An Examination of Bariatric Surgery - Obesity Treatment Outcomes

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BY

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ABSTRACT

Objective: The objective of this study to examine the impact of bariatric surgery on the obese patients enrolled in a nationwide health insurance plans and assess whether surgery leads to more efficient uses of health care resources by lowering health care utilization and claims payments post surgery. An additional analysis will compare surgical performance between facilities that have been accredited by the American College of Surgeons Bariatric Surgery Center Network (ACS BSCN) to perform bariatric surgery against non-accredited facilities. If accredited facilities produce more efficient outcomes, care organizations can improve weight management programs that focus on positive clinical outcomes by directing patients to accredited facilities.

Design: The design of this study is a secondary data analysis of health insurance claims submitted to a United States health care insurer. Identification of bariatric surgery cases will be based upon an inpatient admission with a Diagnosis Related Group (DRG) of 288-O.R. Procedure for Obesity.

Methods: Insurance claims data will be retrospectively examined to identify bariatric surgical cases. To determine the impact of bariatric surgery on the health care utilization of the study population a pre-test/post-test comparison will be completed. The pre-test period will be identified as 1-year prior to surgery and the post-test period is 1-year after surgery with the date of admission for surgery being the index date. To evaluate the value of having a surgery completed at an accredited facility a comparison of utilization outcomes will be completed. The methods will focus on surgical differences between accredited facilities and non-accredited facilities.

Results: Results showed that there are changes in utilization patterns for individuals undergoing bariatric surgery within one year following surgery. Comparisons showed decreases in number of scripts filled and the number of physician visits and a resulting increase in inpatient admissions following surgery ($P < 0.05$). Comparisons on average physician payments using pre/post periods was conducted. Results showed a difference in average physician payments and average inpatient payments. Average physician payments decreased after surgery while average inpatient payments increased after surgery ($P < 0.05$). There was not any statistical difference in average pharmacy payments between study periods. To better understand average payment differences by utilization category between periods for the population further research using linear regressions was performed. The focus was to examine if there were differences relating to age, sex, number of co-morbid conditions and regional surgical location. Results varied by utilization category. In general, females tended to have less health care spending post surgery in the both physician spending and pharmacy spending and no significant difference was noted for inpatient spending. Other physician analysis showed that as age and number of co-morbid conditions increased potential savings decreases. There were a few statistically significant ($P < 0.05$) regional differences. The West Region on average has higher spending post surgery; however, both the West and Southwest regions showed significant physician savings in the post period. Overall variation was not explained by the independent variables tested (R^2 between 1.1% - 1.3%). The research on accreditation status showed no difference between facilities (accredited versus non-accredited) when examining bariatric surgery length of stay and bariatric surgery costs. Chi-square analysis on surgical complications showed that complications are not strongly linked to facility accreditation status. Linear models showed that there was statistical significant difference in surgical costs with regards to age, sex, # of co-morbidities and geographic region. Linear models related to surgical length of stay only showed similar results. Both linear models reported that variations in surgical costs and length of stay were not statistically significant based on accreditation status. Variation explained by these models was low, an approximately 98% of the noted variation could not be explained by the independent variables tested.

Conclusion: Bariatric surgery has a statistically significant positive impact on physician and pharmacy health care resources within one year of surgery but had the opposite effect on inpatient health care resources. In addition, it was found that there was a statistically significant improvement in average physician spending within one year of surgery; but an increase in inpatient spending one year following surgery. There was no statistically significant change in average pharmacy spending between the to time periods. By and large results do not provide an over-arching justification to support coverage of the surgery. In addition, study results showed no evidence found to support the value of having a surgery completed at an accredited facility. Surgical payments, surgical length of stay and indication of complications following surgery were not found to be statistically significant based on accreditation statuses.

Key Words: bariatric surgery, DRG 288, health care organization, utilization of health care services, accreditation

Table of Contents

CHAPTER 1: INTRODUCTION

1.1: Background and Significance

Obesity is fast becoming a serious health problem world wide. In the United States, studies on obesity have shown that 25% of American adults are considered obese and greater than half (60%) are considered overweight. These figures have risen considerably over the past few years and it is predicted that they will continue to rise (Elmer, 2004; Must, 1999; Sheperd, 2003). Therefore, obesity has become a major public health concern as it could lead to premature death and is associated with a variety of illnesses including Type II diabetes, hypertension, dyslipidemia, vascular disease, depression, sleep apnea and endometrial, breast, prostate and colon cancers (NIH, 1998; Obesity Society, 2004). In addition, obesity has been linked to excessive utilization of health care resources and higher medical costs. Recent figures suggest that the United States is currently spending billons of dollars to treat obesity and obesity related complications (Cornier, 2002; Mokdad, 2001; Obesity Society, 2004; Finkelstein, 2004). As this obesity epidemic continues, health care utilization and costs will escalate. One study reported that the US spends $45.8 billion dollars on the treatment of obesity and obesity related conditions (Wolf & Colditz, 1990). This finding is further substantiated by studies that have examined the link between Body Mass Index (BMI) or Waist Circumference (WC) and medical costs. One of these studies showed that individuals with a WC of > 103.5 cm (≈ 40.7 inches) had 85% more inpatient charges than individuals with a WC of <83.3 cm (≈ 32.8 inches) and was significantly higher ($p=0.038$) than all other groups (Cornier, 2002). Other studies showed that as an individual's BMI increased so does their health care costs and the use of medical services. Individuals with a BMI greater than 30 kg/m^2, in general, will have more costs related to inpatient hospitalizations, pharmacy, outpatient visits and physician office visits (Thompson, 2001 and Reidpath, 2002). The connection between obesity and costs is evident; however, recent advancements in surgical management of obesity may help curb this epidemic. Bariatric surgery is has become one of the preferred medical treatments in the battle against obesity. Where traditional methods (i.e. restriction of food/low calorie diets, alteration of dietary intake, behaviour modification therapy, increased physical activity/exercise, pharmacological programs or a combination thereof) have failed to yield sustained weight loss, bariatric surgery has been shown to have a higher success rate (50% or greater). Long-term weight loss was found to be between 5 – 10% for bariatric surgical patients compared to patients who lost weight by traditional methods (Sjostrom, 1992; Balsiger, 2000; Ahroni, 2005; Bond, 2004).

Weight loss alone is not the only favourable outcome of bariatric surgery. The positive impact of bariatric surgery on obesity related conditions such as Type II diabetes, hypertension, dyslipidemia and sleep apnea are well documented. Frigg et al, reported near complete resolution of Type II diabetes and hypertension in 83% - 100% of the population with the stated conditions (Analysis based on a 4-year period). Rubino, et al reviewed multiple studies that demonstrate the positive impact of bariatric surgery on obese Type II diabetics. They hypothesized that bariatric surgery could be the primary procedure for diabetes treatment. (Rubino and Gagner, 2002; del Amo, 2002; Frigg, 2004). The economic implications surgical treatment of obesity offers is staggering. For example, in 2002 nineteen percent (19%) or $92 billion dollars of total healthcare spending in the United States was spent on diabetes and its' related complications. (Dolan, 2003; NIDDK, 2002; ADA, 2002). The potential savings from preventing diabetes and/or diabetic complications may be profound. It establishes a basis for potential reduction in resource consumption by the obese.

Bariatric surgery has recently become one of the more common elective surgical procedures. The United States has seen a steady rise in bariatric surgeries year after year. According to the Agency for Healthcare Research and Quality (AHRQ), there were 13,386 bariatric surgeries performed in 1998 compared to 121,055 in 2004. This represents an 8 fold increase of during this six-year period (AHRQ/HCUP, 1998 & 2004). Due to the dramatic increase in bariatric surgery, payors and customers looked for ways to evaluate the outcomes and performance of bariatric surgery centers and surgeons. Some national organizations, such as the American College of Surgeons (ASC), Centers for Medicaid & Medicare Services and the American Society of for Metabolic and Bariatric Surgery developed accreditation programs based on quality and effective bariatric surgery practices. These organizations evaluate an applicant's bariatric surgery protocols including pre-operative, intra-operative and post-operative care (including evaluation and reporting of surgical outcomes). The attainment of accreditation demonstrates an applicant's willingness to provide quality medical care and promotes to patients and other health care providers that the institution has demonstrated competence in perform bariatric procedures.

The proposed study will evaluate (a) health plan resource utilization and payments both before and after surgery and (b) examine/analyze facility accreditation using various factors average length of stay, surgical payments and readmissions based on facility accreditation. *Note: Facility accreditation will be determined by guidelines set forth by the American College of Surgeons (ACS).*

1.2: Dissertation Structure

The proposed study will be a retrospective analysis of medical claims to evaluate utilization outcomes and the impact of facility accreditation on patients undergoing bariatric surgery. The dissertation structure will follow the traditional chapter format: Abstract, Background and Significance, Literature Review, Hypothesis and/or Research Questions, Methods and Materials, Specific Findings/Results, Discussion and Conclusions.

CHAPTER 2: LITERATURE REVIEW

2.1: Introduction

Obesity is on the rise in the United States as is health care spending. The two are inherently linked and provide ample opportunity for data exploration. This research will assess the impact weight reduction surgery has on health care utilization. The analysis will evaluate potential savings realized by analyzing utilization patterns of patients who underwent bariatric surgery for treatment of obesity. In addition, it will ascertain the value of accredited bariatric surgery centers. This research will produce valuable information for the health care insurer because it will broaden understanding on how weight reduction surgery may influence utilization patterns and also determine whether there is value in performing bariatric surgeries at accredited facilities. This research will establish the basis for developing weight management programs or the design of benefit plans for obesity management. These obesity management programs will not only promote a healthier lifestyle but will also strive to reduce the excessive medical spending attributed to obesity.

2.2: Obesity

What is obesity? According to Merriam-Webster's Online Dictionary, obesity is a condition that is characterized by the excessive accumulation/storage of fat in the body (Merriam Webster, 2007). It is commonly defined by an individual's body mass index (BMI) or Quetelet index, which is a calculation based on an individual's weight and height. The mathematical formula is weight (kg)/ height^2 (meters) (Sheperd, 2003). This calculation measures body adiposity composition – fat or thin. There are six (6) BMI classifications that range from underweight to extreme obesity. Table 1 below describes current BMI classifications based upon the World Health Organization's (WHO) criteria. Table 2 displays the BMI classification by height (inches) and weigh (lbs).

Table 1: Body Mass Index Classification

Classification	Obesity Class	BMI (kg/m^2)
Underweight		< 18.5
Normal Weight		18.5 – 24.9
Overweight		25.0 – 29.9
Obesity	I II	30.0 – 34.9 35.0 – 39.9
Extreme Obesity (Morbid)	III	> 40.0

Source: Pi-Sunyer, 2002

Table 2: Body Mass Index – Height and Weight Combinations

Weight (lbs)	Height (inches) 58	60	62	64	66	68	70	72	74	76
100	20.9	19.5	18.3	17.2	16.1	15.2	14.3	13.6	12.8	12.2
110	23.0	21.5	20.1	18.9	17.8	16.7	15.8	14.9	14.1	13.4
120	25.1	23.4	21.9	20.6	19.4	18.2	17.2	16.3	15.4	14.6
130	27.2	25.4	23.8	22.3	21.0	19.8	18.7	17.6	16.7	15.8
140	29.3	27.3	25.6	24.0	22.6	21.3	20.1	19.0	18.0	17.0
150	31.3	29.3	27.4	25.7	24.2	22.8	21.5	20.3	19.3	18.3
160	33.4	31.2	29.3	27.5	25.8	24.3	23.0	21.7	20.5	19.5
170	35.5	33.2	31.1	29.2	27.4	25.8	24.4	23.1	21.8	20.7
180	37.6	35.2	32.9	30.9	29.0	27.4	25.8	24.4	23.1	21.9
190	39.7	37.1	34.7	32.6	30.7	28.9	27.3	25.8	24.4	23.1
200	41.8	39.1	36.6	34.9	32.3	30.4	28.7	27.1	25.7	24.3
210	43.9	41.0	38.4	36.0	33.9	31.9	30.1	28.5	27.0	25.6
220	46.0	43.0	40.2	37.8	35.5	33.4	31.6	29.8	28.2	26.8
230	48.1	44.9	42.1	39.5	37.1	35.0	33.0	31.2	29.5	28.0
240	50.2	46.9	43.9	41.2	38.7	36.5	34.4	32.5	30.8	29.2
250	52.2	48.8	45.7	42.9	40.3	38.0	35.9	33.9	32.1	30.4
260	54.3	50.8	47.5	44.6	42.0	39.5	37.3	35.3	33.4	31.6

Source: Sheperd, 2003

Overweight
Obese
Normal Weight
Underweight

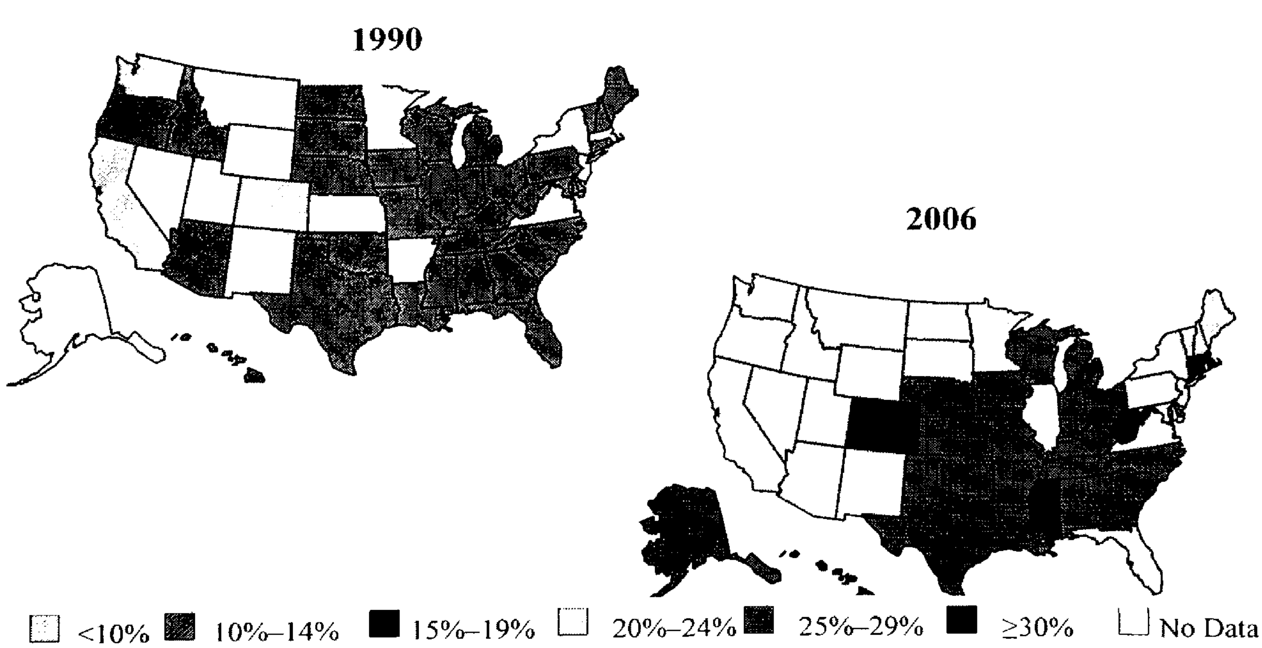
Waist circumference is another measurement than can be used to classify obesity. It is calculated by measuring at the smallest part of the waist (typically right above the naval). Men with a waist circumference ≥ 40 inches and women with a waist circumference ≥ 35 inches indicate increased health risk due to excessive abdominal fat accumulation. This increase health risk is related to development of obesity related co-morbid conditions. Obesity can also be defined using the Waist:Hip Ratio (WHR) or by measuring simple waist circumference. WHR is calculated by dividing one's waist measurement (defined as the smallest point of the waist) by one's hip measurement (defined as widest point of the hips). Women with a WHR of .85 indicates increased health risks and a man with a WHR greater than .9 (some literature cites greater than 1.0) has a similar increased risk. Both WHR and waist circumference take into consideration abdominal fat accumulation. Either of these measurements can assist in identifying an individual's shape classification (apple versus pear) which has been shown to predict heart disease. Individuals who carry most of their excess weight around their waist (known as central adiposity or "apple" shape) are at a greater risk of developing heart disease than those that carry the majority of their weight below their waist ("pear" shape) (Ofei, 2005; Mayo Clinic Staff, 2008; Obesity Society, 2008). Advisory boards, such as the United States Preventive Services Task Force (USPSTF), recommend that not only should clinicians measure BMI (height/weight) but also measure waist circumference to evaluate abdominal fat accumulation (Berg, 2003).

World wide there is an obesity epidemic. It is plaguing both industrialized and non-industrialized nations. The public health systems in many countries have began to study the epidemic and it has been an important topic of discussion by the World Health

Organization (WHO). The WHO's latest projections indicate that in 2005 at least 1.6 billion adults (Age > 15) are overweight and 400 million adults are obese globally. By 2015, it is forecasted that 2.3 billion adults will be overweight and more than 700 million will be obese (WHO, 2006). The alarming prevalence rate of obesity predicted by WHO demonstrates how serious obesity has become and establishes a clear need for a world wide health care solution.

The United States has seen a considerable increase in the reported cases of obesity. Self reported data from the Behavioural Risk Factor Surveillance System (BRFSS) between 1998 and 2000 estimated an adult obesity rate of 20% (Finkelstein, 2004). Others, such as The National Center for Health Statistics, reported that 61% of adults in 1999 were overweight and 26% were classified as obese (Must, 1999, Berg, 2003). The Centers for Disease Control (CDC) reported a similar increase in US obesity rates. In 1990, adult obesity was less than 15% in most states. This is in contrast to 2006 survey results as twenty-two (22) states reported adult obesity to rates of 25% or greater (CDC, 2006).

Figure 1: Prevalence of Adult Obesity in the United States 1990 and 2006

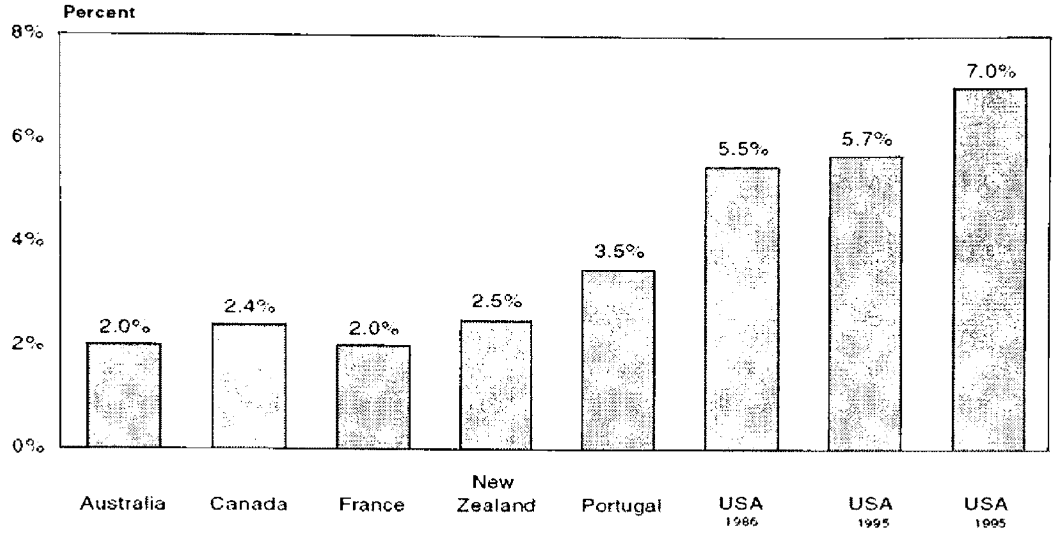


Source: CDC Behavioral Risk Factor Surveillance System, 2006

Efforts to prevent or reduce obesity rates have not been successful as obesity rates are continuing to rise. Alarming still, increased obesity rates are now reported children. In 2005, there were 20 million children under the age of 5 who were obese. (World Health Organization, 2006). A similar trend was evident in data from National Health and Nutrition Survey (NHANES). It pointed to a found a significant increase in childhood (Ages 2-19) obesity rates between 1999 and 2004 (13.9% versus 17.1%) (Odgen, 2006). Research on childhood obesity has shown a clear link to adult obesity. The Bogalusa Heart Study, which included a biracial (black-white) population of children in Southern Louisiana, showed a clear link between obesity in children and adults. The CDC survey on obesity found that children with a BMI in the 95th percentile have a 66% chance of remaining obese as adults (BMI $\geq$ 35) (Blue, 2008). This finding reinforces the fact that obesity needs to be addressed sooner rather than later in an effort to reduce future disease burden.

The obesity epidemic has put a strain on the health care system through increased medical expenditures required to treat this condition. The United States, according to a review of international studies, has higher-medical care costs attributable to obesity than many other countries. The medical care costs for obesity in the United States (in terms of % of national health expenditures) is between 5.5 – 7.0%. This rate is approximately twice the rate of all other countries (2.0 – 3.5%) (Thompson and Wolf, 2001). The difference in reported medical care costs by country is shown in the below chart:

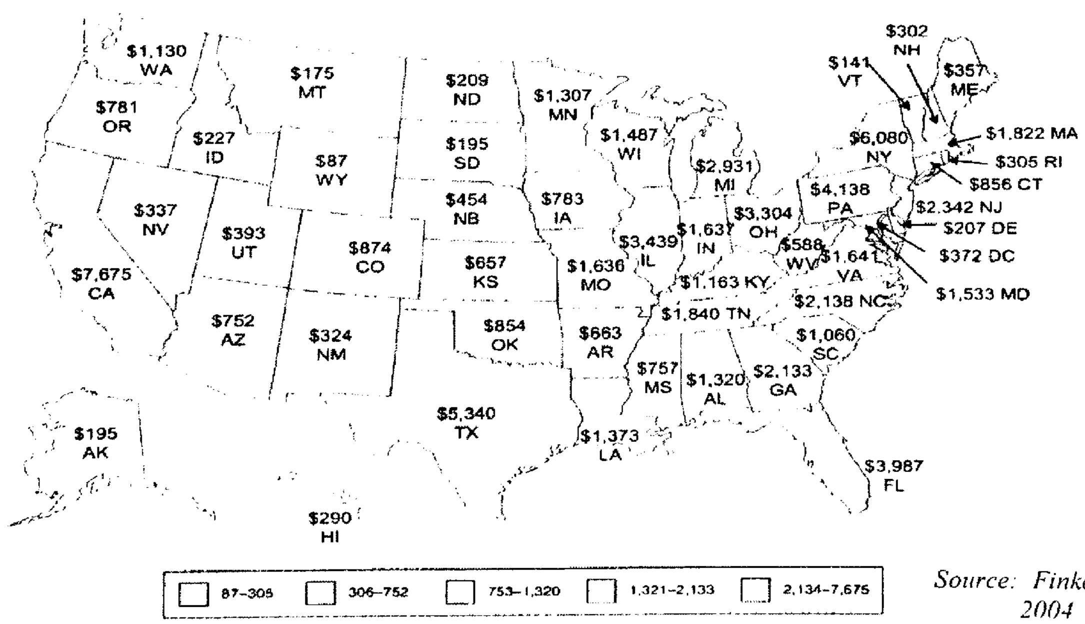
Figure 2: Percentage of National Health Care Expenditures Attributable to Obesity



Source: Thompson and Wolf, 2001
(Note: USA rates are from separate reviews of health care expenditures)

The estimated annual expenditures on obesity in the United States is $75 billon dollars (2003 Dollars). There are significant variations among states with average obesity health care expenditures ranging between $87 million in Wyoming to $7.7 billion in California. Without taking the appropriate actions to prevent treatment of obesity escalating costs will further burden on the already strained US health care system. State-level estimates of annual medical expenditures attributable to obesity are shown below (Finkelstein, 2004; Obesity Society, 2004).

