and 30-day readmission was defined as readmission to the index hospital for any reason within 30 days of discharge after the index procedure. Intensive care unit stay was defined as the period from admission to the ICU to discharge from the unit, and overall complications were defined as the presence of 1 or more postoperative complications within the period from the index procedure to hospital discharge. The UHC clinical database provides an estimated cost of patient care using a ratio of cost to charge methodology. The UHC collects detailed patient charges at the revenue code level and estimates costs by multiplying charges by the cost center-specific ratio of cost to charges from the annual Medicare cost report submitted by each individual hospital.

Statistical analysis

Patient demographics were reported by accreditation status, and chi-square tests were used to compare the distributions of patient characteristics by hospital type to offer insight regarding the patient population within accredited and nonaccredited centers. Results for the differences in patient demographics are exploratory and not of primary focus.

Perioperative outcomes were compared by accreditation status. Continuous outcomes (length of hospital stay and cost) were compared at the hospital level by analyzing differences in the means using 2-sample *t*-tests with unequal variances. Binary outcomes (mortality, overall complications, ICU stay, and 30-day readmission) were compared at the patient level by relative risks using binomial regression with a log link function; robust standard errors were used for inference to account for the possibility of model misspecification.[7] To adjust for multiple comparisons, a Bonferroni correction was applied to the 6 tests (6 outcomes). So, to control the family-wise type I error to be at the 0.05 level, a test was declared statistically significant if the corresponding p value was less than $0.05/6 = 0.0083$. Adjusting for potential confounders in each of the 6 models was not possible due to the unavailability of specific chart information for each patient. Instead, risk adjustments for in-hospital mortality was performed by calculation of patient-level expected mortality for accredited vs nonaccredited centers based on the UHC's risk model that takes into account preprocedural patient demographic and comorbidity information. Risk-adjusted in-hospital mortality was then calculated by multiplying the mean mortality of the entire study population by the O/E mortality ratio for accredited and nonaccredited groups.[8] Because the risk-adjusted mortality rates were calculated based on the entire group and not at the patient-level data, we did not perform statistical comparison for this parameter.

In post-hoc analyses, we reanalyze the outcomes stratified by procedural type (banding vs bypass), admit severity of illness risk (moderate + major vs minor), and in a selected group of patients considered to have major complications (those with and without a prolonged ICU stay [≥7 days] and those with and without a prolonged hospital stay [≥7 days]). These post-hoc analyses are exploratory in na-

ture and are meant to generate hypotheses that may explain the findings of our primary endpoint.

RESULTS

Patient characteristics

A total of 35,284 patients underwent bariatric surgery for treatment of morbid obesity in the UHC database during the specified time frame. As shown in Table 1 (patient characteristics), 31,479 patients underwent bariatric surgery at 71 accredited centers and 3,805 patients underwent bariatric surgery at 43 nonaccredited centers. The mean number of bariatric operations performed per center during the study period was significantly higher at accredited centers (443 vs 88 cases, respectively, $p < 0.05$). The proportion of females was higher in the nonaccredited group than in the accredited group (80.2% vs 77.7%, respectively, $p < 0.05$), but there was no significant difference in proportion of severity class between groups. The distributions of age, race, and procedure types were not statistically different between the 2 types of centers.

Perioperative outcomes and costs

The analysis of perioperative outcomes for patients who underwent bariatric surgery within accredited vs nonaccredited centers is shown in Table 2. Nonaccredited centers are associated with a 3.5-fold increase in observed in-hospital mortality risk (95% CI 1.5 to 8.0) compared with accredited centers ($p = 0.003$). The O/E mortality ratio was 0.61 for accredited centers and 2.31 for nonaccredited centers. The calculated risk-adjusted in-hospital mortality was 0.046% at accredited centers and 0.175% at nonaccredited centers. The mean length of stay was significantly longer at nonaccredited centers, with a mean difference of 0.3 days (95% CI 0.16 to 0.44, $p < 0.001$). The relative risks for overall complications, ICU stay, and 30-day readmission were 0.96 (95% CI 0.77 to 1.20), 0.92 (95% CI 0.81 to 1.03), and 1.22 (95% CI 0.98 to 1.51), respectively. The procedural cost was significantly higher at nonaccredited compared with accredited centers, with a mean difference of $3,758 (95% CI $2,965 to $3,952, $p < 0.001$).

