2013

Disruptive Transformations in Health Care: Technological Innovation and the Acute Care General Hospital

D. Pulane Lucas
Virginia Commonwealth University

Disruptive Transformations in Health Care:

Technological Innovation and the Acute Care General Hospital

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

By
D. Pulane Lucas
B.S., California State University, Hayward, 1988
M.B.A., Harvard Business School, 1991
M.T.S., Harvard Divinity School, 1994

Dissertation Committee

Dissertation Chair: Carl F. Ameringer, Ph.D.
Professor of Health Policy and Politics, L. Douglas Wilder School of Government and Public Affairs

Roice D. Luke, Ph.D.
Professor Emeritus, Department of Health Administration

Wally R. Smith, M.D.
Professor, School of Medicine

I-Shian Suen, Ph.D.
Associate Professor, L. Douglas Wilder School of Government and Public Affairs

Virginia Commonwealth University
Richmond, Virginia
May 2013

ACKNOWLEDGEMENTS

The completion of my doctoral studies is a significant accomplishment for me. It has been a very long journey, and I have been blessed to have the love, support, and guidance of many individuals along the way. I am deeply appreciative to everyone who has touched my life during this process and humbled by God's mercy and grace.

Dr. Michael D. Pratt, thank you for your guidance during my early years at VCU. Your advice helped me refocus my dissertation topic, and for that I am grateful. Thank you to the members of my dissertation committee. Dr. Carl F. Ameringer, who serves as my advisor, professor, and dissertation committee chair; your presence in my life has been a gift. You have helped to guide my doctoral studies with patience, kindness, and firmness. I have benefitted tremendously from your keen analysis of the dynamics in the health care industry and your insights into public policy and administration. Dr. Roice D. Luke, your suggestions provide the foundation for the theoretical and methodological frameworks formulated for this dissertation research project. I am honored to have had the opportunity to work with you and appreciate deeply the hours that we have shared working together with the Intellimed dataset, which is the primary dataset for this research. Thank you also for introducing me to Art Layne and the Intellimed System. Mr. Layne, I am eternally grateful for the access you afforded me to the information-rich, user-friendly Intellimed database. I also want to thank your outstanding staff for their accessibility, knowledge, and professionalism. Dr. I-Shian Suen, thank you for offering an outstanding data analysis course. The statistical knowledge acquired in your course, as well as your insights into and advice on the data analysis components of this research, have been invaluable. Dr. Wally R. Smith, I have benefitted greatly from the many opportunities to work with you. I appreciate the guidance you have offered to me as a mentor and friend. Your

presence on my committee and the clinical perspective that you bring to discussions are priceless. Thanks to each of you for your time and commitment to my academic and professional development.

I also want to thank Dr. Niraj Verma, Director of the L. Douglas Wilder School of Government and Public Affairs, for your advice and for taking an interest in my career. I am delighted to have had the opportunity to study with top-notched VCU Wilder School and Health Administration faculty members. The administrative support offered by Wilder School staff members, Dr. Richard R. Huff, Betty Moran, Lisbeth D. Dannenbrink, and Justine Coleman has been much appreciated. I sincerely appreciate the financial support afforded me during my doctoral studies from the Wilder School and the VCU Graduate School.

To the late Harvard Divinity School Dean Ronald F. Theimann and Rev. Dr. Preston N. Williams, thank you for believing in me and for affording me wonderful opportunities to expand my knowledge and implement my ideas. To the outstanding Harvard Divinity School, Harvard Business School, and the John F. Kennedy School of Government professors with whom I have had the opportunity to work, you exposed me to exciting new concepts and knowledge, and you challenged me to think differently about the world and myself. For each of you, I am grateful.

To Joyce Montgomery and Anita Blake, my dearest friends, your love for me has never wavered. Your advice, prayers and spiritual support, and our emotional bonds have served as pillars and guideposts in my life. I am eternally grateful for your commitment to my family and me, and to helping me accomplish my academic goals. Your advice has helped me develop into a better person on so many levels.

And to members of my family who have showered me with unconditional love and support, I am incredibly blessed to have each of you in my life. It is to my children that I dedicate this work. Stanley, my handsome son, your patience and faith in me are astounding. Stay focused, and keep up the good work on your journey! Fredericka, my brilliant, beautiful daughter, your talents are amazing and your accomplishments mesmerizing. Hold tight to your dreams! You are an inspiration to me and many others. Rev. Dr. Frederick A. Lucas, Jr., my beloved husband, I thank God for your presence in my life. Our journey together has been a blessed one. Thank you for your understanding, patience, and sacrifice during these years. I would like to thank and acknowledge my parents, Delbert L. Evans, Sr., and Deanna J. Evans. Thank you for instilling in me an unwavering faith in God and myself. I continue to carry in my heart words of encouragement and values imparted as a child. Thanks also for your trust and giving me the freedom to be me. The foundation you laid for me equipped me with the metal necessary to achieve my dreams. I love you all.

Finally, I send my heartfelt appreciation to my Brooklyn Community Church family and the numerous individuals who offered support, shared words of encouragement, and kept me in their prayers.

TABLE OF CONTENTS

List of Figures

List of Tables

List of Exhibits, Maps, and Appendices

Exhibits

Maps

Appendices

List of Abbreviations

ACBS Appendectomy, Cholecystectomy, and Bariatric Surgery

ACGH Acute Care General Hospital

AHA American Hospital Association

ASC Ambulatory Surgery Center

CBSA Core-Based Statistical Area

CDC Centers for Disease Control and Prevention

CMS Centers for Medicare and Medicaid Services

HOPD Hospital Outpatient Department

OPD Outpatient Department

OPPS Outpatient Prospective Payment System

PPS Prospective Payment System

ABSTRACT

DISRUPTIVE TRANSFORMATIONS IN HEALTH CARE:
TECHNOLOGICAL INNOVATION AND THE ACUTE CARE GENERAL HOSPITAL

By D. Pulane Lucas, MBA

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

Virginia Commonwealth University, 2013

Dissertation Chair: Carl F. Ameringer, Ph.D.
Professor of Health Policy and Politics, L. Douglas Wilder School of Government and Public Affairs

Advances in medical technology have altered the need for certain types of surgery to be performed in traditional inpatient hospital settings. Less invasive surgical procedures allow a growing number of medical treatments to take place on an outpatient basis. Hospitals face growing competition from ambulatory surgery centers (ASCs). The competitive threats posed by ASCs are important, given that inpatient surgery has been the cornerstone of hospital services for over a century. Additional research is needed to understand how surgical volume shifts between and within acute care general hospitals (ACGHs) and ASCs. This study investigates how medical technology within the hospital industry is changing medical services delivery.

The main purposes of this study are to (1) test Clayton M. Christensen's theory of disruptive innovation in health care, and (2) examine the effects of disruptive innovation on appendectomy, cholecystectomy, and bariatric surgery (ACBS) utilization. Disruptive innovation theory contends that advanced technology combined with innovative business models—located outside of traditional product markets or delivery systems—will produce simplified, quality products and services at lower costs with broader accessibility. Consequently, new markets will emerge, and conventional industry leaders will experience a loss of market share to "non-traditional" new entrants into the marketplace. The underlying assumption of this work is that

ASCs (innovative business models) have adopted laparoscopy (innovative technology) and their unification has initiated disruptive innovation within the hospital industry. The disruptive effects have spawned shifts in surgical volumes from open to laparoscopic procedures, from inpatient to ambulatory settings, and from hospitals to ASCs. The research hypothesizes that: (1) there will be larger increases in the percentage of laparoscopic ACBS performed than open ACBS procedures; (2) ambulatory ACBS will experience larger percent increases than inpatient ACBS procedures; and (3) ASCs will experience larger percent increases than ACGHs.

The study tracks the utilization of open, laparoscopic, inpatient and ambulatory ACBS. The research questions that guide the inquiry are:

1. How has ACBS utilization changed over this time?
2. Do ACGHs and ASCs differ in the utilization of ACBS?
3. How do states differ in the utilization of ACBS?
4. Do study findings support disruptive innovation theory in the hospital industry?

The quantitative study employs a panel design using hospital discharge data from 2004 and 2009. The unit of analysis is the facility. The sampling frame is comprised of ACGHs and ASCs in Florida and Wisconsin. The study employs exploratory and confirmatory data analysis.

This work finds that disruptive innovation theory is an effective model for assessing the hospital industry. The model provides a useful framework for analyzing the interplay between ACGHs and ASCs. While study findings did not support the stated hypotheses, the impact of government interventions into the competitive marketplace supports the claims of disruptive innovation theory. Regulations that intervened in the hospital industry facilitated interactions between ASCs and ACGHs, reducing the number of ASCs performing ACBS and altering the trajectory of ACBS volume by shifting surgeries away from ASCs and into ACGHs.

CHAPTER 1 - INTRODUCTION

This research explores disruptive innovation in the hospital industry and the manner in which abdominal surgery is performed. The study aims to understand better the dynamics of technological innovation and competition within the hospital industry. The work uses Christensen's theory of disruptive innovation as a lens to examine the impact that laparoscopy and ambulatory surgery centers (ASCs) have had on the delivery of three types of abdominal surgeries traditionally performed in acute care general hospitals (ACGHs). Disruptive innovation theory contends that advanced technology fused with an innovative business model can ignite transformations in the delivery of health care—reducing product and service costs, improving quality, increasing accessibility and utilization, and shifting market share among institutions. General hospitals face increasing competition from new market entrants and substitute products and services. As ASCs acquire innovative medical technologies to more efficiently perform surgical procedures, greater pressure is placed on hospitals to attract patients and maintain market share (Gelijns, Halm, & Institute of Medicine, 1991; Riley & Brehm, 1989). Additional research is needed to comprehend shifts in surgical volume between acute care general hospitals and ASCs, and how medical technology is impacting and changing the delivery of medical services (Casalino et al, 2003).

This work contends that disruptive innovation is transforming institutional dynamics in the hospital industry, and it assumes that disruptive innovation has created favorable environments for laparoscopy and ASCs, spurring volume shifts. In many cases, laparoscopic surgery has become a substitute for open surgical procedures, ambulatory settings have emerged as alternative to inpatient settings, and ASCs are increasingly sought instead of hospitals. According to disruptive innovation theory, many hospitals should have experienced a decline in

market share for some surgical procedures. The research aims to identify trends in laparoscopy and ambulatory surgery, as well as their impact on acute care general hospitals.

The remainder of this chapter is divided into ten sections. The first section provides a contextual backdrop for the research. The second section discusses the purpose of the study. The research questions and hypotheses that guide the investigation are posed in the third and fourth sections, respectively. The fifth section presents the theoretical framework that structures the research endeavor, and the research design is discussed in the section six. The seventh section comments on the scope and methodological approaches to the research. The data analysis plan is presented in section eight. The rationale for the research and its significance are discussed in section nine. A summary statement is provided in the final section, along with an outline of the remaining chapters.

Context

Why are the impacts of laparoscopy and ambulatory surgery centers on acute care general hospitals important public policy concerns? As the dominant economic institutions in the health care industry, hospitals have come under more intense scrutiny as health care costs continue to rise (Coddington et al., 1985). Although the hospital industry has become increasingly competitive, leading business administration scholars contend that it is not functioning well: costs are high, care is poor, medical errors are prevalent, and inexplicable variations in the costs, utilization, and quality of service delivery exist across geographical regions (Porter & Teisberg, 2004; Christensen et al., 2009). Competition in the hospital industry should improve efficiency and quality, and expand markets. Good businesses should prosper and bad businesses should improve, or be driven out of the marketplace (Porter & Teisberg, 2006). This, however, is not the case in the health care industry. Inefficient health care organizations continue to operate, and

hospitals are being charged with unnecessarily duplicating services and being wasteful. Consequently, costs remain high (Dranove et al., 1992). Organizational performance remains low and many medical products and treatments remain trapped in obsolete delivery systems. Such inefficiencies have buttressed assertions of market failure in the health care industry (Rutkow, 1989b; Valdeck & Rice, 2009) and increased calls for regulation given the departure from the standard notions of competitive market behavior[1] (Russell, 1979). Christensen and colleagues (2009) contend that inefficiencies in the health care industry can be addressed in part through disruptive innovation. Advanced medical technology, in combination with innovative business models, can serve as a transformational force in the highly competitive health care industry—reducing the costs of, and increasing accessibility to, medical products, services, and procedures (Christensen et al., 2009).

Rising Health Care Spending

One of the foremost challenges facing health care policymakers today is controlling rapidly rising health care costs and improving the efficiency of the nation's health care system (Ranji et al., 2010). Steep increases in health care spending are projected in the United States well into the future (Payer, 1996). The rapid rise in medical expenditures is a growing concern across the country for several reasons. First, since the early 1980s, health care spending in the U.S. has outpaced spending on all goods and services (Levit et al., 1993). Health care expenditures are projected to continue growing at a rate of 6.7 percent well into the future, outpacing the growth of the gross domestic product (GDP) by an average of 1.9 percentage points. In 2007, total health care spending accounted for 16 percent of the country's GDP. In 2009, it is estimated that health care spending rose to 17.3 percent of GDP, and by 2017, health

[1] The competitive market standard is based on decisions where "benefits (measured by price) are equal to costs at

care spending as a percent of GDP is expected to hit 19.5 percent (about $4.3 trillion) (Keehan et al., 2008). By 2025, the Congressional Budget Office projects that health care costs will reach 25 percent of GDP (Wennberg et al., 2008). With health care consuming a larger proportion of spending on goods and services, an increasing number of Americans are not able to afford quality care.

As health care spending rises, state and federal governments spend an increasing proportion of their budgets on health care. Spending on Medicaid, Medicare, and other public health insurance programs are crowding out spending on other critical government programs and services (Thorpe et al., 2006). Rising health care spending place burdens on American businesses that offer health benefits to their employees and retirees, and their families. Increases in costs associated with corporate-sponsored health insurance result in higher prices for U.S. products and services, making American companies less competitive in world markets (Christensen et al., 2009).

A multitude of factors contribute to rising health care spending, which is determined in large part by the frequency of health care utilization. Almost two-thirds of the rise in health care utilization is attributed to growing disease prevalence and new medical procedures designed to treat high prevalence medical conditions such as obesity, hypertension, diabetes, cancer (i.e., lung, breast, colon, prostate, uterine, throat, bladder, kidney, and brain), stroke, coronary heart disease, acute myocardial infarction (AMI), and chronic obstructive pulmonary disease (Thorpe, 2005; Goldman et al., 2005; Olshansky, 2005; Daviglus, 2005; Lakdawakka et al., 2005; Joyce et al., 2005). Rising labor costs are another reason for increasing health care spending. Competition among health care facilities for health care professionals (physicians, nurses, technicians, etc.) drives up labor costs that are already higher than other developed countries

(Hunkar, 2009). Other explanatory factors for rising health care costs include consumer- and supplier-driven demand, medical technology diffusion, population growth, and the aging of the population. Competition among medical equipment manufacturers and the inability of health plans to stem health care cost inflation also contribute to rising health care spending (Keehan et al., 2008; Garber et al., 2007; Joyce et al., 2005; Thorpe, 2005; Thorpe et al., 2004; Chernew et al. 2004).

Health Care Sector: Hospitals

Hospitals represent the traditional form of inpatient medical care, with surgeons viewed as master craftsmen in their workshops performing high-cost, expertise-intensive procedures (Stevens, 1989; Christensen et al., 2009). Growing costs and utilization concerns have placed increasing pressure on hospitals to contain costs by reducing the length of hospital stays, standardizing products and service, and shifting less complex surgeries to outpatient departments (Coddington et al., 1985). The 1980s witnessed the beginning of major changes in the operation of hospitals, particularly with the major restructuring of the incentives built into inpatient reimbursement, via prospective payment system (PPS). Greater controls were placed on hospital admissions. Outpatient surgery departments developed rapidly, and inpatient surgical procedures began to decline (Stevens, 1989).

The nation has witnessed dramatic growth in the number of outpatient surgical centers. Inpatient surgery—while still the cornerstone of hospital services—is under siege by outpatient surgical departments and free-standing surgical facilities that offer lower cost ambulatory surgery. Outpatient surgical centers[2] represent an increasingly popular organizational form through which surgery is performed that does not require an overnight's stay. Over the past

[2] Outpatient surgical centers include hospital/physician-owned free-standing ASC joint-ventures, corporate/physician-owned free-standing ASC joint-ventures, and physician only-owned free-standing ASCs.

several decades, outpatient surgical centers have experienced tremendous growth that reflects increasing specialization (Stevens, 2006) and rising demand for minimally invasive, lower cost surgical options (Scott et al., 2000).

Health Care Sector: Specialty Surgical Facilities

There is fierce competition between hospitals and specialty surgical facilities, such as specialty hospitals that provide inpatient services and ASCs that focus primarily on outpatient procedures. Both types of medical facilities have faced tremendous obstacles in their effort to compete with general hospitals (Schragg, 2005, 2006; Sorrel, 2009). In 2002, there were roughly 100 physician-owned specialty hospitals in the U.S. that focused on inpatient heart, orthopedic, and surgery specialties (Hackbarth, 2005). The number of ASCs stood much higher. Between 1991 and 2001, the number of ASCs doubled (Shactman, 2005), while over roughly the same period (1996 to 2006) the number of outpatient visits to free-standing ASCs tripled (Sorrel, 2009). Between 2000 and 2007, the number of Medicare-certified ASCs increased 64% to 4,964 ambulatory surgery facilities, and the amount that Medicare spent on ASC services more than doubled (Thorpe et al., 2006). (*See Appendix A*: Number of Medicare-certified Ambulatory Surgery Centers, 2000–2007.) By 2009, there were approximately 5,000 free-standing ASCs in the U.S. (Sorrel, 2009).

Ambulatory surgery is considered a lower-cost alternative to inpatient surgery largely because ambulatory surgical procedures require less than 24-hour hospital stays, but also because procedures are performed in ambulatory settings that have lower administrative overhead than do hospitals (Russo et al., 2007). The nation has witnessed dramatic growth in the number of surgeries performed in ambulatory settings. In the early 1990s, outpatient surgical procedures outpaced inpatient procedures. In 2006, it was estimated that roughly 53.4 million ambulatory

surgical procedures were performed: 30.8 million in hospital-based facilities; 22.6 million in free-standing ASCs (National Center for Health Statistics, 2006a). The figure for free-standing ambulatory surgery center visits represents a roughly 300 percent increase over the 10-year period between 1996 and 2006 (Cullen et al., 2009).

While Americans in general are living longer, a rising number of adults are being diagnosed with a chronic disease, and many have multiple chronic conditions. The rising number of co-morbid conditions among individuals with a primary chronic illness serves to exacerbate the spike in surgery utilization (Thorpe, 2005; Goldman et al., 2005; Olshansky, 2005; Daviglus, 2005; Lakdawakka et al., 2005; Joyce et al., 2005). Many patients living with chronic illnesses increasingly are choosing to undergo surgical procedures as their preferred treatment option, instead of enduring a lifetime of prescription drugs and ongoing treatments for their medical conditions. High prevalence medical conditions such as hypertension, obesity, diabetes, gallbladder disease, cancer, and coronary heart disease contribute to the rising demand for surgery, particularly elective surgical procedures in ambulatory settings (Joyce et al., 2005).

Given that inpatient surgery has been the cornerstone of hospital services for over a century, additional investigative studies are needed to understand better the particular threats that ASCs pose to hospitals and how surgical volumes are shifting. As ASCs gain market share over hospitals (Stevens, 1989: xvii), the strategic responses of hospitals are greatly complicated by the fact that physicians on hospital medical staffs are among those seeking to establish competitive free-standing surgical facilities (Burns et al., 2011). Physicians who invest in the acquisition of advanced technology to establish free-standing surgical facilities are further straining the already taxed hospital-physician relations when they offer competitive products and services (Shortell & Rundall, 2003). Hospitals are responding to the shifts in surgery to free-standing ASCs by

bolstering their outpatient departments and affiliating with free-standing ASCs. A growing proportion of hospital revenues are now derived from hospital-based outpatient surgical services (McFarland, 1987).

Medical Technology Diffusion

Hospitals have become medical technology centers faced with powerful competitive pressures to adopt the latest innovations (Halm & Gelijns, 1991). New medical technologies give hospitals competitive and marketing advantages in local, regional, and international markets (Ladapo et al., 2009). Hospitals that offer the latest medical devices and surgical procedures are viewed as providers of high-quality health care and are better able to attract leading physicians and surgical teams. New medical innovations afford improvements in the ability to diagnose, treat, and prevent disease. Technological innovations are helping patients rehabilitate faster, regain lost functional capacity, and live longer. Yet, as technology permits physicians and hospitals to offer more services than ever, the overall cost of care continues to rise. This is in part because medical innovations extend life, resulting in greater demand for existing technology, and for the development of newer innovative techniques (Riley & Brehm, 1989).

While new medical technologies help to diagnose diseases at earlier stages, conduct surgery with minimal tissue damage, improve the benefits associated with undergoing surgical procedures, and reduce the probability of infection and death (Garbutt et al., 1999; The Southern Surgeons Club et al., 1995; Reissman et al., 1996; Bennett et al., 1997), the dissemination of new medical technology is a driver of rising health care spending (Cutler & McClennan, 2001; Baker & Atlas, 2004; Chernew et al., 2004; Lubitz, 2005; Ladapo et al., 2009). Between 1965 and 2002, health care spending as a percentage of GDP rose 9.2 percentage points, from 5.7 percent to 14.9 percent. The unprecedented diffusion of medical technology accounted for at least half of

the growth during this time (Lubitz, 2005). The dissemination of advanced medical technology has been associated with more flexible insurance reimbursement policies that are allowing coverage for an increasing number of procedures performed in outpatient settings, growth in specialty surgical centers, increased affordability, and a rise in the number of surgeries performed resulting from patient- and physician-driven demand (Chernew et al., 2004; Thorpe, 2005; Lubitz, 2005; Garber et al., 2007). Yet, while the diffusion of medical technology has been identified as a factor in rising health care spending, medical technology also serves as a transformational force in the health care industry—reducing the costs of, and increasing accessibility to, some medical products, services, and procedures through standardization and simplification (Christensen et al., 2009; National Center for Health Statistics, 2010).

Purpose of Study

The purposes of this study are to: (1) test Clayton M. Christensen's theory of disruptive innovation in health care, and (2) examine the effect of disruptive innovation on the utilization of ambulatory and laparoscopic ACBS. Disruptive innovation theory contends that advanced technology combined with innovative business models—located outside of traditional product markets or delivery systems—will produce simplified, quality products and services at lower costs with broader accessibility. Consequently, new markets will emerge, and conventional industry leaders will experience a loss of market share to "non-traditional" new entrants into the marketplace.

The work examines the impact of technology innovation on the delivery of select types of abdominal surgery. Advancements in laparoscopic surgical procedures are responsible for shifting once highly complex abdominal surgeries that required extensive incisions and lengthy overnight hospital stays to outpatient departments and surgical centers where more standardized,

less invasive, lower cost procedures are performed (Russo et al., 2007). The research focuses on three categories of abdominal surgery: appendectomy, cholecystectomy, and bariatric surgery (ACBS), and aims to identify the trends in and determinants of ACBS procedures. This research will:

1. Describe and analyze changes in ACBS utilization trends in ACGHs and ASCs;
2. Assess technology shifts by identifying the percent changes in the number of open and laparoscopic ACBS performed;
3. Examine shifts in surgical settings by identifying the percent changes in the number of ACBS performed in inpatient and ambulatory settings;
4. Investigate medical facility shifts by identifying the percent changes in the number of ACBS performed in ACGHs and ASCs;
5. Analyze the influence of demographic and facility-level factors on ACBS utilization.

Research Questions

The study tracks and compares the number of open, laparoscopic, inpatient, and ambulatory ACBS performed in Florida and Wisconsin general acute care hospitals and ASCs in 2004 and 2009. The research questions that guide the inquiry are:

1. How has the utilization of ACBS changed over this time?
2. How do ACGHs and ASCs differ in the utilization of ACBS?
3. How do states differ in the utilization of ACBS?
4. Do study findings support the application of Christensen’s disruptive innovation theory in the hospital industry?

Hypotheses

This research assumes that technological innovation in the hospital industry has created a favorable environment for ambulatory surgery centers performing selective abdominal surgery procedures. Compared to ACGHs, ASCs are growing in number and experiencing an increase in the number of laparoscopic surgical procedures performed. An increasing number of abdominal surgical procedures (e.g., appendectomy, cholecystectomy, and bariatric surgery) are being performed laparoscopically in ambulatory settings. Based on these assumptions, the following hypotheses are proposed:

(A) *Technology Shift*: Compared to open ACBS, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed.

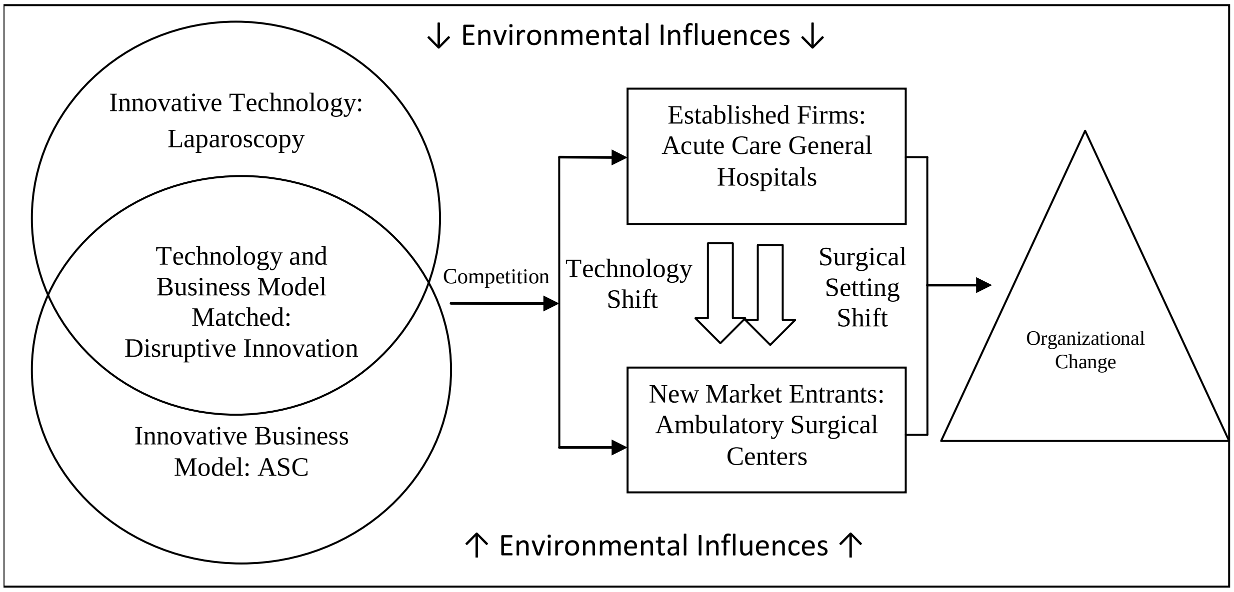
(B) *Medical Facility Shift*: Compared to ACGHs, ASCs will experience a larger percentage increase in the number of ACBS procedure performed.