Figure 3: Estimated Adult-Obesity Attributable Medical Expenditures (2003 Dollars)
(In Millions)



Source: Finkelstein, 2004

Several studies have demonstrated the economic impact of obesity on the health care system. Wee, et al conducted an analysis on the 1998 Medical Expenditure Panel Survey to determine health care expenditures associated with US adults classified as overweight and obese. This study showed clear evidence that individuals classified as overweight or obese had annual health care expenditures that were greater than normal weight counterparts. In his analysis, overweight and obese individuals had annual health care expenditures of $3,038 and $4,333 (December 2003 dollars) compared to their normal weight counterparts whose expenditures were $2,970. These findings demonstrate that higher BMI values are related to higher health care expenditures ($P<0.001$). In addition, Wee also noted that health care expenditures, associated with obesity, increased with age (Wee, 2005). In other studies as the obese population ages their related health care expenditures also increase. In addition it can be inferred that with early treatment of obesity, there is a greater opportunity to impact health care costs considering the association between age and obesity. Further proof comes from a Kaiser Permanente study that explored the association between BMI and their health plan membership. They found that higher BMI values were associated with specific chronic conditions (diabetes, hypertension and cardiovascular disease). Furthermore, there was a clear association between BMI and mean costs (annual) with gradual increase in cost by BMI classification. While individuals with a BMI of 30-34.9 (Obesity I) had 25% higher costs those with a BMI of 35 or higher (Obesity II) had 44% higher costs than those with a normal BMI (20 – 24.9), respectively (Quensenberry, 1998). Analysis on inpatient utilization showed that individuals with a BMI ≥ 35 on average had a higher relative risk of staying in the hospital longer than patient with a normal BMI range (1.74 (1.50-2.02)

$p < 0.001$) In addition, inpatient costs were between 33% (BMI 30-34.9) and 44% (BMI ≥ 35) higher compared to those with a normal BMI (Quensenberry, 1998). Obesity costs have also been examined in relation to waist circumference (WC). Cornier and others found that individuals with a WC of > 103.5(≈ 40.7 inches) had 85% more inpatient charges than individuals with a WC of <83.3 cm (≈ 32.8 inches) ($p=0.038$). In a population based study, Reidpath examined the differences in the use of health care services by BMI. Results showed that individuals with higher BMIs tended to have higher odds of using health care services and medication than their normal weight counterparts (Reidpath, 2002). Schafer and Ferraro examined the impact of obesity by examining avoidable inpatient hospitalizations. Avoidable hospitalizations are inpatient admissions that could have been handled in an ambulatory setting without requiring a hospitalization intervention. Avoidable admissions for the study were defined as admissions with a primary ICD-9-CM diagnosis of the following: angina, asthma, cellulitis, chronic obstructive pulmonary disease, congestive heart failure, dehydration, diabetes mellitus, gangrene, gastroenteritis, grand mal status and epileptic convulsions, hypertension, hypoglycaemia, hypokalemia, immunizable conditions, kidney/urinary tract infections, pneumonia conditions, ruptured appendix and severe ear, nose or throat infection. Results showed that long-term obesity is highly associated with avoidable hospitalizations (1.82, 95% CI, 1.31-2.51) (Schafer and Ferraro, 2007). These avoidable admissions actually represent additional financial costs because treatment in an inpatient setting is higher compared to treatment in an ambulatory setting. The financial impact of these admissions is considerable and therefore it is reasonable to expect that bariatric surgery can reduce overall admissions. The findings by Schafer and Ferraro further validate the inherent association between obesity and increased health care expenditures.

Bertakis and Azari also examined the difference in health care service usage for one year for identified obese and non-obese populations. Results showed that obese patients had a significantly higher mean number of visits to primary care physicians when compared to the non-obese group (4.21 versus 3.26, $p = 0.0005$). Obese individuals also had significantly higher specialty visits than their non-obese counterparts (3.17 versus 2.20, $p = 0.0006$). The study also reported that obese individuals total medical care expenditures (mean and median annual per capita medical charges) were significantly higher than non-obese individuals ($8204.52 versus $5082.89, p=0.0033). Total charges were comprised of the following categories: Primary care, Specialty care, Diagnostic services, Emergency department, and Hospitalizations (Bertakis, 2005).

2.3: Obesity Related Conditions and Treatment Costs

Numerous studies have demonstrated how obesity can be a risk factor for certain diseases and conditions. These diseases include Type II diabetes, hypertension, dyslipidemia and cardiovascular disease (Pi-Sunyer, 2002). A study by Bell also validated a direct relationship exists between known obesity related complications - sleep apnea, depression, musculoskeletal pain, high blood pressure, high cholesterol and childhood BMI values (Bell, 2007). The Behavioural Risk Factor Surveillance System (BRFSS) study results found that individuals with a BMI $\geq$ 40 had a higher risk (odds ratio) of specific obesity related health conditions than normal weight counterparts. Specifically, the results showed individuals with BMI $\geq$ 40 had greater risk of developing diabetes (OR=7.37, 95% CI, 6.39-8.50); higher blood pressure (OR=1.88, 95% CI, 1.67 –

2.13); higher cholesterol levels (OR=2.72, 95% CI, 2.38 – 3.12) and overall fair/poor health status (OR=4.19, 95% CI, 3.68 – 4.76) (Mokdad, 2003). Field, et al examined obesity and the risk of developing common chronic conditions over a 10-year period. The results, which are based on data obtained from the Nurses' Health Study (female nurses) and the Health Professional Follow-up Study (male health professionals), showed the likelihood of developing diabetes, gallstones, hypertension and heart disease increased in both men and women as BMI increased. For both men and women classified as Obesity Level II and Morbidly Obese (BMI >35.0) the relative risk of developing diabetes was highest [RR 23.4/CI 19.4-33.2; RR17.0/CI 14.0 - 20.5) when compared to normal weight peers (BMI < 25.0). The risk of developing hypertension also increased with BMI. The relative risk of developing hypertension was 2.3 (CI 2.1-2.6) for women and 3.0 for men (CI 2.3-3.9) (Field, 2001).

As evident by these studies there is a clear link between obesity and certain chronic medical conditions. These findings suggest that as the prevalence of obesity increases so does the prevalence of these diseases. In 2000, the prevalence of obese diabetics was 2.9%. Results from the cross-sectional telephone survey - Behavioural Risk Factor Surveillance System (BRFSS) depict a 49 % increase in the self-reported cases of diabetes between the years 1990 and 2000 (4.9% versus 7.3%) (Mokdad, 2001). There has also been a recorded increase in the diagnosis of Type II diabetes in children in the past 10 years. (Thompson, 2007; CDC, 2008) As the prevalence in both adult and childhood diabetes increases so does the incremental cost for treatment. According to the American Diabetes Association (ADA), the per capita cost of health care for people with diabetes increased 30% from 1997 to 2002 ($10,071 to $13,243). The spending for diabetes and diabetes related complications represents nineteen percent (19%) of total healthcare spending in the United States (2002 Dollars). This equates to $92 billion dollars of direct medical costs associated with the treatment of diabetes (Balsiger, 1999; NIDDK, 2002; ADA, 2002).

Oster, et al studied the economic burden of obesity on a managed care plan by completing an analysis on population-attributable risk. Oster examined the risk for specific diseases (Hypertension, Hypercholesterolemia, Type II Diabetes, Coronary Heart Disease, Stroke, Gall Bladder Disease, Osteoarthritis of the Knee and Endometrial Cancer) on the risk factor – obesity. This study estimated that the annual health care cost attributable to obesity was $345.9 million or $0.41 cents for every dollar spent on the eight diseases studies. (Note: Plan Membership Estimates = 1 million Age 35-84) (Oster, 2000).

In a published article in the American Journal of Managed Care, author Ann Wolf cites a presentation that was completed on obesity using a Cost of Illness Model. This model projected that a managed care plan with a population of 200,000 members could have an annual savings of $10 million if members with a BMI of 27 kg/m^2 or higher achieved a 10% weight loss. The savings were a result of a decrease in costs associated with specific diseases: Type II diabetes (31% of savings), Hypertension (17% of savings), cardiovascular disease (8% of savings) and osteoarthritis (24% of savings) (Wolf, 1998). Another study by Wolf, et al found that total direct costs (Direct costs defined as medical costs for prevention, diagnosis and treatment of a disease) for diseases that were linked to obesity was $51.6 billion (in 1995 Dollars) or 5.7% of the total National Healthcare Expenditures. Of the $51.6 billion, most costs associated with obesity were linked to Type II diabetes; hypertension and cardiovascular disease represented 83% or $42.6 billion (Wolf, 1998).

Literature has clearly shown that there is a positive relationship between obesity and the use of health care services with subsequent increases in health care expenditures. Based on these studies, the link between obesity and higher utilization of health care resources is evident; therefore, a reduction in weight should correlate to a reduction in resource utilization and overall expenditures. Bariatric surgery offers individuals an opportunity to lose weight and reverse obesity related complications. Moreover it offers the ailing health care system a weapon in the battle against rising health care expenditures.

2.4: Bariatric Surgery

Surgical interventions for obesity have changed dramatically over the years. Historically, one of the first operations performed to address obesity was jaw wiring. Jaw wiring consists of wiring the jaw in a semi-closed position so as to not allow consumption of large amounts of solid food. The technique does provide temporary weight loss; however, long-term weight loss is typically not maintained once the wiring apparatus is removed (Elder, 2007). Bariatric surgery for weight loss first became popular in the United States in the 1960s. It derives its name from the Greek word *baros* which means "weight" and *iatrikos* which means "medicine" (Mun, 2007). Today, it is more commonly referred to as gastric bypass and it has become one of the most popular surgeries for obese individuals, as evident by the increasing number of surgeries performed each year. The American Society for Bariatric Surgery (ASBS) reported that the number of surgeries performed in the early 1990s was around 16,000 and in 2003 the number of surgeries increased to over 103,000 (NIH, 2007). The Agency for Healthcare Research (AHRQ) has reported a similar explosion in the number of surgeries performed. Their data (based on Nationwide Inpatient Samples from 1998 and 2004) estimated an 804% increase in the number of surgeries performed (AHRQ, 1998/2004). Another study by Giusti, et al, which examined various weight loss techniques, cited that the number of surgeries performed doubled between 1997 and 2001 from 18% to 36% ($p<0.001$) and the number of low-calorie diets decreased from 10% to 2% ($P<0.01$) (Giusti, et al 2003). A prevalence study by Smoot, et al examined National Hospital Discharge Survey data (1998 to 2002) to determine if there was a significant change in the number of bariatric surgeries performed in the United States. Their results showed significant increases from 7.0 to 38.6/100,000 adults ($p < 0.001$). Further analysis of the same survey data showed an increase in surgeries across the nation regardless of geographical area. The majority of procedures being performed were primarily on women (>80%) – nearly 5 times the number of surgeries performed on men (Smoot, 2006). A population based analysis on bariatric surgery performed on a Nationwide Inpatient Sample from 1996 to 2002 found similar results as the aforementioned statistics. The number of surgeries performed in 1996 was 3.5 per 100,000 and the number of surgeries performed in 2002 was 24.0 per 100,000 (US Population based). The increase in surgeries was consistent in all age groups; however, the most noteworthy increase was in the age band 20-64 who saw a 6+ fold increase from 5.8 per 100,000 to 37.0 per 100,000. This age group also represented 97% of overall surgeries performed (Davis, 2006). These findings are supported by Mehrotra, et al who reported between a 4.6 fold increase in the number of bariatric procedures performed between 1990-92 and 2000-02 in Wisconsin. This same study also showed a higher rate of surgery for women (>80%) in both periods and also an increase in mean age of adult patients having surgery (Mehrotra, 2005). According to Bond, et al, bariatric surgery has the potential to grant individuals a "new lease on life" in which they can attain permanent weight loss depending on their willingness and dedication to take ownership for their own health (Bond, 2004).

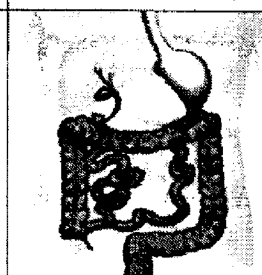
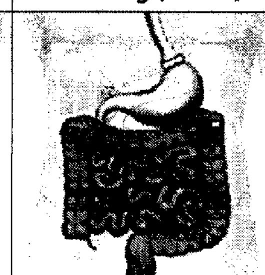
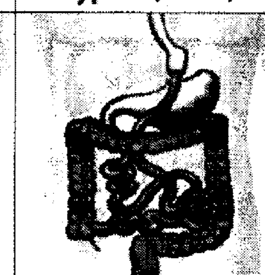
2.5: Bariatric Surgery Techniques

There are various types of surgical techniques that are classified as bariatric surgery. These surgeries are commonly classified as restrictive, malabsorptive and combination restrictive/malabsorptive (Mun, 2007). Restrictive surgery reduces the size of the stomach and thereby limiting the amount of food intake. The two common restrictive procedures are Vertical Banded Gastroplasty (VBG) and Laparoscopic Gastric Banding (LAGB). Vertical Banded Gastroplasty is more generically known as "stomach stapling". In this surgical procedure, bands/staples are placed on the uppermost portion of the stomach to restrict size. A small narrow passage is then created to connect the smaller stomach pouch to the remaining intestines. The creation of the smaller pouch is what causes weight loss to occur (Shekelle, 2004; Mun, 2007). Laparoscopic Gastric Banding (LABG) restricts food consumption by placing a silicone band around the entrance to the stomach that is attached to a port that resides underneath the skin of the patient. The port allows a physician the flexibility to adjust the size of the band based on the individual specific needs. The ability to adjust the band width and performing the surgery laparoscopically limits the amount of scaring a patient may have. In addition, laparoscopic procedures have been shown to have overall fewer complications than traditional open surgical procedures (Mun, 2007).

Malabsorptive surgical procedures limit the absorption of foods in the intestinal tract by "bypassing" a section(s) of the small intestine. Key to this surgery is the small intestines nutrient (carbohydrates, proteins, fats and vitamins) absorption process. This procedure shortens the length of the small intestine and thus limits the amount of nutrients that are absorbed by the body, causing weight loss. The jejunoileal bypass, a malabsorptive procedure, was one of the first bariatric operations performed. According to the American Society for Bariatric Surgery (ASBS), the first procedure was performed in the 1950s at the University of Minnesota (ASBS, 2005). In this malabsorptive procedure, approximately 12 – 18 inches of the small bowel is detached, leaving an extended loop excluded from the food stream. This procedure does not modify the size of the stomach or limit food intake; however, it is associated with multiple complications and is no longer performed today (Mun, 2001). Currently, the top malabsorptive procedure performed is the Biliopancreatic diversion with or without a duodenal switch. In this surgical procedure, a portion of the stomach is removed and the remaining portion is attached to the lower segment of the small intestine. This procedure is very invasive and is not commonly performed in the United States (NAASO, 2007).

The final bariatric procedure type is a combination restrictive/malabsorptive procedure. This procedure has both a restrictive element (creation of smaller stomach) and a malabsorptive element (shortens length of small intestine – creating decreased nutrient absorption). The Roux-en-Y Gastric Bypass (RYGB) is the most commonly known combination procedure. The RYGB restricts the size of the stomach to less than 30 mL by creating a smaller stomach pouch. It then connects the smaller stomach pouch to a segment of the intestines (the jejunum) which bypasses the duodenum thus reducing food absorption. This procedure can be performed as an open surgical procedure or laparoscopically. The reduction requires that individuals adhere to a new diet and permanently change their eating habits (NAASO, 2007; Mun, 2007; Shinogle, 2005). The table below from the Obesity Association of America summarizes the various types of bariatric procedures.

Table 3: Bariatric Surgery Procedures

	Biliopancreatic Diversion (BPD) or BPD With Duodenal Switch (BPD/DS)	**Laparoscopic Adjustable Gastric Banding (LAGB)**	**Roux-en-Y Gastric Bypass (RYGB)**
Schematic			
Type	Malabsorptive	Restrictive	Combined (restrictive and malabsorptive)
Description	Bypasses most of the small intestine	An adjustable gastric band creates a small pouch and stoma	Creates a small pouch and bypasses a portion of the small intestine
Method	Open or laparoscopic	Usually laparoscopic	Usually laparoscopic

Source: NAASO, 2007

As with any surgical procedure, there is risk. Surgical risks, in general, include excessive bleeding, pain, adverse reaction to anaesthesia or medications, deep vein thrombosis, stroke or heart attack (Bariatric Edge, 2007). A study by Shinogle et al found that the complication rate for individuals undergoing bariatric surgery was no different than other common surgical procedures, ~10% (surgical procedures comparisons: prostatectomy, appendectomy, hip/knee replacement, hysterectomy or choletectomy) (Shinogle, 2005). Common surgical complications associated with bariatric surgery include infection at the incision, stomach leakage (anastomotic leak) into the stomach cavity, stomach leakage near the intestine (peritonitis), bleeding and/or blood clots (pulmonary embolism), collapsed lung(s) and ultimately death as a result of one of the aforementioned complications. These surgical risks are not to be taken lightly and should be considered along with other long-term post-operative complications before undergoing surgery. Long-term post-operative complications include an increased risk for gall stones (reports indicate that 33% of patients have gallstones), hernias (15% - 25% of patients experience an incisional hernia), ulcers, gas, nausea/vomiting (gastroparesis or dumping syndrome), gastroesophageal reflux disease (GERD), nutritional deficiencies (which can contribute to anemia, pellagra or osteoporosis) and neurological deficits (Wernicke-Korsakoff Syndrome) (Klein, 2002; NIH, 2007; Bariatric Edge, 2007; Mun, 2001).

In order to qualify as a bariatric surgery candidate, individuals must meet certain criteria. The National Institute of Health (NIH) published a Consensus Statement in 1991 that established guidelines on bariatric (gastric bypass) surgery. These guidelines are commonly used as the foundation for establishing whether a patient qualifies for the procedure. The crux of the guideline is a weight/BMI requirement. At minimum, an individual must have a BMI equal to or higher than 35 kg/m^2 with the presence of an obesity-related co-morbidity or be classified as morbidly obese (BMI of at least 40 kg/m^2) (NIH, 1991). To put this into perspective, a BMI of 40 kg/m^2 is the equivalent of being 100 lbs overweight for a male or 80 lbs overweight for a female (Health A to Z, 2007). In addition to meeting the BMI requirements, many surgeons require patients to (a) see a specialist for any identified co-morbid conditions, (b) undergo nutrition classes and (c) meet with a mental health professional to ascertain whether they are prepared to undergo such a life changing surgery. The specialist visit provides a baseline physical check-up. It evaluates a patient's current health status including verification of any current co-morbid conditions. Nutrition classes are also required and are meant to assist the individual in understanding the impact of surgery on their diet post-surgery. The mental health professional will help a patient to understand the lifestyle change that will occur after surgery and assist with developing coping skills for these changes (Mun, 2007). Typically, surgical candidates will not immediately have surgery. The surgery usually occurs weeks or months after the initial visit with a surgeon. This type of surgery is not a simple procedure and before performing the procedure, a good surgeon will make sure that his/her patient is well educated about the surgical benefits and risks.

The overarching goal of surgery is to improve an individual's health which in turn should improve the overall quality of life. However, weight loss success is dependent upon an individual's ability to make long term life style changes. Weight gain is common in individuals that do not change their eating habits or lifestyle. Weight gain is more commonly seen in patients that have undergone RYGB - gastric bypass or a stapled gastroplasty procedure. Revisions to the original procedure are possible but bariatric surgery revisions carry an even higher risk of complication than the original surgical procedure (Klein, 2002).

2.6: Bariatric Surgery Outcomes

Over the past few decades there has been an increased interest for healthy weight management and diet programs to promote healthier lifestyles. These programs which focus on diet, exercise, behaviour modification and/or pharmacological interventions produce short term results; however, they do not have the same long term impact surgical interventions offer (Mun, 2001). Bariatric surgery has now become one of the most frequently performed gastrointestinal procedures performed which has led to an increased interest in further explorations of its approach, techniques and complications. This section will highlight current research on bariatric surgery.

Initial studies on bariatric surgery showed through scientific rigor that surgical methods have better weight loss outcomes than other methods. In most instances, surgical candidates lose between 50% - 60% of excess body weight in the first 1-2 years following surgery (Balsiger, 2000). This far exceeds other reported weight loss outcomes using traditional methods (dies, exercise, and behaviour modification). The Swedish Obesity Subject (SOS) study, which began in 1987, is one of the most in-depth research endeavours regarding obesity. The primary purpose of the SOS is to evaluate mortality and morbidity rates among the obese by examining surgical treatment for weight loss against traditional weight loss methods (Lissner, 1998 and Narbro, 2002). Initial results from the SOS study showed that at follow-up Year 1, 60% of individuals who were treated surgically had lost 50% or more of their initial excess body weight compared to those that were treated with traditional methods (3% had lost 50% or more of initial excess body weight) (Sjostrom, 1992). A longitudinal study, from the SOS, on outcomes showed that average weight change at Year 7 was more for surgically treated individuals (-16.7%) than those treated conventionally for obesity (+.9%) ($p < .001$) (Argen, 2002). Similar results were found in a cross-sectional study on pharmaceutical savings by Narbro, et al. Surgically treated individuals reached a maximum weight loss of 25% one year after surgery. Those participants that followed conventional weight loss methods had no changes at the one year follow up period. At Year 6, those treated conventionally had a weight gain of +1% while the surgically treated group had a weight loss of 16% (Narbro, 2002). Shekelle, et al conducted an analysis to review current literature regarding surgical treatment for obesity and pharmaceutical treatment for obesity for the Agency for Healthcare Research and Quality (AHRQ). They examined a variety of studies including randomized control trials, controlled clinical trials, cohort studies (surgery only) and case series (surgery only) on the subject. They found that data strongly supported the "superiority" of surgical treatment for individuals with BMI between 35 - 40 kg/m^2. The average weight loss, at 1 – 2 years, for these surgical studies was between 44 - 88 lbs (20 - 40 kg) compared indirectly to the pharmaceutical literature which only showed 4 – 11 lbs (2 -5 kg) (Shekelle, 2004).

2.7: Bariatric Surgery and Obesity Related Conditions

As study results began to demonstrate sustained weight loss for individuals undergoing bariatric surgery, researchers began to examine the relationship between surgery (weight loss) and obesity related co-morbid conditions. A study on hospital discharge data that showed patients who underwent bariatric surgery (DRG 288) had a primary diagnosis of morbid obesity (ICD-9-CM 278.01) and on average listed 3.7 additional diagnoses. These additional diagnoses included essential hypertension, joint diseases (osteoarthritis), diabetes, sleep apnea and esophageal reflux. Additional comparison of hospital discharge data to other hospital discharges showed that by comparison obesity-related co-morbid conditions was significantly higher for bariatric cases than all other discharges (Shinogle, 2005).

