

## The relationship between duration of stay and readmissions in patients undergoing bariatric surgery

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**Background.** Hospital readmissions are a quality indicator in bariatric surgery. In recent years, duration of stay after bariatric surgery has trended down greatly. We hypothesized that a shorter postoperative hospitalization does not increase the likelihood of readmission.

**Methods.** The University HealthSystem Consortium (UHC) is an alliance of academic medical centers and affiliated hospitals. The UHC's clinical database contains information on inpatient stay and returns (readmissions) up to 30 days after discharge. A multicenter analysis of outcomes was performed by the use of data from the January 2009 to December 2013 for patients 18 years and older. Patients were identified by bariatric procedure International Classification of Diseases, Ninth Revision, codes and restricted by diagnosis codes for morbid obesity.

**Results.** A total of 95,294 patients met inclusion criteria. The mean patient age was 45.4 ( $\pm 0.11$ ) years, and 73,941 (77.6%) subjects were female. There were 5,423 (5.7%) readmissions within the study period. Patients with hospitalizations of 3 days and more than 3 days were twice and four times as likely to be readmitted than those with hospitalizations of one day, respectively ( $P < .001$ ).

**Conclusion.** Patients with longer postoperative hospitalizations were more likely to be readmitted after bariatric surgery. Early discharge does not appear to be associated with increased readmission rates. (Surgery 2015;158:501-7.)

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HOSPITAL READMISSION RATES HAVE BECOME A QUALITY METRIC. The Affordable Care Act introduced the Hospital Readmission Reduction Program, which allows the Centers for Medicare and Medicaid Services to

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penalize hospitals with greater-than-expected rates of readmission. Reducing readmissions has thus become an integral strategy in controlling costs and improving patient care.<sup>1</sup> Another major strategy for controlling health care costs has been to focus on decreasing the duration of hospital stay after operative procedures. In bariatric surgery, publications describing successful “fast-track” programs for patients who undergo laparoscopic Roux en-Y gastric bypass (LRYGB)<sup>2,3</sup> have led to increasing pressure from insurance companies to discharge patients in 1 day or less.<sup>4</sup>

There have been definite safety concerns regarding this policy.<sup>5</sup> What has received less attention is the possible relationship between decreased duration of stay and readmissions after bariatric surgery. An emerging body of literature suggests that decreased duration of stay may be associated with an increased rate of readmissions and increased overall cost of care for hospitalized patients.<sup>6-8</sup> Much of the referenced work has

examined this relationship in cardiac patients, Medicare beneficiaries, and at Veteran's Hospitals. We sought to determine the relationship between duration of stay after bariatric surgery and the rate of readmissions using a large national administrative database. Our hypothesis was that decreasing duration of hospital stay was not associated with an increased rate of readmission.

## METHODS

After institutional review board approval, a multicenter analysis of patient outcomes was performed with the University HealthSystem Consortium (UHC) clinical database, Clinical Database/Resource Manager. The UHC is an alliance of 117 academic medical institutions and their 300 affiliated hospitals across the United States. The administrative database contains information on inpatient stay with readmission flags for returns up to 30 days after discharge.<sup>9</sup> The database was queried for adult patients (18 years or older at the time of surgery) who underwent bariatric surgery from January 2009 to December 2013. Patients were selected using *International Classification of Diseases*, Ninth Revision (ICD-9) codes for laparoscopic Roux en-Y gastric bypass (LRYGB): 4431, 4438, 4468; laparoscopic gastric banding (LAGB): 4495; and laparoscopic sleeve gastrectomy: 437, 4382, 4389. Patients must also have had an ICD-9 code for morbid obesity (2780, 27800, 27801) as their primary diagnosis. Additional variables collected for analysis from the database include age, race, sex, admission risk of mortality, admission severity of illness, comorbidities (#), duration of stay, expected duration of stay (used to calculate a duration stay index—observed/expected), readmission, time to readmission, complications, mortality, and cost.

The UHC database uses logistic regression analysis for risk adjustment of outcomes. The UHC risk-adjustment models involve 3 components: selection of a patient population to serve as the basis of the model (provide norms); use of multiple regression techniques to predict duration of stay, direct cost, and probability of mortality based on the normative patient population; and assignment of an expected duration of stay, direct cost, and probability of mortality to every patient in the database. UHC uses the 3M All Patient Refined-Diagnosis Related Grouper to estimate the severity of illness based on the ICD-9, Clinical Modification diagnosis and procedure codes. Furthermore, the Agency for Healthcare Research and Quality co-morbid states were used to estimate the illness severity by taking into account 29 specific co-morbid conditions.

Each patient data point was assigned to an illness severity level according to a patient classification scheme that uses a combination of principal and secondary diagnosis, procedures, and specific patient factors. The 4 illness severity categories were minor, moderate, major, and extreme.

Patients were first grouped by procedure and compared by an analysis of variance for continuous variables, and a  $\chi^2$  test was used for categorical variables. They were then grouped into readmission status and analyzed using a Student *t* test for continuous variables and a  $\chi^2$  or Fisher exact test for categorical variables. A logistic regression model was then built using a stepwise backward selection procedure. Variables not considered in the backward selection process include: time to readmission, difference between duration of stay and expected duration of stay, expected duration of stay, duration of stay index, and total cost. The reason the time to readmission variable was excluded from the model was because the variable only applied to those who were readmitted. The difference between duration of stay and expected duration of stay, expected duration of stay, and duration of stay index variables were excluded from the model because the information provided by the variables was also provided by the length of stay variable. Total cost was excluded from the model because of the range and distribution of the observations plus cost was missing in more than 3,000 records. The variable for duration of stay and the variable for number of comorbid conditions were discretized because the observations did not follow a normal distribution and were nonlinear. Four categories were created for the duration of stay variable: 1 day, 2 days, 3 days, or more than 3 days. Six categories were created for the number of comorbid conditions variable: 0 conditions, 1 condition, 2 conditions, 3 conditions, 4 conditions, and more than 4 conditions. Statistical analysis was conducted using SAS 9.2 (SAS Institute, Cary, NC).

## RESULTS

A total of 95,294 patients met the inclusion criteria. The mean age of the study population was 45.6 ( $\pm 0.04$ ) years with 73,941 (77.6%) female subjects. There were a total of 5,423 (5.7%) readmissions within the study period with 83 (0.1%) reported deaths (Table 1). The majority of procedures performed during the study interval were LRYGB. When grouped by procedure, patients undergoing LRYGB experienced the greatest rate of readmission followed by laparoscopic sleeve gastrectomy and finally LAGB.

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