Post hoc analyses

Results for bariatric surgery outcomes performed at accredited vs nonaccredited centers examined by procedural type are presented in Table 3. Observed in-hospital mortality, length of hospital stay, overall complications, 30-day readmission, and cost were comparable between accredited and nonaccredited centers for gastric banding. However, the relative risk of an ICU stay comparing nonaccredited to accredited centers was 0.35 (95% CI 0.21to 0.57). For gastric bypass, the relative risk for observed in-hospital mortality comparing accredited with nonaccredited centers was 4.25 (95% CI 1.72 to 10.51); the mean differences in length of hospital stay and cost were 0.41 days (95% CI 0.23 to 0.60 days) and $4,920 (95% CI $3,903 to $5,191), respectively; overall complications, ICU stay, and 30-day readmission were comparable between accredited and nonaccredited centers.

When we examined mortality based on admission severity of illness, the relative risks of observed in-hospital mortality comparing accredited with nonaccredited centers were 4.71 (95% CI 1.86 to 11.96) for the moderate and major severity of illness risk group, and 1.40 (95% CI 0.17

Table 1. Characteristics of 35,284 Patients Undergoing Bariatric Surgery at Accredited vs Nonaccredited Centers, 2007 to 2009

Case volume, demographics, and procedure type	Accredited centers	Nonaccredited centers
Total number of cases	31,479	3,805
Number of centers	71	143
Mean number of cases per center, 2007–2009	443	88*
Median number of cases per center (IQR), 2007–2009	382 (225–581)	58 (18–111)
Age, n (%)		
18–30 y	3,841 (12.2)	462 (12.1)
31–50 y	16,841 (53.5)	2,077 (54.7)
51–64 y	9,475 (30.1)	1,169 (30.7)
≥ 65 y	1,322 (4.2)	97 (2.5)
Female sex, n (%)	24,459 (77.7)	3,052 (80.2)†
Race, n (%)		
White	23,452 (74.5)	2,618 (68.8)
African-American	4,155 (13.2)	742 (19.5)
Hispanic	1,668 (5.3)	270 (7.1)
Asian	126 (0.4)	15 (0.4)
Other or unknown	2,078 (6.6)	160 (4.2)
Procedures, n (%)		
Open gastric bypass	2,454 (7.8)	305 (8.0)
Laparoscopic gastric bypass	21,358 (67.8)	2,498 (65.7)
Laparoscopic adjustable gastric band	7,371 (23.4)	940 (24.7)
Laparoscopic gastroplasty	296 (0.9)	62 (1.6)
Severity class, n (%)		
Minor	19,076 (60.6)	2,272 (59.7)
Moderate and major	12,403 (39.4)	1,533 (40.3)

*$p < 0.05$ compared with accredited centers, 2-sample *t*- test.
†$p < 0.05$ compared with accredited centers, chi-square tests.
IQR, interquartile range.

Table 2. Primary and Secondary Outcomes of Bariatric Surgery Performed at Accredited vs Nonaccredited Centers, 2007 to 2009

Perioperative outcomes	Accredited centers	Nonaccredited centers	Mean difference* or relative risk (95% CI)	p Value
Observed in-hospital mortality rate,† %	0.06	0.21	3.5 (1.5–8.0)	0.003‡
Observed-to-expected mortality ratio	0.61	2.31	—	—
Risk-adjusted in-hospital mortality, %	0.046	0.175	—	—
Mean (median; IQR) length of hospital stay, d	2.4 ± 3.1 (2; 2.0–2.8)	2.7 ± 4.2 (2.4; 2.0–3.1)	0.30* (0.16–0.44)	<0.001‡
Overall complications, %	2.3	2.2	0.96 (0.77–1.20)	0.75
ICU stay, %	8.0	7.3	0.92 (0.81–1.03)	0.15
30-d readmission, %	2.0	2.5	1.22 (0.98–1.51)	0.072
Mean (median, IQR) cost, $	13,203 ± 4,028 (12,735; 9,974–15,953)	16,961 ± 9,172 (14,759; 11,436–19,071)	3,758* (2,965–3,952)	<0.001‡

To account for multiple comparisons, we use the Bonferroni correction and report the comparison to be significant if the p value $< 0.05/6 = 0.0083$. Rates and relative risks are reported for mortality, overall complications, ICU stay, and 30-day readmission.

