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Comparing Outcomes of Laparoscopic Adjustable Banding and Laparoscopic Sleeve Gastrectomy Bariatric Surgery

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Abstract

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MHA, Walden University, 2015

BSc, University of Utah, 2013

Doctoral Study Submitted in Partial Fulfillment

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Doctor of Philosophy

Healthcare Administration

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Abstract

Bariatric surgery is an effective procedure type for morbidly obese patients when all else fails. Because obesity is a chronic disease, prolonged assessment and understanding of the credibility of procedure types and their effects on bariatric surgery outcomes are essential, yet current evidence shows decreasing utilization of one of the dominant procedure types. To better compare outcomes of procedure type, this research was designed to control for volume, hospital size, age, gender, season, month, year, and ethnicity. The goal of the study was to compare the outcomes of laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG) bariatric surgery using the epidemiologic triad model. This study was a retrospective cross-sectional review of Nationwide Inpatient Sample (NIS) from 2009 to 2014. Univariate and multivariate logistic regression were conducted to analyze the data. This study was based on a secondary analysis previously collected from NIS data. A convenience sample of 73,086 patients who underwent bariatric surgery using ICD-9 diagnosis and procedure codes was used. Multiple logistic regression analysis indicated that LAGB (odds ratio [*OR*] =.043) and LSG (*OR* =.030) were positively associated with in-hospital mortality. Similarly, LAGB (*OR* =.041) and LSG (*OR* =.425) were positively correlated to length of stay (LOS). Finally, LAGB (*OR* = .461) and LSG (*OR* = .480) was positively related to reoperation. LAGB, when compared to LSG for LOS, had a substantial advantage over biliopancreatic diversion. The LOS findings may contribute to patients' value proposition, including cost reduction for third party insurance payers and for the community.

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Dedication

The research is dedicated first to the Creator of the Universe, Yah. To all my family who continues to provide me with lasting support. The study is also dedicated to Jessica Baffoe my wife, for proofreading my drafts and making some suggestions on how to improve it. Although we had some challenges along the way during this journey, Jessica has been my best friend, loving, generous, great wife, and a fantastic mother to our kids.

To my future doctoral candidates, my children (Gabriel, Aliyah, Michael, and future kids) who were understanding of my time during my dissertation process when I could not play with them. I love you, and I hope you value education and books as much as I do; never stop learning. To Joseph Kwesi Baffoe (Father) whose dreams of his children reaching the highest of education planted the seed in me that has propelled me forward. He has always cheered me on and continues to do so. To Wilhelmina Baffoe (Mother) who worked hard to make sure her kids were happy. To Benjamin (Brother) and Sisters (Edith, Golda, and Briggitte) who all provided encouragements and love. To Kathy Grover, who provided initial support when I was deciding to pursue my doctoral degree. Lastly, to all those who may have helped me in my doctoral journey whose names are not mentioned here. To everyone, that stands for good and peace in the world.

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I thank Dr. James Rohrer, my mentor for giving me tough love, guidance, and encouragement throughout my dissertation process. Dr. James Rohrer, you are indeed a master sculptor; for only a master sculpture know how to take a ball of clay in the right proportions to make a masterpiece. I would like to thank Dr. James Goes for being a great committee member. I appreciated all your insights, contributions, funny feedback, and excellent editorial. I would like to thank Dr. Ron Hudak for ensuring that my work meets doctoral level scholarship and feedback. My appreciation to Dr. Zhamak Khorgami for always responding to my questions about the Nationwide Inpatient Sample data.

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Introduction

Obesity Problem

Obesity rates increased by two-fold in the United States between the years of 1960 and 2004 (Orehek & Vazeou-Nieuwenhuis, 2016). Besides being a serious health epidemic, obesity is also costing obese Americans an average of an additional $1,500 per year in healthcare costs (Orehek & Vazeou-Nieuwenhuis, 2016). This is not surprising, however, as obesity leads to cardiovascular disease, stroke, and some types of cancer (Orehek & Vazeou-Nieuwenhuis, 2016). Although there is conflicting research discussing the causes of obesity, Orehek & Vazeou-Nieuwenhuis (2016) suggested that some research findings indicate that those who are obese are less likely to listen to hunger cues and more focused on enjoyment and food convenience. Whatever the underlying causes may be, obesity is an epidemic that needs to be explored and treated so that Americans can live a longer, healthier life.

Obesity Comorbidities

Obesity has many associated morbidity and mortality risks, including chronic conditions and debilitating disease outcomes that facilitate cardiovascular diseases, diabetes, osteoarthritis, stroke, hypertension, nephropathy, sleep apnea, nonalcoholic fatty liver diseases, dyslipidemia, and cancer that translated to 3.4 million deaths (Athyros, Tziomalos, Karagiannis, & Mikhailidis, 2011; Ng et al., 2014). Pinkney and Kerrigan (2004) provided a different view on bariatric surgery effectiveness for type 2 diabetes by indicating that insufficient evidence existed to support the claim. In contrast, Evans and

Kurukulaaratchy (2013), Talbot, Jorgensen, and Loi, (2005), and Levy, Fried, Santini, and Finer (2007) claimed that bariatric surgery is the safest intervention method for comorbidities such as type 2 diabetes and asthma control. Bariatric surgery is an effective intervention for treating many other disease and chronic conditions as described by Fritscher et al., (2007); Goday et al., (2014); and Sugerman et al., (1999), including respiratory distress events and cardiovascular risks.

Economic Ramifications

Gulliford et al., (2016) suggested that the goal of reducing utilization costs associated with bariatric surgery should not outweigh the benefit of the intervention, including preventing diabetes emergence and declining mortality. Bariatric surgery volume and treatment costs increased 9.3 times for private insurance patients compared to a 9.1-fold increase in the uninsured from 1998-2004 (Zhao & Encinosa, 2006). Paxton and Matthews (2005) added that laparoscopic gastric bypass is more economical than open gastric bypass when comparing surgically influenced weight loss strategies.

The costs associated with obesity per annum is projected to be between Canadian (CAD) $4.6 and $7.1 billion, including direct costs, hospital utilization costs, medication expenses, and physician cost (Twells, 2015). Medical expenditure for morbidly obese patients is estimated to continue to increase exponentially (Twells, 2015). The average costs for a patient who underwent a single procedure type intervention for bariatric surgery is estimated from $11, 086 to $13,073 (Grenda, Pradarelli, Thumma, & Dimick, 2015).

Ideal Candidates for Bariatric Surgery

Obesity is a growing pandemic; bariatric surgery is effective treatment for morbid obesity when other methods have been exhausted (Colquitt, Pickett, Loveman, & Frampton, 2014; Kwok et al., 2014; Monteforte & Turkelson,2000; Ng et al., 2014; Scopinaro, 2014; Stevens et al., 2012). Laparoscopic gastric banding (LGB) is a leading intervention for treating bariatric surgery globally; however, failure rate for LGB procedure type was about 50% (Ramly et al., 2016). Thus, obesity patients can use bariatric surgery to ameliorate or control comorbidities and other adverse health complications.

Benefits of the Surgery

Management of nonalcoholic fatty liver disease after Roux-en-Y gastric bypass (RYGB) for patients was more successful than adjustable gastric banding (Caiazzo et al., 2014). In comparing conventional medical therapy to bariatric surgery, Mingrone et al. (2015) concluded that bariatric surgery had better outcomes than the standard medical therapeutic intervention for hyperglycemia in morbidly obese individuals having type 2 diabetes conditions. Wentworth et al.'s (2014) findings are consistent with Mingrone et al. (2015) results. Gastric banding is an effective technique to support a health-related quality of life advancement leading to weight loss (Robert, Denis, Badol-Van Straaten, Jaisson-Hot, & Gouillat, 2013). However, Freeth, Prajuabpansri, Victory, and Jenkins (2012) challenged the benefit of bariatric surgery procedure type, including Roux-en-Y gastric bypass and laparoscopic adjustable gastric banding's (LAGB) effect on promoting dietary benefit. Freeth et al. (2012) explained that physician recommendation after bariatric surgery facilitates risks associated with selenium imbalance and "glutathione peroxidase (GTP; as a functional measurement of selenium)" (p. 1660).

Problem Statement

The obesity pandemic affects about 2 billion people ages 18 and up (Khan et al., 2016). The long-term treatment for a person who is morbidly obese is bariatric surgery (Khan et al., 2016; Marek, Ben-Porath, & Heinberg, 2016). The socioeconomic impact of obesity is spurring debates about the pandemic, as obesity expenses contributed to 20.6% of the national health budget of United States (Cawley & Meyerhoefer, 2012). By 2030, the U.S. national health expenditure is expected to increase by two-fold every decade, to $861- $957 billion, including 16-18% of overall healthcare expenditure because of overweight and obesity morbidity (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008).

The death rate for people who are overweight or obese continues to rise rapidly. Nguyen et al. (2014) suggested that obesity and being overweight were projected to contribute to about 3.4 million deaths, a 3.9 % reduction in life expectancy and a 3.8 % increase in morbidity globally in 2010. The global age-standardized estimate for obesity occurrence doubled from 6.4% to 12.0% from 1980 to 2008 (Stevens et al., 2012). In 2048, obesity will be common among American adults (Wang, et al., 2008). Although lifestyle change, dieting, and physical activities can control overweight and obesity, some patients still struggle to maintain a healthy weight (Adams et al., 2006). Patients who undergo bariatric surgery lose more weight on average than those who use nonsurgical methods of weight reduction (Berrington de Gonzalez et al., 2010; Kwok et al., 2014).

Bariatric surgery provides robust treatment for people who are morbidly obese and are concerned about their health (Morgan, Ho, Armstrong, & Litton, 2015). Bariatric surgery lowers morbidity and mortality when evaluated against long-duration complication; similarly, bariatric surgery contributed to a reduction in hospital readmission (Morgan et al., 2015). Research completed by Zhao and Encinosa (2006) indicated that patients experienced a weight reduction between 62%-70% after bariatric surgery. Because obesity is a chronic disease, prolonged assessment and understanding of the credibility of procedure types and their effects on bariatric surgery outcomes are essential, yet current evidence shows decreasing utilization of one dominant procedure type.

Population-driven studies can provide meaningful information on how different types of bariatric surgery have various complications; however, no current study has compared outcomes of LAGB and laparoscopic sleeve gastrectomy (LSG) bariatric surgery using the Healthcare Cost and Utilization Project Nationwide Inpatient Sample (HCUP- NIS) derived data from 2009- 2014. None of the studies examined have investigated bariatric surgery using HCUP-NIS data beyond 2013, including controlling for seasonal influence on procedure type. To better compare outcomes of LAGB and LSG, this study controlled for volume, hospital size, age, gender, season, month, year, and ethnicity. By comparing the results of LAGB and LSG bariatric surgery using HCUP-NIS data from 2009- 2014, patients and experts may better understand efficacy, safety, and adverse outcomes associated with procedure type. Subsequently, having knowledge of the optimal intervention type may facilitate health literacy and improve decision making for patients who require bariatric surgery. For this purpose, I filled the gap in the literature by comparing the outcomes for LAGB and LSG bariatric surgery.

Purpose of the Study

My intention with this study was to compare outcomes for LAGB and LSG bariatric surgery using the epidemiologic triad model. My study was different from other research work conducted in the field because this research addressed the following questions utilizing epidemiologic triad model:

RQ1: To what extent, if any, was in-hospital mortality associated with the type of bariatric surgery procedure?

RQ2: To what extent, if any, is the length of stay related to the type of bariatric surgery procedure?

RQ3: To what extent, if any, is reoperation associated with the type of bariatric surgery procedure?

While many researchers such as Rohrer, Grover, and Moats (2013) have applied the epidemiologic triad model to different diagnoses, there is no evidence that other researchers have yet utilized the epidemiologic triad model to study the bariatric surgery procedure and complications when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity. This study generated evidence that adds to the scientific understanding of how LAGB and LSG contribute to complications and quality of care.

Research Questions and Hypotheses

RQ1: To what extent, if any, was in-hospital mortality associated with the type of bariatric surgery procedure used on the patient?

$H_0$1 ($\beta 1 = 0$): In-hospital mortality is not related to the type of bariatric surgery procedure used on the patient when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

H_a1 ($\beta 1 \neq 0$): In-hospital mortality is related to the type of bariatric surgery procedure used on the patient when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

RQ2: To what extent, if any, is length of stay associated with the type of bariatric surgery procedure?

$H_0$2 ($\beta 2 = 0$): Duration of residence is not related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

H_a2 ($\beta 2 \neq 0$): Length of stay is related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

RQ3: To what extent, if any, is reoperation associated with the type of bariatric surgery procedure?

$H_0$3 ($\beta 3 = 0$): Reoperation is not related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

H_a3 ($\beta 3 \neq 0$): Reoperation is related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

Conceptual Framework for Study

The conceptual framework used for this research was the epidemiologic triad. The epidemiologic triad concept explains a person, place, and time (Centers for Disease Control and Prevention, 2012; Rohrer et al., 2013). The model has been widely used to study public health, disease outbreak, and in scientific research (e.g., Rohrer et al., 2013). The epidemiologic triad approach has allowed researchers to examine seasonality, place, and person (Rohrer et al, 2013). Subsequent studies may benefit from utilizing the epidemiologic triad model because of the conceptual framework rigor and simplicity (Rohrer et al., 2013). The association of conceptual framework between people, place, and time is shown below in Table1.

Table 1

Association of Variables to Conceptual Framework.

People	Place	Time
Patients undergoing LAGB	Hospital Size	Season
Patients undergoing LSG	Volume	Months
Patients undergoing BPD/DS	Length of stay (LOS)	Year
Age	In-hospital mortality	
Gender	Reoperation	
Ethnicity		

Independent variables	Dependent variables	Covariates
LAGB	In-hospital mortality	Hospital size
LSG	Duration of stay	Volume
BPD/DS	Reoperation	Age
		Gender
		Season
		Month
		Year
		Ethnicity

The conceptual framework is illustrated in Figure 1 below:

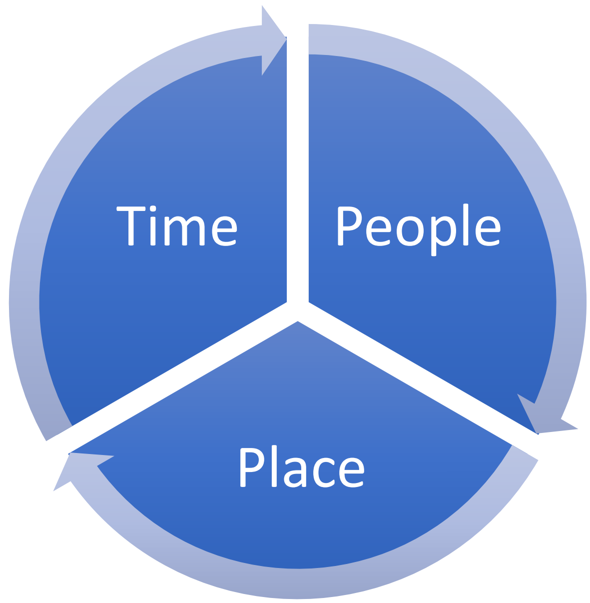

Figure 1. The epidemiologic triad diagram.

Nature of the Study

The nature of the study is focused on retrospective cross-sectional analysis consistent with quantitative research methods to compare outcomes of LAGB and LSG bariatric surgery using data from HCUP-NIS database. The epidemiologic triad was utilized as the conceptual framework to study the relationship between the LAGB and LSG complication outcomes. The unit of analysis was the patient.

The independent variables were defined as LAGB and LSG. The dependent variables are in-hospital mortality (IHM), the length of stay (LOS), and reoperation (RE-OP). The control covariates in this study were volume, hospital size, age, gender, season, month, year, and ethnicity.

Literature Search Strategy

I conducted online search queries for this study in the research databases obtained through PubMed (Medline), Google Scholar, the Walden University Library, the University of Utah Libraries, Cochran Database, SCOPUS, and CINAHL. The key words used in these searches included but were not limited to, *gastric banding, sleeve gastrectomy, hcup and bariatric surgery.* The results from these queries prioritized a publication period of 5 years ranging from 2012-2017. Peer reviewed articles were narrowed within the date ranges identified to reflect current scholarly resources.

The literature review search for sleeve gastrectomy from University of Utah Libraries returned a search result yielding more than 6,446 resources. A Google Scholar query search for gastric banding surgery yielded more than 6,130 resources. The literature review was in line with Figure 2.

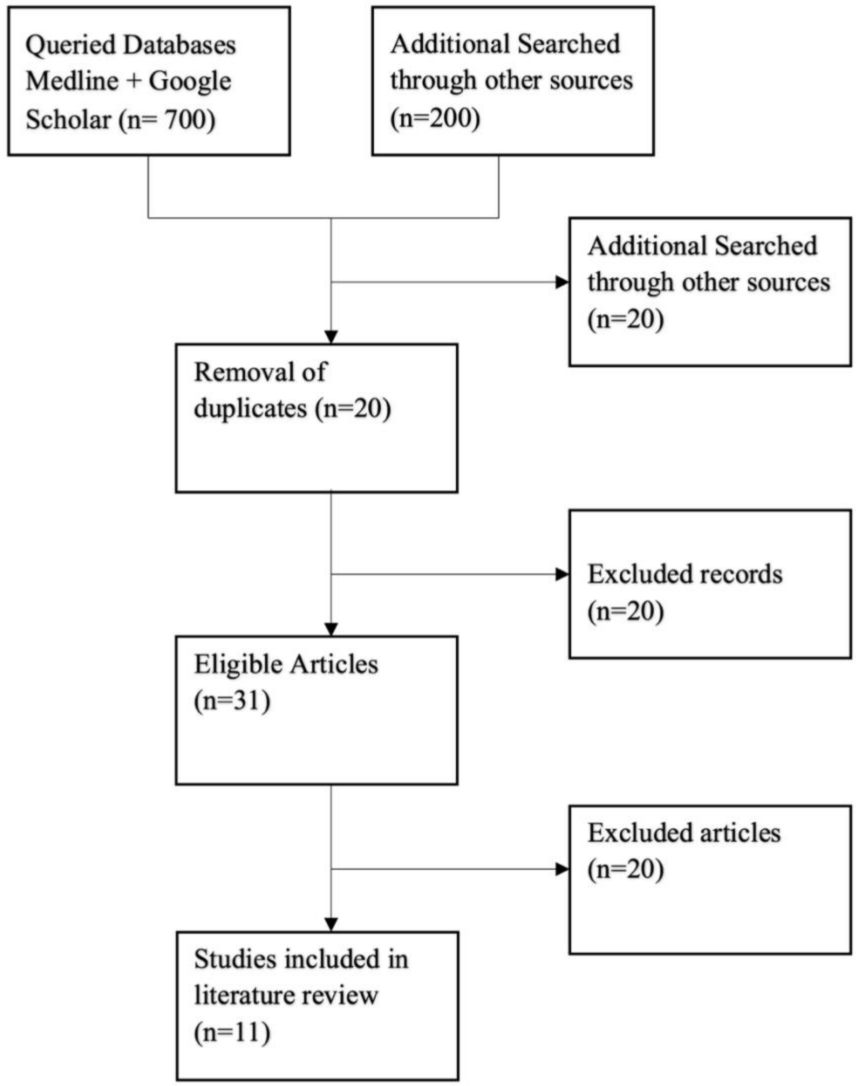

Figure 2. Flow diagram of selected literature review articles.

Literature Review Key Variables and Concepts

Trends in Bariatric Surgery

Khan et al. (2016) proposed that bariatric surgery procedure trends in volume remained unchanged in America in comparison to LAGB and gastric bypass (GB), LSG is a well-accepted bariatric surgery procedure type. LSG is the technique of choice for physicians in the United States, Canada, Asia, and the Pacific. In comparison, RYGB is the most popular procedure type for physicians in Europe and Latin or South America (Angrisani et al., 2015).

The volume of care. The larger the volume of care, the greater the quality of care. In fact, Al-Qurayshi, Robins, Buell, and Kandil (2016) suggested there was a correlation between surgeon volume, outcome, and cost. Surgeon's volume affects procedure type intervention success (Boudourakis, Wang, Roman, Desai, & Sosa, 2009). Likewise, Gourin et al., (2011) established that hospital volume of care impacts LOS and costs. Hence, high volume of care is associated with quality of care, LOS reduction, cost improvement, and effective care. Thus, while the trend is stable, high volume of care improves quality outcomes.

Seasonality and utilization. Durkin et al. (2015) provided information on how surgical site infections increase in the summer compared to rest of the year. Worni et al. (2013) asserted that obese Black and White patients using Laparoscopic gastric banding (LGB) between 2002 and 2008, have a different utilization rate, indicating slowing use. The LGB volume for Blacks and Hispanics was significantly less than for White patients. Fuchs et al. (2015) linked disproportionate utilization of bariatric surgery to inequitable gender gap facilitated by socioeconomics and ethnicity. The prevalence of gender difference in bariatric surgery utilization indicates that men use bariatric surgery the least. Stroh et al. (2013) found that German Nationwide Survey data points out that sufficient evidence exists to explain gender-driven selection differences among patients undergoing bariatric surgery in preoperative comorbidities intervention treatment type.

Laparoscopic Gastric Banding

Safety and Efficacy

Samakar et al. (2016) compared single-stage conversion of LAGB to laparoscopic Roux-en-Y gastric bypass (LRYGB). The total sample size was 94 patients. They used a retrospective design and case control to examine the safety and effectiveness of failed LAGB conversion to LRYGB. The researchers reported the statistical significance of the study using various statistical methods, including chi-square test, *t* test or Mann-Whitney U-test, and Fischer's exact test.

Samakar et al. (2016) determined that LAGB single-step conversion to LRYGB has limited complications. Similarly, the LOS for single-stage conversion was similar to LRYGB (Samakar et al., 2016). Revisional bariatric surgery was more technically demanding than first-stage bariatric intervention (Samakar et al., 2016). While the study by Samakar et al. (2016) was thorough, the evidence presented to substantiate the claim was weak—65 % of the original population were missing resulting in only a 35 % representation of the study. Per Samakar et al. (2016), "Assuming a 1 % control group (i.e., primary cohort) leak rate, this study with 94 patients per group has approximately 9 % power to detect a 1 % difference between groups" (, p 5457). The strength of the evidence presented by Samakar et al. (2016) is insufficient because the researchers used 1% control group to support the claim of 9% power.

Revision Procedures and Effectiveness

Alqahtani et al. (2013) compared unsuccessful LAGB conversion to LSG from a sample size of 184 total patients; 56 patients underwent LAGB removal and concomitant

LSG, and 128 of the patients underwent primary LSG procedures. The study design was based on retrospective analysis of all patients that underwent LAGB revisional concurrent LSG and LSG procedure techniques at the King Saud University from September 2007 to April 2012. They concluded that failed LAGB conversion to LSG quality outcomes is equivalent to primary LSG.

Alqahtani et al. (2013) reported findings applied the mean ± standard deviation statistical method; however, the researchers did not show how they derived the *p* value in the study. The reported statistical significance did not correlate to the direction of the effect. Because of the difference in sample size, the study lacked appropriate effect size. To clarify, the LAGB conversion to LSG size is smaller than the compared primary sample, increasing the risk of bias in the findings. While Alqahtani et al. (2013) studies are consistent with other RE-OP findings, the study design and methods lack rigor as there was no discussion of effect size. Therefore, because of the impression in how Alqahtani et al. (2013) calculated the *p* value, the threat to validity and reliability of the results was increased.

Duration and Revision Rate

Lazzati et al. (2016) examined adjustable gastric banding (AGB) historical trends in France between 2007 and 2013, with a sample size of 52,868 indicating patients undergoing AGB procedure. Of these, 10,815 patients received intervention to remove the bands comprising of adults ages 18 and up (Lazzati et al., 2016). The data was derived from the Programme De Me´dicalisation des Systemes d'Information (PMSI) database, and the study applied a retrospective design. The statistical methods used by

Lazzati et al. (2016) includes: mean ± standard deviation, the Cox proportional hazard model, univariate, and multivariate analysis. The researchers concluded that AGB bariatric surgery intervention type has about 6 % yearly removal rate and patient RE-OP rate of about 67% needing revisional surgery; therefore, AGB was not an effective viable intervention type for controlling obesity.

Because Lazzati et al. (2016) failed to conduct proper control or randomization, the study cannot be generalized. The study had an internal threat to maturity problem. While the conclusion by Lazzati et al. (2016) is reasonable, the study lacked consistency, directness, and precision.

Revisions. Ngiam et al. (2016) examined the revisional LAGB in Singapore based on 10- year follow up. The researchers reported a total sample size of 365 patients. The purpose of the study was to determine the long-term outcome for LAGB of bariatric surgery. The study utilized a retrospective design and a mean standard statistical method. The researchers concluded that revisional bariatric surgery resulting from complication had similar safety outcomes as primary surgery; however, revisional bariatric surgery for weight loss was subpar to primary surgery.

Effect size. The effect size in Ngiam et al. (2016) study is not stated, raising some question as to whether the appropriate controls were performed. Researchers reported the largest percentage of excess weight loss (%EWL) in the first year as 31.5, and 27.3 for the second year; the findings were not consistent with other previous studies. The investigator's work does not explain the variability and imprecision in the results. Although Ngiam et al. (2016) provided enough evidence to support the claim, the data could not be used to argue for the conclusion because of the limited effect size of 22.5% of bands removed compared to a total sample size of 365 and variability in intervention technique.

Statistical methods. Lee et al. (2015) compared LAGB with gastric plication (LAGB-P) to primary LAGB and LSG, with a total sample size of 42 patients, comprising 21 males and 21 females. The patients underwent the surgery at the Department of Surgery of the Min-Sheng General Hospital, National Taiwan University. The statistical method used includes: ANOVA, chi-square, and mean standard deviation to conduct a retrospective analysis. The purpose of Lee et al. (2015) study was to determine the efficacy and safety of LAGB-P compared to primary LAGB and LSG. Lee et al. (2015) suggested that combining LAGB with plication synergistically promotes weight loss comparable to LSG but facilitates an increase in complication outcomes.

Short-term results. Lee et al. (2015) study lacks appropriate statistical power and effect size. The reported finding estimation was imprecise because there were no studies to compare the outcome of research findings. However, Lee's et al. (2015) conclusion remained that LAGB-P can provide a safe way to fortify LAGB procedure with plication to improve the technique effectiveness.

Laparoscopic Sleeve Gastrectomy

Procedure Type Comparison

Carandina et al. (2014) compared the conversion of LAGB to LRYGB and LSG, encompassing patients who underwent 1 or 2 conversion type interventions from November 2007 to June 2012. The investigators studied the reliability, quality, and safety of one-step or two-step conversion of failed LAGB to LRYGB and LSG. This sample includes108 total patients with 74 LAGB conversions to LRYGB patients, and 34 primary LSG. Carandina et al. (2014) used a t-test statistical method and a retrospective design. They concluded that primary LSG is safe. However, the procedure effectiveness was comparable to the intervention rate for failed LAGB conversion to LRYGB.

In addition, Carandina et al. (2014) suggested that LRYGB patients sustained a higher propensity for weight loss at the two years follow up compared to the LSG patients. In contrast, patients who underwent LSG procedures experienced reduced postoperative morbidity. The authors offer no explanation for early complication discrepancy for failed LAGB conversion to LRYGB compared to LSG, yet they conclude that the LAGB to LRYGB is equally effective to LSG. Likewise, the study reported that there were 100 females to 8 male patients, raising some consistency issues with the effect size. While the findings are consistent with current literature, the strength of evidence for establishing the efficacy and safety of failed LAGB conversion to LRYGB and LSG is lacking because of the effect size and limited evidence provided.

Complications and Analysis of Outcomes

Ramly et al. (2016) compared the concomitant removal of the gastric band and LSG, with a total patient sample size of 11,546, patients who received LSG intervention were 11,189, and 357 for patients undergoing LSG/ Gastric banding removal (GBR). They used retrospective review design along with bivariate, multivariate and t-test statistical method for determining the results. The authors implied that LSG and LGB intervention techniques had a low risk of sickness and death; in contrast, LSG and LGB procedures have a higher propensity for complications leading to postoperative sepsis.

Ramly et al. (2016) used the American College of Surgeons' National Surgical Quality Improvement program database (ACS-NSQIP) to support their findings. However, the database lacked complication outcomes for procedure type. By address the problem with procedure type to infections, Ramly et al. (2016) selected postoperative sepsis as the primary measure for complication infection; yet, Ramly et al. (2016) failed to show the direct correlation of evidence to procedure specific, thereby contributing to threat to validity and reliability issues with the results. Thus, the strength of evidence for LSG and LGB contributing to postoperative sepsis complication was not consistent with the supporting evidence because of comparable limitation of 11,189 patients to 357 LSG/GBR.

Intervention Type Outcomes

Marin-perez et al. (2014) compared procedural results for failed AGB to LSG or RYGB. The study had a total sample of 59 patients, 11 men, and 48 women. The study was based on retrospective design. The researchers' statistical analysis was conducted using the: %EWL, t-test, Chi-square test, Fisher's exact test, and mean ± standard. They concluded that LSG and LRYGB procedure types are a superior alternative for patients undergoing revisional LAGB; likewise, RE-OP was common for patients experiencing LAGB complications Consequently, LAGB while safe in the short term, it was a complication prone intervention when compared to other techniques.

Marin-perez et al. (2014) used a solid study design and conducted proper control of the data. Studies of Marin-perez et al. (2014) has indicated how revisional LAGB was safe. However, the study does not clearly show which procedure outcome was the best for patients, since the intent of the authors was to compare intervention treatment type results to determine which procedure type was superior. Thus, the authors failed to show which procedure type was more effective for conversion because of limited evidence.

Single-Stage Revision

Yeung et al. (2016) compared single stage conversion of failed LAGB to LRYGB or LSG, with a total sample size of 104 patients, 32 patients single-stage revision to LRYGB, and 72 patients to LSG. The study design was retrospective; however, the reported statistical methods in the study are t-test and chi-square test. They concluded that although the single-stage revision of LAGB to LRYGB is possible, it was neither safe nor effective because of high complication rate associated with the procedure. The revision of LAGB to LRYGB had similar RE-OP, readmission, etc. Furthermore, the researchers reported that there was a greater level of complication associated with LRYGB revision than other intervention types. The work of Yeung et al. (2016) indicated that revision of LAGB to LRYGB had a high complication outcome, but the researchers failed to account for the data's variability thereby affecting the consistency and rigor of the conclusion. The reported data difference made it difficult to generalize the findings.

An Effective Bariatric Surgery Alternative

Yazbek, Safa, Denis, Atlas, and Garneau, (2013) study examined the safety and efficacy of conversion of LAGB to LSG, with total sample size of 90 patients that underwent the conversion of LAGB to LSG, 77 patients were women, and 13 were men. The investigators used a retrospective design. The statistical method applied in the study are fisher's exact test and mean standard. They concluded that while primary LSG was safer and has fewer complications than revisional conversion of LAGB to LSG, LAGB conversion intervention promotes good outcomes.

Yazbek et al. (2013) work conveyed a great deal about conversion of LAGB to LSG and its relevance; however, could this work be generalized to the population? The male and female sample size difference in the study affected the credibility of the conclusion. What was the practical implication of the study if the conversion of LAGB to LSG had a higher complication rate? Although Yazbek et al. (2013) study lacked data consistency, the researchers clearly did not demonstrate firm evidence support the conclusion because of small effect size. Based on Yazbek et al. (2013) sample size and effect size, the conclusion in the study is inadequate and unsatisfactory.

Effectiveness and safety. Dogan et al. (2015) compared LAGB, LRYGB, and LSG, with 735 total patient sample size, 245 in each cohort. The study design was retrospective and dual institutions data collection. The statistical method used were ANOVA test and t-test. The researchers concluded that LRYGB intervention yields sustained, feasible, and positive outcomes for the morbidly obese for a long duration of time. LSG intervention type is optimal and safe for weight loss and reduced complications outcomes for patients. LAGB is subpar to both LRYGB and LSG.

The Dogan et al. (2015) study results are consistent with current literature findings. The sample size in the Dogan et al. (2015) study was adequate; likewise, the results were well supported by the stated conclusion. The association was strong for the reported finding of Dogan et al. (2015). Although the study was rigorous, one limitation was that the study cannot be generalized. The researcher's work had practical implications to scholars in the field and the community.

Synthesis of Literature

LSG was an effective option for bariatric surgery. Conversely, LGB had many associated complications; however, when LGB was combined with plication the success rate was comparable to LSG. Nevertheless, Laparoscopic adjustable gastric banding (LAGB) was among the lowest risk type of any bariatric surgery. In comparison, the techniques used in LAGB were subpar to other bariatric surgery procedure types (Lee et al., 2015). Although obesity continues to increase globally, the demand for bariatric surgery remains steady. The demand for the bariatric procedure is gender specific, as females are more likely to get bariatric surgery than males. Failed initial procedure type conversions may have had a similar effectiveness as primary intervention models such as LSG and LRYGB etc. As with any bariatric surgery, physicians with a higher volume of care for bariatric surgery had better quality outcomes than those with a lower volume of care.

Table 2.

Literature Review Summary

Study	Design	Data Collection	Patient Sample Size	Statistical Methods	Covariates	Variables Used
Carandina et al. (2014)	Retrospective	Institution	108 total Patients 74 LRYGB 34 LSG	t-test chi-square	N/A	LAGB LRYGB LSG
Ramly et al. (2016)	Retrospective	ACS-	11,546 total Patients	t-test	N/A	LSG LSG/GBR

		NSQIP database	11,189 LSG 357LSG/GBR	bivariate analysis multivariate analysis		
Samakar et al. (2016)	Retrospective Case-control	Institution	94 total Patients	Chi-square test T-test or Mann-Whitney *U*-test Fischer's exact test	Age Gender BMI Year of operation	LAGB LRYGB
Alqahtani et al. (2013)	Retrospective	Institution	184 total patients 56 LGB removal and concomitant LSG 128 LSG	mean ± standard deviation	N/A	LAGB LSG
Lazzati et al. (2016)	Retrospective	national prospective database (PMSI)	52,868 total patients 10,815 removed bands	mean ± standard deviation Cox proportional hazard model Univariate Multivariate	N/A	AGB
Ngiam et al. (2016)	Retrospective	Institution	365 total patients	mean ± standard two sample t-test	BMI Comorbidities	LAGB RYGB Biliopancreatic diversion (BPD)
Lee et al. (2015)	Retrospective	Institution	42 total patients 21 males 21 females	Chi-square test ANOVA mean ± standard	N/A	LAGB with gastric plication (LAGB-P) LAGB LSG
Marin-perez et al. (2014)	Retrospective	Institution	59 total patients 11 men 48 women	%EWL t-test Chi-square test Fisher's exact test mean ± standard	N/A	LAGB LRYGB LSG
Yeung et al. (2016)	Retrospective	Institution	32 Single-stage revision to LRYGB 72 LSG	t-test Chi-square test	N/A	Single-stage revision to LRYGB LSG
Yazbek, Safa, Denis,	Retrospective	Institution	90 total patients 77 women	Fisher's exact test	N/A	LAGB LSG

Atlas, & Garneau, (2013)			13 men	mean ± standard		
Dogan et al. (2015)	Retrospective	Dual institution	735 total patients 245 LAGB LRYGB LSG	ANOVA test t-test	Gender Age	LAGB LRYGB LSG

Operational Definitions

Bariatric Surgery Procedure Type

Gastric banding had been around for a long time. However, LGB (an alternative name for LAGB) were first identified by Morino, Toppino, Garrone, and Morino (1994); Franco, Ruiz, Palermo, and Gagner, (2011) explained that LAGB was a modifiable intervention type that was restrictive. While there was a wide range of LAGB procedure types, the most common was pars flaccida, a high distinction from perigastric technique to increase band effectiveness (Franco, Ruiz, Palermo, & Gagner, 2011). In describing how to place the per-oral balloon, Franco, et al. (2011) elucidated that "per-oral balloon is inflated to calibrate the adjustment of the device creating a 15–25-ml gastric pouch" (p. 1459). Most patients who underwent the LAGB in the United States received the Lap-Band system while other patients received the alternative version to Lap-Band, Swedish adjustable gastric band, etc. (Franco, et al., 2011). As previously noted, the LAGB procedure type was simpler to execute.