(C) *Surgical-Setting Shift within ACGHs*: Compared to inpatient ACBS, ambulatory procedures will experience a larger percentage increase in the number of ACBS procedures performed (ACGH Only)

(D) *Technology Shift within ACGHs*: Compared to open ACBS, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed (ACGH Only).

The following diagram depicts the conceptual model. (*See Figure 1*: Theoretical Model of Disruptive Transformation in the Hospital Industry.)

Figure 1: Conceptual Model of Disruptive Transformation in the Hospital Industry



Overview of Theoretical Framework

The theoretical framework consists of three areas of study: organization theory, competitive strategy, and disruptive innovation theory.

Organization Theory

The Health Care Sector as an Organizational Field

While the study examines disruptive innovation in the competitive hospital industry through an analysis of ACBS utilization patterns, it acknowledges the importance of organization theory in providing a framework for understanding health care organizations and the fields in which they compete. According to DiMaggio and Powell, an organizational field is comprised of "those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resources and product consumers, regulatory agencies, and other organizations that produce similar services or products" (2004: 113). Organizational fields include vertical relationships, such as those between headquarters or governing bodies and local or regional operations; and horizontal relationships between individual organizations and their exchange

partners and competitors. Organizational fields also include organizational populations, aggregates of organizations that display like structures and provide similar or related services (Scott et al., 2000). In his 1994 work, "Conceptualizing Organizational Fields: Linking Organizations and Societal Systems," Scott explains that "the boundaries of fields connotes the existence of a community of organizations that partake of a common meaning system and whose participants interact more frequently and fatefully with one another than with actors outside the field" (Scott et al., 2000: 13). The theoretical construction of an organizational field affords the comprehension of both *connectedness* and *structural equivalence* among organizations in an industry (DiMaggio & Powell, 2004: 113).

Open System Perspective

This study employs an open system approach in its understanding of the environment in which hospitals and ambulatory surgery centers operate. In contrast to closed systems—that are understood to be self-contained, self-sustained entities "sealed off from their environments," (Scott, 2003: 28), open systems are shaped by and dependent upon endogenous and external environmental factors. A key feature of open systems is the bidirectionality of exchange across intra-organizational and inter-organizational linkages. Ideas, values, norms, rules, and cultures, as well as personnel, financial, equipment, and information are just a few of the resources that are exchanged. Health care organizations and systems are characterized by their interdependency (Scott, 2003).

Competitive Strategy

Porter's framework for the structural analysis of industries emphasizes the forces that drive competition in an industry. Porter writes:

> The essence of formulating competitive strategy is relating a company to its environment. Although the relative environment is very broad, encompassing social as well as economic forces, the key aspect of the firm's environment is the industry or industries in which it competes. Industry structure has a strong influence in determining the competitive rules of the game as well as the strategies potentially available to the firm. Forces outside the industry are significant primarily in a relative sense; since outside forces usually affect all firms in the industry, the key is found in the differing abilities of firms to deal with them (Porter, 1980: 3).

The theoretical model draws upon Porter's (1980) structural analysis of industries framework. Porter (1979) makes salient the hidden forces in competitive industries. According to Porter, five basic forces determine the state of competition in an industry: rivalry among existing firms, the threat of new entrants, bargaining power of buyers, bargaining power of sellers, and the threat of substitute products and services (*See Exhibit 1*: Forces Shaping Industry Competition). All five competitive forces play a role in determining the state of competition in an industry and its ultimate profit potential (Porter, 1980). Existing firms that view competitive forces as both opportunities and threats are better able to stake out their position in an industry (Porter, 1979; McFarland, 1987).

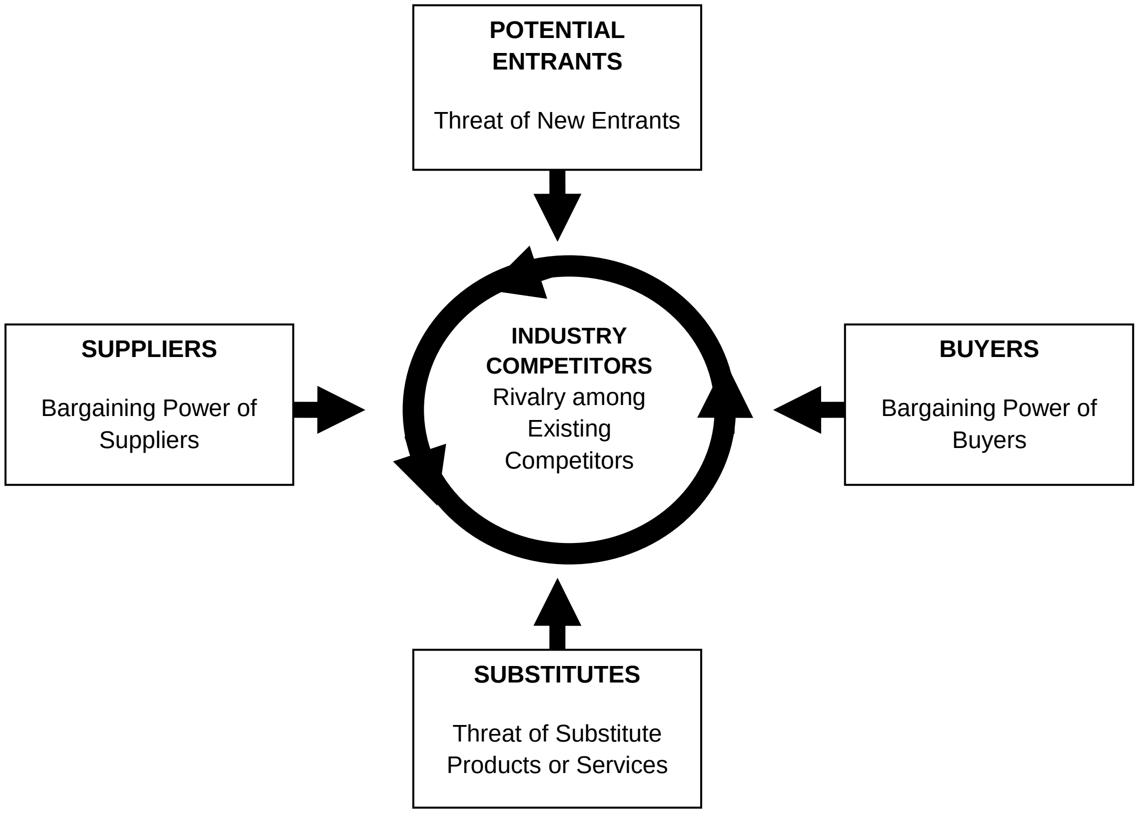
Hospitals face all five competitive forces. For example, intense rivalries exist among hospitals and multihospital systems to establish and maintain dominance in local and regional markets (Ginsburg, 2005; Luke et al., 1999; 2004; McFarland, 1987). New health care providers maneuver around entry barriers to enter the hospital industry, accelerating competition for specialized services (Choudhry et al., 2005). Powerful public and private insurers and HMOs (buyers) place increasing pressure on hospitals to contain costs while also seeking expanded service options for health care consumers (Chernew et al., 2004). Physician specialists

(suppliers) demand higher compensation and acquisition of the latest medical technology from hospitals (Ginsburg, 2005). Additionally, medical device and diagnostic equipment (MDDE) companies are developing products for use in ASCs, physician offices, and homes that substitute those offered in hospitals (Christensen et al., 2009).

Research has examined all five sources of threat to hospital competitors (McFarland, 1987; Porter & Teisberg, 2006). But, one of these–substitution–has been relatively understudied in the health care industry. Substitutes are different goods and services that can replace one another in the marketplace (Goldstein & Horgan, 1988; Davis & Russell, 1972). Lower cost, higher quality substitutes that are valued by new and existing consumers limit the profitability of existing competitors (Porter, 1980). Usually, substitutes represent relatively minor threats in most industries, which is one reason why firms and industries grow. However, rapid changes in technology combined with growing costs concerns–both of which are true in the health care industry–increase dramatically the threat from substitution products.

Substitution rivalries posed by new medical technologies and organizational structures—such as that posed by laparoscopic surgical techniques to open surgery, and ambulatory surgical facilities to acute care hospitals—present significant challenges in the health care industry. This work analyzes these technological and organizational shifts in the health care industry through the lens of disruptive innovation theory. Porter’s framework on the threat of substitute products and services is utilized in order to illuminate some of the market dynamics that are underway in the health care industry, and to elaborate further on the process of disruptive innovation.

Exhibit 1: Forces Shaping Industry Competition



Source: Porter, M. E. (2008). *On Competition*. Boston, MA. Harvard Business School Publishing

Disruptive Innovation

Disruptive innovations often facilitate the substitution of products and services in new and emerging markets for the products and services of existing businesses (Porter, 1980). The term disruptive innovation is attributed to Christensen, who first coined the term in a 1995 *Harvard Business Review* article titled, "Disruptive Technologies: Catching the Wave" (Bower & Christensen, 1995). Christensen's theory of disruptive innovation highlights how new technologies can invade established markets leaving existing industry organizations caught off-guard by a loss of market share due to the emergence of new technologies and organizations in the industry. Bower and Christensen (1995) contend that in established markets, industry leaders place too much focus on meeting the needs of mainstream customers rather than anticipating

technological changes and the needs of future generations of customers. This myopic perspective among leading organizations has established a consistent “pattern of failure” that is evident in numerous industries. In the computer industry, Digital Equipment Corporation (DEC), the leading manufacturer of high-end minicomputers, failed to capitalize on the personal computer market and lost out to IBM. In the photocopy industry, Xerox failed to take advantage of smaller, less costly but slower tabletop copier technology, losing out to Canon. Other industries include rail transportation, radio, automobiles, and photography. These businesses employ strategies that sustain technological innovations that give their valued customer-base more or improved products and services. Sustaining innovations are high performance, expensive, expertise-intensive products and services designed to meet the needs of the most demanding customers in established firms.

While disruptive innovation has been studied extensively in industries from communication to transportation, computers to banking, and music to retail shopping, the stages of disruption have been studied much less in health care (Christensen et al., 2009). The paucity of disruption research is in part due to the distortions created by the lack of pricing transparency, government regulations of the supply of surgeons through licensing and certifying, and the creation of incentives generated by public and private payer reimbursement policies. These and other distortions complicate the functioning of disruptive forces in the health care industry.

Yet, in health care, competitive forces are at work shaping the industry. Competition goes beyond the rivalries between existing hospitals and hospital systems. Customers, suppliers, substitutes, and potential new entrants are viewed as competitors that shape the health care industry (Porter, 1980). Free-standing ambulatory surgery centers, physician-owned specialty hospitals, retail clinics offering primary care in CVS and Wal-Mart stores, and medical devices

and diagnostic equipment designed for homes and physician offices are examples of competitive pressures facing hospitals and disruptive forces that are reshaping the health care industry.

This research employs Christensen's theory of disruptive innovation in order to understand better the threat of substitutes and new entrants in the health care industry. The study tests the impact of combining of two essential components of Christensen's theory of disruptive innovation: a simplifying technology and an innovative business model on acute care general hospitals. The third element, the value network and regulatory standards and industry standards that facilitate change are discussed contextually but are not a central focus of the work.

The theory of disruptive innovation is employed to shed light on technology and its impact on the delivery of medical services. Laparoscopic surgical techniques represent a simplifying technology. Ambulatory surgery centers represent innovative business models. The study focuses on how advanced technology is adopted by innovative businesses to generate disruptive innovation in health care by shifting: (1) open surgical techniques to less invasive laparoscopic procedures, (2) inpatient surgical settings to more affordable ambulatory surgical settings, and (3) procedures typically performed in acute care general hospitals to more specialized ambulatory surgery centers.

Research Design

The research design provides a framework for descriptive and comparative analyses of hospitals and ASCs in the delivery of appendectomy, cholecystectomy, and bariatric surgery. The non-experimental research design also is formulated to examine the relationship between explanatory and dependent variables, while identifying factors that influence ACBS utilization. The study employs a retrospective panel design that allows for analysis and comparison of utilization trends over time. Panel designs afford evaluation of patterns of persistence and change

(Babbie, 2005). Panel designs also allow for the identification of influences on surgery utilization (dependent variable) and the determination of whether or not shifts in trends are operative in the delivery of surgical procedures.

ACBS utilization will be observed longitudinally in two states: Florida and Wisconsin. Surgical procedures are tracked for years 2004 and 2009. The research design employs repeated measures for the longitudinal study. The term, repeated measures, refers to an observation schedule consisting of at least two similarly timed data collection points (Scott, M., 2004). Intellimed[3] collects hospital discharge data and assembles it on a quarterly basis. This research aggregated the quarterly data into annual totals. The observation points are 2004 and 2009. The unit of analysis is the medical facility, categorized as either an ambulatory surgery center or an acute care general hospital.

Scope and Methodological Approach

Sample

The study tracks the number of appendectomy, cholecystectomy, and bariatric surgery procedures performed during 2004 and 2009. The sampling frame consists of all acute care general hospitals and ASCs in Florida and Wisconsin. The sample is comprised of 602 medical facilities located in Florida and Wisconsin. There are 459 facilities from Florida (76.2% of the sample), and 143 from Wisconsin (23.8% of the sample). The medical facilities are located in 57 CBSAs.[4] Each CBSA consists of an area of at least 10,000 people. CBSAs are divided into metropolitan and micropolitan areas, depending on population size. The sample consists of 34

---

[3] Secondary data used in the study are licensed from Intellimed International Corporation.

[4] "In 2003, the Office of Management and Budget implemented Core-Based Statistical Areas (CBSA) to replace MSA codes, which had been in use since about 1990" (http://www.zip-code-download.com/cbsa.php).

metropolitan CBSAs (15 in Wisconsin; 19 in Florida), and 21 micropolitan CBSAs (12 in Wisconsin; 9 in Florida). Rural areas are categorized as a group labeled “Undefined”. While facilities are designated as being located in undefined areas, these areas are not given unique names by which to identify them. Most of the facilities are located in metropolitan areas (503 facilities or 83.6% of the sample). Fifty-one facilities (8.5% of the sample) are located in micropolitan areas, with 48 facilities (8.0% of the sample) located in rural/undefined areas. (*See Table 1*: Facilities by Core-Based Statistical Area (CBSA) Category.)

Table 1: Facilities by Core-Based Statistical Area (CBSA) Category

State	Micropolitan CBSA	Metropolitan CBSA	Undefined Area CBSA (rural)	Total Facilities
Wisconsin				
Acute Care General Hospitals	4	18	1	23
Ambulatory Surgery Centers	22	61	37	120
Subtotal	26	79	38	143
Florida				
Acute Care General Hospitals	9	255	2	266
Ambulatory Surgery Centers	16	169	8	193
Subtotal	25	424	10	459
Total	**51**	**503**	**48**	**602**

Data Source

The study employs secondary data licensed from Intellimed International Corporation.[5] The Intellimed system uses CMS-MedPar Standard Analytical File (SAF) databases for the nation. Intellimed data are gathered for 100% percent of general acute care hospitals and ambulatory surgery centers in selected states. The Intellimed system tracks provider, patient, clinical, payer, admission, discharge, market share, and utilization data. For this study Intellimed data are merged with other datasets including those from the American Hospital Association (AHA), American Medical Association (AMA), and the U. S. Census Bureau.

[5] Intellimed data are not derived from a sample.

Data Analysis Plan

Two types of analyses guide the data analysis plan: exploratory and confirmatory. Descriptive assessments and determination of the statistical significance of predictors comprise the exploratory phase. The aim of the exploratory phase is to understand better the composition of the dataset and characteristics of the variables. It is during this initial stage that the relation between independent and dependent variables is assessed, in order to formulate parsimonious statistical models. Variables lacking usefulness in regression models have been dropped from the dataset. It also is during this phase that multicollinearity diagnostic tests are performed. Upon completion of the exploratory analysis, the confirmatory data analysis plan was devised based on exploratory findings. The confirmatory data analysis plan consists of testing theories and hypotheses based on variable relationships that are theoretically-grounded and statistically-justified. Results have been used to make revisions to the conceptual model, research questions, and hypotheses, as well as determining the appropriate statistical procedures to employ. Data analysis includes the following analytic techniques:

Descriptive Analysis provides a summary of the dataset using univariate analysis (e.g., frequency, sum, mean, standard deviation, and percentages) based on various characteristics. Descriptive Analysis asks: How many different types of medical facilities comprise the dataset?

Independent Samples T-Test is interested in comparing the mean scores of two groups comprising the same variable. T-test asks: Do Florida and Wisconsin differ in the provision of ACBS laparoscopic surgery?

Bivariate Regression Analysis allows for the development of a predictive model based on the linear relation between an independent variable and a dependent variable. Bivariate analysis

might asks: How many more laparoscopic ACBS cases can an ACGH expect to perform, on average, compared to an ASCs?

Multivariate Regression Analysis allows for the development of a predictive model based on a linear relationship as well, except the analysis allows for the assessment of an association between several independent variables and a dependent variable. Multivariate regression analysis asks: What is the relationship between percent change in open ACBS and percent change in laparoscopic ACBS procedures performed, holding all else constant?

The work features facility-level analyses, and it seeks to understand the impact of technological innovation on hospital and ASC surgical utilization through comparative analyses of facility types, surgical settings, and procedure types. See Table 2: Variables and Categories, for operationalization of these variables. In addition to analyzing the pooled data, subgroup analyses also will compare states (i.e., Florida and Wisconsin) and surgery types (i.e., appendectomy, cholecystectomy, and bariatric surgery procedures).

Table 2: Variables and Categories

Variables	Categories
Year (T)	0 = 2004; 1 = 2009
State (s)	0 = Wisconsin; 1 = Florida
Facility Type (f)	0 = Ambulatory Surgery Center (ASC); 1 = Acute Care General Hospital (ACGH)
Surgical Setting (s)	0 = Ambulatory (Outpatient); 1 = Inpatient
Procedure (p)	0 = Open; 1 = Laparoscopic
Abdominal Surgery Type (a)	0 = Bariatric Surgery; 1 = Appendectomy; 2 = Cholecystectomy

Equation 1

Equation 1 demonstrates the manner in which outcome measures for Hypotheses A, B, C, and D have been operationalized.

$$\%\Delta Y_{fskpa} = \frac{T2009_{fskpa} - T2004_{fskpa}}{T2004_{fskpa}}$$

The outcome measure for Equation 1 is operationalized as: $\%\Delta Y_{fskpa}$ = *Percentage Change in Number of Surgical Procedures Performed in 2004 Compared to 2009* where the variables represent the *f*th facility, in the *s*th state, in the *k*th surgical setting, for procedure *p*, for abdominal surgery type *a*. Percent change in open, laparoscopic, inpatient, and ambulatory ACBS has been calculated using the above formula. For t-tests and regression analyses, percent changes occur at the facility level and will draw mean comparisons between ACGHs and ASCs. For descriptive statistics, percent change calculations are based on annual totals. Table 3 further defines variable categories.

The influence of predictors on dependent variables will be assessed using the following equations.

Equation 2

$$\%\Delta LapACBS = b_0 + b_1\%\Delta OpenACBS + b_2 FACILITY + b_3 STATE + b_4 POP\%\Delta + b_5 METRO + \varepsilon$$

Equation 2 is formulated to assess technology shifts in the pooled data set of both ASCs and ACGHs, and in the ACGH-only dataset. $\%\Delta LapACBS$ represents *Percent Change in Number of Laparoscopic ACBS Procedures Performed in 2004 Compared to 2009*. Coefficients are b_0, b_1, b_2, b_3, and b_4. The independent variable is *Percent Change in Number of Open ACBS* ($\% \Delta OpenACBS$). Control variables are *facility* (*FACILITY*), *state* (*STATE*), *percent change in CBSA population* ($POP\% \Delta$), *metropolitan area* (*METRO*), and *error term* (ε).

Equation 3

$$\%\Delta AmbLapACBS = b_0 + b_1 FACILITY + b_2 STATE + b_3 POP\% + b_4 METRO + \varepsilon$$

Equation 3 is formulated to determine shifts between medical facilities. $\%\Delta AmbLapACBS$ represents *Percent Change in Number of Ambulatory Laparoscopic ACBS Procedures Performed in 2004 Compared to 2009*. Coefficients are b_0, b_1, b_2, b_3, and b_4. Independent variable is *facility* (*FACILITY*). Control variables are *state* (*STATE*), *percent change in CBSA population* (*POP%*Δ), *metropolitan area* (*METRO*), and *error term* (ε).

<u>Equation 4</u>

$$\%\Delta AmbACBS = b_0 + b_1 \%\Delta InpatientACBS + b_2 FACILITY + b_3 STATE + b_4 POP\%\Delta + b_5 METRO + b_6 LOGBEDSIZE + b_7 FORPROFIT + \varepsilon$$

Equation 4 is formulated to assess surgical-setting shifts. Due to the lack of available information on ASCs for the study period, the sample consists of hospitals only. $\%\Delta Amb$ represents *Percent Change in Number of Ambulatory ACBS Procedures Performed in 2004 Compared to 2009*. Coefficients are b_0, b_1, b_2, b_3, and b_4. The independent variable is *Percent Change in Number of Inpatient ACBS* (*%*Δ*InpatientACBS*). Control variables are *facility* (*FACILITY*), *state* (*STATE*), *percent change in CBSA population* (*POP%*Δ), *metropolitan area* (*METRO*), *log bed size* (*LOGBEDSIZE*), *for-profit* (*FORPROFIT*), and *error term* (ε).

The control variables are categorized at the facility- and demographic-levels. (*See Appendix B*: Measures, Descriptions, and Sources.)

Rational and Significance

As health care costs continue to rise, and poor quality and access barriers remain concerns, disruptive innovation is heralded as a way to improve health care market efficiency. Medical technology has altered the need for certain types of surgery to be performed in traditional hospital settings. Advances in laparoscopic surgical procedures have changed the manner in which surgery is performed, shifting many types of procedures from (1) open to less-

invasive surgery techniques; (2) overnight inpatient to lower cost ambulatory surgery settings; and (3) acute care general hospitals to more specialized ambulatory surgery centers. The diffusion of new medical technologies is responsible in part for shifting highly complex abdominal surgeries that require extensive incisions and lengthy hospital stays to more standardized minimally invasive surgeries that do not require overnight hospital stays, cost less, and reduce recovery time (Russo et al., 2007). ACGHs face competition from ASCs, as less invasive surgical procedures allow more treatments to take place in outpatient settings.

The radical changes in the performance of surgery are the reason that three categories of abdominal surgical procedures are the focus of this research. Appendectomy, cholecystectomy, and bariatric surgery historically have required large incisions to access the abdominal cavity. Open abdominal surgeries are high-cost, expertise-intensive, high-risk, and extremely complex procedures that required multiple days of inpatient hospital care. A premise of this study is: Disruptive innovation is occurring in the delivery of appendectomy, cholecystectomy, and bariatric surgery. Laparoscopic technology has simplified the performance of many types of abdominal surgery causing volume shifts within and between medical facilities. The impact of laparoscopy has been compared to the surgical milestones of vascular surgery and organ transplantation (De, 2004).

This study is significant because limited research focuses on disruptive innovation in the health care industry in general, and the hospital industry in particular. The analysis of shifting surgical patterns from a disruptive innovation theory perspective is a relatively understudied area. The work also has significance because of both interdisciplinary and multi-level analytical approaches to examining changes within the hospital industry. The work features a business management theory contextualized in population ecology theory that is applied to health care

with public policy implications. The research has policy, methodological, and theoretical significance.

Policy Significance

Technological innovation in health care is increasingly heralded as a way to improve access to care by increasing the number of venues providing a medical service of procedure (Vijayaraghavan, 2011). Disruptive innovation is viewed as an alternative to government intervention into the healthcare system (Hwang, 2011). This work stands to inform public and health policy by highlighting the effects of technology innovation in the hospital industry.

The policy implications of the research also are based on its ability to inform health and public policy decision-making. As medical technology evolves, simplified, lower costs, and more accessible health care solutions are emerging in the health care marketplace. Health care surgical settings are becoming more portable and decentralized—moving from inpatient hospital settings to ambulatory surgical settings (Christensen et al., 2009). Yet, substitute products and services create tension between traditional providers and new entrants in competitive health care markets, as for instance ambulatory surgery facilities generate competitive pressures for acute care hospitals (Hackbarth, 2005; Schraag, 2005; Pyrek, 2005; Sorrel, 2009). Critics contend that specialty surgical facilities:

- Profit when physicians steer patients to their own facilities;
- Treat patients who are less severely ill, “cherry picking”;
- Concentrate surgical specialties on relatively more profitable DRGs;
- Serve a lower share of Medicare and poor patients than community hospitals; and

- Threaten to undermine the ability of acute care hospitals to provide less profitable services, which are cross-subsidized from patients who self-pay or have private insurance.

Supporters of ambulatory surgery centers argue that these more cost-efficient health facilities are engaged in healthy competition with acute care general hospitals. Supporters also contend that ASCs are identifying traditionally overlooked segments of the consumer-base and are filling unmet demand for services (Hackbarth, 2005; Christensen et al., 2009). In a competitive environment, the surgical volumes of acute care hospitals may decline. Established hospitals, however, must adjust and identify alternative sources of revenue to remain profitable (Hackbarth, 2005).

Few studies have focused on disruptive innovation in the hospital industry in part because challenges to the formation of specialty surgical facilities have impeded disruptive processes (Hwang & Christensen, 2008). Barriers to the development of new business models include the fragmentation of health care delivery systems, third-party payment systems and the lack of price transparency, and government regulations, such as the federal moratoria on specialty hospitals, certificate of need (CON) policies, and restrictions on physician ownership of medical facilities (Hwang & Christensen, 2008).

Methodological Significance

Most studies of disruptive innovation are qualitative or descriptive industry analyses conducted at the meta-level of industries such as communication, computers, printers, banking, and transportation (Bower & Christensen, 1995; Hwang & Christensen, 2008; Christensen et al., 2009; Yu & Hang, 2009). This work is methodologically significant because of multi-level analytical approaches to examining change in the hospital industry. Until recently, standardized

data on ambulatory surgery centers was difficult to access. Analyses of shifts in organizational setting from hospitals to ASCs were almost impossible to perform. Consequently, limited quantitative research has examined the volume shifts between hospitals and ASCs and changes in the patterns of care. The study is methodologically significant because it takes a quantitative approach, using hospital discharge databases, to examining the claims of disruptive innovation as they are applied to a healthcare context.

The methodological implications of the work are significant for two primary reasons. With the inclusion of ambulatory surgery data in hospital discharge databases, there are greater opportunities to investigate how the delivery of surgical procedures shifts between different types of health care organizations over time. While the mostly descriptive nature of disruptive innovation research offers opportunities for understanding broad industry trends, more data-driven quantitative analyses are needed to objectively document industry shifts and identify determinants of disruptive innovation. This work seeks to identify technology and surgical-setting trends, as well as volume shifts between medical facilities within the hospital industry through a quantitative longitudinal investigation.

Additionally, limited research has focused on laparoscopic surgery in the context of disruptive innovation. This work has methodological significance because of its organizational approach to analyzing medical facilities (ACGH to ASC), technology (open to laparoscopic procedures), and surgical setting (inpatient to outpatient) shifts. The work also is methodologically significant because of its preliminary exploratory approach to analyzing the data. The process eliminates variables that lack significance and improves the predictive value of analytic models. The research design aims to ground variables both theoretically and statistically prior to their inclusion into more advanced models at the confirmatory data analysis phase.

