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How Supply Standardization Affects Non-Emergent Laparoscopic Cholecystectomy Costs and Length of Stay

Marc Lopez
Walden University

Walden University

College of Management and Human Potential

This is to certify that the doctoral study by

Marc Lopez

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Kourtney Nieves, Committee Chairperson, Health Sciences Faculty
Dr. James Rohrer, Committee Member, Health Sciences Faculty
Dr. Melissa Green, University Reviewer, Health Sciences Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Abstract

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MSHA, Texas Tech University Health Sciences Center, 2018

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

This study was conducted to identify if there were practices that could be implemented to decrease costs in the operating room without negatively effecting patient outcomes. With the cost of healthcare in the United States consistently increasing, studies that focus on cost-reduction measures such as this one are crucial to ensure health systems continue to operate with a neutral or positive margin to remain available to provide patient care. This was a retrospective quantitative research study built on the diffusion of innovation theory. It focused on motivating factors such as differences in cost between surgical cases that used a standardized surgeon preference card and surgical cases that used a surgeon-specific preference card, with the cards listing variables including disposable items used. There was also a focus on determining if post-surgery length of stay was affected. A multiple linear regression was used to quantify if a relationship existed between the mean cost per case and mean length of stay for surgeons who used a standardized preference card versus those who used a surgeon-specific card. The results of this study showed standardized preference cards did not explain variation in total case costs for non-emergent laparoscopic cholecystectomies; however, the results of this study did show an impact on length of stay. While the results of this study did not support reduced costs, the positive social change impact still exists. This was a process that engaged surgeons and made them aware of the true cost of their case; and that motivated additional specialties to want to reduce their costs. Changes like these, which are surgeon-driven, build momentum within a healthcare organization, leading to continued discussions to find more opportunities for savings to lower the cost that is ultimately passed on to the patient.

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Dedication

The completion of this study is dedicated to several people in my life who directly influenced my journey. To my parents, Mario and Zelda Lopez, you both never set limits on what I could achieve and were always confident that I could accomplish anything I put my mind to…it looks like you were right. To my sister, Crystal Vasquez, your own higher education journey was constant motivation for me to keep pushing through to the end, just like you did. To Crystal Cook and Kaitlyn Moreno, you have been both the rock I needed and the push I needed to see this through. To Melissa Carballo, your friendship helped me persevere at a time I needed it the most. And to Patricia Lopez, you have been there since undergrad. Every time I told you I wanted more education you told me to go for it. You always knew to keep me from selling myself short and that is something I will forever be grateful for.

Acknowledgments

I would like to express a great appreciation to all the faculty who helped guide me through my journey of completing this doctoral study. To my committee chair, Dr. Kourtney Nieves, thank you for your genuine interactions we had. I always appreciated relying on you for advice or for your honest feedback. You made this whole experience completely enjoyable. And to my committee member, Dr. James Rohrer, thank you for always being willing to take our one-on-one calls to discuss my analysis. Your hands-on involvement made me extremely confident that I was producing a quality doctoral study, and I truly appreciate how direct you were in our communications.

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Section 1: Foundation of the Study and Literature Review

Introduction

The United States has a higher gross domestic product (GDP) per capita going towards health care than any other country in the world (CMS, n.d.). In fact, Hultman (2019) identified that between 1970 and 2009, US healthcare spending per capita increased by 2300%, whereas the number of physicians practicing in the US only increased by 150%, which is in line with the growth of the population. That percentage of healthcare spending far outpaced the growth of practicing physicians, which can possibly be attributed to inefficiencies in hospital settings, including places of service like the operating room. With such a slow growth in physician/overall population, the percentage increase in spending per capita far outpaces what one would expect.

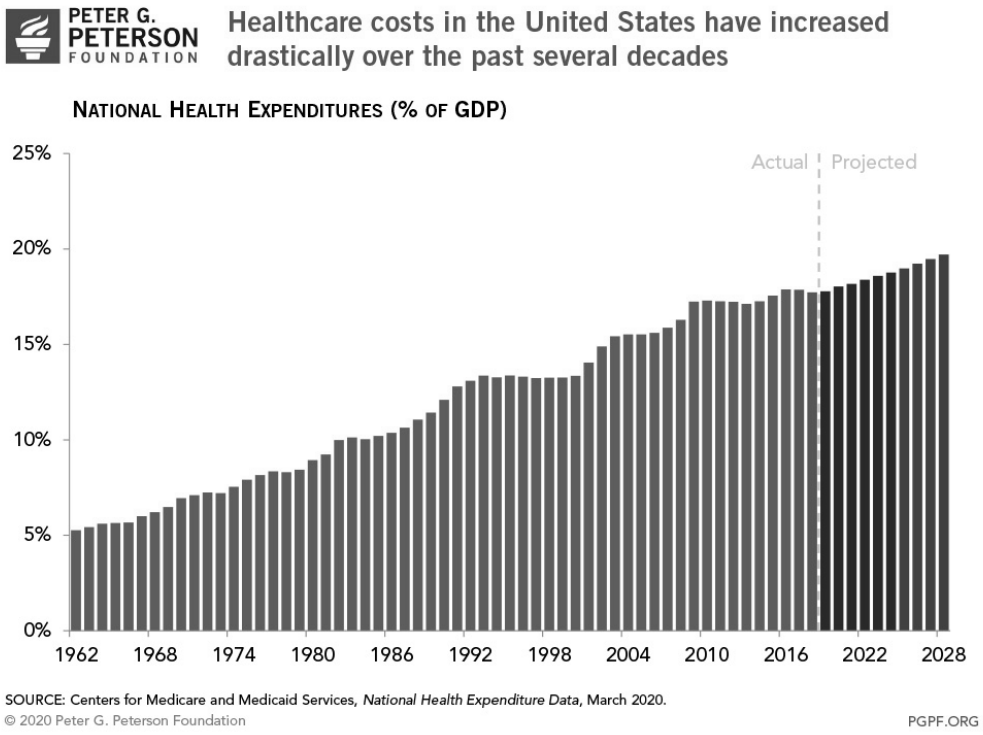
According to the Peter G. Peterson Foundation (2020), a non-partisan foundation founded to bring awareness of the US' fiscal challenges and develop solutions, the US had an estimated $3.6 trillion in healthcare expenditures, which is 18% of the GDP; based on the population of the US at the time, that is an estimated $11,000 per person that was spent on healthcare. This is an increase of 13% compared to previous data from 1960 that showed a much smaller expenditure on healthcare.

In fact, as Figure 1 illustrates, the US is expected to continue this trend of increasing healthcare expenditures. The Centers for Medicare and Medicaid Services (CMS) have projected that the US will have as high as $6.2 trillion in healthcare expenditures, which is estimated to be $18,000 per person as of 2028. This amount equates to approximately 20% of the US' GDP. It is important to note, as the Peter G.

Peterson Foundation (2020) points out, that these figures that were projected do not consider the effects the COVID-19 pandemic has had on the cost of healthcare.

Figure 1

Healthcare Costs in the US



Age of the Population

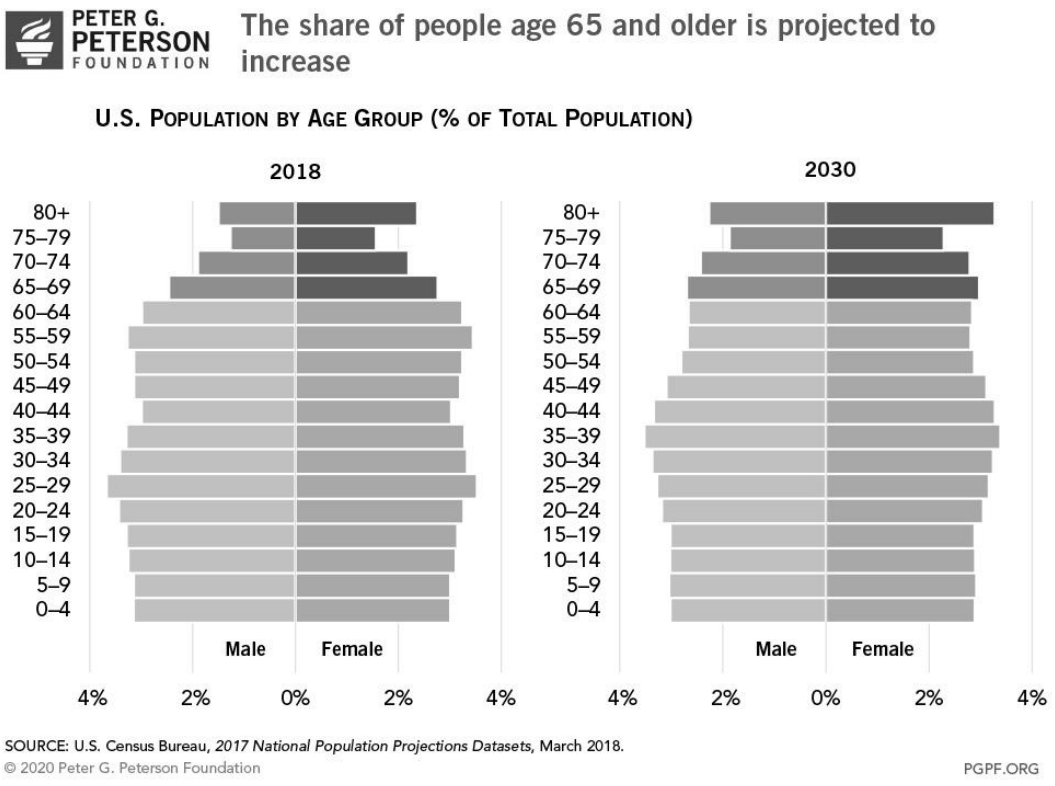
As Peter G. Peterson Foundation (2020) identifies, rising healthcare expenditures are the result of an aging population and a rise in healthcare costs. One of the largest populations in the US was that of the "Baby Boomer" generation (those born from 1946 to 1964, Pew Research Center, [2020]), who peaked in 1999 with a total of 78.8 million adults. It was just recently in 2019 that Millennials, those born from 1981 to 1996, finally surpassed the Baby Boomer generation; those ages 23 to 38 in 2019 were numbered at

72.1 million, while those ages 55 to 73 were numbered at 71.6 million (Pew Research Center, 2020). This overtaking of Millennial adults is a clear indication that what was once the largest generation of adults living in the US has now reached a point where their age is having effects on their health and number of life years.

As Figure 2 demonstrates, the age of those 65+ is expected to increase beyond 20% of the population by 2030, which is up from the 16% as of 2018 (Peter G. Peterson Foundation, 2020). With this increase of adults that are hitting that 65-year threshold, more adults will become eligible for Medicare.