Per Trastulli et al. (2013) "LSG was defined as the laparoscopic vertical resection of the greater curvature of the stomach, including the body and the antrum up to the angle of His" (p. 817). The LSG technique was first described by Hess (1998) and Marceau et al. (1998) (Franco, et al., 2011). Hess (1998) elaborated that while dealing with biliopancreatic diversion (BPD/DS), it was effective to synergistically combine to duodenal switch (DS) to create a new procedure type that is similar sleeve gastrectomy. Marceau et al. (1998) described using sleeve gastrectomy in combination with DS balanced against distal gastrectomy (DG).

Complications

In-hospital mortality (IHM): Death occurring during the duration of hospital stay. The two common ways of examining procedure-type deaths are in –hospital mortality, and 30-day mortality (Borzecki, Christiansen, Chew, Loveland, & Rosen, 2010). In-hospital mortality assessment requires knowing the length of stay.

Length of stay (LOS): The duration of stay from admission to hospital and discharge from the hospital. Controlling LOS has many benefits, including cost reduction and sustained performance (Meyer, Britt, Mchale, & Teasell, 2012). LOS can affect patients negatively due to the increasing cost.

Reoperation (RE-OP): Failed procedure type intervention requiring revision. RE-OP assessment is a control indicator for quality of care and efficiency of treatment (Gangl et al., 2011). Empirical evidence on RE-OP indicates that re-intervention had a higher probability of causing death (Gangl et al., 2011). Therefore, healthcare service organizations must have preventative measures to ameliorate RE-OP rates.

Assumptions

The following assumptions were considered in this research study:

1. It was assumed that LAGB and LSG procedure types had many benefits to morbidly obese patients.
2. The study was based on a convenience sample.
3. The research data was valid and that the data meets scholarly requirements.
4. Data gathered from participants represent the best available information and unbiased data.
5. Constructive measures were put in place to address internal threat to validity and design.
6. The inpatient sample may reflect the population demographics.
7. The Nationwide Inpatient Sample generated enough power level for an unbiased analysis of the procedure type variables.

Limitations

The following restrictions in this study are described below:

1. This study was derived from a secondary data; therefore, some of the variables may have time element constraints.
2. It was difficult to establish the direction of change between the exposure and the outcome. Therefore, it was problematic to determine the causal relationship between the interest variables.
3. Because the secondary data used in this study was not a contemporaneous sample, the inferences drawn from the secondary data may be limited.
4. Because the data was collected over a short-term period, the sample may lack prospective accuracy.

5. Missing data in secondary data or respondents' response may create some biases that may affect association identified.
6. The Nationwide Inpatient sample was redesigned in 2012, therefore, earlier data may not adequately reflect the respondent's report from 2009-2011, and may contribute to information biases.
7. The applied methodology in this study may be subject to respondent biases because of time imprecision.

Scope and Delimitations

This study is based on 2009-2014 Nationwide Inpatient Sample (NIS) from HCUP. The scope of the study encompasses comparing the outcomes of LAGB and LSG when controlling for covariates. Because the study was a convenience sample, the researchers had no encounter with NIS participants.

The delimitations considered in this study included:

1. The research method used in this study was based on cross-sectional quantitative method.
2. The study design was dependent on a retrospective review.
3. The study was restrictive to both independent and dependent variables in the study.
4. The study was delimited to internal threat to history and duration of collection.
5. The study only compares Laparoscopic gastric banding and Laparoscopic sleeve gastrectomy procedure types excluding other bariatric surgery

intervention techniques, including Laparoscopic Roux-en-Y gastric bypass etc.

6. The research was based on a secondary data and a convenience sample.
7. The assumption of normalcy of data.
8. The integrity of data was dependent on how the data was gathered.
9. Internal threat to validity issues.

The Significance of the Study and Social Change Implications

Khan et al. (2016) determined that LSG was the preferred procedure type in bariatric surgery in comparison to gastric bypass (GB) and LAGB. The original contribution of this study was to follow-up with Khan et al. (2016) and Weller and Rosati (2008) studies etc. to perhaps compare LSG and LAGB and determine the best bariatric surgery alternative to promote positive outcomes when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity. In addition, this study also accounted for IHM, LOS, and RE-OP. The public health professional contribution of this study may provide insights into how different bariatric surgery procedure types could facilitate community health and wellness. The healthcare administration implications for this study may be to uphold the non-maleficent standard while improving quality, patient safety, and increasing the value proposition for patients and the community.

A stronger understanding of the results of this research may enhance health literacy for bariatric surgery patients and experts about which technique type is the safest and most efficient. Because complications from bariatric surgery may contribute to reduced quality of life for patients, a poor understanding of the efficacy, the safety, and the risks associated with procedure type may be dangerous for patients; thus, patients may be able to use knowledge from these research findings to encourage meaningful decision-making. If the technique type that the patient desires do not align with the outcome the patient is seeking, it may create undesirable consequence for the patient. Consequently, morbidly obese patients with sufficient understanding of procedure type may have a better chance at improving obesity-related comorbidities while reducing risks factors. A reduced quality of life affects wellbeing and health of morbidly obese patients and may create some economic challenges for the patient and the community, including budget constraints etc.

Economic constraints may contribute to government budget deficit. Effective engagement and support of members of the community are predicated on community health and rapport. The positive social change relevance of this study may be to identify ways of improving health literacy on the efficacy of bariatric surgery intervention type, including addressing some inequities in the therapeutic intervention treatment for people who are morbidly obese or overweight.

Summary and Conclusions

Bariatric surgery is an alternative intervention for morbidly obese patients. LAGB and LSG procedure types are efficient and safe with some complication. There were still debates about the efficacy of LAGB because the procedure has greater complications; however, when combined with plication, complications from the LAGB procedure type were acceptable and comparable to other intervention types such LSG and LRYGB. Trends in bariatric surgery were relatively stable in the United States.

The primary aim of section two is to describe the research design and data collection procedure. The underpinnings guiding my research inquiry and design are explained in detail in section two, including validity, reliability, power analysis, ethical concerns, etc.

Section 2: Research Design and Data Collection

Introduction

The previous section focused on the obesity problem, benefits of bariatric surgery, literature review, and significance of the study. In this section, I describe research design, statistical methods, and ethical concerns.

Research Design and Rationale

I performed a retrospective cross-sectional review of NIS from 2009 to 2014. NIS data was attained from HCUP, funded by the Agency for Healthcare Research and Quality. The NIS contains information for LAGB and LSG, including IHM, LOS, RE-OP, volume, hospital size, age, gender, season, month, year, and ethnicity. Per Zhao and Encinosa (2006), "HCUP includes the largest all- payer encounter-level collection of longitudinal health care data (inpatient, ambulatory surgery, and emergency department) in the United States, beginning in 1988" (p. 3). The information obtained from HCUP represents a wide range of data results from many health service organizations in the United States.

The rationale for selecting a retrospective cross-sectional approach was because the design was appropriate for determining association between variables (Frankfort-Nachmias, 2008). Cross-sectional studies are widely used in social science to study associations between independent and dependent variables, including via surveys (Frankfort-Nachmias, 2008). Shi (2008) suggested that using secondary data promotes time-saving and cost reduction. Secondary data information was readily available for analysis (Shi, 2008). The use of secondary data provides some flexibility for researchers, including a large sample size that was difficult to obtain with some primary research (Shi, 2008). Large sample size enhances the effect size and directedness of data to findings. Consequently, secondary data provides a rich source of information for meaningful analysis of phenomenon using sophisticated statistical methods for extrapolation.

Methodology

In this section I describe a breakdown of how the study will be conducted, including study area, secondary data management, sampling procedures, threats to validity issues, and ethical concerns.

Study Area

The original NIS sample in 1988 consisted of only eight States (Houchens, Ross, & Jiang, 2014). The sampling expanded to 22 States in 1998; however, the study area increased to 46 States in 2011, including 97% of the U.S population nationwide (Houchens et al., 2014). The 46 NIS sampling states remain unchanged currently (Houchens et al., 2014). To address some sampling challenges associated with using the 46 States, the NIS sample was redesigned in 2012 to enhance approximation effectiveness and data gathering (Houchens et al., 2014). While, the NIS sample has some limitations, research based on the sample was useful in understanding trends in healthcare such as cost, quality, utilization, and health service organization (HSO) effectiveness.

Secondary Data Management

I used the HCUP-NIS database, which contains hospital discharge information intended to assist and facilitate HSO capacity to make meaningful healthcare judgment, thereby promoting health-related outcomes for the U.S population nationwide (Houchens et al., 2014). According to Houchens et al. (2014), about 1,000 hospitals are evaluated yearly. The NIS data encompasses 8 million discharges, making up about 20% stratified community HSO. Because of the nature of the information contained in the datasets, proper management of the data is essential to preserve confidentiality and to prevent unlawful access to the data.

Before obtaining the HCUP-NIS data, I finished the HCUP data user agreement training. The training was designed to educate researchers on the requirements to use the data, obligation to protect, and proper management of secondary data. To obtain the NIS dataset, I agreed to keep the data in a secured location. The dataset will be re-encrypted in a different file format and stored on an external hard drive. The password to access the dataset was separated and stored in a different location. The dataset was also encrypted to prevent illegal access should my computer be breached. The dataset was stored in multiple locations, and I have backed up data to preempt any data loss and data corruption.

Population and Sampling Procedures

The sample design in this research was based on multistage clustering. The standard way of thinking about multistage clustering is that when it is difficult to categorize the underlying makeup of the population, clustering sample is the preferred design approach (Creswell, 2014). Multistage clustering sample design approach allows the researcher to sample groups within a population (Creswell, 2014). My study applied multistage clusters to stratify the population, including identifying elements within the population such gender. (Creswell, 2014).

The NIS represents a proportional population sample of hospitals that reflects almost all of U.S population. The NIS is designed to estimate the hospital sample using stratified probability (Houchens et al., 2014). Houchens et al. (2014) stated that NIS data stratification is categorized into five frames: "ownership /control, bed size, teaching status, urban/rural location, and U.S regions," to provide accurate estimation, representation of hospital and discharges (p. 1). Therefore, stratification was necessary to study the NIS data to allow researchers to describe sampling frame at the backdrop of providing meaningful analysis of the data. The NIS data encompasses all categories of patients, including those with Medicaid, Medicare, privately insured and uninsured (Khan et al., 2016). The unit of analysis in the study was the patient.

Inclusion and Exclusion Criteria

The criteria for selection was based on patients who underwent bariatric surgery from January 1, 2009, to December 31, 2014. The study encompassed all patients who underwent procedure types such as LAGB, LSG, and subcategories identified within the inpatient intervention types for bariatric surgery. The patient inclusion selection and exclusion criteria were determined using relevant diagnosis and procedure codes based on the *International Classification of Diseases*, 9th Revision, Clinical Modification (ICD-9-CM). The study involved patients undergoing bariatric surgery using identified procedure codes: LSG (43.82) and LAGB (44.95). Patients who were aged 18 and up were included in this study; however, patients younger than 18 were excluded from the study.

Data Collection Tools

The HCUP-NIS data collection tools involve nationwide partners who collaborate on healthcare data gathering to provide longitudinal health service organization care data in the United States. The HCUP contains the largest healthcare datasets. The data collection was redesigned in 2012 to bolster the rigor and effectiveness of the data to perform predictive inference (Houchens et al., 2014).

Quality Assurance and Control

To assure the integrity and quality of the data, I used SPSS analytical predictive software version 24 from IBM Corporation. I used the SPSS software program to "clean the data," including running a descriptive analysis to examine the spread of data while identifying: missing data, outliers, and data normalcy. I cleaned out any missing data and removed outliers in SPSS dataset. I also used reverse coding when necessary to improve data normalcy.

Procedure for Gaining Access to the Data Set

To gain access to the data set, I completed the HCUP data use agreement training course. The training takes about 15 to 20 minutes to complete. After completing the training, I went on to purchase the data. Eligibility for data purchase was predicated on completing the HCUP data use agreement. The cost of the data was rated on whether the person requesting the data was a student or a professional. It was less expensive for student researchers compared to professional researchers. The encrypted data was then sent to me through e-mail with the password in separate e-mail. To open the data, I used a zip file software. It was particularly challenging to open the data on an apple mac computer because of compatibility and encryption issues.

Another challenge arose when the data were loaded into the program from the original file format to SPSS. The online tutorial only covered SAS analytics software program and not SPSS. This created some challenges on how to load the data correctly in SPSS, as the quick start guide provided by HCUP on how to load the data lacks depth. I overcame the challenge by calling technical support to resolve the issue.

Sample Size

Nguyen (2016) found that the sample size of patients undergoing a bariatric surgery procedure type between 2009 and 2012 was estimated to be between 81,005 and 114,780 cases per annum. The sample size in this study included a total of 73,086.

Justification for Effect Size, Alpha Level, and Power Level Chosen

A small effect size was selected to establish validity and effect relationship of the study. I used the standard alpha (α) level of $\alpha = .05$ in this study. The accepted *p* value to determine significance of analyses conducted in the study was less than .05. The standard accepted power level is .80; likewise, the power level in this study was based on the established standard probability. The power analysis and the number of cases were calculated using OpenEpi, a free web software program.

Sample Size:X-Sectional, Cohort, & Randomized Clinical Trials

Two-sided significance level(1-alpha):	95
Power(1-beta, % chance of detecting):	80
Ratio of sample size, Unexposed/Exposed:	1
Percent of Unexposed with Outcome:	0.01
Percent of Exposed with Outcome:	0.02
Odds Ratio:	2
Risk/Prevalence Ratio:	2
Risk/Prevalence difference:	0.01

	Kelsey	**Fleiss**	**Fleiss with CC**
Sample Size - Exposed	235508	235507	255119
Sample Size-Nonexposed	235508	235507	255119
Total sample size:	471016	471014	510238

References

Kelsey et al., Methods in Observational Epidemiology 2nd Edition, Table 12-15
Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 &3.19
CC = continuity correction
Results are rounded up to the nearest integer.
Print from the browser menu or select, copy, and paste to other programs.

Results from OpenEpi, Version 3, open source calculator--SSCohort
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

Figure 3. Total sample size required for hypothesis 1.

Sample Size:X-Sectional, Cohort, & Randomized Clinical Trials	
Two-sided significance level(1-alpha):	95
Power(1-beta, % chance of detecting):	80
Ratio of sample size, Unexposed/Exposed:	1
Percent of Unexposed with Outcome:	50
Percent of Exposed with Outcome:	55
Odds Ratio:	1.2
Risk/Prevalence Ratio:	1.1
Risk/Prevalence difference:	4.5

	Kelsey	Fleiss	Fleiss with CC
Sample Size - Exposed	1896	1895	1939
Sample Size-Nonexposed	1896	1895	1939
Total sample size:	3792	3790	3878

References

Kelsey et al., Methods in Observational Epidemiology 2nd Edition, Table 12-15
Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 &3.19
CC = continuity correction
Results are rounded up to the nearest integer.
Print from the browser menu or select, copy, and paste to other programs.

Results from OpenEpi, Version 3, open source calculator--SSCohort
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

Figure 4. Total sample size required for hypothesis 2.

Sample Size:X-Sectional, Cohort, & Randomized Clinical Trials			
Two-sided significance level(1-alpha):			95
Power(1-beta, % chance of detecting):			80
Ratio of sample size, Unexposed/Exposed:			1
Percent of Unexposed with Outcome:			30
Percent of Exposed with Outcome:			34
Odds Ratio:			1.2
Risk/Prevalence Ratio:			1.1
Risk/Prevalence difference:			4
	Kelsey	**Fleiss**	**Fleiss with CC**
Sample Size - Exposed	2176	2174	2225
Sample Size-Nonexposed	2176	2174	2225
Total sample size:	4352	4348	4450

References
Kelsey et al., Methods in Observational Epidemiology 2nd Edition, Table 12-15
Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 &3.19
CC = continuity correction
Results are rounded up to the nearest integer.
Print from the browser menu or select, copy, and paste to other programs.

Results from OpenEpi, Version 3, open source calculator--SSCohort
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

Figure 5. Total sample size required for hypothesis 3.

The largest number of cases required for hypothesis 1 was 510,000; I had 73,086. Therefore, my sample was not within power level estimate. However, if the procedure type value is unknown or if the number is smaller than expected, I used the odd ratio of two (2) to test the hypothesis. The estimated number of cases required for each of the hypotheses to make reasonable judgment for the required power level is shown in the table below:

Table 3.

Total Sample Size Required

Premise Number	Total number of cases required	Total number of cases if odd ratio is 2.0 for all hypothesis
Hypothesis 1	510,238	510,238
Hypothesis 2	3,878	296
Hypothesis 3	4,450	306

Instrumentation and Operationalization of Constructs

The instrument used to collect the data was based on a survey. The data was specifically designed to gather HCUP nationwide data. The instrumentation to collect the data was modified in 2012 to make the data gathering comprehensive and effective. The survey aimed to assist researchers in evaluating and establishing meaningful conclusions about the data. I obtained permission to use the HCUP data. The permission to used came by way of taking the HCUP data use agreement training course. I purchased the data after completing the HCUP use agreement training.

Operationalization

Unit of analysis: The unit of analysis for this study was the patient. Thus, all patients in the study were counted a single time for each inpatient bariatric surgery procedure types and subcategories performed in span of a year. However, the unit of observation for NIS inpatient core files, disease severity measure files, diagnosis, and procedure group was examined on a discharge- level. In contrast, the unit of observation for hospital weight file was established on hospital-level.

Table 4

International Classification of Diseases, Ninth Revision (ICD-9), Procedure and Diagnosis Codes Applied to Determine Procedure Type, Type of Complications and Infections

		ICD-9 Code
	Procedure Types	
Laparoscopic adjustable banding		44.95
Laparoscopic sleeve gastrectomy		43.82
Biliopancreatic diversion (BPD)/DS		43.89
		ICD-9 Code
	Type of Complication	
Reoperation	Reopening of recent laparotomy	54.12
	Drainage of intraperitoneal abscess or hematoma	54.19
	Reclosure of postoperative disruption of abdominal wall	54.61
	Removal of foreign body from peritoneal cavity	54.92
	Lysis of adhesions	54.51, 54.59

Table 5.

Research Variables Relating to Conceptual Framework

People	Place	Time
Patients undergoing LAGB	Hospital Size	Season
Patients undergoing LSG	Volume	Months
Patients Undergoing BPD/DS	Length of Stay (LOS)	Year
Age	In-Hospital Mortality	
Gender	Reoperation	
Ethnicity		

Independent Variables	Dependent Variables	Covariates
LAGB	In-hospital Mortality	Hospital Size
LSG	Duration of Stay	Volume
BPD/DS	Reoperation	Age
		Gender
		Season
		Month
		Year
		Ethnicity

Data Collection Technique

The HCUP-NIS data was collected between 2009 and 2014. The unit of analysis consisted of patients undergoing various bariatric surgery procedure types, including LAGB and LSG.

Data Analysis Plan

The analyses were performed in accordance with Figure 6.

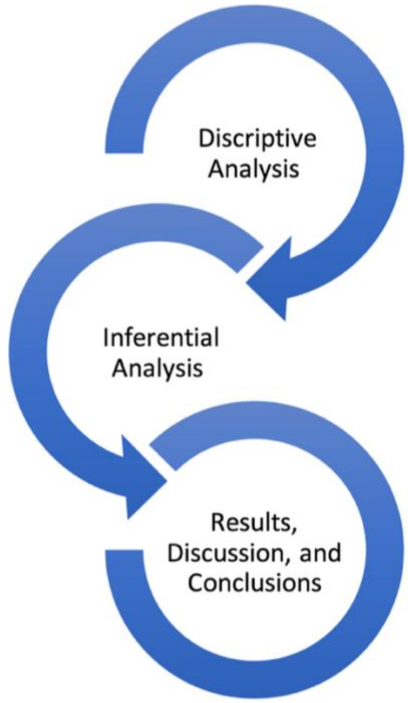

Figure 6. Data analysis procedure.

The data analyses were completed using SPSS version 24. A simple descriptive analysis tests was used to produce graphs, frequencies, graphs, tables etc. Univariate analyses were conducted using chi-square statistical tests in SPSS. Bivariate tests were performed to determine variation and direction of change. I utilized multiple logistic regression tests to examine the correlation between independent variables of bariatric surgery procedure types, dependent variable outcomes including: IHM, LOS, RE-OP, and covariates.

Research Questions and Hypotheses

RQ1: To what extent, if any, was in-hospital mortality associated with the type of bariatric surgery procedure used on the patient?

$H_0$1 (β1= 0): in-hospital mortality was not related to the type of bariatric surgery procedure used on the patient when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

H_a1 (β1$\neq$ 0): in-hospital mortality was related to the type of bariatric surgery procedure used on the patient when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

RQ2: To what extent, if any, was length of stay associated with the type of bariatric surgery procedure?

$H_0$2 (β2= 0): Duration of residence was not related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

H_a2 (β2$\neq$ 0): length of stay was related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

RQ3: To what extent, if any, was reoperation associated with the type of bariatric surgery procedure?

$H_0$3 (β3= 0): Reoperation was not related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

H_a3 (β3$\neq$ 0): Reoperation was related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity.

Threats to Validity

Virtually all research datasets are prone to some form of threats to validity. The threats to validity and reliability presented some issues to the researcher and how the study may be used to draw a meaningful conclusion about an event or phenomenon. There may be some internal and external threats to validity because the data is a secondary data. Some of the internal threats to validity may include history, construct, content, maturity, etc. (Creswell, 2014). The external threats to the study results may come from: interaction of history and treatments (Creswell, 2014). Missing data and some outlier may skew the normalcy and bias inferences. To control the threat to validity, the data was 'cleaned' and recoded to ensure accuracy and effectiveness of data use.

Ethical Procedures

The dataset used in this study is based on the HCUP-NIS data. Because the dataset was secondary data there may be some ethical concerns that are unknown to the researcher in this study. HCUP-NIS dataset meets the moral standard for data gathering and application of the data for research inference. The Institutional Review Board (IRB) at Walden University still required approval before the data was analyzed and used to generate meaningful inferential conclusions. Although the HCUP –NIS has already been subject to IRB approval, a subsequent IRB approval was obtained from Walden University to ensure that my research thoroughly meets the ethical consideration of using human subjects either directly or indirectly, and the appropriate use data for conducting research. Walden University IRB approval for number for this study is 05-31-17-0455865 (Appendix A). Walden University IRB approval facilitated my ability to perform descriptive, inferential statistics tests, discuss results, and provide conclusions about the findings.

Dataset Treatment Post-Analysis

The dataset will be re-encrypted to secure the data from unauthorized access of the data. Accessibility of the data was restricted to only me. The password for accessing the data was stored in separate location from the post analysis data. In summary, I took appropriate steps to ensure the confidentiality, reliability, and validity of the data post analysis.

Conclusion

Section two of this research work provided a comprehensive explanation on the applicable research design, the underpinning for conducting the research, and the methodology. The sample was derived from the NIS bariatric surgery procedure types, including LAGB and LSG from 2009 to 2014. An elaboration on the method of inquiry comprised: study area, secondary data management, procedure for sampling, instrumentation, construct operationalization, variable in operationalization, data gathering technique, data analysis, and ethical treatment of data. The potential internal and external threats to validity were addressed in this research.

Subsequently, in section three I performed data analysis using SPSS predictive software, present the results, and interpretation of results. Challenges involving the use of secondary data was explored and described. Both univariate and bivariate statistical analysis were performed. A multiple logistic regression tests was used to further quantify the data.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this study was to compare the outcomes of LAGB with LSG. However, BPD/DS was compared to the other procedure types (LAGB and LSG) as well because prior to 2012, NIS coded LSG as BPD/DS. The three research questions explored whether IHM, LOS, and RE-OP had any association with procedure types. Specifically, the research questions answered: (a) to what extent, if any, was in-hospital mortality associated with the type of bariatric surgery procedure used on the patient; (b) to what extent, if any, was length of stay associated with the type of bariatric surgery procedure; and (c) to what extent, if any, was RE-OP associated with the type of bariatric surgery procedure. The null hypotheses were that the dependent variables (IHM, LOS, and RE-OP) were not related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity. The alternative hypotheses were vice versa to the null hypotheses.

In Section 3, I begins with the purpose of the research, information on research questions, the null hypotheses, alternative hypotheses, and covariates. I analyzed the NIS secondary data using SPSS software version 24, including simple descriptive, univariate, and multiple logistic regression. The section ends with reported inferential analysis of my results and a summary of findings.

Data Collection of Secondary Data Set

As indicated in Section 2, the research data requested from HCUP NIS was from the period of January 2009 to December 2014. The HCUP-NIS data collection tools involved nationwide partners that cooperate on healthcare data gathering to provide longitudinal health service organization care data in the United States. The HCUP contains the largest healthcare datasets. The data collection was reformed in 2012 to increase the effectiveness of the data to perform predictive inference (Houchens et al., 2014).

Data collection of HCUP-NIS secondary dataset came from 46 States. In 2012, the HCUP-NIS changed the stratum used to poststratify hospital to census regions to census divisions. The hospital identification were also changed to reflect the new 2012 data gathering redesign. The standard for determining hospital size is different for HCUP-NIS dataset. The NIS data bedsize is categorized into census regions prior to 2012 and beginning in 2012 poststratified in census divisions. The bedsize stratum consists of a combination of census region or divisions, location or teaching, and status (teaching or nonteaching). For example, what is considered small (1-49) hospital bedsize in rural census regions prior to 2012 was not the same urban, nonteaching with small bedsize hospital in the same census region stratum. However, the conventional thinking is that hospital bedsize standard should remain the same regardless of census region or divisions, location or teaching, and status. Thus, it was difficult to derive individual hospital data from HCUP-NIS data.

Univariate Analysis

Descriptive Characteristics of the Sample

Over the period of 2009 to 2014, an estimate of 73,086 met the eligibility standard for patients that underwent surgical procedure for LAGB, LSG, and BPD/DS. Among these patients, 16,024 (21.9 %) underwent LAGB, 43,084 (58.9%) underwent LSG, 13,978 (19.1%) underwent BPD/DS. Patients under the age of 18 years were excluded from the study. The age of patients that were undergoing the bariatric procedure types are aged between 18-99 years. The sample consisted of mostly women (76.2%) and few men (23.7%). The frequency distribution of patients who underwent the various intervention types are shown in Table 6.

Table 6

Descriptive Characteristics of Patients Undergoing LAGB, LSG, and BPD/DS

Procedure type	Frequency	Percent	Valid percent	Cumulative percent
Laparoscopic adjustable banding	16024	21.9	21.9	21.9
Laparoscopic sleeve gastrectomy	43084	58.9	58.9	80.9
Biliopancreatic diversion (BPD)/DS	13978	19.1	19.1	100.0
Total	73086	100.0	100.0	

Most patients who underwent bariatric surgery chose LSG to LAGB and BPD/DS. LAGB was the procedure type selected second most by patients, as depicted in Figure 7.

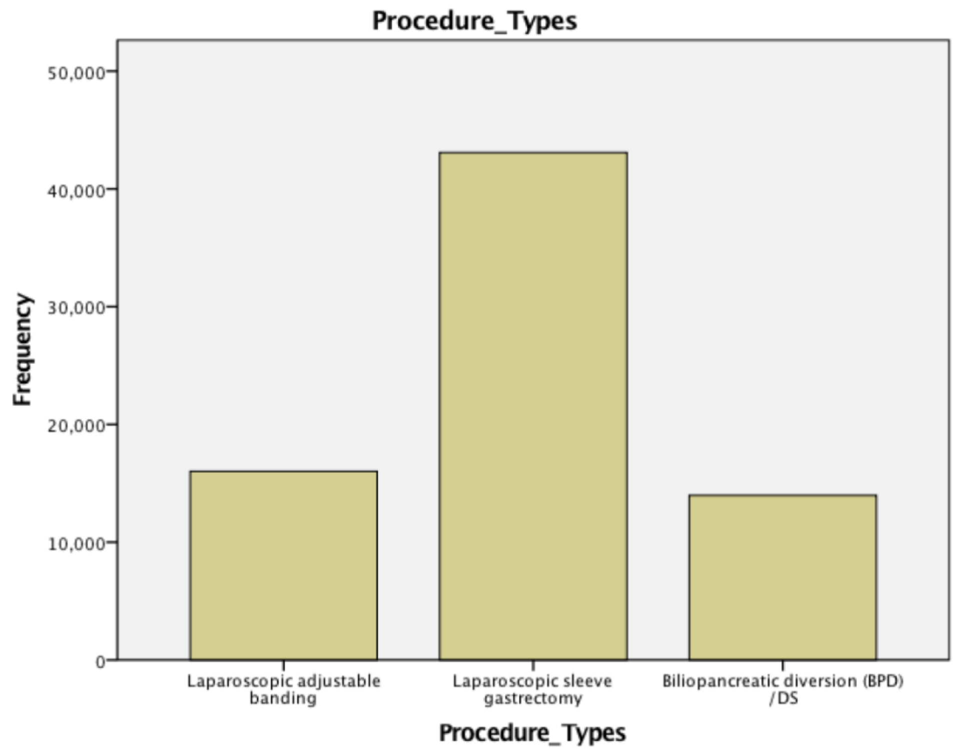

Figure 7. This is a histogram of a procedure types figure caption.

A total of 72,876 (99.7%) patients did not experience in-hospital mortality. The number of patients who died during hospitalization was 206 (.3%) as shown in Table 7. Thus, most patients did not die during hospitalization.

Table 7

Descriptive Frequency of Patients with In-Hospital Mortality

In-hospital mortality	Frequency	Percent	Valid percent	Cumulative percent
Did not die	72876	99.7	99.7	99.7
Died during hospitalization	206	.3	.3	100.0
Total	73082	100	100	

The number of patients who died during hospitalization was small compared to those who survived, as depicted in Figure 8.

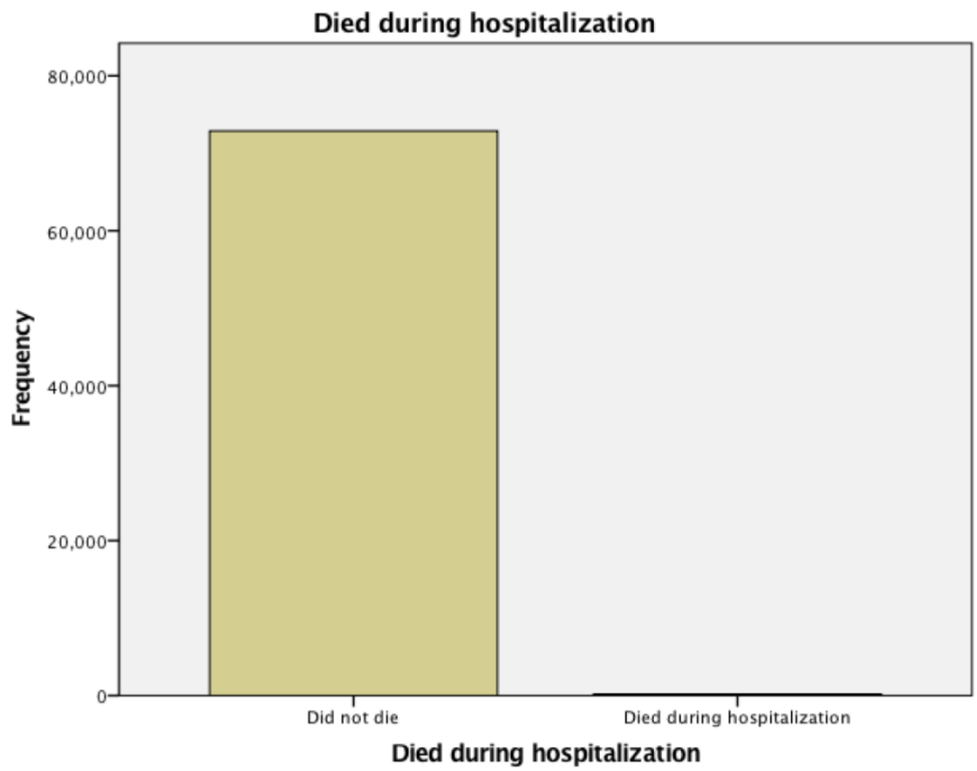

Figure 8. Patient who died during hospitalization.

A total of 39,119 (53.5%) patients had a prolonged duration of stay compared to 33,967 (46.5%) who had low LOS. The frequency of distribution of patients' LOS is displayed in Table 8.

Table 8

Frequency of Duration of Stay for Patients Undergoing Bariatric Surgery

Duration of stay	Frequency	Percent	Valid percent	Cumulative percent
Low	33967	46.5	46.5	46.5
High	39119	53.5	53.5	100.0
Total	73086	100.0	100.0	

The trend for patients' duration of stay is shown in *Figure 9*.

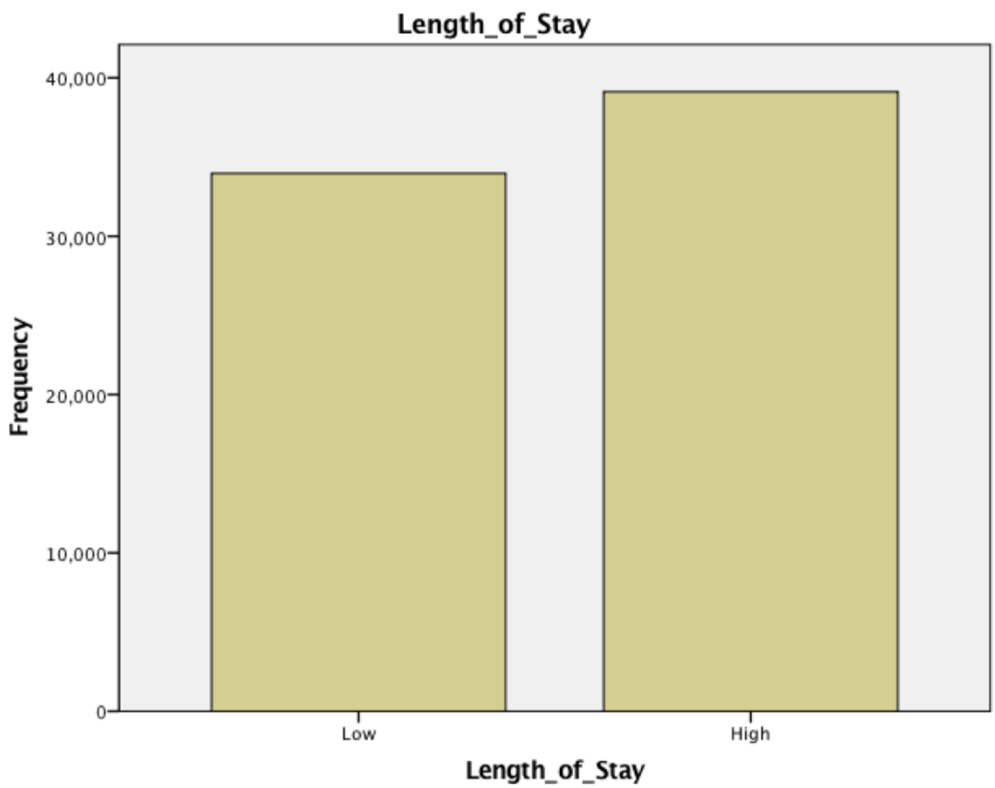

Figure 9. Patients' length of stay.