Theoretical Significance

The interdisciplinary work features a business management theory that is contextualized in organizational theory, applied to healthcare, which has implications for public policy. The study situates ACGHs and ASCs in an organizational field (Fennell & Alexander, 1993; DiMaggio & Powell, 2004) and acknowledges that they are open systems, shaped by and dependent on endogenous and external environmental factors (Scott, 2003). Population ecology theory provides a theoretical framework for this study. Disruptive innovation and population ecology theories both highlight the role of environmental factors in organizational founding, change, and survival. In this work, these theories frame the investigation that emphasizes the roles of inertial pressure, organizational size, and generalist and specialist approaches to organizational strategy, a determinant of organizational variation (Christensen et al., 2009; Baum & Shipilov, 2004). This work has significant theoretical implication because it stands to inform disruptive innovation theory through its simultaneous investigation into technology (open to laparoscopic surgical techniques), surgical-setting (inpatient to ambulatory), and medical facility (ACGH to ASC) shifts, across three types of abdominal surgery.

Based on the rationale and significance of this work, the research is poised to make a contribution to the fields of health and public policy, and the areas of business and health services administration.

Conclusion and Outline of Remaining Chapters

The problems of inefficient health care markets and rising health care spending provide the backdrop for this research. The theory of disruptive innovation posits that advanced medical technology has the ability to transform the health care industry by increasing access to appendectomy, cholecystectomy, and bariatric surgery procedures. Through technological

innovation, more affordable and more accessible substitute products and services should emerge stimulating surgical shifts in the hospital industry. Disruptive transformations should reduce the market share of more expensive, expertise-intensive products and services, making many of these products, services, and delivery systems obsolete over time.

With medical technology accounting for an increasing percentage of health care spending, additional research is needed to understand the disruptive effects of innovative technology within the hospital industry. This study tracks the utilization of abdominal surgery and assesses technology, surgical settings, and facility shifts. The following outlines the remaining chapters in the study. Chapter 2 provides a review of previous literature on medical technology in competitive environments, and the rise of laparoscopic surgery and ambulatory surgery centers. Literature on technology shifts and organizational setting shifts in the health care industry also is reviewed in chapter two. Chapter 3 features the theoretical framework and conceptual model that guide the research project. This chapter discusses Porter's Competitive Forces Model (1980) and the threat of substitution in a health care context. Clayton M. Christensen's theory of disruptive innovation (2009) also is discussed and applied to the utilization of ACBS procedures in ASCs and inpatient and outpatient settings in hospitals.

Chapter 4 details the methodological framework for the research. The research design, hypotheses, and questions, as well as data sources and variables are outlined. The analytical approach also is formulated in this chapter. Chapter 5 presents an overview of results, along with tables illustrating statistical analysis. Chapter 6 summarizes findings and interprets results. This chapter also discusses the study implications and presents study limitations, suggestions for future research, and the conclusion.

CHAPTER 2 – LITERATURE REVIEW

This chapter is divided into six primary sections. The first section of the literature review presents the origins, components, and applications of disruptive innovation theory. The second section examines elements of the theory as they related to the health care industry. Criticisms of the disruptive innovation theory are the focus of part three. Section four takes a look at a specific type of innovative technology: laparoscopy and how it has changed the way some surgeries are performed. The fifth section examines the competitive environment of the U.S. hospital industry, discussing economic and service utilization trends, highlighting market characteristics, costs and expenditures, and discharge trends in hospitals. The sixth section focuses on the emergence of specialty medical facilities—with particular attention given to ASCs, considered innovative business models. This section takes a look at the rate of facility growth over time. This section also examines the trends of specialty medical facilities in the hospital market and explores the basis for some of the conflicts resulting from their emergence. Section seven, the conclusion, offers summary comments. The literature reviewed in this chapter provides a contextual framework for the research.

Disruptive Innovation Theory

Introduction: Origins, Components, and Applications

Clayton M. Christensen first coined the term “disruptive technology” after examining the manner in which technology creates disruptions in industries when new simpler, more affordable and accessible products enter markets at the low end, igniting shifts and allowing smaller firms to capture market share traditionally controlled by established firms, (Christensen, 2008). Christensen details in his 1997 book, *The Innovator’s Dilemma*, disruptive technology theory and how the management practices of well-managed firms impede their ability to anticipate and respond efficaciously to emerging innovative technologies. He contends that the very

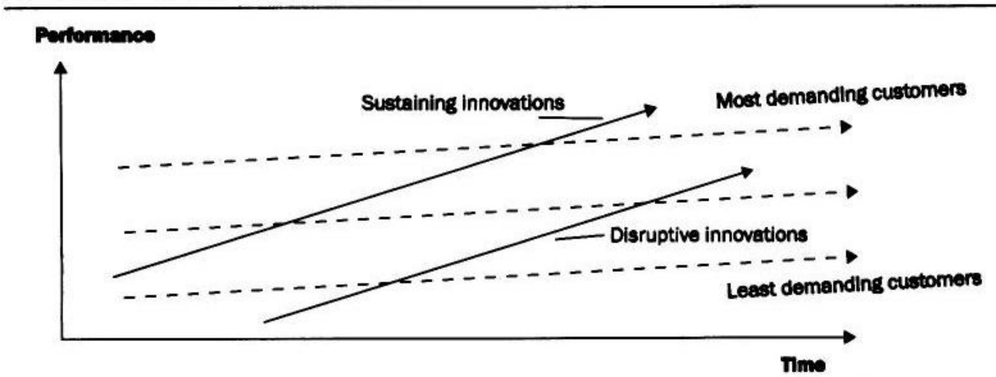
management practices that contribute to successful firms becoming industry leaders are the same ones that contribute to organizational failure when firms are faced with disruptive technologies. Well-managed firms develop sustaining technologies to improve product performance and satisfy customer needs. Yet, these same practices that emphasize listening to customers, focusing on larger markets, increasing or maintaining growth rates, seeking higher profit margins, meeting the product and service needs of existing customers, and achieving the profit expectations of investors, can foster organization inertia (Christensen, 2003). Christensen later realizes that technological enablers are operative in all firms, and disruptive processes were occurring in engineering and manufacturing, as well as marketing, investment, and managerial. Christensen (2008) asserts that disruptive innovation is everywhere. According to Christensen (2003), many industries have experienced disruptions that have altered the established trajectories of technological progress.

In a 1995 *Harvard Business Review* article titled "Disruptive Technologies: Catching the Wave", Christensen broadens the concept of disruptive processes and widened the application of his theory, coining the term "disruptive innovation" (Christensen, 2008; Yu & Hang, 2010). According to Christensen, technology is defined as "the processes by which an organization transforms labor, capital, materials, and information into products and services of greater value. . . . Innovation refers to a change in one of these technologies" (2003, xvi). A disruptive innovation is a new technology or service that displaces the status quo, giving rise to new processes, customers, and markets. The product or service typically enters the market at the low performance end or through an underserved segment of the industry, and over time gains market share from established firms, possibly resulting in the failure of large well-managed firms (Christensen, 2008; Christensen et al., 2009; Dalziel & Shah, 2010).

Prior to the formulation of disruptive innovation theory, technological innovation was classified as either: (1) revolutionary, discontinuous, and radical; or (2) evolutionary, continuous, and incremental (Yu & Hang, 2010). Christensen concluded that the shifts he had observed in the hard disk drive industry did not adequately fit into either of these categories. Subsequently, he conceptualized technological innovations into sustaining and disruptive phenomena (Yu & Hang, 2010). Disruptive innovations target customers whose needs have been overlooked by established firms, and they are typically new applications of products or services that have lower performance measures compared to sustaining innovations.

According to the theory of disruptive innovation, established businesses tend to focus on meeting the needs of their main customers by employing strategies that sustain technological innovations that give their valued customers more or improved products and services. *Sustaining innovations* are high performance, expensive, expertise-intensive products and services that are designed to meet the needs of the most demanding customers. Sustaining innovations are reflected below in the more inclined solid-lined arrows in Exhibit 2: The Theory of Disruptive Innovation (Christensen et al., 2009; Yu & Hang, 2010).

Exhibit 2: The Theory of Disruptive Innovation



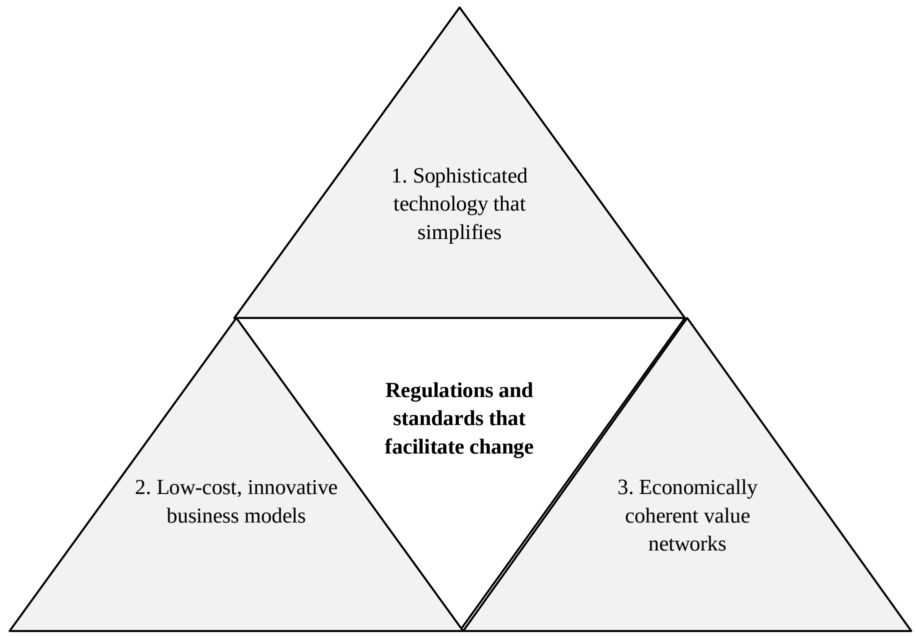
SOU CE: C.M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fall* (Boston: Harvard Business School Press, 1997).

Disruptive innovations are products and services that usually perform worse on one or two dimensions that are highly important to existing customers of established businesses, making them unattractive investments (Christensen et al., 2009; Yu & Hang, 2010). Disruptive innovations are reflected in the bottom solid-lined arrow in Exhibit 2. Yet, disruptive products and services typically perform well on other important dimensions that are considered valued attributes to new customers in emerging markets (Christensen et al., 2009; Bower & Christensen, 1995). Disruptive innovations target customers whose needs have been overlooked by established firms, and those who are in undervalued markets. Disruptive innovations also often facilitate the substitution of existing products and services in new and emerging markets (Porter, 1980). Established companies that failed to launch disruptive products and services during the early stages of development lag behind new entrants that did launch products and services, leaving opportunities to capture a growing share of the market (Christensen et al., 2009; Bower & Christensen, 1995). Disruptive innovation theory asserts that established firms are often selected out because of their failure to capitalize quickly on innovative technology and unmet demand in the marketplace (Christensen, 2003).

Hwang and Christensen present the theory as a conceptual business administration model designed to illustrate how well-managed firms fail, and to explain how "industries have coupled cost-reducing technologies with innovative business models to deliver increasingly affordable and accessible products and services" (2008: 1329). Christensen's theory consists of three enabling elements: (1) technological enabler, (2) business model innovation, and (3) value network (Christensen et al., 2009: xx). (*See Exhibit 3*: Elements of Disruptive Innovation.) Regulations and industry standards that facilitate change are operative at the center of three

elements "lubricat[ing] interactions among the participants in the new disruptive industry" (Christensen et al., 2009: xx-xxi).

Exhibit 3: Elements of Disruptive Innovation



Source: Christensen et al., 2009: xx.

The theory of disruptive innovation contends that new organizational forms emerge as vehicles that are designed to fit technological innovations. These new organizations bring to the marketplace the benefits of technology. In other words, innovative business models, known as technology enablers, are coupled with innovative technology, and the technological advancement moves through a series of growth waves that lead to centralization and decentralization of advanced industries. During *Wave One*, the initial growth wave, modern technology enters a market, bringing vast improvements over the customary ways of doing things by hand (Stage Zero). New, more reliable, products and services with improved performance are delivered in a centralized fashion in part because they are complicated, expertise-intensive, and expensive. Successive growth waves (*Wave Two* and *Wave Three*) of disruptive technology simplify products and services making them more accessible and more affordable. The decentralizing

waves of disruptive technology are evident across a number of industries from communications to entertainment (Christensen et al., 2009). (*See Table 3*: Patterns in the centralization and decentralization of access to technology.)

The evolution of the book printing and publishing industry offers an example of the impact of disruptive innovation. During Stage Zero, manuscripts were handwritten with ink on blocks of wood and or carved in clay; few people had access to these cumbersome books, and most were illiterate. With the advent of paper, manuscripts became more mobile affording greater accessibility to written materials, yet mostly religious leaders and the elite had access to these documents. The printing press, which brought vast improvements over hand-written documents, represents *Wave One* of decentralization book publishing. *Wave Two* decentralized book publishing even more with electronically-published books accessible on desktop computers. *Wave Three* has brought increased growth with the availability of books on handheld devices, such as Amazon’s Kindle and Apple’s iPad. *Waves Two* and *Wave Three* brought quantum improvements in quality, cost, and speed of book publishing (Christensen et al., 2009).

Table 3: Patterns in the Centralization and Decentralization of Access to Technology (Abbreviated List)

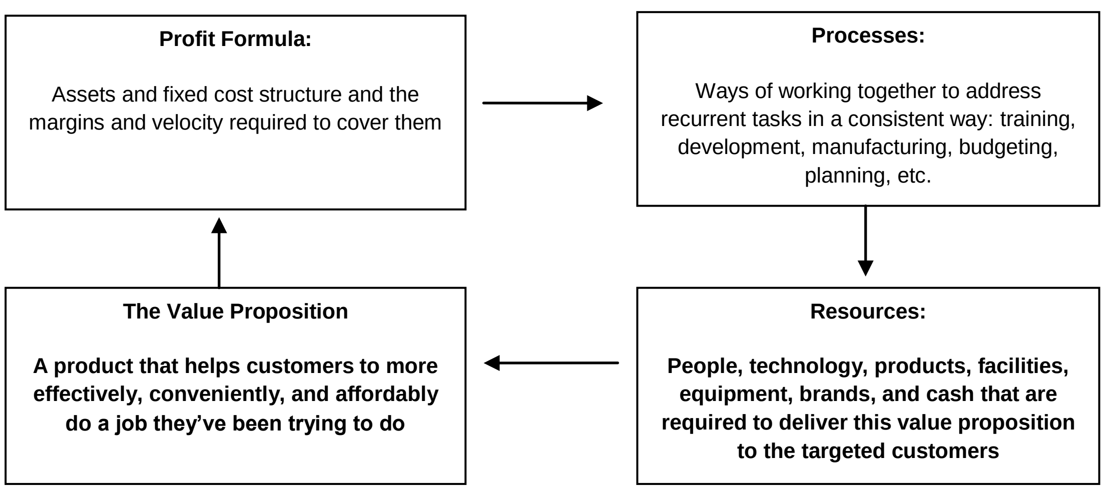
Industry	**Stage Zero**	**Growth Wave One**	**Growth Wave Two**	**Growth Wave Three, etc.**
Communication	Letters were the only way to communicate over a distance	We went to the telegraph office, where an operator transmitted out message in Morse code.	With wireline phones we just had to go to the next room to have a long distance conversation.	Mobile phones allow us to have distance conversations from any place, to any place.
Shopping	We went from shop to shop to get what we needed.	Downtown department stores like Macy's brought the goods to a central place. We went there to get what we needed.	Suburban shopping malls brought the goods closer to our homes.	Instead of our having to travel to where the goods are, Internet retailing brings the goods to us.
Entertainment	We entertained each other.	We went to where the movies were—in big downtown theaters and drive-ins.	We could watch movies in our homes, on VCRs, DVD players, and premium cable television networks.	We can watch movies anywhere on portable DVD players or by downloading or streaming them onto handheld devices and mobile phones.
Banking/Money Management	We hid our money in a jar at home.	We kept our money in a downtown bank, which was open during "bankers' hours": 9:00 A.M. to 3:00 P.M.	ATMs allow us to access cash at any time anywhere in the world.	With credit cards and online banking, we need to go to ATMs and handle cash less and less often.
Medical Care	Doctors, nurses, and family took care of the sick in the patients' home.	We take our patients to the general hospital, where doctors and nurses provide care.	Procedures that once required hospitalization can be performed in ambulatory clinics and surgery centers.	Procedures that once required going to an ambulatory clinic or surgery center can be done in doctors' offices.

Source: Christensen et al., 2009: 316.

Disruptive Innovations in the Health Care Industry

Hwang and Christensen (2008) contend that the process of disruptive innovation in health care has been slow, which in part explains the rapidly rising costs in health care. According to Burns and colleagues, "disruptive technologies are frequently heralded as a solution to delivering higher quality, lower cost health care" (2011; 69). If lower costs, higher quality, and greater accessibility are to be the outcome of combining innovative technology with innovative business models in the hospital industry, four components are essential: efficient and effective processes, availability of requisite resources, a product or service with a value proposition that improves life, and the ability to maximize profit (*See Exhibit 4*: The Four Components of a Business Model).

Exhibit 4: The Four Components of a Business Model

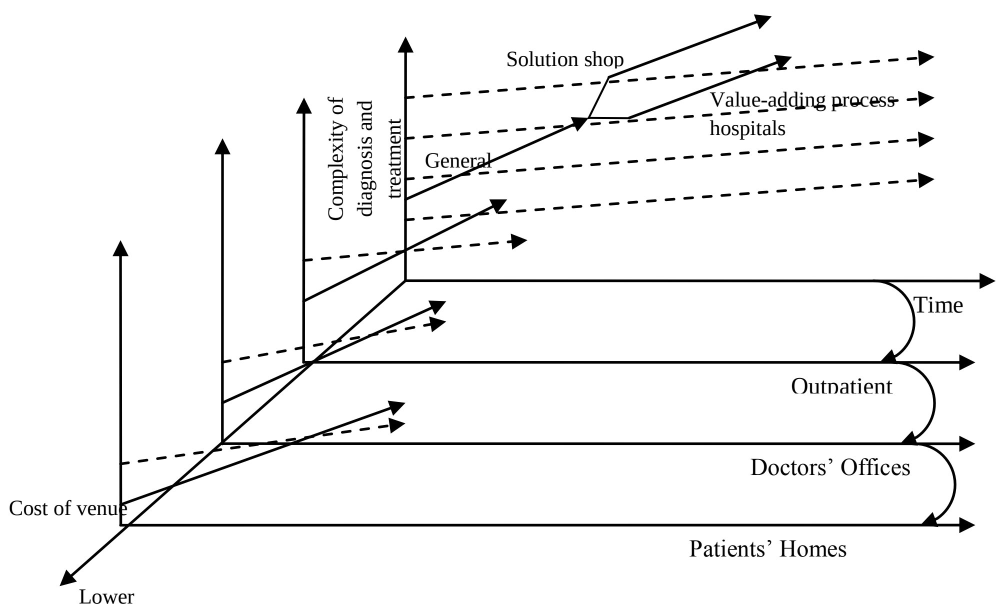


Source: Hwang & Christensen, 2008: 1331

While disruptive innovations in health care have lagged behind other industries, innovative technologies in the hospital industry are increasingly fueling disruptive innovation in medicine. During Stage Zero in the medical field, physicians and nurses made house calls to provide medical care. Wave One centralized the delivery of health care in general hospitals where a wide array of products and services are provided. During this phase, products and

services delivered in hospitals are complicated and expensive, in part because of the burden of high fixed costs and administrative overhead. During the second growth wave, procedures are simplified and delivery decentralized in ambulatory clinics, where administrative overhead and fixed costs are lower. In the third wave, procedures are simplified even more allowing their delivery to shift from ambulatory clinic to doctors' offices. According to Christensen and colleagues (2009), disruptive transformations are in earlier stages in the medical device and diagnostic equipment (MDDE) industry. Yet, the shift from centralized products and services to decentralization is evident. Blood glucose monitoring, pregnancy testing, and other blood work have moved from central laboratories to doctors' offices to home testing devices (Christensen et al., 2009). For a schematic illustrating how technology is transforming the health care sector see Exhibit 5: Continuous Cascade of Disruption in Health Care. (Other MDDE procedures are listed below in Table 4: Cycles of Centralization and Decentralization in Medical Procedures where normal fonts represent the past, bold fonts today, and italics the future.)

Exhibit 5: Continuous Cascade of Disruption in Health Care



Source: Christensen et al., 2009: 102.

Table 4: Cycles of Centralization and Decentralization in Medical Procedures

Stage Zero	**Growth Wave One**	**Growth Wave Two**	**Growth Wave Three, etc.**
Doctors examined blood samples through microscopes in their offices.	**Blood samples are sent to central labs, where high-speed multi-channel machines run the required tests. Results are then sent back to the doctor.**	Tabletop and hand-held diagnostic devices such as Istat brought testing to the physician's office.	*Home testing equipment and mail-order services enable patients to monitor their own blood chemistries without having to see a doctor.*
Patients have heart attacks, seemingly at random. They recover or die.	**Cardiac surgeons perform bypass surgeries in academic medical centers, and later, general hospitals.**	**Cardiologists perform angioplasty in hospitals, but a cardiac surgeon must be waiting in the wing in case something goes wrong.**	*Equipment enables cardiologists to safely perform these procedures in ambulatory clinics without needing a surgeon-in-waiting.*
Many doctors' offices had basic X-ray machines.	**Patients go to general hospitals' radiology departments, where experts use CT, MRI, and PET scanners to look inside out bodies.**	Stand-alone imaging centers bring these machines closer to the neighborhoods in which we live. Trucks even take this equipment into areas that cannot support a permanent center.	*Portable, affordable CT and MRI machines are in VAP clinics, operated by surgeons, and integrated into the patient process flow.*
Doctors intuited problems by listening through stethoscopes and feeling lumps.	**Ultrasound machines installed in radiology departments of hospitals enable radiologists to see soft tissues in motion.**	Smaller, cart-based ultrasound machines became available in many obstetric and cardiology practices.	Hand-held ultrasound devices are allowing doctors in intensive care units, emergency departments and primary care clinics to take a 'quick look" to help guide diagnoses.
Patients died of kidney failure.	**Patients with renal failure were hospitalized where they underwent dialysis on massive machines.**	Smaller, cart-based ultrasound machines became available in many obstetrics and cardiology practices.	Hand-held ultrasound devices are allowing doctors in intensive care units, emergency departments and primary care clinics to take a "quick look" to help guide diagnoses.
Doctors diagnosed diabetes by tasting whether patients' urine was sweet.	**Machines in hospital labs could measure the amount of glucose in a patient's blood. Nurses drew the blood; orderlies carried it to the lab, and technicians operated the machine.**	**Chemical reagent strips were developed for use in endocrinologists' office. Nurses drew the blood and compared the color on the strip against a template to estimate glucose levels.**	**Patients take portable meters—the size of pocket calculators—with them wherever they go. They prick their own fingers and apply a drop of blood onto a reagent strip.**
Surgical skill depended on dexterity, among other things. Patients often traveled long distances to find the best surgeon.	**Surgical robots enable surgeons to perform intricate, minimally invasive procedures with much better outcomes. Only the largest hospitals can typically afford these million-dollar robots.**	Remote surgery, in which surgeons control robots from a different site, allows patients to access some of the best surgeons closer to home.	Some surgical robots such as modern LASIK machines have become self-contained operating rooms.

Font indications: Normal fonts indicate the past. **Bold** fonts indicate today. *Italicized* fonts indicate the future.
Source: Christensen et al., 2009: 316.

Criticism of Disruptive Innovation Theory

The definition and scope of disruptive innovation have increasingly come under criticism for its vagueness and inconsistency (Yu & Hang, 2010). Christensen and colleagues (2009) contend that disruptive processes cause large well-managed firms to fail when smaller innovative business models introduce seemingly inferior technology into the marketplace and grab increasing segments of the market—eventuating in the displacement of the dominant technology by the inferior technology (Yu & Hang, 2010). Danneels (2004) highlights Christensen's lack of precision and consistency in his conceptualization of disruptive innovation. Telles (2006) argues that it is difficult to determine whether disruptive innovations were first underperforming or inferior performing technologies (Yu & Hang, 2010). Danneels (2004) and Tellis (2006) find problematic the retrospective nature of disruptive innovation. They contend that the disruptive innovation model was developed post hoc and question its predictive value. Conversely, Christensen maintains that although the model was formulated based on historical accounts of industry trends, "the definition of disruptiveness exists independent of the outcomes" (Yu & Hang, 2010: 6). While established firms frequently fail by reluctantly responding to the emergence of disruptive innovations, Christensen concedes that the collapse of such firms is not always the case (Yu & Hang, 2010). "Disruptive innovation does not always imply that the entrant business will completely replace the incumbent business and the winner will take all" (Yu & Hang, 2010: 6-7). Christensen and Bower (1996) contend that a limited number of established firms have managed to capitalize on disruptive innovations. Some business managers have successfully maneuvered the course of their firms in the face of disruptive processes without being dethroned by smaller new entrants (Christensen & Bower, 1996). These findings have led some to ask why most large incumbent firms fail but some do not (Yu & Hang, 2010).

A key feature of disruptive innovation theory is that disruptive products and services have a lower performance measure than established products and services. Because disruptive innovations usually perform worse on one or two dimensions that are highly important to existing customers of established businesses, they are considered as unattractive investments by traditional firms (Christensen et al., 2009; Yu & Hang, 2010). Nevertheless, disruptive products and services typically perform well on other important dimensions that are considered valued attributes to new customers in emerging markets (Christensen et al., 2009; Bower & Christensen, 1995). Govindarajan and Kopalle (2006) maintain that disruptive innovations are not only low-performing products and services, but also can be high-end innovations, such as cellular phones, which were high-priced when initially introduced during a time when land-lines were preferable because of cost, coverage, and reliability (Yu & Hang, 2010). Yu and Hang write in reference to high-end disruptive innovations: "Disruptive innovation (having inferior performance in traditional attributes) with a high price . . . is indeed a white space where Christensen's theory (inferior performance with low unit cost) has not set foot" (2010: 4).

In their work "Game Changing or Disruptive Innovation," Rapoport and associates (2011) provide an overview of Christensen's framework for disruptive innovation, and they present an informative review of literature on disruptive innovations in health care. The authors examine more than 100 articles from a broad range of health care service areas that are witnessing the affects of "game changing innovations," including primary care (Deloitte Center for Health Solutions, 2008; Rohrer et al., 2009; Deloitte Center for Health Solutions, 2009), diagnostic imaging (Hansen, E., & Bozic, K.J., 2009), hospital-based care (Satava, 2003; Burns et al., 2011; Girotto et al., 2010) and information technology (White, 2008; Ziegler, 2009;

Deloitte Center for Health Solutions, 2010; Goldstein & Rothstein, 2010; Shih et al., 2010). Yet, few of the articles reviewed offer quantitative analysis to support their claims.