Figure 2

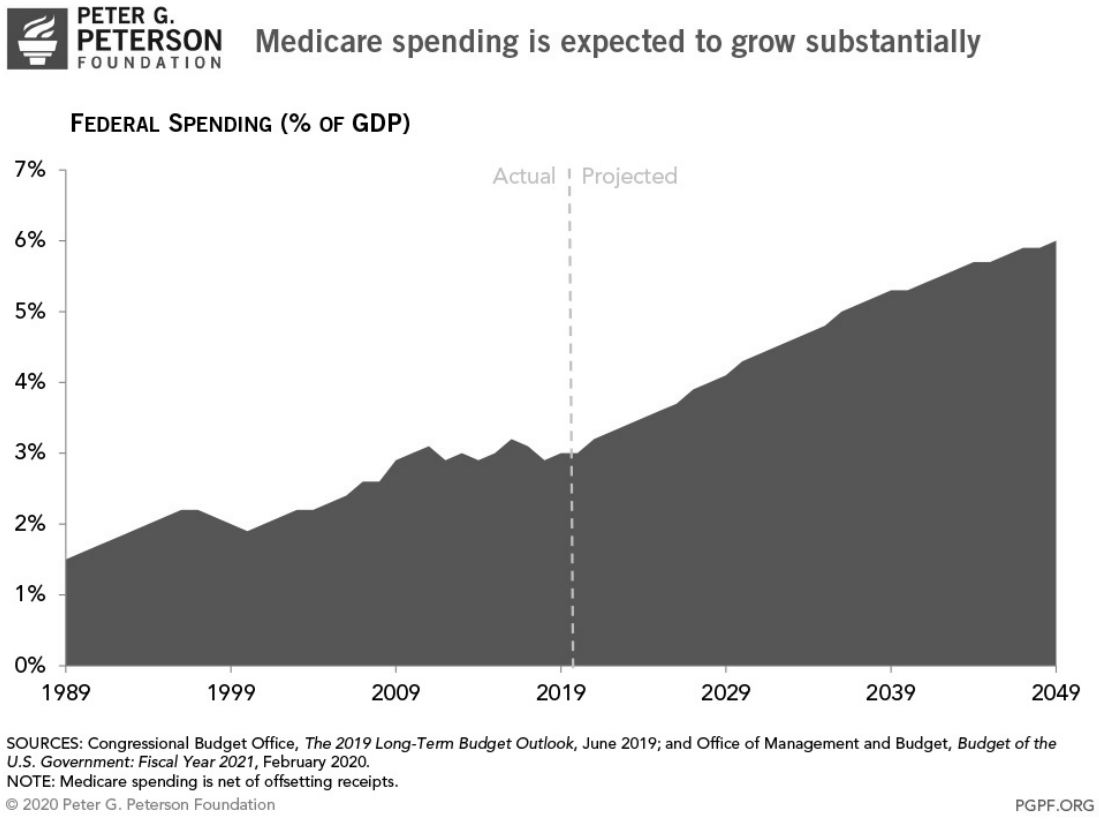
Share of Population in the US



This eligibility materialization is expected to increase the number of enrolled adults by 25% (60 million in 2018 to 75 million by 2028), thus increasing Medicare costs. These costs were projected by the Congressional Budget Office to, at minimum, double over the next 30 years. As of 2019, Medicare costs accounted for 3% of the GDP; as of 2049, Medicare costs are projected to be 6% of the US' GDP, as demonstrated in Figure 3 (Peter G. Peterson Foundation, 2020).

Figure 3

Medicare Spending



Healthcare Costs

When looking at how these healthcare costs are attributed, there are ten categories that CMS has identified to account for healthcare expenditures: hospital care; physician and clinical services; retail prescription drugs; other health, residential, and personal care services; nursing care facilities and continuing care retirement communities; dental services; home health care; other professional services; other non-durable medical products; and durable medical equipment. Of these various categories, hospital care accounted for the highest share.

With hospital care, this specific expenditure category accounted for 31% of the US' National Health Expenditures (CMS, n.d.). In fact, according to CMS (2020), hospital expenditures in 2019 had grown faster than the growth that was experienced in 2018, from 4.2% to 6.2% to a total of approximately $1.2 trillion. Physician and clinical services accounted for the second highest share at 21% or approximately $694.3 billion, and retail prescription drugs accounted for 10% of the share, or $333.4 billion (CMS, n.d.).

Surgical Health Care Expenditures

When looking specifically at surgical health care expenditures, Munoz et al. (2010) identified that they accounted for 29% of health care expenditures, which consisted of 15.9% of the GDP for 2005, or $1.9733 trillion. When comparing that to the GDP, surgical health care expenditures accounted for 4.6%, or $1615 per person. There is an expectation that surgical expenditures are to grow from $525 billion in 2005 to $912 billion by 2025, which is estimated to be 7.3% of the US GDP) (Munoz et al., 2010).

Section Preview

The next section will move on to the background of the study, which will show that standardization has been researched as a way to reduce surgical health care expenditures. With this standardization comes the necessity to provide results to health care providers and administrators to prove cost-savings in the operating room (OR) are achievable. Following this, the problem statement will be presented, which will promote the need to study the long-term implications of initiatives to encourage additional opportunities for cost savings without compromising patient care. The purpose of the study will identify the type of study, as well as introduce the dependent and independent variables that the study will revolve around.

With the purpose of the study in mind, the next section will consist of the research questions and hypotheses. These questions and hypotheses are built on the task of proving or disproving the difference in surgical case costs and patient length of stay. The theoretical framework will then explore how the diffusion of innovation theory relates to the various study elements The nature of the study will then be discussed to summarize the methodology and variables.

The following part of section one will review the literature search strategy, which identifies the resources and search terms that were used to acquire relevant literature related to the study topic. The literature review will synthesize the relevant material that was found during the literature review and describe its relation to the study variables. This will then lead into the definitions section, which will define the independent and dependent variables, as well as terms that are used in the study that could have multiple

meanings. Lastly, I will discuss the assumptions, scope, delimitations, and limitations, as well as the impact they have on the study. In addition, this section will close with the significance this study would have and what it could mean for health care organizations going forward.

Background

While there have been efforts made to reduce costs throughout the healthcare industry, there are still numerous possibilities that have yet to be uncovered that could benefit both health care organizations and consumers of healthcare. From the literature review, it was evident that hospitals are aware that reviewing their methods of operations in the OR is a powerful method to begin reducing costs. While some hospitals have shifted to be more transparent with their major players in the OR (such as informing surgeons of what the cost of each item they use is), others are using standardization to help eliminate waste and reduce costs.

While the literature has proven that standardizing is an efficient way to reduce the cost per surgical case, there are still questions of if these savings are sustainable, and if there are any adverse patient outcomes when compared to operations where standardization is not at the forefront. This study was necessary to provide material for administration and health care providers in the surgical setting to consider when determining if great cost-savings can be achieved without harm to the patient through standardizing certain operations of the OR.

Problem Statement

As Rigante et al. (2017) identified, hospital ORs are accountable for 70% of a hospital's overall waste. In fact, in their study, nuerointerventional procedures performed in their OR resulted in $2.9M of waste per year, a number that included disposable supplies. The findings showed that disposable supply costs in the operating room have consistently exceeded their budget by well over $1M year-over-year. While this study covered the amount of waste in the operating room, their process did not involve standardizing preference cards (Rigante et al., 2017).

Looking at Johnson et al. (2019), it was also noted that a relationship exists between surgeon awareness in pricing and the overall cost of a surgical case. If a surgeon is more informed on the price of what they are using, there is a greater likelihood that they will use the less expensive option. This study was specifically focused on providing pricing transparency to the surgeons and achieving cost-savings through this initiative, with little information mentioned regarding updating the surgeon's preference card.

Similarly, Robinson et al. (2018) identified that there was too much variability of supplies used in their pediatric laparoscopic appendectomies, which led to high surgical case costs. After standardizing their surgeon preference cards, they were able to see an immediate cost difference for their total case costs. This provides evidence that other procedures could be standardized and emphasizes the need for follow-up studies to identify if there are potential changes in areas, such as the patient's length of stay, as a result of using a standard card.

Because there are documented studies that prove waste exists across ORs in the United States, reducing costs while maintaining optimal patient care is crucial for all involved in the health care industry. This is why it is important to understand the long-term implications of initiatives, such as standardizing preference cards, for hospital leadership to determine if further standardization should occur, and if there are additional opportunities for cost savings without compromising patient care. Initiatives like these are crucial for healthcare leadership because they can contribute to lower costs for the hospital, and ultimately, lower costs for the patient.

Purpose of the Study

The purpose of this quantitative study was to examine differences in case costs between surgical cases with a standardized preference card and surgical cases that have surgeon-specific preference cards. In addition, differences in length of stay were examined for surgical cases with a standardized preference card and surgical cases that had surgeon-specific preference cards. The independent variable for this study was the surgeon preference card, and the dependent variables were the overall cost of the disposable supplies and the patient's length of stay. The covariate was the surgeon's practice status. This project was unique because it addressed the sustainability of savings and variations in length of stay with standardized preference cards to reduce healthcare expenditures.

Research Questions and Hypotheses

RQ1 – Quantitative: To what extent were there differences in surgical case costs (disposable items used in the case) between standardized physician preference cards and

non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented surgical case data, there were no statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

H1 – Based on documented surgical case data, there were statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

RQ2 – Quantitative: To what extent were there differences in patient length of stay between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented patient data, there were statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

H1 – Based on documented patient data, there were no statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

Theoretical Framework

The diffusion of innovation theory was the theoretical framework for the study. Gabriele Tarde, a French Sociologist, was the first person to discuss this theory in 1903, however, Everett Rogers gave this theory its modern recognition in his 1962 publication (Kaminski, 2011). This theory provides an understanding of how new ideas are

discovered, chosen to be implemented, and carried out (Gonzalo et al., 2018). There are five stages included in the theory: knowledge (how participants are made aware of the potential new idea), persuasion (gaining backing of the new idea), decision (plan to incorporate the new idea), implementation (process to guide the participants through the new idea), and maintenance (providing support to the participants to encourage their continuation of the innovation) (Gonzalo et al., 2018). As applied to this study, the conclusion of the results corresponded with step five of this theory. Using case costs (i.e., showing a reduction in costs) as one variable and length of stay (i.e., showing a flat trend) as the other, the data can be used to provide evidential support that this intervention is worth continuing.

Nature of Study

The study was a retrospective quantitative research study with a time series design that examined the pre-intervention data, time of intervention data, and post-intervention data. A multiple linear regression was used to quantify if a relationship existed between the mean cost per case and mean length of stay for surgeons who used a standardized preference card versus those who used a surgeon-specific card.

The data for all these time periods were already collected. As part of a circulating nurse's role in the OR, they are responsible for capturing all supplies and implants used during the surgical procedure in the patient's electronic health record (EHR). In addition to this, they are responsible for capturing various elements throughout the procedure, including patient in-room time, anesthesia start time, surgery start time, etc. This documentation data, which was already collected, was the data queried from the

hospital's EHR data warehouse. An identified time period was used for the dataset, which spanned from May 2019 to October 2020 (prior to implementation of the intervention [May 2019 to October 2019], during the intervention [November 2019 to April 2020], and post-implementation of the intervention [May 2020 to October 2020]). As previously mentioned, all data had already been collected as part of the circulating nurse's role and documented in the EHR which was fed into the data warehouse; the EHR data warehouse was queried for the pertinent data elements necessary to perform an analysis.

An inferential analysis was conducted to determine what differences exist between surgical case costs and length of stay for patients that had a standardized preference card and a surgeon-specific preference card. The independent variable for each time period was the surgeon preference card, and the dependent variables were the surgical case costs and length of stay. The covariate for this study was the surgeon's practice status.

Literature Search Strategy

As evidenced by the research, ORs are heavy financial players and major stakeholders when it comes to expenses in health care and financial efficacy for hospitals; in short, they contribute greatly to the bottom line of health care organizations. Because of this, many hospitals have implemented cost-savings measures through the OR to assist with keeping costs low for the hospitals, as well as the patients. The keywords searched for this literature review were *surgical waste, preference card standardization, surgical case costs, anesthesia minutes, anesthesia cost, appendectomy minutes, surgeon preference card,* and *surgery supplies* in a Thoreau multi-database search.