An analysis was conducted to determine the RE-OP occurrence for patients of bariatric surgery. The majority of patients did not have RE-OP. The number of patients with RE-OP was 5,155 (7.1%) compared to those patients with no RE-OP, 67,931 (92.9%). The descriptive characteristics of patients with RE-OP are shown in Table 9.

Table 9

Descriptive Characteristics of Patients Undergoing Reoperation

Reoperation	Frequency	Percent	Valid Percent	Cumulative percent
Patients with no reoperation	67931	92.9	92.9	92.9
Patients with reoperation	5155	7.1	7.1	100.0
Total	73086	100.0	100.0	

The sample is comprised of mostly women (76.2%) and only a few men (23.7%). Males were less likely to undergo bariatric surgery compared to females. The frequency distribution of gender is shown in Table 10.

Table 10

The Frequency of Patients Gender

Indicator of sex	Frequency	Percent	Valid percent	Cumulative percent
Male	17307	23.7	23.7	23.7
Female	55700	76.2	76.3	100.0
Total	73007	99.9	100.0	

About 7,403 (10.1%) patients in age group 18-29 constituted the lowest group of patients that underwent bariatric surgery. The highest age group of patients that underwent various procedure types were between 40-49 consisting of about 20,493 (28.0 %). The distribution for age group was normal as shown in Table 11.

Table 11

The Age frequency of patient undergoing procedure types

Age in categories	Frequency	Percent	Valid percent	Cumulative percent
18-29	7403	10.1	10.2	10.2
30-39	17148	23.5	23.5	33.7
40-49	20493	28.0	28.1	61.8
50-59	16744	22.9	23.0	84.8
>60	11069	15.1	15.2	100.0
Total	72857	99.7	100.0	

The trend for age group distribution is shown in *Figure 10.*

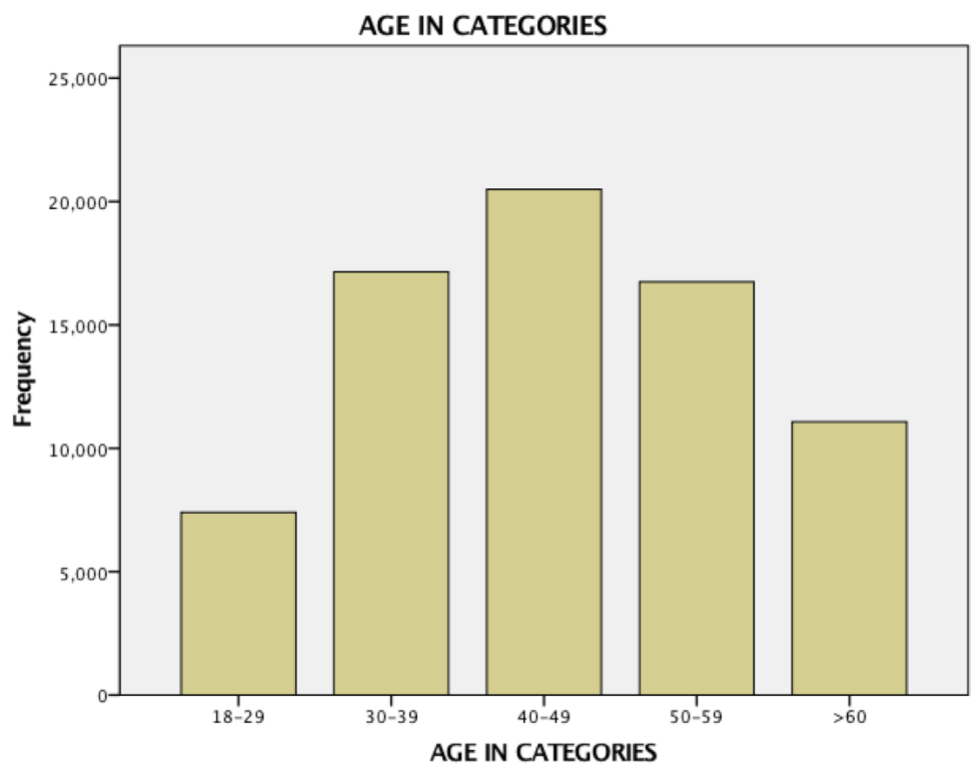

Figure 10. Age in categories of bariatric surgery patients.

A total of 68,203 patients of different races underwent bariatric surgery. Among the various ethnicities, 45,360 (62.1%) were White, which constituted the highest number of patients with bariatric surgery. The number of Black patients followed with 11,335 (15.5%). Native Americans had the lowest bariatric surgery rates with about 306 (.4%). The distribution by ethnicity is shown in Table 12.

Table 12. The frequency of race (ethnicity)

Ethnicity (race)	Frequency	Percent	Valid percent	Cumulative percent
White	45360	62.1	66.5	66.5
Black	11335	15.5	16.6	83.1
Hispanic	7888	10.8	11.6	94.7
Asian or Pacific Islander	682	.9	1.0	95.7
Native American	306	.4	.4	96.1
Other	2632	3.6	3.9	100.0
Total	68203	93.3	100.0	

The trend of patients by race in displayed in Figure 11.

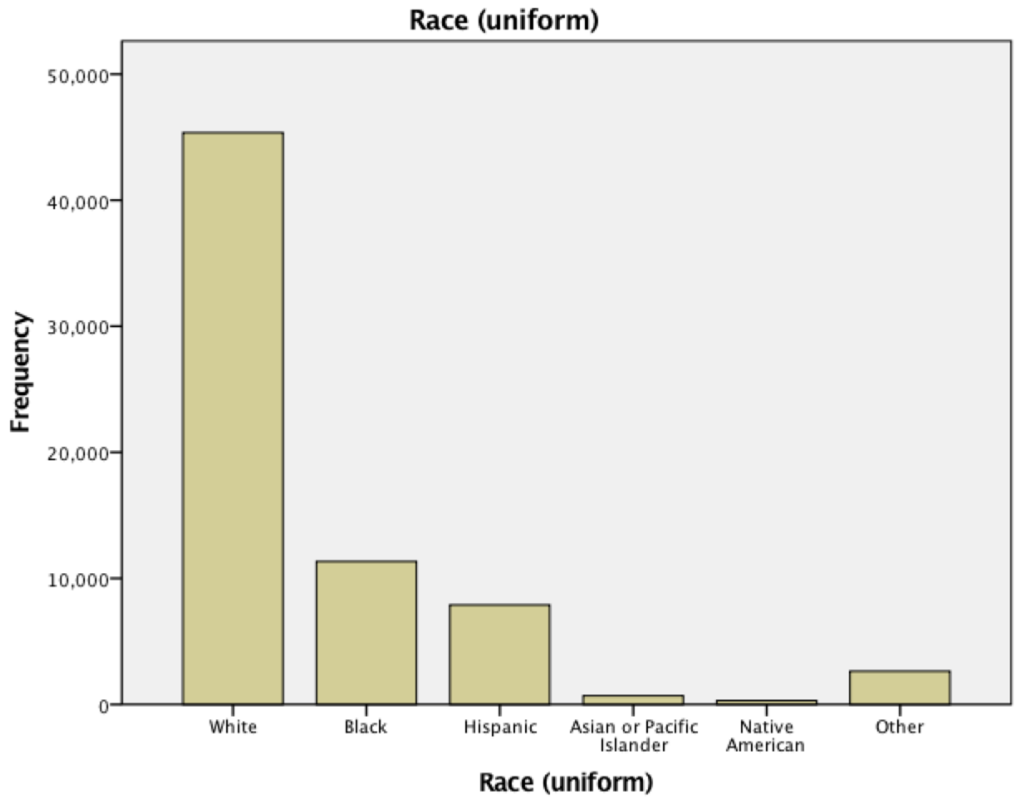

Figure 11. This is a sample of patient ethnicity.

A total of 73,086 patients underwent bariatric surgery. There were more bariatric surgeries performed in the year 2014. The lowest number of bariatric surgeries performed was in the year 2009. Calendar year is shown in Table 13.

Table 13

Frequency Showing Trends in Calendar Year

Calendar year	Frequency	Percent	Valid percent	Cumulative percent
2009	8274	11.3	11.3	11.3
2010	9589	13.1	13.1	24.4
2011	9123	12.5	12.5	36.9
2012	11381	15.6	15.6	52.5
2013	16072	22.0	22.0	74.5
2014	18647	25.5	25.5	100.0
Total	73086	100.0	100.0	

The trend of patients who underwent bariatric surgery based on calendar year is shown in *Figure 12.*

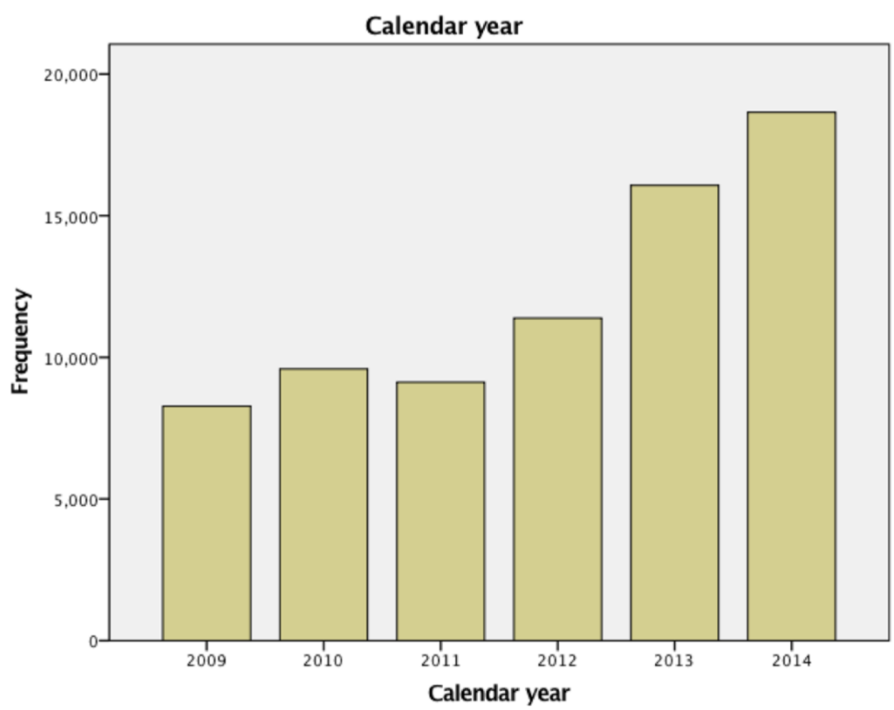

Figure 12. The frequency trends of patient based on calendar year.

A total of 20,252 (27.7%) patients underwent bariatric surgery in fall, which was the highest number by season. There were about 14,904 (20.4%) patient that were undergoing bariatric surgery in the winter. The cycle of seasons exhibits a downward trend from winter, spring, summer, and fall as shown in Table 14.

Table 14

The Frequency of Cycles of Season for Patients Undergoing Bariatric Surgery

Cycle of seasons	Frequency	Percent	Valid Percent	Cumulative percent
Winter	14904	20.4	21.0	21.0
Spring	17555	24.0	24.7	45.7
Summer	18352	25.1	25.8	71.5
Fall	20252	27.7	28.5	100.0
Total	71063	97.2	100.0	

The downward trend for cycles of seasons in depicted in Figure 13.

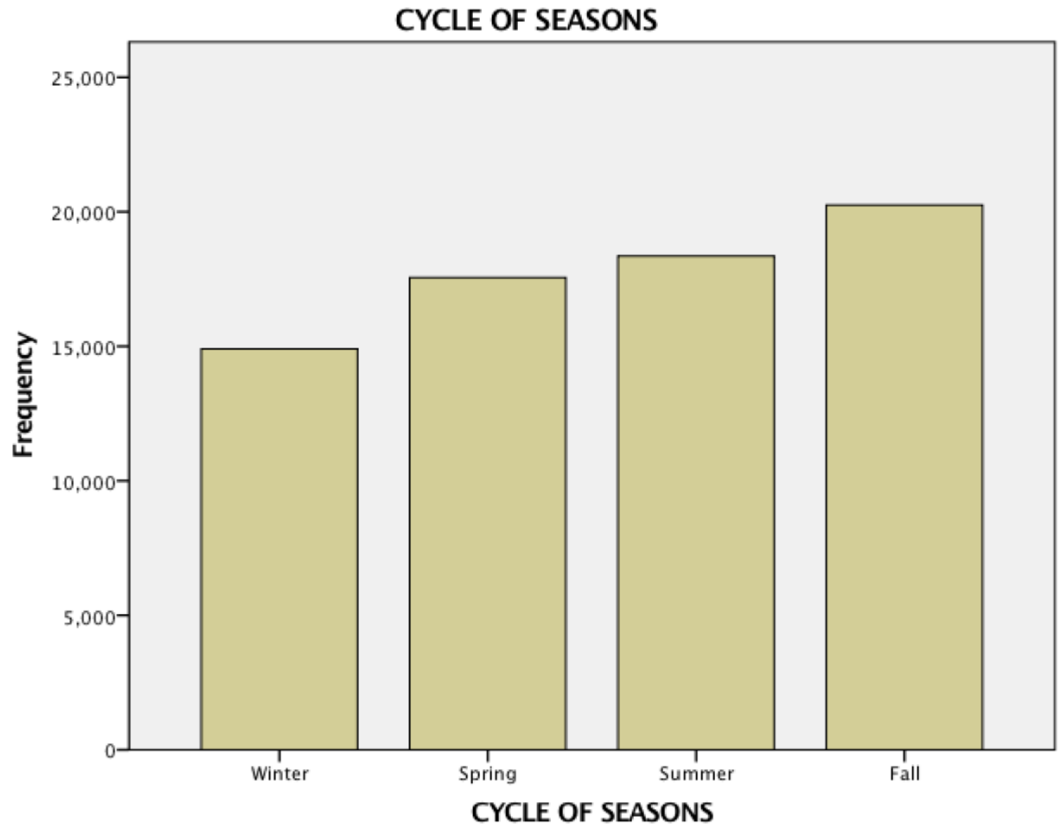

Figure 13. Seasonal trends of bariatric surgery.

A total of 71,063 patients underwent bariatric surgery within a year. Most patients undergoing the bariatric surgery received their intervention in the month of December, 7,896 (10.8%). The month with the lowest number of patients who underwent bariatric surgery was February, 4,591 (6.3%). The monthly distribution for bariatric surgery is shown in Table 15.

Table 15

Monthly Distribution of Patients Who Underwent Procedure Types

Months	Frequency	Percent	Valid percent	Cumulative percent
January	4779	6.5	6.7	6.7
February	4591	6.3	6.5	13.2
March	5534	7.6	7.8	21.0
April	5732	7.8	8.1	29.0
May	5724	7.8	8.1	37.1
June	6099	8.3	8.6	45.7
July	6150	8.4	8.7	54.3
August	6239	8.5	8.8	63.1
September	5963	8.2	8.4	71.5
October	6429	8.8	9.0	80.5
November	5927	8.1	8.3	88.9
December	7896	10.8	11.1	100.0
Total	71063	97.2	100.0	

The monthly trend for patients of bariatric surgery is depicted in *Figure 14.*

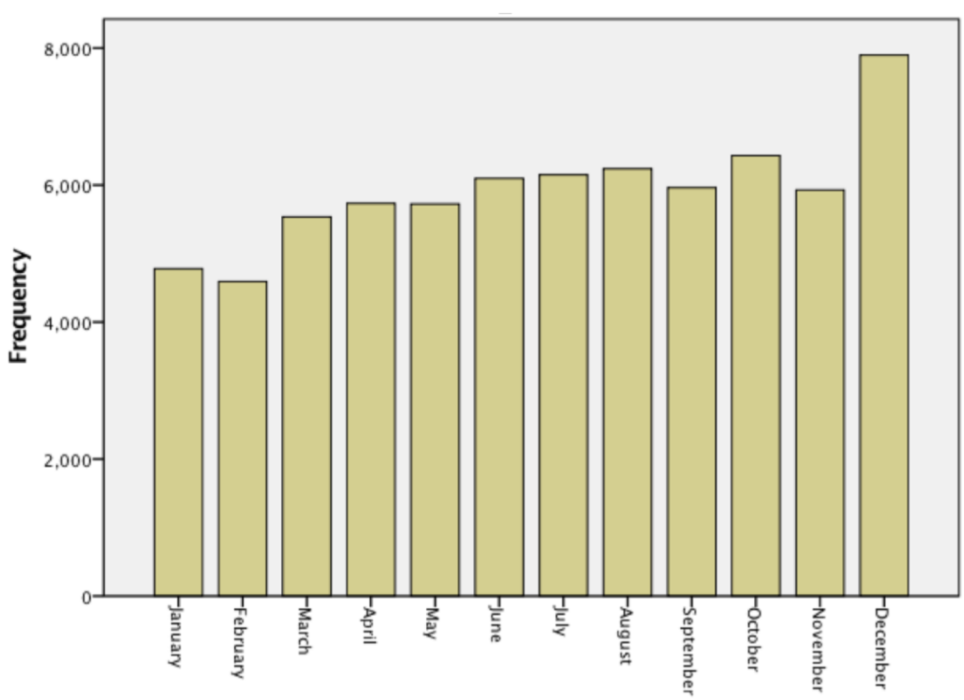

Figure 14. Monthly frequency of patient that received intervention types.

A total of 73,086 patients underwent bariatric surgery in the NIS control hospital stratum. Private, not-for-profit constituted the highest category. Private, either not-for-profit or investor-owned had the lowest frequency for bariatric surgery patients. The distribution for the control frequency is shown in Table 16.

Table 16

The Control Frequency of Patients Based on the Nationwide Inpatient Sample

Control	Frequency	Percent	Valid Percent	Cumulative percent
Government or private	17712	24.2	24.2	24.2
Government, nonfederal	3983	5.4	5.4	29.7
Private, not-for-profit	36208	49.5	49.5	79.2
Private, investor-owned	14604	20.0	20.0	99.2
Private, either not-for-profit or investor-owned	579	.8	.8	100.0
Total	73086	100.0	100.0	

The trend for control is depicted in Figure 15.

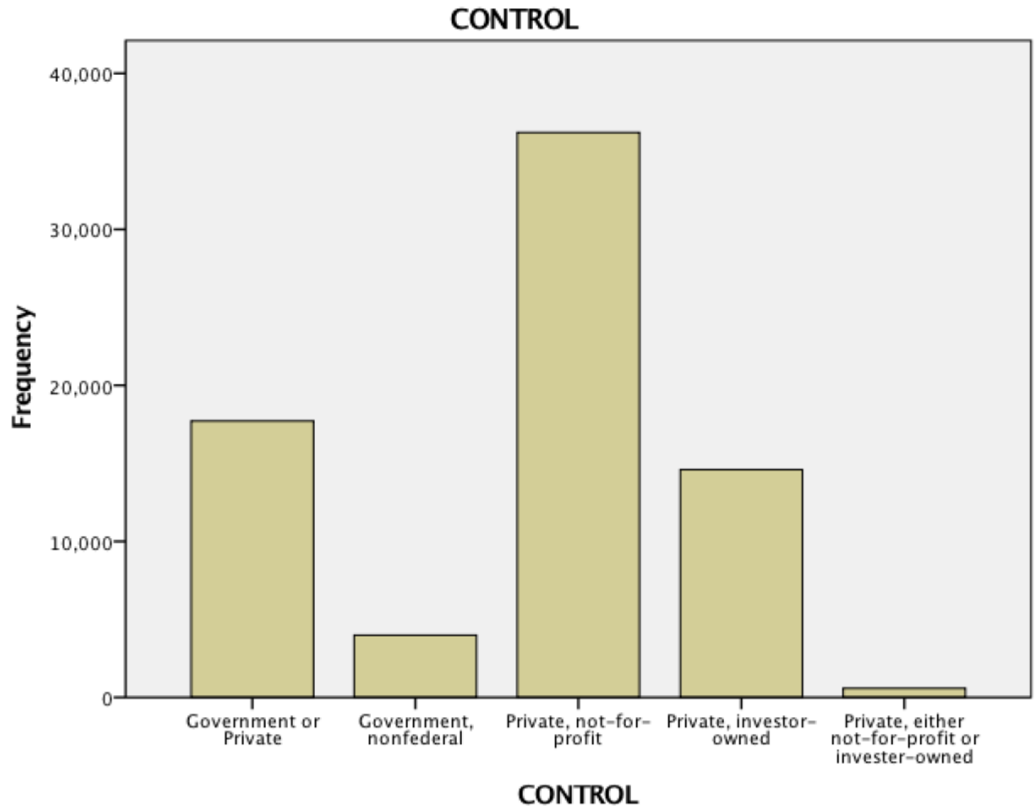

Figure 15. Control frequency of patients.

There was a greater level of bariatric surgery performed in Urban teaching hospitals. Rural hospitals had the lowest bariatric surgery performed. The frequency for location or teaching is shown in Table 17.

Table 17

The Frequency of Location or Teaching Status of a Health Service Organization

Location or teaching	Frequency	Percent	Valid percent	Cumulative percent
Rural	2616	3.6	3.6	3.6
Urban nonteaching	27706	37.9	37.9	41.5
Urban teaching	42764	58.5	58.5	100.0
Total	73086	100.0	100.0	

The trend for location or teaching is shown in Figure 16.

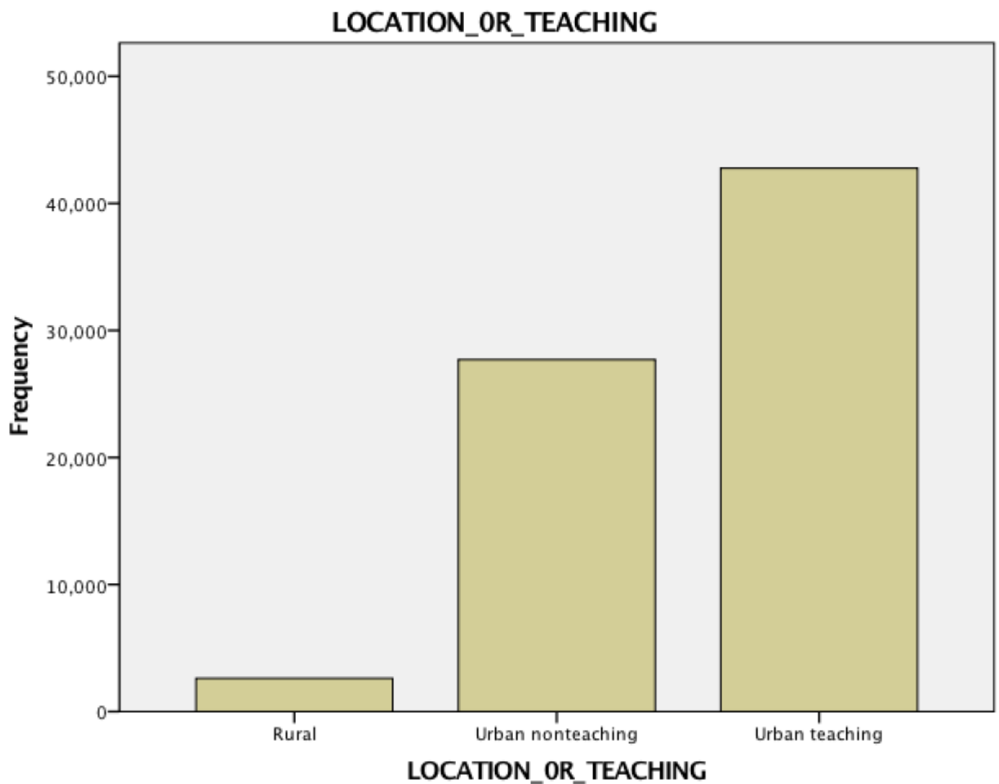

Figure 16. Health service organization frequency showing location or teaching.

The large bedsize HSOs performed most bariatric surgery. Small bedsize had the lowest bariatric surgery. Medium bedsize HSOs fit in the middle between large and small bedsize HSOs as shown in Table 18.

Table 18

Descriptive Characteristics Description of Bedsize

Bedsize	Frequency	Percent	Valid percent	Cumulative percent
Small	14936	20.4	20.4	20.4
Medium	20548	28.1	28.1	48.6
Large	37602	51.4	51.4	100.0
Total	73086	100.0	100.0	

The trend for bedsize is displayed in Figure 17.

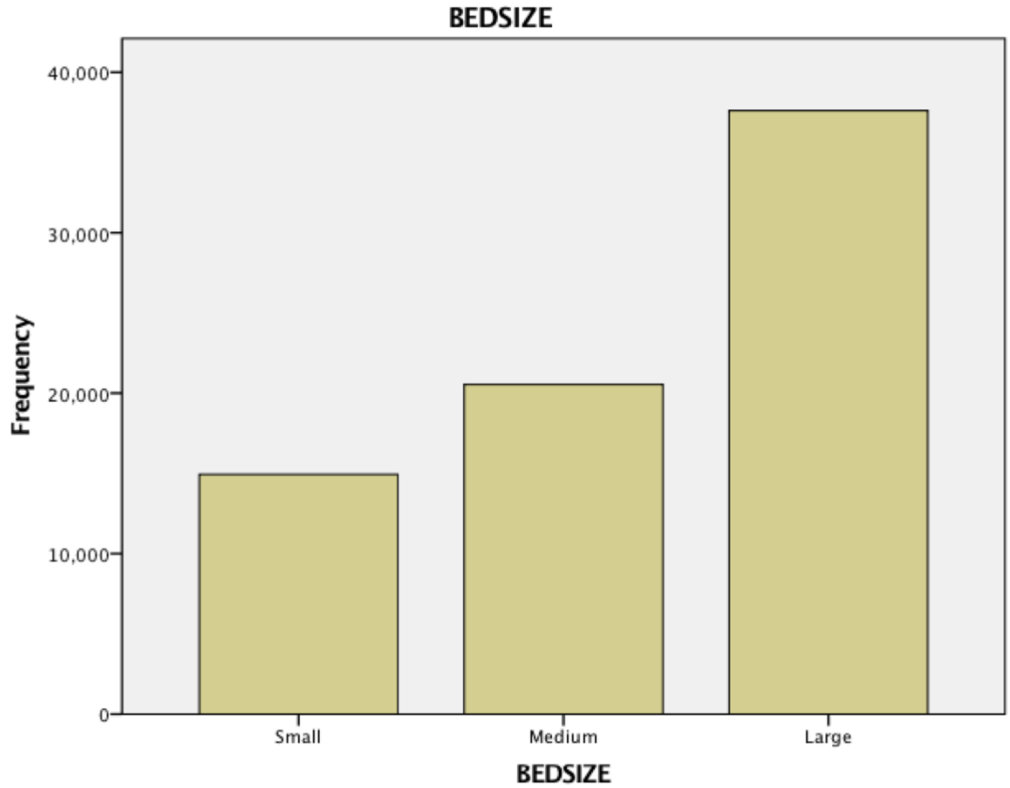

Figure 17. The frequency of bedsize.

The missing category for census region prior to 2012 was highest. Although, the missing category was highest, the missing category in the data was because NIS switched the census region to census division in 2012. Based on the census region prior to 2012 the south had the highest frequency for bariatric surgery when ignoring the missing category. The lowest was found in the West when ignoring the missing category as shown in Table 19.

Table 19

Census Region Prior to 2012.

Census region prior to 2012	Frequency	Percent	Valid percent	Cumulative percent
Northeast	9227	12.6	12.6	12.6
Midwest	15543	21.3	21.3	33.9
South	16433	22.5	22.5	56.4
West	7171	9.8	9.8	66.2
Missing	24712	33.8	33.8	100.0
Total	73086	100.0	100.0	

The trend census region prior to 2012 as depicted in *Figure 18.*

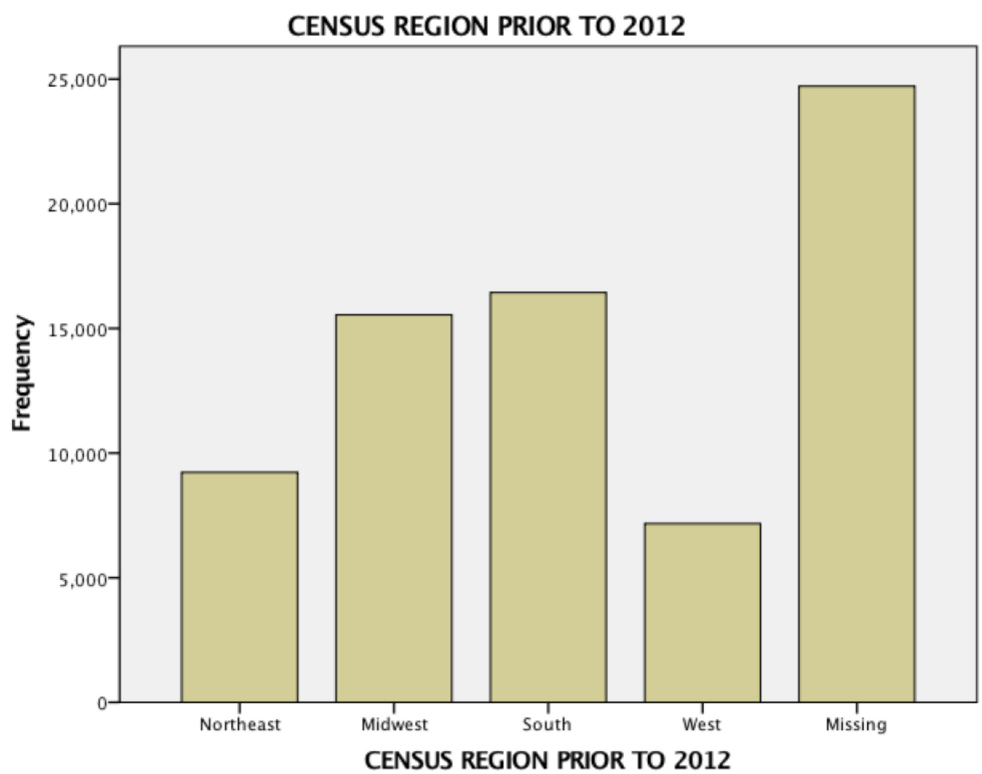

Figure 18. Trend of census region prior 2012.

The total for census division was about 73,086. East North Central had the highest census. Mountain had the lowest census for patients. The distribution of census is skewed to the left as shown in Table 20.

Table 20

The frequency of Census division beginning with 2012

Census division starting with 2012	Frequency	Percent	Valid Percent	Cumulative percent
New England	9227	12.6	12.6	12.6
Mid-Atlantic	15543	21.3	21.3	33.9
East North Central	16433	22.5	22.5	56.4
West North Central	7171	9.8	9.8	66.2
South Atlantic	7806	10.7	10.7	76.9
East South Central	3189	4.4	4.4	81.2
West South Central	7742	10.6	10.6	91.8
Mountain	2402	3.3	3.3	95.1
Pacific	3573	4.9	4.9	100.0
Total	73086	100.0	100.0	

The trend of census division is shown in Figure 19.

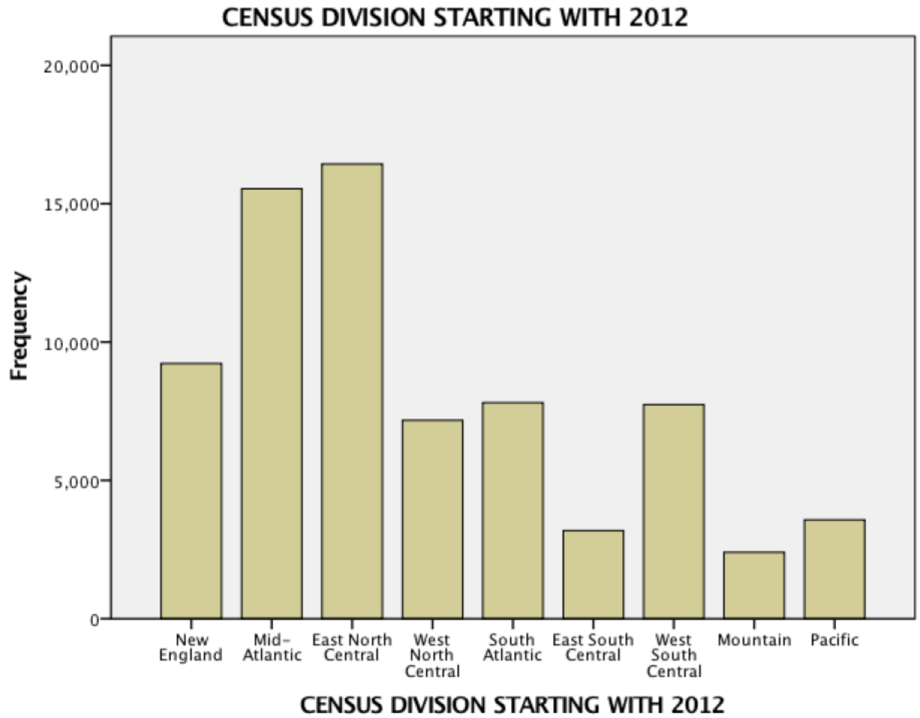

Figure 19. Census division starting with 2012.

The total for census division was 72,731. Low hospital volume was the highest for the census division starting in 2012. Very high hospital volume had the lowest census division for hospital volume as shown in Table 21.

Table 21

The Frequency for Hospital Volume

Hospital volume	Frequency	Percent	Valid percent	Cumulative percent
Very Low	24201	33.1	33.3	33.3
Low	33002	45.2	45.4	78.7
Medium	3893	5.3	5.4	84.0
High	10864	14.9	14.9	98.9
Very High	771	1.1	1.1	100.0
Total	72731	99.5	100.0	

The trend for hospital volume is shown in Figure 20.

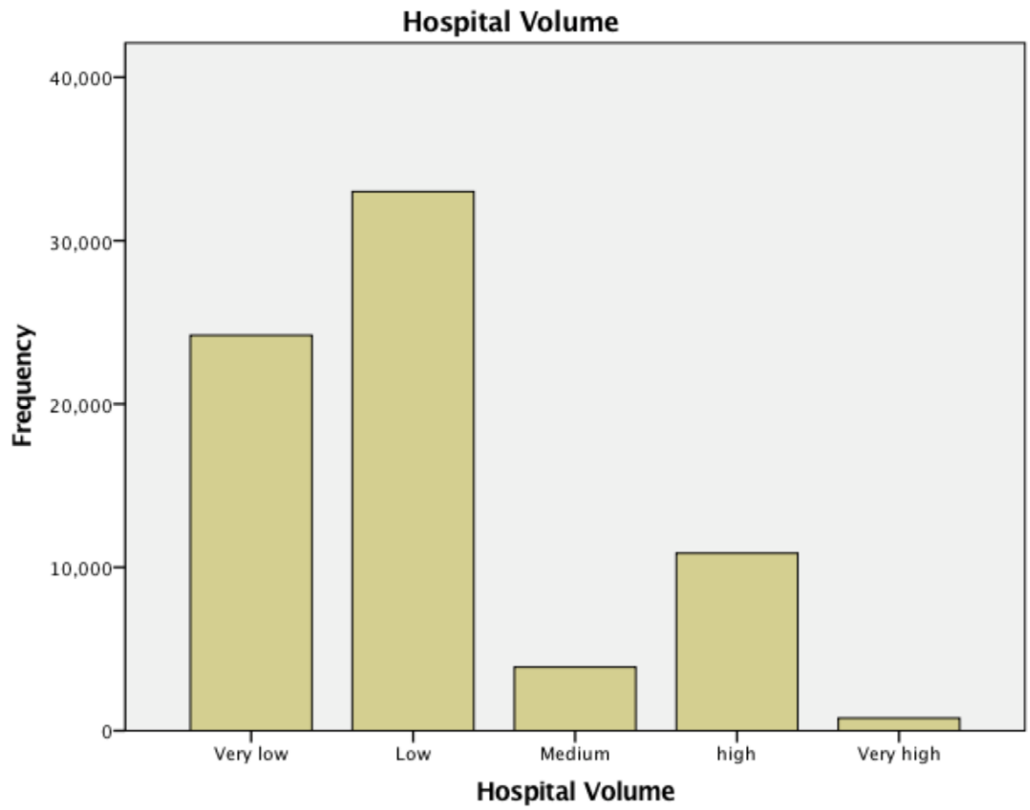

Figure 20. Frequency of Hospital Volume.