Christensen identifies the innovation of LASIK eye surgery as an example of a disruptive technology. Invented in the 1960s, it took almost three decades for eye surgeons to gain confidence in the technology, and for the procedure to attain approval from the Food and Drug Administration. LASIK is now commonplace and "has rendered obsolete the products and services provided by lens manufacturers and opticians and, in some states, is now being performed by optometrists instead of ophthalmic surgeons" (Burns et al., 2011: 69).

Hansen and Bozic (2009), for example, discussed the impact of disruptive innovations in orthopedics in their piece on the shifting trends in imaging technologies. They explained how the field of musculoskeletal care is shifting away from traditional x-ray technology and toward mini-fluoroscan. This shift is altering the manner in which bone fraction care is being performed. Mini-fluoroscans, also known as mini-C-arms, are now producing high-quality, point-of-service, real-time images. Compared to traditional x-rays, these radiographs cost less, are simpler to use, and emit lower doses of radiation.

While disruptive innovation theory in health care is increasingly heralded as a way to lower costs, while improving both the quality and accessibility of care (Vijayaraghavan, 2011); the theory is relatively new. There is a limited but growing body of work on the topic. Yet, most disruptive innovation research lacks quantitative evidence to support its claims. There are numerous quantitative medical care studies focused on patient outcomes that compare different types of technology used to perform a procedure, such as open versus laparoscopy (Marzouk et al., 2003; Hutter et al., 2006; Jen & Shew, 2010; Talpur et al., 2011). Other quantitative studies have compared medical facility settings, such as specialty versus general hospital (Cram et al.,

2007; Cram et al., 2005). Yet, little research has examined the interplay in the utilization of surgical procedures among hospitals and ASCs. Bian and Morrisey (2007) conducted the first nationally represented study on the impact of ambulatory surgery centers on hospital surgical volume. Using data from the 2002 Medicare Online Survey Certification and Reporting System (OSCAR), and the 1993–2001 American Hospital Association (AHA) Annual Surveys of Hospitals, the authors found that, "on average, one additional ASC per 100,000 population in a metropolitan area was associated with 4.3% fewer hospital outpatient surgeries each year. ASCs had essentially no effect on hospital inpatient procedures" (Bian & Morrisey, 2007: 206). Bian and Morrisey's work supports prior studies that find ASCs to be significant players in the hospital industry and demonstrates the need for more nationally generalizable research on ASCs and hospitals, as well as the impact of ASCs on local hospital markets.

Few studies have highlighted the impact of disruptive innovations in health care and their accompanying shifts in the medical industry. This study aims to test Clayton M. Christensen's theory of disruptive innovation in health care by examining industry trends and associations in relation to innovative technology and innovative business models. The objective of the research is to test the claims of disruptive innovation theory in the hospital industry by examining the impact of combining laparoscopy and ambulatory surgery centers on surgical utilization (Hwang & Christensen 2008).

Innovative Technology: Laparoscopy

Advances in medical technology have altered the need for certain types of surgery to be performed in traditional hospital settings. Less invasive surgical procedures have allowed a growing number of medical treatments to take place in ambulatory surgery centers (ASCs). In the medical field, new surgical techniques and innovative technologies are emerging so rapidly

their impacts are being felt throughout the industry. Surgeons are developing new surgical techniques based on their experience, resources, knowledge, and experimentation. While new technologies typically spawn from new practices and techniques within a surgical field, others originate from outside of the surgical field and are later adopted by surgeons based on need and demand for progress. Innovative technologies create new surgical treatments for a variety of diseases and a broader range of patients (Mattioli, 1994).

Research highlights the industry-transforming effects of computer tomography (CT) scanners, magnetic resonance imaging (MRI), arthroscopic and laparoscopic surgical technologies (Baker & Atlas, 2004; Lubitz, 2005), and other innovative technologies, as well as their roles in preserving and restoring health (Thorpe, 2005; Lubitz, 2005; Goldman et al., 2005). Many of these medical advances have contributed to major technological breakthroughs in modern surgery since the 1950s. Disruptive innovations in medical technology, such endoscopy, laparoscopy, surgical robotics, and other computer-assisted surgical instruments, have fostered new concepts about how operating rooms should be constructed and organized (Satava, 2003), led to modifications in the hierarchical organization of surgical departments (Girotto et al., 2010), and altered the manner in which surgery is performed (Ballantyne et al., 1994; Steichen & Welter, 1994; Hunter & Sackier, 1993; Clancy & Brooks, 2004; Palanivelu, 2008; Katkhouda, 2010).

Laparoscopy is a minimally invasive surgical technique that uses computerized video monitors and small incisions to access the abdominal cavity to diagnose and treat a variety of stomach conditions (Soltesz & Brooks, 2004; Katkhouda, 2010). Compared to traditional open surgical procedures, which are performed with large instruments and incisions and more blood loss (Hunter & Sackier, 1993), laparoscopic surgical technology has grown in popularity in the

past 30 years (Soltesz & Brooks, 2004). Dr. Semm performed the first laparoscopic appendectomy in 1983. In 1987, French surgeon Mouret performed the first recorded laparoscopic cholecystectomy. Surgeons in the United States began performing the procedure the following year (McKernan, 1994; Soltesz & Brooks, 2004).

The demand for laparoscopy is fueled in part by the public's increasing demand for minimally invasive surgical procedures and general surgeons' interests in new techniques and innovative technologies (Soltesz & Brooks, 2004). The dissemination of laparoscopic procedures among surgeons has varied over time. Miller and colleagues (2006) analyzed the diffusion patterns of different laparoscopic procedures from the time of their introduction to the medical field. Using data from the Nationwide Inpatient Sample (NIS), Miller and associates compared laparoscopic cholecystectomies, fundoplications, hysterectomies, and nephrectomies over the period from 1989-2003. Laparoscopic cholecystectomy was introduced in 1989 and diffused very rapidly. Laparoscopic hysterectomies and fundoplications disseminated less rapidly than cholecystectomies. Laparoscopic nephrectomies experienced the slowest rate of diffusion (Miller et al., 2006). Diffusion patterns for innovative medical technologies are dynamic in nature, and they vary based on environmental conditions (Renshaw et al., 1990; Oh et al., 2005). The diffusion of innovative technology is influenced by a number of factors including the financial profitability of investment and technological preeminence (Teplensky et al, 1995; Russell, 1977), clinical excellence (Teplensky et al., 1995), the availability of information on and familiarity with the technology, and the cost of the investment (Russell, 1977), as well as regulation and third party payment systems (Russell, 1979; Renshaw et al., 1990).

The Competitive Environment of the Hospital Industry

Economic and Health Service Utilization Trends

The hospital industry is becoming more competitive and complex: existing hospitals and care facilities, new market entrants, substitute treatments and procedures, shifts in the locus of care, and more. Many question how well the hospital industry is functioning since costs remain high; care—in many cases—is poor; medical errors continue to rise; and inexplicable variations in costs, utilization, and quality of service delivery exist across geographical regions (Porter & Teisberg, 2004). Competition in the hospital industry should improve efficiency and quality, and expand markets. Well-managed medical facilities should prosper, and inefficient facilities should improve or be driven out of the marketplace (Porter & Teisberg, 2006). Yet, write Berenson and colleagues: "Contrary to mainstream economic theory, hospitals in more competitive environments had higher costs per case and per day than those in less competitive environments, when other factors were controlled" (2006: w338). The fact that costs remain high, and low performing health care organizations continue to operate, serves to buttress claims of market failure in the hospital industry (Rutkow, 1989b).

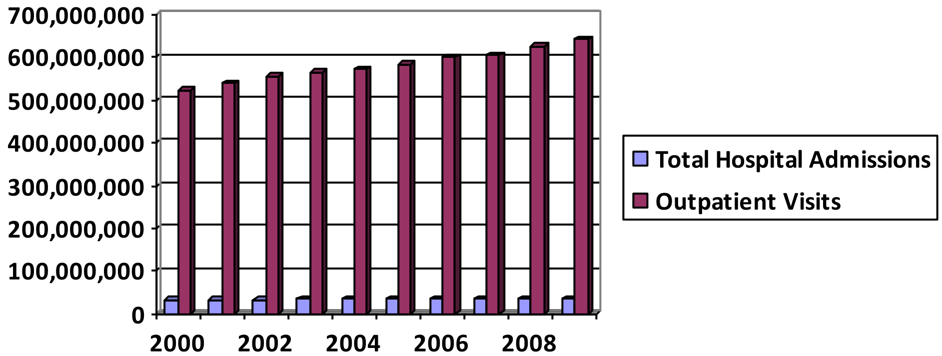
In 2009, national health care expenditures stood at $2,486 billion with hospital care accounting for $759 billion or roughly 30.5%, a figure that has remained steady since 2000 and is expected to remain the same over this next decade. Labor cost is a major component of national health care expenditures. Between 2002 and 2009, labor costs (i.e., physicians, nurses, technicians, and other health care personnel salaries and benefits) grew between 5% and 8%, consuming more than half of total hospital expenses. Non-labor costs, such as expenditures on pharmaceuticals, professional fees, plant and capital expenditures, and technology also continue to grow (Guerin-Calvert & Israilevich, 2011). Health care expenditures that include hospital and

physician services, home healthcare, and pharmaceuticals are expected to rise at a steady rate of 6.7 percent well into the future, outpacing GDP growth by an average of 1.9 percentage points. Total health care spending rose from 16% of the country's GDP in 2007 to roughly 17.3% in 2009. The Congressional Budget Office projects a jump in health care costs to 25% of GDP by 2025 (Wennberg et al., 2008; Guerin-Calvert & Israilevich, 2011).

After rising through the 1970s, the total hospitalization rate[6] steadily declined between 1980 and 1995, and the rate leveled off during the period from 1995 through 2007 (Hall et al., 2010). While inpatient hospital admissions rose by 7% between 2000 and 2009; since 2004, the number of inpatient admissions has flattened as more medical services have moved to outpatient settings (Guerin-Calvert & Israilevich, 2011). (*See Figure 2*: Hospital Admission Trends, 2000-2009.) Between 2000 and 2009, however, outpatient visits for all U.S. hospitals rose 23% (Guerin-Calvert & Israilevich, 2011). (*See Table 5*: Hospital Admissions Trends, 2000-2009.) Hospital outpatient visits may take place in a hospital's outpatient department, or in an emergency room, where diagnostic and other services that help physicians treat patients are provided (Schappert & Burt, 2006; MedPAC, 2012; CMS, 2012). A person who is classified as a hospital outpatient is registered with the hospital to receive a procedure or service during the day, but the patient is not expected to need overnight accommodations (CMS, 2012; MedPAC, 2012). The increase in outpatient visits is driven in part by a rise in high-deductible health insurance policies with large out-of-pocket payments for non-catastrophic services (Berliner, 2008). Other factors that have driven patients to less expensive modes of outpatient health care services are advances in anesthesia and medical technology, and the rising number of private payers (Berliner, 2008).

[6] Rates calculated using U.S. Census Bureau estimates of the civilian population (Hall et al., 2010).

Figure 2: Hospital Admission Trends, 2000 - 2009



Source: Analysis of AHA Annual Survey data for community hospitals.

Table 5: Hospital Admissions Trends, 2000 – 2009

Year	Total Hospital Admissions	Medicare Admissions	Medicare Admissions as % of Total Admissions	Medicaid Admissions	Medicaid Admissions as % of Total	Outpatient Visits
2000	33,089,467	13,567,553	41.00%	5,210,907	15.70%	521,404,976
2001	33,813,589	13,884,333	41.10%	5,462,091	16.20%	538,480,378
2002	34,478,280	14,197,195	41.20%	5,903,648	17.10%	556,404,212
2003	34,782,742	14,163,774	40.70%	6,121,649	17.60%	563,186,046
2004	35,086,061	14,498,549	41.30%	6,321,973	18.00%	571,569,334
2005	35,238,673	14,769,486	41.90%	6,475,521	18.40%	584,428,736
2006	35,377,659	14,716,159	41.60%	6,590,939	18.60%	599,553,025
2007	35,345,986	14,689,388	41.60%	6,693,701	18.90%	603,300,374
2008	35,760,750	14,912,904	41.70%	6,870,817	19.20%	624,098,296
2009	35,527,377	14,964,804	42.10%	7,074,220	19.90%	641,953,442

Source: Guerin-Calvert & Israilevich, 2011; Source: Analysis of AHA Annual Survey data for community hospitals.

Hospital administrators and public policy decision-makers are increasingly concerned about the rising share that Medicare and Medicaid admissions comprises of total inpatient hospital admissions. Between 2000 and 2009, Medicaid admissions grew from 5,210,907 to 7,074,220—a jump of 36%. The growth represents a shift from 15.7% to 19.9% in Medicaid admissions as a percent of total inpatient admissions for the same period. In 2000, there were 13,567,553 Medicare admissions. By 2009, the number stood at 14,964,804—a 10% leap. Medicare admissions shifted from 41% to 42.1% of total inpatient admissions. By 2009,

Medicaid and Medicare combined stood at more than 60% of inpatient hospital admissions (Guerin-Calvert & Israilevich, 2011). A particular concern for hospital administrators and public policy decision-makers is that government reimbursements fail to cover the full costs of caring for Medicare and Medicaid recipients; payment shortfalls place additional pressures on hospital finances. In their newly released report, *Assessment of Cost Trends and Price Differences for U. S. Hospitals,* Margaret Guerin-Calvert and Guillermo Israilevich, state: "The AHA [American Hospital Association] estimates that Medicare payment-to-cost ratios fell from 99.1% in 2000 to 90.1% in 2009. Similarly, Medicaid payment-to-cost ratios fell from 94.5% in 2000 to 89.0% in 2009" (2011: 11). Findings from AHA data also revealed that uncompensated care costs stood at about 6% of total hospital expenses in 2009 (Guerin-Calvert & Israilevich, 2011).

As hospitals face growing financial pressures, they seek strategies to help maintain financial viability that include absorbing the costs of Medicare/Medicaid shortfalls and uncompensated care, or they look to offset these costs with other revenue streams, such as those from more profitable patients who self-pay or hold private insurance (Choudhry et al., 2005; Shactman, 2005). However, as increasing numbers of patients seek medical care in outpatient venues, covering inpatient payment shortfalls have become more difficult (Hadley et al., 1996; Evans, 2012; Nissley, 2012).

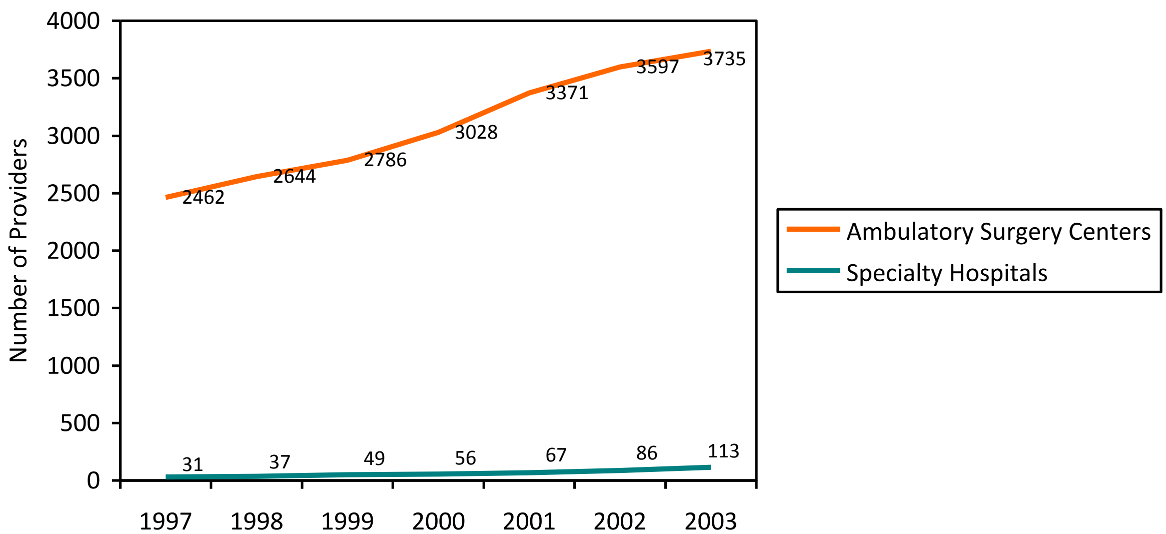
Growth in Specialty Medical Facilities

Hospitals face competition from new types of inpatient and outpatient specialty service providers, such as specialty hospitals and ambulatory surgery centers (ASCs) (Bian & Morrisey, 2007). The rapid growth of ASCs and specialty hospitals (*See Figure 3*: Increases in the Number of Ambulatory Surgery Centers and Specialty Hospitals from 1997 to 2003) is the result of a number of factors, including market forces, technological advances, physician autonomy, and

public policy (Casalino et al., 2003). Both types of medical facilities threaten the financial viability of general hospitals.

ASCs and specialty hospitals represent an increasingly popular organizational form that is less bureaucratic. As hospitals have become more bureaucratically-structured and administratively-directed, a growing number of physicians are turning away from traditional hospital settings and choosing to practice in smaller, less complex organizational forms. Many of these physicians are leaving hospital settings to join or establish ASCs and specialty hospitals in search of more autonomy, greater authority, and more personal responsibility over their work and its consequences (Starr, 1982; Freidson, 1989).

Figure 3: Increases in the Number of Ambulatory Surgery Centers and Specialty Hospitals from 1997 to 2003



Source: Iglehart, J. (2005). The emergence of physician-owned specialty hospitals, *The New England Journal of Medicine*, 352(1), 78-84.

The 2008 SDI Outpatient Surgery Center Market Report highlights similar trends when comparing the total number of hospitals to the number of ASCs (Becker's ASC Review, 2008a). Between 2002 and 2008, the total number of hospitals in the U.S. rose from 6,794 to 6,957, representing a 2.4% increase. During this same timeframe, ASCs jumped from 3,570 to 5,876

facilities, a 64.6% rise. In 2002, the number of ASCs stood at just over 50% of the number of hospitals. By 2008, the number of ASCs was close to 85% of the number of hospitals. (*See Table 6*: Total Number of Hospitals and Ambulatory Surgery Centers, 2002 - 2008.)

Table 6: Total Number of Hospitals and Ambulatory Surgery Centers, 2002 – 2008

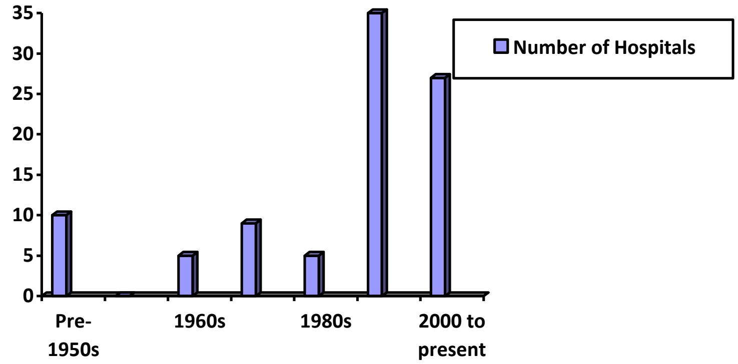
Year	Total Hospitals	Total ASCs	Difference between Number of Hospitals and ASCs	ASCs as a % of Hospitals
2002	6,794	3,570	3,224	52.5%
2003	6,823	3,605	3,218	52.8%
2004	6,864	3,987	2,877	58.1%
2005	6,898	4,946	1,952	71.7%
2006	6,945	5,349	1,596	77.0%
2007	6,968	5,673	1,295	81.4%
2008	6,957	5,876	1,081	84.5%
Percent Change	2.4%	64.6%	-66.5%	

Source: Becker's ASC Review (2008a). http://www.beckersasc.com/news-analysis/trending-growth-of-hospitals-and-surgery-centers-over-last-seven-years.html

The specialty hospital, however, is not a new organizational form. In the United States, psychiatric hospitals are the earliest known specialty hospitals that provided inpatient services focused on a specific patient population and offered a limited number of medical procedures. By the late 1800s, there were approximately 178 hospitals devoted to caring for the mentally ill (Stevens, 1971). Since the 1960s, however, a different type of specialty medical facility entered the hospital industry. These specialty hospitals are defined as "short-term acute care hospitals that treat primarily a limited number of diagnoses or perform a select number of procedures" (U.S. GAO, 2003). Instead of complementing the services of general hospitals, the more modern version of specialty hospitals was established to pull patients and revenue away from general hospitals (Choudhry et al., 2005). By 2002, there were roughly 100 physician-owned specialty hospitals in the U.S. (*See Figure 4*: Opening Years of Existing Specialty Hospitals, by Decade), which represented about 2% of the short-term acute care hospitals nationally (U.S. GAO, 2003).

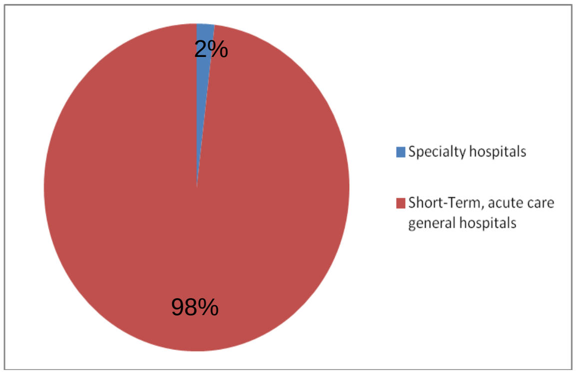
(*See Figure 5*: Number of Specialty Hospitals Relative to All Short-Term, Acute Care General Hospitals.) While this percentage is small, the number of specialty hospitals had tripled since 1990. Specialty hospitals are concentrated in 28 states, with over half (60%) located in seven: Arizona, California, Kansas, Louisiana, Oklahoma, South Dakota, and Texas (Iglehart, 2005; Sagness, 2007). Most specialty hospitals are for-profit entities, and they are located in rapidly growing urban areas where public policies are conducive for their development.

Figure 4: Opening Years of Existing Specialty Hospitals, by Decade



Source: U.S. General Accounting Office, Specialty Hospitals (GAO-03-683R), April 18, 2003.

Figure 5: Number of Specialty Hospitals Relative to All Short-Term, Acute Care General Hospitals



Source: U.S. General Accounting Office, Specialty Hospitals (GAO-03-683R), April 18, 2003.

Many critics of specialty hospitals maintain that they benefit from unfair financial advantages (Choudhry et al., 2005; Mitchell, 2005; Heard, 2005; U.S. GAO, 2003). In addition to being concentrated geographically in states where policies are supportive of their expansion,

they typically diagnose or treat one or two diseases or conditions, or perform particular types of surgery. In many ways, specialty hospitals pose a greater threat to acute care general hospitals than ASCs because specialty hospitals provide highly-profitable inpatient care and focus on profitable service lines or diagnosis-related groups (DRGs), such as cardiology, cancer, orthopedics, and select types of surgery (Hackbarth, 2005; Shactman, 2005). Critics contend that the strategies of specialty hospitals are causing increasing financial challenges for general hospitals. The siphoning off of the most profitable services by specialty hospitals compromises the financial stability of acute care general hospitals—leaving them less able to absorb the costs of Medicare/Medicaid shortfalls and uncompensated care, and to offset the costs of low payment departments such as psychiatric or emergency. Critics also argue that specialty hospitals tend to treat patients who are less ill, leaving sicker patients to seek care in general hospitals. (Guerin-Calvert & Israilevich, 2011).

The Ambulatory Surgery Center Association (ASCA) defines ASCs as hospital-affiliated or free-standing health care facilities that provide "a more convenient alternative to hospital-based outpatient procedures focused on providing same-day surgical care, including diagnostic and preventive procedures" (ASCA, http://www.ascassociation.org/ASCA/AboutUs/WhatisanASC/). Like specialty hospitals, ASCs were originally created to draw patients and revenue away from hospital inpatient units. Over time, the competitive dynamics brought shifts to the hospital industry as more hospitals have developed and expanded outpatient surgery departments, ASCs no longer compete only with inpatient units. ASCs now compete directly with hospitals for outpatient business (Casalino et al., 2003).

The nation has witnessed dramatic growth in the number of outpatient surgical centers, which may include hospital/physician-owned free-standing joint-ventures, corporate/physician-owned free-standing joint-ventures, and physician only-owned free-standing ASCs. Like hospital outpatient departments, ASCs offer surgical and nonsurgical procedures that do not require an overnight stay in the hospital (O'Donovan, 1976: New Jersey Commission on Rationalizing Health Care Resources, 2008). Like specialty hospitals, ASCs are entering the health care market at increasing numbers. The number of ASCs is much higher than those of specialty hospitals, and they are growing more rapidly than specialty hospitals because they are less complex to establish, less capital-intensive, and are subject to fewer government regulations (Casalino et al., 2003; Choudhry et al., 2005). Most ASCs are small medical facilities with just two to four operating rooms that focus on a particular kind of surgery. During the period from 2000 to 2007, the number of Medicare-certified ASCs increased 64%, rising to 4,964 ambulatory surgical facilities, essentially equaling the number of hospital-owned outpatient surgery departments with which they competed (Casalino et al., 2003). By the early 1990s, outpatient surgical procedures outpaced inpatient procedures. Between 1991 and 2001, the number of ASCs doubled (Shactman, 2005), while over roughly the same period (1996 to 2006), the number of outpatient visits to free-standing ASCs tripled (Sorrel, 2009).

The amount that Medicare spent on ASC services more than doubled between 2000 and 2007 (*See Appendix A*: Number of Medicare-certified Ambulatory Surgery Centers, 2000-2007). In 2006, it was estimated that during 34.7 million ambulatory visits, roughly 53.3 million ambulatory surgical procedures were performed: 19.9 million visits were hospital-based facilities, and 14.9 million in free-standing ASCs. The figure for free-standing ambulatory surgery center visits represents a roughly 300 percent increase over the 10-year period between

1996 and 2006 (Cullen et al., 2009), and by 2009, there were approximately 5,000 free-standing ASCs in the U.S. (Sorrel, 2009). Forty-five percent of outpatient surgical procedures (24 million) were performed in facilities in the southern region of the U.S., compared to 12.6 million (24%) in the Midwest, 8.7 million (16.3%) in the West, and 8 million (15%) surgical procedures in the Northeast (Cullen et al., 2009).

Over the past several decades, rapidly changing technological advances in surgical procedures, along with improvements in anesthesia, have accelerated the transition from inpatient hospital to outpatient surgical procedures. ASCs represent an increasingly popular health care setting option, reflecting greater demand for lower cost surgery (Scott et al., 2000). Ophthalmological procedures, such as cataract removal and lens insertion, are commonly performed on an outpatient basis; as well as gastroenterology procedures, such as colonoscopy and upper gastrointestinal endoscopy (Casalino et al., 2003; Choudhry et al., 2005). Other common ASC procedures focus on the digestive and musculoskeletal systems, the eye, integumentary system (skin, hair, nails), ear, nose, mouth, and pharynx; as well as the nervous and cardiovascular systems, and male and female genital organs (Cullen et al., 2009; Russo et al., 2007). Recent technological advances have influences greatly the transition of several surgical procedures from inpatient to outpatient settings, and from open to minimally invasive surgical procedures. This pattern has been most common in the removal of the appendix (appendectomy), the removal of the gallbladder (cholecystectomy), repair of the abdominal wall (hernia repair), and the surgical treatment for obesity (bariatric surgery) (Russo et al., 2007). Rising demand for these procedures reflect demand for minimally invasive surgical options that are offered at lower costs with faster recovery periods, without an overnight's stay (Scott et al., 2000).