Literature Review Related to Key Variables and/or Concepts

Various Costs of the Operating Room

When it comes to surgical costs in the operating room, the costliest aspect of this health care expenditure is that of anesthesia services. According to French et al. (2016), this service has the highest cost associated in the entire health care delivery world with the highest average price per service charged. This service is the only professional service that uses time as a component of its billing methodology; every other professional service is billed by service rendered or by visit.

As French et al. (2016) identifies, this time component is broken up into three different units. There is a base unit, which is based on procedure type and the American Society of Anesthesiologists [ASA] Physical Status classification of a patient's physical state, time unit that are based on the start and end times of the anesthesia service, and special units that take into account complicated conditions. Schuster et al. (2004) identified that the duration of the surgical case and the type of surgery that is occurring can result in large differences in the hourly clinical productivity of the anesthesia providers present in these cases; this productivity is a huge component of the costs that anesthesia brings to the table. Approximately 79% of anesthesia costs are directly tied to personnel costs, while 21% of costs are tied to other anesthesia costs (French et al., 2016).

Suffice it to say, there are opportunities available to reduce the costs associated with anesthesia services by decreasing the overall time involved in the process and/or increase the productivity of personnel (French et al, 2016). With inefficiencies in the

process, which include inefficiencies in OR turnover such as room setup based on the physician preference card, there stands for waste to occur with this expensive component of surgical health care expenditures.

Surgical Waste

When it comes to waste in healthcare, ORs account for 70% of waste in the hospital setting, which is a major contributing factor to the continued rise in healthcare costs (Rigante et al., 2017). In the study by Rigante et al. (2017), neurosurgical cases were found to have waste at a cost of $968 per case. Based on the surgical volume for this specialty at this facility, that accounted for $242,968 per month, or $2.9 million per year. With orthopedic cases, Rigante et al. (2017) identified that 1.8% of cases resulted in implant waste, which resulted in a loss of $634 thousand per year. With anesthesiology, approximately 20% of cases generated routine waste for the study hospital. Because this study hospital recognized the need to make changes to prevent waste, they made changes beginning with revising their disposable packs for plastic and hand cases. This change decreased the amount of opened and unused materials, which saved the study hospital $17,381.05 per year (Rigante et al., 2017).

Surgeon Awareness for Surgical Case Cost

When looking at health care costs, Johnson et al. (2019) estimated that by 2020, they will account for 20% of the GDP in the US. Physicians are responsible for approximately 60% to 80% of the decisions that account for these expenditures, which is why there is a need for them to collaborate with health care administrators in order to help decrease these costs without compromising the quality of care they provide. Despite

this high number attributed to physician decision-making, a 2013 JAMA study reported that only 36% of practicing physicians believed they had a major responsibility to control the cost of health care in the US.

Johnson et al. (2019) conducted a cross-sectional (qualitative) study with the purpose of identifying a surgeon's cost awareness related to the setting of rotator cuff repairs. There were 345 respondents from 23 countries; a total of 89% were from the US, with 79.7% identifying as a form of cost-conscious when making decisions with their surgical treatment/care of the patient. Rotator cuff repairs are one of the most common procedures performed, with approximately 250,000 performed per year, which then accounts for $1 billion in health care costs. If a focus was made to reduce these costs, this could save approximately $80 million to $262 million per year.

For this particular procedure, a suture anchor, which is the main implant used in these cases, was determined to be the variable that surgeons have the most control over (Johnson et al., 2019). There are several studies that show physicians have limited knowledge when it comes to the cost of the implants they use in their surgical cases or the cost of their supplies. With this particular implant, Johnson et al (2019) identified that surgeons knew the correct cost of the implant 21% of the time, with 80% of the surgeons indicating that the cost of the implant is an important factor when making their device selection. This is a cost that accounts for as much as 87% of the orthopedic procedure cost, with waste accounting for 30%.

With the retrospective study conducted by Zhao et al. (2019), the purpose was to implement a strategy to reduce costs that varied from common tried methods. Because

surgical costs are directly under the surgeon's control, the study hospital implemented receipts to inform the surgeon within three days of the case what items/equipment were used, and what the overall cost was; the purpose, of course, to provide the surgeons with information regarding the cost of their case to engage them in cost-saving practices. After implementation, three of the five focus procedures showed a significant decrease in median cost (Zhao et al., 2019). For laparoscopic cholecystectomies, the median cost per case decreased from $886.77 to $816.13; for thyroidectomies, the median case cost decreased from $861.21 to $825.90; and for inguinal hernia repairs, the median cost per case decreased from $429.45 pre-implementation to $372.49 post-implementation (Zhao et al., 2019).

Outdated Physician Preference Cards

Another contributing factor to waste in the operating room is the result of outdated physician preference cards. Rose et al. (2019) conducted a quantitative study in which one of their senior general surgeons had their surgical cases observed to identify how much waste resulted at the end of their cases. Over the duration of a six-month period, this surgeon had 30 cases observed in which residents identified items that were opened and used during the case, as well as the items that were improperly opened.

After the end of the observation period, Rose et al. (2019) were able to determine the percentage of items wasted per case to be 0% to 27%, averaging 8.3% of items. Of the wasted items, $4,528.18 were the result of instruments that were opened and not used; $693.93 were from items routinely opened and not used; $1,388.65 were from items that were marked as available (have in the suite readily available, but not to be opened until

requested by the surgeon), opened, and not used; and $2,446.20 were from supplies that were opened in error.

Physician Preference Card Deviations

Yonce et al. (2012) reviewed deviations from the physician preference card to identify the effects this had on the flow of the operating room. Based on observations over the defined period (a total of 74 cases were observed), there was an average of 0.541 deviations per case. These deviations resulted in a case delay of approximately 2.52 minutes, which resulted in a trickle-down effect for various surgical case elements (anesthesia duration, patient in-room minutes, etc.).

Preference Card Standardization

When it comes to preference card standardization, there are studies that have identified that cost savings are achievable when physician preference cards are standardized. Skarda et al. (2015) conducted a retrospective study on surgical case data for laparoscopic appendectomies after their standard cards were implemented. With laparoscopic appendectomies, variation is common as a result of the individual surgeon's training and preferences. The children's hospital in this study obtained a consensus from the six applicable surgeons affected by standardizing the preference card. There were a total of 342 laparoscopic appendectomies completed before the implementation, and 362 performed after the intervention. The median cost for these procedures decreased from $829.73 to $279.76 for nonruptured cases, and $874.08 to $361.57 for ruptured cases. Skards et al. (2015) indicated that the savings that resulted as a direct result of the intervention was $195,041.98 for the 12-month period after implementation.

In addition to these findings, Skards et al. (2015) also noted that the operative time (incision to close) changed from 31.2 minutes to 35 minutes for nonruptured cases, and 41.7 minutes to 43.4 minutes for ruptured cases. For the overall OR time (patient in room to patient out of room or wheels in to wheels out), the minutes changed from 55.6 minutes to 58.3 minutes for nonruptured cases, and 66.6 minutes to 68.8 minutes for ruptured cases. Regarding length of stay, the hours changed from 22.5 hours to 24.9 hours for nonruptured cases, and 106.6 hours to 93.6 hours for ruptured cases. With all these changes, Skards et al. (2015) did not identify any significant differences in the patient outcomes.

Regarding laparoscopic cholecystectomies, Allen and Polk (2002) performed a retrospective study with data pulled from this procedure type. The purpose of this was to identify cost savings opportunities with standardizing physician preference cards. When looking at the data prior to any implementation, case costs ranged from $92 to $637, with an average case associated with $333 in costs. The greatest factor for the surgeon who had that $92 case cost was that they used mainly reusable instruments instead of the disposable ones.

There were approximately 1000 laparoscopic cholecystectomies performed per year at the study hospital. When converting all surgeons that perform these procedures from disposable instruments to reusable ones, there was a decrease in cost per case of approximately $500. This decrease in costs equates to approximately $500 thousand per year in savings.

Resident Involvement

As Uecker et al. (2013) points out, the operating room serves as a crucial element when it comes to resident education; hands-on experience consistently proves to be the gold standard, even with emerging technology that continues to offer a plethora of platforms for educational experience. This retrospective study was conducted to identify statistical differences of resident involvement in surgical cases regarding case duration. Uecker et al. (2013) hypothesized that the inclusion of graduate medical education (general surgery residents) would have a major effect on their operative times and postoperative outcomes.

When examining the data, there were 2,280 procedures performed. Of these procedures, 1,130 were from the nonresident group and 1,150 were from the resident group. When specifically looking at the laparoscopic cholecystectomy data, there was a minimal increase in the duration of the surgical case for the resident group (71 + 32 vs 66 + 28, $p = 0.02$). While this procedure did show a slight increase in case minutes, the overall study identified that resident involvement in surgical cases could lead to a reduction in length of stay, while only leading to a slight (if any) increase in operative times (Uecker et al., 2013). The data for this doctoral study was from a teaching hospital, so this provided support that resident participation in the dataset would have no effect on the results of the analyses.

Definitions

The following list pertains pertinent definitions which were relevant to this study:

Acute Care Surgery Model: – creates a dedicated general surgical team for consulting trauma and urgent nontrauma surgeries who are free from all other clinical duties (Lau and Difronzo, n.d.).

Circulating Nurse: - a key role in the operating room, this Registered Nurse works outside the sterile field to anticipate and support the needs of the other members in the operating room (Neyens et al., 2019). They are the voice of the patient throughout the surgical case and ensure that all surgical protocols are in place and carried out during the preparation and intra-operative phase.

Electronic Health Record (EHR): - a system used to record and store a patient's health care data (Rasmi et al., 2020).

Laparoscopic Cholecystectomy: - a surgical approach to treat gallstone disease (Xiong et al., 2020).

Length of Stay (LOS): - the number of days elapsed for a person inhabiting a bed in a health care facility based on their day admitted to the day they are discharged. The most common calculation for determining LOS is to subtract the day of admission from the day of discharge. (Buttigieg et al., 2018).

Operating Room (OR): - a location where surgical interventions, examinations, and procedures which needing a high level of asepsis and/or anesthesia care are performed (Carneiro et al., 2019).

Physician Preference Card: - this is a communication tool which contains important information specific to the surgeon and their scheduled surgical case. Such information includes their preference for specific supplies, patient positioning, and

physician's orders for certain medications that the surgeon could use during the case (Dawson et al., 2005).

Practice Status: - for the purpose of this study, it will be the designation of a surgeon as a private surgeon or a surgeon with an academic appointment.

Assumptions

The following assumptions were present in this study: It was assumed that the documentation of the circulating nurse was 100% accurate. The patient medical record was a legal document that required accuracy when patient medical history was being recorded. It was assumed that the price of supplies was up to date from the hospital's Materials Management Information System (MMIS). This system was updated by various personnel of the hospital's Supply Chain group as contract negotiations took place. It was assumed that the population of this study was an accurate representation of the general community hospital patient population. Community hospitals which serve as teaching hospitals often have a more complex patient population.

Scope and Delimitation

The data that were reviewed was delimited to only nonemergent laparoscopic cholecystectomies, limiting the cholecystectomy surgical case volume which was reviewed. This ensured that the results of the study were not skewed by outlying procedures.

Limitations

The following limitations/delimitations were present in this study: This study had a limited sample size determined by the number of patients presenting to the operating room with nonemergent cholecystitis.