Univariate Logistic Regression for In-Hospital Mortality

The first univariate logistic regression was performed for the dependent variable for in-hospital mortality. The variables in the univariate analyses included independent variables: procedure types (LAGB, LSG, and BPD/DS) and covariates year, race, cycles of season, months, gender, age in category, hospital size (control, location or teaching, bedsize, census region prior 2012, census division starting with 2012), and hospital volume. The results for the IHM univariate logistic regression are shown below in Table 21.

Procedure types. The variables for procedure types (LAGB and LSG) when compared to BPD/DS, the reference category, which was the omitted category, were determined to be significant predictors (*p < .05)* for IHM. The results for procedure types and IHM univariate logistic regression are shown below in Table 21. The Wald test and the *p-values* indicated that LAGB and LSG were significant predictors of IHM when compared to BPD/DS, the reference category, which was the omitted category: LAGB, ($\beta = -3.183$), Wald $\chi2$ ($df = 1$) = 86.921, $p < .001$; LSG, ($\beta = -4.067$), Wald $\chi2$ ($df = 1$) = 156.899, $p < .001$.

A patient undergoing LAGB has only .041 times tendency of dying during hospital stay compared to BPD/DS patients, the reference category, which was the omitted category. Likewise, a patient that undergoes LSG when compared to BPD/DS was only .017 times as likely of dying during in-hospital stay as a patient undergoing BPD/DS, the reference category, which was the omitted category. Therefore, there was sufficient evidence to show that there was an association between procedure types (LAGB and LSG) when compared to BPD/DS, the reference category, which was the omitted category, and IHM.

Year. The variables for the years (2009- 2011) when compared to 2014 the reference category, which was the omitted category, was determined to be significant predictors (*p < .05)* for IHM. The results for Year and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* showed that the period from 2012 and 2013 were insignificant to predicting IHM; however, the years from 2009 to 2011 were significant predictors of IHM when compared to 2014 to the reference category, which was the omitted category: 2009, ($\beta = .940$), Wald $\chi 2$ ($df = 1$) = 14.049, $p < .001$; 2010, ($\beta = 1.138$), Wald $\chi 2$ ($df = 1$) = 23.857, $p < .001$; 2011, ($\beta = 1.124$), Wald $\chi 2$ ($df = 1$) = 22.664, $p < .001$; 2012, ($\beta = .389$), Wald $\chi 2$ ($df = 1$) = 2.147, $p = .143$; 2013, ($\beta = -.162$), Wald $\chi 2$ ($df = 1$) = .331, $p = .565$. A patient in the year 2009 when compared to 2014 was only 2.6 times likely to not die during hospitalization. Patients from the years 2010 and 2011 when compared to 2014 was only 3.1 times likely to not die during hospitalization. Patients in the years 2010 and 2011 have similar exposure outcomes for IHM.

Race. Hispanic people, when compared to other ethnicities, the reference category, which was the omitted category, were determined to be significant predictors ($p < .05$) for IHM; however, the following races were found to be insignificant: White, Black, and Asian Pacific Islanders. The results for race and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* showed that White, Black, and Asian Pacific Islanders were insignificant to predicting IHM; however, the IHM for Hispanics were significant predictors compared to other ethnicities in the reference category, which was the omitted category: White, ($\beta = .325$), Wald $\chi 2$ ($df = 1$) = .607, $p = .436$; Black, ($\beta = .214$), Wald $\chi 2$ ($df = 1$) = .232, p =.630 ; Hispanic, ($\beta = -1.281$), Wald $\chi 2$ ($df = 1$) = 4.472, $p = .034$; Asian or Pacific Islander, ($\beta = -.442$), Wald $\chi 2$ ($df = 1$) = .167, $p = .683$; Native American, ($\beta = 0$), Wald $\chi 2$ ($df = 1$) = .000, $p = .955$. A Hispanic patient when compared to other ethnicities was only .3 times likely to die during hospitalization. There is correlation between Hispanics and IHM.

Cycles of seasons. The variables for winter, spring, and summer when compared to fall, the reference category, which was the omitted category, were determined to be insignificant predictors ($p > .05$) for IHM. The results for Cycles of Seasons and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* showed that seasons from winter, spring, and summer were insignificant predictors of IHM when compared to fall, the reference category, which was the omitted category: winter, ($\beta = .147$), Wald $\chi 2$ ($df = 1$) = .533, $p = .465$; spring, ($\beta = -.018$), Wald $\chi 2$ ($df = 1$) = .008, $p = 1.158$; summer, ($\beta = .061$), Wald $\chi 2$ ($df = 1$) = .098, $p = .754$. Because the $p > .05$, there is no difference in cycles of season when compared to fall, the reference category, which was the omitted category.

Months. The variables for January when compared to December the reference category, which was the omitted category was determined to be significant predictors ($p < .05$) for IHM. However, the following months (February, March, April, May, June, July, August, September, October, and November) were insignificant predictors to IHM when compared to December the reference category, which was the omitted category. The results for Months and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* showed that the period from February to November were insignificant to predicting IHM; however, the month of January was significant predictors of IHM when compared to December the reference category, which was the omitted category: January, ($\beta = .716$), Wald $\chi 2$ ($df = 1$) = 4.797, $p = .029$; February, ($\beta = .107$), Wald $\chi 2$ ($df = 1$) = .077, $p = .782$; March, ($\beta = .162$), Wald $\chi 2$ ($df = 1$) = .201, $p = .654$; April, ($\beta = -.316$), Wald $\chi 2$ ($df = 1$) = .588, $p = .443$; May, ($\beta = .434$), Wald $\chi 2$ ($df =$

1) = 1.686, p = .194; June, (β = .316), Wald χ2 (df = 1) = .872, p = .350; July, (β = -.018), Wald χ2 (df = 1) = .002, p = .960; August, (β = .236), Wald χ2 (df = 1) = .473, p = .492; September, (β = .540), Wald χ2 (df = 1) = 2.794, p = .095; October, (β = .206), Wald χ2 (df = 1) = .360, p = .548; November, (β = .451), Wald χ2 (df = 1) = 1.861, p = .173. A patient in January when compared to December was only 2 times likely to not die during hospitalization.

Gender. The variables for Female when compared to Male the reference category, which was the omitted category, were determined to be significant predictors ($p < .05$) for IHM. The results for Gender and IHM univariate logistic regression are shown in Table 21. The results for female and IHM when compared to Male the reference category, which was the omitted category: Female, (β = .818), Wald χ2 (df = 1) = 33.314, p < .001. A Female patient when compared to Male was only 2.3 times likely to not die during hospitalization. There is enough evidence to indicate that there is a difference for Female when compared to Male the reference category, which was the omitted category and IHM.

Age in Category. The variables for all the age categories when compared to >60 the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for IHM. The results for Age Group and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* showed that all the age categories were significant predictors of IHM when compared to those of patient aged 60 and up (> 60) to the reference category, which was the omitted category: 18-29, (β = -3.255), Wald χ2 (df = 1) = 41.275, p < .001; 30-39, (β = -3.872), Wald χ2 (df = 1) =

72.555, $p < .001$; 40-49, ($\beta = -2.887$), Wald $\chi 2$ ($df = 1$) = 120.494, $p < .001$; 50-59, ($\beta = -2.238$), Wald $\chi 2$ ($df = 1$) = 107.281, $p < .001$.

The OR for the age category 18-29, 30-39, 40-49, and 50-59 compared to > 60 the reference category, which was the omitted category are .039, .021, .056, and .107 respectively. Except for age group 30-39 (OR =.021) which is an outlier, the rest of the age group show a general trend OR increasing with age (OR for 18-29 = .039, OR for 40-49 = .056, OR for 50-59 = .107). However, the OR for all the Age in Category are almost similar. Therefore, while the OR for exposure for the age group have almost similar outcomes for IHM, a patient in the age group 50-59 have higher odds of experiencing IHM.

Control. When Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned variables are compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category were found to be insignificant predictors (*p > .05)* for IHM. The results for Control and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* showed that the Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned were insignificant predictors of IHM when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category: Government or Private, ($\beta = .410$), Wald $\chi 2$ ($df = 1$) = .327, $p = .567$; Government, nonfederal, ($\beta = -.544$), Wald $\chi 2$ ($df = 1$) = .471, $p = .492$; Private, not- for-profit, ($\beta = -.486$), Wald $\chi 2$ ($df = 1$) = .459, $p = .498$; Private, investor-owned, ($\beta = -.627$), Wald $\chi 2$ ($df = 1$) = .729, $p = .393$. There was no difference for Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned variables when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category and IHM.

Location or Teaching. The variables for Rural and Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category were determined to be insignificant predictors ($p >.05$) for IHM. The results for Location or Teaching and IHM univariate logistic regression are shown in Table 21. The result showed that Rural and Urban nonteaching were insignificant to predicting IHM when compared to Urban teaching to the reference category, which was the omitted category: Rural, ($\beta = .444$), Wald $\chi2$ ($df = 1$) = 2.153, $p = .142$; Urban nonteaching, ($\beta = -.183$), Wald $\chi2$ ($df = 1$) = 1.478, $p = .224$. There is no association between Rural and Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category.

Bedsize. The variables for Small and Medium when compared to Large the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for IHM. The results for Bedsize and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* results showed that Small and Medium were significant to predicting IHM when compared to Large the reference category, which was the omitted category: Small, ($\beta = -1.202$), Wald $\chi2$ ($df = 1$) = 21.904, $p < .001$; Medium, ($\beta = -.503$), Wald $\chi2$ ($df = 1$) = 8.909, $p =. 003$.The OR for Small and Medium compared to Large the reference category, which was the omitted category are .301 and .605 respectively. A patient in a Small bedsize health service organization (HSO) when compared to Large was only 30% likely to die during hospitalization. A patient in a Medium bedsize health service organization (HSO) when compared to Large was only .6 likely to die during hospitalization. Bedsize was predictor for a patient experiencing IHM.

Census region prior to 2012. The variables for Northeast, South, and West when compared to Missing the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for IHM. The results for Census Region Prior to 2012 and IHM univariate logistic regression are shown in Table 21. The results are follows: Northeast, ($\beta = .612$), Wald $\chi 2$ ($df = 1$) = 7.303, $p = .007$; Midwest, ($\beta = .176$), Wald $\chi 2$ ($df = 1$) = .638, $p = .425$; South, ($\beta = .698$), Wald $\chi 2$ ($df = 1$) = 13.308, $p < .001$; West, ($\beta = .586$), Wald $\chi 2$ ($df = 1$) = 5.637, $p = .18$.The OR for Northeast, Midwest, South, and West compared to Missing the reference category, which was the omitted category are 1.844, 1.193, 2.009, and 1.798 respectively. Although Northeast, South, and West provide significant evidence for IHM, Midwest is insignificant predicator of IHM. Because the census region prior to 2012 had large missing category it is difficult to ascertain the direction of effect and exposure to outcome for IHM.

Census division starting from 2012. The variables for New England, East North Central, and West North Central when compared to Pacific the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for IHM. The results for Census Division Starting from 2012 and IHM univariate logistic regression are shown in Table 21. Based on the Wald tests and the *p-values* New England, East North Central, and West North Central*,* there is evidence to indicate that

Census division starting from 2012 are predictors of IHM when compared to Pacific to the reference category, which was the omitted category: New England, ($\beta = 1.164$), Wald $\chi 2$ (d*f* = 1) = 4.827, *p* = .028; Mid-Atlantic, ($\beta = .728$), Wald $\chi 2$ (d*f* = 1) = 1.907, *p* = .167; East North Central, ($\beta = 1.249$), Wald $\chi 2$ (d*f* = 1) = 5.870, *p* = .015; West North Central, ($\beta = 1.138$), Wald $\chi 2$ (d*f* = 1) = 4.463, *p* = .035; South Atlantic, ($\beta = .830$), Wald $\chi 2$ (d*f* = 1) = 2.291, *p* = .130; East South Central, ($\beta = 1.032$), Wald $\chi 2$ (d*f* = 1) = 3.038, *p* = .081; West South Central, ($\beta = -.080$), Wald $\chi 2$ (d*f* = 1) = .017, *p* = .896; Mountain, ($\beta = .804$), Wald $\chi 2$ (d*f* = 1) = 1.549, *p* = .213.

There is no difference ($p > .05$) for IHM for the following variables: Mid-Atlantic, South Atlantic, East South Central, West South Central, and Mountain compared to Pacific the reference category, which was the omitted category. The OR for West North Central, New England, and East North Central, illustrates that odds of a patient dying during hospitalization was higher for West North Central, New England, and East North Central. A patient in West North Central, New England, and East North Central when compared to Pacific is 3.1, 3.2, and 3.5 times likely not to die during hospitalization respectively.

Hospital volume. The variables for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category were determined to be insignificant predictors ($p > .05$) for IHM. The results for hospital Volume and IHM univariate logistic regression are shown in Table 21. The Wald tests and the *p-values* showed that the model was insignificant to predicting IHM: Very Low, ($\beta = 16.348$), Wald $\chi 2$ (d*f* = 1) = .000, *p* = .991; Low, ($\beta = 12.996$), Wald $\chi 2$ (d*f* = 1) =

.000, p = .993; Medium, (β = 14.729), Wald χ2 (df = 1) = .000, p = .992; High, (β = 13.009), Wald χ2 (df = 1) = .000, p = .993. The OR for all hospital volume category were .000, indicating that the model did not work for IHM. Thus, hospital volume is not significant predicator of IHM.

Table 21

Univariate Regression for In-Hospital Mortality

Comparison	B	S.E.	Wald	df	Exp(B)	95% C.I. for EXP(B)	*p*value
Univariate **Procedure Type**							
LAGB	-3.183	.325	86.921	1	.041	.021-.081	<.001
LSG	-4.067	.074	156.899	1	.017	.009-.032	<.001
Constant	-4.301	.341	3412.307	1	.014		<.001
Year							
2009	.940	.251	14.049	1	2.560	1.566-4.186	<.001
2010	1.138	.233	23.857	1	3.122	1.977-4.930	<.001
2011	1.124	.236	22.664	1	3.076	1.937-4.886	<.001
2012	.389	.266	2.147	1	1.476	.877-2.483	.143
2013	-.162	.281	.331	1	.851	.491-1.475	.565
Constant	-6.431	.183	1238.575	1	.002		<.001
Race							
While	.325	.417	.607	1	1.384	.611-3.136	.436
Black	.214	.445	.232	1	1.239	.518-2.967	.630
Hispanic	-1.281	.606	4.472	1	.278	.085-.910	.034
Asian or Pacific Islander	-.442	1.081	.167	1	.643	.077-5.347	.683
Native American	-15.121	2297.679	.000	1	.000	.000	.995
Constant	-6.081	.409	221.399	1	.002		<.001
Cycles of Seasons							
Winter	.147	.201	.533	1	1.158	.781-1.717	.465
Spring	-.018	.201	.008	1	.983	.663-1.457	.930

Summer	.061	.195	.098	1	1.063	.726-1.556	.754
Constant	-5.924	.136	1890.205	1	.003		<.001
Months							
January	.716	.327	4.797	1	2.046	1.078-3.881	.029
February	.107	.387	.077	1	1.113	.521-2.379	.782
March	.162	.361	.201	1	1.176	.579-2.387	.654
April	-.316	.413	.588	1	.729	.325-1.636	.443
May	.434	.334	1.686	1	1.544	.802-2.972	.194
June	.316	.339	.872	1	1.372	.706-2.664	.350
July	-.018	.369	.002	1	.982	.476-2.023	.960
August	.236	.343	.473	1	1.266	.646-2.482	.492
September	.540	.323	2.794	1	1.717	.911-3.236	.095
October	.206	.343	.360	1	1.229	.627-2.409	.548
November	.451	.330	1.861	1	1.569	.821-2.998	.173
Constant	-6.139	.243	639.252	1	.002		<.001
Gender							
Female	.818	.142	33.314	1	2.267	1.717-2.993	<.001
Constant	-6.130	.091	4536.480	1	.002		<.001
Age in Category							
18-29	-3.255	.507	41.275	1	.039	.014-.104	<.001
30-39	-3.872	.455	72.555	1	.021	.009-.051	<.001
40-49	-2.887	.263	120.494	1	.056	.033-.093	<.001
50-59	-2.238	.216	107.281	1	.107	.070-.163	<.001
Constant	-4.267	.081	2747.671	1	.014		<.001
Control							
Government or Private	.410	.716	.327	1	1.506	.370-6.129	.567
Government, nonfederal	-.544	.792	.471	1	.581	.123-2.741	.492
Private, not-for-profit	-.486	.717	.459	1	.615	.151-2.509	.498
Private, investor-owned	-.627	.734	.729	1	.534	.127-2.253	.393
Constant	-5.665	.708	63.956	1	.003		<.001
Location or Teaching							
Rural	.444	.303	2.153	1	1.559	.861-2.823	.142
Urban nonteaching	-.183	.151	1.478	1	.833	.620-1.119	.224
Constant	-5.824	.089	4261.450	1	.003		<.001

Bedsize							
Small	-1.202	.257	21.904	1	.301	.182-.497	<.001
Medium	-.503	.169	8.909	1	.605	.435-.841	.003
Constant	-5.575	.084	4396.973	1	.004		<.001
Census Region prior to 2012							
Northeast	.612	.226	7.303	1	1.844	1.183-2.874	.007
Midwest	.176	.221	.638	1	1.193	.774-1.838	.425
South	.698	.191	13.308	1	2.009	1.381-2.922	<.001
West	.586	.247	5.637	1	1.798	1.108-2.917	.018
Constant	-6.242	.144	1866.437	1	.002		<.001
Census Division starting from 2012							
New England	1.164	.530	4.827	1	3.203	1.134-9.046	.028
Mid-Atlantic	.728	.527	1.907	1	2.071	.737-5.823	.167
East North Central	1.249	.516	5.870	1	3.489	1.270-9.586	.015
West North Central	1.138	.539	4.463	1	3.122	1.086-8.977	.035
South Atlantic	.830	.548	2.291	1	2.293	.783-6.712	.130
East South Central	1.032	.592	3.038	1	2.807	.879-8.958	.081
West South Central	-.080	.613	.017	1	.923	.278-3.067	.896
Mountain	.804	.646	1.549	1	2.234	.630-7.926	.213
Constant	-6.794	.500	184.413	1	.001		<.001
Hospital Volume							
Very Low	16.348	1447.766	.000	1	12581921.470	.000	.991
Low	12.996	1447.766	.000	1	440769.950	.000	.993
Medium	14.729	1447.766	.000	1	2493954.318	.000	.992
High	13.009	1447.766	.000	1	446275.685	.000	.993
Constant	-21.203	1447.766	.000	1	.000		.988

Multivariate Logistic Regression for In-Hospital Mortality

The first multiple logistic regression was performed for the dependent variable for in-hospital mortality. The variables in the multivariate analyses included independent variables: procedure types (LAGB, LSG, and BPD/DS) and covariates year, race, cycles of season, months, gender, age in category, hospital size (control, location or teaching, bedsize, census region prior 2012, census division starting with 2012), and hospital volume. The results for the IHM multiple logistic regression are shown below in Table 22.

Procedure types. The variables LAGB and LSG when compared to BPD/DS the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for IHM. The results for procedure types and IHM multivariate logistic regression are shown below in Table 22. The Wald test and the *p-values* indicated that LAGB and LSG were significant predictors of IHM when compared to BPD/DS to the reference category, which was the omitted category: LAGB, ($\beta = -3.138$), Wald $\chi 2$ ($df = 1$) = 40.422, $p < .001$; LSG, ($\beta = -3.520$), Wald $\chi 2$ ($df = 1$) = 89.192, $p < .001$.

A patient undergoing LAGB has only .043 times tendency of dying during hospital stay compared to BPD/DS patients the reference category, which was the omitted category. Likewise, a patient that undergoes LSG when compared to BPD/DS was only .030 times as likely of dying during in-hospital stay as a patient undergoing BPD/DS the reference category, which was the omitted category. Therefore, there is sufficient evidence to show that there is an association between procedure types (LAGB and LSG) when compared to BPD/DS the reference category, which was the omitted category and IHM.

Calendar year. The variables for all of years from 2009 to 2013 when compared to 2014 the reference category, which was the omitted category were determined to be insignificant predictors ($p > .05$) for IHM. The results for Calendar Year and IHM multivariate logistic regression are shown below in Table 22. The Wald tests and the *p-values* showed that the period from 2009 to 2013 were insignificant to predicting IHM when compared to 2014 to the reference category, which was the omitted category: 2009, ($\beta = -.576$), Wald $\chi 2$ ($df = 1$) = 1.964, $p = .161$; 2010, ($\beta = -.434$), Wald $\chi 2$ ($df = 1$) = 1.217, $p = .270$; 2011, ($\beta = -.597$), Wald $\chi 2$ ($df = 1$) = 2.194, $p = .139$; 2012, ($\beta = -.206$), Wald $\chi 2$ ($df = 1$) = .546, $p = .460$; 2013, ($\beta = -.332$), Wald $\chi 2$ ($df = 1$) = 1.306, $p = .253$. Calendar year does not contribute to the model after controlling for it.

Race. Hispanic when compared to White the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for IHM. The results for Hispanic and IHM multivariate logistic regression are shown below in Table 22. The Wald tests and the *p-values* showed that Black, Asian Pacific Islanders, and Other ethnicities were insignificant to predicting IHM; however, IHM for Hispanics were significant predictors compared to the White reference category, which was the omitted category: Black, ($\beta = .025$), Wald $\chi 2$ ($df = 1$) = .014, $p = .906$; Hispanic, ($\beta = -1.272$), Wald $\chi 2$ ($df = 1$) = 6.141, $p = .013$; Asian or Pacific Islander, ($\beta = -1.556$), Wald $\chi 2$ ($df = 1$) = 2.363, $p = .124$; Other (including Native American) ($\beta = .079$), Wald $\chi 2$ ($df = 1$) = .034, $p = .468$. A Hispanic patient when compared to Whitepatients was only .3

times likely to die during hospitalization. There is a correlation between Hispanics and IHM. Race contributes to the model after controlling for it.

Cycles of seasons. The variables for Winter, Spring, and Summer when compared to Fall the reference category, which was the omitted category were determined to be insignificant predictors (*p > .05)* for IHM. The results for Cycles of Seasons and IHM multivariate logistic regression are shown in Table 22. The Wald tests and the *p-values* showed that seasons from Winter, Spring, and Summer were insignificant predictors of IHM when compared to Fall to the reference category, which was the omitted category: Winter, (β = -.100), Wald $\chi 2$ (d*f* = 1) = .231, *p* = .631; Spring, (β = -.218), Wald $\chi 2$ (d*f* = 1) = 1.072, *p* = .300; Summer, (β = -.101), Wald $\chi 2$ (d*f* = 1) = .248, *p* = .618. Because the *p > .05,* there is no difference in cycles of season when compared to Fall to the reference category, which was the omitted category. Season does not contribute to the model after controlling for it.

Gender. The variables for Male when compared to Female the reference category, which was the omitted category were determined to be insignificant predictors (*p > .05)* for IHM. The results for Gender and IHM multivariate logistic regression are shown in Table 22. The results for Male and IHM when compared to Female the reference category, which was the omitted category: Male, (β = .190), Wald $\chi 2$ (d*f* = 1) = 1.578, *p* = .209. There is not enough evidence to indicate that there is a difference for male when compared to female the reference category, which was the omitted category and IHM. Gender (male) do not contribute to the model after controlling for it.

Age in category. The variables for all the age categories when compared to >60 the reference category, which was the omitted category, were determined to be significant predictors (*p < .05)* for IHM. The results for Age Group and IHM multivariate logistic regression are shown in Table 22. The Wald tests and the *p-values* showed that all the age categories were significant predictors of IHM when compared to those of patient aged 60 and up (> 60) to the reference category, which was the omitted category: 18-29, (β = -2.341), Wald $\chi2$ (d*f* = 1) = 20.800, *p* < .001; 30-39, (β = -3.042), Wald $\chi2$ (d*f* = 1) = 43.761, *p* < .001; 40-49, (β = -2.223), Wald $\chi2$ (d*f* = 1) = 64.297, *p* < .001; 50-59, (β = -1.723), Wald $\chi2$ (d*f* = 1) = 58.398, *p* < .001.

The OR for the age category 18-29, 30-39, 40-49, and 50-59 when compared to the age group > 60 the reference category, which was the omitted category are .096, .048, .108, and .179 respectively. Except for age group 30-39 (OR = .048) which is an outlier, the rest of the age group show a general trend OR increasing with age (OR for 18-29 = .096, OR for 40-49 = .108, OR for 50-59 = .179). However, the OR for all the Age in Category are almost similar. Therefore, while the OR for exposure for the age group have almost similar outcomes for IHM, a patient in the age group 50-59 have higher odds of experiencing IHM. Age group does contribute to the model after controlling for it.

Control. When Government, nonfederal, Private, not-for-profit, and Private, investor-owned, and Private, either not-for-profit or investor-owned variables are compared to Government or Private the reference category, which was the omitted category were found to be insignificant predictors (*p > .05)* for IHM. The results for Control and IHM multivariate logistic regression are shown in Table 22. The Wald tests and the *p-values* showed that Government, nonfederal, Private, not-for-profit, and Private, investor-owned, and Private, either not-for-profit or investor-owned were insignificant predictors of IHM when compared to Government or Private the reference category, which was the omitted category: Government, nonfederal, ($\beta = -.324$), Wald $\chi 2$ (df = 1) = .488, $p = .485$; Private, not- for-profit, ($\beta = -.098$), Wald $\chi 2$ (df = 1) = .094, $p = .760$; Private, investor-owned, ($\beta = -.036$), Wald $\chi 2$ (df = 1) = .010, $p = .922$; Private, either not-for-profit or investor-owned, ($\beta = -.481$), Wald $\chi 2$ (df = 1) = .347, $p = .556$. The was no difference for Government, nonfederal, Private, not-for-profit, and Private, investor-owned, and Private, either not-for-profit or investor-owned variables when compared to Government or Private the reference category, which was the omitted category and IHM. The control variables do not contribute to the model after controlling for it.

Location or teaching. The variables for Rural and Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category, were determined to be insignificant predictors ($p > .05$) for IHM. The results for Location or Teaching and IHM multivariate logistic regression are shown in Table 22. The result showed that Rural and Urban nonteaching were insignificant to predicting IHM when compared to Urban teaching to the reference category, which was the omitted category: Rural, ($\beta = .369$), Wald $\chi 2$ (df = 1) = 1.028, $p = .311$; Urban nonteaching, ($\beta = .012$), Wald $\chi 2$ (df = 1) = .004, $p = .950$. There is no association between Rural and Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category. The Location or teaching variables does not contribute to the model after controlling for it.

Bedsize. The variables for Small when compared to Large the reference category, which was the omitted category were determined to be significant predictors (*$p < .05$*) for IHM. The results for Bedsize and IHM multivariate logistic regression are shown in Table 22. The Wald tests and the *p-values* results showed that Small bedsize was significant to predicting IHM when compared to Large the reference category, which was the omitted category: Small, (β = -.888), Wald $\chi 2$ (df = 1) = 9.859, p = .002; Medium, (β = -.244), Wald $\chi 2$ (df = 1) = 1.849, p =.950. The OR for Small compared to Large the reference category, which was the omitted category are .411. A patient in Small bedsize health service organization (HSO) when compared to Large was only .4 likely to die during hospitalization. The Bedsize (Small) variables contribute to the model after controlling for it.

Census division starting from 2012. The variables for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, and Mountain when compared to Pacific the reference category, which was the omitted category were determined to be insignificant predictors (*$p >.05$*) for IHM. The results for Census Division Starting from 2012 and IHM multivariate logistic regression are shown in Table 22. Based on the Wald tests and the *p-values,* there was no evidence to indicate that Census division starting from 2012 are predictors of IHM when compared to Pacific to the reference category, which was the omitted category: New England, (β = .523), Wald $\chi 2$ (df = 1) = .820, p = .365; Mid-Atlantic, (β =

.182), Wald $\chi2$ ($df = 1$) = .105, $p = .746$; East North Central, ($\beta = .391$), Wald $\chi2$ ($df = 1$) = .488, $p = .485$; West North Central, ($\beta = .305$), Wald $\chi2$ ($df = 1$) = .275, $p = .600$; South Atlantic, ($\beta = .544$), Wald $\chi2$ ($df = 1$) = .935, $p = .334$; East South Central, ($\beta = .980$), Wald $\chi2$ ($df = 1$) = 2.570, $p = .109$; West South Central, ($\beta = .221$), Wald $\chi2$ ($df = 1$) = .123, $p = .726$; Mountain, ($\beta = .579$), Wald $\chi2$ ($df = 1$) = .758, $p = .384$.

There was no difference ($p > .05$) for IHM for the following variables: New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, and Mountain compared to Pacific the reference category, which was the omitted category. The census division variables did not contribute to the model after controlling for it.

Hospital volume. The variables for Low, Medium, and High when compared to Very Low the reference category, which was the omitted category were determined to be insignificant predictors ($p > .05$) for IHM. The results for hospital Volume and IHM multivariate logistic regression are shown in Table 22. The Wald tests and the *p-values* showed that the Low hospital volume was significant to predicting IHM: Low, ($\beta = -.889$), Wald $\chi2$ ($df = 1$) = 5.468, $p = .019$; Medium, ($\beta = .042$), Wald $\chi2$ ($df = 1$) = .008, $p = .929$; High, ($\beta = -.237$), Wald $\chi2$ ($df = 1$) = .101, $p = .750$. The OR for Low volume hospital category were .411, indicating that the model did work for IHM. Thus, low hospital volume is significant predicator of IHM. A patient in a low volume hospital was only .41 likely to experience or die during hospitalization. The Low hospital volume contributes to the model after controlling for it.

Table 22

A Multiple Logistic for In-Hospital Mortality

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Procedure Types								
Laparoscopic adjustable banding	-3.138	.494	40.422	1	<.001	.043	.016	.114
Laparoscopic sleeve gastrectomy	-3.520	.373	89.192	1	<.001	.030	.014	.061
Calendar Year								
2009	-.576	.411	1.964	1	.161	.562	.251	1.258
2010	-.434	.393	1.217	1	.270	.648	.300	1.401
2011	-.597	.403	2.194	1	.139	.550	.250	1.213
2012	-.206	.279	.546	1	.460	.814	.471	1.406
2013	-.332	.291	1.306	1	.253	.717	.406	1.268
Race (Uniform)								
Black	.025	.212	.014	1	.906	1.025	.677	1.554
Hispanic	-1.272	.513	6.141	1	.013	.280	.103	.767
Asian Or Pacific Islander	-1.556	1.012	2.363	1	.124	.211	.029	1.534
Other (including Native Americans)	.079	.427	.034	1	.854	1.082	.468	2.498
Cycle of Seasons								
Winter	-.100	.209	.231	1	.631	.905	.601	1.362
Spring	-.218	.211	1.072	1	.300	.804	.532	1.215
Summer	-.101	.202	.248	1	.618	.904	.608	1.344
Gender								
Male	.190	.151	1.578	1	.209	1.209	.899	1.626
Age in Categories								
18-29	-2.341	.513	20.800	1	<.001	.096	.035	.263

30-39	-3.042	.460	43.761	1	<.001	.048	.019	.118
40-49	-2.223	.277	64.297	1	<.001	.108	.063	.186
50-59	-1.723	.225	58.398	1	<.001	.179	.115	.278
Control								
Government, nonfederal	-.324	.464	.488	1	.485	.723	.291	1.796
Private, not-for-profit	-.098	.320	.094	1	.760	.907	.484	1.697
Private, investor-owned	-.036	.364	.010	1	.922	.965	.473	1.970
Private, either not-for-profit or invester-owned	-.481	.817	.347	1	.556	.618	.125	3.064
Location or Teaching								
Rural	.369	.364	1.028	1	.311	1.447	.708	2.955
Urban nonteaching	.012	.199	.004	1	.950	1.012	.686	1.494
Bedsize								
Small	-.888	.283	9.859	1	.002	.411	.236	.716
Medium	-.244	.179	1.849	1	.174	.784	.552	1.114
Census Division Starting With 2012								
New England	.523	.578	.820	1	.365	1.688	.544	5.238
Mid-Atlantic	.182	.562	.105	1	.746	1.199	.398	3.611
East North Central	.391	.560	.488	1	.485	1.479	.493	4.435
West North Central	.305	.582	.275	1	.600	1.357	.434	4.248
South Atlantic	.544	.563	.935	1	.334	1.723	.572	5.195
East South Central	.980	.611	2.570	1	.109	2.663	.804	8.821
West South Central	.221	.629	.123	1	.726	1.247	.363	4.280
Mountain	.579	.666	.758	1	.384	1.785	.484	6.581
Hospital Volume								
Low	-.889	.380	5.468	1	.019	.411	.195	.866
Medium	.042	.468	.008	1	.929	1.043	.417	2.609
High	-.237	.744	.101	1	.750	.789	.184	3.390
Constant	-2.736	.620	19.485	1	<.001	.065		

Note. (*N* =73086).

Univariate Logistic Regression for Length of Stay

The second univariate logistic regression was completed for the dependent variable for Length of Stay (LOS). The variables in the univariate analyses included independent variables: procedure types (LAGB, LSG, and BPD/DS) and covariates year, race, cycles of season, months, gender, age in category, hospital size (control, location or teaching, bedsize, census region prior 2012, census division starting with 2012), and hospital volume. The results for the IHM univariate logistic regression are shown below in Table 23.

Procedure types. The variables for LAGB and LSG when compared to BPD/DS the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for LOS. The results for procedure types and LOS univariate logistic regression are shown below in Table 23. The Wald tests and the *p-values* indicated that LAGB and LSG were significant predictors of LOS when compared to BPD/DS to the reference category, which was the omitted category: LAGB, ($\beta = -3.135$), Wald $\chi 2$ ($df = 1$) = 9923.216, $p < .001$; LSG, ($\beta = -.613$), Wald $\chi 2$ ($df = 1$) = 781.173, $p < .001$. A patient underwent LAGB has only .043 times tendency of not having high LOS compared to BPD/DS patients the reference category, which was the omitted category. A patient that undergoes LSG was only a half times as likely to not have a high LOS when compared to BPD/DS the reference category, which was the omitted category. Both LAGB and LSG are significant predicators of LOS.