Diabetes

There is a proven connection between Type II Diabetes and obesity. On average, the risk of developing Type II Diabetes increases 3 fold when one's BMI is > 25 kg/m^2. (Pi-Sunyer, 2002) Current estimates (2007) from the National Diabetes Information Clearinghouse (a service of the NIDDK) reported that 23.6 million or 7.8 % of the population has diabetes (17.9 million diagnosed and 5.7 million undiagnosed) with a large portion of this population being considered overweight or obese (NIDDK Diabetes, 2007). There is a substantial body of evidence on the relationship between obesity and diabetes. Polyzogopoulou, et al reported that individuals with pre-operative Type II diabetes maintained normal fasting glucose levels 3-months post-operatively. One year following surgery, fasting insulin values were still normal even though participants where still classified as obese (Average BMI of 30 kg/m^2) (Polyzogopoulou, 2003). Diniz, et al examined glycemic control (HbA1c) after bariatric surgery. This study defined 3 study populations based on glycemic control: (a) Out of Control: > 8.0% (42% of population) (b) Fair Control: 7.0% - 8.0% (19.3% of population) and (c) Excellent: ≤ 7.0% (38.7% of population). After surgery, (median follow-up 24 months) 90.3% of individuals had HbA1c values ≤ 7.0% with no one experiencing values greater than 8.0% (Diniz, 2004). These findings validate the benefits of bariatric surgery on diabetes due to the lowering of HbA1c values. Clinically, lower HbA1c values indicate a reduction in the risk of developing diabetes related complications. Some findings allude to the fact that diabetes can be "cured" through surgery. Frigg, et al found that overtime Type II diabetes was cured in about 83% of the study population (Frigg, 2004). A review by Rubino and Gagner on bariatric surgery and Type II diabetes cited many references wherein individuals having Type II diabetes prior to surgery were medicine free within one month of surgery. The reduction in medication use is significant because individuals were still at more than 80% of their ideal weight at the time of evaluation (Rubino and Gagner, 2002). Batsis, et al reported findings of a reduction in the diagnosis of diabetes of -19.3% in individuals having undergone bariatric surgery to a non-operative control group who had an increase of +8.3% ($p < 0.001$) (Batsis, 2007). A univariate analysis conducted by Dolan, et al studied the remission of diabetes in scientific literature. The analysis showed the only significant predictor of diabetes remission was %Excess Weight Loss (%EWL) at 6-months ($p=0.01$). At 6-months follow-up, individuals who lost >30.6% of EWL were significantly more likely to not require/stop medication use compared to those who had lost <30.6% ($P=0.005$) (Dolan, 2003).

The demonstration of diabetes remission in these articles has a dramatic impact on overall health care expenditures. In 2007 total direct and indirect costs for the treatment of diabetes was $174 billion dollars. Approximately 2/3 (66.7%) of these expenditures was related to direct medical care. Health care expenditures among diabetics are 2.3 times higher than non-diabetics – after adjusting for age and sex (NIDDK Diabetes, 2007). Therefore, by virtually curing diabetes in obese individuals there is opportunity to save on overall medical care costs for those who had diabetes prior to the surgery.

Heart Disease/Hypertension

Both hypertension and heart disease are associated with obesity. The impact of weight loss on these conditions is well documented in the literature. Hypertension is defined as having a systolic blood pressure (BP) $\geq$ 140 mm Hg or a diastolic blood pressure of $\geq$ 90 mm Hg. The disease has been reported as one of the most common obesity related conditions whose prevalence increases with increased BMI (Must, 1999). The Framingham Heart Study reported that higher BMIs (> 30 mg/m^2) have a negative impact on life expectancy and further substantiated the association between obesity and heart disease (Peeters, 2003). If the prevalence of hypertension increases with obesity, it is logical to conclude that weight loss would reduce the incidence of hypertension. Mertens and Van Gaal reviewed various studies to understand the correlation between hypertension and modest weight loss. The Trail of Nonpharmacologic Intervention in the Elderly study, showed that a modest weight loss of only 4.5 kg (~ 10 lbs) significantly reduces the risk for high blood pressure in those 60-80 years old (Mertens and Gaal, 2000). Because of the inherent link between weight loss and hypertension, researchers have also investigated the impact of bariatric surgery on hypertension. In an early study by Foley, et al, two-thirds (66%) of patients with pre-operative hypertension were non-hypertensive within 4 years of surgery (Foley, 1992). This was supported by Busetto, et al and White, et al. Busetto, el at reported a decrease in the prevalence of hypertension 12-18 months post-operatively (46.7% reduction) (Busetto, 2004). White, et al reported resolution of hypertension in 65% of patients, an improvement in hypertension was noted in another 25% of patients (White, 2005).

The Swedish Obese Subjects Intervention study found that the 2-year unadjusted incidence of hypertension was lower in those that were surgically treated for obesity compared to their matched obese controls who maintained a stable weight (3.2% compared to 9.9% p=0.032). However analysis on the incidence of hypertension at year 8 showed no difference between the two study groups. (Sjostrom C D, 2000). The results from Sjostrom suggest that longer follow-up periods show no change on the incidence of hypertension.

The presence of hypertension can be an indicator of future coronary heart disease. Because of research showing the impact of bariatric surgery on hypertension, one can expect that it would have a similar impact on coronary heart disease. Using the Framingham Risk Scores (FRSs), Vogel et al, assessed whether there was a change of one's tabulated risk prior to surgery compared to the expected risk of the general population using published tables of coronary heart disease rates by age. The scores focused on age, calculated low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, systolic blood pressure, diabetes mellitus status and smoking status. Results showed weight loss through bariatric surgery was effective in reducing the FRS 10-year predicted risk in men and women. (Baseline 6 ± 5 versus Follow-Up 4 ± 3, $p < 0.0001$) (Vogel, 2007). In another study by Batsis, et al a cohort of hypertensive patients were followed for 10 years to evaluate their 10-year risk for the development of cardiovascular disease. The study followed two groups - individuals who underwent bariatric surgery and those that had elected to not have surgery. (All study participants had an initial BMI ≥ 35). Results showed that bariatric surgery caused significant improvements and limited the risk of developing a cardiovascular event and death when compared to the control group ($p<0.001$) (Batsis, 2007).

Dyslipidemia

Dyslipidemia is a lipid disorder that involves blood cholesterol and triglycerides (fatty substance). It is commonly linked to coronary artery disease as well as obesity. Many researchers have examined the impact of bariatric surgery on dyslipidemia and results are promising. White, et al examined the impact of surgery on dyslipidemia. Pre-surgical unstable lipid control was found in 81% of surgical patients (73% had elevated cholesterol levels, 31% had elevated triglycerides and 54% had elevated cholesterol/HDL ratios). Post-surgery follow-up(median follow up 48.6 months) results showed overall dyslipidemia had resolved in 34% of the population, 38% showed an improvement, 7% remained unchanged and 10% had deteriorated (Note: 11% of the individuals were lost to follow-up) (White, 2005). del Amo, et al reported that 5-years triglyceride and serum cholesterol levels became normal for patients who were treated surgically for obesity. Seventy-eight percent of individuals identified with high triglycerides pre-surgery registered normal levels and thirty-four percent of individuals with elevated serum cholesterol levels had normal readings post-surgery (del Amo, 2002). This was further supported by Vogel, et al who found similar results in their study of coronary heart disease and bariatric surgery. Both men and women achieved significant total cholesterol reductions (201 mg/dl versus 176 mg/dl, <0.0001) following bariatric surgery. Values for low-density lipoprotein cholesterol and triglyceride values also showed significant improvement (Vogel, 2007).

Sleep Apnea

Sleep apnea is a condition wherein an individual stops breathing during sleep. It is commonly associated with individuals that are overweight (ASAA, 2008). Because of the link to obesity, various studies have examined the impact of bariatric surgery on sleep apnea. Ahroni, et al found that prior to surgery 81% of patients diagnosed with sleep apnea used Continuous Positive Airway Pressure (CPAP) machines. At 1 year post-surgery, only one-third were still using CPAP machines (Reduction of 47%, p<0.0001)

(Ahroni, 2005). Benotti and Forse, in an early review of the impact of bariatric surgery, cited multiple studies that saw reductions in sleep apnea. One cited study reported that pulmonary function (including sleep apnea) was improved in as many as 90% of individuals who underwent surgery (Benotti, 1992). A small (n=8) historical, retrospective study performed by Guardiano, et al examined the explicit impact of bariatric surgery (gastric bypass) on obstructive sleep apnea. This study matched individuals who underwent bariatric surgery to a database of patients who were diagnosed with obstructive sleep apnea (n=28). A sleep apnea index was calculated and re-evaluated after surgery (Average follow-up was 28-months). Results showed a significant reduction in the Respiratory Disturbance Index (RDI), a mean value reduction of 75% (p=0.01); improvement in nocturnal oxygen saturation improved 95% to 97% (p=0.04) and 63% of individuals (5 out of 8) no longer required the use of a CPAP machine. This study provides clear evidence of the impact of bariatric surgery on sleep apnea and further validates other studies that have found similar results. Results from the well-known SOS study sites various studies that report bariatric surgery has a "substantial benefit" for individuals who suffer from sleep apnea (Shekelle, 2004).

As demonstrated in the above study results on co-morbid conditions and bariatric surgery, weight loss is not the only positive outcome. The surgery offers individuals the opportunity to improve their overall health by reducing the risk of developing certain conditions or improving current conditions to the point of no longer being able to detect the presence of such condition.

2.8: Pharmaceutical Impact

Bariatric surgery has a positive impact on medication use. In the aforementioned study by Ahroni, et al – medication usage was decreased or discontinued for the following co-morbid conditions: Asthma 82%; Diabetes 81%; GERD 74%, hyperlipidemia 32% and hypertension 49% (Ahroni, 2005). Dolan, et al reported that two-thirds (65.3%) of patients with diabetes prior to surgery no longer required medications (no statistical difference between insulin and non-insulin dependent diabetics ($p=0.4$). Further he found that patients who lost >30.6% of excess weight were more likely to be off all medications for treatment of diabetes (as compared to those who lost < 30.6%, $p=0.005$) (Dolan, 2003). Ponce, et al examined the impact of bariatric surgery on medication usage for individuals with a diagnosis of Type II diabetes and/or hypertension over a two-year period. In the diabetic portion of the study, diabetics were divided into two groups based upon the duration of their illness: <5 years or > 5 years. All participants were required to be on medication to treat diabetes in order to be included in the analysis. Results showed that at 12-months, 66% of the study population no longer required medication to treat diabetes. At 18-months, 70.6% no longer required medication and at 24-months 80% no longer required medication. In addition, the study noted a decrease in average HbA1c values (7.25 pre-operatively to 5.87 at 12-months, 5.68 at 18-months and 5.58 at 24-months. Ponce noted that individuals with a diabetes diagnosis < 5 years had a better chance of improvement than those with the disease > 5 years (83% versus 35%, $p<0.001$). The hypertension portion of the study focused on an individual's use of anti-hypertensive medication. At 12-months 59.8% of individuals no longer required anti-hypertensive medication. By 24-months, 74% of the population no longer required medication to control hypertension (Ponce, 2004). Bariatric surgery clearly reduced prescription medicate usage.

The reduction of prescription drugs that are used to treat specific co-morbid conditions such as diabetes and hypertension also has a positive economic impact. A study by Potteiger, et al examined this trend. This study analyzed medication use to treat diabetes and hypertension pre-operatively and post-operatively (9-month follow-up). The average number of prescriptions utilized was reduced following bariatric surgery (Pre-operative 2.44 ± 1.86, Post-operative 0.56 ± .81, $p < 0.001$). This reduction also resulted in a reduction in overall prescription spending per patient (Pre-operative $187.24 ± $237.41, Post-operative $42.53 ± $116.60, $p < 0.001$). The majority of the savings was of a result of the reduction in utilization and expenditures for the treatment of diabetes (Potteiger, 2004).

Monk, et al investigated bariatric surgery to determine if, after surgery, there are significant reductions in overall pharmaceutical spending in relation to the treatment of sleep apnea, Type II diabetes, hypertension, gastro-esophageal reflux disease and asthma. Using a Wilcoxon signed rank test, a significant reduction ($p<0.01$) in average monthly spending on pharmaceuticals dropped from $317 preoperatively (SEM 47.25, range $23.13 - $1801.19) to $135 postoperatively. (SEM 35.35, range $0.00 - $1122.72) (Monk, 2004) Narbro, et al examined a sample of obese individuals and compared pharmaceutical costs of patients who underwent bariatric surgery to patients that were treated for obesity using other treatment methods over a 6-year period. Results showed an overall reduction of prescriptions costs for diabetes and cardiovascular disease in the surgically treated group. However, he found an increase in prescription costs for gastrointestinal tract disorders; anemia and vitamin deficiency medications (Narbro, 2002). This increase was likely a result of common post-surgical complications. Research conducted at the University of South Alabama College of Medicine found similar pharmaceutical savings post-operatively after individuals underwent the laparoscopic Roux-en-Y bariatric procedure (N=78). Researchers examined pharmaceutical usage preoperatively and postoperatively. Pre-operatively patients consumed approximately 4.2 drugs per patient per day. Post-operatively patients consumed 1.4 drugs per patient per day at 6-months and 1-year and 1.5 drugs per patient per day at 2 years. The average drug cost per patient per month went from $369 per patient per month to $104.66 per patient per month at 2 years postoperatively. Annual figures for pharmaceutical usage preoperatively was $345,056 and 2-years postoperatively pharmaceutical usage was $97,962 – giving an annualized average saving of $240,000. Researchers then compared the cost of surgery to annualized pharmaceutical savings to determine whether the benefits of bariatric surgery (i.e. pharmaceutical savings) would pay for the costs of surgery. Results showed that pharmaceutical savings paid for the cost of surgery in 32 months (Snow, 2004). In addition, a study by Sears, et al estimated that within seven years of surgery, prescription cost savings alone covered the cost of bariatric surgery (Sears, 2008).

2.9: Bariatric Surgery Health Care Savings

Literature has shown a link between the remediation of specific co-morbid conditions and bariatric surgery. This link has a direct impact on pharmaceutical expenditures but could surgery have other benefits. A study by Cooney, et al investigated bariatric surgery cost outliers at Penn State College of Medicine after implementation of a clinical pathway for perioperative care following bariatric surgery. The study found that patients with severe co-morbidities had higher costs than patient without severe co-morbidities (\$10,804 ± \$1,137 versus \$8,302 ± \$358). Co-morbidities were defined as severe based on the following: degenerative joint disease – inability to walk independently; sleep apnea – sleep study documenting severe obstructive sleep apnea or obesity-hypoventilation syndrome; hypertension, diabetes mellitus and asthma were considered severe if a patient took more than three prescribed medications for their condition. The differences in costs were tied to increased utilization during the hospital stay. This same study found that 7 out of 8 patients (88%), who were classified as having severe co-morbidities, were admitted to the intensive care unit (ICU) following surgery. Therefore, severe co-morbidities can lead to increased costs during the hospitalization for bariatric surgery (Cooney, 2003). Argen, et al compared the cost of inpatient care for Swedish obese patients over a 7-year period. The study examined two populations (N=962). The first group consisted of individuals who had bariatric surgery and the second group were individuals who were treated with other methods for weight loss. Remarkably, this study found that once costs and services common to bariatric surgery were removed from the dataset there were no difference in the number of hospitalization days or hospitalization costs between the two groups. Thereby, from a hospitalization standpoint bariatric surgery did not help with reduce hospitalizations. If hospitalization costs related to the surgery were included, the surgical group over the 7-year period had significantly higher costs than the conventionally treated group. (Discounted values \$9,533 ± \$10,156 versus \$2,540 ± 6,113 p<.001). Notably, this study focused only on inpatient costs and did not analyze the full gambit of health care utilization/costs (Argen, 2002). An observational matched cohort study by Christou, et al found the exact opposite. Results showed that surgically treated patients had fewer hospitalization (2.75 vs. 3.17), lower average length of stays (21.05 vs. 36.59) and fewer physicians visits (9.62 vs. 17.00) compared to matched controls ($p = 0.001$). In addition, the average total direct costs (including the cost for bariatric surgery) for the surgical group was $8,813 less compared to than the non-surgical groups costs, $11,854 (1996, Canadian $, $p = 0.001$). It was therefore concluded that total costs for those receiving surgery may be reduced by 45% within 5 years of surgery (Christou, 2004).

Further proof comes from the Canadian observational cohort study of McGill University Health Centre. These investigators compared individuals who underwent bariatric surgery with matched obese controls who did not have bariatric surgery for a period of 5-years. The initial year comparison showed higher spending per 1,000 patients for those individuals in the study group (having had bariatric surgery) compared to their obese counterparts (Part of this increased spending is relative to costs related to surgery, as these costs were not excluded in comparing overall health-care costs). However, after 3.5 years the investment for bariatric surgery paid off. The results from this study show that over the 5-year study period surgical direct health care costs were reduced by 29% (5.7 million Canadian dollars/1000 patients) (Sampalis, 2004).

Kuhlman, et al sent out a questionnaire to all health care facilities to determine health care savings resulting from bariatric surgery in 1997. The survey was brief and only contained three questions: (a) How many primary operations in obesity surgery were preformed in your clinic in 1997? (b) Which procedure(s) have been performed? and (c) What was the average costs of the operations billed by the hospital? The researchers concluded that bariatric surgery is the only sensible treatment option for morbid obesity and could fund it through savings associated with preventing co-morbidities. However, given the current costs associated with the procedure and the health care environment in Germany the possibility of maintaining coverage (i.e. for obesity surgery) is yet to be determined (Kuhlmann, 2000). Another study by Gallagher, et al examined the economic impact of bariatric surgery on the Veterans Administration Healthcare System. This study found that surgical treatment for obesity reduced obesity related expenditures and utilization within the first year following surgery ($10,788 ± $2,460 preoperatively versus $2,840 ± $622 postoperatively p=.005). The study demonstrated overall health care savings through bariatric surgery, however, the study population was small (N=25) and was disproportionately male (72%) (Gallagher, 2003).

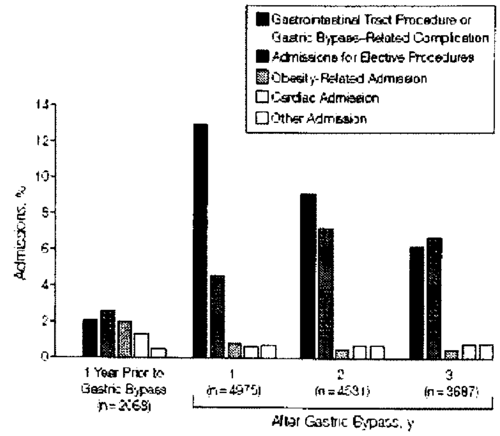
Because of conflicting study results, Salem, et al in 2004 performed a systematic review of the economic impact of bariatric surgery to reveal evidence of its cost-effectiveness. Of the multiple studies examined, researchers found only three (3) that expressed treatment effectiveness – defined as cost/QALY. All three purported the cost effectiveness of bariatric surgery (at less than $50,000/QALY); however, each had limitations in their design and overall analysis. The majority of articles demonstrate positive outcomes associated with a reduction in co-morbidities, suggesting this surgical intervention is something that health care payors and other stakeholders should continue to examine (Salem, 2005).

2.10: Bariatric Surgery Complications

Complications are defined in a variety of ways but when discussing surgical cases it is commonly examined by temporal sequence of certain events or by studying readmission rates following surgery. Readmissions seem to be a persistent issue for the obese population. Some studies have supported this hypothesis and others such as a study by Zingmond, et al does not. Zingmond, et al examined 24,678 patients who had bariatric surgery in California and for whom they had 3-year pre-surgical and 3-year post-surgical data. Results actually indicated an increased rate of admissions in the 3-year period following bariatric surgery compared to the 3-years prior to surgery (40.4% admissions rate compared to 20.2%). It was also noted that of this population only 8.4% was admitted in the year prior to surgery and 20.2% was admitted in the year following surgery. In addition, the costs associated with admissions both pre/post surgery are drastically different. The mean hospital charges for the 3-year period prior to surgery were $4,970 which is drastically lower than the 3-year post-surgery period of $20,651. To further examine this phenomenon, the researchers looked at the reasons for admission. It was found that prior to surgery the reason for admission was most often related to an elective procedure (hysterectomy and cholecystectomy); however, post–surgery the most common reason for admission was gastrointestinal tract or related bariatric procedure complications (gastric revision, ventral hernia repair, wound infection, small bowel obstruction or hypovolemia) (Zingmond, 2005). The study findings raised concern for the medical community on whether the surgery has an overall positive or negative impact on hospital utilization. The below graph lists reasons for admission in the pre/post surgical period:

Bariatric Surgery, 1995 - 2001

Figure 4:
Rates and Indications for Hospital Admissions Before and After



Source: Zingmond, 2005

When considering bariatric surgery one should evaluate risks and complications associated with the procedure. Encinosa, el at examined complications and utilization of health care resources following bariatric surgery. The top five reasons for complications were: dumping syndrome (19.5%), anastomosis (12.3%), abdominal hernias (7.1%) infection (5.7%) and pneumonia (4.1%). Complication by time frame was also examined. The researcher expanded the standard 30-day post op follow up period to review 30-180 days period. Approximately, 11% of individuals who did not have a diagnosed complication prior to 30-day had one in the 30-180 day period. Overall the number of readmissions increased 50% between the 30 -180 day period (4.8% to 7.2%). Statistically significant increases were found in the following complications: anastomosis, marginal ulcers, abdominal hernias and dumping syndrome. Additional analysis by age band showed that older patients (age 40-64) were more likely than younger patients (Age 18-39) to have complications during the initial surgery, a readmission or office visits ($p < 0.01$). A Cox proportional hazard regression model demonstrated that older patients (Age 40-65) had a statistically higher risk (33%, hazard rate of 1.33.CI 1.14 – 1.57) of complication by the end of 6-months. Other hazard regression performed on sex and the number of co-morbidities could not explain complications over time (Encinosa, 2004). Mehrotra, et al also examined complications in a population-based study. Complications were defined as extended lengths of stay (>5 days) and readmissions within 30 days after discharge for two time frames (a) 1990-92 and (b) 2000-02. Results showed length of stay for the procedure declined from 6.2 days to 3.7 days (Mehrotra, 2005). Some of the change was likely due to the advances in bariatric procedures including increased popularity and movement of laparoscopic compared to open procedures. When examining the combined impact of longer length of stay and readmissions within 30 days between 1990-92 and 2000-02, it was found complication rates dropped from 27.8% in 1990-92 to 23.3% in 2000-02. In 2000-02, it was determined that the relative risk of having a readmission was 8.4 (95% CI, 6.68, 10.45) if the individual had an extended length of stay (defined as a stay > 5 Days). Additionally, ¾ of all readmissions required an additional surgical procedure. This additional surgical procedure could be related to the revision of the bariatric procedure or an additional procedure to address a specific complication. (Mehrotra, 2005).

Saunders, et al examined the 30-day readmission rate during a 3-year period at a high volume bariatric center (n=2,823). The results showed a 6.5% readmission rate with in the first 30 days (165 patients with 184 readmissions = 184/2,823) The median time for readmission was 8 days and the median length of stay upon readmission was 3 days. To better understand leading causes of readmission a step-wise regression was completed. Results showed that a Technical Complication due to surgery accounted for 75 admissions (40.2%). The common surgical complications were (a) stricture requiring dilatation-13.0%, (b) bowel obstruction- 7.5%, (c) wound complication-5.4%, (d) perforated viscus-4.9% and (e) postoperative bleeding-4.3%. Other readmissions reasons were: gastrointestinal complaints - 23.4% (vomiting, diarrhea, constipation, dehydration, acute cholecystitis), abdominal pain without vomiting – 9.2%, pulmonary complications – 9.2%, pulmonary embolism/deep vein thrombosis – 4.3% and kidney stone or urinary tract infection (UTI) – 3.8%. The overall findings of this study are comparable to other studies on readmissions rates following bariatric surgery. The researchers further concluded that the readmission rates were not dissimilar to other complex gastrointestinal surgical procedures (Saunders, 2007).

Another factor to consider when examining costs/outcomes associated with bariatric surgery is the costs associated with readmissions. The financial impact of these admissions is considerable. Encinosa reported that the mean 180-day total health care expenditures for patients experiencing a complication was $36,542 compared to those who did not have a complication, $25,337 (Risk Adjusted analysis, $p<0.01$). The results for a 6-month period following surgery were similar. Those individuals with complications following surgery had total risk adjusted health care expenditures of $65,031 compared to $27,125 for individuals that did not have complications (Encinosa, 2004).