Significance

Overall, the topic of this doctoral study involved decreasing the cost of care in the perioperative setting. This was done through standardizing physician preference cards for certain surgical procedures – such as a laparoscopic cholecystectomy – so the surgeons perform the procedure in the most cost-effective way for simple cases. While this particular project does benefit healthcare leadership by reducing supply expenses, it also has a social change aspect to it. Through the standardization of preference cards, if surgeons saw that length of stay remained the same, whether a surgeon-specific preference card or standardized preference card was used, then they were more likely to standardize other procedural cards – even across service lines – to help reduce waste. Laureate Education (2015) called this particular phenomenon a ripple effect. This has the potential to not only reduce expenses for the hospital, but also benefit the patient and payer. If the hospital is using less supplies, or less expensive supplies in their surgical cases, the cost passed on to the patient and payer becomes less.

Summary

The above discussion serves as proof that operating rooms are extremely expensive places to provide care (from the service provided by anesthesia providers to the cost of the implants used in surgical cases). And, that there are key players involved

in all aspects from administration to the surgeons that are welcoming various methods to reduce case costs. Standardizing physician preference cards has proven to be a great way to reduce the cost of a surgical case and shows substantial savings opportunities for the organizations that implement this initiative, which makes the physician preference card the ideal independent variable in this study. This variable has the ability to impact sustainable cost savings and length of stay, which highlights the significance of these understudied variables that will be evaluated using the following methods indicated in section two.

Section 2: Research Design and Data Collection

Introduction

As section one indicated, the purpose of this study was not just to identify if cost-savings were achieved from standardizing practices in the OR. As the literature has proven, there were cost savings that were achievable when using a standardized physician preference card versus a surgeon specific preference card in a surgical case. What has not been identified is if these savings were sustained when no further intervention was implemented (i.e., the standard card is implemented, and administration and the surgeons remove their oversight from this initiative).

An overview of the research design and rationale for the design was discussed to provide in-depth information on why a retrospective quantitative research study was an appropriate study design to prove the hypotheses of this study. In addition to this, the methodology of the study was examined to supply a detailed overview of the various components so other researchers had the information identified to replicate this study. Finally, any threats to validity were reviewed.

Additional methodology notes were reviewed including the proposed study population being identified, providing an explanation of the sampling and sampling procedures, and providing information on the instrumentation and operationalization of constructs. These three components provided a precise overview of how the data was sampled and analyzed, which ensured any future researcher had the opportunity to replicate these results. Lastly, any threats to external or internal validity and the ethical procedures were identified. Any internal or external threat was appropriately addressed,

and all ethical procedures were documented accordingly to comply with the outline of the study.

Research Design and Rationale

The variables that this study focused on consisted of independent and dependent variables. The independent variable for this study was the physician preference card. This variable influenced a plethora of other items, which make up the dependent variables. The dependent variables consisted of the cost of the surgical case and the length of stay for the patient. While these were the two main dependent variables that this study focused on, there were other variables that could also be considered in regard to this study: patient in room minutes to surgeon start minutes (the amount of time from when the patient gets to the room to the when the surgeon makes their first incision), anesthesia start time, which can determine the number of minutes from when the patient wheels into the room to when induction takes place, case duration, turnover time, etc. The covariate for this study was the surgeon's practice status (i.e., private surgeon versus a surgeon with an academic appointment). Because private surgeons were reimbursed differently than surgeons with academic appointments, it is obvious that this status potentially influenced the cost per case. Using the surgeon status as an explanatory variable allowed this study to run a multiple linear regression with surgeon status and case cost as the response variables.

Because this study used secondary data – that is, the data has already been collected by another entity outside of this study – the research method most appropriate for determining the outcomes of the study was a retrospective quantitative study. As the

National Council for Osteopathic Research (2014) indicated, retrospective studies use data that were collected in the past. While there are less controls over the input of the data quality, it had already been addressed through the assumptions that this study was still the most appropriate format. In addition to this, this study followed a similar study design addressed in the discovered literature. Skarda et al. (2015) conducted a retrospective quantitative study to identify if there were cost savings associated with their laparoscopic appendectomy cases after implementation of their intervention. Similar to their study, this study consisted of similar facets to prove or disprove the hypotheses.

Methodology

Population

The target population for this study was all patients who required a non-emergent laparoscopic cholecystectomy and were served at a community teaching hospital that saw greater than 800,000 patient encounters for 2019. Because they were at a community hospital, they were a source of care for a wide-ranging population. Moreover, because of the industry of business, they were not geared towards serving a specific population type; instead they were established to provide health care services for any and everybody, as they sought services.

Because this study focused on the standardization of physician preference cards for laparoscopic cholecystectomies, the population was limited to patients who had a laparoscopic cholecystectomy during the defined time period, which was before the implementation of the intervention, at the time the intervention was implemented, and for a specified time after the intervention had been implemented. The total volume of

procedures that were relevant to this study for the aforementioned timeframe equated to 1,949, prior to determining if there were any outliers that should be omitted; a total of 969 procedures had a surgeon under the acute care surgeon model (which implemented standard cards), and 980 procedures were with all other surgeons.

Sampling and Sampling Procedures

Because there were other factors that could contribute to a patient needing a cholecystectomy, there were contingencies that the population had to meet to ensure that the mean of each data set could be compared to one another. That is why this study focused on nonemergent laparoscopic cholecystectomies; these were procedures that should have no underlying conditions that could affect the surgical intervention. There were times when multiple services operated on a patient concurrently or successively; in these instances, the data would be skewed if these laparoscopic cholecystectomies were included. A multi-system trauma would have costs associated to the case that would inflate various aspects of the surgical case, such as the mean cost of the case, the mean case minutes, the mean length of stay, etc.

Sampling Strategy

A simple random sample was used for each time period. A list of each surgical case had been generated with the total cost. These surgical cases were assigned a sequential number, from which a random number of these elements will be selected. IBM's Statistical Package for Social Sciences (SPSS) Statistics, a statistical software program was utilized to generate random numbers so the sample could be provided for each time period.

Data Collection

Medical records of patients that had a laparoscopic cholecystectomy were abstracted from the hospital's data warehouse. The data was queried by using a defined timeframe and specific primary procedure: laparoscopic cholecystectomy, which excludes open cholecystectomies and robot-assisted cholecystectomies. Data were pulled using Cerner Surginet's Discern Analytics V2.0. The data were exported and saved into a Microsoft Excel document. From there, Microsoft Excel was used for basic analyses. A more in-depth analysis was conducted when the data were exported into IBM's SPSS Statistics (a statistical software program).

Secondary Data

For this study, the data that were used were secondary data – that is, they were data that had already been collected prior to the enactment of this study. In the operating room, the circulating nurse is responsible for documenting all aspects of the surgical case. These elements include: all time components (each time a person enters the room, each time an event is started or ended, etc.), patient assessments, equipment used during the surgical procedure, supplies used and/or wasted during the surgical procedure, items that were implanted and/or wasted during the surgical procedure, etc. It is based on this patient record which lays out the surgical procedure that the data for this study were gathered. A query was done against the hospital's EHR to extract the circulator nurses' documentation for laparoscopic cholecystectomies to conduct the analysis against. This was the best data to use for this study because it represented the most accurate account of

what supplies were used for these specific surgical procedures and what outcomes were associated with the surgeon-specific versus standardized preference cards.

Power Analysis

A power analysis was completed using IBM SPSS v27 to determine what an appropriate sample size would be for this study. A power level of 0.80 was used to ensure a Type II error did not occur, which is the result of insufficient power. A significance level of 0.05 was used so the sample size would be large enough to indicate that there was a less than 5% chance that the null hypothesis is correct. Based on these inputs, the sample size that was populated indicated a minimum sample size of 144 would be large enough to satisfy these requirements.

Table 1

Power Analysis

Power Analysis Table

			Predictors		Test Assumptions			
	N	Actual Power[b]	Full	Nested	Power	Full[c]	Nested[d]	Sig.
Type III F-test[a]	144	.802	2	1	.8	.1	.05	.05

a. Intercept term is included.

b. Predictors are assumed to be fixed.

c. Squared multiple correlation coefficient in full model.

d. Squared multiple correlation coefficient in nested model.

Note: Sources is *SPSS (2021).*

Instrumentation and Operationalization of Constructs

Operationalization

For this study, the independent variable was the physician preference card. This variable was the main piece that influenced the various outcomes of the surgical case. It

contained the surgeons order set, which included pharmaceuticals for the procedure, patient positioning, surgical equipment, instrument sets, and disposable surgical items. This variable was manipulated by standardizing all the aforementioned items for each surgeon that was on the ACS team.

For the dependent variables, there were two that this study focused on. This included the cost of the surgical case, which was the overall cost of all disposable and implantable items used in the case. This data was measured by the percentage change in overall mean case cost for surgeons with standard cards versus those with surgeon-specific cards.

For the second dependent variable, the length of stay of a patient was reviewed. The length of stay is a general patient measure that is examined by both physicians and hospital administration. It identified the length of time that a patient was admitted to the hospital. For the purposes of this study, the data were measured by the percentage change in overall mean length of stay for surgeons with standard cards versus those with surgeon-specific cards.

There was also a covariate that was used in this study which was the surgeon's practice status. This covariate served as the dummy variable for the multiple linear regression and had the values of 1 or 0 assigned. The 1 represented a surgeon that was a private surgeon, and 0 represented the absence of that characteristic.

Data Analysis Plan

When conducting the analysis, two types of data analytic software were used. Microsoft Excel was used to clean the data, binary numbering was added, assigned

sequential numbering for random sampling, etc. IBM's SPSS was used to conduct a multiple linear regression for the cost per case analysis and for the length of stay analysis to quantify if a relationship existed between the mean cost per case and mean length of stay for surgeons who used a standardized preference card versus those who used a surgeon-specific card.

A dummy variable was used for the multiple linear regression. The surgeon's practice status was coded with either a 1 or a 0, with 1 representing the surgeon belonging to a private practice. This allowed the researcher the ability to determine if there were quantitative differences between the two groups in regard to the cost of the surgical case and the length of stay for patients in the study population.

For the multiple linear regression, the researcher ensured that the four assumptions were met: (a) a linear relationship between the independent and dependent variables existed through the examination of the plotted points; (b) the residuals had no correlation after conducting a Durbin-Watson test; (c) there was constant variance for the residuals as identified in the scatterplot; and (d) there was normal distribution with the residuals, which was verified using the Normality plots with tests option in SPSS.

Research Questions and Hypotheses

RQ1-Quantitative: To what extent were there differences in surgical case costs (disposable items used in the case) between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented surgical case data, there were no statistically significant differences in the surgical case cost (disposable item costs) controlling for the surgeon's practice status.

H1 – Based on documented surgical case data, there were statistically significant differences in the surgical case cost (disposable item costs) controlling for the surgeon's practice status.

RQ2-Quantitative: To what extent were there differences in patient length of stay between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented patient data, there were statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

H1 – Based on documented patient data, there were no statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

Threats to Validity

With any quantitative research design, there was a possibility of a threat to validity in the research – both internal and external. These threats were essentially other plausible reasonings behind explaining the results versus those that the researcher had proven. Because this data revolved around the surgical care of patients and there were numerous possibilities of what could occur during a surgical case, there did stand a chance that the history was a valid internal threat to this study. Because of this concern,

outlying data points were determined and removed to account for those particular instances where a surgeon deviated based on the trajectory of the surgical intervention (i.e., if the patient had an emergent vs elective procedure).

Ethical Procedures

With this dataset, a deidentifying process took place when the data was pulled from the EHR. No identifying patient information was obtained, and no specific dates were used. Instead, the cases were assigned sequential numbers, and the dates were generalized to the year rather than the specific date. These data were maintained in a controlled environment with zero public access. Once the study was completed, the data were destroyed. Should the data ever need to be used again, it can be repulled via the same methods through the EHR.