*Mean differences between accredited and nonaccredited centers.

†Primary outcome.

‡$p < 0.0083$.

IQR, interquartile range.

to 11.63) for the minor severity of illness risk group (Fig. 1). When we examined a selected group of patients requiring prolonged ICU stay or not, the relative risks of observed in-hospital mortality comparing accredited with nonaccredited centers were 4.04 (95% CI 1.19 to 13.74) for prolonged ICU stays (≥7 days) vs 2.78 (95% CI 0.90 to 8.62) for ICU stays <7 days. Similarly, for prolonged hospital stays, the relative risks of observed in-hospital mortality comparing accredited with nonaccredited centers were 3.70 (95% CI 1.24 to 10.87) vs 2.78 (95% CI 0.75 to 10.26), respectively, for hospital stays <7 days.

DISCUSSION

Within the context of academic medical centers during the period between 2007 and 2009, almost 90% of all bariatric operations were performed within accredited centers. In-hospital mortality was rare for both accredited and nonaccredited centers. However, accredited centers were associated with nearly a 4-fold reduction in the risk for in-hospital mortality as compared with nonaccredited centers. Due to the inherent higher procedural volume at accredited centers, we were unable to determine if the improved outcomes were related to accreditation status, procedural volume, or a combination of both. Because accreditation is defined partly by procedural volume, it is statistically impossible to tease out the contributions from each source individually. Secondary benefits within accredited centers include a shorter length of hospital stay and lower cost. Although statistically significant, the small difference in length of stay is probably not of practical importance. Post-hoc analyses based on procedural type and admission severity of illness suggest improved mortality for patients

Table 3. Post-Hoc Analyses of Outcomes for Bariatric Surgery Performed at Accredited vs Nonaccredited Centers (2007 to 2009) According to Procedure Type

Perioperative outcomes	Accredited centers	Nonaccredited centers	Mean difference* or relative risk (95% CI)	p Value
Banding procedures, n	7,371	940	—	—
Observed in- hospital mortality, %	0.04	0.11	0.41 (0.06–3.08)	0.39
Mean (median, IQR) length of hospital stay, d	1.24 ± 1.30 (1.25; 1.12–1.55)	1.31 ± 1.81 (1.23; 1.09–1.47)	0.07* (-0.5–0.2)	0.25
Overall complications, %	1.1	1.2	1.11 (0.60–2.08)	0.75
ICU stay, %	4.9	1.7	0.35 (0.21–0.57)	<0.001
30-d readmission, %	0.8	0.7	0.91 (0.42–2.00)	0.82
Mean (median, IQR) cost, $	7,053 ± 3,584 (6,957; 5,966–8,509)	7,335 ± 3,809 (6,898; 5,490–8,272)	282* (25–534)	0.03
Bypass procedures, n	23,812	2,803	—	—
Observed in- hospital mortality (%)	0.06	0.25	4.25 (1.72–10.51)	0.002
Mean (median, IQR) length of hospital stay, d	2.7 ± 3.4 (2.66; 2.27–3.02)	3.1 ± 4.7 (3.08; 2.62–4.00)	0.41* (0.23–0.60)	<0.001
Overall complications, %	2.7	2.6	0.96 (0.76–1.22)	0.74
ICU stay, %	8.4	9.3	1.11 (0.98–1.25)	0.11
30-d readmission, %	2.4	3.1	1.30 (1.04–1.62)	0.023
Mean (median, IQR) cost, $	14,072 ± 4,166 (13,328; 10,819–16,615)	18,992 ± 7,272 (16,219; 12,768–21,714)	4,920* (3,903–5,191)	<0.001

Rates and relative risks are reported for mortality, overall complications, ICU stay, and 30-day readmission.

*Mean differences between accredited and nonaccredited centers.