2.11: Mortality

Another way to examine bariatric surgery is to analyze mortality. Stevens, et al, found that as BMI increases, so does the chance of mortality. Individuals (both men and women – age 30-74) with higher BMIs are at a higher risk of mortality for all causes as compared to individuals with lower BMIs (Stevens, 1998). This same finding was confirmed by other Calle, et al. (Calle, 1999). Sjostrom, in his analysis on mortality showed that chance of mortality almost doubled for the obese (BMI $\geq$ 35 kg/m^2) as compared to normal weight individuals. These findings further validate further the health risk of obesity on an individual's health. maintaining a normal weight will not only diminish the risk for the development of specific chronic conditions but it also impacts longevity by decreasing mortality risk.

The relationship between bariatric surgery and mortality was consistent and reproducible. The perioperative mortality rate ranges between 0 - 1.5% (Klein, 2002). The majority of deaths were caused by anastomotic leaks and peritonitis. The rest were a result of a pulmonary embolism or sepsis (Klein, 2002). White, et al examined in detail 342 obese individuals who underwent bariatric surgery between January 1990 and April 2003. In his extensive research, there was no reported death within 30-days and only 5 deaths (1.5% - 5/342) in the follow-up period (6 months – 13 years) none of which were directly related to the surgery (White, 2005). Encinosa performed a retrospective analysis of bariatric surgery outcomes. He reported a 180-day mortality rate of 0.2% (Encinosa, 2004). Similar results were found by a University of California research group. From 1995 to 2004 the in-hospital mortality rate for bariatric surgery performed in California was 0.18%, 30-day mortality rate was 0.33% and one-year morality rate was .91 %. (Zingmond, 2005) Omalu, et al completed a state specific study on bariatric surgeries performed in Pennsylvania for a similar time frame (1995 and 2004). This study reported an overall mortality rate of 2.6% (440/16,683) for the study period and the 30-day mortality rate was 0.9% (150/16683). It appears that mortality is clearly a risk for patients undergoing this type of procedure. Common causes of death linked found in the literature are: pulmonary embolisms, coronary heart disease, sepsis cardiovascular conditions, myocardial infarction, sudden death, cerebrovascular damage/stroke and leaks at the junction of the stomach and small intestines (peritonitis) (Adams, 2007; Omalu, 2007 and Sjostrom, 2007). There is clearly a risk of death associated with bariatric surgery as evident by the studies referenced above.

Additional studies death after bariatric surgery has been examined. Christou, et al completed an observational study of bariatric surgery patients to a matched obese control group (gathered from a health insurance database). The 5-year mortality for the surgical group was less than the matched control group (.68% less, 6.17%; Relative Risk 0.11) (Christou, 2004). Another study by Adams, et al examined bariatric surgery patients mortality against matched controls found using a driver license bureau database. Total deaths for the surgical group were 213 or 37.6 deaths/10,000 person years compared to 321 deaths or 57.1 deaths/10,000 person years, p<.001) (Adams, 2007; Buckeley, W.). The Swedish Obesity Subject (SOS) study has also examined mortality. The 10-year study compared 2,010 individuals who underwent bariatric surgery to a population of 2,037 who received conventional weight loss treatments. The surgery group had a hazard ratio of .76 compared to the control group. Indicating the odds of dying are less for the surgical group than the control group (p=.04). Deaths in the follow-up period for the surgical group was 101 (5.0%) versus 129 deaths (6.3%) for the control group (Sjostrom, 2007; Bulkeley, 2007).

A short- and long-term mortality study on bariatric surgery was conducted by Flum and Dellinger. This retrospective study examined a state-wide hospital discharge database and state vital records for a mortality comparison on individuals who underwent surgery to matched obese controls. Long-term results (15 years) revealed that 11.8% of individuals in the surgical group had died compared to 16.3% of individuals who had not received the procedure. The surgical group's hazard ratio at 1-year follow up was .67 which is significantly less than the non-surgical group. The 5-year odds ratio (short term) of surviving following hospitalization was examined. It was determined that a patient undergoing a bariatric procedure (gastric bypass) was 19% more likely to survive than their matched cohort (Flum and Dellinger, 2004). In another study by Flum, et al he examined mortality following bariatric surgery in the Medicare population. The post-operative 1-year mortality rate was high 4.6% which indicates age may influence risk of mortality for bariatric surgery. However, it should be noted that the Medicare population makes up only a small percentage of patients undergoing this procedure (Flum, 2005).

As with any surgical procedure there is a natural risk and bariatric surgery is not any different. However, mortality risk for the procedure has been shown to be small in comparison to the benefit of life years gained. The literature clearly shows bariatric surgery offers obese individuals the opportunity to live longer lives as compared to obese counterparts. The surgery is a chance to fight back against the overwhelming odds that weigh against an individual suffering from obesity.

2.12: Coverage for Bariatric Surgery

In 2004, the Centers for Medicare & Medicaid Services (CMS) included coverage for the surgical treatment of obesity. The government will cover bariatric surgery, for older individuals who have Medicare when the procedure is proven medically appropriate and if it can impact obesity-related co-morbidities (NIDDK, 2008). This benefit change has opened the door for a larger portion of the obese population to seek surgical treatment for obesity. However, many private insurance companies still do not cover this type of procedure. The decision not to cover bariatric surgery was not well received by the medical community as the benefit markedly outweighed the risks of these procedures. The opinion of various surgical authorities is clear with unwavering support for those who need this surgery. Dr. Bruce Schirmer, MD, a professor of surgery at the University of Virginia Health System in Charlottesville, believes the refusal for coverage stems from public opinion about obesity. "You can't take an operation that treated cancer effectively and not cover it" says Schirmer "You don't see insurance companies saying they won't pay for a lung operation because the patient smokes. Yet the inherent societal biases and public opinion about obesity have allowed them" to put limitations on the coverage for bariatric surgery (Mitka, 2006). Harvey Sugerman, MD, Emeritus Professor of Surgery at Virginia Commonwealth University explained his opinion on the current mentality of health plans on bariatric surgery "Health plans that deny bariatric surgery for their severely obese members prevent these patients from receiving the single treatment that is most likely to lead to substantial improvement in all realms of living" (Sugerman, 2005). Some private insurers cover this procedure with specific evidence based guidelines and others (including self-funded groups) opted to exclude this surgery for all of their members.

Although the medical field has made steps in the right direction some clinicians still view these as only small victories. The 1991 publication of the Consensus Statement by the National Institute of Health and the change by CMS is a step in the right direction; however, it also has sparked some ethical concerns from the medical profession regarding reimbursement and bariatric surgery in general. Some believe the establishment of the consensus statement provides the basis for coverage for a medical condition (obesity) while others have concern that the guideline opened the door for surgeons to freely recommend surgery as an option for all. The latter concern continues to be an issue as evident by the dramatic increase in surgeries being performed annually.

A population based study in Wisconsin compared bariatric hospital discharge data between 1990-92 and 2000-02. Discharge analysis showed an increase in charges to Medicaid (8.9% to 13.7%) and Medicare (6.5% to 10.2%) which presumably demonstrates an overall increase in the number of surgeries performed for this population (Mehrotra, 2005). This shift was likely a result of policy by the government related to the treatment for obesity. Other health care insurers have not implemented a policy for coverage. Instead many rely on a policy of evidence based coverage of medically necessary procedures. Bariatric surgery coverage by employers and health plans vary. The high costs associated with complications and poor outcome results, including death and non-sustained weight loss do not warrant coverage, have caused some health plans to limit coverage (Foust, 2006). Foust, et al highlighted a single case study on the impact of covering bariatric surgery by a single employer, MediCorp (3,000 employees, located in Northern Virginia). MediCorp reported a substantial increase in the number of surgeries performed from zero (0) in 2001 to sixteen (16) performed in 2003. Many of these cases cost the employer in excess of $100,000 (Average Surgery Cost $40,000/case) and thus brought to the forefront obesity as a covered service. The organization realized that bariatric surgery may be an option for some employees and does provide health care benefits to specific chronic conditions (diabetes, heart disease, cancer, sleep apnea, depression, arthritis, back pain). It was also thought that the surgery could improve overall productivity of their employees. Using this information, Medicorp decided to develop a comprehensive Disease Management program for obesity. This program would include compliance monitoring, patient accountability and behavioural change support. If a covered individual is compliant with the weight management program for six months he/she can elect to have surgery upon approval from the program. The surgical candidates then meet with a surgeon and are required to follow a rigid post-surgical follow up program. MediCorp will pay for all services as long as the individual is compliant. In the event of non-compliance, the individual will become responsible for all fees via a pre-authorized payroll deduction. Critical to the success of this program was the establishment of program objectives and performance targets. Ultimately, MediCorp wanted to determine some estimate of ROO (return on outcomes) and ROI (return on investment). The development of baseline data was key in measuring success of the program. Since implementation, 14 employees enrolled and are pre-authorized for surgery. Of these 14 individual, 11 have elected to not have surgery and have achieved health weight goals through the program (Weight loss of participants was between 60 and 172 pounds), 2 individuals are in the beginning stages and 1 individual (who was not compliant) dropped out of the program and elected to self-pay for the surgery. MediCorp has estimated a net savings of $432,138 (2004 $$). These savings are based on claims analysis including savings related to avoided surgeries but do not include the reduction/elimination of medications, reduction in health care system usage or the remediation of co-morbid conditions. MediCorp's annual cost per participant in the weight management program is $662 (Foust, 2006). This individual case study gives evidence to the impact an obesity program can have on an insured population. Albeit, this program requires strict program adherence, which is reinforced via repayment of program costs if participants are not compliant, it still demonstrates the positive impact of comprehensive weight management programs. By treating obesity as another chronic medical condition through a disease management programs, MediCorp showed a positive effect for both health outcomes and health care costs. It is noteworthy that this program is not built on an auto-deny policy for bariatric surgery rather it offers coverage for bariatric surgery for those willing to take control of their disease and better manager their condition.

2.13: Accreditation and Bariatric Surgery

Although there has been a significant increase in the number of bariatric surgeries performed over the past five-years, the location of where these surgeries are performed varies. In 2003, 26% of procedures performed in the US were done at low volume facilities (< 125 cases per year); however, low-volume facilities made up 74% of total US hospitals that offered bariatric surgeries (Livingston, 2007). To establish performance standards for the medical community, the American Society for Bariatric Surgery developed guidelines for the establishment of a "Center of Excellence". These guidelines focus on a variety of standards, including the ability to provide long-term patient care follow-up and a threshold for surgical cases performed per year. The basis for the threshold guideline relates to other studies that have examined the relationship between volume and outcomes (Nguyen, 2004). The guidelines for a Center of Excellence accreditation are referenced below:

Table 4: ASBS – Center of Excellence Criteria for Bariatric Surgery
• Perform > 125 Bariatric Surgical Cases per Year
• Bariatric Surgeon with 51% of practice in bariatrics
• Full consultative staff and critical care services
• Institutional commitment to in-service education program
• Full line of equipment and instruments for the care of bariatric patients

- Bariatric Medical Director
- Perioperative care standardized with utilization of clinical pathways
- Accredited nurse or physician for care and education
- Organized and supervised support groups
- Long-term follow-up with a system for outcome reporting.

Source: Nguyen, 2004

These guidelines were established to assist surgeons and/or hospitals demonstrate their effectiveness in providing treatment for obesity; as well as, provide a comfort level to individuals seeking treatment. By meeting the aforementioned guidelines a hospital or surgeon can achieve various accreditation levels. A *Provisional* Status signifies that the Surgical Review Corporation (SRC) is confident that the applicant possesses the necessary resources to provide safe and effective bariatric surgery. *Full* status approval signifies that the applicant possesses the experience to perform surgeries based on a review of outcomes – which include an onsite visit (Sugerman, 2005). In theory practice perfect techniques and enhances in skills combined with increased volume a facility has for bariatric surgery, the lower the risk of complication and mortality. Results from a study using the National Inpatient Survey (NIS) database showed that for each unit decrease in surgeries performed per year, the odds for in-house mortality increased by 1.002 (95% CI, 1.001-1.004, $p<0.001$). Although it was a statically significant result, one can ascertain that the difference is small and mortality in a lower-volume facility is close to that of higher-volume facilities (Livingston, 2007). Livingston, further commented that the 125-case per year threshold that has been established by accreditation bodies restricts access because it limits a patients choice in facilities considering that 73% of hospitals are low-volume (<125 cases per year) (Livingston, 2007). Following the American Society for Bariatric Surgery (ASBS) release of a proposed categorization of "Centers of Excellence", Nguyen, et al examined the relationship between hospital volume and outcome in bariatric surgery at Academic Medical Centers. The purpose of the study was to determine the effect of hospital volume related to bariatric surgery against morbidity, mortality and costs. Results showed lower-volume hospitals have longer lengths of stay than high-volume facilities (5.1 versus 3.8 $p < 0.01$), higher overall complication rates (14.5 % versus 10.2%, $p < 0.01$) and lower costs ($13,908 versus $10,292, $p < 0.01$). This study found no differences in expected mortality rate (both high-low volume = .06%); however, observed mortality was higher at low-volume hospitals than high-volume hospitals (1.2% versus 0.3%, $p < 0.01$). Classification of Academic Medical Centers in this study were defined as high volume - hospitals having completed > 100 cases/year; medium-volume hospitals completed between 50 – 100 cases/year and low-volume hospitals completed less than 50 cases/year (Nguyen, 2004).

Over the past two decades there has been considerable change in the way obesity is regarded and treated. The development of medical societies that explicitly focus on obesity and obesity surgery are a clear indication of the dedication of clinicians to help fight this epidemic. Likewise, the establishment of accreditation guidelines helps to ensure the quality and effectiveness of services being provided to those who seek out bariatric surgery as a treatment for their condition.

2.14: Conclusion

There is currently no long time cure for morbid obesity. The overall theme found in the literature demonstrates a positive correlation between the reduction in co-morbid conditions and bariatric surgery and even provides some financial savings that can be achieved via surgical intervention. However, there is still lingering doubt as to whether the surgical treatment option provides enough benefit to be considered a standard covered benefit.

CHAPTER 3: RESEARCH QUESTIONS AND HYPOTHESIS

3.1 Overview

As previously stated, the treatment costs for obesity and obesity related complications are straining many health care insurers. Bariatric surgery maybe an economically viable intervention that will directly target the high volume of healthcare resources used to treat obesity and its co-morbidities. It is the objective of this study to examine the impact of bariatric surgery on obese patients to assess whether it leads to more efficient use of health care resources. If proven, this analysis will assist health care organizations in developing benefit packages and disease management programs for obesity management through weight reduction interventions (such as bariatric surgery). To further evaluate the impact of bariatric surgery, an additional analysis will compare accredited to non-accredited bariatric surgery facilities. The goal of this analysis is to determine whether accredited facilities have better surgical outcomes. This in turn can help to build a foundation for developing quality health care weight management programs to address this epidemic.

3.2 Research Questions and Hypothesis

Question 1: Does bariatric surgery decrease utilization and payments for health care resources within one year? Health care resources, in this analysis, are defined using utilization metrics and claims payments for the following identified health care categories (inpatient admissions, physician office visits and prescription filled).

<u>Null Hypothesis A:</u> *Bariatric surgery for the obese has no impact on inpatient admissions for individual's one year post-bariatric surgery.*

<u>Alternative Hypothesis A:</u> Bariatric surgery for the obese has an impact on inpatient admissions for individual's one year post-bariatric surgery.

<u>Null Hypothesis B</u>: Bariatric surgery for the obese has on the number of physician office visits for individual's one year post-bariatric surgery.

<u>Alternative Hypothesis</u> B: Bariatric surgery for the obese has an impact on physician office visits for individual's one year post-bariatric surgery.

<u>Null Hypothesis C</u>: Bariatric surgery for the obese has no impact on the number of prescriptions filled for individual's one year post-bariatric surgery.

<u>Alternative Hypothesis C:</u> Bariatric surgery for the obese has an impact on the number of prescriptions filled for individual's one year post-bariatric surgery.

<u>Null Hypothesis D</u>: Bariatric surgery for the obese has no impact on inpatient admission payments for individual's one year post-bariatric surgery.

<u>Alternative Hypothesis D:</u> Bariatric surgery for the obese has an impact on inpatient admission payments for individual's one year post-bariatric surgery.

<u>Null Hypothesis E</u>: Bariatric surgery for the obese has no impact on physician office payment visits for individual's one year post-bariatric surgery.

<u>Alternative Hypothesis E</u>: Bariatric surgery for the obese has an impact on physician office visit payments for individual's one year post-bariatric surgery.

<u>Null Hypothesis F</u>: Bariatric surgery for the obese has no impact on prescription payments for individual's one year post-bariatric surgery.

<u>Alternative Hypothesis F:</u> Bariatric surgery for the obese has an impact on the amount of prescription payments for individual's one year post-bariatric surgery.

By understanding the impact on resource utilization for individuals who have the surgery, health plans can determine the potential financial savings attributed to individuals who have undergone surgery and review coverage of surgery as a treatment for obesity.

Question 2: Are surgeries performed in accredited bariatric facilities associated with more favourable quality and payment outcomes compared to those performed in non accredited facilities? (Note: Accreditation is based on a accreditation by the American College of Surgeons. The accreditation is determined by a facility's ability to demonstrate physical resources, human resources, clinical standards, surgeon credentialing standards, data reporting standards and verification/approval process standards.)

Null Hypothesis G: *Bariatric surgeries performed at accredited facilities have no difference in surgical payments than bariatric surgeries performed at Non-Accredited facilities.*

Alternative Hypothesis G: *Bariatric surgeries performed at accredited facilities have lower surgical payments than bariatric surgeries performed at Non-Accredited facilities.*

Null Hypothesis H: *Bariatric surgeries performed at accredited facilities have no difference in average lengths of stay (ALOS) than bariatric surgeries performed at Non-Accredited facilities.*

Alternative Hypothesis H: *Bariatric Surgeries performed at accredited facilities have shorter average lengths of stay (ALOS) than bariatric surgeries performed at Non-Accredited facilities.*

Null Hypothesis I: *There is no association between complications and accreditation status.*

Alternative Hypothesis I: *There is an association between complications and accreditation status.*

Development of better outcome measurements for bariatric surgery will assist health plans in compiling a list of preferred facilities and surgical teams that demonstrate quality and efficiency outcomes in the performance of bariatric surgery. Subsequently, this information will allow members seeking bariatric surgery to select from identified "best in class" for their surgery. It will provide them with additional reference information on selection for a service and assist in attaining the best clinical outcomes.

CHAPTER 4: DATA AND METHODS

4.1: Introduction

This study retrospectively examined bariatric surgery. The first analysis investigated resource utilization of bariatric surgery patients prior to surgery (pre-period) and after surgery (post period). The study examined utilization of resources based on the following categories: Inpatient (admissions and admissions claims payments), Physician services (visits and visit claims payments) and Pharmacy (# of prescriptions filled and prescription claims payments). The second analysis assessed relevant outcome differences between accredited facilities (by the American College of Surgeons, Bariatric Surgery Center Network Program) and non-accredited facilities. The analysis compared facility bariatric surgical payments, lengths of stay and complication rates.

4.2: Data Sources

This research used data from a large commercial health care insurer claims warehouse. The analysis focused on the commercially insured population and will not include any individuals with primary coverage through a governmental program (Medicare or Medicaid). The insurer's covered lives included membership across the United States in all geographic regions (Northeast, East, Southeast, Central, Southwest and West).

The claims warehouse contains the following data tables: Demographic, Inpatient Utilization, Physician Utilization and Outpatient Pharmacy. Data are updated monthly and maintained by the Information Technology division of the health insurer. Extracted data was stripped of all patient identifiers such as patient name, address, phone number, and social security number. A claims system generated patient identifier was used to uniquely identify members for this research. All electronic data was stored on a secure network location in password protected Access Database files or Excel files. After completion of the dissertation defense, all data relevant to this study will be returned to the health care insurer and the database file destroyed.

A request to use the claims warehouse was submitted to health plan leadership and approved on June 15, 2007. Prior to final release of the dissertation, the national health care insurer reserves the right to review the work to verify that the data parameters and the health care organization (or any subsidiaries of the organization) are de-identified.

4.2.1 Data – Question 1

To better under the impact of bariatric surgery on the obese population a data set identifying individuals who had bariatric surgery was extracted from the claims data warehouse. The parameters for population selection were:

(a) Surgery Identification – Inpatient hospital claim with a Diagnosis Related Group (DRG) of 288 – O.R. Procedure for Morbid Obesity and a Primary ICD-9 Diagnosis of 278.xx – Morbid Obesity, within the time frame of 1/1/2006 thru 12/31/2006

(b) Patients must be 18 years or older on the date of surgery

(c) Patients must have been enrolled in the health plan for at minimum 1 year prior to surgery and have continued enrolment for 1 year after surgery

(d) Patient must be enrolled in a Commercial Product and approved to have the surgery. *This analysis will not include individuals enrolled in governmental programs (Medicare/Medicaid.)*

Once the sample population was identified, utilization data covering a period of one year prior to surgery and one year after surgery was collected. Claims extraction included data on the surgery claim, Inpatient Utilization, Physician Utilization and Outpatient Pharmacy Utilization.

The claims data logic contained within the warehouse buckets each claim into appropriate database tables. Claims for each identified category being analyzed are described below:

Inpatient: Inpatient Admissions are identified by extracting individual cases (claims with an Inpatient Admission of DRG 288) via the Unique Patient Identifier, Admit Date and Facility from the Inpatient Data Table.

Physician: Physician Visits are identified by extracting individual office visits based on identified Unique Patient Identifier (Member Identification), Date of Service, Provider (Physician) and one of the following Evaluation and Management CPT Codes: (Office Visits associated with Pre-Op/Post-Op Bariatric Surgery will be excluded from analysis by examining provider specialty of submitted claims).

Table 5: CPT Physician Visit Codes

Code	Code Description
99201-99205	New Patient Office or Other Outpatient Visit
99211-99215	Established Patient Office of Other Outpatient Visit
99381-99387	Preventative Medicine New Patient Office Visit
99391-99397	Preventative Medicine Established Patient Office Visit
99477, 99499	Other Evaluation and Management Services (Unlisted)

Pharmacy: Outpatient Pharmacy are identified by extracting individual prescriptions via the Unique Patient Identifier, Fill Date and Drug Identification (Brand Name). Pharmacy data was only extracted for individuals who have pharmacy benefits through the national insurer. An indicator from the Member Demographic table was collected to evaluate whether individuals do or do not have pharmacy coverage.

In addition to the above referenced category, demographic information containing the unique patient identifier, age, sex, geographic location was extracted. A detailed listing of the data elements for each category can be found in Appendix A.

4.2.2 Data – Question 2

To better understand the value of having bariatric surgery performed at an accredited facility, a new data set identifying all bariatric surgeries performed from 1/1/2006 – 12/31/2006 was extracted from the claims warehouse. (Note: This dataset did not have any limitations regarding continuous enrolment prior to surgery but did include logic to check for continuous enrolment post surgery.) The parameters for selection are:

(a) Surgery Identification – Inpatient hospital claim with a Diagnosis Related Group (DRG) of 288 – O.R. Procedure for Morbid Obesity and a Primary ICD-9 Diagnosis of 278.xx – Morbid Obesity within the time frame of 1/1/2006 thru 12/31/2006

(b) Patients must be 18 years or older on the date of surgery

(c) Patient must be enrolled in a Commercial Product and was approved to have the surgery. *This analysis did not include individuals enrolled in governmental programs (Medicare/Medicaid.)*

(d) Patients must have continued enrolment for 6-months after surgery

In addition to the inpatient bariatric surgery claims data, additional utilization data to examine complications was extracted. This extraction included Inpatient and

Outpatient Utilization (Emergency Room Visits) for a 6-month time frame following discharge. (See Appendix B for file layouts). A surgical complication was defined as one of the following: (a) An emergency room visit with specific diagnosis classifications related to surgery complication (See Appendix C) (b) Prolonged Length of Stay (A length of stay that is in the top 10^{th} percentile) and (c) a readmission to a facility within 90 days after discharge with specific diagnosis classifications related to complications from the bariatric surgery. (Note: Individuals who have a claim that meets any of the above criteria will be identified with an indicator showing that their bariatric case had complications.)