For the past fifty years, the number of medical procedures that can be performed in ASCs and specialty hospitals has continued to grow. Physicians are able to offer new services and procedures to an ever-expanding patient population in a wider variety of settings. Growth in the number of ASCs and specialty hospitals reflects the benefits of increased specialization and standardization (Scott et al., 2000; Stevens, 2006). Yet, the hospital industry has become a critical battleground over the impact of specialty facilities on general hospitals. Advocates for ASCs and specialty hospitals contend that, as hospital costs continue to rise, these facilities are able to concentrate on profitable service lines and procedures to offer high quality medical services at lower costs than general hospitals. Proponents also argue that patients indicate high levels of satisfaction with service quality, ease of scheduling and personal attention (Ambulatory Surgery Center Association).

Critics assert that the movement of highly profitable services and well-insured patients away from general hospitals comes at a cost—the weakened financial solvency of general hospitals. These opponents maintain that as the number of specialty facilities rises and the volume of procedures performed in full-service setting declines, the ability of general hospitals to cross-subsidize and provide quality care is threatened (Choudhry et al., 2005; Berliner, 2008). They argue that income from privately insured patients helps offset costs related to underinsured patients and uncompensated care; and profits from well-compensated services help cover the costs associated with those that are less profitable (Choudhry et al., 2005). Unlike general hospitals, ASCs and specialty hospitals are not required to provide unprofitable departments and are not obligated to cover the costs of uncompensated care which helps lower costs (Berenson et al., 2006; Sagness, 2007). Positions such as these inform public policy decision-making that

determines whether markets or regulations are most efficient in reforming the U.S. health care industry (Choudhry et al., 2005).

Conclusion

The literature review discusses the origins of disruptive innovation theory, and highlights its applications in general, as well as in the health care industry. Some criticisms of disruptive innovation theory were discussed, particularly its vagueness and lack of precision. Laparoscopy is presented as a disruptive innovation that has changed the way some surgeries are performed. The literature review illustrated how laparoscopic procedures have influenced organizational dynamics in the hospital industry, allowing an increasing number of procedures to be performed on an outpatient basis. The literature review then shifted the discussion to the competitive environment of the U.S. hospital industry. Rising health care expenditures, shifting hospital admissions rates, and the dynamic trends among the number of traditional medical facilities and new entrants in the hospital industry were featured.

In the 1980s, writes Rosemary A. Stevens:

> The stage was set for major transformations of hospitals . . . , including the rapid development of outpatient surgery, reduced inpatient utilization across the board, controls on individual admissions, and a major restructuring of the incentives built into inpatient reimbursement (via prospective reimbursement schemes) (1989: 309).

Over the past 30 years, the health care industry in the United States has become increasingly complex. While still the dominant economic institutions in the health care industry, hospitals—once isolated from many competitive forces—have become more exposed to competition (Coddington et al., 1985; McFarland, 1987). Deregulation, new market entrants, new payment schemes and systems, and technological advances have led to growing pressures for hospitals to reduce costs and the length of hospital stays, enhance quality, improve access, and boost efficiency of health care service delivery. These and other pressures have coalesced to alter the

dynamics of the health care industry. This work draws upon disruptive innovation theory as a framework to help shed light on shifts that are occurring within the hospital industry.

CHAPTER 3 – THEORETICAL FRAMEWORK AND CONCEPTUAL MODEL

The purpose of this study is to test Clayton M. Christensen's theory of disruptive innovation in health care. Disruptive innovation theory contends that the combination of advanced technology and innovative business models will yield simplified, quality products and services at lower costs to a wider market. New markets emerge as new organizational forms adopt and utilize innovative technology. Conventional industry leaders often experience a loss of market share or fail when "non-traditional" new entrants enter into the marketplace. The research analyzes the interplay between different types of organizations (i.e., medical facilities) in the provision of abdominal surgery. Population ecology theory is employed to provide an organization theory lens through which disruptive innovation theory is examined. Three central lines of inquiry in population ecology theory (i.e., structural inertia theory, the liability of smallness, and niche width theory) will be utilized as tools for understanding organizational change in the health care industry. In the post-prospective payment system (PPS) era, few studies have made use of disruptive innovation theory at the system level to analyzed medical technology shifts and organizational changes in the hospital industry (Fennell & Alexander, 1993). In summary, the work integrates disruptive innovation theory with population ecology in the study of the hospital industry, and it investigates medical technology shifts and organizational change at the system level rather than from a single hospital, multi-hospital system, or a diversified health system perspective (Fennell & Alexander, 1993). Prior to discussing and illustrating the conceptual model, the theoretical backdrop for this work is presented.

Theoretical Backdrop: System-Level Analysis & Open System Perspective

System-Level Analysis

A key element in this study is the examination of interplay between hospitals and ambulatory surgery centers. Hospitals compete among themselves and with outpatient medical facilities for patients, physicians, and medical staff in local markets, as well as at the regional and national levels. These medical facilities operate in the hospital industry, also known as an organizational field (Fennell & Alexander, 1993; DiMaggio & Powell, 2004). DiMaggio and Powell describe organizational fields as "those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resources and product consumers, regulatory agencies, and other organizations that produce similar services or products" (2004: 113). Organizational fields include vertical relationships, such as those between headquarters or governing bodies and local or regional operations; and horizontal relationships between individual organizations and their exchange partners and competitors. Organizational fields also include organizational populations, aggregates of organizations that display like structures and provide similar or related services (Scott et al., 2000). In his 1994 work, "Conceptualizing Organizational Fields: Linking Organizations and Societal Systems," Scott explains that the "boundaries of fields connotes the existence of a community of organizations that partake of a common meaning system and whose participants interact more frequently and fatefully with one another than with actors outside the field" (Scott et al., 2000: 13).

The construct of an organizational field is based on the *connectedness* between and *structural equivalence* among institutions (DiMaggio & Powell, 2004). The process of defining an organizational field—and the institutions within the field—begins with an examination of the activities of a diverse set of organizations, followed by determining whether or not

homogenization is present among organizational forms (DiMaggio & Powell, 2004). This process is known as ‘structuration,’ which is comprised of recognizing four organizational dynamics: (1) increasing amounts of interaction among organizations in the field; (2) emerging sharply defined interorganizational structures of domination and patterns of coalition; (3) increasing amounts of information with which organizations in a field must contend; (4) and developing mutual awareness among participants in a set of organizations that they are involved in a common enterprise (DiMaggio & Powell, 2004).

Open System Perspective

This study uses an open system approach to organizational analysis. Open systems are shaped by, and dependent on, endogenous and external environmental factors. Conversely, closed systems are understood to be self-contained, self-sustained entities that are “sealed off from their environments” (Scott, 2003: 28). The open system perspective provides a systematic approach for examining sets of organizations in organizational fields, which allows for the analysis of input and output resource flows between organizations and their environments, and the assessment of environmental impacts on the transformation of organizations. The open system perspective characterizes organizations and systems by their connectedness and interdependency, and emphasizes the bidirectionality of exchange across intraorganizational and interorganizational linkages. Ideas, values, norms, rules, and culture, as well as personnel, financial, equipment, and information are just a few of the resources that are exchanged (Scott, 2003). Pfeffer and Salancik (2003) explain that the essential premise of open systems theory is that “‘organizational activities and outcomes are accounted for and by the context in which the organization is embedded’” (Tian, 2006; See also: Granovetter, 1985). The open systems perspective emphasizes an organization’s interdependence, while it is embedded in an

environmental context. Tian writes: "The environment is perceived to be the ultimate source of materials, energy, and information, all of which are critical to the survival of organizations" (2006: 48).

Both endogenous and exogenous forces within technical and institutional environments are influencing the hospital industry (*See Table 7*: Forces and Environmental Factors Influencing Hospital Industry). Government regulations are important coercive aspects of the institutional environment of hospitals and other medical care facilities (DiMaggio & Powell, 2004; Hannan & Freeman, 1988). The prospective payment system (PPS) for Medicare reimbursement launched in 1983 stands out as the most significant regulatory change within the hospital industry in the last 25 years. The PPS radically altered that manner in which the federal government pays hospitals for Medicare services. The payment structure shifted from cost-based to prospective payments that were predetermined at a specified rate for each discharge. This structure gave hospitals incentives to provide care below the established rates (Fennel & Alexander, 1993: 103). Zajac and Shortell (1989) equate the implementation of PPS to "an environmental jolt or shift for the entire hospital industry" (Fennell & Alexander, 1993: 103). With PPS, the evolution of the federal government as a financer and regulator of hospital services continued. Scott and Lammers (1985) assert that "the federal government's role has shifted from that of the builder of hospitals in the post-war period, to the purchaser of services through the 1950s and 1960s, to the regulator and catalyst of cost containment in the 1980s and onward" (Fennell & Alexander, 1993: 103). PPS altered the traditionally stable environment in which the hospital industry had operated. PPS played a role in the reduction of inpatient Medicare expenditures by offering cost incentives for increased use of technological treatments and diversification into ambulatory services (Fennell & Alexander, 103). PPS offers one example of how the hospital industry has

become increasingly vulnerable to exogenous influences in technical and institutional environments.

Table 7: Forces and Environmental Factors Influencing Hospital Industry

Environments Forces	**Technical**	**Institutional**
Endogenous	Physicians (norms, values - collegial relations) Medical and Health Care Characteristics (labor characteristics and cost factors) Medical Care Organizational Structure (department, service, and product options) Technology (nature and cost factors)	Medical Education System Physicians (professional associations) Medical Profession Policies, Practices, Principles (licensing, certification)
Exogenous	Technology Diffusion Market shifts (segmentation – generalists and specialists) Demographic Change (i.e., aging population, disease prevalence)	Regulation (i.e., utilization review, reimbursement - PPS, competition - CON) Legal Structures

Several organizational theories are compatible with the open systems perspective. These theories view institutions as persistent structures in the midst of environmental change. In addition to population ecology theory (Hannan & Freeman, 1977; Aldrich, 1999; Scott, 2003), institutional theory (DiMaggio & Powell, 2004; Scott & Davis, 2007), resource dependency theory (Pfeffer & Salancik, 2003), and network theory (Nohria & Gulati, 1994; Uzzi, 1997; Scott & Davis, 2007) also are compatible with the open system perspective. All of these theories offer different lenses through which organizations can be analyzed and understood. They provide a set of tools to understand how organizations respond and interact in competitive environments, and how environment factors change organizations and influence their performance.

The following section of the chapter formulates a theoretical model based on Clayton M. Christensen's theory of disruptive innovation.

Disruptive Innovation Theory

The purpose of the study is to test Clayton M. Christensen's theory of disruptive innovation in the hospital industry. Disruptive innovation theory contends that advanced technology combined with an innovative business model, located outside of traditional product markets or delivery systems will produce simplified, quality products and services at lower costs with broader accessibility. Consequently, shifts will occur in the industry and new markets will emerge, and conventional industry leaders will experience a loss of market share to "non-traditional" new entrants into the marketplace. Compared to the conventional industry leaders, Christensen maintains that non-traditional new market entrants tend to be smaller, more innovative organizations that specialize in niche areas not capitalized on by industry leaders.

The underlying assumption of this work is that laparoscopy (an innovative technology) and ASCs (an innovative business model) have combined to generate a disruptive transformation within the hospital industry. The transformation has caused shifts from open to laparoscopic surgical procedures, from inpatient to ambulatory surgical settings, and from hospitals to ASCs. This research assumes that the combination of laparoscopy and ASCs has altered the need for certain types of surgery to be performed in traditional hospital settings. The work hypothesizes that: (1) surgical utilization varies by the medical facility type; (2) the number of ASCs providing laparoscopic surgery is increasing; and (3) ASCs will experience larger increases in surgical utilization than acute care general hospitals (ACGH).

Development of Conceptual Model

This work examines the merging of two essential components of Christensen's theory of disruptive innovation: (1) simplifying technology and (2) an innovative business model (Christensen et al., 2009). Regulations and industry standards are discussed as environmental

factors in this work. They are not, however, central elements of the conceptual model or the analysis. Economically coherent value networks are recognized as elements of disruptive innovation theory, nevertheless, they not a focus of this research. Christensen highlights technological advances as the most industry-transforming element in his theory. The innovative business model is an organizational entity that is profit-oriented, process-driven, resource-dependent, product-focused, and technology-enabling. Only products or services with "value propositions that fit existing resources, processes, and profit formula of the organization can be successfully taken to market" (Hwang & Christensen, 2008: 1332). Hwang and Christensen highlight that in "health care, most technological enablers have failed to bring about lower costs, higher quality, and greater accessibility" (2008: 1332). The primary reason for this failure, according to Hwang and Christensen, is a weak business model innovation.

Theoretical Framework: Population Ecology[7]

Population Ecology Theory

Population ecology theory is a prominent organization theory that understands organizational change through the process of selection (Scott et al., 2000). Until the mid-1970s, many management and organizational theorists viewed organizations as undergoing adaptive change (Baum & Shipilov, 2004). Organizational change through *adaptation* occurs when established organizations do new things, or they do old things in new ways. Hospitals adapt to changing environments by adding services, merging with other hospitals and medical organizations, or joining health care systems. Adaptation also happens when hospitals equip outpatient surgical departments with new equipment and technologies, and offer new types of surgical procedures. As the environment changes, the features and structure of organizations with adaptive natures also are altered, as they are realigned by leaders and dominant coalitions

[7] Population ecology and organizational ecology are used interchangeably.

in the organizations to fit environmental demands (Hannan & Freeman, 1977; also see Baum & Shipilov, 2004; Lawrence & Lorsh, 1976; Pfeffer & Salancik, 1978; Porter, 1980). Institutional theory (Alexander & D'Aunno, 1990, 2003; DiMaggio & Powell, 2004; DiMaggio & Walter, 2004; Scott & Davis, 2007), resource dependency theory (Pfeffer & Salancik, 1978; Burt, 1983), network theory (Nohria & Gulati, 1994; Uzzi, 1997; Scott & Davis, 2007), and strategic management theory (Chandler, 1962; Miles & Snow, 1978) emphasize adaptive change in organizations.

In the mid-1970s, organizational theorists began looking at organizational change from a different perspective. While still interested in the effects of the environment on organizational structure, population ecologists offered a different approach to studying organizational change: environmental selection processes (Aldrich & Pfeffer 1976; Hannan & Freeman 1977; Aldrich 1979; Baum & Shipilov, 2004). Organizational change that occurs through *selection* happens when existing organizations fail, or are “selected out”, such as when independent community hospitals are replaced by the emergence of multihospital systems. The selecting out process is also evident with the decline in the number of general hospitals and rise in the number of specialty medical facilities (Kaluzny et al., 1987; Scott et al., 2000). The growth in the number of free-standing ambulatory care facilities, on the other hand, is an example of organizations “resisting selection” (Kaluzny et al., 1987).

Theoretical strands from biology, economics, and sociology inform population ecology, which emphasizes the roles of exogenous forces (i.e., demographic, technological, ecological and environmental processes) in organizational birth, change, death (Baum & Amburgey, 2002). The theory emphasizes the study of diverse organizational populations, consisting of organizations that share a general form. Organizational forms are adapting over time, while simultaneously undergoing a process of selection whereby they emerge, transform, or die at varying rates (Scott

& Davis, 2007). During the process of selection, a multitude of diverse organizational forms are embedded (Granovetter, 1985) in a confluence of environmental forces while utilizing macro-structural influences to shape simultaneously their environments (Nohria & Gulati, 1994). Variation, selection, retention, and competition are basic processes that contribute to changes in organizational populations (Baum & Amburgey, 2002; Baum & Shipilov, 2004). Variation occurs, for example, when the pace of environmental change is so rapid or uncertain that organizations cannot change fast enough to meet environmental demands, and humans attempt to adjust an organization's relationship to the environment through technical competencies, management expertise, and other administrative skills (Baum & Shipilov, 2004).

The population ecology view holds that organizational change is an outcome of "environmental selection processes that are outside of the control of any individual organization" (Fennell & Alexander, 1993). Organizations might "resist selection" and survive because they 'fit' best the demands of the environment at a given time, or they might be selected out when there is a lack of fit (Hannan & Freeman, 1977; Baum & Shipilov, 2004). Baum and Shipilov explain:

> Although selection processes favour organizations that are fit with their environment, the match between organizations and their environments is constantly eroding as managerial bounded rationality, informational constraints and inertial pressures prevent organizations from keeping pace with constantly changing environments (2004: 70).

As organizations that no longer fit environmental demands are selected out, organizational variation occurs as new innovative institutional structures enter the marketplace to meet unmet needs. Organizational variation is occurring in the hospital industry with the emergence of specialty hospitals, ambulatory surgery centers, minute clinics, free standing birthing and emergency centers, and other new types of medical facilities that are designed to reduce costs and improve access to health care.

Organizational ecology aims to understand organizations by taking a population or community perspective and offering theoretical tools for discerning how environments determine organizational form and change at the industry level. One theory, known as the systems-structural view, holds that "environments create new organizational forms by prompting old ones to change—for example, by the force of new resource contingencies, new accountabilities, new regulations, or new product or process technologies" (Sandelands & Drazin, 1989: 460). The second theoretical perspective, according to Aldrich (1979), is derived from competitive theory and maintains that "environments select out organizations that do not fit the niche that they are occupying and select for competing organizational forms that are relatively better performers" (Sandelands & Drazin, 1989: 460). "According to this perspective, new organization forms arise primarily from the birth of new variations of organization that are better competitors." This view is reflective of Michael Porter's (1985) view of competitive strategy, although the two perspectives approach organization theory from different levels of analysis: organizational field vs. single organization. Porter's work highlights the importance of the strategic actions of the individual manager or decision maker in the firm.

Organizational ecology is particularly appropriate for a study of the hospital industry because the theory acknowledges the increasing influence of regulation on economic, social, and organizational change and action. Regulatory policies and mechanisms serve to constrain and foster growth in the diversity of organizational forms. Safety legislation, affirmative action, and minimum wage are examples of regulations that are influencing the development of organizational forms in a wider marketplace. The Medicare prospective payment system (PPS), certificate of need legislation, the Stark Law, and licensing laws that restrict entry into the field of medicine impact the diversity of organizational forms in the hospital industry specifically

(Starr, 1982; Hannan & Freeman, 1977; Makar, 1991; Mathews, 1993; National Conference of State Legislatures, 2011).

Few studies have utilized population ecology theory to analyze organizational change in the medical care sector (Fennell & Alexander, 1993). Studies of organizational change in the health care sector have focused primarily on change resulting from either strategic choice/rational approaches or resource dependency theory. The strategic choice/rational model emphasizes the role of decision makers within organizations and contends that organizational change is the outcome of “a strategic process of decision-making in which the organization. . . actively chooses one course of action over another” (Fennell & Alexander, 1993). The strategic choice/rational model also aims to explain “hospital behavior in terms of monitoring, anticipating, and responding to changes in the environment” (Fennell & Alexander, 1993: 98). Resource dependency theory defines organizational success as the maximization of power derived through the exchange of resources within and between organizations (Pfeffer, 1981). The theory assumes organizations focus on inter-organizational linkages that are acquired to access needed resources while actively responding to environmental influences (Fennell & Alexander, 1993). Resource dependency theory offers tools that highlight the behavior of organizations desirous of gaining greater control over scarce resources and their environments by reducing their dependency on other organizations, while increasing other organizations’ dependency on them (Pfeffer & Salancik, 2003). For example, an organization might adopt technology or acquire skilled surgeons in order to reduce their dependency on other medical facilities and gain control over service delivery.

Organizational ecology, on the other hand, emphasizes organizational variation in the context of environmental change. Renshaw and colleagues (1990) combined population ecology

and technology diffusion theory in their study of magnetic resonance imaging (MRI) technology that emerged in the unpredictable health care environment of the 1980s. While hospitals were initially the primary purchasers of MRI, they began to defer purchasing the technology two years after the introduction of MRI. According to Renshaw and colleagues, the vast majority of hospitals considered the environment to be highly uncertain and deferred MRI investment because they believed the decisions were risky, consequently creating opportunities for physician-investors. By 1985, physician-owned free-standing imaging organizations had rapidly entered the market. Yet, by the end of the 1980s, MRI purchase patterns shifted back to hospitals. In the wake of the disruption, a variety of nontraditional organizational forms had emerged as technology enablers. In addition to traditional forms of hospital ownership arrangements, sophisticated MRI technology was owned by hospital consortiums, joint hospital/physician-groups, physicians or physician groups, venture capitalists, intermediary organizations, and through various types of lease agreements with medical staff joint ventures (Renshaw et al., 1990). The authors found that unpredictable environments affect organizational forms differently, "posing overwhelming obstacles for some, minor constraints for others, and opportunities for still others" (Renshaw et al., 1990: 196). Nevertheless, by the end of the decade,

> hospitals had once again become, proportionately, the dominant investors in MRI technology. Two factors contributed to this evolution: the competitive situation, which both increased uncertainty and increased pressures to act to ensure organizational survival, and the development of new, low-risk acquisition alternatives (Renshaw et al., 1990: 196).

From a population ecology perspective, all health care workers and medical facilities operate within the same general environment characterized by rapid changes and unpredictability (Renshaw et al., 1990). Examining medical technology and organizational shifts in a single organization, multi-hospital systems, and diversified health systems is important to

understanding intra-agency, local and regional variations that may be masked when analyzing national or industry trends (Rothberg, 1982). Fennell and Alexander (1993) assert that more hospital sector level analyses are needed that explore the interaction between technology and organizational change from the hospital sector perspective. A primary aim of this work is to understand better the effects of innovative technology and organizational dynamics at the hospital industry level.

Theory Usage: Disruptive Innovation and Population Ecology

Disruptive innovation theory is the primary theory being tested in this work. Population ecology is employed "as a framework for understanding organizational change" (Kaluzny et al., 1987: 5). Population ecology theory provides an organization theory lens through which to view disruptive innovation theory. Population ecology theory also establishes a conceptual framework that theoretically grounds this analysis in organization theory. The theories are compatible with one another. Both are concerned with the influence of context on the firm, as well as organizational survival, change, and death (Hannan & Freeman, 1977; Christensen & Rosenbloom, 1995; Christensen et al., 2009). According to disruptive literature, write Burns and colleagues, "local hospitals and physicians (incumbent providers) may be unable to competitively responded to . . . 'creative destruction' and alter their business models for a host of reasons, thus threatening their future survival" (2011: 69). In their work, "Competition and Survival of Health Service Organizations: A Population Ecology Approach," Kaluzny and associates write: "In particular, the key features of the population ecology model are applied to help explain the survival of various forms of health service organizations at this particular time" (1987: 5). In addition to organizational survival, both theories also are concerned with the disruptive aspects of environmental influences in competitive markets through their

acknowledgment of the roles that legislation and regulatory standards have on sector-wide organizational changes (Baum & Shipilov, 2004; Christensen et al., 2009). Both theories further emphasize the roles of inertial pressure, organizational size, and generalist and specialist approaches to organizational strategy as determinants of organizational variation and survival. These factors are discussed in more detail below.

Structural Inertia

Established health care delivery firms often succumb to very strong inertia pressures that arise from internal factors, such as resource constraints and internal politics; and external factors, such as those resulting from regulation, rapidly changing competitive environments (e.g., uncertainty). The perceived lack of public legitimacy of an organization's activity also may contribute to inertia pressures. These pressures can be sufficiently strong enough to restrict an organization's ability to change to meet environmental demands. According to Blau and Scott (1962), in most environments "individual organizations (and populations of organizations) have the potential to expand almost without limit" (Hannan & Freeman, 1977: 957). In competitive environments, structural inertia can limit organizational expansion and thereby create opportunities for new firms to emerge, increasing the diversity of organizational forms. Competition, in essence, serves as a mechanism that spurs isomorphic activity as classes of organizations are formed with relatively homogeneous purposes and structures (Hannan & Freeman, 1977, 1984).

In competition theory, isomorphism (DiMaggio & Powell, 2004) "can result either because nonoptimal forms are selected out of a community of organizations or because organizational decision makers learn optimal responses and adjust organizational behavior accordingly" (Hannan & Freeman, 1977: 939). While the theory of the firm holds that managers

and other organizational decision makers develop strategic responses and adapt organizational structures to environmental threats and opportunities in order to maximize profit and enhance the probability of organizational survival, the population ecology perspective maintains that "it is the environment which optimizes" (Hannan & Freeman, 1977: 939). Organizational ecologists hold that ultimately—no matter how much environmental scanning or strategic planning—the environment selects optimal organizational forms; and organizational variation is a necessary condition for environmental selection.

Michael E. Porter's structural analysis of industries is instructive for the study of organizational change in competitive health care environments. Porter's framework for the structural analysis of industries emphasizes the forces that drive competition in an industry.

> The essence of formulating competitive strategy is relating a company to its environment. Although the relative environment is very broad, encompassing social as well as economic forces, the key aspect of the firm's environment is the industry or industries in which it competes. Industry structure has a strong influence in determining the competitive rules of the game as well as the strategies potentially available to the firm. Forces outside the industry are significant primarily in a relative sense; since outside forces usually affect all firms in the industry, the key is found in the differing abilities of firms to deal with them (Porter, 1980: 3).

This study proposes to test disruptive innovation theory propositions in the hospital industry by examining and comparing trends in select abdominal surgeries performed at acute care general hospitals and ambulatory surgery centers. The development of the conceptual model attempts to illustrate the merging of innovative technology (laparoscopy) with lower-cost business models (ASCs), capture the interaction between medical facilities, and reflect organizational change, while acknowledging environmental forces that influence the hospital industry. Christensen's theory serves as a framework by which the impact of technology and organizational change in the competitive health care market can be assessed. Yet, the theory of disruptive innovation is a conceptual model borrowed from the field of business administration,

and few studies have applied the theory to the health care industry. Most disruptive innovation research in the hospital industry has been qualitative or descriptive (Yu & Hang, 2009), with much of the work describing general medical service and technology trends. Christensen and colleagues (Bower & Christensen, 1995; Christensen et al., 2000; Christensen et al., 2009) have formulated conceptual frameworks for disruptive innovation theory that describe industry trends, model theoretical concepts, and state underlying assumptions. While their research features the contributions of various innovative technologies to the transformation of the health care industry, their work typically lacks quantitative support.

A number of articles focus on the role of inertial pressures and explain how the health care sector in general, and the hospital industry in particular, are undergoing changes due to disruptive technologies. Christensen points to balloon angioplasty that is performed by interventional cardiologists as a disruptive innovation. Although originally developed in the 1970s, the perception of poor effectiveness stifled diffusion of balloon angioplasty. It took almost 20 years before the procedure became commonplace. “The procedure (involving a coronary stent) was initially limited to less complex cases, but since has partially replaced invasive heart bypass surgery performed by cardiothoracic surgeons” (Burns et al., 2011: 69).