Summary

In this section, the methodology was described that was used to determine if there were statistical differences between the variables of a standard physician preference card versus a surgeon specific preference card. Included in this methodology was a description of the design of the study, the setting and the sample size that were used, a description of the variables, the research questions and hypotheses, and the data collection and secondary data elements. Section three provides the results that are attributed to this study and includes a discussion of the results and any implications for social change.

Section 3: Presentation of the Results and Findings

Introduction

This section addresses the data collection, study results, and the summary of the study's findings. The purpose of this retrospective quantitative study was to determine the differences of surgical case costs (for disposable items) between standardized physician preferences and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies. In addition to this, I examined the differences in patient length of stay between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies. A multiple linear regression analysis was completed for the cost per case analysis and length of stay analysis to quantify if a relationship existed between the mean cost per case and mean length of stay for surgeons who used a standardized preference card versus those who used a surgeon-specific card, when controlling for surgeon's practice status. The following are the research questions and hypotheses formulated for this study:

RQ1 – Quantitative: To what extent were there differences in surgical case costs (disposable items used in the case) between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented surgical case data, there were no statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

H1 – Based on documented surgical case data, there were statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

RQ2 – Quantitative: To what extent were there differences in patient length of stay between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented patient data, there were statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

H1 – Based on documented patient data, there were no statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

Data Collection of Secondary Data Set

The data collection for this study involved developing a custom query utilizing Cerner Surginet's Discern Analytics V2.0 from the data provider. This query was developed for the period of May 2019 to October 2020, pulling all laparoscopic cholecystectomy cases performed, which resulted in 770 surgical cases produced for the dataset. Because this dataset is all-encompassing for laparoscopic cholecystectomies, it was considered representative for a larger population.

The dataset was exported to SPSS where descriptive statistics were derived:

Table 2

Frequency of Surgeon Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	642	83.4	83.4	83.4
	1	128	16.6	16.6	100.0
	Total	770	100.0	100.0	

Based on the frequency table output from SPSS, the surgeon status variable had two categories indicated by the one and zero on the table (zero indicating an academic status, and one indicating a private status). The zeroes were identified to have a frequency of 642, which accounted for 83.4% of the data. The ones were identified to have a frequency of 128, which accounted for 16.6% of the data.

Table 3

Frequency of Preference Card

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	364	47.3	47.3	47.3
	1	406	52.7	52.7	100.0
	Total	770	100.0	100.0	

Based on the frequency table output from SPSS, the preference card variable had two categories, indicated by the one and zero on the table (the zeros indicating a surgeon-specific card and ones indicating a standardized card). The zeroes were identified to have a frequency of 364, which accounted for 47.3% of the data. The ones were identified to have a frequency of 406, which accounted for 52.7% of the data.

Table 4

Frequency of Period

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Intervention	217	28.2	28.2	28.2
	Post-Intervention	252	32.7	32.7	60.9
	Pre-Intervention	301	39.1	39.1	100.0
	Total	770	100.0	100.0	

Based on the frequency table output from SPSS, the period variable had three categories indicated by the intervention, post-intervention, and pre-intervention labels on the table. The intervention variable was identified to have a frequency of 217, which accounted for 28.2% of the data. The post-intervention variable was identified to have a frequency of 252, which accounted for 32.7% of the data. The pre-intervention variable was identified to have a frequency of 301, which accounted for 39.1% of the data.

Table 5

Descriptive Statistics for Length of Stay and Total Cost

		LOS	Total Cost	Valid N (listwise)
N Statistic		770	770	770
Minimum Statistic		.14	137.64	
Maximum Statistic		61.96	3127.75	
Mean Statistic		2.62	491.85	
Std. Deviation Statistic		3.84	260.14	
Skewness	Statistic	6.47	4.37	
	Std. Error	.09	.09	
Kurtosis	Statistic	79.31	29.24	
	Std. Error	.18	.18	

For the variable length of stay, the range of data was from 0.140 to 61.96 days with a mean of 2.62 days, and standard deviation of 3.84. The skewness of 6.47 indicated that the histogram had a very positive skew and the kurtosis of 79.31 indicated that the histogram was extremely pointy. Both observations were representative of an asymmetric distribution.

For the variable total cost, the range of data was from 137.64 to 3127.75 dollars, with a mean of 491.85 and standard deviation of 260.14. The skewness of 4.37 indicated the histogram had a positive skew, and the kurtosis of 0.18 indicates that the histogram had a point. Both of these observations were representative of an asymmetric distribution.

Table 6

Outlier Descriptive Statistics for Total Cost

			Statistic	Std. Error
Total Cost	Mean		491.85	9.37
	95% Confidence Interval for Mean	Lower Bound	473.44	
		Upper Bound	510.25	
	5% Trimmed Mean		457.35	
	Median		422.49	
	Variance		67670.60	
	Std. Deviation		260.14	
	Minimum		137.64	
	Maximum		3127.75	
	Range		2990.11	
	Interquartile Range		173.82	
	Skewness		4.37	.09
	Kurtosis		29.24	.18

For the variable total cost, the descriptive statistics in SPSS identified an upper bound of 510.25 and a lower bound of 473.44. An interquartile range of 173.82 was also

indicated. Considering the range of data of 137.64 to 3127.75 and the aforementioned observations, it is evident that outliers in this likely exist.

Figure 4

Stem-and-Leaf Plot for Total Cost

```
Total Cost Stem-and-Leaf Plot

 Frequency    Stem &  Leaf

     1.00        1 .  &
      .00        1 .
     4.00        2 .  3&
    81.00        2 .  57777778888888888888888888899999999&
    81.00        3 .  000000111112222233333333333344444444
   151.00        3 .  55555555666666667777777777777777788888888888888888888888888888899999999
   129.00        4 .  000000000000000001111111111122222222222233333333333344444444
    73.00        4 .  555555555566666777777788888899999
    71.00        5 .  000000000001111111222222333334444
    48.00        5 .  555555666677777777888999
    29.00        6 .  0000112223344
    25.00        6 .  555667888899
     7.00        7 .  04&
    13.00        7 .  555667&
    57.00 Extremes    (>=802)

 Stem width:  100.0000
 Each leaf:        2 case(s)


 & denotes fractional leaves.
```

When looking at the stem and leaf plot that was created from SPSS, the results indicated that 57 data points were determined to be outliers. These data were for values of total cost that are greater than or equal to 802. These outliers will remain in the data when conducting the analysis.

Table 7

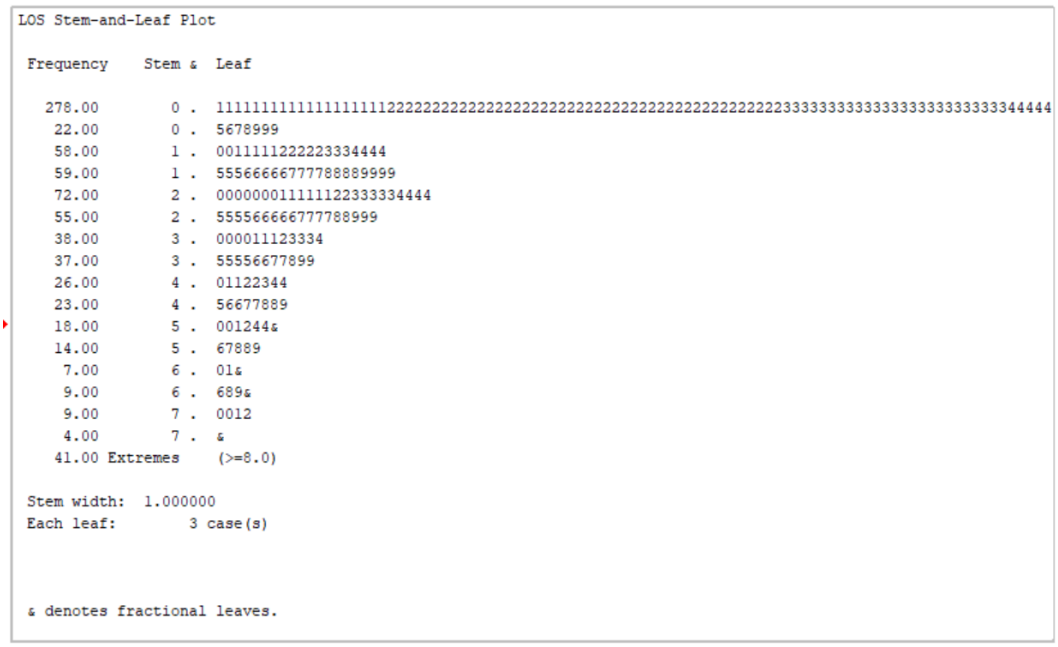
Outlier Descriptive Statistics for Length of Stay

			Statistic	Std. Error
LOS	Mean		2.62	.14
	95% Confidence Interval for	Lower Bound	2.34	
	Mean	Upper Bound	2.89	
	5% Trimmed Mean		2.09	
	Median		1.72	
	Variance		14.76	
	Std. Deviation		3.84	
	Minimum		.14	
	Maximum		61.96	
	Range		61.82	
	Interquartile Range		3.08	
	Skewness		6.47	.09
	Kurtosis		79.31	.18

For the variable length of stay, the descriptive statistics in SPSS identified an upper bound of 2.89 and a lower bound of 2.34. An interquartile range of 3.08 was also indicated. Considering the range of data of 0.14 to 61.96, and the aforementioned observations, it is evident that outliers in this likely exist.

Figure 5

Stem-and-Leaf Plot for Length of Stay



```
LOS Stem-and-Leaf Plot

 Frequency    Stem &  Leaf

   278.00        0 .  11111111111111111112222222222222222222222222222222222222222222222233333333333333333333333333344444
    22.00        0 .  5678999
    58.00        1 .  0011111222223334444
    59.00        1 .  55566666777788889999
    72.00        2 .  00000001111112333334444
    55.00        2 .  555566666777788999
    38.00        3 .  000011123334
    37.00        3 .  55556677899
    26.00        4 .  01122344
    23.00        4 .  56677889
    18.00        5 .  001244&
    14.00        5 .  67889
     7.00        6 .  01&
     9.00        6 .  689&
     9.00        7 .  0012
     4.00        7 .  &
    41.00 Extremes    (>=8.0)

 Stem width:  1.000000
 Each leaf:        3 case(s)


 & denotes fractional leaves.
```

When looking at the stem and leaf plot that was created from SPSS, the results indicated that 41 data points were determined to be outliers. These data were for values of total cost that are greater than or equal to 8.0. These outliers will remain in the data when conducting the analysis.

Table 8

ANCOVA for Dependent Variable: Total Cost

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	40297.394[a]	2	20148.697	.297	.743
Intercept	143422181.253	1	143422181.253	2115.542	.000
SurgeonStatus	11132.652	1	11132.652	.164	.685
PreferenceCard	10168.536	1	10168.536	.150	.699
Error	51998394.839	767	67794.517		

(*table continues)*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Total	238312505.188	770			
Corrected Total	52038692.233	769			

a. R Squared = .001 (Adjusted R Squared = -.002)

When conducting an ANCOVA in SPSS to include the covariate of the surgeon's status (i.e., the surgeon's status as an academic or private physician), the results indicated that the covariate, by preference card interaction when looking at total cost of the procedure, is not statistically significant.

Table 9

ANCOVA for Dependent Variable: Length of Stay

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1572.700[a]	2	786.350	61.665	.000
Intercept	4451.305	1	4451.305	349.070	.000
SurgeonStatus	96.357	1	96.357	7.556	.006
PreferenceCard	855.770	1	855.770	67.109	.000
Error	9780.693	767	12.752		
Total	16626.115	770			
Corrected Total	11353.394	769			

a. R Squared = .139 (Adjusted R Squared = .136)

When conducting an ANCOVA in SPSS to include the covariate of the surgeon's status (i.e., the surgeon's status as an academic od private physician), the results indicated that the covariate, by preference card interaction when looking at length of stay, is statistically significant.