Calendar year. The variables for all the calendar years from 2009 to 2013 when compared to 2014 the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for LOS. The results for Calendar year and LOS univariate logistic regression are shown below in Table 23. The Wald tests and the *p-values* showed that the years from 2009 to 2013 were significant predictors of LOS when compared to 2014 to the reference category, which was the omitted category: 2009, (β = -1.254), Wald $\chi 2$ (df = 1) = 1972.789, $p < .001$; 2010, (β = -.978), Wald $\chi 2$ (df = 1) = 1418.693, $p < .001$; 2011, (β = -.321), Wald $\chi 2$ (df = 1) = 155.062, $p < .001$; 2012, (β = .098), Wald $\chi 2$ (df = 1) = 16.171, $p < .001$; 2013, (β = .075), Wald $\chi 2$ (df = 1) = 11.478, $p < .001$. A patient in the year 2009 when compared to 2014 was only .3 times likely to not having a high LOS. A patient in the year 2010 when compared to 2014 was only .4 times likely to not having a low LOS. A patient in the year 2011 when compared to 2014 was only .7 times likely to not having a low LOS. The odds of a patient not having to experience low LOS trend increases from 2009 to 2011.

However, there was an increase in trends in 2012 and 2013 for a patient exposure to outcome for LOS. Patients in the year 2012 and 2013 when compared to 2014 was only 1.1 times likely to not have a high duration of stay. Year was significant predictor of whether a patient would experience low or high LOS.

Race. The variables for White, Hispanic, and Native American when compared to Other ethnicities the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for LOS; in contrast, Asian or Pacific Islander and Black are insignificant predictors of LOS when compared to Other ethnicities the reference category, which was the omitted category. The results for Race and LOS univariate logistic regression are shown below in Table 23. The Wald tests and the *p-*

values showed that White, Hispanic, and Native American were significant to predicting LOS; however, LOS for Black and Asian or Pacific Islander were insignificant predictors compared to Other ethnicities the reference category, which was the omitted category: White, (β = -.231), Wald $\chi 2$ (d*f* = 1) = 32.520, *p* <.001; Black, (β = .053), Wald $\chi 2$ (d*f* = 1) = 1.488, *p* =.223; Hispanic, (β = -.114), Wald $\chi 2$ (d*f* = 1) = 6.345, *p* = .012; Asian or Pacific Islander, (β = .068), Wald $\chi 2$ (d*f* = 1) = .600, *p* = .439; Native American, (β = -.807), Wald $\chi 2$ (d*f* = 1) = 42.102, *p* <.001. The OR for White, Hispanic, and Native American patients when compared to Other ethnicities were .8, .9, and .4 respectively.

White, Hispanic, and Native American patients when compared to Other ethnicities are only .8, .9, and .4 to not have low LOS respectively. White and Hispanics when compared to Other ethnicities the reference category, which was the omitted category had a significantly higher outcome for LOS than Native Americans. There was no difference for Blacks and Asian or Pacific Islander when compared to Other ethnicities the reference category, which was the omitted category. There is sufficient evidence to indicate that race was significant predictor of LOS.

Cycles of seasons. The variables for Winter, Spring, and Summer when compared to Fall the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for LOS. The results for Cycles of Seasons and LOS univariate logistic regression are shown below in Table 23. The Wald tests and the *p-values* showed that seasons from Winter, Spring, and Summer were significant predictors of LOS when compared to Fall to the reference category, which was the omitted category: Winter, (β = -.090), Wald $\chi 2$ (d*f* = 1) = 17.267, *p* <.001; Spring, (β = -.104), Wald $\chi 2$ (df = 1) = 25.128, p <.001; Summer, (β = -.043), Wald $\chi 2$ (df = 1) = 4.424, p = .035. The OR for Winter, Spring, and Summer compared to Fall the reference category, which was the omitted category are .914, .901, and .958 (about 1). A patient in Summer when compared to Fall does not affect the odds of outcome for LOS because the OR is 1. There is no association between Summer and LOS. The seasonal difference between Winter, Spring, and Summer to LOS is minimal. The model shows that Winter, Spring, and Summer are statistically significant.

Months. The variables for August, October, and November when compared to December the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for LOS. The following months (January, February, March, April, May, June, July and September) were insignificant ($p > .05$) for LOS. The results for Months and LOS univariate logistic regression are shown below in Table 23. The months of August, October, and November showed that the Wald tests and the *p-values* were significant predictors of LOS when compared to December the reference category, which was the omitted category. However, the other months were insignificant predicators of LOS: January, (β = .022), Wald $\chi 2$ (df = 1) = .347, p = .556; February, (β = .035), Wald $\chi 2$ (df = 1) = .881, p = .348; March, (β = -.015), Wald $\chi 2$ (df = 1) = .177, p = .674; April, (β = -.021), Wald $\chi 2$ (df = 1) = .360, p = .548; May, (β = .008), Wald $\chi 2$ (df = 1) = .053, p = .818; June, (β = .008), Wald $\chi 2$ (df = 1) = .050, p = .822; July, (β = .032), Wald $\chi 2$ (df = 1) = .909, p = .340; August, (β = .082), Wald $\chi 2$ (df = 1) = 5.791, p = .016; September, (β = .063), Wald $\chi 2$ (df = 1) = 3.348, p = .067; October, (β = .204), Wald $\chi 2$ (df = 1) = 36.473, p = <.001; November, (β = .129), Wald $\chi 2$ (df = 1) = 1.137, p <.001. A patient in August, October, and November when compared to December was only 1.1, 1.2, and 1.1 times likely to not experience low LOS. The model implies that August, October, and November are statistically significant predictor of LOS. The odds for August and November were similar.

Gender. The variables for Female when compared to Male the reference category, which was the omitted category were determined to be insignificant predictors (*p > .05)* for LOS. The results for Gender and LOS univariate logistic regression are shown in Table 23. The results for female and LOS when compared to Male the reference category, which was the omitted category: Female, (β = .020), Wald $\chi 2$ (d*f* = 1) = 1.279, *p* = .258. There was no difference for Female patient when compared to Male the reference category, which was the omitted category for LOS.

Age in category. The variables for all the age categories when compared to >60 the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for LOS. The results for Age Group and LOS univariate logistic regression are shown in Table 23. The Wald tests and the *p-values* showed that all the age categories were significant predictors of LOS when compared to those of patient aged 60 and up (> 60) to the reference category, which was the omitted category: 18-29, (β = -.352), Wald $\chi 2$ (d*f* = 1) = 135.827, *p* < .001; 30-39, (β = -.256), Wald $\chi 2$ (d*f* = 1) = 108.039, *p* < .001; 40-49, (β = -.216), Wald $\chi 2$ (d*f* = 1) = 82.528, *p* < .001; 50-59, (β = -.147), Wald $\chi 2$ (d*f* = 1) = 35.437, *p* < .001.

The OR for 18-29, 30-39, 40-49, and 50-59 are .703, .774, .805, and .863 respectively. Therefore, there were only .703, .774, .805, and .863 odds likely that patients in each 18-29, 30-39, 40-49, and 50-59 age group respectively would not experience low LOS. There was marginal increase of the odd for LOS each age group. Thus, the trend showed a rise for each age group for LOS odds when compared to >60 the reference category, which was the omitted category.

Control. When all the other Control variables are compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category, were found to be significant predictors ($p < .05$) for LOS. The results for Control and LOS univariate logistic regression are shown in Table 23. The Wald tests and the *p-values* showed that the other control variables (Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned) were significant predictors of LOS when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category: Government or Private, ($\beta = .408$), Wald $\chi 2$ ($df = 1$) = 20.562, $p < .001$; Government, nonfederal, ($\beta = 1.390$), Wald $\chi 2$ ($df = 1$) = 214.897, $p < .001$; Private, not- for-profit, ($\beta = 1.177$), Wald $\chi 2$ ($df = 1$) = 173.199, $p < .001$; Private, investor-owned, ($\beta = .598$), Wald $\chi 2$ ($df = 1$) = 43.846, $p < .001$.

The OR for Government or Private, Government, nonfederal, Private, not- for-profit, and Private, investor-owned variables when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category are 1.504, 4.016, 3.243, and 1.818 for LOS respectively. Government nonfederal had the highest odds for LOS when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category. Government or Private had the lowest odds for LOS when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category. Because the large sample size all the control variables were statistically predictor of LOS.

Location or teaching. The variables for Rural and Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category, were determined to be significant predictors (*p <.05)* for LOS. The results for Location or Teaching and LOS univariate logistic regression are shown in Table 23. The result showed that Rural and Urban nonteaching were significant to predicting LOS when compared to Urban teaching to the reference category, which was the omitted category: Rural, (β = -.221), Wald $\chi2$ (d*f* = 1) = 29.941, *p* = <.001; Urban nonteaching, (β = -.569), Wald $\chi2$ (d*f* = 1) = 1334.367, *p* <.001.

The OR for Rural when compared to Urban teaching to the reference category, which was the omitted category, is .802. The OR for Urban nonteaching when compared to Urban teaching to the reference category, which was the omitted category is .566. The location or teaching can be seen to show a downward trend for Rural followed by Medium as indicated in Table 23.

Bedsize. The variables for Small and Medium when compared to Large the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for LOS. The results for Bedsize and LOS univariate logistic regression are shown in Table 23. The Wald tests and the *p-values* results showed that Small and Medium were significant to predicting LOS when compared to Large the reference category, which was the omitted category: Small, (β = -.363), Wald $\chi2$ (d*f* = 1) = 348.933, *p* < .001; Medium, (β = -.054), Wald $\chi2$ (d*f* = 1) = 9.619, *p* =. 002.

The OR for Small and Medium compared to Large the reference category, which was the omitted category are .696 and .947 respectively. A patient in Small bedsize health service organization (HSO) when compared to Large was only .7 likely to not have a low LOS. A patient in Medium bedsize health service organization (HSO) when compared to Large has no effect. Bedsize was predictor for a patient experiencing LOS.

Census region prior to 2012. The variables for Northeast, South, and West when compared to Missing the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for LOS. The results for Census Region Prior to 2012 and LOS univariate logistic regression are shown in Table 23. The results are follows: Northeast, (β = -.324), Wald $\chi 2$ (df = 1) = 175.669, p <.001; Midwest, (β = .095), Wald $\chi 2$ (df = 1) = 21.056, p <.001; South, (β = -.084), Wald $\chi 2$ (df = 1) = 17.049, p < .001; West, (β = -.647), Wald $\chi 2$ (df = 1) = 562.649, p <.001.The OR for Northeast, Midwest, South, and West compared to Missing the reference category, which was the omitted category are .723, 1.100, .920, and .523 respectively. Although Northeast, Midwest, South, and West provide significant evidence for LOS. Because the census region prior to 2012 had a large missing category it was difficult to ascertain the direction of effect and exposure to outcome for LOS despite statistical significance due to large sample size.

Census division starting from 2012. Except for East North Central which was insignificant ($p > .05$), the variables for New England, Mid-Atlantic, West North Central, South Atlantic, East South Central, West South Central and Mountain when compared to Pacific the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for LOS. The results for Census Division Starting from 2012 and LOS univariate logistic regression are shown in Table 23. Based on the Wald tests and the *p-values,* New England, Mid-Atlantic, West North Central, South Atlantic, East South Central, West South Central and Mountain when compared to Pacific the reference category, which was the omitted category*,* there was enough evidence to indicate that Census division starting from 2012 are predictors of LOS when compared to Pacific to the reference category, which was the omitted category: New England, (β = -.245), Wald $\chi 2$ (d*f* = 1) = 38.473, *p* <.001; Mid-Atlantic, (β = .174), Wald $\chi 2$ (d*f* = 1) = 21.802, *p* <.001; East North Central, (β = -.004), Wald $\chi 2$ (d*f* = 1) = .014, *p* = .906; West North Central, (β = -.568), Wald $\chi 2$ (d*f* = 1) = 189.096, *p* <.001; South Atlantic, (β = .429), Wald $\chi 2$ (d*f* = 1) = 109.095, *p* <.001; East South Central, (β = .153), Wald $\chi 2$ (d*f* = 1) = 9.650, *p* = .002; West South Central, (β = -.163), Wald $\chi 2$ (d*f* = 1) = 16.147, *<.001*; Mountain, (β = -.210), Wald $\chi 2$ (d*f* = 1) = 15.859, *p <.001*.

There is no difference (*p > .05)* East North Central for LOS. The OR for the following variables: New England, Mid-Atlantic, West North Central, South Atlantic, East South Central, West South Central and Mountain when compared to Pacific the reference category, which was the omitted category are: .783, 1.190, .566, 1.536, 1.165, .850, and .810. South Atlantic had the highest OR (1.536) for LOS. West North Central had the lowest OR (.566). Census division supported the model because it was a significant predictor of LOS.

Hospital volume. The variables for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for LOS. The results for hospital Volume and LOS univariate logistic regression are shown in Table 23. The Wald tests and the *p-values* showed that the model was significant to predicting LOS: Very Low, (β = 3.229), Wald $\chi 2$ (d*f* = 1) = 510.182, *p* <.001; Low, (β = 3.031), Wald $\chi 2$ (d*f* = 1) = 450.648, *p* <.001; Medium, (β = 2.327), Wald $\chi 2$ (d*f* = 1) = 254.229, *p* <.001; High, (β = .770), Wald $\chi 2$ (d*f* = 1) = 28.193, *p* <.001. The OR for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category are 25.266, 20.720, 10.252, and 2.160. The odds for Very Low was the highest for LOS. High had the lowest OR for LOS. Thus, hospital volume is significant predicator of LOS.

Table 23

A binary logistic of Duration of Stay

Comparison	B	S.E.	Wald	df	Exp(B)	95% C.I. for EXP(B)	*P*-Value
Univariate **Procedure Type**							
LAGB	-3.135	.031	9923.216	1	.043	.041-.046	<.001
LSG	-.613	.022	781.173	1	.541	.519-.565	<.001
Constant	1.107	.020	3197.567	1	3.025		<.001
Year							
2009	-1.254	.028	1972.789	1	.285	.270-.302	<.001
2010	-.978	.026	1418.693	1	.376	.357-.396	<.001
2011	-.321	.026	155.062	1	.726	.690-.763	<.001
2012	.098	.024	16.171	1	1.103	1.052-1.158	<.001
2013	.075	.022	11.478	1	1.078	1.032-1.125	.001
Constant	.418	.015	779.771	1	1.519		<.001
Race							
White	-.231	.041	32.520	1	.794	.733-.859	<.001
Black	.053	.044	1.488	1	1.055	.968-1.149	.223
Hispanic	-.114	.045	6.345	1	.892	.816-.975	.012

Asian or Pacific Islander	.068	.087	.600	1	1.070	.902-1.270	.439
Native American	-.807	.124	42.102	1	.446	.349-.569	<.001
Constant	.300	.039	57.947	1	1.350		<.001
Cycles of Seasons							
Winter	-.090	.022	17.267	1	.914	.876-.954	<.001
Spring	-.104	.021	25.128	1	.901	.866-.939	<.001
Summer	-.043	.020	4.424	1	.958	.920-.997	.035
Constant	.212	.014	224.446	1	1.236		<.001
Months							
January	.022	.037	.347	1	1.022	.951-1.098	.556
February	.035	.037	.881	1	1.036	.963-1.114	.348
March	-.015	.035	.177	1	.985	.920-1.056	.674
April	-.021	.035	.360	1	.979	.915-1.048	.548
May	.008	.035	.053	1	1.008	.942-1.079	.818
June	.008	.034	.050	1	1.008	.942-1.077	.822
July	.032	.034	.909	1	1.033	.966-1.104	.340
August	.082	.034	5.791	1	1.085	1.015-1.160	.016
September	.063	.034	3.348	1	1.065	.996-1.139	.067
October	.204	.034	36.473	1	1.227	1.148-1.311	<.001
November	.129	.035	13.912	1	1.137	1.063-1.217	<.001
Constant	.110	.023	23.612	1	1.116		<.001
Gender							
Female	.020	.017	1.279	1	1.020	.986-1.055	.258
Constant	.137	.008	260.751	1	1.147		<.001
Age in Category							
18-29	-.352	.030	135.827	1	.703	.663-.746	<.001
30-39	-.256	.025	108.039	1	.774	.738-.813	<.001
40-49	-.216	.024	82.528	1	.805	.769-.844	<.001
50-59	-.147	.025	35.437	1	.863	.822-.906	<.001
Constant	.331	.019	294.263	1	1.392		<.001
Control							
Government or Private	.408	.090	20.562	1	1.504	1.261-1.795	<.001
Government, nonfederal	1.390	.095	214.897	1	4.016	3.335-4.836	<.001
Private, not-for-profit	1.177	.089	173.199	1	3.243	2.722-3.864	<.001
Private, investor-owned	.598	.090	43.846	1	1.818	1.523-2.170	<.001

Constant	-.732	.089	68.076	1	.481		<.001
Location or Teaching							
Rural	-.221	.040	29.941	1	.802	.741-.868	<.001
Urban nonteaching	-.569	.016	1334.367	1	.566	.549-.584	<.001
Constant	.367	.010	1390.312	1	1.443		<.001
Bedsize							
Small	-.363	.019	348.933	1	.696	.670-.723	<.001
Medium	-.054	.017	9.619	1	.947	.916-.980	.002
Constant	.231	.010	494.572	1	1.260		<.001
Census Region prior to 2012							
Northeast	-.324	.024	175.669	1	.723	.689-.759	<.001
Midwest	.095	.021	21.056	1	1.100	1.056-1.145	<.001
South	-.084	.020	17.049	1	.920	.884-.957	<.001
West	-.647	.027	562.649	1	.523	.496-.552	<.001
Constant	.245	.013	364.320	1	1.277		<.001
Census Division starting from 2012							
New England	-.245	.040	38.473	1	.783	.724-.846	<.001
Mid-Atlantic	.174	.037	21.802	1	1.190	1.106-1.281	<.001
East North Central	-.004	.037	.014	1	.996	.926-1.071	.906
West North Central	-.568	.041	189.096	1	.566	.522-.614	<.001
South Atlantic	.429	.041	109.095	1	1.536	1.417-1.664	<.001
East South Central	.153	.049	9.650	1	1.165	1.058-1.283	.002
West South Central	-.163	.041	16.147	1	.850	.785-.920	<.001
Mountain	-.210	.053	15.859	1	.810	.730-.899	<.001
Constant	.166	.034	24.301	1	1.180		<.001
Hospital Volume							
Very Low	3.229	.143	510.182	1	25.266	19.091-33.438	<.001
Low	3.031	.143	450.648	1	20.720	15.662-27.411	<.001
Medium	2.327	.146	254.229	1	10.252	7.701-13.648	<.001

High	.770	.145	28.193	1	2.160	1.626-2.870	<.001
Constant	-2.606	.142	335.239	1	.074		<.001

Multivariate Logistic Regression for Length of Stay

The second multiple logistic regression was performed for the dependent variable for LOS. The variables in the multivariate analyses included independent variables: procedure types (LAGB, LSG, and BPD/DS) and covariates year, race, cycles of season, months, gender, age in category, hospital size (control, location or teaching, bedsize, census region prior 2012, census division starting with 2012), and hospital volume. The results for the LOS multiple logistic regression are shown below in Table 24.

Procedure types. The variables LAGB and LSG when compared to BPD/DS the reference category, which was the omitted category, were determined to be significant predictors ($p < .05$) for LOS. The results for procedure types and LOS multivariate logistic regression are shown below in Table 24. The Wald test and the *p-values* indicated that LAGB and LSG were significant predictors of LOS when compared to BPD/DS to the reference category, which was the omitted category: LAGB, ($\beta = -3.198$), Wald $\chi 2$ ($df = 1$) = 4653.727, $p < .001$; LSG, ($\beta = -.856$), Wald $\chi 2$ ($df = 1$) = 429.527, $p < .001$.

A patient undergoing LAGB has only .041 times tendency of dying during hospital stay compared to BPD/DS patients the reference category, which was the omitted category. Likewise, a patient that undergoes LSG when compared to BPD/DS was only .43 times as likely of not experiencing a high LOS for a patient that underwent BPD/DS the reference category, which was the omitted category. Therefore, there was sufficient evidence to show that there is an association between procedure types (LAGB and LSG) when compared to BPD/DS the reference category, which was the omitted category and LOS. LSG has the highest OR for LOS when compared to BPD/DS the reference category, which was the omitted category.

Calendar year. The variables for all of years from 2009 to 2013 when compared to 2014 the reference category, which was the omitted category were determined to be significant predictors ($p <.05$) for LOS. The results for Calendar Year and LOS multivariate logistic regression are shown below in Table 24. The Wald tests and the *p-values* showed that the period from 2009 to 2013 were significant to predicting LOS when compared to 2014 to the reference category, which was the omitted category: 2009, (β = -.430), Wald $\chi 2$ (df = 1) = 47.857, p = < .001; 2010, (β = -.797), Wald $\chi 2$ (df = 1) = 181.153, p < .001; 2011, (β = -.411), Wald $\chi 2$ (df = 1) = 53.283, p < .001; 2012, (β = .442), Wald $\chi 2$ (df = 1) = 267.802, p < .001; 2013, (β = .196), Wald $\chi 2$ (df = 1) = 69.950, p < .001.

The year 2012 had the highest OR (1.556), followed by 2013 OR (1.216) when compared to 2014 the reference category, which was the omitted category. The year 2010 had the lowest OR (.451) when compared to 2014 the reference category, which was the omitted category. The OR (.650) for 2009 and the OR (.663) for 2011 were similar when compared to 2014 the reference category, which was the omitted category. Calendar year contributed to the model for LOS after controlling for it.

Race. The variables for Black, Hispanic, Asian or Pacific Islander, Native American, and Other when compared to White the reference category, which was the omitted category, were determined to be significant predictors ($p < .05$) for LOS. The results for Race and LOS multivariate logistic regression are shown below in Table 24. The Wald tests and the *p-values* showed that Black, Hispanic, Asian or Pacific Islander, Native American, and Other were significant to predicting LOS when compared to White the reference category, which was the omitted category: Black, (β = .025), Wald $\chi2$ (d*f* = 1) = .014, *p* = .906 ; Hispanic, (β = -1.272), Wald $\chi2$ (d*f* = 1) = 6.141, *p* = .013; Asian or Pacific Islander, (β = -1.556), Wald $\chi2$ (d*f* = 1) = 2.363, *p* = .124; Native American, (β = .079), Wald $\chi2$ (d*f* = 1) = .034, *p* = .468; Other (β = .079), Wald $\chi2$ (d*f* = 1) = .034, *p* = .468.

Asian or Pacific Islander was determined to have the highest OR of 1.408 for LOS. In contrast, Native American had lowest OR of .451 for LOS. There was a correlation between Black, Hispanic, Asian or Pacific Islander, Native American, and Other when compared to White the reference category, which was the omitted category for predicting LOS. Race contributes to the model after controlling for it.

Cycles of seasons. The variables for Spring and Summer when compared to Fall the reference category, which was the omitted category were determined to be significant predictors (*p<.05)* for LOS. The results for Cycles of Seasons and LOS multivariate logistic regression are shown in Table 24. The Wald tests and the *p-values* showed that seasons from Spring and Summer were insignificant predictors of LOS when compared to Fall to the reference category, which was the omitted category: Winter, (β = .047), Wald $\chi2$ (d*f* = 1) = 3.372, *p* = .066; Spring, (β = -.053), Wald $\chi2$ (d*f* = 1) = 4.865, *p* = .027; Summer, (β = -.058), Wald $\chi2$ (d*f* = 1) = 6.071, *p* = .014.

The OR's for Spring was .949 and Summer is .944, they were similar when compared to Fall the reference category, which was the omitted category. There was no difference for Winter when compared to Fall the reference category, which was the omitted category. Season contributed to the model for LOS after controlling for it.

Gender. The variables for Male when compared to Female, the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for LOS. The results for Gender and LOS multivariate logistic regression are shown in Table 24. The results for Male and LOS when compared to Female, the reference category, which was the omitted category: Male, (β = -.084), Wald $\chi 2$ (df = 1) = 16.391, $p < .001$. There is enough evidence to indicate that there was a difference for male when compared to female the reference category, which was the omitted category for LOS. Gender (male) contributed to the model for LOS after controlling for it.

Age in category. The variables for all the age categories when compared to >60 the reference category, which was the omitted category, were determined to be significant predictors ($p < .05$) for LOS. The results for Age Group and LOS multivariate logistic regression are shown in Table 24. The Wald tests and the *p-values* showed that all the age categories were significant predictors of LOS when compared to those of patient aged 60 and up (> 60) to the reference category, which was the omitted category: 18-29, (β = -.555), Wald $\chi 2$ (df = 1) = 219.905, $p < .001$; 30-39, (β = -.555), Wald $\chi 2$ (df = 1) = 180.618, $p < .001$; 40-49, (β = -.371), Wald $\chi 2$ (df = 1) = 148.664, $p < .001$; 50-59, (β = -.241), Wald $\chi 2$ (df = 1) = 60.006, $p < .001$.

The OR for the age category 18-29, 30-39, 40-49, and 50-59 when compared to the age group > 60 the reference category, which was the omitted category were .574, .656, .690, and .786 respectively. All the age group from (OR for 18-29 = .574; 30-39 OR = .656; OR for 40-49 = .690; and OR for 50-59 = .786) showed a general trend of OR increasing with age. While the OR for exposure for the other age group have almost similar outcomes for LOS, a patient in the age group 50-59 have higher odds of experiencing LOS. Age group contributed to the model for LOS after controlling for it.

Control. The variables for Government, nonfederal and Private, either not-for-profit or invester-owned when compared to Government or Private the reference category, which was the omitted category were found to be insignificant predictors ($p < .05$) for LOS. The results for Control and LOS multivariate logistic regression are shown in Table 24. The Wald tests and the *p-values* showed that the other control variables (Government, nonfederal, Private, not-for-profit, and Private, investor-owned, and Private, either not-for-profit or invester-owned) were significant predictors of LOS when compared to Government or Private the reference category, which was the omitted category: Government, nonfederal, ($\beta = .232$), Wald $\chi 2$ ($df = 1$) = 16.462, $p < .001$; Private, not- for-profit, ($\beta = .013$), Wald $\chi 2$ ($df = 1$) = .078, $p = .780$; Private, investor-owned, ($\beta = .050$), Wald $\chi 2$ ($df = 1$) = 1.139, $p = .286$; Private, either not-for-profit or invester-owned, ($\beta = -.303$), Wald $\chi 2$ ($df = 1$) = 5.416, $p <$ 001. There was no difference for Private, not-for-profit, and Private, investor-owned when compared to Government or Private the reference category, which was the omitted category. Government, nonfederal had the highest OR (1.261) for LOS when compared to Government or Private the reference category, which was the omitted category. Private, either not-for-profit or invester-owned had the lowest OR (.739) for LOS. The control variables contributed to the model for LOS after controlling for it.

Location or teaching. The variables for Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for LOS. The results for Location or Teaching and LOS multivariate logistic regression are shown in Table 24. The result showed that Rural was insignificant to predicting LOS when compared to Urban teaching to the reference category, which was the omitted category: Rural, ($\beta = .041$), Wald $\chi 2$ ($df = 1$) = .555, p = .456; Urban nonteaching, ($\beta = -.318$), Wald $\chi 2$ ($df = 1$) = 234.498, $p < .001$. There was no association for Rural when compared to Urban teaching the reference category, which was the omitted category. Thus, there was sufficient evidence to show that Urban nonteaching was significant predictor for LOS. The Location or teaching variables contributed to the model for LOS after controlling for it.

Bedsize. The variables for Small and Medium when compared to Large the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for LOS. The results for Bedsize and LOS multivariate logistic regression are shown in Table 24. The Wald tests and the *p-values* results showed that Small and Medium bedsize was significant to predicting LOS when compared to Large the reference category, which was the omitted category: Small, ($\beta = -.301$), Wald $\chi 2$ (df = 1) = 153.564, $p < .001$; Medium, ($\beta = -.067$), Wald $\chi 2$ ($df = 1$) = 10.498, p =.001.

The OR for Small and Medium compared to Large the reference category, which was the omitted category were .740 and .935. Medium bedsize was associated with a higher OR for LOS when compared to Large the reference category, which was the omitted category. Rural bedsize had the lowest OR for LOS when compared to Large the reference category, which was the omitted category. The Bedsize (Small and Medium) variables contributed to the model for LOS after controlling for it.

Census division starting from 2012. Except for the variable for East South Central which was not significant, the following variables for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, West South Central, and Mountain when compared to Pacific the reference category, which was the omitted category were determined to be significant predictors (*$p < .05$*) for LOS. The results for Census Division Starting from 2012 and LOS multivariate logistic regression are shown in Table 24. Based on the Wald tests and the *p-values,* there was enough evidence to indicate that Census division starting from 2012 are predictors of LOS when compared to Pacific to the reference category, which was the omitted category were predictors for LOS: New England, ($\beta = 1.152$), Wald $\chi2$ ($df = 1$) = 541.188, $p < .001$; Mid-Atlantic, ($\beta = .530$), Wald $\chi2$ ($df = 1$) = 168.221, $p < .001$; East North Central, ($\beta = .539$), Wald $\chi2$ ($df = 1$) = 155.543, $p < .001$; West North Central, ($\beta = .323$), Wald $\chi2$ ($df = 1$) = 43.195, $p < .001$; South Atlantic, ($\beta = .377$), Wald $\chi2$ ($df = 1$) = 75.368, $p < .001$; East South Central, ($\beta = .073$), Wald $\chi2$ ($df = 1$) = 1.984, $p = .159$; West South Central, ($\beta = -.113$), Wald $\chi2$ ($df = 1$) = 6.684, $p = .010$; Mountain, ($\beta = -.245$), Wald $\chi2$ ($df = 1$) = 18.770, $p < .001$.

New England census division had the highest OR of 3.165 for LOS when compared to Pacific the reference category, which was the omitted category. The Mountain census division had the lowest OR of .782 for LOS when compared to Pacific the reference category, which was the omitted category. The census division variables can be seen to show a downward trend of OR for the following variables: New England (Highest), Mid-Atlantic, East North Central, West North Central, South Atlantic, West South Central, and Mountain (Lowest) for LOS when compared to Pacific the reference category, which was the omitted category. The census division variables contributed to the model for LOS after controlling for it.

Hospital volume. The variables for Low, Medium, High, and Very High when compared to Very Low the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for LOS. The results for hospital Volume and LOS multivariate logistic regression are shown in Table 24. The Wald tests and the *p-values* showed that the Low hospital volume was significant to predicting LOS: Low, ($\beta = -.289$), Wald $\chi 2$ ($df = 1$) = 145.742, $p < .001$; Medium, ($\beta = -.269$), Wald $\chi 2$ ($df = 1$) = 39.820, $p < .001$; High, ($\beta = -.286$), Wald $\chi 2$ ($df = 1$) = 34.647, $p < .001$; Very High, ($\beta = -.612$), Wald $\chi 2$ ($df = 1$) = 15.950, $p < .001$.

Based on the OR for Very High volume (.542), the OR for Very High volume hospital was lowest for LOS when compared to Very Low the reference category, which was the omitted category. The rest of the OR for Low (.749), Medium (.764), and High (.751) were almost similar for LOS when compared to Very Low the reference category, which was the omitted category. Thus, hospital volume was a significant predicator of LOS. Hospital volume contributed to the model for LOS after controlling for it.

Table 24

A Multiple Logistic for Length of Stay

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Procedure Types								
Laparoscopic adjustable banding	-3.198	.047	4653.727	1	<.001	.041	.037	.045
Laparoscopic sleeve gastrectomy	-.856	.041	429.527	1	<.001	.425	.392	.461
Calendar Year								
2009	-.430	.062	47.857	1	<.001	.650	.576	.735
2010	-.797	.059	181.153	1	<.001	.451	.401	.506
2011	-.411	.056	53.283	1	<.001	.663	.594	.740
2012	.442	.027	267.802	1	<.001	1.556	1.476	1.641
2013	.196	.023	69.950	1	<.001	1.216	1.162	1.273
Race (Uniform)								
Black	.243	.025	92.819	1	<.001	1.275	1.214	1.340
Hispanic	.105	.029	13.035	1	<.001	1.111	1.049	1.176
Asian Or Pacific Islander	.342	.091	14.039	1	<.001	1.408	1.177	1.683
Native American	-.378	.132	8.159	1	.004	.685	.528	.888
Other	.201	.047	18.356	1	<.001	1.223	1.115	1.341
Cycle of Seasons								
Winter	.047	.025	3.372	1	.066	1.048	.997	1.102
Spring	-.053	.024	4.865	1	.027	.949	.905	.994
Summer	-.058	.024	6.071	1	.014	.944	.901	.988
Gender								
Male	-.084	.021	16.391	1	<.001	.920	.883	.958
Age in Category								
18-29	-.555	.037	219.905	1	<.001	.574	.533	.618
30-39	-.421	.031	180.618	1	<.001	.656	.617	.698

40-49	-.371	.030	148.664	1	<.001	.690	.650	.733
50-59	-.241	.031	60.006	1	<.001	.786	.739	.835
Control								
Government, nonfederal	.232	.057	16.462	1	<.001	1.261	1.127	1.410
Private, not-for-profit	.013	.046	.078	1	.780	1.013	.925	1.109
Private, investor-owned	.050	.047	1.139	1	.286	1.051	.959	1.152
Private, either not-for-profit or invester-owned	-.303	.130	5.416	1	.020	.739	.573	.953
Location or Teaching								
Rural	.041	.054	.555	1	.456	1.041	.936	1.158
Urban nonteaching	-.318	.021	234.498	1	<.001	.728	.699	.758
Bedsize								
Small	-.301	.024	153.564	1	<.001	.740	.706	.776
Medium	-.067	.021	10.498	1	.001	.935	.898	.974
Census Division Starting With 2012								
New England	1.152	.050	541.188	1	<.001	3.165	2.873	3.488
Mid-Atlantic	.530	.041	168.221	1	<.001	1.699	1.568	1.841
East North Central	.539	.043	155.543	1	<.001	1.714	1.575	1.865
West North Central	.323	.049	43.195	1	<.001	1.381	1.254	1.521
South Atlantic	.377	.043	75.368	1	<.001	1.457	1.338	1.587
East South Central	.073	.052	1.984	1	.159	1.076	.972	1.191
West South Central	-.113	.044	6.684	1	.010	.893	.819	.973
Mountain	-.245	.057	18.770	1	<.001	.782	.700	.874
Hospital Volume								
Low	-.289	.024	145.742	1	<.001	.749	.714	.785
Medium	-.269	.043	39.820	1	<.001	.764	.703	.831
High	-.286	.049	34.647	1	<.001	.751	.683	.826
Very High	-.612	.153	15.950	1	<.001	.542	.402	.732
Constant	1.587	.075	447.546	1	<.001	4.889		

Univariate Logistic Regression for Reoperation

The third univariate logistic regression was performed for the dependent variable for RE-OP. The variables in the univariate analyses included independent variables:

procedure types (LAGB, LSG, and BPD/DS) and covariates year, race, cycles of season, months, gender, age in category, hospital size (control, location or teaching, bedsize, census region prior 2012, census division starting with 2012), and hospital volume. The results for the RE-OP univariate logistic regression are shown below in Table 25.

Procedure types. The variables for LAGB and LSG when compared to BPD/DS the reference category, which was the omitted category, were determined to be significant predictors (*$p < .05$)* for RE-OP. The results for procedure types and RE-OP univariate logistic regression are shown below in Table 25. The Wald tests and the *p-values* indicated that LAGB and LSG were significant predictors of RE-OP when compared to BPD/DS to the reference category, which was the omitted category: LAGB, (β = -.768), Wald $\chi 2$ (d*f* = 1) = 320.618, $p < .001$; LSG, (β = -.722), Wald $\chi 2$ (d*f* = 1) = 471.816, $p < .001$. Patient that underwent LAGB or LSG have only .5 times tendency to have RE-OP compared to BPD/DS patients in the reference category, which was the omitted category. Both LAGB and LSG are significant predicator for RE-OP.