Dominant organizations are often at a disadvantage when new technologies emerge. Managerial processes, organizational dynamics, and the characteristics of the technological innovation are a few of the factors that may contribute to established firms lagging behind new market entrants (Christensen & Rosenbloom, 1995). Disruptive innovation theory contends that established firms often overlook, or are reluctant to adopt, new technologies, which leave firms at a competitive disadvantage compared to new innovative business models. Compared to larger established firms, new innovative business models have competitive advantages because they are

technology enablers that have found a niche, entered the marketplace, and became the low cost producer of more simplified, quality products and services with broader accessibility. In the short-run, disruptive theory maintains that conventional industry leaders experience a loss of market share to "non-traditional" new entrants into the marketplace. According to Christensen et al. (2009), the non-traditional new organizational forms focus on a specialized product or service, or niche, which has not been capitalized on by larger firms. While Christensen holds that structural inertia among large firms is a reason for disruptive shifts in markets, organizational ecologists argue that inertial pressures in large organizations may be beneficial because core changes within organizations can be disruptive—particularly in the short-term. For example, "if the organization manages to overcome the hazards associated with the initial disruption" explain Baum and Shipilov, [structural inertia] may, ultimately, be adaptive in the long-run" (2006: 75).

Both disruptive innovation theory and organizational ecology are concerned with the influence of environmental factors on organizations of different sizes (Baum & Shipilov, 2004), as well as the manner in which disruptive effects vary by industry (Renshaw et al., 1990). According to Christensen, large organizations are more likely than small firms to be reluctant to respond to environmental changes. Failure to respond or slow responses can result from a variety of factors: internal politics, bureaucratic processes, governmental regulations, environmental uncertainty, lack of information, path dependency, or numerous other factors. Similar to disruptive theory assertions, organizational theorists assume:

> existing organizations frequently have difficulty changing strategy and structure quickly enough to keep pace with the demands of uncertain, changing environments and emphasizes that major organizational innovations often occur early in the life-histories of organizations and populations. Organizational change and variability are thus regarded to reflect primarily relatively inert (i.e. inflexible) organizations replacing each other over time (Baum & Shipilov, 2004: 56).

While understanding that larger, more generalist organizations may be slower to fit environmental demands—which may jeopardize their survival in competitive markets (Burns et al., 2011), organizational ecologists contend that "[l]arge size can buffer organizations from the disruptive effects . . . by, for example, helping to maintain both old and new ways of doing things during the transition period or to overcome short-term deprivations and competitive challenges that accompany the change attempt" (Baum & Shipilov, 2004: 74-75).

Liability of Smallness

The *liability of smallness*[8] is a central tenet of organizational ecology that hypothesizes: organizational size affects failure rates. According to Aldrich and Auster (1986), small organizations are considered more likely to fail because of difficulties in "raising capital, recruiting and training a workforce, meeting higher interest payments and handling the administrative costs of compliance with government regulations" (Baum & Shipilov, 2004: 62). Population ecology assumes that larger organizations are less likely to fail because they are believed to be more reliable (Hannan & Freeman, 1984) and more likely to have established track records and more legitimacy (Baum & Shipilov, 2004). Inertia pressures within large organizations may be beneficial when time is needed to respond to core changes within organizations that can be chaotic in the short-term. Large organizations that are able to generate necessary resources and develop stable relationships during initial disruptive activity may in fact reduce their chance of failure (Baum & Shipilov, 2004).

Disruptive innovation theory holds that large established firms that succumb to inertial pressures are more likely to fail, at least in the short-term, because they are left at a competitive disadvantage compared to smaller new innovative business models that have competitive

[8] The liability of smallness is often confounded with the liability of newness because new organizations tend to be small. The association can yield spurious results if it is assumed that organizational size increases with age and failure rates decrease with size (Baum & Shipilov, 2004).

advantages based on their market niches. Conversely, organizational ecology maintains that large organizations are in fact less likely to fail compared to small organizations that suffer from the *liability of smallness*.

Niche Width Dynamics

Disruptive innovation theory and population ecology theory both highlight differential survival patterns between generalist and specialist organizations. Specialist and generalist approaches are defined by the strategic focus of organizations, which is a feature of niche width theory (Hannan & Freeman, 1977, 1989). Disruptive innovation theory contends that large size can be a liability for generalist firms that may be unable to respond quickly enough to market shifts and take longer to capitalize on new business opportunities. Disruptive innovation theory argues that smaller more agile and specialized business models are better able to enter the market relatively quickly and take advantage of new technologies, making smallness an advantage—not a liability (Burns et al., 2011).

Niche width theory emphasizes that there are a set of environmental conditions that influences the likelihood of organizational survival based on the strategic focus or niche position of organizations. Organizational structures with generalist strategies aim to "appeal to the mass market and exhibit tolerance for more varied environments. . . . [T]he generalist must carry extra capacity that sustains its ability to perform in [a variety of] environmental conditions" (Baum & Shipilov, 2004: 81). In essence, the generalist "accepts a lower level of exploitation in return for greater security" (Hannan & Freeman, 1977: 948); while the specialist, on the other hand, "maximizes its exploitation of [a narrower] environment and accepts the risk of having that environment change." According to Baum and Shipilov (2006), specialists seek to exploit a narrower range of resources than generalists.

Since specialists possess few slack resources and focus on a narrow range of customers, population ecologists assert that specialists are most productive in stable, certain environments. Specialists also are said to perform better in environments that fluctuate with infrequent variations. Specialists are more likely to have trouble sustaining themselves during long unfavorable periods when environmental variability is high, and market fluctuations are periodic. Generalists, on the other hand, are more likely to be productive in high variability environments with periodic market fluctuations (Hannan & Freeman, 1977). However, in conditions of environmental uncertainty and large variations, specialists with organizational strategies that fit environmental demands are able to "ride out the fluctuations" and "out-compete generalists" (Baum & Shipilov, 2004: 81). Generalists typically lack the ability "to respond quickly enough to operate efficiently" (Baum & Shipilov, 2004: 81).

Overview of Conceptual Model

This section first provides descriptions of key terms used in this study. An overview of the conceptual model that is tested in the research follows. The conceptual model also guides the formulation of the research design.

Description of Key Terms

Acute Care General Hospital

The primary function of the acute care general hospital is the provision of inpatient diagnostic and therapeutic (surgical and non-surgical) services to a broad population for a wide variety of medical conditions. Most patients treated at acute care general hospitals are in an acute phase of illness or injury requiring medical attention for a single episode or fairly short term (Sources: American Hospital Association; Washington Publishing Co. Available online: http://www.aha.org/content/00-10/10-ib-def-hospital.pdf; http://codelists.wpc-

edi.com/wpc_properties.asp?IndexID=8104). Acute care general hospitals also provide outpatient medical care (surgical and non-surgical) for severe injury or episodic illness or conditions, and emergency services (Sources: American Hospital Association; U. S. Department of Health & Human Services. Available online: http://www.aha.org/; http://www.hhs.gov).

Ambulatory Surgery Center

The primary function of the ambulatory surgery center is the provision of surgical services that do not exceed 24 hours or require hospital admission or overnight hospitalization. The services provided by ambulatory surgery centers include diagnostic and preventive procedures, medical treatments, and surgery (Sources: Ambulatory surgery Center Association; Center for Medicare & Medicaid Services. Available online: http://www.ascassociation.org; https://www.cms.gov.) Outpatient surgical centers are comprised of a variety of ownership structures, such as: hospital/physician-owned free-standing ASC joint-ventures, corporate/physician-owned free-standing ASC joint-ventures, and physician only-owned free-standing ASCs.

Inpatient Surgical Setting

An inpatient surgical setting refers to the care a patient receives when hospitalized for at least one night in order to receive or recover from a medical procedure or treatment (Sources: American Hospital Association; U. S. Department of Health & Human Services. Available online: http://www.aha.org/; http://www.hhs.gov). More risky, medically complex surgical procedures typically occur in inpatient settings, where there is quick access to emergency services and onsite specialists.

Ambulatory (Outpatient) Surgical Setting

An ambulatory or outpatient surgical setting refers to a care environment located in a hospital or clinic that does not require the patient to stay in the medical facility overnight. Ambulatory surgeries are typically less risky and using more standardized procedures. Ambulatory surgical settings offered through hospital outpatient departments afford access to emergency rooms and onsite specialists (Sources: Ambulatory Surgery Center Association; Center for Medicare & Medicaid Services. Available online: http://www.ascassociation.org; https://www.cms.gov.).

Open and Laparoscopic Surgical Procedures

Open abdominal surgical procedures have been practiced for hundreds of years (De, 2004). Traditional open surgery, once the "gold standard" for many procedures, is characterized by a long extensive incision cut in abdominal muscles by a surgeon to gain visibility of and direct access to organs using hands and surgical instruments. (*See Exhibit 6*: Incisions for Open and Laparoscopic Abdominal Surgical Procedures.)

Exhibit 6: Incisions for Open and Laparoscopic Abdominal Surgical Procedures

(Source: DioMedia. http://cache.diomedia.com/170/01/AE/QS/01AE-QSZ0.jpg)

Increasingly, physicians and patients are opting for less invasive surgical techniques, such as arthroscopic, endoscopic, and laparoscopic procedures, instead of undergoing open surgical procedures. Laparoscopic surgical techniques require that several small incisions be made in the abdominal area and a tiny telescope on a small thin tube be inserted into the body. Magnified images of internal organs are viewed by the surgeon on a television screen (Society of American Gastrointestinal and Endoscopic Surgeons, 2004. Available online: www.medicinenet.com/cholecystectomy/article.htm). Laparoscopic techniques are revolutionizing surgical procedures and have been compared to the surgical milestones of vascular surgery and organ transplantation (De, 2004). New medical technologies, such as laparoscopy, allow physicians to perform minimally invasive (smaller incision) procedures that reduce tissue damage, taking less time and inflicting less pain. Laparoscopic surgical procedures also cost less than open surgery. Technological innovations and advances in anesthesia have fueled the transition from open to laparoscopic surgical procedures (Russo et al., 2007).

Cholecystectomy

Cholecystectomy is the surgical removal of the gall bladder and gallstones (Martin, 2004; American College of Surgeons). Technological advances have spurred the utilization of cholecystectomy, which has become one of the most common elective surgical procedures performed in the United States (Fendrick, et al., 1994; Buechner, 2001; Russo et al., 2007). Since the advent of laparoscopic cholecystectomy in 1988, the procedure has become the gold-standard for gallbladder removal (Davis, 1984; Clancy & Brooks, 2004; De, 2004; Soltesz & Brooks, 2004). It is estimated that by 1995 as many as 80 percent of cholecystectomies are performed laparoscopically (Sherwinter et al., 2011), and as of 2003, at least half of cholecystectomies are performed in ambulatory settings (Russo et al., 2007).

Appendectomy

Appendectomy is the treatment for appendicitis[9] (Hume & Simpson, 2006). Appendectomy is the second most common abdominal procedure performed after cholecystectomy, and it is the most common abdominal surgical emergency (Guller et al., 2004; Olmi et al., 2005). For more than a century, open appendectomy has been the standard treatment for acute appendicitis (Marzouk et al., 2003). Open appendectomy is considered a safe procedure, despite the post-operative complications (Marzouk et al., 2003; Hume & Simpson, 2006).

In 1983, Kurt Semm was first to report the use of laparoscopic technology for the removal of the appendix (Easter, 1993; Harrison et al., 1994; Marzouk et al., 2003). Recent studies tout the benefits of laparoscopic appendectomy: shorter surgical time compared to open appendectomy, quicker discharge, less anesthesia, faster recuperation, and reduced rate of postoperative wound infection (Byrne & Bell, 1994; Marzouk et al., 2003; Guller et al., 2004).

Bariatric Surgery

Bariatric surgery is the only proven method for durable weight loss (ASMBS, 2005). The surgical treatment "involves restricting the size of the stomach and bypassing part of the intestines to reduce the absorption of food" (Encinosa et al., 2005: 1039). Over the past 60 years, over 50 different types of bariatric surgical procedures[10] have been performed. Bariatric surgery is indicated for adults classified as extremely obese (BMI > 40), or obese (BMI 35-39.9), with one or more comorbidities (Obesity Education Initiative, 2000; Solomon & Dluhy, 2004).

---

[9] Appendicitis may be classified as inflamed (simple) or perforated or gangrenous (complicated) (Hume & Simpson, 2006).

[10] Bariatric surgeries have evolved from those inducing malabsorptions and restricting consumption to electrical stimulation, gastric balloons, and extra-gastrointestinal innovations, combing both open and laparoscopic surgical techniques.

The first weight loss operations in the United States were likely performed in 1953 by Dr. Richard L. Varco of the Department of Surgery at the University of Minnesota who performed a jejunoileal bypass[11] (Buchwald, 2007, 2010; Martin, 2004). In the 1960s, Drs. Mason and Ito developed the gastric bypass. Over time, the gastric bypass was modified to use a Roux-en-Y limb of intestine (RYGBP) [12] (Buchwald & Buchwald, 2002, 2008). Technological advances have shaped the development and utilization of bariatric surgery (Russo et al., 2007). In the mid-1990s, Drs. Wittgrove and Clark conducted the first laparoscopic RYGBP (ASMBS, 2005: http://asmbs.org/story-of-obesity-surgery-gastric-bypass-and-laparoscopic-bypass/).

Laparoscopic procedures have become the most common methods of bariatric surgery (Morton et al., 2011) because laparoscopy requires a smaller incision; creates less tissue damage and fewer infections; results in reduced costs; and leads to shorter hospitalization, fewer post-operative complications, and reduced morbidity associated with bariatric surgery (Encinosa et al., 2009; NIDDK. Available online: http://www.win.niddk.nih.gov/publications/gastric.htm).

Disruptive Technology

A disruptive technology radically transform industries by displacing more expensive, complex, and expert-intensive products and services with those that are generally less expensive, simpler, smaller, and more convenient. For example, MRI machines, and CT and PET scanners offer physicians very clear images of internal tissues on desktop computers. Compared to X-ray technology that is unable to produce images of soft internal tissues, these innovative imaging technologies offer superior visual clarity, allowing surgeons to forego some exploratory surgeries

[11] "The jejunoileal bypass (JIB) induced a state of malabsorption by bypassing most of the intestines while keeping the stomach intact" (American Society of Metabolic and Bariatric Surgery. Available online: http://asmbs.org/story-of-obesity-surgery-jejunoileal-bypass/.)

[12] The operation is now performed as a "Roux-en-Y" with a limb of intestine connected to a very small stomach pouch which prevents the bile from entering the upper part of the stomach and esophagus.

(Christensen, 2009). Laparoscopy, along with molecular diagnostics, diagnostic imaging technology, and widespread telecommunication are examples of disruptive technologies. Disruptive technologies are innovations that typically target the least profitable, underserved, and poorest customers in the market. Disruptive technology is essential to expanding access to more affordable products and services (Christensen et al., 2009; Glabman, 2009).

Innovative Business Model

For disruptive technology to diffuse and transform an industry, it must be enabled by an innovative business model (Glabman, 2009). There are three types of innovative business models: solution shops, value-adding process businesses, and facilitated networks (Christensen et al., 2009).

Three Types of Innovative Business Models

- **Solution shops** diagnose problems and recommend solutions, and must be compensated on a fee-for-service basis.
- **Value-adding process businesses** perform procedures in which definitively diagnosed problems are repaired or treated through a relatively standard sequence of steps, and paid for a fee-for-outcome basis.
- **Facilitated networks** serve to help professionals and patients exchange with and help each other, and whose coordinators typically need to be compensated on a fee-for-membership basis (Christensen, 2009: 421).

Writes Christensen and colleagues:

> Every disruption is comprised of three components: a technology that transforms the fundamental technical problem in an industry from a complicated one into a simple one; a business model that can take that simplified solution to the market at low cost; and a supporting cast of suppliers and distributors whose business models are consistent with one another, which we call a value network (Christensen, 2009: 420).

Christensen and others (2009) contend that the conventional business model of general hospitals leaves them ill-equipped to compete in today’s rapidly changing competitive

marketplace. Most general hospitals would collapse, write Christensen and colleagues, "[i]n the absence of an array of cross-subsidies, restraints on competition, and philanthropic life support" (Christensen et al., 2009: 420). Ambulatory surgery centers are one of several types of innovative business models that are enabling technological advances and aggressively competing with general hospitals. Christensen has identified the ambulatory surgery center as an innovative business model (Burns et al., 2011). ASCs are classified as value-adding businesses that perform "procedures in which definitively diagnosed problems are repaired or treated through a relatively standard sequence of steps, and paid for a fee-for-outcome basis" (Christensen et al., 2009: 421).

ICD-9 Procedure Codes

Open and laparoscopic appendectomy, cholecystectomy, and bariatric surgery (ACBS) procedure totals are derived using ICD-9 procedure codes from the 2004 and 2009 Intellimed Database (*See Table 8*: ICD-9 Procedure Code Details). Procedure codes are classified according to the International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9, CM). Open appendectomy procedures are based on ICD-9 codes: 47.09, 47.1, and 47.19. Laparoscopic appendectomy procedures are drawn from ICD-9 codes: 47.01 and 47.11. Open cholecystectomy cases are derived from ICD-9 procedure codes: 51.21 and 51.22; and laparoscopic cholecystectomy cases are from ICD-9 procedure codes: 51.23 and 51.24. Cases for high gastric bypass procedures are based on ICD-9 codes: 44.31 and 44.39; with cases for laparoscopic gastric restrictive procedures drawn from ICD-9 codes: 44.38, 44.68, and 44.95.

Table 8: ICD-9 Procedure Code Details

PROCEDURE CODE	Surgical Procedure Type	Source
ICD-9 PROCEDURE 47.01, 47.11	Laparoscopic appendectomy procedures	INTEL
ICD-9 PROCEDURE 47.09, 47.1, 47.19	Open appendectomy or other appendectomy procedures	INTEL
ICD-9 PROCEDURE 51.23, 51.24	Laparoscopic cholecystectomy and laparoscopic partial cholecystectomy procedures	INTEL
ICD-9 PROCEDURE 51.21, 51.22	Open cholecystectomy	INTEL
ICD-9 PROCEDURE 44.31, 44.39	High gastric bypass and other gastroenterostomy procedures	INTEL
ICD-9 PROCEDURE 44.38, 44.68, 44.95	Laparoscopic gastroenterostomy (laparoscopic Roux-en-Y), laparoscopic gastroplasty, and laparoscopic gastric restrictive procedures	INTEL

Core-Based Statistical Areas (CBSA)

Each Core-Based statistical area (CBSA)[13] consists of an area of at least 10,000 people. CBSAs are divided into metropolitan, micropolitan, and undefined areas depending on population size. A metropolitan area contains a core urban area of 50,000 or more in population. A micropolitan area has an urban core of at least 10,000 in population but less than 50,000. Undefined areas are typically rural areas that lack CBSA codes. A CBSA consists of one or more counties, which includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) within the urban core (OMB Bulletin No. 09-01).

Conceptual Model

Since the 1980s, the hospital industry has undergone radical transformations. Hospitals, the principal players in the hospital industry, represent the traditional form of inpatient medical

[13] A CBSA is a collective term for micropolitan and metropolitan statistical areas. "In 2003, the Office of Management and Budget implemented Core-Based Statistical Areas (CBSA) to replace MSA codes, which had been in use since about 1990" (http://www.zip-code-download.com/cbsa.php).

care (Stevens, 1989). But growing cost concerns led to "reduced inpatient utilization across the board, controls on individual admissions, and a major restructuring of the incentives built into inpatient reimbursement (via prospective reimbursement schemes) have placed increasing pressures on hospitals to reduce the length of hospital stays" (Stevens, 1989: 309). It is against the backdrop of PPS, and other regulatory and environmental changes outlined in Chapter 2, that the conceptual model is formulated. PPS altered the incentive structure for efficient production of medical services, and the reimbursement scheme contributed to shifting the context in which technological medical innovations are diffused. PPS helped spur new opportunities, which led to new organizational forms, increased competition, and more uncertainty in the marketplace. "More significantly, perhaps, the hospital is no longer the sole, or sometimes even the primary, adopter of costly medical technology" (Renshaw et al., 1990: 182). Write Fennell and Alexander:

> PPS established a set of financial constraints on hospital reimbursement that has channeled the direction of medical innovations toward outpatient diagnosis. New medical technologies (such as MRI) often do not require hospitalization but are so expensive that hospitals are still the most likely purchasers of such equipment. Now, however, it is unlikely that the hospital will be the only purchaser; physician groups, provider networks, and joint ventures among multiple organizations are investing in the new medical technologies (Renshaw et al., 1990: Scott, 1990; McKinney et al., 1991) (1993: 102-103).

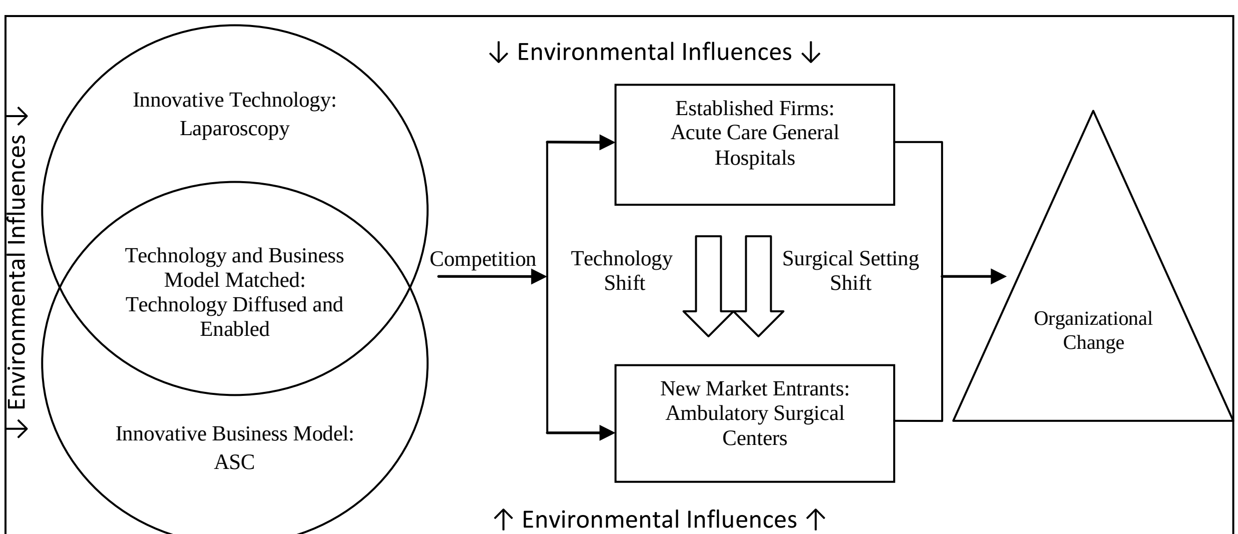
In other words, innovative medical technology is being adopted by a variety of innovative organizational forms that serve as technology enablers. The impact of PPS in the hospital industry has, in part, initiated technological and organizational changes that are disrupting traditional hospital delivery systems (Christensen et al., 2009; Bower & Christensen, 1995). As hospitals respond to these pressures, the competitive atmosphere is ripe for the rapid growth in the number of free-standing ambulatory surgery centers and outpatient surgery departments in hospitals. The new competitive environment in the hospital industry requires new perspectives

and approaches to research in order to capture the effect of innovative technologies and new organizational complexities (Renshaw et al., 1990).

This work assumes that the hospital industry responds to the environmental changes that include shifts in regulation, third party payment systems, demographic patterns, technological advances, and more. Large established hospitals may be reluctant to respond quickly to environmental changes as they attempt to manage bureaucratic systems, acquire and decipher information, assess administrative and clinical implications, determine the cost and profitability associated with investments, and understand the importance of technological preeminence and clinical excellence in the new regulatory environment, and understand the impact of new environmental conditions. In the short term, as hospitals succumb to inertial pressures, new organizational forms emerge that capitalize on changes in the marketplace and gain market share.

The conceptual model below illustrates key elements and relationships in disruptive innovation theory (*See Figure 6*: Conceptual Model of Disruptive Transformation in the Hospital Industry), with disruptive activities situated within an organizational ecology framework where a variety of environmental influences are at play. According to the model, the utilization of laparoscopic surgery and ambulatory surgery settings are functions of a diverse set of factors.

Figure 6: Conceptual Model of Disruptive Transformation in the Hospital Industry



The conceptual model depicts two requisite components of Christensen's theory of disruptive innovation: (1) innovative technology, and (2) an innovative business model. Once ASCs adopt laparoscopy and enter the marketplace, they join other ASCs to compete with ACGHs. The model shows the effect of disruptive innovation on the interplay between ACGHs and ASCs in the provision ACBS as (1) technology shifts from open to laparoscopic procedures, and (2) surgical settings shift from inpatient to outpatient occur. Both medical technology shifts and surgical settings shifts are evidence of disruptive innovation in the health care industry (Hwang & Christensen, 2008). The model depicts a host of environmental pressures, such as regulatory reforms, cost-cutting measures, new industry standards, technological advances, demographic trends, and market shifts that facilitate interactions among medical facilities in a disruptive industry (Christensen et al., 2009: xx-xxi). According to disruptive innovation theory, ASCs are new entrants in the competitive marketplace. As their numbers rise, access to innovative products and service will increase as they capture a growing share of the market. Established hospitals will fail to launch disruptive products and services during the early stages of development and lag behind new entrants (Christensen et al., 2009; Bower & Christensen, 1995). Organizational ecology predicts that as ACGHs and ASCs engage in the competitive marketplace, the process of selection stimulates increased organizational variation (Scott & Davis, 2007; Baum & Amburgey, 2002; Baum & Shipilov, 2004).

Hypotheses

This research assumes that disruptive innovation in the hospital industry has created a favorable environment for ambulatory surgery centers performing select abdominal surgery procedures, particularly since medical professionals desire to reduce pain and infections by avoiding the opening the abdomen surgically and payers seek to cut health care costs

(Department of Health and Human Services). Compared to ACGHs, ASCs are growing in number and experiencing an increase in the number of laparoscopic surgical procedures performed. Disruptive innovation occurs when innovative business models adopt innovative technology. This work assumes that laparoscopy has matched with ASCs in the delivery of three categories of abdominal surgical procedures (i.e., appendectomy, cholecystectomy, and bariatric surgery). It is predicted that medical facility type (ACGH or ASC) influences the degree of shifts in surgical technology and surgical settings, ultimately spurring organizational change and impacting the patterns of procedure utilization. Based on these assumptions, the following hypotheses are proposed. The first two hypotheses (*A* and *B*) are based on the pooled dataset that is comprised on ACGHs and ASCs. The second set of hypotheses (*C* and *D*) is asserted based on a dataset that includes ACGHs only.

Hypothesis A - Technology Shift: Compared to open ACBS, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed.

Hypothesis B - Medical Facility Shift: Compared to ACGHs, ASCs will experience a larger percentage increase in the number of ACBS procedures performed.

Hypothesis C - Surgical-Setting Shift Within-ACGHs: Compared to inpatient ACBS, ambulatory procedures will experience a larger percentage increase in the number performed (ACGH Only).

Hypothesis D - Technology Shift Within-ACGHs: Compared to open ACBS, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed (ACGH Only).