Inpatient: Inpatient Admissions were identified by extracting individual cases (claims with an Inpatient Admission of DRG 288), Admission Date, Discharge Date and Facility from the Inpatient Data Table.

Outpatient Utilization: Emergency Room Visits were identified by extracting individual emergency room visits based on Unique Patient Identifier, the Date of Service, Facility and Place of Service = Emergency Room.

Accreditation status for a facility was based upon the American College of Surgeons: Bariatric Center Network Program. (http://www.facs.org/cqi/bscn/). A list containing the facilities that have been accredited and their current accreditation status was downloaded from the ACS website. An Excel spreadsheet was created and subsequently imported into the ACCESS database to serve as a table of accredited providers. (See Appendix D) Providers were matched based on Facility Name and location against the Inpatient Utilization File.

4.3: Methods and Techniques

Question 1: Does bariatric surgery decrease utilization of health care resources? Health care resources, in this analysis, are defined using utilization metrics and claims payments for inpatient admissions, physician office visits and prescriptions filled.

A retrospective pre-post design study was utilized to understand the impact of bariatric surgery:

T_1 S T_2

T_1 = Observation Period 1 (1-year Pre-Surgical Period)
S = Bariatric Surgery
T_2 = Observation Period 2 (1-year Post-Surgical Period)

The identified population's pre-utilization was compared against the identified populations post-utilization. This test determines the probability that the two populations (pre and post) are the same with respect to the variable tested.

Table 6: Pre/Post Data Capture

	Pre-Surgery (1 Year Prior)	Post-Surgery (1 Year Post)
Mean Number of Inpatient Admissions	0.49	1.08
Mean Number of Office Visits	6.43	5.71
Mean Number of Prescriptions Filled	24.70	20.17
Average Payment Inpatient Admissions	$2,670.94	$7,773.44
Average Payment Office Visits	$54.77	$48.42
Average Payment Prescriptions Filled	$45.52	$46.98

Once paired t-test analysis is complete, additional analysis using linear regression models will be utilized to further explain the study population. The linear regression model address differences in health care resources in the pre/post period in the following categories: Inpatient Admissions Payments, Physician Office Visit Payments and Prescriptions Payments.

Table 7: Health Care Resource Operationalization of Variables	
Independent	
Age	Individual Age at Surgery: Values 18-71
Sex	Male, Female
Geographic Region	Northeast, East, Central, Southeast, Southwest, West
Co-Morbid Conditions	0, 1, 2, 3, 4, 5, 6
Dependent	
Difference in Payments	Inpatient Admission Payments, Physician Office Visit Payments, Prescription Filled Payments

<u>**Models:**</u>

Dependent Variables

Y1 = Difference in Payments

Independent Variable:

X1 = Age
X2 = Sex
X3 = Geographic Region
X4 = Number of Co-Morbid Conditions

<u>Limitations:</u>

The data source, a medical claims database, lacks the required elements to create a true control group. Claims submission forms contain limited data fields and do not currently include BMI values or Height/Weight data elements that could have been utilized to create a control group (i.e. Individuals that meet BMI criteria to have surgery (BMI) but do not.) . In addition to lack of available data elements, coding techniques among providers vary. These differences influence what diagnosis and procedure codes are filed on a claim and can lead to a bias toward the null if claims submissions are not completed to the highest level of accuracy or vary widely by provider.

Coverage for bariatric surgery varies between employer groups and is not typically a part of benefits covered under the certificate of coverage. Therefore, individuals included within this analysis were either eligible for coverage because of their employer group elected to cover this procedure or they reside within a state that has legislation on coverage for morbid obesity. These differences could be a potential bias to the study results (See Appendix E). Selection bias for candidate selection for surgery may also bias results. Individuals who seek out treatment for obesity via surgery are evaluated based on BMI and existing co-morbid conditions – therefore results will not address the entire obese population but rather those that have the potential for surgical intervention.

The analysis does not distinguish bariatric surgery by procedure type. It is based on a submitted claim by the facility that groups to the Diagnostic Related Grouper (DRG) 288 O.R. Procedure for Morbid Obesity. This DRG Grouper classification does not provide detail as to the specific surgery and therefore distinction is not available. This results in a generic classification of all bariatric surgeries and does not take into consideration any specific surgical techniques.

Question 2: Is accreditation by the American College of Surgeons for bariatric surgery, associated with better surgical outcomes than surgeries performed at non-accredited facilities? Accreditation identifies a facility that has demonstrated physical resources, human resources, clinical standards, surgeon credentialing standards, data reporting standards and verification/approval process standards

A retrospective case-control research design was utilized to understand the impact of accreditation regarding bariatric surgery. Those facilities identified as having accreditation will be the intervention group (case), while those identified as not having achieved accreditation standards will be the control group.

Comparison of the two identified groups of facilities (Accredited and Non Accredited) will be conducted using two sample t-test analysis and chi-square. The null hypothesis, outlined in Chapter 3, assumes that accredited facilities will have statistically different payments and statistically different surgical lengths of stay. In addition complications were examined to understand if there was any association with accreditation status. Other statistical analysis will include linear regression models to determine if accreditation status has a significant impact (predictor) on surgical length of stay outcomes or cost outcomes. Linear regressions have been selected to assist in determining the best fit to the model related to outcomes. The models will examine facility type (Accredited versus Non Accredited) and other demographic factors (Age, Sex and Geographic Region, # of co-morbid conditions present) against each of the two variables of interest (1) surgical costs (Charges $) and (2) surgical lengths of stay. Correlation/Association analysis (Chi Square or Pearson's) may be utilized to examine the differences between each of the two identified facility populations in relation to complications.

Table 8: Accreditation Analysis Operationalization of Variables	
Independent	
Accreditation Status	Accredited (0), Non Accredited (1)
Age	Individual Age at Surgery: Values 18-71
Sex	Male, Female
Geographic Region	Northeast, East, Central, Southeast, Southwest, West
Co-Morbid Conditions	0, 1, 2, 3, 4, 5, 6
Dependent	
Payments	Total Payment to Facility (2006 Dollars)
Surgical Length of Stay	Inpatient Length of Stay (Discharge Date – Admit Date)

Models:

Dependent Variables

Y1 = Surgical Payments; Y1 = Surgical LOS

Independent Variable:

X1 = Accreditation Status
X2 = Age
X3 = Sex
X4 = Geographic Region
X5 = Number of Co-Morbid Conditions

Limitations:

The above study design is dependent on data obtained from a national insurers' medical claims database and therefore has limitations on data availability. Lack of detailed billing on claims and the potential variation of coding practices among providers may impact study findings. Specifically when analyzing complications, lack of detailed coding may influence results. Other limitations include limited data in the claims system that can be used to determine Body Mass Index (BMI) which is directly related to co-morbid conditions that can alter a patient's likelihood of a surgical complication. Results will not address the impact of BMI on overall complication rates.

In addition to the above mentioned limitations, there is an additional limitation on facility selection. Facility selection by an individual member is mainly dependent upon surgeon preference or referral. The typical scenario for health care is to seek out the physician first and then select a facility (typically a facility wherein the surgeon has privileges). In this analysis, the surgeon factor is not analyzed and the assumption is that both populations followed the same selection practices when deciding to have bariatric surgery.

4.4: Additional Areas of Bariatric Study

This analysis establishes a baseline of research on the topic of bariatric surgery. It was undertaken (in part) to assist in understanding the impact of obesity on a particular health insurer and to evaluate one alternative in the fight against obesity. The next research area beyond this dissertation should include analysis to determine a better "control" group for outcomes measures. The current data is limited as a result of data elements contained in the claims data warehouse; perhaps, additional techniques associated with propensity scoring and predictive modeling can be utilized to examine outcomes between those that elected to have surgery and those that meet criteria but did not elect to have surgery. The determination of financial and clinical impact from surgical outcomes is of particular interest to health plans. In addition, additional analysis on determining impact of surgery in states with legislation to cover morbid obesity treatment could be an area of study as coverage for surgery is brought to the forefront of benefit design. It is in the best interest of national health insurance carriers to stay in tune with health care legislation as it can impact benefit structure and coverage.

CHAPTER 5: RESULTS

5.1: Introduction

Claims data files for each study population was obtained and analyzed. The files contained all relevant data items necessary for the outlined research; however, each file required some additional data cleaning and a detail review prior to completing statistical comparisons. Listed below are the data steps that were completed prior to beginning analysis:

- Verification of data specific parameters
- Identification of Bariatric surgery date to determine pre/post study time periods
- Removal of claims were unique members could not be established. Unique Identifier = 1 or -1. (Database anomaly)
- Removal of Surgical Follow up visits from Pre/Post Physician Data
- Identification of Co-morbid conditions using ICD-9 Coding (See Appendix F)
- Recoding of Region data using Dummy Variables
- Identification of Accreditation facilities based on Name/Location
- Additional ICD-9 Code claims review to identify BMI Classifications
- Identification of Inpatient Readmissions within 30 days of Surgery
- Identification of Complications following surgery

Each study population data was combined into two (2) individual datasets for analysis using SPSS software (v13) and/or Minitab (v14). File Layouts for each data file can be found in Appendix G.

5.2: Results – Pre/Post Analysis

There were 5,442 adult bariatric surgery cases between January 1, 2006 and December 31, 2006 wherein individuals where continuously enrolled one-year prior and one-year post surgery. The average surgery cost was $16,087 with an average length of stay of 2.3 days. Basic demographic characteristics of the patient population are shown in Table 9. The majority of patients were female (79.7%) compared to male (20.3%). Patient average age for surgery was 43.7 with the majority of patients falling into the 30-39 (30.2%) and 40-49 (30.0%) age groups (See Table 9).

Table 9: Patient Demographics Age/Sex Breakdown

Sex				
	Female		Male	
	4,339	79.7%	1,103	20.3%
Age Groups				
	Less than 19	27		0.5%
	20-29	527		9.7%
	30-39	1,548		28.4%
	40-49	1,681		30.9%
	50-59	1,396		25.7%
	60 and Above	263		4.8%
	Total	5,442		100.0%

In addition, a geographic breakdown of surgical cases was performed. Most bariatric surgeries were performed in the Central Region (24.1%) and Southwest Region (33.4%). The State of Texas performed the most operations with the cities of Dallas (11%) and Houston (10.9%) ranking higher than any other location – see Appendix H for additional details.

Table 10: Geographic Breakdown

Central	1,313	24.1%
East	536	9.8%
Northeast	501	9.2%
West	406	7.5%
Southeast	870	16.0%
Southwest	1,816	33.4%
	5,442	100.0%

A review of the study population was conducted to determine the existence of co-morbid conditions. Results revealed that on average most patients had between 1 and 2 co-morbid conditions, 31.2% and 29.1% respectively. An examination of the types of co-morbid conditions showed that half of the population had some type of coronary disease (50%). Sleep Apnea was also seen in about one-third of the population (28%). Diabetes (24%) and High Cholesterol (21%) was also noted as leading co-morbid conditions.

Table 11: CoMorbid Types and Condition Counts

CoMorbid Conditions			CoMorbid Condition Count		
Asthma	528	10%	0	1,116	20.5%
Backpain	337	6%	1	1,696	31.2%
COPD	69	1%	2	1,582	29.1%
Diabetes	1,285	24%	3	835	15.3%
Coronary Disease	2,711	50%	4	187	3.4%
High Cholesterol	1,146	21%	5	20	0.4%
Osteoarthrosis	655	12%	6	6	0.1%
Sleep Apnea	1,518	28%		5,442	100.0%

*See Appendix F for diagnosis classifications.

A paired t-test was used to examine the impact of bariatric surgery on health care utilization (number of prescriptions filled, physician visits and inpatient admissions). Individual patients acted as their own comparison in the post period and excluded individuals who did not have any utilization counts/health care expenditures in the particular health cost category in either period. Results showed that there is a significant difference ($p < 0.05$) between utilization before and after surgery in all utilization categories. The mean prescription count before surgery was 24.70 ± .71 compared to the mean prescription count after surgery of 20.17 ± .58; mean physician visits before was 6.43 ± .07 and after 5.71 ± .07 and mean inpatient admissions before was .49 ± .02 and after 1.08 ± .04. Results indicated a drop in both physician visits and number of prescriptions filled and after surgery an increase in the number of inpatient admissions.

Results varied slightly when examining the impact of bariatric surgery using paid amounts. There was a significant difference ($P < 0.05$) in average paid dollars for both physician visits and inpatient admissions before and after surgery; however, there was no significant difference in the average amount of dollars paid for prescriptions before and after. The mean physician payment per visit before was \$54.77 ± \$0.40 and after \$48.42 ± \$0.38 – a decrease. Mean inpatient payments increased – before \$2,670.94 ± \$156.14 compared to after surgery average payments of \$7,773.44 ± \$419.32.

As a result of inpatient utilization and average payments increasing, a further review of the dataset was performed. It was determined that the initial dataset did not contain any claims exclusions related to admissions associated with complications during the post-surgery timeframe. A revised data set was prepared that excluded complication related admissions (See Appendix C for ICD-9 Bariatric Surgery Complication Codes) within 30-days following bariatric surgery. This additional data review reduced the claims extraction by 200+ admissions in the post period. The dataset was again analyzed using paired t-tests and results were similar. There is a statistical difference between inpatient admissions and average inpatient payments before and after surgery (*Before* .551 ± .026 /*After* .997 ± .038 and *Before* \$3,011.28 ± \$173.22 / *After* \$7,118.32 ± \$409.10, $P < 0.05$).

Table 12: Paired T Test Results - Pre/Post Bariatric Surgery Analysis												
	Utilization						Average Payments					
Category	N	Pre Mean	Std. Error Mean	Post Mean	Std. Error Mean	Sig	N	Pre Mean	Std. Error Mean	Post Mean	Std. Error Mean	Sig
Pharmacy	1376	24.7	0.711	20.17	0.577	0.000	1375	46.52	1.59	46.98	2.01	0.000
Physician	5339	6.43	0.073	5.71	0.073	0.000	5338	54.77	0.39736	48.42	0.38262	0.000
Inpatient	1167	0.49	0.024	1.08	0.037	0.000	1167	2679.94	156.14	7773.44	419.32	0.000
Inpatient (With Exclusions)	1035	0.551	0.026	0.997	0.039	0.000	1035	3011.58	173.22	7118.32	409.1	0.000

Further investigation into inpatient post utilization consumption showed that 715 of the 838 (85%) individuals having a post-operative admit did not have any admissions to a hospital in the preceding year. The majority of these individuals, 62.8%, had one admission in the post period (526/838). The data suggests that a high majority of individuals who underwent surgery and had a post surgical admission did not have one in the preceding year – thus increasing both utilization counts and inpatient spending. A detailed review of the inpatient claims data showed that a total of 715 individuals who did not have a pre-surgical inpatient admission that had a post surgical admission. Approximately 74% of these individuals had one admissions following bariatric surgery with total inpatient spend of $4.8 million dollars. On average, these post-surgical spent on average $9,248 dollars per admit and there was twenty-nine (29) individuals that had over $75,000 in total spending during the post-surgery period. There was one outlier individuals that had $625,000 in Post-Surgical dollars and was admitted multiple times 4.5 months following surgery for sepsis and identified as a complication from surgery.

TABLE 13: Post-Surgical Inpatient Utilization Detail Review Individuals with No Pre-Surgical Inpatient Utilization with Post-Surgical Utilization (N = 715)					
Category	Individual Count	Individual %	Total Admits	Admit %	INP Post-Surg Total Paid $
1 Post-Surgical Admission	526	73.6%	526	50.6%	$4,874,612
2 Post-Surgical Admission	130	18.2%	260	25.0%	$3,662,825
3 Post-Surgical Admission	30	4.2%	90	8.7%	$1,080,821
4 or More Post-Surgical Admission	29	4.1%	164	15.8%	$3,109,552
Total	**715**		**1040**		**$9,618,258**
Average Payments per Admit				**$9,248.32**	
Average Payments per Patient		**$13,452.11**			

Having examined the volume of admissions it leads one to investigate this specific population further to determine if there are other factors that influence certain individuals to have a post-surgical admit. The top reasons for admission in the post surgical period for individuals not having an admission in the pre-period are shown below. The majority of these admissions types are known to be associated with complications from bariatric procedures.

Table 14: Top Post Surgery Admission Reasons with No Admissionsin in Pre Surgical Period (All Post Surgical Admissions Encluded - No Restrictions)		
Description	Count	%
Esophagitis, Gastroent & Misc Digest Disorders	97	9.3%
Other Digestive System Disorder	55	5.3%
Nutritional and Misc Metabolic Disorders	51	4.9%
Peritoneal Adhesiolysis	49	4.7%
Laparoscopic cholecystectomy	34	3.3%
Uterine & Adnexa Procedución for Non-Malignancy	28	2.7%
Postoperative and Post-Traumatic Infections	28	2.7%
Major Joint Replacement or Reattachment of Lower Extremity	28	2.7%
Hernia procedures except inguinal & femoral	23	2.2%

To further evaluate inpatient utilization post –surgery one must examine individuals that had both Pre/Post Surgical Admissions to determine if the overall change was positive or negative. Upon review of the detailed data file it was found that overall individuals who had utilization in both the Pre/Post time frame (N=122 which represents

2.2% of Total Bariatric Surgery Population) had larger spend in the post period (Mean Increase of $4,175/patient). When examining the same population but focusing only on those that had decreased utilization in the post period (N= 26), the results showed overall savings. However, this potential savings (45.8%) does not offset the overwhelming increases seen in the post period for individuals who had increased medical expenditures. It was noted in the detail that six individuals had total spending in the post-period that exceeded $100,000. These individuals were admitted on average eight times post surgery. The table below describes the results seen when examining this subset of data:

Table 15: Pre/Post Inpatient Utilization Detail Review
Individuals with both Pre and Post Inpatient Utilization
(N=122)

Category	Individuals	INP PreSurg Total Paid $	INP PostSurg Total Paid $	% Change
Same Utilization (Pre = Post)	59	$505,510	$695,344	37.6%
Increased Utilization Post - 1 Admission	24	$306,370	$976,736	218.8%
Increased Utilization Post - 2 Admissions	8	$53,029	$313,727	491.6%
Increased Utilization Post - 3 or More Admissions	5	$50,203	$770,145	1434.1%
Sub Total Increased	37	$409,602	$2,060,608	403.1%
Decreased Utilization Post - 1 Admission	16	$528,414	$431,448	-18.4%
Decreased Utilization Post - 2 Admissions	8	$363,136	$73,695	-79.7%
Decreased Utilization Post - 3 or More Admissions	2	$70,660	$16,238	-77.0%
Sub Total Decreased	26	$962,210	$521,381	-45.8%
TOTAL	**122**	**$2,286,924**	**$5,337,940**	**133.4%**

A final analysis of the detail inpatient data examined individuals that had admissions in the pre-surgical period but no admissions in the post-surgical period (N=330). The review was conducted to understand the potential savings in the post period because of no inpatient utilization. The predominance of individuals (89%) had one pre-surgical admission and no post-surgical admissions, the remaining 11 % of the population had at least two pre-surgical admissions. Average savings per admit (based on pre-surgery spending) is approximately, $6,588. This data clearly shows that these individuals had reduced admissions/spending following surgery; however, additional economical models should be used to evaluate true savings related to this specific group.

Table 16: Pre-Surgical Inpatient Utilization Detail Review Individuals with Pre-Surgical Inpatient Utilization and No Post-Surgical Inpatient Utilization (N=330)					
Category	Individual Count	Individual %	Total Admits	Admit %	INP PreSurg Total Paid $
1 Pre-Surgical Admission	294	89.1%	294	89.1%	$1,867,225
2 Pre-Surgical Admission	26	7.9%	52	15.8%	$398,833
3 or More Pre-Surgical Admission	10	3.0%	32	9.7%	$224,400
Total	**330**		**378**		**$2,490,458**
Average Savings per Patient		**$7,546.84**			
Average Savings per Admit				**$6,588.51**	

In addition to reviewing the potential savings, a review on the the types of admissions was conducted. It was determined that a majority of inpatient admissions in the pre-surgical period were related to child birth (10.8%) and other female specific diagnosis (Uterine and Adnexa Procedures – 5.8%). However, the other admissions types were found to be obesity related ailments including Chest Pain (6.1%), Esophagitis, Gastroentestinal Disorders (4.2%), Circulatory Disorders (3.4%), Cellulitis (3.4%) and Percutaneous Cardiovascular Procedures (3.4%).

Table 17: Top Pre Surgery Admission Reasons with No Admissionsin in Post Surgical Period (N = 378)		
Description	Count	%
Chest Pain	23	6.1%
Vaginal Delivery	22	5.8%
Uterine and Adnexa Proceducre for Non-Malignancy	22	5.8%
Cesarean Delivery	19	5.0%
Esophagitis, Gastroent & Misc Digest Disorders	16	4.2%
Circulatory disorders except AMI, w card cath	13	3.4%
Cellulitis	13	3.4%
Percutaneous Cardiovasc Proc with Stent	13	3.4%
Simple Pneumonia and Pleurisy	9	2.4%
Diabetes	9	2.4%
Laparoscopic cholecystectomy	9	2.4%
Major Joint Replacement or Reattachment of Lower Extremity	8	2.1%
Back and Neck Proc except Spinal Fusion	8	2.1%

To further evaluate the pre/post dataset, statistical tests were conducted using a linear regression model (Method: Enter). The analysis focused on examining the surgical population and the impact specific variables (age, sex, region or # of co-morbidities) have on the differences between the pre/post periods. Using SPSS a new variable to calculate the differences in payments between the two periods (pre/post) was created for each healthcare category (inpatient, outpatient and pharmacy). Findings varied by healthcare category. Holding all other variables constant, the West region on average pays more in the post period for inpatient care than all other regions. Physician payment differences were noted in both the West and Southeast region. These payment differences were found to be statistically significant equating to larger savings (i.e. the difference between before/after physician payments is greater in the pre-period than the post-period). In addition, females were found to have greater savings after surgery and as age and the number of co-morbid conditions increased – the potential savings decreased. The only significance found related to Pharmacy spending was in the category of gender. Females tended to have less pharmacy spending post-surgery than males. In reviewing the models, none of the independent variables examined (Age, Sex, Number of Co-Morbid conditions and geographic regions) was powerful enough to explain/predict why there is a difference in spending (Inpatient, Physician, or Pharmacy) in the pre/post time period. The independent variables tested explained only between 1.1% and 1.3% (R^2 values) of the variation. (See next page – Table 18).

Table 18: Pre/Post Linear Regression Model: [Enter]						
	Inpatient		Physician		Pharmacy	
R Square	0.011		0.012		0.013	
Adjusted R Square	0.004		0.010		0.007	
	Inpatient		Physician		Pharmacy	
	B	Sig.	B	Sig.	B	Sig.
Constant	-3544	0.097	14.544	0.00	-17.019	0.018
Sex	-928.101	0.433	***4.082***	***0.001***	***10.552***	***0.008***
Age	-57.309	0.224	***-0.197***	***0.00***	0.236	0.137
# of CoMorbid Conditions	850.705	0.056	***-1.157***	***0.01***	2.448	0.102
Central	-78.567	0.95	1.714	0.172	1.989	0.637
East	1467.458	0.387	-2.824	0.097	-3.767	0.51
Northeast	779.394	0.654	1.265	0.469	1.88	0.749
West	***-4588.232***	***0.016***	***6.516***	***0.001***	-1.851	0.772
Southeast	-78.887	0.956	***3.558***	***0.013***	1.681	0.726

5.3: Results – Accreditation Analysis

There were 7,275 surgeries performed between January 1, 2006 and December 31, 2006 that qualified for the study. Of the 7,275 surgeries, 706 (9.7%) were performed at accredited facilities. More females underwent bariatric surgery than males (80.1% compared to 19.9%/ 4:1 ratio). The majority of patients having surgery were between the ages of 30 – 49 with an average age of 43 (See Table 19). Geographically, most cases were performed in the Central Region (1,726 cases – 23.7%) and Southwest Region (2,505 cases – 34.4%) - (See Table 20).