Table 10

Mean by Period – Total Cost

Preference Card	Period	Mean	N	Std. Deviation
0	Intervention	521.003	91	298.800
	Post-Intervention	499.326	151	305.348
	Pre-Intervention	480.237	122	216.396
	Total	498.347	364	276.608
1	Intervention	483.790	126	216.292
	Post-Intervention	482.633	101	322.962
	Pre-Intervention	489.501	179	211.383
	Total	486.020	406	244.624
Total	Intervention	499.395	217	254.189
	Post-Intervention	492.636	252	311.997
	Pre-Intervention	485.746	301	213.118
	Total	491.848	770	260.136

The total number of cases that were analyzed using IBM's SPSS were 770. This included 301 cases during the pre-intervention period, 217 cases during the intervention period, and 252 cases during the post-intervention period. Dummy variables were used to represent preference card type for this dataset, with one being standardized and zero being surgeon-specific. Based on this data, the following percentage changes were noticed amongst the various time periods:

Table 11

Total Cost Percentage Differences

	Intervention	Post-Intervention	Post-Intervention vs Pre-Intervention
Surgeon-Specific	-0.40%	-0.20%	-0.60%
Standardized	7.25%	-4.16%	2.80%

For the period of the intervention, those surgical cases that utilized a standardized surgeon preference card saw an average decrease in cost per case of 0.40% compared to the pre-intervention period. For that same period for surgeon-specific cards, the mean cost per case increased by 7.25% compared to the mean cost per case for the pre-intervention period. For the post-intervention period, surgical cases that utilized standardized surgeon preference cards saw a decrease of 0.20% for the mean cost per case compared to the intervention period. For this same period, surgical cases which utilized the surgeon-specific preference card saw a decrease of 4.16% for their mean cost per case compared to the intervention period. When comparing the post-intervention period to the pre-intervention period for surgical cases that utilized standardized cards, there was a decrease of 0.60% in mean cost per case. Finally, when comparing the post-intervention period to the pre-intervention period for surgical cases that used surgeon-specific cards, there was an increase of 2.80% in mean cost per case.

Multiple Regression Analysis

Total Cost

A multiple regression analysis was conducted to examine the first research question:

RQ1 – Quantitative: To what extent are there differences in surgical case costs (disposable items used in the case) between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

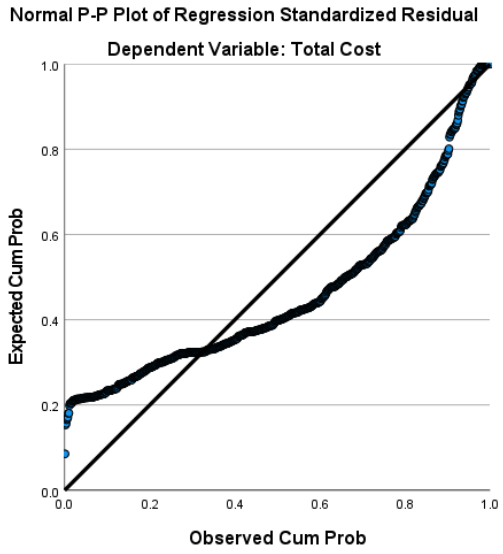
H01 – Based on documented surgical case data, there are no statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

H1 – Based on documented surgical case data, there are statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

The assumption of a linear relationship existing between the dependent and independent variables was examined through the use of a collinearity test in IBM's SPSS. The results of this test showed the plots had a clear relationship between x and y however, these plots did not have a linear relationship. Because of this, this assumption was not met.

Figure 6

Regression Plot – Total Cost



In addition to this, the assumption of independence of errors was tested using the Durbin-Watson test. The results of this test were 1.902, which is close to 2. This indicated that there was no correlation among residuals. This assumption was met.

Table 12

Regression Model Summary – Dependent Variable: Total Cost

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.024[a]	.001	-.001	260.232	.001	.431	1	768	.512	
2	.028[b]	.001	-.002	260.374	.000	.164	1	767	.685	
3	.029[c]	.001	-.003	260.534	.000	.058	1	766	.810	1.902

a. Predictors: (Constant), Preference Card

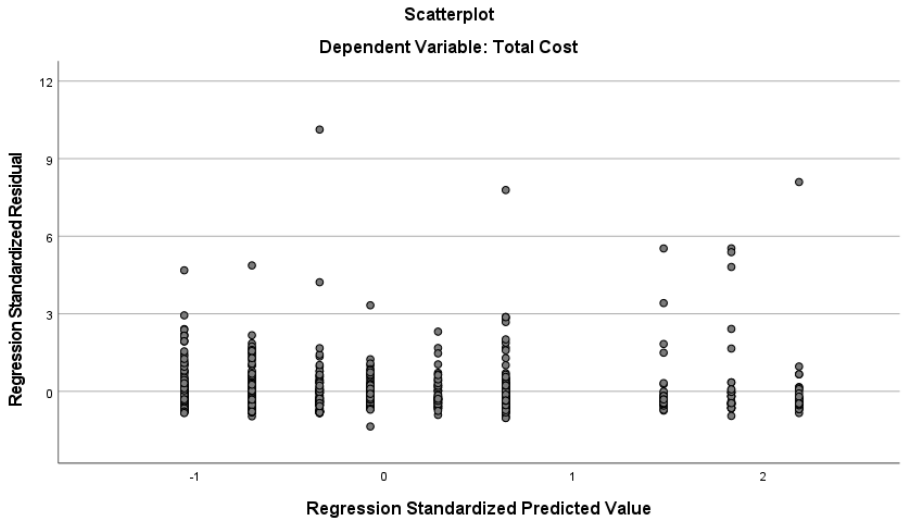
b. Predictors: (Constant), Preference Card, SurgeonStatus

c. Predictors: (Constant), Preference Card, SurgeonStatus, Period

The assumption that there was constant variance for the residuals was tested using a scatterplot. Based on the scatterplot below, the regression showed strong homoscedasticity as no specific pattern was found to be formed. This indicated that the variance for the dependent variable was the same for all the data, so this assumption was violated. This was potentially a result of outliers in the dataset.

Figure 7

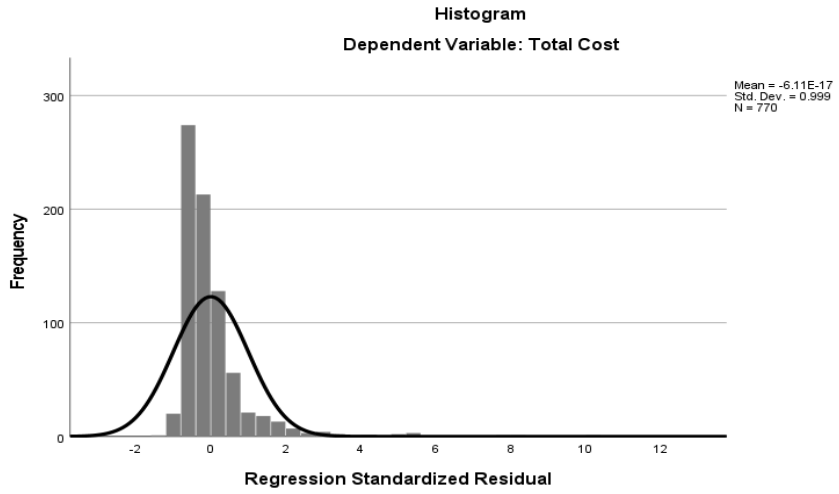
Scatterplot – Total Cost



Lastly, the histogram below was used to identify if a normal distribution existed with the residuals. Based on the figure, there was a violation of errors with the assumption of normal distribution. The histogram was skewed to the right, which gave an indication that there were several outliers affecting this data.

Figure 8

Histogram – Total Cost



RQ1 Results

As shown in the regression results the variables preference card and surgeon type suggested that there was no statistical significance at 0.05 level of significance. With an R-squared of 0.001 for preference card, this indicated that 0.1% of the variation in total case cost was explained by the explanatory variable, while the 99.9% was explained by factors outside this analysis. With a p-value of 0.699 for preference card controlling for surgeon status, this did not meet our significance level of $p < 0.05$ For this reason, we failed to reject the null hypothesis. These results were not unexpected considering the assumptions of the linear regression were not met – likely as a result of outliers in the data set.

Table 13

Coefficients – Dependent Variable: Total Cost

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	498.347	13.640		36.536	.000
	Preference Card	-12.327	18.784	-.024	-.656	.512
2	(Constant)	494.274	16.949		29.163	.000
	Preference Card	-8.254	21.313	-.016	-.387	.699
	SurgeonStatus	11.582	28.582	.017	.405	.685
3	(Constant)	488.574	29.114		16.781	.000
	Preference Card	-7.457	21.581	-.014	-.346	.730
	SurgeonStatus	11.752	28.608	.017	.411	.681
	Period	2.713	11.260	.009	.241	.810

Logistic Regression – Total Cost

As a result of the outcome of the linear regression, a decision was made to conduct a logistic regression to determine the probability of a binary event occurring. In this case, the odds that a standardized preference card was selected when the cost of the surgical case increased. The cumulative percentage used as the cutoff point was 80% - anything higher than $573.95 was recategorized as having a high total cost (an outlier in this data).

When interpreting the odds ratio for time period, the p-values for period (pre-intervention), period (1) (intervention), and period (2) (post-intervention) all indicated the results were not significant, at 0.527, 0.436, and 0.758, respectively. The surgeon status had a p-value of 0.045, which was significant given the threshold of significance $p < 0.05$. This means that the odds of a surgical case with a high cost outlier were lower for patients with a private surgeon status versus those with an academic status. With a p-value of 0.859, preference card was not significant given the significance threshold of $p < 0.05$. This indicated that the odds of there being a high-cost outlier for patients with standard versus surgeon specific preference cards were not different.

Table 14

Logistic Regression Results – Total Cost

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Period			1.281	2	.527	
	Period (1)	-.171	.219	.608	1	.436	.843
	Period (2)	.070	.229	.095	1	.758	1.073
	Surgeon Status	-.610	.304	4.018	1	.045	.543
	Preference Card	-.036	.202	.032	1	.859	.965
	Constant	-1.228	.192	41.076	1	.000	.293

a. Variable(s) entered on step 1: Period, Surgeon Status, Preference Card.

Length of Stay

A multiple regression analysis was conducted to examine the second research question:

RQ2 – Quantitative: To what extent are there differences in patient length of stay between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

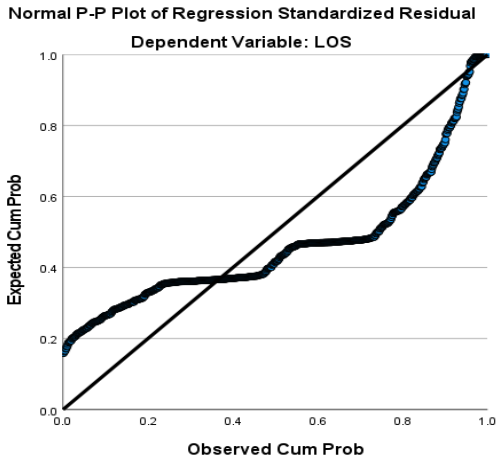
H01 – Based on documented patient data, there were statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

H1 – Based on documented patient data, there were no statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

The assumption of a linear relationship existing between the dependent and independent variables was examined through the use of a collinearity test in IBM's SPSS. The results of this test showed the plots have a clear relationship between x and y however, these plots did not have a linear relationship. Because of this, this assumption was not met.