In sum, *Hypotheses A* and *D* predict that the percent change for annual laparoscopic and ACBS will increase significantly between the six-year period from 2004 and 2009, compared to

open ACBS. *Hypothesis B* focuses on medical facilities and predicts that compared to ACGHs, ASCs will experience significant increases in the percent change of annual totals between the six-year period from 2004 and 2009. *Hypotheses C* predict that the percent change for annual ambulatory ACBS will increase significantly between the six-year period from 2004 and 2009, compared to inpatient ACBS. The null hypotheses for *Hypotheses A*, *C*, and *D* state that the percent change in open and inpatient ACBS procedure volume will be greater than or equal to the percent change in laparoscopic and ambulatory ACBS, respectively, over the six-year period. The null hypothesis for *Hypothesis B* states that the percent change in ACBS procedure totals for ACGHs will be greater than or equal to the percent change for ASCs. The null and researcher's hypotheses are formally stated as follows, where μ is the mean percent change in ACBS case volume from 2004 to 2009 annual totals:

<u>*Hypotheses A* and *D*</u>	<u>*Hypothesis B*</u>	<u>*Hypothesis C*</u>
Ho: $\mu_{Open} \geq \mu_{Lap}$	Ho: $\mu_{ACGH} \geq \mu_{ASC}$	Ho: $\mu_{Inpatient} \geq \mu_{Amb}$
H_R: $\mu_{Open} < \mu_{Lap}$	H_R: $\mu_{ACGH} < \mu_{ASC}$	H_R: $\mu_{Inpatient} < \mu_{Amb}$

This work aims to test disruptive innovation theory through an investigation of surgical procedure types, facility types, and surgical settings. The objectives are to understand the impact of disruptive innovative on abdominal surgery and the different types of surgical procedures performed, as well as on the facilities in which the procedures are delivered.

Operationalization of Variables

Hypothesis A

The research assumes that laparoscopic ACBS procedures will experience a larger percent increase than open ACBS procedures. The dataset for *Hypothesis A* includes both ACGHs and ASCs. The dependent variable for *Hypothesis A* is *Percent Change in ACBS*

Laparoscopic Procedures, *%∆LapACBS*, which is based on the number of laparoscopic ACBS procedures performed in 2004 and 2009 at the facility level ($LapACBS_{2004}$ and $LapACBS_{2009}$). The equations used to derive the dependent variable follows:

(a) Percent Change in Laparoscopic ACBS = (Total 2009 laparoscopic ACBS – Total 2004 laparoscopic ACBS)/ Total 2004 laparoscopic ACBS.

The independent variable that will be used to test *Hypothesis A* is: *Percent Change in Open ACBS Procedures*, *%∆OpenACBS*, which is based on the number of open ACBS procedures performed in 2004 and 2009 at the facility level ($OpenACBS_{2004}$ and $OpenACBS_{2009}$). The equation used to derive the independent variable is as follows:

(b) Percent Change in Open ACBS = (Total 2009 open ACBS – Total 2004 open ACBS)/Total 2004 open ACBS.

The association between the independent and dependent variables reflects the technology shift. See Tables 9 and 10 for more information on the measurement of dependent and independent variables.

Hypothesis B

The research assumes that the type of medical facility (ACGH or ASC) is associated with ACBS procedure volumes and the setting where surgery is performed. The dataset for *Hypothesis B* includes both ACGHs and ASCs. The dependent variable that will be used to test *Hypothesis B* is: *Percent Change in Ambulatory Laparoscopic ACBS Procedures*, *%∆AmbLapACBS*, which is derived from the number of ambulatory laparoscopic ACBS procedures performed in 2004 and 2009 at the facility level ($AmbLapACBS_{2004}$ and $AmbLapACBS_{2009}$). The equations used to derive the dependent variable follows:

(c) Percent Change in Ambulatory Laparoscopic ACBS = (Total 2009 ambulatory laparoscopic ACBS – Total 2004 ambulatory laparoscopic ACBS)/Total 2004 ambulatory laparoscopic ACBS.

The independent variable used to test Hypothesis B is *Facility*, where ASC = 0; ACGH = 1. The association between the independent and dependent variables represents the medical facility shift.

Hypothesis C

The research assumes that within ACGHs ambulatory ACBS procedures will experience a larger percent increase than inpatient ACBS procedures. The dataset for *Hypothesis C* is comprised of ACGHs only. The dependent variable for *Hypothesis C* is *Percent Change in ACBS Ambulatory Procedures*, *%ΔAmbACBS*, which is based on the number of ambulatory ACBS procedures performed in 2004 and 2009 at the facility level ($AmbACBS_{2004}$ and $AmbACBS_{2009}$). The equations used to derive the dependent variable follows:

(d) Percent Change in Ambulatory ACBS = (Total 2009 ambulatory ACBS – Total 2004 ambulatory ACBS)/Total 2004 ambulatory ACBS.

The independent variable that will be used to test *Hypothesis C* is: *Percent Change in Inpatient ACBS Procedures, %ΔInpatientACBS*, which is determined by the number of inpatient ACBS procedures performed in 2004 and 2009 at the facility level ($InpatientACBS_{2004}$ and $InpatientACBS_{2009}$). The equation used to derive the independent variable is formulated as follows:

(e) Percent Change in Inpatient ACBS = (Total 2009 inpatient ACBS – Total 2004 inpatient ACBS)/Total 2004 inpatient ACBS.

The association between the independent and dependent variables reflects the surgical-setting shift.

Hypothesis D

The research assumes that within ACGHs laparoscopic ACBS will experience a larger percent increase than open ACBS procedures. The dataset for *Hypothesis D* comprised of ACGHs only. The dependent variable for *Hypothesis D* is *Percent Change in ACBS Laparoscopic Procedures*, *%∆LapACBS*, which is based on the number of laparoscopic ACBS performed in 2004 and 2009 at the facility level ($LapACBS_{2004}$ and $LapACBS_{2009}$). The equations used to derive the dependent variable follows:

(f) Percent Change in Laparoscopic ACBS = (Total 2009 laparoscopic ACBS – Total 2004 laparoscopic ACBS)/Total 2004 laparoscopic ACBS.

The independent variable that will be used to test *Hypothesis D* is: *Percent Change in Open ACBS Procedures, %∆OpenACBS*, which is based on the number of open ACBS performed in 2004 and 2009 at the facility level ($OpenACBS_{2004}$ and $OpenACBS_{2009}$). The equation used to derive the independent variable is as follows:

(g) Percent Change in Open ACBS = (Total 2009 open ACBS – Total 2004 open ACBS)/Total 2004 open ACBS.

The association between the independent and dependent variables reflects the technology shift within ACGHs.

Table 9: Measurement of Dependent Variable

Dependent Variable	Outcome	Objective	Operationalization	Source
Hypotheses A & D: Percent Change in Laparoscopic ACBS	Technology Shift: Substitution Threat (Surgery Procedure)	Determine trend in ACBS procedure utilization	(Total 2009 laparoscopic ACBS – Total 2004 laparoscopic ACBS)/ Total 2004 laparoscopic ACBS	Intellimed
Hypothesis B: Percent Change in Ambulatory Laparoscopic ACBS	Medical Facility Shift: Substitution Threat (Facility Type)	Determine trend in ACBS facility type	(Total 2009 ambulatory laparoscopic ACBS – Total 2004 ambulatory laparoscopic ACBS)/Total 2004 ambulatory laparoscopic ACBS	Intellimed
Hypothesis C: Percent Change in Ambulatory ACBS	Surgical Setting Shift: Substitution Threat (Surgical Setting)	Determine trend in ACBS surgical setting	(Total 2009 ambulatory ACBS – Total 2004 ambulatory ACBS)/Total 2004 ambulatory ACBS	Intellimed

Table 10: Measurement of Independent Variables

Independent Variable	Type	Level of Measure	Operationalization	Source
Percent Change in Open ACBS	Continuous	Ratio	(Total 2009 open ACBS – Total 2004 open ACBS)/Total 2004 open ACBS	Intellimed
Facility Type	Categorical	Nominal	ACGH = 0 ASC = 1	Intellimed
Percent Change in Inpatient ACBS	Continuous	Ratio	(Total 2009 inpatient ACBS – Total 2004 inpatient ACBS)/Total 2004 inpatient ACBS	Intellimed

The following section describes control variables that are categorized under two topical areas: facility characteristics and demographic characteristics.

Facility Characteristics

Control variables include: a categorical variable representing the state in which a medical facility is located, *STATE*: (Wisconsin = 0; Florida = 1); a categorical variable based on the CBSA classification that designates where a medical facility is located, *CBSA*: (Non-

metropolitan (micropolitan and rural) = 0; Metropolitan = 1); a continuous variable representing the log transformations of the number of staffed beds at each hospital (BEDSIZELOG); and a categorical variable reflecting the ownership structure of a medical facility that is defined by tax exempt status as for profit or non-profit hospital (FORPROFIT). (*See Table 11*: Measurement of Control Variables for more details.)

Demographic Characteristics

The demographic control variable is a continuous variable formulated to measure CBSA population change that is calculated based on U.S. Census Bureau annual population estimates of metropolitan and micropolitan statistical areas for 2004 and 2009 formulated as percent change in CBSA population, POP%: ($CBSAPOP_{2009}$-$CBSAPOP_{2004}$)/$CBSAPOP_{2004}$). (*See Table 11*: Measurement of Control Variables for more details.)

Table 11: Measurement of Control Variables

Facility Characteristics				
Variable	Variable Type	Level of Measure	Operationalization	Source
STATE	Categorical	Nominal	Wisconsin = 0 Florida = 1	Intellimed
CBSA	Categorical	Nominal	Micropolitan = 0 Metropolitan = 1 Rural = 0	Intellimed
BEDSIZELOG	Continuous	Interval/Ratio	The log of the number of operational Hospital Beds	AHA
FORPROFIT	Categorical	Nominal	Nonprofit = 0 For Profit = 1	AHA
Demographic Characteristics				
Variable	Variable Type	Level of Measure	Operationalization	Source
POPULATIONCHANGE	Continuous	Interval/Ratio	Percent change in annual CBSA population between 2004 and 2009	U.S. Census Bureau, Population Division

Description of Variables

This work assumes that facility and environmental factors help spark disruptive innovation by contributing to the emergence of new entrants in the hospital sector that influence industry-wide shifts (Hwang & Christensen, 2008). In developing the conceptual model that describes the effect of disruptive innovation in the hospital industry, a variety of determinants are expected to influence organizational change and effect the amount and type of surgical procedures utilized. The variables used in the models are derived from the literature review in Chapter 2 and the theoretical discussion featured in this chapter. The following provides the logic for the inclusion of the aforementioned variables in the statistical models.

Dependent Variables

ACBS Laparoscopic Procedures[14]

Appendectomy, cholecystectomy, and bariatric surgery are among the most common elective surgical procedures performed (National Center for Health Statistics, 2006b; Russo et al., 2007). Cholecystectomy is one of the most common elective surgical procedures performed in the United States (Russo et al., 2007). Bariatric surgery is among the fastest growing elective surgical procedures in the country (Encinosa et al., 2009). Elective surgery may be optional or medically required (http://www.surgeryencyclopedia.com/Ce-Fi/Elective-Surgery.html).

Laparoscopic surgical procedures increasingly are touted for their clinical advantages and cost-effectiveness. The first reported laparoscopic appendectomy was recorded in 1983, and later that decade the first laparoscopic cholecystectomy was reported (Nguyen et al., 2004). The earliest laparoscopic bariatric surgery procedure occurred in the 1990s (Nguyen et al., 2004). Laparoscopy has been proven as a safe and reliable surgical technique, and it has become the

[14] The discussion of the independent variable, *ACBS Open Procedures*, occurs together with the discussion of the dependent variable, *ACBS Laparoscopic Procedures*.

"gold standard" for cholecystectomy (removal of the gall bladder) (Soltesz & Brooks, 2004). Laparoscopic surgery has been proven superior to the open method in many cases. In fact, laparoscopic cholecystectomy is now one of the most commonly performed general surgery procedures (Buechner, 2001; Clancy & Brooks, 2004). Compared to open surgical procedures, the benefits of laparoscopy include reduced post-operative pain, infection rate, and disability; smaller scars, shorter hospitalization, and faster recovery. In combination with advances in anesthesia and the enactment of regulations, these benefits have stimulated the rapid adoption of laparoscopic surgery for common bile duct stones, appendectomy, bariatric surgery, gastrointestinal procedures, and other surgical procedures (Hunter & Sackier, 1993; Steichen & Welter, 1994; Ballantyne et al., 1994; Clancy & Brooks, 2004; Soltesz & Brooks, 2004; Palanivelu, 2008; Katkhouda, 2010).

Cholecystectomy and bariatric surgery are two surgical procedures related to obesity (Martin, 2004). Technological advances have greatly influenced the utilization of cholecystectomy and bariatric surgery (Buechner, 2001; Russo et al., 2007). While laparoscopic cholecystectomy and bariatric surgery are growing in popularity, not all patients are suitable for laparoscopic procedures. "Patients who are extremely obese, who have had previous abdominal surgery, or have complicating medical problems may require the open approach" (http://www.win.niddk.nih.gov/publications/gastric.htm). There remains much debate regarding the optimal surgical treatment of appendicitis. Studies reveal conflicting results related to shorter length of stay, reduced infection rates and post-operative pain, and intra-abdominal perforation or trauma during surgery (Nguyen et al., 2004; Humes & Simpson, 2006). It is unclear whether the benefits of laparoscopic appendectomy outweigh those of open appendectomy procedures; yet, the utilization of the laparoscopy continues to rise (Nguyen et al., 2004).

Compared to open ACBS procedures, laparoscopic ACBS will have a higher percent increase.

ACBS Ambulatory Procedures[15]

Ambulatory surgery is becoming an increasingly popular alternative to inpatient surgery. Its popularity is attributed to improvements in anesthesia and advances in surgical technology (Russo et al., 2007). These factors have influenced the transition from inpatient to outpatient surgical settings for appendectomy, cholecystectomy, and bariatric surgery procedures.

In 2003, about 16% of appendectomies were administered in outpatient settings. As this proportion continues to rise, studies reveal that patients between the ages of 18 and 44 are more likely to receive an appendectomy in an ambulatory setting, while individuals 65 and over are more likely to be administered inpatient appendectomies. And while males and females equally received inpatient appendectomies, females were more likely to undergo the procedure in an outpatient setting (Russo et al., 2007).

Research indicates that in 2003 at least half of cholecystectomies are performed in ambulatory settings (Russo et al., 2007). Since the advent of laparoscopic cholecystectomy in 1988, this procedure has become the treatment of choice for symptomatic gall bladder disease (De, 2004; Davis, 1984). Others maintain that laparoscopic cholecystectomy has become the gold-standard for gall bladder removal and estimate that as many as 80% of cholecystectomies are performed in this manner (http://www.lapsurg.org/gallbladder.html). In 2003, patients under 64 years of age were more likely to receive a cholecystectomy in an outpatient setting, while those 65 and older were more likely to be administered an inpatient cholecystectomy (Russo et

[15] The discussions regarding the independent variable, *ACBS Inpatient Procedures*, occurs in conjunction with the dependent variable, *ACBS Ambulatory Procedures*.

al., 2007). Females received more than 75% of the outpatient cholecystectomies performed in 2003, and 67% of the inpatient procedures performed (Russo et al., 2007).

Bariatric surgery is comprised of several different types of surgical procedures designed to treat obesity, and the procedure has become one of the fastest growing surgical procedures in the country (Encinosa et al., 2009). An increasing number of patients are undergoing bariatric surgery not only to lose weight but also to eliminate or reduce the risk of diabetes, high blood pressure, heart disease, and musculoskeletal disease. In 2003, almost all bariatric surgery procedures were performed in inpatient settings; only 3 percent of bariatric surgeries took place in ambulatory settings (Russo et al., 2007). Between 2001 and 2006, the use of laparoscopic bariatric surgery increased from 9% to 71%, in part due to smaller incision; reduced trauma associated with operative exposure; fewer infections, complications, and deaths associated with the procedure; and reductions in costs (Encinosa et al., 2009). Between 2004 and 2006, there was a slight drop in the number of inpatient surgeries and a dramatic decrease in the open bariatric procedures performed, such as high gastric bypass surgery (http://home.thomsonhealthcare.com/News/view/?id=1241). Surgeries performed laparoscopically and in outpatient settings continue to grow in popularity. “In many hospitals and specialty centers, bariatric surgery is the most common class of operations being performed” (Buchwald & Buchwald 2008: 3).

The average age was about 42 for a patient receiving inpatient or outpatient bariatric surgery in 2003. Almost all bariatric surgery procedures performed in ambulatory settings were administered on patients between 18 and 64 years of age. Females comprised almost 83% of the patients receiving both inpatient and outpatient bariatric surgery procedures (Russo et al., 2007).

Compared to inpatient ACBS, ambulatory ACBS procedures will have a higher percent increase.

Independent Variables

Facility

ASCs and ACGHs are in the same organizational field and are subject to many of the same environmental forces (Scott et al., 2000; DiMaggio & Powell, 2004); yet, they are considered different sets of organizations that respond differently to environmental influences. As open systems, the activities and outcomes of ASCs and ACGHs are defined by the contexts in which they are embedded and are characterized by their connectedness and interdependency, and intraorganizational and interorganizational linkages (Granovetter, 1985; Pfeffer & Salancik 2003; Tian, 2006). These and other factors affect organizational change and contribute to a medical facility's performance (Haveman, 1993).

Over the past twenty years, the number of surgeries performed in outpatient settings has increased (Russo et al., 2007; MedPAC, 2011). Rising health care costs and the overutilization of inpatient surgery are two factors that have generated greater focus on ambulatory surgery as a lower-cost alternative to inpatient surgery, largely because ambulatory surgical procedures require less than 24-hour hospital stays. ASCs also have lower administrative overhead than do hospitals (Russo et al., 2007). The particular threats that ASCs pose to hospitals are especially important, given that inpatient surgery has been the cornerstone of hospital services for over a century. The monopoly that hospitals once had on surgery appears to be eroding (Stevens, 1989: xvii). Many applaud the acceleration of efforts to shift services out of hospitals. The Federal Trade Commission (FTC), Department of Justice (DOJ), and advocates for specialty hospitals and ambulatory surgery centers support the development of market-driven responses to high cost

hospital-based care (Federal Trade Commission & Department of Justice, 2004; Choudhry et al., 2005). They contend that specialty medical facilities, like ASCs, help to improve the functioning of the hospital industry by increasing competition, reducing costs, broadening access, and improving the quality of health care services.

The hospital industry has witnessed profound shifts in the types of procedures performed and in the locus of care as fewer open surgeries are administered and more medical services have moved from traditional hospital settings to hospital outpatient departments and free-standing physician-controlled sites. As ASCs focus on a select number of more profitable services and take market share away from acute care general hospitals, it has become more difficult for hospitals to cross-subsidize to provide a wide range of general services. In response to new entrants in the competitive environment, hospitals and hospital systems have added, expanded, and enhanced their facilities and service offerings in order to retain market share and revenues, (MedPAC, 2011). As a result, hospital costs and health expenditures have continued to rise, in part from increased service volume (i.e., duplication of services, excess capacity, and physician-driven demand), but the increase has occurred at a slower rate than expected (Berenson et al., 2006; Steen, 2006; MedPAC, 2011: 49).

Hospitals, hospital systems, and leading health industry associations, such as the American Hospital Association (AHA) and the Federation of American Hospitals (FAH) are concerned about ASCs eroding the hospital's ability to cross-subsidize "by 'cherry picking' relatively well-insured and healthy patients (where profit margins are higher) and by limiting or denying care outright to underinsured, indigent, and less healthy patients" (Choudhry et al., 2005: w5-363). While ASCs focus on the most profitable patients and procedures, uninsured and underinsured patients must seek health care at general hospitals. Consequently, financial and

service disparities may worsen because profitable patients are cared for in specialty facilities, while less profitable patients remain the responsibility of general hospitals.

Compared to ACGHs, ASCs will have a higher percent increase in laparoscopic ACBS procedures.

Compared to ACGHs, ASCs will have a higher percent increase in ambulatory ACBS procedures.

Control Variables

State

ACBS data from Wisconsin and Florida medical facilities are featured is this work in an effort to highlight regional variation in ACBS utilization. Florida is situated in the extreme southeastern corner of the United States and ranks 22nd in size (square miles) among the 50 states (Source: http://www.city-data.com/states/Florida-Location-size-and-extent.html). Located in the eastern north-central section of the United States, Wisconsin is 26th in terms of size (Source: http://www.city-data.com/states/Wisconsin-Location-size-and-extent.html).

Research indicates that surgical utilization varies by state (Rutkow, 1989a; Russo et al., 2007). Numerous studies have documented regional variations in health care delivery (Payer, 1996; Levit et al., 1993; Martin et al., 2002; AHA, 2009; Wennberg et al., 2002; Wennberg & Gittelsohn, 1982; Wennberg & Wennberg, 2003). A variety of factors contribute to geographical variations, including demographic characteristics, disease prevalence, type of insurance coverage, and access to health care (Wennberg, 1989; Payer, 1996; Martin et al., 2002). Factors such as these influence organizational performance and change (i.e., growth and decline) (Scott, 1992; Baum & Shipilov, 2004; Christensen et al., 2009). Regional variations in surgical utilization rates are well researched. A comparative analysis of state regional variations across

six common elective procedures found a threefold to fourfold variation in surgical rates (Rutkow, 1989b). A comparative analysis of state variation in Maine and Vermont found as much as 100% variation in the utilization of non-common surgical procedures (Rutkow, 1989b). Wennberg and colleagues found that residents of New Haven, Connecticut were twice as likely as Bostonians to undergo a coronary bypass (Rutkow, 1989b).

Yet, while the study of regional variation as an analytical methodology is well-established (Rutkow, 1989b, Wennberg & Gittelsohn, 1982; Wennberg et al., 2004), there remains much debate regarding the determinants of the variation. Research suggests that the differential supply of surgeons is the cause of regional variations in surgery rates (Mitchell & Cromwell, 1982). Others point to diverse medical practice styles as indicators of wide regional variations in hospital utilization (Wennberg et al., 1989). Still, others point to waste inherent in America's health care system as a determinant of regional variation (Berman & Gertman, 1982). Variations in rates of surgical utilization are particularly important public and health policy concerns due to the escalating costs associated with the growth in unnecessary and excessive surgeries (Mitchell & Cromwell, 1982).

Research reveals that a complexity of factors drive regional variations in the utilization of elective surgical procedures; yet, limited research explores the underlying factors that influence regional variations in the utilization of cholecystectomy and bariatric surgery (AHA, 2009). State variations among elective surgeries point to the performance of clinically inappropriate levels of surgical procedures. Wide variations in surgical case volumes suggest inefficiencies in the health care sector. Regional differences in surgical case volumes also indicate that unnecessary surgeries could be eliminated yielding reductions in health care spending and utilization without harming health in low or high case volume regions (Orszag, 2008).

Compared to Wisconsin, Florida will have a higher percent increase in laparoscopic ACBS.

Compared to Wisconsin, Florida will have a higher percent increase in ambulatory ACBS.

CBSA

Organizational survival depends on the formulation of strategies that fit local environments (Hannan & Freeman, 1977; Baum & Shipilov, 2004). “Location and proximity to markets are important factors for service organizations generally and hospitals in particular” write Goldstein and colleagues (2002: 65). Geographic location is an important environmental factor that influences hospital decision-making because hospitals are high contact service organizations, and most of their market share comes from areas in relatively close proximity to facilities (Robinson & Luft, 1985; Goldstein et al., 2002). Determining whether a medical facility is located in a metropolitan, micropolitan, or rural area is essential because market structure impacts expenditures and health care costs, and “hospitals in more competitive environments exhibited significantly higher costs of production than [do] those in less competitive environments” (Robinson & Luft, 1985: 333). Metropolitan locations are generally regarded as more advantageous for hospitals than rural locations with limited resources and populations, and little or no competition in the immediate area of the hospital. In their study on the effects of location, strategy, and operations technology on hospital performance, Goldstein and colleagues (2002) found that management strategy can modify the effects of hospital location.

Compared to non-metropolitan, metropolitan is positively associated with laparoscopic ACBS.

Compared to non-metropolitan, metropolitan is positively associated with ambulatory ACBS.

Log Bed Size

Organization size influences performance and organizational change (Hannan & Freeman, 1977, 1984). Christensen and colleagues (2009) maintain that larger organizations can be less flexible, more bureaucratic, and slower to respond rapidly in competitive markets that are adapting to technological innovation. In her work on organizational size and change, Haveman (1993) found that organization size impacts the speed with which organizations enter new markets. In reference to organizations and environmental context, Haveman writes:

> size should not be conceptualized as solely an organizational characteristic. Instead, the context in which organizational size has an effect must be considered. In this industry, organizational size is primarily an indicator of the extent to which organizational action is externally constrained. The relationship between size and change thus depends on external constraints that vary from setting to setting.

Kimberly asserts that “different aspects of size are primarily relevant to different kinds of organizational problems and hence related to different dimensions of organizational structure” (1976: 592). In other words, different measures of size are appropriate for different sets of organizations facing different types of organizational issues. This work focuses on the impact of technological innovation on organizational change (i.e., change in surgical utilization). The log transformations of bed size serves as a proxy for hospital size. Damanpour “found that the size-innovation correlation is slightly stronger when a log transformation rather than a raw measure of size is used” (1992: 386). Damanpour further writes:

> . . . on average, a curvilinear relationship better represents the relationship between size and innovation than does a linear relationship. A curvilinear relationship indicates that innovation increases with size at a declining rate; in other words, when an organization becomes larger, more resources are required to produce equivalent changes in the degree of innovativeness.

Log bed size is positively associated with laparoscopic ACBS surgical utilization.

Log bed size is positively associated with ambulatory ACBS surgical utilization.

For-Profit

Environmental factors influence hospital performance (Hannan & Freeman, 1977; Christensen et al., 2009). In the competitive hospital industry, hospitals "develop strategies to respond to environmental factors and competitive challenges. Those strategies drive operational decisions regarding investments in new or updated technology" (Goldstein et al., 2002: 63). Ownership arrangement (i.e., for-profit, non-profit, and government-owned) also informs operational and technology decisions, as well as organizational goals and strategies (Scott et al., 2000). Research suggests that compared to for-profit hospitals, non-profit Catholic hospitals have been slower to invest in advanced technology and equipment (Prince, 1994; Goldstein et al., 2002). Non-profit hospitals are typically not held exclusively to economic standards of performance and may place a higher value on social welfare interests. Yet, while non-profit hospitals remain the dominant type in the hospital industry, many are embracing the more competitive orientation and strategies of for-profit providers. With the significant rise in the number of for-profit hospitals, particularly specialized, the distinction between for-profit and non-profit forms and behaviors has blurred (Scott et al., 2006). It is hypothesized that compared to non-profit hospitals, for-profit hospitals will have more strict profitability and return on investment criteria. For-profit hospitals also are more likely to allocate resources for acquisition and mergers, as well as for the adoption, expansion, and utilization of innovative technologies.

Compared to non-profit status, for-profit status is positively associated with laparoscopic ACBS surgical utilization.

Compared to non-profit status, for-profit status is positively associated with ambulatory ACBS surgical utilization.

Demographic Characteristics

Demographic characteristics within markets and regions serve as broader environmental factors of organizational behavior and change (Hannan & Freeman, 1977; Baum & Sipilov, 2006). Organizations respond to population changes, the availability of resources, and shifting trends within environments. These factors are determinants of health care demand (Baker, 2000) and affect the interplay between hospitals and specialty surgical facilities (Devers, 2003).