Calendar year. The variable 2009 when compared to 2014 the reference category, which was the omitted category, were determined to be significant predictors ($p < .05$) for RE-OP. There was no difference for the years from 2010 to 2013 when compared to 2014 the reference category, which was the omitted category for RE-OP. The results for calendar year and RE-OP univariate logistic regression are shown below in Table 25. The Wald test and the *p-value* showed that the years from 2009 was significant predictors of RE-OP when compared to 2014 to the reference category, which was the omitted category: 2009, (β = .321), Wald $\chi 2$ (d*f* = 1) = 44.535, $p < .001$; 2010, (β

= .001), Wald $\chi2$ (df = 1) = .000, p = .984; 2011, (β = .073), Wald $\chi2$ (df = 1) = 2.120, p = .145; 2012, (β = .015), Wald $\chi2$ (df = 1) = .101, p = .751; 2013, (β = -.018), Wald $\chi2$ (df = 1) = .182, p = .670. A patient in the year 2009 when compared to 2014 was only 1.4 times likely to not have RE-OP. There was no significance for the period of 2010 to 2013 for RE-OP when compared to 2014 the reference category, which was the omitted category. The year 2009 was a significant predictor of whether a patient would experience RE-OP.

Race. The variables for White and Black when compared to Other ethnicities the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP; in contrast, Hispanic, Asian or Pacific Islander and Native American were insignificant predictors of RE-OP when compared to Other ethnicities the reference category, which was the omitted category. The results for Race and RE-OP univariate logistic regression are shown below in Table 25. The Wald tests and the *p-values* showed that White and Black were significant to predicting RE-OP; however, RE-OP for Hispanic, Asian or Pacific Islander and Native American were insignificant predictors compared to Other ethnicities the reference category, which was the omitted category: White, (β = -.231), Wald $\chi2$ (df = 1) = 32.520, p <.001; Black, (β = .053), Wald $\chi2$ (df = 1) = 1.488, p =.223; Hispanic, (β = -.114), Wald $\chi2$ (df = 1) = 6.345, p = .012; Asian or Pacific Islander, (β = .068), Wald $\chi2$ (df = 1) = .600, p = .439; Native American, (β = -.807), Wald $\chi2$ (df = 1) = 42.102, p <.001. The OR for White, Hispanic, and Native American patients when compared to Other ethnicities were .8, .9, and .4 respectively.

White and Black patients when compared to Other ethnicities the reference category, which was the omitted category are only 1.2 and 1.3 to not have RE-OP respectively. Black have higher odds for having no RE-OP. There was no difference for Hispanic, Asian or Pacific Islander and Native American when compared to Other ethnicities the reference category, which was the omitted category. There is sufficient evidence to indicate that White and Black was significant predictor of RE-OP.

Cycles of seasons. The variables for Winter, Spring, and Summer when compared to Fall the reference category, which was the omitted category were determined to be insignificant predictors ($p > .05$) for RE-OP. The *p*-value for Winter is barely not statistically significant for RE-OP when compared to Fall the reference category, which was the omitted category. The results for Cycles of Seasons and RE-OP univariate logistic regression are shown below in Table 25. The Wald tests and the *p-values* showed that seasons from Winter, Spring, and Summer were insignificant predictors of RE-OP when compared to Fall to the reference category, which was the omitted category: Winter, ($\beta = .079$), Wald $\chi 2$ ($df = 1$) = 3.694, $p = .055$; Spring, ($\beta = -.036$), Wald $\chi 2$ ($df = 1$) = .782, $p = .377$; Summer, ($\beta = -.024$), Wald $\chi 2$ ($df = 1$) = .369, $p = .544$. None of the analyses for Cycles of seasons were significant predictor for RE-OP when compared to Fall the reference category, which was the omitted category.

Months. The variables for January and February when compared to December the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. However, there was no difference for the rest of other month in calendar year for the following months (March, April, May, June, July, August, September, October and November) were insignificant (*p > .05)* for RE-OP. The results for Months and RE-OP univariate logistic regression are shown below in Table 25.

The months of January and February showed that the Wald tests and the *p-values* were significant predictors of RE-OP when compared to December the reference category, which was the omitted category. However, the other months were insignificant predicators for RE-OP: January, (β = .169), Wald χ2 (d*f* = 1) = 5.841, *p* = .016; February, (β = .163), Wald χ2 (d*f* = 1) = 5.247, *p* = .022; March, (β = .069), Wald χ2 (d*f* = 1) = 1.019, *p* = .313; April, (β = .053), Wald χ2 (d*f* = 1) = .602, *p* = .438; May, (β = -.003), Wald χ2 (d*f* = 1) = .001, *p* = .970; June, (β = .047), Wald χ2 (d*f* = 1) = .002, *p* = .965; July, (β = .047), Wald χ2 (d*f* = 1) = .485, *p* = .486; August, (β = .036), Wald χ2 (d*f* = 1) = .293, *p* = .588; September, (β = -.003), Wald χ2 (d*f* = 1) = .002, *p* = .969; October, (β = .050), Wald χ2 (d*f* = 1) = .572, *p* = .450; November, (β = .119), Wald χ2 (d*f* = 1) = 3.161, *p* = .075. A patient in January and February when compared to December was only 1.2 times likely to not experience RE-OP. None of the other months were statistically significant predictor for RE-OP. The odds for January and February were similar.

Gender. The variables for Female when compared to Male the reference category, which was the omitted category was determined to be significant predictors (*p < .05)* for RE-OP. The results for Gender and RE-OP univariate logistic regression are shown in Table 25. The results for female and RE-OP when compared to Male the reference category, which was the omitted category: Female, (β = -.104), Wald χ2 (d*f* = 1) = 9.002, *p* = .003. Female patient has only .9 odds for RE-OP when compared to Male the reference category, which was the omitted category.

Age in category. The variables for all the age categories when compared to >60 the reference category, which was the omitted category were determined to be significant predictors (*p < .05)* for RE-OP. The results for Age Group and RE-OP univariate logistic regression are shown in Table 25. The Wald tests and the *p-values* showed that all the age categories were significant predictors of RE-OP when compared to those of patient aged 60 and up (> 60) to the reference category, which was the omitted category: 18-29, (β = -1.761), Wald $\chi2$ (d*f* = 1) = 445.848, $p < .001$; 30-39, (β = -1.155), Wald $\chi2$ (d*f* = 1) = 567.144, $p < .001$; 40-49, (β = -.636), Wald $\chi2$ (d*f* = 1) = 246.039, $p < .001$; 50-59, (β = -.247), Wald $\chi2$ (d*f* = 1) = 39.226, $p < .001$.

The OR for 18-29, 30-39, 40-49, and 50-59 are .703, .774, .805, and .863 respectively. Therefore, there were only .172,.315, .529, and .781 odds likely that patients in each 18-29, 30-39, 40-49, and 50-59 age group respectively would not experience RE-OP. There was a marginal increase of the odd for RE-OP each age group especially for 50-59 when compared to >60 the reference category, which was the omitted category. Those in age group 50-59 when compared to >60 the reference category, which was the omitted category had the highest RE-OP odds. Thus, the trend showed a rise for each age group for RE-OP odds when compared to >60 the reference category, which was the omitted category. Age group was a significant predictor for RE-OP.

Control. The variable for Government or Private, Private, not- for-profit, and Private, investor-owned variables when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category were found to be insignificant predictors (*p > .05)* for RE-OP. However, Government nonfederal was significant predictor ($p < .05$) for RE-OP. The results for Control and RE-OP univariate logistic regression are shown in Table 25. The Wald tests and the *p-values* showed that Government, nonfederal was a significant predictors of RE-OP when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category: Government or Private, (β = .025), Wald $\chi 2$ (df = 1) = .026, p = .872; Government, nonfederal, (β = -.409), Wald $\chi 2$ (df = 1) = 5.864, p = .015; Private, not-for-profit, (β = -.210), Wald $\chi 2$ (df = 1) = 1.827, p = *.176*; Private, investor-owned, (β = -.073), Wald $\chi 2$ (df = 1) = .214, p = .643.

The OR for Government, nonfederal when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category was .664 for RE-OP. The odd for Government nonfederal patients not experiencing RE-OP was only .7 when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category.

Location or teaching. The variables for Rural when compared to Urban teaching the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. The results for Location or Teaching and RE-OP univariate logistic regression are shown in Table 25. The result showed that Rural was significant to predicting RE-OP when compared to Urban teaching to the reference category, which was the omitted category: Rural, (β = -.265), Wald $\chi 2$ (df = 1) = 9.093, p = .003; Urban nonteaching, (β = .021), Wald $\chi 2$ (df = 1) = .513, p = .474.

The OR for Rural when compared to Urban teaching to the reference category, which was the omitted category is .8. Rural patient only has .8 odds of having for RE-OP when compared to Urban teaching to the reference category, which was the omitted category. There was no difference for Urban nonteaching for RE-OP when compared to Urban teaching to the reference category, which was the omitted category.

Bedsize. The variables for Small and Medium when compared to Large the reference category, which was the omitted category were determined to be significant predictors (*$p < .05$)* for RE-OP. The results for Bedsize and RE-OP univariate logistic regression are shown in Table 25. The Wald tests and the *p-values* results showed that Small and Medium were significant to predicting RE-OP when compared to Large the reference category, which was the omitted category: Small, ($\beta = .199$), Wald $\chi 2$ ($df = 1$) = 28.344, $p < .001$; Medium, ($\beta = .251$), Wald $\chi 2$ ($df = 1$) = 56.488, $p <.001$.

The OR for Small and Medium compared to Large the reference category, which was the omitted category are 1.2 and 1.3 respectively. A patient in Small bedsize health service organization (HSO) when compared to Large was only 1.2 likely to not have RE-OP. A patient in Medium bedsize health service organization (HSO) when compared to Large has better odds than a Small bedsize HSO when compared to Large the reference category, which was the omitted category. Bedsize was predictor for whether a patient would experience RE-OP because it was statistically significant.

Census region prior to 2012. The variables for Northeast, Midwest, South, and West when compared to Missing the reference category, which was the omitted category were determined to be significant predictors (*$p < .05$)* for RE-OP. The results for Census Region Prior to 2012 and RE-OP univariate logistic regression are shown in Table 25. The results are follows: Northeast, ($\beta = .308$), Wald $\chi 2$ ($df = 1$) = 43.919, $p <.001$;

Midwest, ($\beta = .279$), Wald $\chi2$ ($df = 1$) = 48.886, p <.001; South, ($\beta = .175$), Wald $\chi2$ (df = 1) = 19.021, $p < .001$; West, ($\beta = .107$), Wald $\chi2$ ($df = 1$) = 3.919, p <.001.The OR for Northeast, Midwest, South, and West compared to Missing the reference category, which was the omitted category are .723, 1.100, .920, and .523 respectively. Although Northeast, Midwest, South, and West provide significant evidence for RE-OP. Because the census region prior to 2012 had a large missing category it was difficult to ascertain the direction of effect and exposure to outcome for RE-OP despite statistical significance due to large sample size.

Census division starting from 2012. The variables for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central and Mountain when compared to Pacific the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. The results for Census Division Starting from 2012 and RE-OP univariate logistic regression are shown in Table 25. Based on the Wald tests and the *p-values,* New England, Mid-Atlantic, West North Central, South Atlantic, East South Central, West South Central and Mountain when compared to Pacific the reference category, which was the omitted category, there was enough evidence to indicate that Census division starting from 2012 are predictors of RE-OP when compared to Pacific to the reference category, which was the omitted category: New England, ($\beta = .820$), Wald $\chi2$ ($df = 1$) = 73.059, p <.001; Mid-Atlantic, ($\beta = .791$), Wald $\chi2$ ($df = 1$) = 72.437, p <.001; East North Central, ($\beta = .688$), Wald $\chi2$ ($df = 1$) = 54.573, p <.001; West North Central, ($\beta = .619$), Wald $\chi2$ ($df = 1$) = 38.467, p <.001; South Atlantic, ($\beta = .484$), Wald $\chi2$ ($df = 1$) = 23.284, p <.001;

East South Central, ($\beta = .648$), Wald $\chi 2$ ($df = 1$) = 33.246, p <.001; West South Central, ($\beta = .688$), Wald $\chi 2$ ($df = 1$) = 48.846, *p<.001*; Mountain, ($\beta = .408$), Wald $\chi 2$ ($df = 1$) = 10.612, *p = .001*.

The OR for the following variables: New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central and Mountain when compared to Pacific the reference category, which was the omitted category are 2.3, 2.2, 2.0, 1.9, 1.6, 1.9, 2.0, and 1.5 respectively. New England patients had the highest OR (2.3) for RE-OP. Mountain Patients had the lowest OR (1.5). Census division supported the model because it was a significant predictor of RE-OP.

Hospital volume. The variables for Very Low, Low, and High when compared to Very High the reference category, which was the omitted category, were determined to be insignificant predictors (*p < .05)* for RE-OP. The results for hospital Volume and RE-OP univariate logistic regression are shown in Table 25. The Wald tests and the *p-values* showed that the model was significant to predicting RE-OP: Very Low, ($\beta = 1.366$), Wald $\chi 2$ ($df = 1$) = 39.513, p <.001; Low, ($\beta = .709$), Wald $\chi 2$ ($df = 1$) = 10.618, p =.001; Medium, ($\beta = .338$), Wald $\chi 2$ ($df = 1$) = 2.134, p =.144; High, ($\beta = .683$), Wald $\chi 2$ ($df = 1$) = 9.604, p =.002. There was no difference for Medium when compared to Very High the reference category, which was the omitted category for RE-OP. The OR for Very Low, Low, and High when compared to Very High the reference category, which was the omitted category are 3.920, 2.032, and 1.980. The odds for Very Low was the highest for RE-OP. High had the lowest OR for RE-OP. Thus, hospital volume is significant predicator of RE-OP.

Table 25

A Binary Logistic for Reoperation

Comparison	B	S.E.	Wald	df	Exp(B)	95% C.I. for EXP(B)	*P*-Value
Univariate							
Procedure Type							
LAGB	-.768	.043	320.618	1	.464	.426-.504	<.001
LSG	-.722	.033	471.816	1	.486	.455-.519	<.001
Constant	-2.024	.026	5903.176	1	.132		<.001
Year							
2009	.321	.048	44.535	1	1.379	1.255-1.516	<.001
2010	.001	.050	.000	1	1.001	.907-1.104	.984
2011	.073	.050	2.120	1	1.075	.975-1.186	.145
2012	.015	.047	.101	1	1.015	.925-1.114	.751
2013	-.018	.043	.182	1	.982	.902-1.068	.670
Constant	-2.627	.029	8090.985	1	.072		<.001
Race							
White	.165	.083	3.960	1	1.180	1.002-1.389	.047
Black	.260	.088	8.702	1	1.298	1.091-1.543	.003
Hispanic	-.090	.095	.909	1	.914	.759-1.100	.340
Asian or Pacific Islander	.144	.170	.711	1	1.154	.827-1.612	.399
Native American	.166	.236	.499	1	1.181	.744-1.875	.480
Constant	-2.724	.081	1128.393	1	.066		<.001
Cycles of Seasons							
Winter	.079	.041	3.694	1	1.083	.998-1.174	.055
Spring	-.036	.041	.782	1	.965	.891-1.045	.377
Summer	-.024	.040	.369	1	.976	.902-1.056	.544
Constant	-2.578	.027	8827.835	1	.076		<.001
Months							
January	.169	.070	5.841	1	1.184	1.033-1.359	.016
February	.163	.071	5.247	1	1.177	1.024-1.352	.022
March	.069	.069	1.019	1	1.072	.937-1.227	.313
April	.053	.068	.602	1	1.055	.922-1.206	.438
May	-.003	.069	.001	1	.997	.871-1.143	.970
June	-.003	.068	.002	1	.997	.872-1.139	.965
July	.047	.067	.485	1	1.048	.919-1.195	.486
August	.036	.067	.293	1	1.037	.909-1.183	.588
September	-.003	.069	.002	1	.997	.872-1.141	.969

October	.050	.066	.572	1	1.051	.923-1.197	.450
November	.119	.067	3.161	1	1.126	.988-1.283	.075
Constant	-2.630	.045	3425.179	1	.072		<.001
Gender							
Female	-.104	.035	9.002	1	.901	.841-.964	.003
Constant	-2.554	.016	24325.116	1	.078		<.001
Age in Category							
18-29	-1.761	.083	445.848	1	.172	.146-.202	<.001
30-39	-1.155	.048	567.144	1	.315	.287-.347	<.001
40-49	-.636	.041	246.039	1	.529	.489-.573	<.001
50-59	-.247	.039	39.226	1	.781	.723-.844	<.001
Constant	-2.002	.029	4651.034	1	.135		<.001
Control							
Government or Private	.025	.156	.026	1	1.025	.755-1.392	.872
Government, nonfederal	-.409	.169	5.864	1	.664	.477-.925	.015
Private, not-for-profit	-.210	.155	1.827	1	.811	.598-1.099	.176
Private, investor-owned	-.073	.157	.214	1	.930	.684-1.265	.643
Constant	-2.450	.154	254.154	1	.086		<.001
Location or Teaching							
Rural	-.265	.088	9.093	1	.767	.646-.912	.003
Urban nonteaching	.021	.030	.513	1	1.022	.963-1.083	.474
Constant	-2.578	.019	18640.545	1	.076		<.001
Bedsize							
Small	.199	.037	28.344	1	1.221	1.134-1.313	<.001
Medium	.251	.033	56.488	1	1.285	1.203-1.372	<.001
Constant	-2.695	.021	16184.821	1	.068		<.001
Census Region prior to 2012							
Northeast	.308	.046	43.919	1	1.360	1.242-1.490	<.001
Midwest	.279	.040	48.886	1	1.321	1.222-1.429	<.001
South	.175	.040	19.021	1	1.192	1.101-1.289	<.001
West	.107	.054	3.919	1	1.113	1.001-1.237	.048
Constant	-2.733	.027	10581.619	1	.065		<.001

Census Division starting from 2012							
New England	.820	.096	73.059	1	2.271	1.881-2.740	<.001
Mid-Atlantic	.791	.093	72.437	1	2.205	1.838-2.646	<.001
East North Central	.688	.093	54.573	1	1.989	1.657-2.387	<.001
West North Central	.619	.100	38.467	1	1.858	1.527-2.259	<.001
South Atlantic	.484	.100	23.284	1	1.622	1.333-1.974	<.001
East South Central	.648	.112	33.246	1	1.911	1.533-2.382	<.001
West South Central	.688	.098	48.846	1	1.990	1.640-2.413	<.001
Mountain	.408	.125	10.612	1	1.504	1.177-1.923	.001
Constant	-3.245	.088	1358.186	1	.039		<.001
Hospital Volume							
Very Low	1.366	.217	39.513	1	3.920	2.561-6.002	<.001
Low	.709	.218	10.618	1	2.032	1.327-3.113	.001
Medium	.338	.231	2.134	1	1.402	.891-2.207	.144
High	.683	.220	9.604	1	1.980	1.285-3.049	.002
Constant	-3.528	.216	265.970	1	.029		<.001

Multivariate Logistic Regression for Reoperation

The third multiple logistic regression was performed for the dependent variable for in-hospital mortality. The variables in the multivariate analyses included independent variables: procedure types (LAGB, LSG, and BPD/DS) and covariates year, race, cycles of season, months, gender, age in category, hospital size (control, location or teaching, bedsize, census region prior 2012, census division starting with 2012), and hospital volume. The results for the RE-OP multiple logistic regression are shown below in Table 26.

Procedure types. The variables LAGB and LSG when compared to BPD/DS the reference category, which was the omitted category were determined to be significant predictors (*$p < .05$)* for RE-OP. The results for procedure types and RE-OP multivariate logistic regression are shown below in Table 26. The Wald test and the *p-values* indicated that LAGB and LSG were significant predictors of RE-OP when compared to BPD/DS to the reference category, which was the omitted category: LAGB, ($\beta = -.775$), Wald $\chi 2$ (df = 1) = 145.110, $p < .001$; LSG, ($\beta = -.734$), Wald $\chi 2$ (df = 1) = 165.260, $p < .001$.

A patient undergoing LAGB has only .46 times tendency of experiencing RE-OP compared to BPD/DS patients the reference category, which was the omitted category. Likewise, a patient that undergoes LSG when compared to BPD/DS was only .48 times as likely to experience RE-OP as a patient that underwent BPD/DS the reference category, which was the omitted category. Procedure type difference for LAGB and LSG was small for RE-OP. Therefore, there is sufficient evidence to show that there was an association between procedure types (LAGB and LSG) when compared to BPD/DS the reference category, which was the omitted category and RE-OP.

Calendar year. The variables for years from 2009 to 2011 when compared to 2014 the reference category, which was the omitted category were determined to be significant predictors (*$p < .05$)* for RE-OP. The results for Calendar Year and RE-OP multivariate logistic regression are shown below in Table 26. The Wald tests and the *p-values* showed that the period from 2009 to 2011 were insignificant to predicting RE-OP when compared to 2014 to the reference category, which was the omitted category: 2009, ($\beta = -.385$), Wald $\chi 2$ (df = 1) = 17.019, $p < .001$; 2010, ($\beta = -.904$), Wald $\chi 2$ (df = 1) = 95.257, $p < .001$; 2011, ($\beta = -.809$), Wald $\chi 2$ (df = 1) = 75.493, $p < .001$; 2012, ($\beta = .010$), Wald $\chi 2$ (df = 1) = .044, $p = .834$; 2013, ($\beta = -.015$), Wald $\chi 2$ (df = 1) = .109, $p = .741$.

The OR for the years 2009, 2010, and 2011 when compared to 2014 the reference category, which was the omitted category are .680, .405, and .446 respectively.

The year 2009 had the highest for experiencing RE-OP when compared to 2014 the reference category, which was the omitted category. While the OR for the year 2011 was lowest for RE-OP, it was almost like the OR for the year 2011 when compared to 2014 the reference category, which was the omitted category. There was no difference for RE-OP for the years from 2012 and 2013. Calendar year from 2009 to 2011 contributed to the model for RE-OP after controlling for it.

Race. Black when compared to White the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. The results for Race and RE-OP multivariate logistic regression are shown below in Table 26. The Wald tests and the *p-values* showed that Black was significant predictors compared to White the reference category, which was the omitted category: Black, ($\beta = .224$), Wald $\chi 2$ ($df = 1$) = 29.283, $p < .001$; Hispanic, ($\beta = -.019$), Wald $\chi 2$ ($df = 1$) = .118, $p = .731$; Asian or Pacific Islander, ($\beta = -.084$), Wald $\chi 2$ ($df = 1$) = .290, $p = .590$; Native American, ($\beta = .103$), Wald $\chi 2$ ($df = 1$) = .198, $p = .656$; Other, ($\beta = -.035$), Wald $\chi 2$ ($df = 1$) = .165, $p = .685$.

There was no difference for RE-OP for Hispanic, Asian or Pacific Islander, Native American, and Other ethnicities when compared to 2014 the reference category, which was the omitted category. A Black patient when compared to White the reference category, which was the omitted category was only 1.3 times likely to not experience RE-OP. Race (Black) contributed to the model for RE-OP after controlling for it.

Cycles of seasons. The variables for Spring and Summer when compared to Fall the reference category, which was the omitted category were determined to be significant predictors (*p* < *.05)* for RE-OP. The results for Cycles of Seasons and RE-OP multivariate logistic regression are shown in Table 26. The Wald tests and the *p-values* showed that Spring and Summer were significant predictors of RE-OP when compared to Fall to the reference category, which was the omitted category: Winter, (β = .029), Wald $\chi 2$ (d*f* = 1) = .458, *p* = .499; Spring, (β = -.086), Wald $\chi 2$ (d*f* = 1) = 4.303, *p* = .038; Summer, (β = -.086), Wald $\chi 2$ (d*f* = 1) = 4.406, *p* = .036. Because the *p* > *.05,* there is no difference in cycles of season for Winter when compared to Fall to the reference category, which was the omitted category for RE-OP. The OR for Spring and Summer were nearly similar (.038 and .036 respectively) for RE-OP when compared to Fall the reference category, which was the omitted category. Spring and Summer contributed to the model for RE-OP after controlling for it.

Gender. The variables for Male when compared to Female the reference category, which was the omitted category were determined to be significant predictors (*p* < *.05)* for RE-OP. The results for Gender and RE-OP multivariate logistic regression are shown in Table 26. The results for Male and RE-OP when compared to Female the reference category, which was the omitted category: Male, (β = -.252), Wald $\chi 2$ (d*f* = 1) = 47.956, *p* < .001. There was adequate evidence to indicate that male when compared to female the reference category, which was the omitted category was significant predictor for RE-OP. Male have about .8 odds of experiencing RE-OP when compared to Fall the reference category, which was the omitted category. Gender (male) contributed to the model for RE-OP after controlling for it.

Age in category. The variables for all the age categories when compared to >60 the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. The results for Age Group and RE-OP multivariate logistic regression are shown in Table 26. The Wald tests and the *p-values* showed that all the age categories were significant predictors of RE-OP when compared to those of patient aged 60 and up (> 60) to the reference category, which was the omitted category: 18-29, (β = -1.673), Wald $\chi 2$ (df = 1) = 371.622, p < .001; 30-39, (β = -1.045), Wald $\chi 2$ (df = 1) = 401.748, p < .001; 40-49, (β = -.528), Wald $\chi 2$ (df = 1) = 142.232, p < .001; 50-59, (β = -.135), Wald $\chi 2$ (df = 1) = 10.110, p = .001.

The OR for the age category 18-29, 30-39, 40-49, and 50-59 when compared to the age group > 60 the reference category, which was the omitted category are .188, .352, .590, and .874 respectively. The age group show a general trend of OR increasing with age for RE-OP when compared to >60 the reference category, which was the omitted category. A patient in the age group 50-59 have higher odds of experiencing RE-OP. Age group 18-29 had the lowest odds for RE-OP when compared to >60 the reference category, which was the omitted category. Age group contributed to the model for RE-OP after controlling for it.

Control. The variables for Government, nonfederal and Private, not- for-profit compared to Government or Private the reference category, which was the omitted category were found to be significant predictors ($p < .05$) for RE-OP. The results for

Control and RE-OP multivariate logistic regression are shown in Table 26. The Wald tests and the *p-values* showed that the other control variables (Private, investor-owned and Private, either not-for-profit or investor-owned) were insignificant predictors of RE-OP when compared to Government or Private the reference category, which was the omitted category: Government, nonfederal, (β = -.494), Wald $\chi 2$ (d*f* = 1) = 24.630, *p* < .001; Private, not- for-profit, (β = -.334), Wald $\chi 2$ (d*f* = 1) = 20.204, *p* <.001 ; Private, investor-owned, (β = -.141), Wald $\chi 2$ (d*f* = 1) = 3.684, *p* = .055; Private, either not-for-profit or investor-owned, (β = .322), Wald $\chi 2$ (d*f* = 1) = 2.756, *p* = .097.

There was no difference for Private, investor-owned and Private, either not-for-profit or investor-owned when compared to Government or Private the reference category, which was the omitted category for RE-OP. Private, investor-owned was nearly not significant. Private, not- for-profit had the highest odds (.7) for RE-OP when compared to Government or Private the reference category, which was the omitted category. Government, nonfederal and Private, not- for-profit contributed to the model for RE-OP after controlling for it.

Location or teaching. The variables for Rural and Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category were determined to be significant predictors (*p <.05)* for RE-OP. The results for Location or Teaching and RE-OP multivariate logistic regression are shown in Table 26. The result showed that Rural and Urban nonteaching were significant to predicting RE-OP when compared to Urban teaching to the reference category, which was the omitted category: Rural, (β = -.239), Wald $\chi 2$ (d*f* = 1) = 4.861, *p* = .027; Urban nonteaching, (β = .170), Wald $\chi 2$ ($df = 1$) = 21.988, $p < .001$. Urban nonteaching OR of 1.2 was highest for not experiencing RE-OP when compared to Urban teaching the reference category, which was the omitted category. The OR for Rural was .8 when compared to Urban teaching the reference category, which was the omitted category for RE-OP. The Location or teaching variables contributed to the model for RE-OP after controlling for it.

Bedsize. The variables for Small and Medium when compared to Large the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. The results for Bedsize and RE-OP multivariate logistic regression are shown in Table 26. The Wald tests and the *p-values* results showed that Small bedsize was significant to predicting RE-OP when compared to Large the reference category, which was the omitted category: Small, ($\beta = .246$), Wald $\chi 2$ ($df = 1$) = 34.554, $p < .001$; Medium, ($\beta = .316$), Wald $\chi 2$ ($df = 1$) = 81.536, $p < .001$. The OR for Small and Medium compared to Large the reference category, which was the omitted category are 1.3 and 1.4 respectively. Medium bedsize hospital was better for not having RE-OP when compared to Large the reference category, which was the omitted category. The Bedsize (Small and Medium) variables contributed to the model for RE-OP after controlling for it.

Census division starting from 2012. Except for the Mountain variable which is insignificant predictor for RE-OP, the following variables for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central when compared to Pacific the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. The results for Census Division Starting from 2012 and RE-OP multivariate logistic regression are shown in Table 26. Based on the Wald tests and the *p-values,* there was evidence to indicate that Census division starting from 2012 are predictors of RE-OP when compared to Pacific to the reference category, which was the omitted category: New England, ($\beta = .920$), Wald $\chi2$ (df = 1) = 80.991, $p < .001$; Mid-Atlantic, ($\beta = .802$), Wald $\chi2$ (df = 1) = 69.557, $p < .001$; East North Central, ($\beta = .653$), Wald $\chi2$ (df = 1) = 43.346, $p < .001$; West North Central, ($\beta = .648$), Wald $\chi2$ (df = 1) = 37.081, $p < .001$; South Atlantic, ($\beta = .385$), Wald $\chi2$ (df = 1) = 14.157, $p < .001$; East South Central, ($\beta = .620$), Wald $\chi2$ (df = 1) = 29.036, $p < .001$; West South Central, ($\beta = .572$), Wald $\chi2$ (df = 1) = 31.394, $p < .001$; Mountain, ($\beta = .217$), Wald $\chi2$ (df = 1) = 2.813, $p = .093$.

There was no difference ($p > .05$) for Mountain when compared to Pacific the reference category, which was the omitted category for RE-OP. The following variables for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central compared to Pacific the reference category, which was the omitted category are 2.5, 2.2, 1.9, 1.9, 1.5, 1.9, 1.8, and 1.8 respectively. New England had the highest OR (1.5) for having no RE-OP when compared to Pacific the reference category, which was the omitted category. South Atlantic had the lowest OR (2.5) for having no RE-OP when compared to Pacific the reference category, which was the omitted category. The census division variables contributed to the model for RE-OP after controlling for it.

Hospital volume. The variables for Low, Medium, High, and Very High when compared to Very Low the reference category, which was the omitted category were determined to be significant predictors ($p < .05$) for RE-OP. The results for hospital

Volume and RE-OP multivariate logistic regression are shown in Table 26. The Wald tests and the *p-values* showed that the Low, Medium, High, and Very High when compared to Very Low was significant to predicting RE-OP: Low, (β = -.316), Wald $\chi 2$ (df = 1) = 56.835, p < .001; Medium, (β = -.642), Wald $\chi 2$ (df = 1) = 49.574, p < .001; High, (β = -.198), Wald $\chi 2$ (df = 1) = 7.665, p = .006; Very High, (β = -.936), Wald $\chi 2$ (df = 1) = 13.583, p < .001.

The OR for Low volume hospital category were .7, indicating that increasing odds for RE-OP when compared to Very Low the reference category, which was the omitted category. The Low volume hospitals have the highest odds for RE-OP when compared to Very Low the reference category, which was the omitted category. Very High volume hospitals have the lowest odds (.4) for a patient experiencing RE-OP when compared to Very Low the reference category, which was the omitted category. Thus, low hospital volume was a significant predicator of RE-OP. Hospital volume contributed to the model for RE-OP after controlling for it.

Table 26

A Multiple Logistic for Reoperation

Variables in the Equation

							95% C.I.for EXP(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Procedure Types								
Laparoscopic adjustable banding	-.775	.064	145.110	1	<.001	.461	.406	.523
Laparoscopic sleeve gastrectomy	-.734	.057	165.260	1	<.001	.480	.429	.537
Calendar Year								
2009	-.385	.093	17.019	1	<.001	.680	.567	.817

2010	-.904	.093	95.257	1	<.001	.405	.338	.486
2011	-.809	.093	75.493	1	<.001	.446	.371	.535
2012	.010	.050	.044	1	.834	1.010	.916	1.114
2013	-.015	.044	.109	1	.741	.986	.904	1.075
Race (Uniform)								
Black	.224	.041	29.283	1	<.001	1.251	1.153	1.356
Hispanic	-.019	.055	.118	1	.731	.981	.882	1.092
Asian Or Pacific Islander	-.084	.157	.290	1	.590	.919	.676	1.249
Native American	.103	.232	.198	1	.656	1.109	.704	1.746
Other	-.035	.086	.165	1	.685	.966	.817	1.142
Cycle of Seasons								
Winter	.029	.043	.458	1	.499	1.029	.947	1.119
Spring	-.086	.042	4.303	1	.038	.917	.845	.995
Summer	-.086	.041	4.406	1	.036	.918	.847	.994
Gender								
Male	-.252	.036	47.956	1	<.001	.777	.724	.835
Age in Categories								
18-29	-1.673	.087	371.622	1	<.001	.188	.158	.222
30-39	-1.045	.052	401.748	1	<.001	.352	.318	.390
40-49	-.528	.044	142.232	1	<.001	.590	.541	.643
50-59	-.135	.042	10.110	1	.001	.874	.804	.950
Control								
Government, nonfederal	-.494	.100	24.630	1	<.001	.610	.502	.742
Private, not-for-profit	-.334	.074	20.204	1	<.001	.716	.619	.828
Private, investor-owned	-.141	.073	3.684	1	.055	.869	.752	1.003
Private, either not-for-profit or investor-owned	.322	.194	2.756	1	.097	1.380	.943	2.018
Location or Teaching								
Rural	-.239	.108	4.861	1	.027	.787	.637	.974
Urban nonteaching	.170	.036	21.988	1	<.001	1.185	1.104	1.272
Bedsize								
Small	.246	.042	34.554	1	<.001	1.278	1.178	1.388
Medium	.316	.035	81.536	1	<.001	1.371	1.280	1.468

Census Division Starting With 2012								
New England	.920	.102	80.991	1	<.001	2.509	2.053	3.065
Mid-Atlantic	.802	.096	69.557	1	<.001	2.230	1.847	2.692
East North Central	.653	.099	43.346	1	<.001	1.921	1.582	2.333
West North Central	.648	.106	37.081	1	<.001	1.911	1.552	2.354
South Atlantic	.385	.102	14.157	1	<.001	1.470	1.203	1.796
East South Central	.620	.115	29.036	1	<.001	1.860	1.484	2.330
West South Central	.572	.102	31.394	1	<.001	1.772	1.450	2.164
Mountain	.217	.129	2.813	1	.093	1.243	.964	1.601
Hospital Volume								
Low	-.316	.042	56.835	1	<.001	.729	.672	.791
Medium	-.642	.091	49.574	1	<.001	.526	.440	.629
High	-.198	.071	7.665	1	.006	.821	.713	.944
Very High	-.936	.254	13.583	1	<.001	.392	.238	.645
Constant	- 1.649	.129	162.657	1	.000	.192		

Summary

The results for NIS were presented in this section. The analyses included a total of 73,086 patients that underwent LAGB, LSG, and BPD/DS bariatric surgery. Based on the three research questions, yes, there were some procedure type differences for LAGB and LSG when compared to BPD/DS. However, except for IHM and LOS which had higher odds for LSG than LAGB when compared to BPD/DS, the procedure type difference for the univariates logistic regressions was minimal for RE-OP when compared to BPD/DS bariatric surgery intervention type

The covariates had some effect on both the univariate and multiple logistic regression. Procedure type difference was almost similar for IHM and RE-OP when compared to BPD/DS. After controlling for the covariate in LOS in the multiple logistic regression, procedure type difference was significantly higher for LSG than LAGB when compared to BPD/DS.