Table 19: Patient Demographics Age/Sex Breakdown

Sex				
Female		Male		
5,827	80.1%	1,448	19.9%	
Age Groups				
Less than 19	40		0.5%	
20-29	865		11.9%	
30-39	2,198		30.2%	
40-49	2,186		30.0%	
50-59	1,663		22.9%	
60 and Above	323		4.4%	
Total	7,275		100.0%	

Table 20: Geographic Breakdown

Central	1,726	23.7%
East	487	6.7%
Northeast	755	10.4%
West	580	8.0%
Southeast	1,222	16.8%
Southwest	2,505	34.4%
	7,275	100.0%

Data showed that the majority of patients undergoing bariatric surgery had between one and two co-morbid conditions (32% and 29%) and the most common co-morbid conditions were Coronary Disease (47%), Sleep Apnea (27%), Diabetes (22%) and High Cholesterol (20%). A break down of identified co-morbid conditions and counts is shown in Table 21 below:

Table 21: CoMorbid Types and Condition Counts

CoMorbid Conditions			CoMorbid Condition Count		
Asthma	696	10%	0	1,583	29.1%
Backpain	456	6%	1	2,308	42.4%
COPD	84	1%	2	2,119	38.9%
Diabetes	1,611	22%	3	1,040	19.1%
Cardiac Disease	237	3%	4	201	3.7%
Hyperlipidemia	1,468	20%	5	19	0.3%
Hypertension	3,217	44%	6	5	0.1%
Osteoarthrosis	862	12%		7,275	133.7%
Sleep Apnea	1,963	27%			

*See Appendix F for diagnosis classifications.

Additional surgical rate analysis was analyzed regarding the general insured populations using the accreditation study population. As seen below, the number of surgeries performed per 100,000 insured members is relatively low; however, with the increased focus placed on this type of surgery these numbers are expected to grow. A breakdown of the general insured population by sub market can be found in Appendix I.

Table 22: General Insured Population Demographics by Region

Region	Average Membership	Bariatric Surgery per 100,000 Insured
Central	4,637,109	37
East	2,135,753	23
Northeast	2,165,605	35
West	1,307,398	44
Southeast	3,745,361	33
Southwest	4,111,108	61

Using a student's t-test for independent samples, the differences between accredited and non-accredited facilities was conducted. Examinations of surgical cases were not adjusted for severity. Results (Table 22) showed that there were not any significant differences with regards to dollars paid for surgery t(7273) = 1.141, p = .254 and bariatric surgery length of stay t(7273) = -1.369, p = .171 between facilities having accreditation and those that were not accredited. The average cost for surgery for the accredited facilities was $15,759.33 and non-accredited was $16,535.27. The average length of stay for the accredited facilities was 2.55 and the average length of stay for the non-accredited was 2.37.

Table 23: Accreditation Independent Samples T-Test Results

	Accredited (N=706)	Non-Accredited (N=6,659)	Significance
Surgical Costs	$15,759.33	$16,535.27	0.254
Surgical Length of Stay	2.55	2.37	0.171

To further evaluate facilities and accreditation status an additional analysis focusing on bariatric surgery complications was conducted using a chi-square test of independence (See Table 24). The analysis examined whether or not surgical complications are related to where a surgery was performed (accredited facility versus non-accredited facility). The results showed (χ^2 = 0.159, df=1, p=.690) that complications are not associated with accreditation status. This is to say that accreditation status is not a predictor of whether or nor a post-surgery complication would occur. Overall results performed on the dataset showed no real difference between non-accredited and accredited facilities when evaluated on payments for surgery, length of stay and number of complications.

Table 24: Complication Analysis Chi Square 2 X 2					
	Complication Identified 1 = Identified Complication 0 = No Identified complication				Total
	0		1		
	Count	%	Count	%	
Non-accredited	5,344	81.4%	1,225	18.6%	6,569
Accredited	570	80.7%	136	19.3%	706
Total	5,914	81.3%	1,361	18.7%	7,275

Chi-Square Tests					
	Value	df	Asymp Sig (2-sided)	Exact Sig (2-sided)	Exact Sig (1-sided)
Pearson Chi-Square	0.159	1	0.69		

Linear regression models [Method: Enter] were used to determine whether or not specific independent variables could account for differences between (a) Surgical costs or (b) Length of Stay. Results showed that sex, age, number of co-morbid conditions and regional location of surgery have a significant impact on the surgical cost. Specifically, males have a higher expenditures than females, the older the patient the more expensive the surgery will be and when all other variables are controlled for both the West and the East pay more on average than other regions. The analysis further showed an adverse relationship between number of co-morbid conditions and costs ($\beta = -1213.58$). This result is interesting and merits further investigation as traditionally medical expenses increase as patients are identified as having multiple health issues. Of all independent variables tested, the only variable that did not show any relation to surgical payment was accreditation status.

Additional linear models on bariatric surgery length of stay were completed. Results showed that age, sex and number of co-morbid conditions are significantly related to bariatric surgery length of stay. The younger a patient is the more likely they are to have a shorter length of stay. Males tended to have a longer length of stay than females. Geographic location of surgery was examined. Results showed the Central Region, on average, has statistically significant longer lengths of stay for bariatric surgery. Other geographic regions tested were not found to be statistically significant in relation to length of stay. In addition, accreditation status was not found to be statistically significant with regards to bariatric surgery length of stay. Although some of the independent variables tested where found to be statistically significant the overall model only accounted for a small part of variation in surgery costs and length of stay (R^2 = 2.2% and 1.6%, respectively). Further, it can be inferred that over 98% of the variation cannot be explained by the predictor variables tested.

Table 25: Accreditation Linear Regression Model: [Enter]

Model	Surgical Cost	Length of Stay
R Square	0.022	0.016
Adjusted R Square	0.021	0.015

	Surgical Cost			Length of Stay		
	B	Sig.		B	Sig.	
Constant	15679.279	0.000		1.2528	0.00	
Accreditation Status	**-997.215**	**.143**	**Not**	0.1865	0.162	**Not**
Sex	1644.528	0.001	Significant	0.31556	0.001	Significant
Age	58.342	0.003	Significant	0.030541	0.000	Significant
# of CoMorbid Conditions	-1213.578	0.000	Significant	-0.26575	0.000	Significant
Central	-1387.095	0.009	Significant	0.4242	0.000	Significant
East	2478.792	0.003	Significant	**0.214**	**0.195**	**Not**
Northeast	-1892.124	0.008	Significant	**0.1262**	**0.365**	**Not**
West	6097.955	0.000	Significant	**0.1942**	**0.207**	**Not**
Southeast	-1791.65	0.003	Significant	**-0.0297**	**0.799**	**Not**

5.4: Summary

Study results showed that there are changes in utilization patterns for individuals undergoing bariatric surgery. Both the number of scripts filled and the number of physician visits decreased while inpatient admissions increased. Average physician payments decreased and average inpatient payments increased after surgery and both changes were found to be statistically significant. There was not any statistical difference in average pharmacy payments between study periods. Additional analysis was conducted on the inpatient detail to review the utilization pre/post more deeply and the reasons for admissions in each period. The results showed a clear adverse relationship in the pre/post period even for individuals who had equal admission counts in the pre/post period (a 37.7% increase in expenditures). In addition, it was clearly seen that many of the admissions in the post period were directly related to complications from bariatric surgery. These admission types included Esophagitis, Gastrointestinal and Miscellaneous Digestive Disorders, Nutritional and Miscellaneous Metabolic Disorders and Other Digestive System Disorder. Linear models examined various demographic characteristics on the study population to the difference in health care expenditures in the time periods. Results varied by health category (physician, pharmacy and inpatient). The most demographic statistical significant findings were found in the physician category – Age, Sex, Number of Co-morbid conditions and three of the six regions were all statistically significant. Pharmacy Spending and Inpatient Spending models showed very little statistical significance results with regards to independent demographic variables tested. Overall, the variation explained by independent variables tests was not high (R^2 between 1.1% – 1.3%).

Accreditation analysis showed that location of surgery (accredited facility versus non-accredited facility) did not impact length of stay or bariatric surgery costs. Research on surgical complications showed no strong association between accreditation statuses. Linear regression models confirmed independent t-test findings that accreditation status is not a statistically significant in explaining variation in payment or surgical length of stay.

Other linear model results showed surgical payment variation is statistically significant in all demographic categories tested except accreditation status. Surgical Length of Stay variation was found to be statistically significant in the following demographic independent variables: sex, age, Number of Co-morbid conditions and the Central geographic region. Although the linear models results showed statistical significance in various demographic categories, overall the model only explained around 2% of the variation – leaving 98% of variation not explained. (R^2 = 2.2% Surgical Costs and 1.6% Surgical Length of Stay).

CHAPTER 6: CONCLUSIONS

6:1 Introduction

The U.S. health care system is facing a health care crisis and adjustments to the current system need to occur. Literature has shown a distinct connection between obesity and health care expenditures. (Cornier, 2002; Mokdad, 2001; Obesity Society, 2004; Finkelstein, 2004, Wolf & Colditz, 1990) Bariatric surgery is one avenue of opportunity that can facilitate change in an over-taxed health care system. However, insurance coverage for this surgery is still under debate. The reasons for coverage are straight forward. It is a proven treatment option in the battle against obesity (Sjostrom, 1992; Balsiger, 2000; Ahroni, 2005; Bond, 2004) and presents an opportunity to change long-term health care expenditures by reducing the shear number of obese individuals in the current population. The results from this retrospective claims analysis study set forth the ground work for analyzing insurance coverage of bariatric surgery. The main focus is to understand how bariatric surgery can impact health care resources within the frame work of a national health care insurer. In addition, it examined facility accreditation to determine if it provides additional value that can be leveraged in determining coverage of bariatric surgery by an insurer.

6:2 Pre/Post Study Discussion

Results from the pre/post study showed that utilization patterns are clearly different before and after surgery. There was a statistically significant drop in both the number of prescriptions filled and physician visits post-surgery, supporting the fact that bariatric surgery can decrease the need for certain medications as well as physician visits. This finding is very similar to other bariatric studies that have found a drop in utilization

(Ahroni, 2005, Dolan, 2003, Ponce, 2004, Potteiger, 2004, Christou, 2004, Gallagher, 2003) and demonstrates that changes in utilization can occur within 1-year of surgery. A recent prospective study by Sears, et al examined specific outcomes one-year following bariatric surgery. The results showed lower use of medications for (Arthritis, Hypertension, Diabetes, High Cholesterol, and Depression) and improvements in several biometric measures, including blood pressure and cholesterol (Sears, 2008). Results from this analysis confirm previous findings and verify that changes do occur within one year following surgery. Further, this post-operative drop in utilization within pharmacy and physician suggests that bariatric surgery patients will align more with traditional utilization patterns of the non-obese. If this new alignment prevails, insurers benefit by covering a healthier population who use less health care resources because obesity has been reduced. The impact on physician utilization is further supported by a decline in average health care payments for physician visits. It is hypothesized that the reduction in payments can be a result of changes in physician contracting between time periods or it may relate to a reduction in the use of specialty physician visits versus primary care physician (Internal Medicine and General Practitioners). Further analysis on this topic is warranted and should include an evaluation in physician specialty in the pre/post period as well as a review of contracts to exclude them as a confounder. Additional analysis could further describe changes in physician utilization patterns and potentially provide more insight regarding the impact surgery has on specific obesity related co-morbid conditions.

Although pharmacy utilization declined, the difference in the pre/post average payments for prescriptions did not. The lack of support for a financial change in the pre/post period is interesting. At first, it would appear that utilization pattern changes would mimic average payment; however, it did not. Upon a broader overview of the pharmacy data, it was theorized that these results may actually be related to the insurer's pharmacy benefit structure. This study design utilized a review of average payment for an individual in the pre/post period; it did not examine total payments per person. Therefore, while the number of prescriptions per patient decreased, the remaining prescriptions analyzed still drove up the average payment similar to the prior year. Leading to the realization that pharmaceutical costs and payment structure is very difficult to evaluate in the insurance industry as it changes periodically. Prescription formularies are subject to review annually and routinely are updated to include tier changes (Preferred Drugs/Brand versus Generic) as well as coverage/removal of specific medications. Additional analysis is needed to provide further details on variations in average payments as well as provide additional clinical information on the impact associated with bariatric surgery. This additional evaluation should include an evaluation of medications use (clinical condition for use), medication type (brand versus generic), quantity and strength of medication being filled. The additional review on medication types could also examine the impact bariatric surgery has on specific obesity related conditions (diabetes, hypertension, cholesterol) and substantiate other bariatric surgery pharmaceutical studies.

Results from the inpatient utilization analysis were not expected. Although the results confirmed a statistical difference in the pre/post period, it also confirmed that utilization and average inpatient payments increased in the post surgical period. Even after adjustment for 30-day readmission rates due to surgical complications results remained the same. Thus, it leads one to conclude that bariatric surgery leads to increased inpatient utilization one-year following surgery.

From a health care industry/payment perspective this finding presents an interesting case against reimbursement for bariatric surgery. In evaluating the coverage for surgery many health care insurers have elected to not cover the surgery because of conflicting research on the benefits. Results from this study confirm an increase in hospitalizations following surgery; however, an evaluation on overall impact should be further analyzed and not compartmentalized to rely on inpatient results only to justify decisions. This study design only focused on a one-year post operative period but subsequent periods may show a favourable medical cost trend. This means that while there were higher medical expenditures within the first year, over time this could stabilize and potentially decrease.

Additionally, the actual number of individuals impacted by post-surgical admissions should be considered. According to the study, 8% of the population experienced an inpatient admissions prior to surgery (452/5,442) and 15% (838/5,442) experienced an inpatient admissions after surgery - admissions doubled. Nonetheless, a vast majority of patients (85% of the population) never experienced a post surgical inpatient admission and this fact should not be overlooked when evaluating coverage of bariatric surgery. If eighty-five percent (85%) of the population does not have increased utilization following surgery, this means potential lower resource consumption by a sizeable portion of patient population.

Overall the results from the pre/post analysis are optimistic. They demonstrate a clear pattern of utilization change as a result of bariatric surgery which is encouraging. A majority of the population examined showed a decrease in the number of prescriptions filled and physician visits within one year following surgery. From a cost perspective, the reduction in average physician costs was found to be significant but it must be weighed against the increased costs associated with inpatient admissions. In a pure economic model the resulting inpatient admissions and increased inpatient expenditures in this one year study may overshadow the positive change seen in physician and pharmaceutical resources. The change in inpatient utilization was further validated by examining base level data detail and outlining the various changes that caused the statistically significant increase in the use of inpatient health care resources. However, with additional post period analysis the savings generated from a healthier non-obese population may drive overall savings to offset any initial inpatient increases in utilization/expenditures. A more detailed analysis of the post-surgical admissions and the population that had post-surgical admissions is suggested. By examining this population more closely, one may determine characteristics that would distinguish individuals as having a higher propensity for admissions following surgery.

The linear regression models in this analysis examined the difference between the pre period average payments to the post period average payments using demographic characteristics. The results offered an overview of variation within the study population. Results suggest that physician spending is impacted by demographic characteristics after surgery. Females in general have less health care expenditures (Pharmacy & Physician) after surgery. As Age increases one unit (year) the potential savings decrease; likewise, as the number of co-morbid conditions increase a patient has less potential for savings (i.e. more costs). These findings were found to be consistent with traditional health care spending patterns. The difference in regional spending is interesting; however, insurance based contractual differences across the United States may be a confounding factor that was not accounted for in this regression analysis.

All linear models reported low R^2 values. These low values represent a model that does not explain a majority of the dependent variables tested - difference in spending between pre/post periods by health cost category. This low R^2 value is representative of the limited independent variables found in the claims data. Using claims data, a secondary data source, limited the availability of variables (independent) to test. Thus the R^2 values attained in this research are not as high as one would expect. Future research should focus on other variables that could provide more population characteristics that could better explain differences in the population. Examples of these types of characteristics could be pre-surgical Body Mass Index (BMI), Total Weight Loss (at varying intervals) and complications.

6:3 Pre/Post Study Limitations

This study had several limitations that precluded additional statistical comparisons. The main limitation of the study was the lack of a recorded Body Mass Index (BMI) for each patient in the study population. The data source for the study was a large nationwide health care insurer claims database and although ICD-9 Coding exists to classify patients into BMI categories (See Appendix F), it is not required for physicians or hospitals to include BMI values on claims submission forms to the insurance carrier. A review of claims data showed less than half (42.4%) of the surgery cases included an ICD-9 Code for BMI classification. Having this additional demographic characteristics may have also provided more explanation in the linear regression model as well as help explain how BMI influences use of resources (utilization and expenditures).

The lack of availability of BMI classifications in the submitted claims is a symptom of the overall differences in billing/coding practices amongst providers. Providers are required to submit appropriate procedure and diagnosis codes on billing/ billing/claims submission forms; however, the degree of detail and level of accuracy can vary amongst providers. This could lead to a bias in the results that is not discernable in the data. This same limitation has been noted in other studies that have used administrative databases to capture clinically based data.

Another limitation to the analysis was the lack of a comparable control group. In order to truly assess the positive impact of bariatric surgery a control group consisting of individuals who did not have surgery but were obese would have been optimal. However, because of the above mentioned lack of recorded Body Mass Index values in submitted claims values a control group was not available.

There is also a limitation associated with the time frame of this analysis. The individual in each population was studied for 24-months (1 year prior to surgery and 1 year post surgery). A more expansive time frame would have been preferable to document the true utilization constraints of an obese individual prior to surgery versus utilization post-surgery. This constraint is a reflection of the ever changing world of health care insurance; wherein, employer groups opt to switch insurance coverage or offer multiple coverage options to employees as well as individuals change jobs thus change insurance.

Finally practice patterns for this surgery may vary across regions. This variation is referred to as unwarranted variation. Unwarranted variation is defined as a difference in the delivery of health care services that is not explained by illness, medical need, or evidence-based medicine. It provides that there are differences in the way providers in certain regional locations treat specific conditions even though evidenced based medicine has set forth protocols for treatment. The effectiveness of bariatric surgery is no different based on the region of surgery but provider practice patterns can influences treatment and there is no way of discerning this from the models examined (Health Dialog, 2009).

6:4 Accreditation Discussion

Industry research on accreditation programs associated with bariatric surgery is still on-going. As popularity of the surgery increases more demand will be placed on health care insurers and providers to offer efficient and effective clinical care for bariatric services. Accreditation status for bariatric surgery providers was examined to evaluate whether or not it provided additional benefits to the insured population. The results could further assist with the development of insurance based accreditation programs for the treatment of obesity and bariatric surgery. These treatment programs could allow patients access to medical services within certified facilities designated as Centers of Excellence.

Results from this study showed that there were no observed differences in accredited versus non-accredited facilities in either category surgery costs or surgical length of stay. These results were not expected and provide scepticism regarding the benefit of directing patients to accredited facilities for surgery. This finding echoes a recently published article by Dr. Edward Livingston. In his research, Dr. Livingston found that patient care costs were actually statistically significantly higher at accredited facilities (Centers of Excellence). However, when adjusted for effect size (estimations of clinical significance for observed differences) the differences between accredited and non-accredited were not clinically significant. This lead to his conclusion that facilities designated as Centers of Excellence are not associated with better outcomes, a fact that was supported by the current study (Livingston, 2009).

Similar to surgical costs and length of stay, the current study results showed that there is no difference between accredited and non-accredited facilities in relation to post-surgical complications. Facility type (accredited or non-accredited) does not guarantee whether or not one is more likely to experience a complication. This result provides additional ammunition against the value of accreditation and further corroborates findings from the Livingston study. Livingston found that inpatient complication rates and death rates were the same regardless of accreditation status (Livingston, 2009). However, the Livingston study contained limitations related to classifications of complications. It only evaluated inpatient complications and it did not analyze post-hospitalization complications (tracking of readmissions/emergency room visits due to surgical complications). The current research did examine a broader definition of surgical complication and still found no difference based on accreditation status. In this analysis a bariatric surgery complication was defined as (a) inpatient complications (prolonged length of stay = length of stay top 10th percentile) and (b) emergency room visit with specific diagnosis classifications related to surgery complication and (c) inpatient readmissions within ninety (90) days after discharge related to bariatric surgery complications. The percentage of complications for each facility type was close, accredited (19.3%) and non-accredited (18.6%).

The linear models utilized in this analysis corroborated the results from the student t-tests. The independent variable, accreditation status, did not show any association with surgical costs or length of stay. The linear models did however provide some interesting information that could benefit payers when evaluating the development of an obesity treatment program. In general, results showed that females have shorter lengths of stay and lower surgical costs than males. Regardless of gender, age also appeared to impact both payment and length of stay. Younger patients have lower costs and shorter lengths of stay. This is an important fact when considering obesity treatment program and the target population for such program. In the development of any type of program it is important to understand who benefits the most from treatment by examining various outcome and demographic factors of the target population.

Ironically, the results from the linear model showed that as the number of co-morbid conditions increased, surgical payments and length of stay was adversely impacted (Linear Model reported negative β values). It is theorized that these results are likely a result of incomplete coding by the provider in recording of co-morbid conditions on the claims form. Approximately, 53% of individuals in the study population had between 0-1 co-morbidities listed on their surgical claim which is very low according to a study by Shinogle. In his research, he found that on average surgical candidates had 3.7 additional diagnoses related to co-morbidities listed on their surgical claim (Shinogle, 2005). This study population only had on average 1.46 additional diagnoses related to co-morbidities filed on claims – less than ½ that reported by the Shinogle study. These results go against traditional medical trends wherein costs increase as patients are identified as being inflicted with multiple health issues. Geographic location of surgery did present some noteworthy data. The results point to no statistically significant differences in length of stay for all regions except the Central Region, which had statistically significant different length of stay (shorter length of stay). When assessing the differences regional for surgical costs, it was found that all regions had statistical significance. The cost for bariatric surgery is widely distributed; however, contracting variations across regions should be considered as a potential confounder variable that was not taken into account in this analysis.

To better understand this payment variation an economic analysis on payment variation for general surgeries compared to bariatric surgeries could be explored. The analysis could examine general surgeries compared to bariatric surgery to see if they have regional patterns. As stated previously, the knowledge on differential payment structures/contractual agreements between regions/facilities is needed. Contractual agreements for facilities tend to fall into three (3) categories – per diems, percentage of billed charges or DRG/Case Rates as well as there are economic payment differentials across the United States. This analysis did not adjust for these differences and was based solely on payments made to facilities by the insurance company. In addition, when analyzing payments it could be argued that length of stay is actually a covariate of payment. Traditional commercial insurance contracts with facilities are commonly one of three types: (a) per diem (b) per case or (c) a percentage of billed charges. For both per diem and percentage of billed charges contracts payment is directly related to the number of days a patient resides in a facility. That being the case it may be considered as a possible explanation variable related to differences in payment. Additional models including length of stay can be ran to determine the influence this variable has on payment.

Overall, the results from the accreditation analysis did not provide justification to recommend specific facilities for bariatric surgery. Outcomes showed that surgical payment and length of stay are similar regardless of facility accreditation type. In addition, there was not a distinction that could be made regarding complications. However, there may be additional clinical measures that warrant testing and they could provide further distinctions between accredited facilities and non-accredited facilities. Other variable considerations are pre-surgical BMI values, total weight loss, types of co-morbid conditions and patient support/follow-up. Additional analysis is still needed to further evaluate accreditation program effectiveness and should be completed prior to development of obesity programs. Still, this study does provide some valuable information that can be used when evaluating the development of bariatric programs to treat obesity.