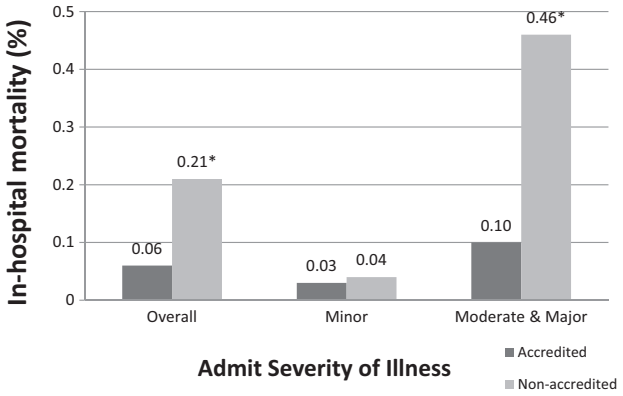

Figure 1. Observed in-hospital mortality for bariatric surgery performed at accredited vs nonaccredited centers according to severity of illness, 2007 to 2009. *$p < 0.05$ compared with accredited centers, chi square tests. Minor, patients with minor severity of illness; moderate and major, mortality for patients with moderate and major severity of illness; overall, overall mortality of the entire cohort of patients.

who underwent complex bariatric operation (gastric bypass) and for patients with higher (moderate or major) severity of illness.

The most important finding from this study was that accreditation status is associated with lower in-hospital mortality. In this study, mortality after bariatric surgery within accredited and nonaccredited centers were low at both; however, accredited centers had a significantly lower observed in-hospital mortality compared with nonaccredited centers. Even though the difference in mortality was relatively small, the relative risk was substantially large and is clinically relevant because the event of interest was death. Post-hoc analyses according to the type of operation and preoperative severity of illness suggested that accreditation status was associated with improved in-hospital mortality in patients who underwent complex bariatric operations such as open or laparoscopic Roux-en-Y gastric bypass and higher risk patients with moderate or major severity of illness. With regard to procedure type, our finding is consistent with the literature in that the volume-outcomes relationship in bariatric surgery has been demonstrated only for gastric bypass and not for gastric banding.[9] Gastric bypass is well known to be associated with a steep learning curve and higher morbidity and mortality compared with gastric banding.[10,11] With regard to treatment of patients with higher severity of illness, accredited centers had a lower in-hospital mortality and may be better at managing these sicker patients.

Few studies have examined the impact of bariatric accreditation on outcomes. Using the 2005 Nationwide Inpatient Sample database, Livingston[12] reported on 24 accredited centers performing 5,420 bariatric operations compared with 229 nonaccredited centers performing 19,363 operations and found that accreditation designation did not result in better outcomes. Except for a higher volume of operations being performed at accredited vs nonaccredited centers, he found no statistically significant differences in morbidity (6.3% vs 6.4%, respectively) or mortality (0.17% vs 0.09%, respectively).[12] However, his findings should be taken within the context of the time period in which the data were collected and analyzed. In 2005, the bariatric accreditation process was in its infancy, with only a small fraction of institutions enrolled in the ASMBS or ACS programs. This is in part because the ASMBS accreditation program only began in 2004 and the ACS accreditation program was initiated in 2005. Before analyzing the outcomes or effectiveness of a newly implemented program, it is important to allow sufficient time for implementation and refinement of the program, for the majority of centers to enroll in the accreditation program, and for the program to mature before determining if accreditation made an impact on quality.

In another study of 15,275 patients undergoing bariatric surgery in Michigan, Birkmeyer and colleagues[13] reported that the frequency of serious complications was relatively low and was inversely associated with hospital and surgeon volume, but unrelated to the center's accreditation by ASMBS or ACS. Their finding is likely due in part to the structure of the Michigan Bariatric Surgery Collaborative (MBSC), which is a payer-funded quality improvement program that administers a prospective, externally audited clinical outcomes registry that follows a similar structure and processes of care as does any ACS or ASMBS accreditation program.

Another important finding from our study is the lower cost associated with accredited centers (22% reduction). The cost savings may be attributed to the shorter length of hospital stay and improved efficiency of care through the presence of clinical pathways and improved recognition and management of complications at accredited centers. This is an important finding, particularly in our current health care economic climate, with initiatives such as "Pay for Performance" being implemented by certain health care plans and Medicare. This is a model that rewards physicians, hospitals, and other health care providers for meeting certain performance measures for quality and efficiency.