The final section is focused primarily on discussion of the results, conclusions, limitation, future recommendation for further research, and social change implications.

Section 4: Discussion, Conclusion, and Future Recommendations

Introduction

This research of NIS data consisted of patients who underwent bariatric surgery from January 2009 to December 2014. There was considerable increase in the use of laparoscopy for bariatric surgery (Nguyen et al., 2005). Therefore, comparing outcomes of bariatric surgery procedure types is imperative in order to improve quality and safety for patients. The aim of the research was to compare the outcome of LAGB and LSG bariatric surgery. The study was based on a quantitative cross-sectional retrospective analysis. The research was guided by the epidemiologic triad conceptual framework.

Concise Summary

Based on the NIS data, three research questions were presented to ascertain the exposure of procedure type on the dependent variables (IHM, LOS, and RE-OP). The sample consisted of a total of 73,086 patients, including 17,307 men, and 55,700 women. The NIS contains one of the largest data repositories for health research. The study tested the hypotheses for procedure types IHM, LOS, and RE-OP.

RQ1: To what extent, if any, was in-hospital mortality (IHM) associated with the type of bariatric surgery procedure used on the patient?

The research findings of procedure types showed that both the univariate and multivariate logistic regression tests for LAGB and LSG were significant predicators of IHM. The odds for LAGB when compared to BPD/DS, the reference category, were barely higher than LSG for the univariate logistic for IHM. The multiple logistic regression analysis test indicated that there was some difference between LAGB and LSG for IHM when compared to BPD/DS, the reference category; however, the difference in the odds was minimal, although both procedure types were significant predictors of IHM.

RQ2: To what extent, if any, was length of stay associated with the type of bariatric surgery procedure?

Both the univariate and multivariate tests showed that procedure type difference odds for LSG were significantly higher than LAGB for LOS when compared to BPD/DS, the reference category. Both LAGB and LSG when compared to BPD/DS, the reference category, were significant predictors for LOS.

RQ3: To what extent, if any, was reoperation associated with the type of bariatric surgery procedure?

Both the univariate and multivariate test showed that procedure type difference odds for LAGB and LSG were almost similar for RE-OP when compared to BPD/DS, the reference category. However, LSG had odds that were slightly higher than LAGB when compared to BPD/DS, the reference category.

Interpretation of Findings

Procedure Type and In-Hospital Mortality

The study was used to test the hypothesis that IHM is associated with the type of bariatric surgery procedure used on the patient, LOS was associated with the type of bariatric surgery procedure, and RE-OP was associated with the type of bariatric surgery procedure. The findings suggested that there is a procedure difference for IHM, LOS, and LOS. The findings are consistent with some research studies in the field although there were some unexpected findings that contradicted other research.

Given that IHM was coded 0 = Did not die during hospitalization and 1 = Died during hospitalization, these coefficients suggest that (a) patients who underwent LAGB had a lower propensity to die during hospital stay, and (b) patients undergoing LSG were less likely to die than with LAGB during hospitalization when compared to BPD/DS, the reference category, which was the omitted category. The tendency to die during in-hospital stay is lower for LSG than LAGB when compared to BPD/DS, the reference category, which was the omitted category. The univariate test indicated that a patient undergoing LAGB had only .041 times greater tendency of dying during hospital stay when compared to BPD/DS patients, the reference category, which was the omitted category. Likewise, a patient who underwent LSG when compared to BPD/DS was only .017 times as likely of dying during in-hospital stay as a patient undergoing BPD/DS, the reference category, which was the omitted category Therefore, there is sufficient evidence to show that there is an association between procedure types (LAGB and LSG) when compared to BPD/DS, the reference category, which was the omitted category, and IHM.

The multivariate test showed that a patient undergoing LAGB had only .043 times greater tendency of dying during hospital stay when compared to BPD/DS patients, the reference category, which was the omitted category. Similarly, a patient who underwent LSG when compared to BPD/DS was only .030 times as likely of dying during in-hospital stay as a patient who underwent BPD/DS, the reference category, which was the omitted category. Therefore, there is sufficient evidence to indicate an association between procedure types (LAGB and LSG) when compared to BPD/DS, the reference category, which was the omitted category, and IHM.

The odds for LAGB when compared to BPD/DS patients, the reference category, barely changed from .041 to .043 for IHM after controlling for the covariates. The change was minimal for LAGB. However, the odds for LSG when compared to BPD/DS patients, the reference category, increased from .017 to .030 for IHM. Thus, there was no difference in odds after controlling for covariates for LAGB when compared to BPD/DS patients, the reference category. The odds improved for LSG when compared to BPD/DS patients, the reference category, for IHM after the model controlled for the covariates. While the findings for IHM were significant for procedure types, the largest number of cases required for hypothesis 1 was 510,000, and the sample size in this study was 73,086. The sample was not large enough to be within power level. Consequently, because IHM lacked the power level, procedure type has no effect for IHM.

Procedure Type and Length of Stay

Given that LOS is coded 1 = Low and 2 =High, these coefficients suggest that (a) patients who underwent LAGB had a higher propensity to have low duration of stay, and (b) those patients who underwent LSG when compared to BPD/DS, the reference category, which was the omitted category, were likely to stay longer after surgery. The trend for LOS implies that LSG patients have a higher tendency to stay longer in hospital than LAGB when compared to BPD/DS, the reference category, which was the omitted category. The univariate test showed that when comparing LAGB to BPD/DS, the reference category, which was the omitted category, the odds ratio (OR) for LAGB is

.043. Given the relationship between LAGB and LOS (coded 1 = Low and 1 = High) is negative (β = -3.135), this shows that every one-unit increase of LAGB compared to BPD/DS, the reference category, which was the omitted category, decreases the odds of low LOS by a factor of .043. Therefore, a patient undergoing LAGB has only .043 times tendency of low hospital stay compared to BPD/DS patients, the reference category, which was the omitted category. LAGB is a significant predicator of LOS. The multivariate test indicated that a patient who underwent LAGB had only .041 times tendency of dying during hospital stay compared to BPD/DS patients. the reference category, which was the omitted category.

The univariate test for LOS showed that the OR for LSG compared to BPD/DS, the reference category, which was the omitted category, is .541. Given that the relationship between LSG and LOS (coded 1 = Low and 2 = High) is negative (β = -.613), this demonstrates that LSG increased the odds of lower duration of stay for a patient. Each one-unit increase of LSG compared to BPD/DS, the reference category, which was the omitted category, lowered LOS by a factor of half. Thus, a patient who underwent LSG was only.5 times as likely to not have a low LOS when compared to BPD/DS, the reference category, which was the omitted category. LSG is a significant predicator of LOS.

The multivariate test revealed that a patient who underwent LSG when compared to BPD/DS was only .43 times as likely of not experiencing a high LOS when compared to patients who underwent BPD/DS, the reference category, which was the omitted category. Therefore, there is sufficient evidence to show that there is an association between procedure types (LAGB and LSG) when compared to BPD/DS, the reference category, which was the omitted category, and LOS. LSG has the highest OR for LOS when compared to BPD/DS, the reference category, which was the omitted category.

The OR for LAGB when compared to BPD/DS, the reference category, which was the omitted category, decreased from .043 for the univariate tests to .041 for the multivariate tests. There was no major difference for LAGB when compared to BPD/DS, the reference category, which was the omitted category, for LOS after controlling for it. The OR for LSG when compared to BPD/DS, the reference category, which was the omitted category, also decreased from .541 in the univariate tests to .425 for the multivariate logistic regression test. After controlling for covariates, LOS decreased for LSG when compared to BPD/DS, the reference category, which was the omitted category.

Procedure Type and Reoperation

Given that reoperation was coded 0 = Patients without RE-OP and 1 = Patients with RE-OP, these coefficients suggest that (a) patients who underwent LAGB have a lower propensity to experience RE-OP, and (b) patients who underwent LSG also have similar tendency to experience RE-OP when compared to BPD/DS, the reference category, which was the omitted category. The affinity for RE-OP was lower for LAGB than LSG when compared to BPD/DS, to the reference category, which was the omitted category, but not by much difference for procedure type RE-OP odds. The univariate test indicated that a patient undergoing LAGB has only .464 times tendency to have RE-OP when compared to BPD/DS, patients the reference category, which was the omitted category. Likewise, a patient who undergoes LSG when compared to BPD/DS was only .486 times as likely to experience RE-OP when compared to a patient who underwent BPD/DS, the reference category, which was the omitted category Therefore, there is sufficient evidence to show that while there was an association between procedure types (LAGB and LSG) when compared to BPD/DS, the reference category, which was the omitted category, the difference for procedure type for REOP was small and the difference was not significant.

The multivariate test showed that a patient undergoing LAGB had only .461 times greater tendency of having RE-OP when compared to BPD/DS patients, the reference category, which was the omitted category. Similarly, a patient who underwent LSG when compared to BPD/DS was only .480 times as likely of having RE-OP as a patient undergoing BPD/DS, the reference category, which was the omitted category. Therefore, there was sufficient evidence to indicate there was an association between procedure types (LAGB and LSG) when compared to BPD/DS, the reference category, which was the omitted category, for RE-OP. The difference for both LAGB and LSG when compared to BPD/DS patients, the reference category, which was the omitted category, was small, indicating that there was no major difference for RE-OP for both LAGB and LSG. Ramly et al.'s (2016) study supported the overall view that LSG and LAGB intervention techniques had a low risk of sickness and death.

Calendar Year and In-Hospital Mortality

The univariate tests showed that the OR for the year 2009 compared to 2014 the reference category, which was the omitted category is 2.560. Given that the relationship between the year 2009 and IHM is positive (β = .940). The OR for the year 2009, illustrates that odds of a patient not dying during hospitalization was higher in the year 2009. For each one-unit increase of a patient dying during in-hospital stay compared to the year 2014 the reference category, which was the omitted category increases not having an in-hospital mortality by a factor of 2.6. Therefore, a patient in the year 2009 when compared to 2014 was only 2.6 times likely to not die during hospitalization.

The univariate tests showed that the OR for the year 2010 compared to 2014 the reference category, which was the omitted category is 3.122. Given that the association between the year 2010 and IHM is positive (β = 1.138). The OR for the year 2010, exemplifies that odds of a patient not dying during hospitalization was higher for the year 2010. Each one-unit increase of a patient dying during in-hospital stay compared to the year 2014 the reference category, which was the omitted category increases not having an in-hospital mortality by a factor of 3.1. Hence, a patient in the year 2010 when compared to 2014 was only 3.1times likely to not die during hospitalization.

The univariate tests showed that the OR for the year 2011 compared to 2014 the reference category, which was the omitted category is 3.076. Given that the relationship between the year 2009 and IHM is positive (β = 1.124). The OR for the year 2011, illustrates that odds of a patient dying during hospitalization was higher in the year 2011. Each one-unit increase of a patient dying during in-hospital stay compared to the year 2014 the reference category, which was the omitted category increases not having an in-hospital mortality by a factor of 3.08. Thus, a patient in the year 2011 when compared to

2014 was only 3.08 times likely to survive during hospitalization. The outcome for the year 2011 was almost like the year 2010 result.

The multivariate logistic regression tests each of the calendar year from 2009 when compared to the year 2014 the reference category, which was the omitted category showed that there was no difference for calendar years for IHM. After controlling for covariates in the model, the results from the findings indicated there was no association between calendar year and IHM. Thus, multivariate showed that there was no effect for calendar year when compared to the year 2014 the reference category, which was the omitted category. This unexpected finding may because there is no change for calendar year for IHM.

Calendar Year and Length of Stay

The univariate tests showed that the OR for the year 2009 compared to 2014 the reference category, which was the omitted category, is .285. Given that the relationship between the year 2009 and LOS is negative ($\beta = -1.254$). The OR for the year 2009, illustrates that odds for LOS for a patient is lower in the year 2009. For each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category decrease the odd of a patient not having a high LOS by a factor of .3. Therefore, a patient in the year 2009 when compared to 2014 was only .3 times likely to not having a high LOS. The model implies that the year 2009 is statistically significant predictor of LOS.

The univariate tests showed that the OR for the year 2010 compared to 2014 the reference category, which was the omitted category, is .376. Given that the relationship between the year 2010 and LOS was negative (β = -.978). The OR for the year 2010, describes that odds for LOS for a patient is lower in the year 2010. For each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category decrease the odd of a patient not having a high LOS by a factor of .4. Therefore, a patient in the year 2010 when compared to 2014 was only .4 times likely to not having a high LOS. The model implies that the year 2010 was statistically significant predictor of LOS.

The univariate tests showed that the OR for the year 2011 compared to 2014 the reference category, which was the omitted category is .726. Given that the relationship between the year 2011 and LOS is negative (β = -.321). The OR for the year 2011, describes that odds for LOS for a patient is lower in the year 2011. For each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category decrease the odd of a patient not having a high LOS by a factor of .7. Therefore, a patient in the year 2011 when compared to 2014 was only .7 times likely to not having a high LOS. The model implies that the year 2011 is statistically significant predictor of LOS.

The univariate tests indicated that the OR for the year 2012 compared to 2014 the reference category, which was the omitted category is 1.103. Given that the relationship between the year 2012 and LOS was positive (β = .098). The OR for the year 2012, illustrates that odds for LOS for a patient was higher in the year 2012. Each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category increase the odds of a patient having a high LOS by a factor of 1.1. Thus, a patient in the year 2012 when compared to 2014 was only 1.1 times likely to have a high duration of stay in hospital. The model indicates that 2012 was a significant predictor of LOS.

The univariate tests revealed that the OR for the year 2013 compared to 2014 the reference category, which was the omitted category is 1.078. Given that the relationship between the year 2013 and LOS is positive ($\beta = .075$). The OR for the year 2013, illustrates that odds for LOS for a patient was higher in the year 2013. Each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category increase the odds of a patient having a high LOS by a factor of 1.1. Thus, a patient in the year 2013 when compared to 2014 was only 1.1 times likely to have a high duration of stay in hospital. The year 2013 had almost no effect on LOS. The model indicates that 2013 is a significant predictor of LOS.

The univariate tests showed that the OR for the year 2012 compared to 2014 the reference category, which was the omitted category, is 1.103. Given that the relationship between the year 2012 and LOS is positive ($\beta = .098$). The OR for the year 2012, illustrates that odds for LOS for a patient was higher in the year 2012. Each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category, increase the odds of a patient having a high LOS by a factor of 1.1. Thus, a patient in the year 2012 when compared to 2014 was only 1.1 times likely to have a high duration of stay in hospital. The model indicates that 2012 is a significant predictor of LOS.

The univariate tests showed that the OR for the year 2013 compared to 2014 the reference category, which was the omitted category, is 1.078. Given that the relationship between the year 2013 and LOS is positive ($\beta = .075$). The OR for the year 2013, illustrates that odds for LOS for a patient was higher in the year 2013. Each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category increase the odds of a patient having a high LOS by a factor of 1.1. Thus, a patient in the year 2013 when compared to 2014 was only 1.1 times likely to have a high duration of stay in hospital. The findings from the year 2013 have some effect on LOS. The model indicated that 2013 was a significant predictor of LOS.

The multivariate tests showed that the OR for the years 2009, 2010, and 2011 compared to 2014 the reference category, which was the omitted category are .650, .451, and .663 respectively. Given that the relationship between the years 2009, 2010, and 2011 and LOS were negative (β for 2009 = -.430; β for 2010 = -.797; and β for 2011 = -.411). The OR for the years 2009, 2010, and 2011, illustrates that odds for LOS for a patient was lower in those years. Each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category decrease the odds of a patient of not having low LOS by factors of .7, .5, and .7 the years 2009, 2010, and 2011 respectively. Thus, a patient in the years 2009, 2010, and 2011 when compared to 2014 are only .7, .5, and .7 times likely to have a high duration of stay in hospital. The model indicated that the years 2009, 2010, and 2011 was a significant predictor of LOS after controlling for it.

The multivariate tests showed that the OR for the years 2012 and 2013 compared to 2014 the reference category, which was the omitted category are 1.556 and 1.216 respectively. There was positive relationship between the years 2012 and 2013 for LOS (β for 2009 = .442; and β for 2011 = .196). The OR for the years 2012 and 2013, illustrates that odds for LOS for a patient was higher in those years. Each one-unit increase of duration of a patient stay compared to the year 2014 the reference category, which was the omitted category increases the odds of a patient of not having high LOS by factors of 1.6 and 1.2 the years 2012 and 2013 respectively. Thus, a patient in the years 2012 and 2013 when compared to 2014 are only 1.6 and 1.2 times likely to have a low duration of stay in hospital. The model indicated that the years 2012 and 2013 were a significant predictor of LOS after controlling for it.

Except for the year 2010 when compared to the year 2014 the reference category, which was the omitted category the odd was cut in half in the multivariate tests, the rest of other years when compared to the year 2014 the reference category, which was the omitted category in both the univariate and multivariate can be seen showing increasing trend for the odds from 2009 to 2013 for LOS. During the period of 2012 and 2013 when compared to the year 2014 the reference category, which was the omitted category the odds for LOS indicated that patients had a lower duration of stay. Thus, the magnitude of effect for patients in the years 2012 and 2013 was better than the years 2009, 2010, and 2011 when compared to the year 2014 the reference category, which was the omitted category for LOS.

Calendar Year and Reoperation

The univariate tests showed that the OR for the year 2009 compared to 2014 the reference category, which was the omitted category is 1.4. Given that the relationship between the year 2009 and RE-OP is positive (β = .321). The OR for the year 2009, illustrates that odds for not having a RE-OP for a patient was higher in the year 2009. Each one-unit increase RE-OP a patient in the year 2009 of RE-OP when compare to the year 2014 the reference category, which was the omitted category increase the odds of a patient having no RE-OP by a factor of 1.4. Thus, a patient in the year 2009 when compared to 2014 was only 1.4 times likely to not have RE-OP. The model indicates that 2009 is a significant predictor of RE-OP.

The multivariate tests showed that the OR for the years 2009, 2010, and 2011 compared to 2014 the reference category, which was the omitted category are .680, .405, and .446 respectively. Given that the relationship between the years 2009, 2010, and 2011 and RE-OP were negative (β for 2009 = -.385; β for 2010 = -.904; and β for 2011 = -.809). The OR for the years 2009, 2010, and 2011, illustrates that odds for RE-OP for a patient was lower in those years. Each one-unit increase of RE-OP when compared to the year 2014 the reference category, which was the omitted category, decrease the odds of a patient having RE-OP by factors of .7, .4, and .5 the years 2009, 2010, and 2011 respectively. Thus, a patient in the years 2009, 2010, and 2011 when compared to 2014 are only .7, .4, and .5 times likely to have RE-OP. The model indicated that the years 2009, 2010, and 2011 was a significant predictor of RE-OP after controlling for it.

The univariate test indicated that patients had higher odds of having no RE-OP. After controlling for the covariates, the multivariate test can be seen to show that the years from 2009 to 2011 when compared to 2014 the reference category, which was the omitted category were predictors of RE-OP. However, the years from 2009 to 2011 when compared to 2014 the reference category, which was the omitted category indicated that patient had lower exposure effect for RE-OP.

Race and In-Hospital Mortality

The univariate tests showed that the OR for Hispanic compared to Other ethnicities the reference category, which was the omitted category is .278. Given that the relationship between Hispanic and IHM is negative ($\beta = -1.281$). The OR for Hispanic, illustrates that odds of a patient dying during hospitalization was lower for Hispanic when compared to Other ethnicities the reference category, which was the omitted category. Each one-unit increase of a Hispanic patient dying during in-hospital stay compared to the Other ethnicities the reference category, which was the omitted category decrease not having in-hospital mortality for Hispanic by a factor of .3. Thus, a Hispanic patient when compared to Other ethnicities was only .3 times likely to die during hospitalization. The model shows that Hispanic is statistically significant.

The multivariate tests showed that the OR for Hispanic compared to Other ethnicities the reference category, which was the omitted category is .280. Given that the relationship between Hispanic and IHM is negative ($\beta = -1.272$). The OR for Hispanic, illustrates that odds of a patient dying during hospitalization was lower for Hispanic when compared to Other ethnicities the reference category, which was the omitted category. Each one-unit increase of a Hispanic patient dying during in-hospital stay compared to the Other ethnicities the reference category, which was the omitted category decrease not having in-hospital mortality for Hispanic by a factor of .3. Thus, a Hispanic patient when compared to Other ethnicities was only .3 times likely to die during hospitalization. The model shows that Hispanic is statistically significant. While, Hispanic was a significant predictor for IHM when compared to the Other ethnicities in the reference category, which was the omitted category, for both the univariate and multivariate tests, there was no difference in odds for IHM.

Race and Length of Stay

The univariate tests showed that the OR for White, Hispanic, and Native American compared to Other ethnicities the reference category, which was the omitted category, is .794, .892, and .446 respectively. Given that the relationship between White, Hispanic, and Native American and LOS is negative (White β = -.231, Hispanic β = -.114, Native American β = -.807). The OR for White, Hispanic, and Native American, illustrates that odds for LOS for a patient was lower for White, Hispanic, and Native American when Other ethnicities compared to the reference category, which was the omitted category. Each one-unit increase of White, Hispanic, and Native American patient duration of stay compared to the Other ethnicities the reference category, which was the omitted category, decreases a patient not having low LOS for White, Hispanic, and Native American by factors of .8, .9, and .4 respectively. Thus, a White, Hispanic, and Native American patient when compared to Other ethnicities are only .8, .9, and .4 to not have low LOS respectively. The model showed that White, Hispanic, and Native American are statistically significant.

The multivariate tests showed that the OR for Black, Hispanic, Asian or Pacific Islander, and Other when compared to White the reference category, which was the omitted category are 1.275, 1.111, 1.408, and 1.223 respectively. Given that the relationship between Black, Hispanic, Asian or Pacific Islander, and Other for LOS are positive (Black $\beta = .243$; Hispanic $\beta = .105$; Asian or Pacific Islander $\beta = .342$; and Other $\beta = .201$). The OR for Black, Hispanic, Asian or Pacific Islander, and Other, illustrates that odds for LOS for a patient was higher for Black, Hispanic, Asian or Pacific Islander, and Other when compared to White the reference category, which was the omitted category. Each one-unit increase of Black, Hispanic, Asian or Pacific Islander, and Other patient duration of stay when compared to the White the reference category, which was the omitted category increase a patient not having high LOS for Black, Hispanic, Asian or Pacific Islander, and Other by factors of 1.3,1.1,1.4, and 1.2 respectively. Thus, a Black, Hispanic, Asian or Pacific Islander, and Other ethnicities patients when compared to White are only 1.3,1.1,1.4, and 1.2 to not have high LOS respectively. The model shows that Black, Hispanic, Asian or Pacific Islander, and Other are statistically significant.

The multivariate tests showed that the OR for Native American when compared to White the reference category, which was the omitted category is .685 respectively. Given that the relationship between Native American and LOS is negative (Native American $\beta = .053$). The OR for Native American, shows that odds for LOS for a patient was higher for Native American when compared to White the reference category, which was the omitted category. Each one-unit increase of Native American patient duration of stay compared to the White the reference category, which was the omitted category decrease a patient having a high LOS for Native American by a factor of .7 each. Thus, a Native American patient when compared to White the reference category was only .7 to not having low LOS respectively.

There was significant difference for Black, Hispanic, Asian or Pacific Islander, and Other than Native American OR for LOS when compared to White the reference category, which was the omitted category. The odds for Black when compared to White the reference category, which was the omitted category increased from 1.1 to 1.3 for LOS after controlling for the covariates. Likewise, the same trend is seen for the odds of Asian or Pacific Islander (1.1 to 1.4) when compared to White the reference category, which was the omitted category. Hispanic trend show an increase in odds from .9 to 1.1 for LOS. Overall, all the trends for each of the race category showed an increase in odds for LOS.

Race and Reoperation

The univariate tests showed that the OR for White and Black compared to Other ethnicities the reference category, which was the omitted category is 1.180 and 1.298 respectively. Given that the relationship between White and Black for RE-OP are positive (White $\beta = .165$; and Black $\beta = .260$). The OR for White and Black, illustrates that odds for RE-OP for a patient was higher when compared to Other ethnicities the reference category, which was the omitted category. Each one-unit increase of White and Black patient RE-OP compared to the Other ethnicities the reference category, which was the omitted category increase a patient not having RE-OP for White and Black by factors of 1.2 and 1.3 respectively. Thus, a White and Black patient when compared to Other ethnicities are only 1.2 and 1.3 to not have RE-OP respectively. The model showed that White and Black are statistically significant.

The multivariate tests showed that the OR for Black when compared to White the reference category, which was the omitted category is 1.251. Given that the relationship between Black and RE-OP is negative (Black $\beta = .224$). The OR for Black, shows that odds for RE-OP for a patient was higher for Black when compared to White the reference category, which was the omitted category. Each one-unit increase of RE-OP for Black patients when compared to the White the reference category, which was the omitted category increase a patient not having a RE-OP for Black by a factor of 1.3 each. Thus, a Black patient when compared to White the reference category was only 1.3 to not have RE-OP.

The univariate test for RE-OP for White and Black patients when compared to the Other ethnicities the reference category, which was the omitted category was significant. However, after controlling for covariates in the multiple logistic regression test, Black patients was significant predictor for RE-OP. The findings indicated that Black when compared to the White the reference category, which was the omitted category patients have a higher tendency to not have RE-OP by a factor of 1.3. Thus, Black patients have better odds for not having RE-OP than other Race when compared to the White the reference category, which was the omitted category.

Cycles of Season and Length of Stay

The univariate tests showed that the OR for Winter, Spring, and Summer when compared to Fall the reference category, which was the omitted category are .914, .901, and .958 (about 1). Given that the relationship between Winter, Spring, and Summer and LOS are negative (Winter $\beta = -.090$, Spring $\beta = -.104$, and Summer $\beta = -.043$). The OR for Summer when compared to Fall the reference category, which was the omitted category, illustrates patients' exposure does not almost affect the odds of outcome for LOS; however, the OR for LOS for Winter and Spring patients are lower. Each one-unit increase of a Summer patient duration of stay compared to Fall the reference category, which was the omitted category almost has no effect on LOS. Winter and Spring have a lower OR for LOS. Thus, a patient in Summer when compared to Fall does not affect the odds of outcome for LOS. There is no association between Summer and LOS. The seasonal difference between Winter, Spring, and Summer to LOS is minimal. The model shows that Winter, Spring, and Summer are statistically significant.

The multivariate tests showed that the OR's for Spring is .949 and Summer is .944, they were similar when compared to Fall the reference category, which was the omitted category. There was no difference for Winter when compared to Fall the reference category, which was the omitted category. The inclusion of Spring and Summer has very small effect, indicating that the OR for Spring and Summer when compared to Fall the reference category, which was the omitted category because it was almost close to one. Season contributed to the model for LOS after controlling for it.

There was no major difference in effect for both the univariate and the multivariate test for seasons and LOS.

Cycles of Season and Reoperation

The univariate tests showed that the OR for Winter compared to Fall the reference category, which was the omitted category is 1.083. Given that the relationship between Winter and RE-OP is positive ($\beta = .079$). The OR for Winter, illustrates that odds of a patient with no RE-OP was higher for Winter when compared to Fall the reference category, which was the omitted category. Each one-unit increase of a Winter patient not having RE-OP when compared to the Fall the reference category, which was the omitted category increase not having RE-OP for Winter by a factor of 1.1. Thus, a patient in the Winter when compared to a Fall the reference category patient was only 1.1 times likely to not have RE-OP. The model shows that Winter is nearly not statistically significant.

The multivariate tests showed that the OR for Spring and Summer when compared to Fall the reference category, which was the omitted category are .917, and .918 (about 1). Given that the relationship between Spring and Summer for RE-OP is negative ($\beta = -.018$). The OR for Spring and Summer, illustrates that odds of a patient having RE-OP was almost equal for Spring and Summer. Each one-unit increase of a Spring patient having RE-OP compared to Fall the reference category, which was the omitted category almost has no effect on RE-OP. Thus, a patient in Spring and Summer when compared to Fall does not affect the odds of outcome for RE-OP. There was no association between Spring and Summer when compared to Fall the reference category, which was the omitted category for RE-OP. The model shows that Spring and Summer was statistically significant predictors of RE-OP. However, the effect for season was small and the OR was close to one, indicating that the exposure does not influence the odds of outcome for RE-OP.

Months and In-Hospital Mortality

The univariate tests showed that the OR for January compared to December the reference category, which was the omitted category is 2.046. Given that the relationship between January and IHM is positive ($\beta = .716$). The OR for January, illustrates that odds of a patient dying during hospitalization was higher in January. Each one-unit increase of a January patient dying during in-hospital stay compared to December the reference category, which was the omitted category increases not experiencing in-hospital mortality by a factor of 2. Thus, a patient in January when compared to December was only 2 times likely to die during hospitalization. The model implies that January was statistically significant predictor of IHM. No multivariate analysis tests performed for months because months and seasons are collinear.

Months and Length of Stay

The OR for August, October, and November compared to December the reference category, which was the omitted category is 1.085, 1.227, and 1.137. Given that the relationship between August, October, and November and LOS is positive (August $\beta =$ .082, October $\beta = .204$, and November $\beta = .129$). The OR for August, October, and November, illustrates that odds of a patient duration of stay was higher for August, October, and November. Each one-unit increase of an August, October, and November patient duration of stay compared to December the reference category, which was the omitted category increases not having a high LOS by factor of 1.1, 1.2, and 1.1 respectively. Thus, a patient in August, October, and November when compared to December was only 1.1, 1.2, and 1.1 times likely to experience low LOS. The model implied that August, October, and November are statistically significant predictor of LOS. Months were significant predictors for LOS. There were no multivariate analysis tests performed for months because months and seasons are collinear.

Months and Reoperation

The OR for January and February compared to December the reference category, which was the omitted category are 1.184 and 1.177 respectively. Given that the relationship between January and February for RE-OP is positive (January $\beta = .169$, February $\beta = .163$). The OR for January and February, illustrated that odds of no RE-OP were higher for January and February. Each one-unit increase of January and February patient having no RE-OP compared to December the reference category, which was the omitted category increases not having RE-OP by factor of 1.2 and 1.2 respectively.

Thus, a patient in January and February when compared to December each was only 1.2 times likely to experience no RE-OP. The model implied that January and February are statistically significant predictor of RE-OP. Months were significant predictors for RE-OP. There were no multivariate analysis tests performed for months because months and seasons are collinear.

Gender and In-Hospital Mortality

The univariate tests showed that the OR for the Female compared to Male the reference category, which was the omitted category is 2.267. Given that the relationship between Female and IHM is positive (β = .818). The OR for the Female, illustrates that odds of a patient not dying during hospitalization was higher for Female. Each one-unit increase of a patient dying during in-hospital stay compared to Male the reference category, which was the omitted category increases of female patients not experiencing in-hospital mortality by a factor of 2.3.

Thus, a Female patient when compared to Male was only 2.3 times likely to not die during hospitalization. However, there sufficient evidence to indicate that female patient IHM compare to Males (reference), the omitted category was significant. There was no difference for Male when compared to Female the reference category, which was the omitted category for the multivariate test for IHM.

Gender and Length of Stay

The univariate test indicated that there was no difference gender: it was insignificant predictor for LOS. The multivariate tests showed that the OR for the Male compared to Female the reference category, which was the omitted category is .920. Given that the relationship between Male and LOS is negative (β = -.084). The OR for the Male, illustrates that odds of a patient not having a low LOS was almost equal to one. Each one-unit increase of a patient duration of stay when compared to Female to the reference category, which was the omitted category has no effect for LOS.

There was no difference for Male when compared to Female the reference category, which was the omitted category for the multivariate test for LOS. However, Male when compared to Female to the reference category, which was the omitted category was a significant predictor for LOS in the multivariate tests.

Gender and Reoperation

The univariate test showed that the OR for Female compared to Male the reference category, which was the omitted category is .920. Given that the relationship between Female and RE-OP is negative (β = -.104). The OR for the Female, illustrates that odds of a patient not having a low RE-OP was almost equal to one. Each one-unit increase of a patient duration of stay when compared to Male to the reference category, which was the omitted category has no effect for RE-OP. There was no difference for Female when compared to Male the reference category, which was the omitted category for the univariate test for RE-OP. However, Female when compared to Male to the reference category, which was the omitted category was a significant predictor for RE-OP.

The multivariate test showed that the OR for the Male when compared to Female the reference category, which was the omitted category is .777. Given that the relationship between Male and RE-OP is negative (β = -.252). The OR for the Male, illustrates that odds of a patient experiencing RE-OP was lower. Each one-unit increase of a patient duration of stay when compared to Female to the reference category, which was the omitted category decrease the odds of having RE-OP. Therefore, a Male patient has only .8 odds of having REOP when compared to Female the reference category, which was the omitted category. Male when compared to Female the reference category, which was the omitted category was a significant predictor for RE-OP. The multivariate test can be seen to have effect for RE-OP after controlling for the covariates when compared to Female the reference category, which was the omitted category.

Age in Category and In-Hospital Mortality

The univariate test showed that the OR for the age category 18-29, 30-39, 40-49, and 50-59 compared to > 60 the reference category, which was the omitted category are .039, .021, .056, and .107 respectively. The relationship between IHM and age in category are all negative (β = -3.255, β = -3.872, β = -2.887, and β = -2.238) in order of magnitude by age in category. Given that the betas (β) are negative and OR is less than 1 for each age in category as related to IHM, there is negative association between IHM and age category. Therefore, IHM is not exclusive to any age group. The OR odds of a patient dying during hospitalization was lower for all age category. Each one-unit increase of a patient in each age group dying during in-hospital stay compared to the year >60 the reference category, which was the omitted category have a lower in-hospital mortality. Patient in each age group when compared to >60 have lower odds of dying during hospitalization. The model shows that all the ages in the category are statistically significant to IHM.

The multivariate test showed that the OR for the age category 18-29, 30-39, 40-49, and 50-59 compared to > 60 the reference category, which was the omitted category are .096, .048, .108, and .179 respectively. The relationship between IHM and age in category are all negative (β = -2.341, β = -3.042, β = -2.223, and β = -1.723) in order of magnitude by age in category. Given that the betas (β) are negative and OR is less than 1 for each age in category as related to IHM, there is negative association between IHM and age category. Therefore, IHM was not limited to any age group. The OR odds of a patient dying during hospitalization was lower for all age category.

Each one-unit increase of a patient in each age group dying during in-hospital stay compared to the year >60 the reference category, which was the omitted category have a lower in-hospital mortality. Patient in each age group when compared to >60 have lower odds of dying during hospitalization. Except for age group between 30-39, the rest of the age group showed increasing trend for IHM with age compared to > 60 the reference category, which was the omitted category for multivariate test. Similarly, the same pattern that existed for the multivariate test exist for the univariate test. The model shows that all the ages in category are statistically significant to IHM.