6:5 Accreditation Limitations

An overarching limitation to this analysis was missing identifiers of Body Mass Index (BMI) in the claims data base (42.0% had a denoted BMI value). Without the BMI identifier, additional analysis to see if BMI impacted the results could not be conducted. Some literature has suggested that accredited facilities tend to attract more complex cases (i.e. Higher BMI Patient). The reason for this is related to the fact that accredited facilities are generally more experienced in performing surgery because they have met threshold requirements on the number of surgeries performed per year. Without having BMI complexity or severity of cases could not be determined.

Claims coding variations may have also influenced results related to the identification of co-morbid conditions. This limitation if a result of retrospectively reviewing claims data. The analysis is dependent upon what is billed on the claim and one does not have the ability to extract additional elements to close any identified gaps. The missing data elements have the potential to not only help further explain the initial results found in this research but could also assist with expanding research on accreditation and whether it has value or not. In general, additional variables should be collected to include in future analysis.

One final limitation is the classification of bariatric cases examined. This analysis was dependent upon claims submissions for surgery to treat obesity (DRG 288 – O.R. Procedure for Morbid Obesity) and a Primary ICD-9 Diagnosis of 278.xx (Morbid Obesity). The analysis on surgical payment and length of stay did not differentiate on surgical procedure type (Vertical Banded Gastroplasty (VBG) and Laparoscopic Gastric Banding (LAGB). Vertical Banded Gastroplasty versus more open procedures like the Roux-en-Y). Additional analysis to make distinctions of the type of surgery being performed may further explain payment differences and length of stay. However, it should be noted that procedure identification is again dependent upon claims submissions with proper procedural coding.

6:6 Conclusions

As obesity trends continue to escalate, investigation on how to treat the obese needs to be reviewed. Bariatric surgery is a viable option to treat obesity and has proven itself as a successful way to lose weight. This research was developed to show the positive influence that bariatric surgery has on health care utilization and health care payments within one year of surgery and to determine if accreditation status of a facility had additional added benefit. The results showed evidence that one year following bariatric surgery there was a positive influence on physician and pharmacy health care resources. However, results also showed an overall increase in inpatient resource consumption. Because of the increase in inpatient utilization and inpatient spending all findings do not support the coverage of bariatric surgery. Additional analysis to explore more deeply the post-surgery period is warranted. As the majority of patients did not experience increased inpatient resource consumption and future periods could potentially offset this one-year post period trend.

Results regarding the impact of accreditation were not favourable. However, it does not necessarily discount the importance of developing obesity treatment programs. The factors examined in this research only focused on surgical payment and length of stay and there are many more clinical variables that were not examined that could directly impact the patient population seen at accredited facilities. Future analysis should include evaluations on patient characteristics, such as BMI, pre-existing co-morbid conditions, total weight loss and long-term maintenance of weight loss over time to provide additional views on the value of accredited facilities. As a result of this research, it is recommended that more extensive research of accreditation programs is undertaken using the aforementioned variables.

In closing, research on bariatric surgery has continued to grow and as trends for surgery continue to increase research should continue. Our nation should continue to evaluation treatment protocols and clinical interventions for leading medical condition cost drivers, such as obesity. Bariatric surgery should remain on the forefront of research as it offers the ever-increasing obese population the opportunity to not only improve their health and longevity but it could also improve trends of health care consumption (which equate to financial savings). This study is a stepping stone in the evaluation of bariatric surgery for a national health care insurer and will serve as a baseline for future analysis on this topic.

APPENDICES

Appendix A: Pre/Post – Extract File Layout

INPATIENT DATA FILE LAYOUT
Individual System ID (Unique Identifier)
DOB
Age Band
Sex
Zip
Eff Date
Exp Date
Member ID
Bariatric Admit Date
Admit Date
Admit Cnt
Length of Stay
DRG Code
DRG Code Description
DRG Code Weight
APR DRG Code
APRDRG Code Description
APRDRG Severity Class
APRDRG Mortality Class
Facility Name
Servicing Provider
Tax Identification Number
Facility Identification Number
ICD-9 Proc Code
ICD-9 Procedure Code Description
ICD-9 Proc1
ICD-9 Proc1 Description
ICD-9 Proc2
ICD-9 Proc2 Description
ICD-9 Proc3
ICD-9 Proc3 Description
ICD-9 Proc4
ICD-9 Proc4 Description
ICD-9 Diag1
ICD-9 Diag1 Description
ICD-9 Diag2
ICD-9 Diag2 Description
ICD-9 Diag3
ICD-9 Diag3 Description
ICD-9 Diag4
ICD-9 Diag4 Description
ICD-9 Diag5
ICD-9 Diag5 Description
ICD-9 Diag6
ICD-9 Diag6 Description
Health Plan Market
Health Plan Region
Funding Type
Product
Place of Service
Billed $
Age (at Surgery)

PHYSICIAN DATA FILE LAYOUT
Individual System ID (Unique Identifier)
DOB
Age Band
Sex
Zip
Member ID
Bariatric Admit Date
Date of Service
Visit Count
Servicing Provider Name
Provider Specialty Code
Provider Specialty Description
Tax Identification Number
Provider Identification Number
ICD-9 Proc Code
ICD-9 Procedure Code Description
ICD-9 Proc1
ICD-9 Proc1 Description
ICD-9 Proc2
ICD-9 Proc2 Description
ICD-9 Proc3
ICD-9 Proc3 Description
ICD-9 Proc4
ICD-9 Proc4 Description
ICD-9 Diag1
ICD-9 Diag1 Description
ICD-9 Diag2
ICD-9 Diag2 Description
ICD-9 Diag3
ICD-9 Diag3 Description
ICD-9 Diag4
ICD-9 Diag4 Description
ICD-9 Diag5
ICD-9 Diag5 Description
ICD-9 Diag6
ICD-9 Diag6 Description
Health Plan Market
Health Plan Region
Funding Type
Product
Place of Service Description
Billed $

PHARMACY DATA FILE LAYOUT
Individual System ID (Unique Identifier)
Member ID
Bariatric Admit Date
Fill Date
Prescribing Physician Name
Precription Count
Brand Name
Generic Name
NDC Code
Days Supply
Strength (Milligrams)
Therapeutic Class Code
Therapeutic Class Description
Generic Fill Indicator
Ingredient Costs/Dispensing Fee
Member Co-Pay

Appendix B: Question 2 - Layout of Data

INPATIENT DATA FILE LAYOUT
Individual System ID (Unique Identifier)
DOB
Age Band
Sex
Zip
Member ID
Bariatric Admit Date
Admit Date
Admit Cnt
Length of Stay
DRG Code
DRG Code Description
DRG Code Weight
APR DRG Code
APRDRG Code Description
APRDRG Severity Class
APRDRG Mortality Class
Facility Name
Servicing Provider
Tax Identification Number
Facility Identification Number
ICD-9 Proc Code
ICD-9 Procedure Code Description
ICD-9 Proc1
ICD-9 Proc1 Description
ICD-9 Proc2
ICD-9 Proc2 Description
ICD-9 Proc3
ICD-9 Proc3 Description
ICD-9 Proc4
ICD-9 Proc4 Description
ICD-9 Diag1
ICD-9 Diag1 Description
ICD-9 Diag2
ICD-9 Diag2 Description
ICD-9 Diag3
ICD-9 Diag3 Description
ICD-9 Diag4
ICD-9 Diag4 Description
ICD-9 Diag5
ICD-9 Diag5 Description
ICD-9 Diag6
ICD-9 Diag6 Description
Health Plan Market
Health Plan Region
Funding Type
Product
Place of Service
Billed $
Age (at Surgery)

OUTPATIENT DATA FILE LAYOUT
Individual System ID (Unique Identifier)
DOB
Age Band
Sex
Zip
Member ID
Bariatric Admit Date
Date of Service
Visit Count
Servicing Provider Name
Provider Specialty Code
Provider Specialty Description
Tax Identification Number
Provider Identification Number
Facility Name
Tax Identification Number
ICD-9 Proc Code
ICD-9 Procedure Code Description
ICD-9 Proc1
ICD-9 Proc1 Description
ICD-9 Proc2
ICD-9 Proc2 Description
ICD-9 Proc3
ICD-9 Proc3 Description
ICD-9 Proc4
ICD-9 Proc4 Description
ICD-9 Diag1
ICD-9 Diag1 Description
ICD-9 Diag2
ICD-9 Diag2 Description
ICD-9 Diag3
ICD-9 Diag3 Description
ICD-9 Diag4
ICD-9 Diag4 Description
ICD-9 Diag5
ICD-9 Diag5 Description
ICD-9 Diag6
ICD-9 Diag6 Description
Health Plan Market
Health Plan Region
Funding Type
Product
Place of Service Description
Billed $

Appendix C: Bariatric Surgery Complication Codes

ICD9 Code	ICD9 Description
437.1	AC CEREBROVASC INSUF NOS
453.8	VENOUS THROMBOSIS NEC
453.9	VENOUS THROMBOSIS NOS
480	VIRAL PNEUMONIA
480.0	ADENOVIRAL PNEUMONIA
480.1	RESP SYNCYT VIRAL PNEUM
480.2	PARINFLUENZA VIRAL PNEUM
480.3	PNEUMON DUE SARS-ASSOC CORONAVIRUS
480.8	VIRAL PNEUMONIA NEC
480.9	VIRAL PNEUMONIA NOS
481	PNEUMOCOCCAL PNEUMONIA
482	OTH BACTERIAL PNEUMONIA
482.0	K. PNEUMONIAE PNEUMONIA
482.1	PSEUDOMONAL PNEUMONIA
482.2	H.INFLUENZAE PNEUMONIA
482.3	STREPTOCOCCAL PNEUMONIA
482.30	STREPTOCOC PNEUMONIA NOS
482.31	GRP A STREP PNEUMONIA
482.32	GRP B STREP PNEUMONIA
482.39	STREPTOCOC PNEUMONIA NEC
482.4	STAPHYLOCOCCAL PNEUMONIA
482.40	STAPH PNEUMONIA NOS
482.41	STAPH AUREUS PNEUMONIA
482.49	STAPH PNEUMONIA NEC
482.8	BACTERIAL PNEUMONIA NEC
482.81	PNEUMONIA D/T ANAEROBES
482.82	E. COLI PNEUMONIA
482.83	GRAM NEG PNEUMONIA NEC
482.89	BACTERIAL PNEUMONIA-NEC
482.9	BACTERIAL PNEUMONIA NOS
483	PNEUMONIA DUE OTHER SPEC ORGANISM
483.0	M.PNEUMONIAE PNEUMONIA
483.1	CHLAMYDIAL PNEUMONIA
483.10	PNEUMONIA: CHLAMYDIA
484	PNEUM IN OTH INFEC DIS
484.1	PNEUM W CYTOMEG INCL DIS
484.3	PNEUMONIA IN WHOOP COUGH
484.5	PNEUMONIA IN ANTHRAX
484.6	PNEUM IN ASPERGILLOSIS
484.7	PNEUM IN OTH SYS MYCOSES
484.8	PNEUM IN INFECT DIS NEC
485	BRONCHOPNEUMONIA ORG NOS
486	PNEUMONIA ORGANISM UNSPECIFIED
518.0	PULMONARY COLLAPSE
518.5	POST TRAUM PULM INSUFFIC
518.81	AC RESPIRATORY FAILURE
560.1	PARALYTIC ILEUS
560.2	VOLVULUS OF INTESTINE
560.30	IMPACTION INTESTINE NOS
560.39	IMPACTION INTESTINE NEC
560.81	INTESTINAL ADHES W OBSTR
560.89	INTESTINAL OBSTRUCT NEC
560.9	INTESTINAL OBSTRUCT NOS

ICD9 Code	ICD9 Description
564.2	POSTGASTRIC SURGERY SYND
578.9	GASTROINTEST HEMORR NOS
584.5	LOWER NEPHRON NEPHROSIS
584.8	AC RENAL FAILURE NEC
584.9	ACUTE RENAL FAILURE NOS
599.0	URIN TRACT INFECTION NOS
997.1	SURG COMPL-HEART
997.3	SURG COMPLIC-RESPIR SYST
997.4	SURG COMPL-DIGEST TRACT
997.5	SURG COMPL-URINARY TRACT
998.0	POSTOPERATIVE SHOCK
998.11	HEMORR COMPLIC PROCEDURE
998.12	HEMATOMA COMPLIC PROCEDURE
998.13	SEROMA COMPLIC PROCEDURE
998.2	ACCIDENTAL OP LACERATION
998.31	DISRUPTION INTERNAL OPERATION WOUND
998.32	DISRUPTION EXTERNAL OPERATION WOUND
998.51	POSTOPERATIVE INFECTION
998.59	OTHER POSTOPERATIVE INFECTION
998.6	PERSIST POSTOP FISTULA

Appendix D: Bariatric Surgery Center Network Acceditation Program

American College of Surgeons
Accessed: 9/14/2008
Inpatient Facilities
http://www.facs.org/cqi/bscn/fullapproval.html
http://www.facs.org/cqi/bscn/provisionlapproval.html

Approval Status	State	Facility Name	Location	Center Level
Full Approval	Alabama	Shelby Baptist Medical Center	Alabaster, AL	Level 1b
Full Approval	Alabama	University of Alabama at Birmingham Hospital	Birmingham, AL	Level 1a
Full Approval	California	Cedars-Sinai Medical Center	Los Angeles, CA	Level 1a
Full Approval	California	Community Medical Center – Clovis	Clovis, CA	Level 1b
Full Approval	California	Kaiser Permanente Medical Center Richmond	Richmond, CA	Level 1b
Provisional Approval	California	Olympia Medical Center	Los Angeles, CA	Level 2b
Full Approval	California	Providence St. Joseph Medical Center	Burbank, CA	Level 1b
Full Approval	California	Stanford Hospital and Clinics	Stanford, CA	Level 1a
Provisional Approval	California	Sutter Auburn Faith Hospital	Auburn, CA	Level 2b
Full Approval	California	Sutter General Hospital	Sacramento, CA	Level 2b
Full Approval	California	UCI Medical Center	Orange, CA	Level 1a
Full Approval	Connecticut	Danbury Hospital	Danbury, CT	Level 1a
Full Approval	Delaware	Christiana Care Health Services	Wilmington, DE	Level 1a
Full Approval	Florida	Cleveland Clinic Florida Hospital	Weston, FL	Level 1a
Full Approval	Florida	Palmetto General Hospital	Hialeah, FL	Level 1b
Full Approval	Georgia	Emory Crawford Long Hospital	Atlanta, GA	Level 1b
Full Approval	Illinois	Evanston Northwestern Hospital	Evanston, IL	Level 1b
Provisional Approval	Illinois	West Surburban Medical Center - RHC	Oak Park, IL	Level 2b
Full Approval	Iowa	Grinnell Regional Medical Center	Grinnell, IA	Level 1a
Full Approval	Iowa	Mary Greeley Medical Center	Ames, IA	Level 2b
Provisional Approval	Kentucky	Norton Hospital	Louisville, KY	Level 1b
Provisional Approval	Kentucky	Norton Suburban Hospital	Louisville, KY	Level 1b
Full Approval	Maine	Southern Maine Medical Center	Biddeford, ME	Level 2b
Full Approval	Maryland	Harford Memorial Hospital	Havre de Grace, MD	Level 2b
Full Approval	Maryland	University of Maryland Medical Center	Baltimore, MD	Level 1a
Full Approval	Massachusetts	Baystate Medical Center	Springfield, MA	Level 1b
Full Approval	Massachusetts	Berkshire Medical Center	Pittsfield, MA	Level 2a
Full Approval	Massachusetts	Beth Israel Deaconess Medical Center	Boston, MA	Level 1a
Full Approval	Massachusetts	Boston Medical Center	Boston, MA	Level 1b
Full Approval	Massachusetts	Brigham and Women's Hospital	Boston, MA	Level 1a
Full Approval	Massachusetts	Caritas Norwood Hospital	Norwood, MA	Level 2-New
Full Approval	Massachusetts	Caritas St. Elizabeth's Medical Center	Boston, MA	Level 2b
Full Approval	Massachusetts	Emerson Hospital	Concord, MA	Level 2a
Full Approval	Massachusetts	Faulkner Hospital	Boston, MA	Level 1a
Full Approval	Massachusetts	Lahey Clinic Medical Center	Burlington, MA	Level 1a
Full Approval	Massachusetts	Lowell General Hospital	Lowell, MA	Level 1a
Full Approval	Massachusetts	Massachusetts General Hospital	Boston, MA	Level 1a
Full Approval	Massachusetts	Mercy Medical Center	Springfield, MA	Level 2b
Full Approval	Massachusetts	Newton-Wellesley Hospital	Newton, MA	Level 1a
Full Approval	Massachusetts	North Shore Medical Center - Salem Hospital	Salem, MA	Level 2a

Approval Status	State	Facility Name	Location	Center Level
Full Approval	Massachusetts	Saint Vincent Hospital	Worcester, MA	Level 2-New
Full Approval	Massachusetts	UMass Memorial Medical Center - Memorial Campus	Worcester, MA	Level 1a
Full Approval	Michigan	Hurley Medical Center	Flint, MI	Level 1a
Full Approval	Michigan	William Beaumont Hospital - Royal Oak	Royal Oak, MI	Level 1a
Full Approval	Minnesota	Cuyuna Regional Medical Center	Crosby, MN	Level 2a
Full Approval	Minnesota	Mayo Clinic – St. Mary's Hospital	Rochester, MN	Level 1a
Full Approval	Minnesota	St. Joseph's Medical Center	Brainerd, MN	Level 2b
Provisional Approval	Minnesota	St. Mary's Medical Center	Duluth, MN	Level 1b
Provisional Approval	New Hampshire	Elliot Hospital	Manchester, NH	Level 2-New
Full Approval	New Hampshire	Portsmouth Regional Hospital	Portsmouth, NH	Level 2b
Full Approval	New Jersey	Hackensack University Medical Center	Hackensack, NJ	Level 1a
Full Approval	New Jersey	Morristown Memorial Hospital	Morristown, NJ	Level 1a
Full Approval	New York	Albany Medical Center	Albany, NY	Level 1b
Full Approval	New York	Forest Hills Hospital North Shore-LIJ Health System	Forest Hills, NY	Level 2b
Full Approval	New York	Highland Hospital	Rochester, NY	Level 1a
Provisional Approval	New York	Lawrence Hospital Center	Bronxville, NY	Level 1b
Full Approval	New York	Lutheran Medical Center	Brooklyn, NY	Level 1b
Full Approval	New York	Montefiore Medical Center	Bronx, NY	Level 1b
Full Approval	New York	New York-Presbyterian Hospital/Columbia Univ Med Ct	New York, NY	Level 1a
Full Approval	New York	New York-Presbyterian Hospital/Weill Cornell Med Ctr	New York, NY	Level 1a
Full Approval	New York	St. Luke's-Roosevelt Hospital Center	New York, NY	Level 1a
Full Approval	New York	Westchester Medical Center	Valhalla, NY	Level 1a
Full Approval	North Carolina	High Point Regional Health System	High Point, NC	Level 1b
Full Approval	Ohio	Cleveland Clinic	Cleveland, OH	Level 1a
Provisional Approval	Ohio	University Hospitals of Cleveland	Cleveland, OH	Level 1a
Full Approval	Oklahoma	Integris Baptist Medical Center	Oklahoma City, OK	Level 2-New
Full Approval	Oklahoma	Saint Francis Hospital	Tulsa, OK	Level 1b
Full Approval	Oregon	Oregon Health & Science University	Portland, OR	Level 1a
Provisional Approval	Oregon	Southern Oregon Bariatric Cneter	Medford, OR	Level 2b
Full Approval	Pennsylvania	Geisinger Medical Center	Danville, PA	Level 1a
Full Approval	Pennsylvania	Lehigh Valley Hospital and Health Network	Allentown, PA	Level 1a
Full Approval	Pennsylvania	Western Pennsylvania Hospital	Pittsburgh, PA	Level 1b
Full Approval	South Carolina	Lexington Medical Center	West Columbia, SC	Level 1b
Full Approval	South Dakota	Avera Queen of Peace	Mitchell, SD	Level 2b
Provisional Approval	Tennessee	Solutions Surgical Weight Loss Center	Dickson, TN	Level 2b
Full Approval	Texas	Del Sol Medical Center	El Paso, TX	Level 1b
Full Approval	Texas	Scott and White Hospital	Temple, TX	Level 1a
Full Approval	Texas	The Methodist Hospital	Houston, TX	Level 1a
Full Approval	Texas	University of Texas Medical Branch	Galveston, TX	Level 1a
Full Approval	Vermont	Fletcher Allen Health Care	Burlington, VT	Level 1b
Full Approval	Virginia	Chesapeake General Hospital	Chesapeake, VA	Level 2b
Full Approval	Virginia	Sentara Norfolk General Hospital	Norfolk, VA	Level 1a
Full Approval	Virginia	University of Virginia Health System	Charlottesville, VA	Level 1a
Full Approval	Washington	Northwest Hospital & Medical Center	Seattle, WA	Level 2-New
Full Approval	Washington	St. Francis Hospital	Federal Way, WA	Level 1b
Full Approval	Washington	University of Washington Medical Center	Seattle, WA	Level 1a
Full Approval	Wisconsin	Theda Clark Medical Center	Neenah, WI	Level 1b

Appendix E: State Mandates on Bariatric Coverage

Accessed: July 2007

State	Mandated Benefit (Y/N)	Compliance Date (if any)	Mandate Summary
California	No	2007	No Mandate. Preventive care services covered under contract and provided by a participating plan provider are not subject to a deductible under the plan contract. Preventive care includes obesity weight-loss programs. Therefore obesity preventive care carries no deductible'.
Georgia	No		Mandated Offer. Enacted a Morbid Obesity Anti-Discrimination Act. Coverage for treatment is available by physicians and medical institutions that are qualified to treat comprehensively complex illness and disease associated with morbid obesity. Instance policies issues after 7/1/1999 providing major medical benefits MAY offer coverage for treatment of morbid obesity.
Indiana	Yes	2006	Mandated Offer. HMOS which provide coverage for basic health care services under a group contract SHALL OFFER COVERAGE for nonexperimental, surgical treatment by a health care provider of morbid obesity which has persisted for a least 5 years and for which nonsurgical treatment that is supervised by a physician has been unsuccessful for at least 6 consecutive months. Follow-up to surgery is required. Physician must report addition of comorbities, body mass index and waist circumference at time of surgery, 30 days, 90 days and 1 year post surgery.
Maryland	Yes	2001 Amended in 2004, 2005 and 2006	Mandates Coverage. Applies to insurers, nonprofits providing hospital medical or surgical benefits to individuals or groups on an ex-ense-incurred basis under health insurance policies issued in Maryland. HMOS and managed care organizations included. Must provide coverage for treatment of morbid obesity through gastric bypass surgery or another surgical method that is recognized by the National Institutes of Health (NHI) and is consistent with guidelines approved by NIH.
New Jersey	Yes/No	2005	No Mandate. However, legislation states that bariatric surgery must be covered as any other surgery that is medically necessary, not experimental or investigational.
New York	No	2005	No Mandate. Opinion states that denials of gastric bypass surgery are subject to utilization review. It is a question of medical necessity and is subject to utilization review.
Virginia	No	2000	Mandated Offer. Requires that insurers, health services plans and HMOs offer and make available coverage for treatment of morbid obesity. Must cover as any other illness when elected and be subject to same deductibles, co-pays, etc. as any other condition.