Figure 9

Regression Plot – Length of Stay



In addition to this, the assumption of independence of errors was tested using the Durbin-Watson test. The results of this test were 1.965 which is close to 2. This indicated that there was no correlation among residuals. This assumption was met.

Table 15

Dependent Variable: LOS

					Change Statistics					Durbin Watson
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	
1	.361[a]	.130	.129	3.586	.130	114.795	1	768	.000	
2	.372[b]	.139	.136	3.571	.008	7.556	1	767	.006	
3	.382[c]	.146	.142	3.559	.007	6.345	1	766	.012	1.965

a. Predictors: (Constant), Preference Card

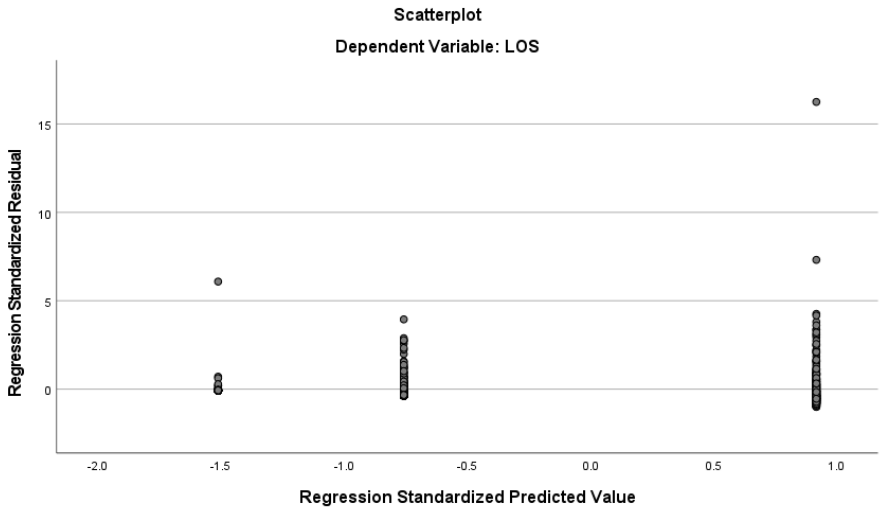
b. Predictors: (Constant), Preference Card, SurgeonStatus

c. Predictors: (Constant), Preference Card, SurgeonStatus, Period

The assumption that there was constant variance for the residuals was tested using a scatterplot. Based on the scatterplot below, the regression showed strong homoscedasticity as no specific pattern was found to be formed. This indicated that the variance for the dependent variable was the same for all the data, so this assumption was violated. This was potentially a result of the presence of outliers in the data.

Figure 10

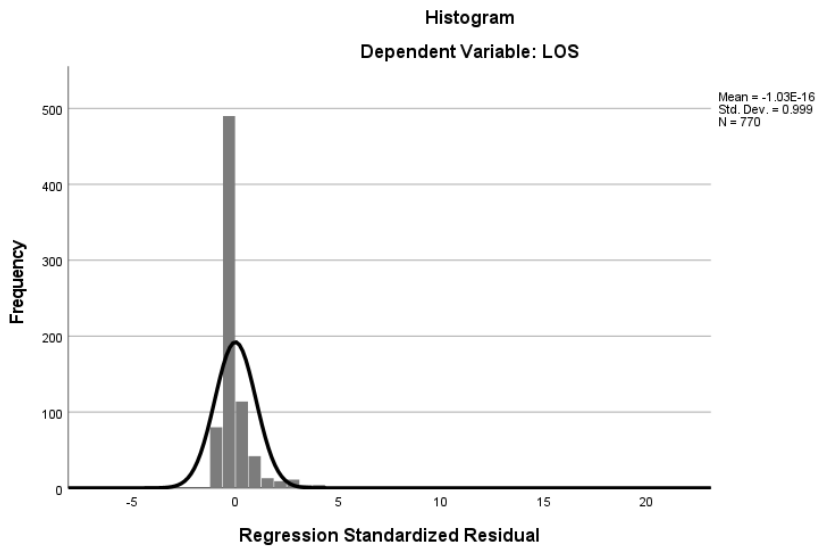
Scatterplot – Length of Stay



Lastly, the histogram below was used to identify if a normal distribution exists with the residuals. Based on the figure, there was a violation of errors with the assumption of normal distribution. The histogram was skewed to the right which gave an indication that there were several outliers affecting this data.

Figure 11

Histogram – Length of Stay



RQ2 Results

As shown in the regression results the variables preference card and surgeon type suggested that there was statistical significance at 0.05 level of significance. With an R-squared of 0.139 for preference card, this indicated that 13.9% of the variation in length of stay was explained by the explanatory variable, while the 87% was explained by factors outside this analysis. With a p-value of 0.000 for preference card controlling for surgeon status, this did meet our significance level of $p < 0.05$. For this reason, we rejected the null hypothesis leading to the conclusion that standardized preference cards do explain no change in variation in length of stay for non-emergent laparoscopic cholecystectomies.

Table 16

Coefficients – Dependent Variable: Length of Stay

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.154	.188		6.142	.000
	Preference Card	2.773	.259	.361	10.714	.000
2	(Constant)	1.533	.232		6.596	.000
	Preference Card	2.395	.292	.311	8.192	.000
	SurgeonStatus	-1.078	.392	-.104	-2.749	.006
3	(Constant)	.719	.398		1.808	.071
	Preference Card	2.508	.295	.326	8.509	.000
	SurgeonStatus	-1.053	.391	-.102	-2.696	.007
	Period	.387	.154	.085	2.519	.012

Logistic Regression – LOS

As a result of three out of four assumptions not being met for the linear regression, a decision was made to conduct a logistic regression to determine the probability of a binary event occurring. In this case, the odds that a standardized preference card is selected when the LOS increases. The cumulative percentage used as the cutoff point was 80% - anything greater than four days was recategorized as having a high LOS (an outlier in this data).

When looking at time period, period (1) (intervention) showed odds which were significant with a p-value of 0.003. The odds of there being a LOS outlier were significantly lower for patients in this time period then the referenced category of period (pre-intervention) suggesting the intervention did make a difference. For period (2) (post-intervention), the p-value was not significant at 0.102 given the threshold of significance

$p < 0.05$. This was an indication that after the standard preference cards had been in place, the effect wore off.

For preference card, the output of the analysis ran in SPSS produced 4.262 as the result for the odds ratio, and a p-value of 0.000. In other words, patients with a standardized preference card had 4.261 higher odds of a high LOS than those with a surgeon specific card. According to Rosenthal (1996), an odds ratio in the range of 4 to 1 equated to a large, or strong effect size, which was a finding that this had practical significance. Surgeon status had a p-value of .009, which was significant given the threshold of significance $p < 0.05$, but the odds were pretty small at 0.067.

Table 17

Logistic Regression Results - LOS

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Period			8.765	2	.012	
	Period(1)	-.694	.235	8.742	1	.003	.500
	Period(2)	-.401	.245	2.674	1	.102	.670
	SurgeonStatus	-2.697	1.026	6.905	1	.009	.067
	Preference Card	1.450	.244	35.232	1	.000	4.261
	Constant	-1.844	.233	62.507	1	.000	.158

a. Variable(s) entered on step 1: Period, SurgeonStatus, Preference Card.

Summary

The purpose of the retrospective multiple linear regression analysis was to determine the linear relationship between the dependent and independent variable to identify if a continuous variable would impact the total cost and length of stay of a non-emergent laparoscopic cholecystectomy as well as determine the statistical significance of each variable. As shown in the regression results the variables preference card and

surgeon type suggested that there was no statistical significance at 0.05 level of significance for total cost, and the R-squared showed extremely low variation explainable by the explanatory variable. Thus, we failed to reject the null hypothesis that standardized preference cards do not explain variation in total surgical case costs for non-emergent laparoscopic cholecystectomies. For the variables preference card and surgeon type, the outcome suggested that there was statistical significance at 0.05 level of significance for length of stay, and the R-squared of 0.139 for preference card controlling for surgeon type indicated zthat variation in length of stay was explained by the explanatory variable. For this reason, we rejected the null hypothesis leading to the conclusion that standardized preference cards do explain no change in variation in length of stay for non-emergent laparoscopic cholecystectomies.

When interpreting the logistic regression, it can be concluded that there was no impact on being a high-cost outlier, but there was an impact on the length of stay. In the later time period, it was interpreted that the effect weakens to the point where it is no longer statistically significant.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

The purpose of this study was to examine differences in case costs between surgical cases with a standardized preference card and surgical cases that have surgeon-specific preference cards. In addition, differences in length of stay were also examined for surgical cases with a standardized preference card and surgical cases that have surgeon-specific preference cards. The study involved the diffusion of innovation theory because this theory provided an understanding of how new ideas were discovered, chosen to be implemented, and carried out (Gonzalo et al., 2018). As applied to this study, the conclusion of the results were attributed to step five of this theory. Using case costs (i.e., showing a reduction in costs) as one variable, and length of stay (i.e., showing a flat trend) as the other, the data can be used to demonstrate to surgeons that this intervention is worth continuing. This section concludes the study, and with this conclusion, interpretations of the findings are discussed, as well as limitations that were experienced during the research. This section will also include implications for social change and how this applies to professional practice.

Interpretation and Findings

The following is the first research question and hypotheses that was formulated for this study:

RQ1 – Quantitative: To what extent are there differences in surgical case costs (disposable items used in the case) between standardized physician preference cards and

non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented surgical case data, there are no statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

H1 – Based on documented surgical case data, there are statistically significant differences in the surgical case cost (disposable item costs) controlling for surgeon's practice status.

Based on the analysis of the multiple regression results, there was no statistical significance at 0.05 level of significance for total cost, and the R-squared showed zero variation explainable by the explanatory variable. Because of these results, I do not feel confident that the results of the sampled data were quantifiable. In this case, we failed to reject the null hypothesis that standardized preference cards do not explain variation in total surgical case costs for non-emergent laparoscopic cholecystectomies. This does not align with Skarda et al. (2015), whose study indicated a savings in preference card standardization. Nor does this align with the theoretical framework, as the goal of the theory is to provide results to the surgeons that this intervention is worth continuing. The results of this research question failed to reject the null hypothesis, which does not provide evidence for continuous engagement.

The following is the second research question and hypotheses that was formulated for this study:

RQ2 – Quantitative: To what extent are there differences in patient length of stay between standardized physician preference cards and non-standardized physician preference cards for non-emergent laparoscopic cholecystectomies?

H01 – Based on documented patient data, there are no statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

H1 – Based on documented patient data, there are statistically significant differences in patient length of stay based on the use of preference cards controlling for surgeon's practice status.

When looking at the outcome of the analysis of the multiple regression results for length of stay, the outcome suggested that there is statistical significance at 0.05 level of significance for length of stay, and the R-squared of 0.139 for preference card controlling for surgeon type indicates that variation in length of stay was explained by the explanatory variable. These results made me feel confident that I could trust the results as true, and that we reject the null hypothesis, thus leading to the conclusion that standardized preference cards do explain no variation in length of stay for non-emergent laparoscopic cholecystectomies. These results do align with Skards et al. (2015), which did not identify any significant differences in the patient outcomes when standard cards were used. In addition, this also aligns with the theoretical framework; with results that show variation in length of stay is not the result of standardized preference cards, surgeons are likely to be motivated to continue with this and other change projects in the future.