In our study, although complication rate and the rate of ICU use were similar between accredited and nonaccredited centers, there was a difference in mortality within a subset of patients requiring prolonged ICU care or hospital stay. These groups of patients were selected as an indicator for the presence of and severity of complications, and we found significantly higher observed in-hospital mortality within nonaccredited centers. The presence of a similar rate

of complications but higher mortality rate within nonaccredited centers may indicate a phenomenon that has been previously described as a failure to rescue.[14] This concept proposed that hospitals with higher mortality but lower rates of complications may potentially fail to recognize and/or fail to rescue complications, leading to higher mortality. Ghaferi and colleagues[14] substantiated the failure to rescue concept in their analysis of 6 different high-risk operations; they found that complication rates were similar between the worst and best hospitals, but the failure to rescue rates were much higher at worse compared with best hospitals. It is not known what makes a hospital better at rescuing patients, but it is well known that early recognition and appropriate management of complications is of utmost importance for better outcomes. Lastly, an important process that is lacking in nonaccredited centers is the availability of a prospective database for data collection and analysis. The knowledge and understanding of outcomes are important parts of any quality improvement initiative. For example, within the Michigan Bariatric Surgery Collaborative, prophylactic vena cava filter placement was found to be associated with higher risks of serious complications, many of which were related to the filter itself. Feedback from this information led to a significant reduction in the use of filters and correspondingly fewer complications, resulting in significant cost savings.[15]

If accreditation truly affects outcomes, it is important to understand the hurdles for bariatric centers in obtaining accreditation. The first and most important hurdle is the volume criteria of 125 cases. It is difficult for many centers to achieve this volume, particularly rural hospitals. A current option for low volume hospitals is to participate in the ACS level 2 centers, representing lower volume hospitals that perform bariatric surgery for lower risk patients, based on age, body mass index, sex, the presence of organ failure, ambulatory status, and lower risk procedure (nonrevisional surgery). Alternatively, with the low mortality data in contemporary bariatric surgery, the centers of excellence construct should be reexamined to put less emphasis on volume and more emphasis on development of a systematic approach for quality improvement similar to the program established by the Michigan Bariatric Surgery Collaborative.[15]

This study has several limitations. Our conclusions were primarily limited by the unavailability of patient-level data to perform comparative analyses between groups for length of stay and cost. These parameters were analyzed in aggregate at the hospital level. The analysis of the 6 endpoints did not involve any covariate adjustment. So we cannot rule out that the observed differences, in particular, in-hospital mortality, were due to other confounding factors. However, we were able to compare the O/E statistics and the risk-adjusted mortality statistics as commonly used by the UHC to take into consideration patient risk profiles between the 2 groups. These statistics did not contradict our findings. Due to the inherent higher volume of bariatric surgery performed at accredited centers, it is difficult to determine if the outcome differences between accredited and nonaccredited centers are related to volume or accreditation status. Medicare patients are self-selected to receive care at accredited centers due to the Centers for Medicare and Medicaid Services requirement, and these individuals had been shown to be a higher risk group of patients, and therefore may skew higher risk patients toward the accredited centers.[3] That is, even with the higher risk patients, accredited centers are still associated with lower in-hospital mortality. The UHC database is compiled from discharge abstract data and is limited to in-hospital morbidity and mortality without follow-up data. The 30-day readmission rate includes only readmission to the index hospital and fails to capture data when patients are readmitted elsewhere. As a result, our statistics underestimate the true 30-day readmission rate.

Complications or deaths arising after discharge would not be captured in this database. We also recognize that some of the limitations of administrative data include accuracy in coding of complications. Nevertheless, the primary endpoint of interest for this study, in-hospital mortality, is a clinically meaningful endpoint that does not require subjective interpretation. Our study was limited to academic centers; however, the majority of centers of excellence are nonacademic centers so our results may not be representative of these centers. Despite these limitations, we believe this study is the first to show that accreditation in bariatric surgery is associated with improved outcomes, particularly in-hospital mortality.

CONCLUSIONS

This study found that almost 90% of bariatric operations are now performed within accredited centers. Within the context of academic centers, accreditation status was associated with a small but significant improvement of in-hospital mortality and perioperative outcomes. Post-hoc analyses performed were exploratory and hypothesis-generating to find reason for improved mortality within accredited centers. These analyses suggested associations between accreditation status and improved in-hospital mortality for patients who underwent the gastric bypass operation and for patients with higher severity of illness. The improved mortality rate associated with accredited centers may be attributed to the centers' ability to recognize and rescue complications.

Author Contributions

Study conception and design: N Nguyen, Stamos, Hohmann

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