Appendix F: ICD-9 Coding for Co-Morbid Conditions and BMI Classifications

Asthma
49320 CHRN OBST ASTHMA NO ASTHMATCUS/UNS
49321 CHR OBS ASTHMA W STAT AS
49322 CHR OBS ASTHMA W AC EXAC
49391 ASTHMA W STATUS ASTHMAT
49392 ASTHMA UNS W AC EXACERB

Lumbago/Back Pain
7242 LUMBAGO
7244 LUMBOSACRAL NEURITIS NOS
7245 BACKACHE NOS
7249 BACK DISORDER NOS

Chronic Obstructive Pulmonary Disease
496 CHR AIRWAY OBSTRUCT NEC

Diabetes
25000 DIABETES UNCOMPL TYPE II
25002 DM UNCOMP TYP II UNCNTRD
25010 DIAB KETOACIDOSIS TYP II
25011 DIAB KETOACIDOSIS TYPE I
25012 DM KETOACID TYPE II UNCN
25013 DM KETOACID TYPE I UNCNT
25022 DM HYPRSMLRTY TYP II UNC
25060 DIAB NEURO MANIF TYPE II
25061 DIAB NEURO MANIF TYPE I
25080 DIAB W MANIF NEC TYPE II
25082 DM MANIF NEC TYP II UNCN
25092 DM COMPL NOS TYP II UNCN
25072 DM CIRC DIS TYP II UNCNT

CORONARY DISEASE

CAD (Coronary Artery Disease)
41400 CORNARY ATHERO-VESL NOS
41401 CORNARY ATHERO-NATV VESL

Congestive Heart Failure
4280 CONGESTIVE HEART FAILURE
412 OLD MYOCARDIAL INFARCT

Heart Disease
412 OLD MYOCARDIAL INFARCT

Hypertension
4019 HYPERTENSION NOS
4011 BENIGN HYPERTENSION
4010 MALIGNANT HYPERTENSION
40290 HYPERT HRT DIS NOS/S CHF

Hyperlipidemia

Hypercholesterolem
2720 PURE HYPERCHOLESTEROLEM

Hyperlipidemia
2724 HYPERLIPIDEMIA NEC/NOS
2722 MIXED HYPERLIPIDEMIA

Osteoarthrosis
71589 OSTEOARTHROSIS MULT SITES SPECIFID
71515 LOC PRIM OSTEOART-PELVIS
71516 LOC PRIM OSTEOART-L/LEG
71535 LOC OSTEOARTH NOS-PELVIS
71536 LOC OSTEOARTH NOS-L/LEG
71596 OSTEOARTHROSIS NOS-L/LEG
71597 OSTEOARTHROSIS NOS-ANKLE
71590 OSTEOARTHROSIS NOS-UNSPEC
71595 OSTEOARTHROSIS NOS-PELVIS
71690 ARTHROPATHY NOS-UNSPEC
71698 ARTHROPATHY NOS-OTH SITE
71699 ARTHROPATHY NOS-MULT

Sleep Apnea
78057 UNSPECIFIED SLEEP APNEA
32723 OBSTRUCTIVE SLEEP APNEA ADULT/PEDI
78051 INSOMNIA W SLEEP APNEA UNSPECIFIED

BODY MASS INDEX
V854 BODY MASS INDEX 40 AND OVER, ADULT
V8538 BODY MASS INDEX 38.0-38.9, ADULT
V8537 BODY MASS INDEX 37.0-37.9, ADULT
V8536 BODY MASS INDEX 36.0-36.9, ADULT
V8535 BODY MASS INDEX 35.0-35.9, ADULT
V8534 BODY MASS INDEX 34.0-34.9, ADULT

Appendix G: Data Analysis File Layouts

BARIATRIC PRE/POST DATA FILE	
Field Name	**Description**
IND	Unique Patient Identifier
DOB	Paitent Date of Birth
AGE_BAND	Age Band
SEX	Sex (Male or Female)
ZIP	Zip Code (Patient)
AGE	Age at Surgery
BARIATRIC DOS	Bariatric Admit Date
SUBMARKET	Sub Market (State/City)
REGION	Region (West, East, Northeast, Southeast, Southwest, Northwest)
# OF CO	# of Comorbid Conditions (Based on Inpatient Diag 1-6)
BMI	Diagnosis Related BMI Value (if provided on claim. Not available for all patients)
SMOKE	ICD-9 Code Diagnosis Identification of Smoking (if available)
RxCoverage	Identifier of Rx Coverage (Y= Benfits include Rx Coverage N= No Benefit for Rx)
RxCntBefore	Rx Script Count Before Bariatric Surgery
RxCntAfter	Rx Script Count After Bariatric Surgery
RxSumBeforePaid	Rx Total Dollars Paid Before Surgery
RxSumAfterPaid	Rx Total Dollars Paid After Surgery
RxAvgBeforePaid	Rx Avg Dollars Paid per Script Before Surgery
RxAvgAfterPaid	Rx Avg Dollars Paid per Script After Surgery
PhyCntBefore	Physician Visit Count Before Bariatric Surgery
PhyCntAfter	Physician Visit Count After Bariatric Surgery
PhySumBeforePaid	Physician Total Dollars Paid Before Surgery
PhySumAfterPaid	Physician Total Dollars Paid After Surgery
PhyAvgBeforePaid	Physician Avg Dollars Paid per Script Before Surgery
PhyAvgAfterPaid	Physician Avg Dollars Paid per Script After Surgery
IPCntBefore	Inpatient Admit Count Before Bariatric Surgery
IPCntAfter	Inpatient Admit Count After Bariatric Surgery
IPSumBeforePaid	Inpatient Total Dollars Paid Before Surgery
IPSumAfterPaid	Inpatient Total Dollars Paid After Surgery
IPAvgBeforePaid	Inpatient Avg Dollars Paid per Script Before Surgery
IPAvgAfterPaid	Inpatient Avg Dollars Paid per Script After Surgery
CENTRAL	Central Region 1 = Central 0 = Not Central
EAST	East Region 1 = East and 0 = Not East
NORTHEAST	Northeast Region 1 = Northeast and 0 = Not Northeast
WEST	West Region 1 = West and 0 = Not West
SOUTHEAST	Southeast Region 1 = Southeast and 0 = Not Southeast
SOUTHWEST	Southwest Region (Central = 0, East = 0, Northeast =0, West =0, Southeast =0)

ACCREDITATION ANALYSIS	
Field Name	Field Description
IND	Unique Patient Identifier
Bariatric DOS	Bariatric Surgery Admit Date
LDOS	Bariatric Surgery Discharge Date
provname	Provider Name
Accreditation	Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility
SUBMARKET	Sub Market (State/City)
DOB	Patient Date of Birth
DAYS	Length of Stay
ADMITS	Admit Count
BILLED	Billed $
PAID	Paid $
ALLOWED	Allowed $
DRG_CD	Diagnosis Related Grouper Code
AGE_BAND	Age Band
SEX	Sex
AGE	Age (at Surgery)
BMI	BMI Diagnosis Code (If provided on claim. Not available for all patients)
# of Co	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)
Complication	Complication Identified (1 = Identified Complication , 0 = No Identified Complication)
HYPERLIPDEMIA	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
BACKPAIN	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
CAD	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
CHF	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
COPD	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
DIABETES TYPE II	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
HEART DISEASE	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
HYPERCHOLESTEROLEM	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
HYPERLIPIDEMIA	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
HYPERTENSION	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
OSTEOARTHOSIS	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
SLEEP APNEA	Condition Indentifier 1 = Identified Condition, 0 = Not Identified Condition
CENTRAL	Central Region 1 = Central 0 = Not Central
EAST	East Region 1 = East 0 = East
NORTHEAST	Northeast Region 1 = Northeast 0 = Not Northeast
WEST	West Region 1 = West 0 = Not West
SOUTHEAST	Southeast Region 1 = Southeast 0 = Not Southeast
SOUTHWEST	If Central =0, East =0, Northeast =0, West =0 and Southeast =0 - Region = Southwest
REGION	Classification Region

Appendix H: Pre/Post Number of Operations by Sub Market

Pre/Post Operations by Sub Market				
Sub Market	Frequency	Percent	Valid Percent	Cummulative Percent
ARIZONA, UTAH	286	5.3	5.3	5.3
ARKANSAS, TENNESSEE	111	2.0	2.0	7.3
CALIFORNIA	308	5.7	5.7	13.0
CENTRAL TEXAS	154	2.8	2.8	15.8
CLEVELAND	91	1.7	1.7	17.5
COLORADO	142	2.6	2.6	20.1
COLUMBUS	114	2.1	2.1	22.2
CONNECTICUT	74	1.3	1.3	23.5
DALLAS	596	11.0	11.0	34.5
LA, MS, AL	240	4.4	4.4	38.9
DAYTON OHIO, CINCINNATI OHIO	136	2.5	2.5	41.4
GEORGIA	113	2.1	2.1	43.5
HOUSTON	595	10.9	10.9	54.4
ILLINOIS	227	4.2	4.2	58.6
INDIANA	89	1.6	1.6	60.2
IOWA	25	0.4	0.4	60.6
KENTUCKY	57	1.1	1.1	61.7
NEBRASKA	109	2.0	2.0	63.7
MASSACHUSETTS, RHODE ISLAND	39	0.7	0.7	64.4
MICHIGAN	74	1.3	1.3	65.7
MISSOURI, KANSAS	265	4.9	4.9	70.6
NEVADA	43	0.8	0.8	71.4
NEW JERSEY	127	2.3	2.3	73.7
NEW YORK	201	3.7	3.7	77.4
NORTH CAROLINA, SOUTH CAROLINA	211	3.9	3.9	81.3
OREGON, WASHINGTON, ALASKA	98	1.8	1.8	83.1
ORLANDO	151	2.8	2.8	85.9
PENNSYLVANIA	60	1.1	1.1	87.0
SOUTH FLORIDA	132	2.4	2.4	89.4
TAMPA	123	2.3	2.3	91.7
WASH DC, MARYLAND, VIRGINIA	325	6.0	6.0	97.7
WISCONSIN	126	2.3	2.3	100.0
TOTAL	5,442	100.0	100.0	

Appendix I: General Insured Population Demographics by Sub Market

SUB MARKET	AVG MEMBERSHIP	BARIATRIC SURGERY PER 100,000 INSURED
ARIZONA, UTAH	880,422	47
ARKANSAS, TENNESSEE	509,302	30
CALIFORNIA	1,001,642	43
CENTRAL TEXAS	361,713	58
CLEVELAND	361,539	32
COLORADO	627,821	34
COLUMBUS	380,068	34
CONNECTICUT	221,305	43
DALLAS	1,346,179	62
DAYTON OHIO, CINCINNATI OHIO	409,482	48
GEORGIA	968,618	18
HOUSTON	799,612	95
ILLINOIS	784,867	38
INDIANA	191,852	60
IOWA	138,093	27
KENTUCKY	205,856	50
LA, MS, AL	606,317	57
MASSACHUSETTS, RHODE ISLAND	384,727	19
MICHIGAN	244,206	42
MISSOURI, KANSAS	784,609	39
NEBRASKA	499,515	28
NEVADA	95,362	74
NEW JERSEY	497,062	39
NEW YORK	770,279	39
NORTH CAROLINA, SOUTH CAROLINA	814,973	35
OREGON, WASHINGTON, ALASKA	305,756	48
ORLANDO	527,799	38
PENNSYLVANIA	292,232	32
SOUTH FLORIDA	549,559	32
TAMPA	583,766	28
WASH DC, MARYLAND, VIRGINIA	1,320,780	15
WISCONSIN	637,022	28

Appendix J: Statistical Tests

(1) Pre/Post Paired Samples Test Results (SPSS v13)

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std Deviation	Std Error Mean	Lower	Upper			
Pair 1	Rx Script Count Before Bariatric Surgery - Rx Script Count After Bariatric Surgery	4 524	18 190	490	3 562	5 486	9.226	1375	.000
Pair 2	Rx Average Dollars Paid per Script Before Surgery - Rx Average Dollars Paid per Script After Surgery	-.45042	58 58094	1 57981	-3 54952	2 64868	-.285	1374	776
Pair 3	Physician Visit Count Before Bariatric Surgery - Physician Visit Count After Bariatric Surgery	715	5 272	072	574	857	9 917	5338	.000
Pair 4	Physician Average Dollars Paid per Visit Before Surgery - Physician Average Dollars Paid per Visit After Surgery	6 34291	34 47071	47180	5 41799	7 26784	13.444	5337	.000
Pair 5	Inpatient Admit Count Before Bariatric Surgery - Inpatient Admit Count After Bariatric Surgery	-.594	1 579	046	-.685	-.503	-12.847	1166	.000
Pair 6	Inpatient Average Dollars Paid per Admit Before Surgery - Inpatient Average Dollars Paid per Admit After Surgery	-5102 49595	15997 96978	468 30570	-6021 31201	-4183 67988	-10 896	1166	000

(2) Pre/Post Paired T Test - Inpatient with Exclusions (Minitab v14)

Paired T-Test and CI: IPCntBefore, IPCntAfter

```
Paired T for IPCntBefore - IPCntAfter

                 N       Mean     StDev   SE Mean
IPCntBefore   1035   0.551691  0.834452  0.025938
IPCntAfter    1035   0.997101  1.253618  0.038967
Difference    1035  -0.445411  1.594134  0.049551


95% CI for mean difference: (-0.542643, -0.348178)
T-Test of mean difference = 0 (vs not = 0): T-Value = -8.99  P-Value = 0.000
```

Paired T-Test and CI: IPAvgBeforePaid, IPAvgAfterPaid

```
Paired T for IPAvgBeforePaid - IPAvgAfterPaid

                    N      Mean     StDev  SE Mean
IPAvgBeforePaid  1035   3011.58   5572.67   173.22
IPAvgAfterPaid   1035   7118.32  13161.26   409.10
Difference       1035  -4106.73  15059.69   468.11


95% CI for mean difference: (-5025.28, -3188.18)
T-Test of mean difference = 0 (vs not = 0): T-Value = -8.77  P-Value = 0.000
```

(3) Pre/Post Linear Regression Models (SPSS v13)

Dependent Variable: Rx Average Dollars Paid Difference

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed
1	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)[a]	.
2	PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL[a]	.

Variables Entered/Removed[b]

Model	Method
1	Enter
2	Enter

a. All requested variables entered.

b. Dependent Variable: Rx Average Dollars Paid Difference

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.108[a]	.012	.010	58.30160
2	.112[b]	.013	.007	58.38055

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery), PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	55056.935	3	18352.312	5.399	.001[a]
	Residual	4660134.595	1371	3399.077		
	Total	4715191.530	1374			
2	Regression	59469.346	8	7433.668	2.181	.026[b]
	Residual	4655722.184	1366	3408.289		
	Total	4715191.530	1374			

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery), PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL

c. Dependent Variable: Rx Average Dollars Paid Difference

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-16.621	6.835		-2.432	.015
	Sex	10.606	3.977	.073	2.667	.008
	Age (at Surgery)	.238	.158	.042	1.506	.132
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	2.386	1.494	.045	1.597	.111
2	(Constant)	-17.019	7.182		-2.369	.018
	Sex	10.552	3.986	.072	2.647	.008
	Age (at Surgery)	.236	.159	.042	1.489	.137
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	2.448	1.498	.047	1.635	.102
	CENTRAL	1.989	4.210	.015	.473	.637
	MID_ATLANTIC	-3.767	5.715	-.019	-.659	.510
	NORTHEAST	1.880	5.864	.009	.321	.749
	PACIFIC	-1.851	6.379	-.008	-.290	.772
	SOUTHEAST	1.681	4.792	.011	.351	.726

a. Dependent Variable: Rx Average Dollars Paid Difference

Dependent Variable: Physician Average Dollars Paid Difference

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed
1	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)[a]	.
2	PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL[a]	.

Variables Entered/Removed[b]

Model	Method
1	Enter
2	Enter

a. All requested variables entered.

b. Dependent Variable: Physician Average Dollars Paid Difference

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.086[a]	.007	.007	34.35180
2	.108[b]	.012	.010	34.29318

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery), PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	47216.175	3	15738.725	13.337	.000[a]
	Residual	6294367.9	5334	1180.046		
	Total	6341584.1	5337			
2	Regression	74561.241	8	9320.155	7.925	.000[b]
	Residual	6267022.8	5329	1176.022		
	Total	6341584.1	5337			

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery), PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL

c. Dependent Variable: Physician Average Dollars Paid Difference

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1	(Constant)	15.767	2.044	
	Sex	4.067	1.189	.047
	Age (at Surgery)	-.193	.047	-.058
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-1.194	.447	-.039
2	(Constant)	14.544	2.141	
	Sex	4.082	1.188	.048
	Age (at Surgery)	-.197	.047	-.059
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-1.157	.446	-.037
	CENTRAL	1.714	1.255	.021
	MID_ATLANTIC	-2.824	1.703	-.024
	NORTHEAST	1.265	1.748	.011
	PACIFIC	6.516	1.901	.050
	SOUTHEAST	3.558	1.428	.038

Dependent Variable: Inpatient Average Dollars Paid Difference

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed
1	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)[a]	.
2	PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL[a]	.

Variables Entered/Removed[b]

Model	Method
1	Enter
2	Enter

a. All requested variables entered.

b. Dependent Variable: Inpatient Average Dollars Paid Difference

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.062[a]	.004	.001	15987.87235
2	.105[b]	.011	.004	15965.18034

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery), PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	1143424819.865	3	381141606.6	1.491	.215[a]
	Residual	297276828552.242	1163	255612062.4		
	Total	298420253372.108	1166			
2	Regression	3261126735.531	8	407640841.9	1.599	.120[b]
	Residual	295159126636.577	1158	254886983.3		
	Total	298420253372.108	1166			

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Sex, Age (at Surgery), PACIFIC, NORTHEAST, MID_ATLANTIC, SOUTHEAST, CENTRAL

c. Dependent Variable: Inpatient Average Dollars Paid Difference

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-3620 275	2034 761		-1.779	075
	Sex	-931.548	1183.739	-.023	-.787	.431
	Age (at Surgery)	-59 134	47 104	- 038	-1.255	210
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	850 100	444 878	059	1.911	056
2	(Constant)	-3544 000	2132 174		-1 662	097
	Sex	-928 101	1183.250	-.023	-.784	.433
	Age (at Surgery)	-57 309	47 056	- 037	-1.218	224
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	850 705	444 587	059	1 913	056
	CENTRAL	-78 567	1249 820	- 002	-.063	950
	MID_ATLANTIC	1467 458	1696.466	027	865	.387
	NORTHEAST	779.394	1740.705	.014	.448	.654
	PACIFIC	-4588 232	1893.620	-.075	-2.423	.016
	SOUTHEAST	-78.887	1422.649	-.002	-.055	.956

a. Dependent Variable: Inpatient Average Dollars Paid Difference

(4) Accreditation: Independent Samples T-Test (SPSS v13)

•

Group Statistics

		Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility	N	Mean	Std. Deviation	Std. Error Mean
Paid $	Non-accredited		6569	16535.274 4	17687.80552	218.23496
	Accredited		706	15759.325 8	11360.38069	427.55357
Length of Stay	Non-accredited		6569	2.37	3.393	.042
	Accredited		706	2.55	2.952	.111

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Paid $	Equal variances assumed	15 087	000	1 141	7273	254	775 94852	680 30936	-557 6552 4	2109 5522 7
	Equal variances not assumed			1 616	1112.107	106	775 94852	480.02974	-165.9175 5	1717.8145 8
Length of Stay	Equal variances assumed	098	754	-1 369	7273	171	-.182	.133	-.442	.079
	Equal variances not assumed			-1 531	917 529	126	- 182	119	- 415	.051

(5) Accreditation: Complication Chi-Square 2 x 2

Chi-Square 2 X 2

	Complication Identified (1 = Identified Complication , 0 = No Identified Complication)		
	0	1	Total
Non-accredited	5344	1225	6569
Accredited	570	136	706
Total	5914	1361	7275

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.159[a]	1	0.69		

(6) Accreditation Linear Regression Models (SPSS v13)

Regression - Enter + Region

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery)[a]	.	Enter
2	MID_ATLANTIC, PACIFIC, NORTHEAST, SOUTHEAST, CENTRAL[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Paid $

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.079[a]	.006	.006	17127.57077
2	.149[b]	.022	.021	16995.29367

Model Summary

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.006	11.542	4	7270	.000
2	.016	23.722	5	7265	.000

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery), MID_ATLANTIC, PACIFIC, NORTHEAST, SOUTHEAST, CENTRAL

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1E+010	4	3385757092	11.542	.000[a]
	Residual	2E+012	7270	293353680.5		
	Total	2E+012	7274			
2	Regression	5E+010	9	5311292964	18.388	.000[b]
	Residual	2E+012	7265	288840006.8		
	Total	2E+012	7274			

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery), MID_ATLANTIC, PACIFIC, NORTHEAST, SOUTHEAST, CENTRAL

c. Dependent Variable: Paid $

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	15486.618	849.883		18.222	.000
	Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility	-807.562	678.734	-.014	-1.190	.234
	Sex	1650.404	509.638	.038	3.238	.001
	Age (at Surgery)	57.566	19.951	.035	2.885	.004
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-1191.658	194.700	-.075	-6.120	.000
2	(Constant)	15679.279	879.499		17.828	.000
	Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility	-997.215	680.473	-.017	-1.465	.143
	Sex	1644.528	506.160	.038	3.249	.001
	Age (at Surgery)	58.342	19.814	.036	2.944	.003
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-1213.578	193.237	-.077	-6.280	.000
	CENTRAL	-1387.095	532.230	-.034	-2.606	.009
	MID_ATLANTIC	2478.792	842.713	.036	2.941	.003
	NORTHEAST	-1892.124	711.033	-.034	-2.661	.008
	PACIFIC	6097.955	786.235	.096	7.756	.000
	SOUTHEAST	-1791.650	594.450	-.039	-3.014	.003

a. Dependent Variable: Paid $

Regression - Enter with Region

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed
1	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery)[a]	.
2	MID_ATLANTIC, PACIFIC, NORTHEAST, SOUTHEAST, CENTRAL[a]	.

Variables Entered/Removed[b]

Model	Method
1	Enter
2	Enter

a. All requested variables entered.

b. Dependent Variable: Length of Stay

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.115[a]	.013	.013	3.332
2	.127[b]	.016	.015	3.328

Model Summary

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.013	24.500	4	7270	.000
2	.003	4.112	5	7265	.001

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery), MID_ATLANTIC, PACIFIC, NORTHEAST, SOUTHEAST, CENTRAL

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1087.967	4	271.992	24.500	.000[a]
	Residual	80710.260	7270	11.102		
	Total	81798.227	7274			
2	Regression	1315.753	9	146.195	13.197	.000[b]
	Residual	80482.474	7265	11.078		
	Total	81798.227	7274			

a. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery)

b. Predictors: (Constant), # of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6), Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility, Sex, Age (at Surgery), MID_ATLANTIC, PACIFIC, NORTHEAST, SOUTHEAST, CENTRAL

c. Dependent Variable: Length of Stay

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta
1	(Constant)	1 362	.165	
	Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility	.189	.132	.017
	Sex	.317	.099	.038
	Age (at Surgery)	.031	.004	.098
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-.266	.038	-.086
2	(Constant)	1.253	.172	
	Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility	187	.133	.016
	Sex	316	.099	.038
	Age (at Surgery)	.031	.004	.095
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-.266	.038	-.086
	CENTRAL	424	.104	.054
	MID_ATLANTIC	.214	.165	.016
	NORTHEAST	126	.139	.011
	PACIFIC	194	.154	.016
	SOUTHEAST	- 030	.116	-.003

Coefficients[a]

Model		t	Sig
1	(Constant)	8.236	.000
	Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility	1.431	153
	Sex	3.201	.001
	Age (at Surgery)	8.044	.000
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-7.012	000
2	(Constant)	7.273	.000
	Accreditation Status 1 = Accredited Facility 0 = Non Accredited Facility	1.400	.162
	Sex	3.183	.001
	Age (at Surgery)	7.870	.000
	# of Co Morbid Conditions (Based on Inpatient Diag Codes 1 - 6)	-7 022	000
	CENTRAL	4 070	000
	MID_ATLANTIC	1.297	.195
	NORTHEAST	906	365
	PACIFIC	1.261	.207
	SOUTHEAST	-.255	799

a. Dependent Variable: Length of Stay

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