Age in Category and Length of Stay

The univariate test showed that the OR for 18-29, 30-39, 40-49, and 50-59 are .703, .774, .805, and .863 respectively. Therefore, there were only .703, .774, .805, and .863 odds likely that patients in each 18-29, 30-39, 40-49, and 50-59 age group respectively would not experience low LOS. There was marginal increase of the odd for LOS each age group. Thus, the trend showed a rise for each age group for LOS odds when compared to >60 the reference category, which was the omitted category.

The multivariate test showed that the OR for the age category 18-29, 30-39, 40-49, and 50-59 when compared to the age group > 60 the reference category, which was the omitted category were .574, .656, .690, and .786 respectively. The betas for each age group was negative, indicating that each one-unit increase of a patient in each age duration of stay compared to the year >60 the reference category, which was the omitted category decrease high LOS. All the age group from (OR for 18-29 = .574; 30-39 OR = .656; OR for 40-49 = .690; and OR for 50-59 = .786) showed a general trend of OR increasing with age. While the OR for exposure for the other age group have almost similar outcomes for LOS, a patient in the age group 50-59 have higher odds of experiencing LOS. Age group contributed to the model for LOS after controlling for it. The general trend for both the univariate and multivariate tests indicate LOS increased with age.

Age in Category and Reoperation

The univariate test showed that the OR for the age category 18-29, 30-39, 40-49, and 50-59 compared to > 60 the reference category, which was the omitted category are .172, .315, .529, and .781 respectively. The relationship between RE-OP and age in category are all negative (β = -1.761, β = -1.155, β = -.636, and β = -.247) in order of magnitude by age in category. Given that the betas (β) are negative and OR is less than 1 for each age in category as related to RE-OP, there is negative association between RE-OP and age category. The OR odds of a patient experiencing RE-OP was lower for all age category.

Each one-unit increase of a patient in each age group for RE-OP compared to the year >60 the reference category, which was the omitted category have a lower odd for experiencing RE-OP. Patient in each age group when compared to >60 the reference category had a lower odd for experiencing RE-OP. The model show that all the age in category are statistically significant to RE-OP. Therefore, RE-OP was not exclusive to any age group, indicating that the odds for RE-OP increase with age group.

The multivariate test showed that the OR for the age category 18-29, 30-39, 40-49, and 50-59 compared to > 60 the reference category, which was the omitted category are .188, .352, .590, and .874 respectively. The relationship between RE-OP and age in category are all negative (β = -1.673, β = -1.045, β = -.528, and β = -.135). Each one-unit increase of a patient in each age group when compared to the year >60 the reference category, which was the omitted category have lower RE-OP. Patient in each age group when compared to >60 have lower odds of experiencing RE-OP. Except for age group between 30-39, the rest of the age group showed increasing trend for RE-OP with age compared to > 60 the reference category, which was the omitted category for multivariate test. Similarly, the same pattern that existed for the multivariate test exist for the univariate test. The model showed that all the age in category are statistically significant to RE-OP.

Control and Length of Stay

The univariate test showed that the OR for Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category are 1.504, 4.016, 3.243, and 1.818 respectively. The OR for Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category was higher for LOS. Given that the relationship between Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned and LOS are positive (Government or Private β = .408; Government, nonfederal β = 1.390, Private, not-for-profit β = 1.177, and Private, investor-owned β = .598).

The OR for the Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned, implies that odds of patients not having lengthy or long duration of stay was higher for Government or Private, Government, nonfederal, Private, not-for-profit, and Private, investor-owned when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category. Each one-unit increase of patient not experiencing high LOS when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category increase the odds for low LOS by factors of 1.5, 4.0, 3.2, and 1.9 respectively. Thus, a patient in Government or Private when compared to Private, either not-for-profit or invester-owned was only 1.5, 4.0, 3.2, and 1.9 times likely to low LOS. Government or Private does contributed to the model because it was statistically significant for LOS.

The multivariate test revealed that the OR for Government, nonfederal when compared to Government or Private the reference category, which was the omitted category is 1.261. Given that the relationship between Government, nonfederal and LOS is positive ($\beta = .232$). The OR for Government, nonfederal, demonstrates that the odds of a patient for low LOS was higher. Each one-unit increase of Government, nonfederal patient compared to Government or Private the reference category, which was the omitted category increase the odds of not having high LOS. The odds for Government, nonfederal is 1.3, indicating that patients have only 1.3 times tendency to not have high LOS when compared to Government or Private the reference category, which was the omitted category. The control stratum for post stratifying hospitals for Government, nonfederal was significant predictors for LOS.

The univariate test indicated that all the control variable, including Government, nonfederal, Private, not-for-profit, and Private, investor-owned when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category. Government, nonfederal has the highest odds for LOS when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category. Government, nonfederal has 4.0 times odds of a patient having low LOS when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category. However, when the reference category was changed from Private, either not-for-profit or invester-owned to Government or Private for the multivariate test, the findings revealed that Government, nonfederal was the only statistically significant variable for LOS.

Control and Reoperation

The univariate test showed that the OR for Government, nonfederal compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category is .664. The OR for Government, nonfederal when compared to Private, either not-for-profit or invester-owned the reference category, which was the omitted category was lower for RE-OP. Given that the relationship between Government, nonfederal and RE-OP is negative (Government, nonfederal $\beta = -.409$).

The OR for Government, nonfederal, infers that the odds of patients experiencing for RE-OP was lower for Government, nonfederal when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category. Each one-unit increase of patient experiencing RE-OP when compared to Private, either not-for-profit or investor-owned the reference category, which was the omitted category increase the odds for RE-OP by factors of .7. Thus, a patient in Government, nonfederal when compared to Private, either not-for-profit or investor-owned was only .7 times likely to have RE-OP. Government, nonfederal contributed to the model because it was statistically significant for RE-OP.

The multivariate test revealed that the OR for Government, nonfederal and Private, not-for-profit when compared to Government or Private the reference category, which was the omitted category are .610 and .716 respectfully. Given that the relationship between Government, nonfederal and Private, not-for-profit and RE-OP are negative (Government, nonfederal $\beta = -.494$, and Private, not-for-profit $\beta = -.334$). The OR for Government, nonfederal and Private, not-for-profit, illustrates that odds of a patient have RE-OP was lower. Each one-unit increase of Government, nonfederal and Private, not-for-profit patients compared to Government or Private the reference category, which was the omitted category decrease RE-OP. The odds for Government, nonfederal and Private, not-for-profit are .6 and .7 indicating that patients are only likely to have .6 and .7 RE-OP respectively when compared to Government or Private the reference category, which was the omitted category. The control stratum for post stratifying hospitals are significant predictors of RE-OP.

Both the univariate and the multivariate tests indicated that Government, nonfederal have lower RE-OP when compared to either Private, either not-for-profit or investor-owned or Government or Private the reference category, which was the omitted category. The multivariate test showed that Private, not-for-profit when compared to

Government or Private the reference category, which was the omitted category was significant predictor for RE-OP; however, Private, not-for-profit was insignificant predictor for RE-OP in the univariate logistic regression test. Thus, controlling for covariate in the multivariate test can be seen reveal that Government, nonfederal and Private, not-for-profit when compared to Government or Private the reference category, which was the omitted category was significant predictor for RE-OP.

Location or Teaching and Length of Stay

The univariate test showed that the OR for the Rural and Urban nonteaching compared to Urban teaching the reference category, which was the omitted category are .802 and .566 respectively. Given that the relationship between Rural and LOS are negative (Rural $\beta = -.221$; Urban nonteaching $\beta = -.569$). The OR for Rural, illustrates that odds of a patient having high LOS was lower for Rural and Urban nonteaching. Each one-unit increase of a patient in either location or teaching compared to Urban teaching the reference category, which was the omitted category increase high LOS by a factor of .8 and .6 respectively. Thus, a patient in Rural and Urban nonteaching when compared to Urban teaching are only .8 and .6 times likely to high LOS. The model was statistically significant for Rural and Urban nonteaching compared to Urban teaching the reference category, which was the omitted category for LOS.

The multivariate test revealed that the OR for Urban nonteaching compared to Urban teaching the reference category, which was the omitted category is .728. Given that the relationship between Urban nonteaching and LOS is negative ($\beta = -.318$). The OR for Urban nonteaching, illustrates that odds of a patient having high LOS was lower for Urban nonteaching. Each one-unit increase of a patient high LOS compared to Urban teaching the reference category, which was the omitted category decrease high LOS by a factor of .7. Thus, a patient in Urban nonteaching when compared to Urban teaching was only .7 times likely to experience high LOS. Urban nonteaching compared to Urban teaching the reference category, which was the omitted category is significant predictor of LOS.

The univariate test indicated that both Rural and Urban nonteaching compared to Urban teaching the reference category, which was the omitted category were significant; however, in the multivariate test only Urban nonteaching compared to Urban teaching the reference category, which was the omitted category was significant predictor for LOS. Thus, Urban nonteaching lower odds for high LOS.

Location or Teaching and Reoperation

The univariate test revealed that the OR for Rural compared to Urban teaching the reference category, which was the omitted category is .767. Given that the relationship between Rural and RE-OP is negative ($\beta = -.265$). The OR for Rural, explains that odds of a patient having RE-OP was lower for Rural. Each one-unit increase of a patient having RE-OP compared to Urban teaching the reference category, which was the omitted category decrease RE-OP by a factor of .8. Thus, a patient in Rural when compared to Urban teaching was only .8 times likely to experience RE-OP. Rural compared to Urban teaching the reference category, which was the omitted category was a significant predictor of RE-OP.

The multivariate test showed that the OR for the Rural and Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category are .802 and .566 respectively. Given that the relationship between Rural and RE-OP are negative and positive respectively (Rural $\beta = -.239$; Urban nonteaching $\beta = .170$). The OR for Rural, illustrates that odds of a patient having RE-OP was lower for Rural. Each one-unit increase of a patient in either location or teaching compared to Urban teaching the reference category, which was the omitted category decrease RE-OP by a factor of .8 for Rural. However, each one-unit increase of a patient in Urban nonteaching compared to Urban teaching the reference category, which was the omitted category increase a patient not having RE-OP by a factor of 1.2 for Urban nonteaching. Thus, a patient in Urban nonteaching 1.2 odds of not having RE-OP while a patient in Rural has a lower odd of .8 to have RE-OP when compared to Urban teaching the reference category, which was the omitted category. The model was statistically significant for Rural and Urban nonteaching compared to Urban teaching the reference category, which was the omitted category after controlling for covariates for RE-OP analysis. Therefore, RE-OP may be more prevalent in Rural locations than Urban nonteaching when compared to Urban teaching the reference category, which was the omitted category,

Bedsize and In-Hospital Mortality

The univariate test revealed that the OR for Small and Medium compared to Large the reference category, which was the omitted category are .301 and .605 respectively. Bedsize was predictor of IHM. The OR for Small compared to Large the reference category, which was the omitted category is .301. Given that the relationship between Small bedsize and IHM is negative (β = -1.202). The OR for Small, illustrates that odds of a patient dying during hospitalization was lower in Small bedsize. Each one-unit increase of a patient dying during in-hospital stay compared for Large bedsize the reference category, which was the omitted category decrease the odds not experiencing in-hospital mortality by a factor less than half. Thus, a patient in Small bedsize health service organization (HSO) when compared to Large was only .3 likely to die during hospitalization. The model denotes that small bedsize is significant.

The univariate test indicated that the OR for Medium compared to Large the reference category, which was the omitted category is .605. Given that the relationship between Medium bedsize and IHM is negative (β = -.503). The OR for Medium, illustrates that odds of a patient dying during hospitalization was lower in Medium bedsize. Each one-unit increase of a patient dying during in-hospital stay compared for Large bedsize the reference category, which was the omitted category decrease the odds not experiencing in-hospital mortality by a factor slightly greater than half. Thus, a patient in Medium bedsize health service organization (HSO) when compared to Large was only .6 likely to die during hospitalization. The model indicates that Medium bedsize is significant.

The OR for Small compared to Large the reference category, which was the omitted category are .411. Bedsize was predictor of IHM. The OR for Small compared to Large the reference category, which was the omitted category is lower for IHM. Given that the relationship between Small bedsize and IHM is negative (β = -.888). The OR for

Small, illustrates that odds of a patient dying during hospitalization was lower in Small bedsize. Each one-unit increase of a patient dying during in-hospital stay compared for Large bedsize the reference category, which was the omitted category decrease the odds not experiencing in-hospital mortality by a factor less than half. Thus, a patient in Small bedsize health service organization (HSO) when compared to Large was only .4 likely to die during hospitalization. The model denotes that small bedsize is significant.

After controlling for the covariate in the multivariate test, only small bedsize HSO was determined to be significant predictor for IHM. While, patients have a lower odd of dying in small hospital, the propensity to die during in hospital stay was high for Small bedsize. Medium is not significant predictor for IHM for the multivariate test.

Bedsize and Length of Stay

The univariate test revealed that the OR for Small and Medium when compared to Large the reference category, which was the omitted category are .696 and .947 respectively. Bedsize was predictor of high LOS. The OR for Small when compared to Large the reference category, which was the omitted category is .7. Given that the relationship between Small and Medium bedsize and LOS is negative (Small $\beta = -.363$; Medium $\beta = -.054$). The OR for Small, illustrates that odds of a patient having high duration of stay was lower in Small bedsize when compared to Large bedsize the reference category.

The OR for Medium is close to one, indicating that there was no effect for LOS when compared to Large the reference category, which was the omitted category. Each one-unit increase of a patient duration of stay when compared for Large bedsize the reference category, which was the omitted category decrease the odds not having low LOS by a factor of .7. Thus, a patient in Small bedsize health service organization (HSO) when compared to Large was only .7 likely to have high LOS. The model denotes that Small and Medium bedsize was significant for LOS.

The multivariate test indicated that the OR for Small and Medium when compared to Large the reference category, which was the omitted category are .740 and .935 respectively. Bedsize was predictor of high LOS. The OR for Small when compared to Large the reference category, which was the omitted category is .7. Given that the relationship between Small and Medium bedsize and LOS is negative (Small $\beta = -.301$; Medium $\beta = -.067$). The OR for Small, illustrates that odds of a patient having high duration of stay was lower in Small bedsize when compared to Large bedsize the reference category.

The OR for Medium is almost equal to one, denoting that there was no effect for LOS when compared to Large the reference category, which was the omitted category. Each one-unit increase of a patient duration of stay when compared to Large bedsize the reference category, which was the omitted category decrease the odds of not having low LOS by a factor of .7. Thus, a patient in Small bedsize health service organization (HSO) when compared to Large was only .7 likely to have high LOS. The model denotes that Small and Medium bedsize was significant for LOS.

Small bedsize HSO independently contributed to the model in both the univariate and multivariate test. Patients have lower odds of having a high LOS for both the univariate and the multivariate test in Small bedsize HSO. While, Medium bedsize HSO when compared to Large the reference category, which was the omitted category had no effect on LOS, Small bedsize contributed to the model after controlling for the covariates.

Bedsize and Reoperation

The univariate test revealed that the OR for Small and Medium when compared to Large the reference category, which was the omitted category are 1.221 and 1.285 respectively. Bedsize was predictor of RE-OP. The OR for Small compared to Large the reference category, which was the omitted category was higher for not having RE-OP. Given that the relationship between Small bedsize and RE-OP are positive (Small β = .199; Medium β = .251). The OR for Small, illustrates that odds of not experiencing RE-OP was higher in Small and Medium bedsize when compared to Large the reference category, which was the omitted category. Each one-unit increase of RE-OP when compared for Large bedsize the reference category, which was the omitted category increase the odds of not experiencing RE-OP by factors of 1.2 and 1.3 respectively. Thus, a patient in Small and Medium bedsize health service organization (HSO) when compared to Large are only 1.2 and 1.3 likely to have no RE-OP. The model denotes that small and Medium bedsize when compared to Large the reference category, which was the omitted category were significant predictors for RE-OP.

The multivariate test showed that the OR for Small and Medium when compared to Large the reference category, which was the omitted category are 1.278 and 1.371 respectively. Bedsize was predictor of RE-OP. The OR for Small compared to Large the reference category, which was the omitted category was higher for not having RE-OP. Given that the relationship between Small bedsize and RE-OP are positive (Small β =

.246; Medium $\beta = .316$). The OR for Small, illustrates that odds of not experiencing RE-OP was higher in Small and Medium bedsize when compared to Large the reference category, which was the omitted category. Each one-unit increase of RE-OP when compared for Large bedsize the reference category, which was the omitted category increase the odds of not experiencing RE-OP by factors of 1.3 and 1.4 respectively. Thus, a patient in Small and Medium bedsize health service organization (HSO) when compared to Large are only 1.3 and 1.4 likely to have no RE-OP. The model denotes that small and Medium bedsize when compared to Large the reference category, which was the omitted category were significant predictors for RE-OP.

The model showed that Small and Medium bedsize when compared to Large the reference category, which was the omitted category for both the univariate and the multivariate tests were significant predictors for RE-OP. Small and Medium bedsize when compared to Large the reference category, which was the omitted category were both contributor for RE-OP after controlling for the covariates. Thus, the odds of not having RE-OP was higher for Medium bedsize than Small bedsize when compared to Large the reference category, which was the omitted category after controlling for the covariates.

Census Division Starting from 2012 and In-Hospital Mortality

The univariate test revealed that the OR for New England, East North Central, and West North Central when compared to Pacific the reference category, which was the omitted category are 3.203, 3.489, and 3.122 respectively. The OR for the New England, East North Central, and West North Central compared to Pacific the reference category, which was the omitted category are higher for IHM. Given that the relationship between the New England, East North Central, and West North Central and IHM are positive (New England $\beta = .728$; East North Central $\beta = .804$; and West North Central $\beta = 1.032$). The OR for New England, East North Central, and West North Central, shows that the odds of patients not dying during hospitalization was higher for New England, East North Central, and West North Central.

Each one-unit increase of patients in New England, East North Central, and West North Central dying during in-hospital stay compared to Pacific the reference category, which was the omitted category increase not having in-hospital mortality by factors of 3.2, 3.5, and 3.1 respectively. The model implies that New England, East North Central, and West North Central compared to Pacific the reference category, which was the omitted category were statistically significant predictor for IHM. The multivariate results indicated that none of the hospitals in the Census Division were significant predictors of IHM when compared to Pacific the reference category, which was the omitted category after controlling for covariates in the model.

Census Division Starting From 2012 and Length of Stay

The univariate test revealed that the OR for New England, West North Central, West South Central, and Mountain when compared to Pacific the reference category, which was the omitted category are .783, .566, .850, and .810 respectively. The OR for the New England, West North Central, West South Central, and Mountain when compared to Pacific the reference category, which was the omitted category, were lower for LOS. Given that the relationship between the New England, West North Central, West South Central, and Mountain and LOS are negative (New England β = -.245; West North Central β = -.568; West South Central β = -.163; and Mountain β = -.210). The OR for New England, West North Central, West South Central, and Mountain, shows that the odds of patients a patient experiencing high LOS was lower for New England, West North Central, West South Central, and Mountain when compared to Pacific the reference category, which was the omitted category.

Each one-unit increase of patients in New England, West North Central, West South Central, and Mountain having a high LOS when compared to Pacific the reference category, which was the omitted category increase not having low LOS by factors of .8, .6, .9 and .8 respectively. The model implies that New England, West North Central, West South Central, and Mountain when compared to Pacific the reference category, which was the omitted category were statistically significant predictor for LOS.

The univariate test revealed that the OR for Mid-Atlantic, South Atlantic, and East South Central when compared to Pacific the reference category, which was the omitted category are 1.190, 1.536, and 1.165 respectively. The OR for the Mid-Atlantic, South Atlantic, and East South Central when compared to Pacific the reference category, which was the omitted category are higher for LOS. Given that the relationship between the Mid-Atlantic, South Atlantic, and East South Central and LOS are positive (Mid-Atlantic β = .174; South Atlantic β = .429; and East South Central β = .153). The OR for Mid-Atlantic, South Atlantic, and East South Central, shows that the odds of patients having lower LOS was higher for Mid-Atlantic, South Atlantic, and East South Central. Each one-unit increase of patients in Mid-Atlantic, South Atlantic, and East South

Central LOS when compared to Pacific the reference category, which was the omitted category increase not high LOS by factors of 1.2, 1.5, and 1.2 respectively. The model implies that Mid-Atlantic, South Atlantic, and East South Central compared to Pacific the reference category, which was the omitted category were statistically significant predictor for LOS.

The multivariate test revealed that the OR for West South Central and Mountain when compared to Pacific the reference category, which was the omitted category are .783, .566, .850, and .810 respectively. The OR for the West South Central and Mountain West South Central and Mountain when compared to Pacific the reference category, which was the omitted category are lower for LOS. Given that the relationship between the West South Central and Mountain and LOS are negative (West South Central β = -.113 and Mountain β = -.245). The OR for West South Central and Mountain, shows that the odds of patients a patient experiencing high LOS was lower for West South Central and Mountain when compared to Pacific the reference category, which was the omitted category. Each one-unit increase of patients in West South Central and Mountain having a high LOS when compared to Pacific the reference category, which was the omitted category increase not having low LOS by factors of .8, .6, .9 and .8 respectively. The model implies that West South Central and Mountain when compared to Pacific the reference category, which was the omitted category were statistically significant predictor for LOS.

The multivariate test revealed that the OR for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, and East South Central when compared to Pacific the reference category, which was the omitted category are 3.165, 1.699, 1.714, 1.381, 1.457 and 1.076 respectively. The OR for the New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, and East South Central when compared to Pacific the reference category, which was the omitted category are higher for LOS. Given that the relationship between the New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, and East South Central and LOS are positive (New England $\beta = 1.152$; Mid-Atlantic $\beta = .530$; East North Central $\beta = .539$; West North Central $\beta = .323$; South Atlantic $\beta = .377$; and East South Central $\beta = .073$). The OR for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, and East South Central, shows that the odds of patients having lower LOS was higher for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, and East South Central.

Each one-unit increase of patients in New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, and East South Central for LOS when compared to Pacific the reference category, which was the omitted category increase not high LOS by factors of 3.2, 1.7, 1.7,1.4, 1.5, and 1.1 respectively. The model implies that New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, and East South Central when compared to Pacific the reference category, which was the omitted category were statistically significant predictor for LOS.

The univariate test showed that South Atlantic had the highest odds for not having high LOS and West North Central had the lowest odds for having high LOS when compared to Pacific the reference category, which was the omitted category. The multivariate test revealed that New England had the highest odds for low LOS and Mountain had the lowest odds for high LOS when compared to Pacific the reference category, which was the omitted category after controlling for covariates. Thus, patients have a higher tendency to have low LOS than Mountain patients who had lowest odds for high LOS when compared to Pacific the reference category, which was the omitted category after controlling for the covariates. Khorgami et al. (2017) suggested that the difference in costs for patient can be attributed in part to LOS. Thus, New England patients had the shortest LOS which translates to lower costs for patients.

Census Division Starting from 2012 and Reoperation

The univariate test showed that the OR for the following variables: New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central and Mountain when compared to Pacific the reference category, which was the omitted category are 2.3, 2.2, 2.0, 1.9, 1.6, 1.9, 2.0, and 1.5 respectively. New England patients had the highest OR (2.3) for RE-OP. Mountain Patients had the lowest OR (1.5) when compared to Pacific the reference category, which was the omitted category. Each one-unit increase of RE-OP increase the odds of a patient not having RE-OP. Census division supported the model because it was a significant predictor of RE-OP.

The multivariate test revealed that the OR for New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central when compared to Pacific the reference category, which was the omitted category are 2.509, 2.230, 1.921, 1.911, 1.470, 1.860, and 1.772 respectively. The OR for the

England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central when compared to Pacific the reference category, which was the omitted category are higher for no RE-OP. Given that the relationship between the England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central and LOS are positive (New England $\beta = .920$; Mid-Atlantic $\beta = .802$; East North Central $\beta = .653$; West North Central $\beta = .648$; South Atlantic $\beta = .385$; East South Central $\beta = .620$; West South Central $\beta = .572$). The OR for England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central shows that the odds of patients having no RE-OP was higher for England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central when compared to Pacific the reference category, which was the omitted category.

Each one-unit increase of patients in England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central for RE-OP when compared to Pacific the reference category, which was the omitted category increase patients not having RE-OP by factors of 2.5, 2.2, 1.9,1.9, 1.5,1.9, and 1.8 respectively. The model implies that England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, and West South Central when compared to Pacific the reference category, which was the omitted category were statistically significant predictor for RE-OP.

All the census division categories contributed to the model in the univariate test for no RE-OP; however, in the multivariate test, Mountain did not contribute to the model after controlling for the covariates when compared to Pacific the reference category, which was the omitted category for RE-OP. New England maintained the highest odds of having no RE-OP for both the multivariate and univariate tests when compared to Pacific the reference category, which was the omitted category. Mountain when compared to Pacific the reference category, which was the omitted category had the lowest odds for not having RE-OP; in contrast, Mountain was insignificant predictor for not having RE-OP after controlling for the covariate in the multivariate test. South Atlantic patients had the lowest odds for not having RE-OP after controlling for covariates in the multivariate test when compared to Pacific the reference category, which was the omitted category. Mid-Atlantic patients had the second highest odds for a patient not experiencing RE-OP when compared to Pacific the reference category, which was the omitted category after controlling for covariates in the multivariate test.

Hospital Volume and In-Hospital Mortality

The multivariate test indicated that the OR for Low, Medium, and High when compared to Very Low the reference category, which was the omitted category are .411, 1.043, and .789 respectively. Given that the association between Low, Medium, and High and the IHM are negative for (Low β = -.889; High β = -.237) and negative for (Medium β = .042), this confirms that lower Hospital Volume increases the odds of a patient having IHM for Low and High when compared to Very Low the reference category, which was the omitted category. Medium volume OR was equal to one, indicating that the hospital volume exposure does not affect the outcome of IHM.

Each one-unit increase of hospital volume increases the odds of a patient experiencing IHM by factors of .4 and .8 for Low and High when compared to Very Low the reference category, which was the omitted category. Low, Medium, and High when compared to Very Low the reference category, which was the omitted category were significant predictors of IHM after controlling for covariates in the multivariate test. The model for the univariate test did not work. A hospital volume study by Birkmeyer et al. (2002) supported my findings that the difference between low and high are significant indicator of whether a patient would experience IHM.

Hospital Volume and Length of Stay

The univariate test indicated that the OR for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category are 25.266, 20.720, 10.252 and 2.160 respectively. Given that the association between Very Low, Low, Medium, and High and the LOS are positive for (Very Low $\beta = 3.229$; Low $\beta = 3.031$; Medium $\beta = 2.327$; High $\beta = .770$), this confirms that higher Hospital Volume increases the odds of a patient having low LOS for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category. Each one-unit increase of hospital volume increases the odds of a patient experiencing low LOS by factors of 25, 21,10, and 2.2 for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category. Low, Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category were significant predictors of LOS.

The multivariate test indicated that the OR for Low, Medium, High, and Very High when compared to Very Low the reference category, which was the omitted category are .749, .764, .751, and .542 respectively. Given that the association between Low, Medium, High, and Very High and the LOS are negative for (Low $\beta = -.289$; Medium $\beta = -.269$; High $\beta = -.286$; Very High $\beta = -.612$), this confirms that lower Hospital Volume increases the odds of a patient having high LOS for Low, Medium, High, and Very High when compared to Very Low the reference category, which was the omitted category. Each one-unit increase of hospital volume increases the odds of a patient experiencing high LOS by factors of .8, .8,.8, and .5 for Low, Medium, High, and Very High when respectively when compared to Very Low the reference category, which was the omitted category. Low, Medium, High, and Very High when compared to Very High the reference category, which was the omitted category were significant predictors of LOS.

The univariate tests indicated that patients have better odds of not having high LOS when compared to Very High the reference category, which was the omitted category; however, the multivariate test showed that patients have lower odds of not having low LOS when compared to Very Low the reference category, which was the omitted category. The likelihood of a patient having high LOS for low volume hospital was lower. Low volume hospital had the highest for high LOS when compared to Very Low the reference category, which was the omitted category for the multivariate test. Patients in a high-volume hospital have the lowest odds for high LOS when compared to Very Low the reference category, which was the omitted category.

Hospital Volume and Reoperation

The univariate test indicated that the OR for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category are 3.920, 2.032, 1.402, and 1.980 respectively. Given that the association between Very Low, Low, Medium, and High and RE-OP are positive for (Very Low $\beta = 3.229$; Low $\beta = 3.031$; Medium $\beta = 2.327$; High $\beta = .770$), this confirms that higher Hospital Volume increases the odds of a patient not having RE-OP for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category. Each one-unit increase of hospital volume increases the odds of a patient not experiencing RE-OP by factors of 4.0, 2.0,1.4, and 2.0 for Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category. Low, Very Low, Low, Medium, and High when compared to Very High the reference category, which was the omitted category were significant predictors of RE-OP.

The multivariate test indicated that the OR for Low, Medium, High, and Very High when compared to Very Low the reference category, which was the omitted category are .729, .526, .821, and .392 respectively. Given that the association between Low, Medium, High, and Very High and RE-OP are negative for (Low $\beta = -.316$; Medium $\beta = -.642$; High $\beta = -.198$; Very High $\beta = -.936$), this confirms that lower Hospital Volume increases the odds of a patient having RE-OP for Low, Medium, High, and Very High when compared to Very Low the reference category, which was the omitted category. Each one-unit increase of hospital volume increases the odds of a patient experiencing RE-OP by factors of .7, .6,.8, and .4 for Low, Medium, High, and Very High when respectively when compared to Very Low the reference category, which was the omitted category. Low, Medium, High, and Very High when compared to Very High the reference category, which was the omitted category were significant predictors of RE-OP.

The univariate test for hospital volume indicated that patients had higher odds of not having RE-OP when compared to Very High the reference category, which was the omitted category. Except for Low hospital volume which did not conform to the trend, Very Low, Medium, and High when compared to Very High the reference category, which was the omitted category showed a downward trend for no RE-OP starting from Very Low to High. In contrast, the multivariate test showed that the same trend however, for patients having RE-OP when compared to Very Low the reference category, which was the omitted category. The odds for a patient having RE-OP was highest for High Hospital Volume, followed in second place by Low volume patients having RE-OP when compared to Very Low the reference category, which was the omitted category. The multivariate test also revealed that Very High hospital volume patients had the lowest for RE-OP when compared to Very Low the reference category, which was the omitted category. Medium Hospital Volume had the lowest odds for not having RE-OP when compared to Very High the reference category, which was the omitted category.

Conceptual Framework in Relationship to Findings

In line with the epidemiologic triad model, people including patients that underwent LAGB, patients that underwent LSG, patients that underwent BPD/DS, patient

Age, Patient Gender, and patient Ethnicity were predictors of IHM, LOS, and RE-OP. After controlling for patients: Age, Gender, and Ethnicity the findings indicated either a downward trend or upward trend, and sometimes there were no trend for IHM, LOS, and RE-OP when compared to various reference categories, the omitted category in the study. The place, including Hospital size (control, location or teaching, bedsize, census region, and census division) and volume can be seen to show various amplitude of change, downward and upward trends for patients for IHM, LOS, and RE-OP. The time (season, months, and year) individually contributed to the model in determining the relationship between the patient (people) and hospital size (place) to procedure types. Seasons, months, and years which are components of the time were significant predictors for IHM, LOS, and RE-OP. The conceptual framework model was in line with Table 27.

Table 27

Conceptual Framework Association to Findings.

People	Place	Time
Patients undergoing LAGB	Hospital Size	Season
Patients undergoing LSG	Volume	Months
Patients undergoing BPD/DS	Length of stay (LOS)	Year
Age	In-hospital mortality	
Gender	Reoperation	
Ethnicity		

Independent variables	Dependent variables	Covariates
LAGB	In-hospital mortality	Hospital size
LSG	Duration of stay	Volume
BPD/DS	Reoperation	Age
		Gender
		Season
		Month
		Year
		Ethnicity

Limitations of the Study

Although, the findings in this study as support the epidemiologic triad as an effective guiding conceptual framework to compare the outcomes of LAGB and LSG of bariatric surgery provided meaningful results for my conclusion, I concede that causality cannot be determined from retrospective data; as only association may be established from such data used in this study. The NIS standard to post-stratify hospital size or stratum may be difficult to generalize, including comparing to other well-accepted traditional hospital size standards. It was difficult to use the NIS data to perform an analysis of individual hospitals without categorizing the hospitals into regions or division. Because the NIS data transitioned from census regions to census division there were some missing values for census regions making difficult to make inference for census regions prior to 2012.The limitation aligns with the validity and reliability issues identified at the end of section one. Although the study had some limitations, the overall results can be generalized to the population because of large sample size and effect size in the research.

Recommendations

The present study only compared the outcomes of LAGB and LSG of bariatric surgery. However, a future study that would compare other competing or emerging procedure types, including laparoscopic Roux-en-Y etc. to either LAGB or LSG may be beneficial to provide meaningful information to physicians and patients to promote and facilitate good decision making on which procedure type are safe, effective, and valuable for patients struggling with the obesity. Adding hospital accreditation as a covariate may be imperative to compare procedure type effect on IHM, LOS, and RE-OP. The study was based on a quantitative research methodology and the research may have profited from a mixed method approach. While a mixed-method approach is more time intensive and expensive, a mixed-method research may provide a more comprehensive overview for physicians to understand other factors that need consideration before recommending a procedure type to patients; as the qualitative method is better suited to study patients' perceptions of procedure types.

Implication for Professional Practice and Social Change

It was essential to ascertain the safety and efficacy of each procedure types, while I acknowledge that there may be other ways to provide value for patients, improve quality and safety, comparing the procedure type exposure to outcome is one way to facilitate meaningful discussions to promote healthy life style and positive social change. To further investigate the implications for professional practice, Koh et al. (n.d.) suggested that LAGB utilization is declining nationally. My study findings indicated that there was little procedure type difference for IHM, LOS, and RE-OP. Consequently, the information from the study findings may help physician reconsider or increase LAGB utilization nationwide as the exposure to outcome are comparable to LSG. The professional practice implication is in line with section one- in which I stated doing no harm is essential in healthcare. Therefore, if a patient could understand the impact of procedure type on health and how it would contribute to IHM it may be vital. The findings of LOS can be used by third payer insurance companies to control costs for patients. Patients may be able to use the information from this research to reduce costs at the backdrop of cutting down LOS. Third payer insurance companies can use the findings to promote the use of procedure type other than BPD/DS.

Conclusion

Because in-hospital mortality was related to the type of bariatric surgery procedure used on the patient when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity; the null hypothesis 1 is rejected. The null hypothesis 2 which indicated that length of stay was not related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity is rejected. The alternative hypothesis 3 has been accepted suggesting that reoperation was related to the type of bariatric surgery procedure when controlling for volume, hospital size, age, gender, season, month, year, and ethnicity. There was no procedure type difference for In-hospital Mortality, Length of Stay (LOS), and Reoperation. The Laparoscopic Adjustable Gastric Banding (LAGB) and Laparoscopic Sleeve Gastrectomy (LSG) were equally beneficial when compared to BPD/DS the reference category, which was the omitted category. However, LAGB, when compared to LSG for LOS, had substantial advantage to BPD/DS. The LOS findings may contribute to patients' value proposition, including cost reduction for third party insurance payers and for the community.

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