Limitations of the Study

Because the data for this study was secondary data, it was extremely difficult to confirm with certainty that the documentation was 100% accurate when pulled out of the hospital's EHR. While the assumption was made, there could have been instances when documenting supplies in the surgical case would have been missed, which could have caused an undervalue in the total cost of the case. In addition to this, there are other fields that could have been used to better focus on key data points. Because of the strict IRB process, data fields that identified a specific surgeon or case identifier were excluded when pulled from the EHR. While the omission of these fields did not impact the validity of the data, these particular fields could have provided for a more focused analysis comparing each surgeon to themselves rather than to entire group.

Recommendations

When this study hospital initially implemented the standard preference card for laparoscopic cholecystectomies, cost savings were noticed immediately for the surgeons who adopted the standard preference card, even though that was not able to be proven with statistical significance in this study. Because of this, it would be important for further research to be conducted to identify additional fields of data within the EHR that could be incorporated into the analysis which can illustrate these savings can be confidently proven and used as evidence of the savings and sustainability, while not altering length of stay.

Implication for Professional Practice and Social Change

While the results of this study did not support the null hypothesis for total cost of the case, the literature review section provided eye-opening data on the waste that occurs in the operating room. Rigante et al. (2017) identified $2.9 million of waste per year at their hospital and an additional 20% of routine waste generated by anesthesia. Skards et al. (2015) standardized their laparoscopic appendectomy preference cards and recognized a savings of $195,041.98 for the 12-month period after implementation. Rose et al. (2019) identified outdated physician preference cards as a resource of waste from items being improperly opened and wasted, with an of 8.3% of items were wasted in their observation of surgical cases from outdated preference cards.

As all of these studies identified, opportunities exist for savings, and surgeons are ready to combat those savings. Just as Johnson et al. (2019) identified, when surgeons are aware of costs, they are willing to use cheaper alternatives to reduce their overall cost of the surgical case. That's where the social change impact comes into play with this study. While the results of the study did not prove in favor of supporting the null hypothesis for research question one, the willingness for those surgeons who participated to even use the standard preference card shows that they want to participate in cost savings measures with their healthcare organization. Instead of staying status quo and utilizing a physician-specific preference cards, surgeons in the study hospital gave up their preferences and utilized a standardized card to drive change and drive down costs.

At the end of the day, while the healthcare organization is the one that pays up front for these costs, that cost is recouped by being passed down to the patient. The

obvious savings opportunities and reduction in waste should be a game changer for an industry that accounts for the highest GDP per capita. If healthcare organizations can get on board with preference card standardization, the benefits not only exist for these entities but more importantly, for the patients.

Conclusion

To close, in this study I provided an overview of the crisis our healthcare system in the United States faces in regard to expenditures, as well as how operating rooms are an integral part of that. While the results of this study did not addresses the sustainability of savings through standardized preference cards in order to reduce these healthcare expenditures, the study still serves as a resource for promoting social change to achieve a lower cost of healthcare per capita.

References

Allen, J. W., & Polk, H. C., Jr. (2002). A study of added costs of laparoscopic cholecystectomy based on surgery preference cards. *The American Surgeon*, *68*(5), 474–476.

Buttigieg, S. C., Abela, L., & Pace, A. (2018). Variables affecting hospital length of stay: A scoping review. *Journal of Health Organization and Management*, *32*(3), 463-493. https://dx.doi.org.ezp.waldenulibrary.org/10.1108/JHOM-10-2017-0275

Carneiro, P., Braga, A. C., & Cabuço, R. (2019). Professionals working in operating rooms: A characterization of biological and chemical risks. *Work*, *64*(4), 869–876. https://doi-org.ezp.waldenulibrary.org/10.3233/WOR-193027

CMS. (n.d.). Historical. Retrieved from https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html

Dawson A, Orsini MJ, Cooper MR, & Wollenburg K. (2005). Medication safety -- reliability of preference cards. *AORN Journal*, *82*(3), 399–407. https://doi-org.ezp.waldenulibrary.org/10.1016/S0001-2092(06)60336-0

French, K. E., Guzman, A. B., Rubio, A. C., Frenzel, J. C., & Feeley, T. W. (2016). Value based care and bundled payments: Anesthesia care costs for outpatient oncology surgery using time-driven activity-based costing. *Healthcare*, *4*(3), 173–180. https://doi-org.ezp.waldenulibrary.org/10.1016/j.hjdsi.2015.08.007

Gonzalo, J. D., Graaf, D., Ahluwalia, A., Wolpaw, D. R., & Thompson, B. M. (2018). A practical guide for implementing and maintaining value-added clinical systems

learning roles for medical students using a diffusion of innovations framework. *Advances in Health Sciences Education: Theory and Practice*, *23*(4), 699–720. https://doi-org.ezp.waldenulibrary.org/10.1007/s10459-018-9822-5

Hultman, J. A. (2019). The high cost of waste in healthcare. *Podiatry Management, 38*(6), 61–67. Retrieved from https://search-ebscohost-com.ezp.waldenulibrary.org/login.aspx?direct=true&db=rzh&AN=137899778&site=eds-live&scope=site

Johnson, J., Pinto, M., Brabston, E., Momaya, A., Huntley, S., He, J. K., … Ponce, B. A. (2019). Attitudes and awareness of suture anchor cost: a survey of shoulder surgeons performing rotator cuff repairs. *Journal of Shoulder and Elbow Surgery*. https://doi-org.ezp.waldenulibrary.org/10.1016/j.jse.2019.06.025

Kamal, R. Cox, C, McDermott, D., Ramirez, M., and Sawyer, B. (2019). U.S. health system is performing better, though still lagging behind other countries. *Peterson-Kaiser Health System Tracker*. Retrieved from https://www.healthsystemtracker.org/brief/u-s-health-system-is-performing-better-though-still-lagging-behind-other-countries/

Kaminski, J. (2011). Diffusion of innovation theory. *Canadian Journal of Nursing Informatics, 6*(2). Retrieved from http://cjni.net/journal/?p=1444

Lau, B., & Difronzo, L. A. (n.d.). An acute care surgery model improves timeliness of care and reduces hospital stay for patients with acute cholecystitis. *American Surgeon*, *77*(10), 1318–1321.

Laureate Education (Producer). (2015h). Social impact of a Doctoral Study [Video file]. Baltimore, MD: Author.

Munoz, E., Munoz III, W., and Wise, L. (2010). National and surgical health care expenditures. *Annals of Surgery*, *251*(2), 195 – 200, https://doi.org/10.1097/SLA.0b013e3181cbcc9a

National Council for Osteopathic Research. (2014). Quantitative research methods. Retrieved from https://www.ncor.org.uk/wp-content/uploads/2014/03/Quantitative_research_methods.pdf

Neyens, D. M., Bayramzadeh, S., Catchpole, K., Joseph, A., Taaffe, K., Jurewicz, K., Khoshkenar, A., San, D., & RIPCHD.OR Study Group. (2019). Using a systems approach to evaluate a circulating nurse's work patterns and workflow disruptions. *Applied Ergonomics*, *78*, 293–300. https://doi-org.ezp.waldenulibrary.org/10.1016/j.apergo.2018.03.017

Rasmi, M., Alazzam, M. B., Alsmadi, M. K., Almarashdeh, I. A., Alkhasawneh, R. A., & Alsmadi, S. (2020). Healthcare professionals' acceptance Electronic Health Records system: Critical literature review (Jordan case study*). International Journal of Healthcare Management*, *13*, 48–60. https://doi-org.ezp.waldenulibrary.org/10.1080/20479700.2017.1420609

Rigante, L., Moudrous, W., de Vries, J., Grotenhuis, A. J., & Boogaarts, H. D. (2017). Operating room waste: disposable supply utilization in neurointerventional procedures. *ACTA Neurochirurgica*, *159*(12), 2337–2340. https://doi-org.ezp.waldenulibrary.org/10.1007/s00701-017-3366-y

Robinson, J. R., Carter, N. H., Gibson, C., Brinkman, A. S., Van Arendonk, K., Speck, K. E., Danko, M. E., Jackson, G. P., Lovvorn, I. H. N., & Blakely, M. L. (2018). Improving the value of care for appendectomy through an individual surgeon-specific approach. Journal of Pediatric Surgery, 53(6), 1181–1186. https://doi-org.ezp.waldenulibrary.org/10.1016/j.jpedsurg.2018.02.081

Rose, E. D., Modlin, D. M., Ciampa, M. L., Mangieri, C. W., Faler, B. J., & Bandera, B. C. (2019). Evaluation of Operative Waste in a Military Medical Center: Analysis of Operating Room Cost and Waste during Surgical Cases. American Surgeon, 85(7), 717–720. Retrieved from https://search-ebscohost-com.ezp.waldenulibrary.org/login.aspx?direct=true&db=rzh&AN=138115988&site=eds-live&scope=site

Rosenthal, J. A. (1996, October 11). Qualitative Descriptors of Strength of Association and Effect Size. *Journal of Social Service Research, 21*(4), 37–59. https://doi.org/10.1300/j079v21n04_02

Schmidt, R. N., Posteraro, R. H., & Lopez, M. (2019). Reducing Waste in the Operating Room through Inventory-Based Supply Chain Optimization. Journal of Business & Behavioral Sciences, 31(1), 74–83. Retrieved from https://search-ebscohost-com.ezp.waldenulibrary.org/login.aspx?direct=true&db=bth&AN=137227632&site=eds-live&scope=site

Schuster, M., Standl, T., Wagner, J. A., Berger, J., Reimann, H., & Am Esch, J. S. (2004). Effect of different cost drivers on cost per anesthesia minute in different anesthesia subspecialties. Anesthesiology, 101(6), 1435–1443.

Skarda, D. E., Rollins, M., Andrews, S., McFadden, M., Barnhart, D., Meyers, R., & Scaife, E. (2015). One hospital, one appendectomy: The cost effectiveness of a standardized doctor's preference card. Journal of Pediatric Surgery, 50(6), 919–922. https://doi-org.ezp.waldenulibrary.org/10.1016/j.jpedsurg.2015.03.009

Uecker, J., Luftman, K., Ali, S., & Brown, C. (2013). Comparable Operative Times With and Without Surgery Resident Participation. Journal of Surgical Education, 70(6), 696–699. https://doi-org.ezp.waldenulibrary.org/10.1016/j.jsurg.2013.06.011

University of Washington. (n.d.). Theories, models, & frameworks. Retrieved from https://impsciuw.org/research/frameworks/

Xiong, W., Li, M., Wang, M., Zhang, S., & Yang, Q. (2020). The Safety of Laparoscopic Cholecystectomy in the Day Surgery Unit Comparing with That in the Inpatient Unit: A Systematic Review and Meta-Analysis. BioMed Research International, 1–11. https://doi-org.ezp.waldenulibrary.org/10.1155/2020/1924134

Yonce, T. C., Montero, P. N., Tsirline, V. B., Phillips, R. C., Sievers, C., & Stefanidis, D. (2012). Preference card deviations adversely impact operating room efficiency. Journal of the American College of Surgeons, 215(3), S108. https://doi-org.ezp.waldenulibrary.org/10.1016/j.jamcollsurg.2012.06.286

Zhao, B., Tyree, G. A., Lin, T. C., Vaida, F., Stock, B. J., Hamelin, T. A., & Clary, B. M. (2019). Effects of a Surgical Receipt Program on the Supply Costs of Five

General Surgery Procedures. Journal of Surgical Research, 236, 110–118. https://doi-org.ezp.waldenulibrary.org/10.1016/j.jss.2018.11.023