Population Change

Population ecology theory suggests that organizations are embedded in environmental contexts from which they depend upon input and output resource flows (Hannan & Freeman, 1977; Granovetter, 1985; Scott, 2003). Demographic shifts and other changes in the environmental context serve as determinants of organizational change and survival (Baum & Shipilov, 2004). These shifts also generate uncertainties that influence organizational decision-making and strategic responses (Pfeffer & Salancik, 1978).

In the hospital industry, population change impacts the availability of health care resources; and affects system and organizational structures, service provision and utilization, and access to medical services (Short et al., 2003). Population growth is associated with rising health care spending and increasing personal health care costs (McCarthy & Finkel, 1980; Mendelson & Schwartz, 1993; Short et al., 2003). In some cases, population growth has outpaced growth in hospital inpatient, outpatient, and emergency room visits placing tremendous strains on health care systems (Roth, 1971; Short et al., 2003).

Population change is positively associated with laparoscopic ACBS surgical utilization.

Population change is positively associated with ambulatory ACBS surgical utilization.

Summary

Disruptive innovation theory emphasizes the market-transforming impact of innovative technology in health care. Both disruptive innovation theory and population ecology theory highlight the importance of environmental factors on institutional change and organizational survival. Disruptive innovation theorists assume that conventional expert-intensive firms that produce complicated, expensive products and services to select high-end customers lose market share when newer more non-traditional, smaller and flexible firms enable innovative technology to produce quality products and services that are more affordable and accessible. Many believe that disruptive innovations will transform the health care industry by changing the system from the outside in (Christiansen et al., 2006; Glabman, 2009).

Based on disruptive innovation theory, a conceptual model was formulated illustrating the effects of environmental influences, such as regulations and standards, market influences, and demographic trends, on the hospital industry. Hospitals and ambulatory surgery centers respond differently to environmental determinants. Based on the model, two sets of hypotheses were developed for testing. Table 12 presents the independent and control variables along with their expected relationship to outcome measures.

The literature review presented in Chapter 2 and the theoretical framework and conceptual model outlined in Chapter 3 provide the groundwork for examining the relation between open and laparoscopic procedures, inpatient and ambulatory procedures, as well as the association between facility type and ambulatory laparoscopic ACBS procedure utilization. The methodologies used to implement the study are described in Chapter 4.

Table 12: Summary of Variables and Their Expected Association with Laparoscopic and Ambulatory ACBS Utilization

Variable Type	Determinant	Expected Relation to Outcome Measure: ACBS Procedure Utilization		
		Technology Shift (Percent Change in Laparoscopic ACBS)	Facility Shift (Percent Change in Ambulatory Laparoscopic ACBS)	Setting Shift (Percent Change in Ambulatory ACBS)
Independent				
	PERCENT CHANGE OPEN ACBS	-	N/A	N/A
	ASCs (Compared to ACGHs)	N/A	+	N/A
	PERCENT CHANGE INPATIENT ACBS	N/A	N/A	-
Control				
Facility Characteristics				
	FLORIDA, Compared to Wisconsin	+	N/A	+
	METROPOLITAN, Compared to non-metro areas	+	N/A	+
	BEDSIZELOG	+	N/A	+
	FORPROFIT, Compared to non-profit	+	N/A	+
Demographic Characteristics				
	POPULATIONCHANGE	+	N/A	+

CHAPTER 4 – METHODOLOGY

The literature review, theoretical framework, and conceptual model presented above provide the groundwork for the methodologies presented in this chapter. The methodologies outlined are employed to examine determinants of laparoscopic and ambulatory appendectomy, cholecystectomy, and bariatric surgery utilization. The research methods described in this chapter serve to frame and guide data analysis.

The chapter flows as follows. After a presentation of the research questions that the study seeks to address, details of the research design are offered. Next, an overview of the data and data sources used are discussed. A description of the sample and sampling process is then presented. Lastly, the statistical methods employed for data analysis are explained.

Research Questions

The study aims to address the following questions:

1. How has the utilization of appendectomy, cholecystectomy, and bariatric surgery procedures (ACBS) changed over time?
2. How do acute care general hospitals and ASCs differ in the utilization of laparoscopic ambulatory ACBS procedures?
3. Does ACBS utilization differ by state?
4. Do study findings support Christensen's disruptive innovation theory?

Research Design

The purposes of this non-experimental study are to (1) test Christensen's theory of disruptive innovation in the hospital industry, and (2) examine the effects of disruptive innovation on the utilization of ACBS. The study compares the utilization of ACBS procedures performed in acute care general hospitals and ambulatory surgery centers in Florida and

Wisconsin. The objective of the research is to investigate technology shifts between open and laparoscopic ACBS, surgical-setting shifts between inpatient and outpatient ACBS, and medical facility shifts between ACGHs and ASCs performing ACBS procedures.

The research examines the relationship between medical facility type (i.e., ACGHs and ASCs), and percent change in ACBS procedure utilization. During the exploratory data analysis phase thirteen control variables were examined. Following stepwise procedures and multicollinearity diagnostic testing, some control variables were dropped from the analysis in order to achieve more parsimonious models. The study controls for facility and demographic factors. They are described generally as follows:

- **Facility characteristics**: facility type, state, metropolitan area, log bed size, and for-profit
- **Demographic characteristics**: CBSA population change

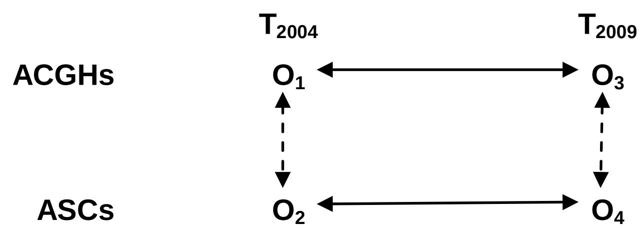
Level of Analysis

The unit of analysis for this work is the individual medical facility. The facility level of analysis is appropriate for disruptive innovation theory, which focuses on the interplay between organizations and their survival. Additionally, population ecology, a theoretical framework for the study, provides instructive conceptual tools for deciding the level on which analysis may take place. This work examines organizational change by assessing the percent change in surgical utilization. Population ecology suggests conducting research at the organizational level for studies that (1) consider variations in rates of organizational founding, change, or failure over time; or (2) that seek to identify the relations between organizational founding, change, or failure and organizational and environmental characteristics (Baum & Shipilov, 2004).

Panel Design

The study primarily describes differences and analyzes trends in laparoscopic and ambulatory ACBS surgical utilization, and identifies factors that influence shifts in utilization. The longitudinal research design uses hospital discharge data to conduct a retrospective, comparative assessment of surgical procedures performed at ACGHs and ASCs (Babbie, 2005). The panel study examines changes in ACBS surgical procedures over a six-year period. Observations from two years, T_{2004} and T_{2009}, are compared. During the course of the study, no interventions are introduced for observation. Figure 7 illustrates the non-equivalent comparison group (ACGHs and ASCs) trend design formulated for this study (Babbie, 2001).

Figure 7: Diagram of Panel Design



Surgical utilization will be observed longitudinally in two types of medical facilities: ACGHs and ASCs. Surgical procedures are tracked for years 2004 and 2009. The research design employs repeated measures data, a term that refers to the observation schedule that consists of at least two similarly timed data collection points (Scott, M., 2004). The dashed vertical line [↕] indicates between facility type comparisons for each observation year — 2004 and 2009. The solid horizontal line [↔] refers to within group comparisons across time between 2004 and 2009. The comparison groups also will be compared with one another over time.

The panel design affords several advantages over a cross-sectional study that observes a sample at one point in time. One advantage of the panel or longitudinal design is that data are

examined at different times from the same subjects allowing for participants or groups to be tracked and measured across time (Babbie, 2005). Researchers are able to assess the association between an independent variable and changes in outcome measures over time (Kerlinger & Lee, 2000; Frankfort-Nachmias & Nachmias, 2008). Longitudinal designs also afford assessments of relationships between independent and dependent variables—allowing for the drawing of associations and making causal inferences between covariates possible (Babbie, 2001).

Panel designs, however, come with disadvantages. One problem with panel designs is identifying a representative sample that is willing to remain in the study over time (Frankfort-Nachmias & Nachmias, 2008). The lack of a representative sample, or loss of study participants over the course of the study, may lead to selection bias. Participants who are no longer in the sample may be very different from those that remain in the study (Babbie, 2005). Sampling strategies and statistical analysis procedures may be employed to lessen some disadvantages of panel designs and control for some factors that may be responsible for threats to internal validity.

Threats to Internal Validity

The non-experimental research design feature of the study, leaves findings open to several threats to internal validity, yet the sampling frame protects findings against a few threats. While the panel design is necessary to determine the association between independent and dependent variables, the research design does not strictly control for confounding variables, leaving findings open to the threats of history, maturation, testing, instrumentation, and mortality.

Intellimed organizes detailed clinical and financial information collected by state agencies. All hospitals, ASCs, and physicians are required to report information in select states,

which makes statistical regression and selection bias unlikely to present threats to internal validity, and reduces the likelihood of history and mortality threats. While history is unlikely to pose a threat when examining ACGHs and ASCs at the national level, it cannot totally be ruled out when comparing medical facilities in different states. State-level events may affect Florida without affecting Wisconsin, and vice versa. For instance, a state may subject medical facilities to rules and legislation that are not enacted in other states. Florida ACGHs are subjected to CON legislation, while Wisconsin ACGHs are not.

Statistical regression is ruled out because medical facilities in the study are not categorized as having extreme positions on any measure. Selection bias is ruled out because all hospitals and ASCs in a given market are included in the sample (Kerlinger & Lee, 2000; Babbie, 2005). Selection bias refers do the comparison of equivalent groups in experimental studies where study participants are randomly assigned to a control and experimental group. The equivalency of groups is important when drawing conclusion. This non-experimental study uses non-equivalent groups, so selection bias in not a threat for this work. It is unlikely that mortality poses a threat because all facilities remained in the study over the study period. In one sense, mortality is controlled because no organization actually withdrew from the sample. To be included in the sample, hospitals and ASCs had to perform at least one surgical procedure in 2004 or 2009. Although mortality could pose a threat when a medical facility performed surgeries in 2004 but failed to perform even one surgery in 2009. Information is not available to determine whether the medical facility simply did not perform a certain type of surgical procedure in 2009, or whether the medical facility merged with or was acquired by another facility, or went out of business.

The research design is potentially vulnerable to the threat of maturation because medical facilities may have changed during the study period through education and experience, or expansion and merger. Organizations change over time—growing older and wiser. It is not known if maturation affected hospitals differently from ASCs during the study period (Kerlinger & Lee, 2000; Babbie, 2005). Findings, therefore, are subject to the threat of maturity, leaving conclusions open to rival hypotheses. The use of secondary data makes it unclear as to whether ACGHs are more subject to threats of testing and instrumentation than ASCs. The effects of testing and instrumentation (measurement processes) on hospitals and ASCs are unknown. Therefore, these threats cannot be completely ruled out (*See Table 13*: Sources of Threats to Internal Validity.)

Table 13: Sources of Threats to Internal Validity

Sources of Threats to Internal Validity	Presence of Threat
History	–/+
Maturation	+
Testing	+
Instrumentation	+
Regression	–
Selection	–
Mortality	–/+

Source: Campbell & Stanley, 1963.

Data and Data Sources

The primary dataset is drawn from secondary data licensed through Intellimed International Corporation.[16] The Intellimed system uses CMS-MedPar Standard Analytical File (SAF) databases for the nation. The Intellimed system includes hospital discharge data that are gathered by state agencies from 100% percent of general acute care hospitals and ambulatory surgery centers in selected states. The Intellimed system tracks provider, patient, clinical, payer, admission, discharge, market share, and utilization data. Intellimed provides the data for the

[16] Intellimed data are not derived from a sample.

sampling frame procedure, as well as data for dependent variables (i.e., technology shift and surgical-setting shift) and the independent variable (i.e., facility type). Intellimed data have been merged with other datasets including those from the U.S. Census Bureau, Centers for Disease Control and Prevention (CDC), and American Hospital Association (AHA). Some of these sources provide information for control variables; others are sources for descriptive analyses. Intellimed supplies information for the state in which a medical facility is located, as well as the facility CBSA codes for metropolitan, micropolitan, and rural classifications.

Availability of data sums up the rationale for selecting the years 2004 and 2009, and the states Florida and Wisconsin. The year 2004 is the earliest year offering information on ASCs in the Intellimed system. Of the many states in the Intellimed system, only Florida and Wisconsin provided reliable information on both ACGHs and ASCs. When the data collection phase commenced for this research study, the year 2009 was the last year with data available for all four quarters.

The AHA annual survey database is comprised of hospital-specific information on 6,500 hospitals in 2009[17]. The AHA collects information on more than 1,000 measures that include organizational structure, hospital facilities and services, utilization statistics, and financial performance[18]. For this study, the AHA is a source of information for facility characteristics, such as log bed size and for-profit status. Population change data are derived from the U.S. Census Bureau's Population Division. Population figures for 2004 and 2009 and the percent change in population size that occurred over the six-year period are based on annual estimates of

[17] Source: http://bcvdc.blogspot.com/2012/03/american-hospital-association-annual.html

the population of metropolitan and micropolitan statistical areas that were released in March 2010.

Sample and Sampling

This work assumes that disruptive innovation in the hospital industry has created a favorable environment for ASCs performing selective abdominal surgery procedures. Consequently, it is hypothesized that the rate of laparoscopic and ambulatory surgical procedures has increased faster at ASCs than ACGHs. Data from Florida and Wisconsin are pooled together in the dataset. The sample is comprised of 602 ACGHs and ASCs located in various regions across Florida and Wisconsin. There are 459 Florida-based facilities, and 143 based in Wisconsin. The unit of analysis is the facility, which is categorized as either an ASC or ACGH. An attempt was made to include all ASCs and ACGHs in Florida and Wisconsin performing ACBS procedures in 2004 and 2009 in the sample. Medical facilities with missing data and those with significant discrepancies after merging datasets, however, were dropped from the sample. Figure 8 illustrates the sampling procedure.

The dataset consists of 14,448 observations. The large number of observations is beneficial for panel designs. The total number of observations is determined by first stratifying the surgical cases at the 602 facilities in the sample by surgery type (appendectomy, cholecystectomy, bariatric surgery), then by procedure type (open, laparoscopic), setting type (inpatient, ambulatory), and year (2004, 2009). There are 11,016 Florida observations, and 3,432 Wisconsin observations. (*See Table 14*: Number of Facilities and Observations.) The large number of observations across states increases the external validity of findings.

[18] Source: http://ams.aha.org/EWEB/DynamicPage.aspx?WebCode=ProdDetailAdd&ivd_prc_prd_key=8a4cae63-c76e-4f16-9a76-b039ea647b65

Table 14: Number of Facilities and Observations

State	Facilities	Observation	Percentage
Florida	459	11,016	76.2%
Wisconsin	143	3,432	23.8%
Total	602	14,448	100.0%

Medical facilities in the sample are located in 55 CBSAs[19]. The sample consists of 34 metropolitan CBSAs (15 in Wisconsin and 19 in Florida) and 21 micropolitan CBSAs (12 in Wisconsin and 9 in Florida). Rural areas having less than 10,000 residents are categorized as a group labeled "Undefined". While facilities are designated as being located in undefined areas, these areas are not given unique names or codes by which to identify them. (*See Table 15*: Florida and Wisconsin Micropolitan and Metropolitan Statistical Areas). CBSAs are divided into metropolitan and micropolitan areas depending on population size. Each CBSA consists of an area of at least 10,000 people. Most facilities are located in metropolitan areas (503 facilities, or 83.6% of sample). Fifty-one facilities (8.5% of sample) are located in micropolitan areas, with 48 facilities (8.0% of sample) located in rural/undefined areas. (*See Table 16*: Core-Based Statistical Areas (CBSA) Category.)

[19] "In 2003, the Office of Management and Budget implemented Core-Based Statistical Areas (CBSA) to replace MSA codes, which had been in use since about 1990" (http://www.zip-code-download.com/cbsa.php).

Figure 8: Sampling Procedure

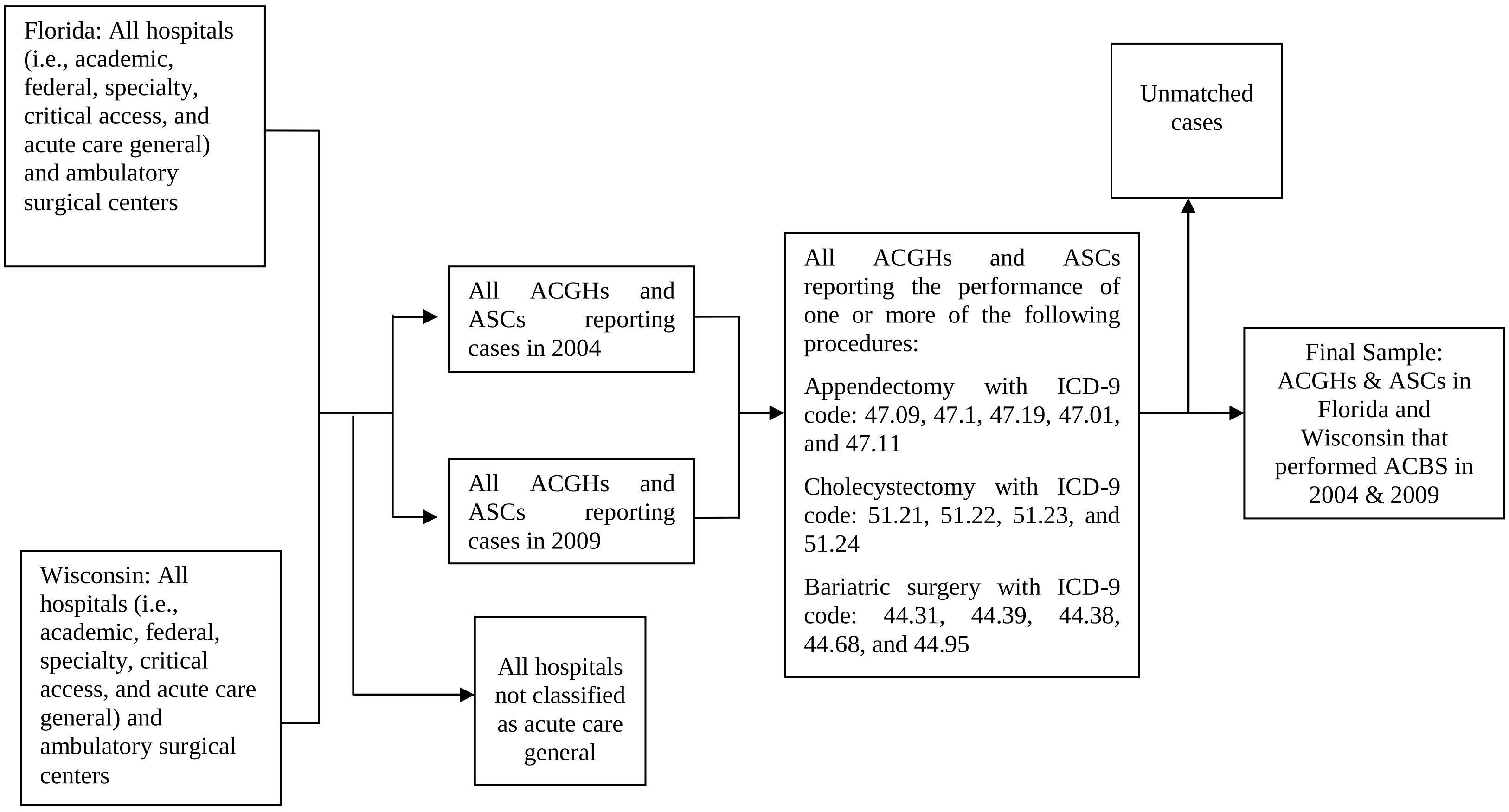


Table 15: Florida and Wisconsin Micropolitan and Metropolitan Statistical Areas*

Florida		Wisconsin	
Micropolitan	**Metropolitan**	**Micropolitan**	**Metropolitan**
1. Arcadia, FL Micro 2. Clewiston, FL Micro 3. Homosassa Springs, FL Micro 4. Key West-Marathon, FL Micro 5. Lake City, FL Micro 6. Okeechobee, FL Micro 7. Palatka, FL Micro 8. Palm Coast, FL Micro 9. Sebring, FL Micro	10. Cape Coral-Fort Myers, FL Metro 11. Deltona-Daytona Beach-Ormond Beach, FL Metro 12. Fort Walton Beach-Crestview-Destin, FL Metro 13. Gainesville, FL Metro 14. Jacksonville, FL Metro 15. Lakeland, FL Metro 16. Miami-Fort Lauderdale-Miami Beach, FL Metro 17. Naples-Marco Island, FL Metro 18. Ocala, FL Metro 19. Orlando, FL Metro 20. Palm Bay-Melbourne-Titusville, FL Metro 21. Panama City-Lynn Haven, FL Metro 22. Pensacola-Ferry Pass-Brent, FL Metro 23. Port St. Lucie-Fort Pierce, FL Metro 24. Punta Gorda, FL Metro 25. Sarasota-Bradenton-Venice, FL Metro 26. Sebastian-Vero Beach, FL Metro 27. Tallahassee, FL Metro 28. Tampa-St. Petersburg-Clearwater, FL Metro	1. Baraboo, WI Micro 2. Beaver Dam, WI Micro 3. Manitowoc, WI Micro 4. Marinette, WI-MI Micro 5. Marshfield-Wisconsin Rapids, WI Micro 6. Menomonie, WI Micro 7. Merrill, WI Micro 8. Monroe, WI Micro 9. Platteville, WI Micro 10. Stevens Point, WI Micro 11. Watertown-Fort Atkinson, WI Micro 12. Whitewater, WI Micro	13. Appleton, WI Metro 14. Chicago-Naperville-Joliet, IL-IN-WI Metro 15. Duluth, MN-WI Metro 16. Eau Claire, WI Metro 17. Fond du Lac, WI Metro 18. Green Bay, WI Metro 19. Janesville, WI Metro 20. La Crosse, WI-MN Metro 21. Madison, WI Metro 22. Milwaukee-Waukesha-West Allis, WI Metro 23. Minneapolis-St. Paul-Bloomington, MN-WI Metro 24. Oshkosh-Neenah, WI Metro 25. Racine, WI Metro 26. Sheboygan, WI Metro 27. Wausau, WI Metro
*Undefined areas are not listed.			

Table 16: Facilities by Core-Based Statistical Area (CBSA) Category

State	Micropolitan CBSA (%)	Metropolitan CBSA (%)	Undefined Area CBSA (rural) (%)	Total by Facility Type (%)
Wisconsin				
Acute Care General Hospitals	4 15.4%	18 22.8%	1 2.6%	23 16.1%
Ambulatory Surgery Centers	22 84.6%	61 77.2%	37 97.4%	120 83.9%
Subtotal	26 100.0%	79 100.0%	38 100.0%	143 100.0%
Florida				
Acute Care General Hospitals	9 36.0%	255 60.1%	2 20.0%	266 58.0%
Ambulatory Surgery Centers	16 64.0%	169 39.9%	8 80.0%	193 42.0%
Subtotal	25 100.0%	424 100.0%	10 100.0%	459 100.0%
Total by CBSA Category	51 8.5%	503 83.6%	48 8.0%	602 100%

The sample for testing *Hypotheses A* and *B* includes all Florida and Wisconsin ASCs and ACGHs reporting appendectomy, cholecystectomy, or bariatric surgery in 2004 or 2009. Hypotheses tests will compare utilization trends and changes in laparoscopic and ambulatory ACBS.

While numerous national and state information surveillance systems have been instituted to track standardized hospital data, most of these surveillance protocols had not been established to track ASC information until recently. Delays in the establishment of standardized systems for compiling information related to ASC organizational structure, performance, and health outcomes have contributed to the dearth of research conducted on ASCs (U.S. Government Accountability Office, 2009). Consequently, due to limited information on ASCs, fewer variables could be operationalized for ASCs in 2004 and 2009. ASCs will be excluded from the sample when testing *Hypotheses C* and *D.* (*See Table 17*: Models, Hypotheses, and Outcome Measures.)

Table 17: Model, Hypotheses, and Outcome Measures

Model	Unit of Analysis	Sample	Hypothesis	Indicator(s)	Objective	Outcomes
State Level (Florida and Wisconsin)	Facility	ACGHs and ASCs	(A) Technology Shift: Compared to open ACBS, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed. (B) Medical Facility Shift: Compared to ACGHs, ASCs will experience a larger percentage increase in the number of ACBS procedure performed.	Disruptive Innovation: Procedure Type and Facility Type	To understand the impact of disruptive innovative on the types of surgical procedures performed and the facilities in which the procedures are formed	(A) Technology Shift: Percent Change in Laparoscopic ACBS (B) Medical Facility Shift: Percent Change in Medical Facilities
		ACGHs Only	(C) Surgical Setting Shift Within-ACGHs: Compared to inpatient ACBS, ambulatory procedures will experience a larger percentage increase in the number performed (ACGH Only). (D) Technology Shift Within-ACGHs: Compared to open ACBS, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed (ACGH Only).	Surgical Setting and Procedure Type	To understand the impact of disruptive innovative on surgical settings and the types of surgical procedures performed within ACGHs	(C) Surgical Setting Shift Within-ACGH: Percent Change Ambulatory ACBS (D) Technology Shift Within-ACGH: Percent Change in Laparoscopic ACBS

Analytical Approach

The data analysis plan consists of two stages: (1) an exploratory phase and (2) a confirmatory phase. The exploratory phase is designed to provide a descriptive overview of the sample and determine the statistical significance of predictors. The exploratory phase aims to attain a better understanding of correlations between independent and dependent variables and to formulate parsimonious statistical models. Variables lacking statistical significance will be dropped from the dataset. During this phase, insight into ACBS utilization trends is gained. The number and type of procedures performed in ACGHs and ASCs are descriptively examined and compared. Analyses performed during the exploratory phase will inform data analyses conducted during the confirmatory data analysis phase, helping to determine the appropriate statistical procedures to employ. The confirmatory data analysis plan consists of testing theoretically-grounded hypotheses. The final statistical models developed are based on findings from the exploratory analysis.

SPSS software was employed to conduct the following statistical procedures: univariate, bivariate, and multivariate regression analyses. The following analytic techniques have been performed:

Univariate Analysis

Univariate analysis procedures were conducted for all variables used in the study. The number and type of medical facilities that comprise the dataset are described, along with the types of ACBS performed in 2004 and 2009. Descriptive statistics (i.e., frequencies, means, standard deviations, etc.) were performed. Tables illustrating subgroup comparisons are used to show growth trends in ACBS procedure utilization between 2004 and 2009 by facility type.

These procedures were conducted to summarize and organize the data, giving character to the sample (Babbie, 2005). In this section, variable distributions are checked for normality.

Bivariate Analysis

Bivariate analysis moves beyond univariate descriptions to examining correlations and making comparisons. Bivariate analysis consists of analyzing the association between two independent variables, or between an independent variable and dependent variable, to identify their empirical relationship (Babbie, 2005). In an effort to highlight variables and their relationship to one another, t-tests, crosstabs, and bivariate regression analyses were employed. T-tests using independent samples assess the association between two groups and a continuous variable. For example, the work examines whether Florida and Wisconsin differ in the percent change of laparoscopic ACBS performed in ASCs. Bivariate regression analyses also will be used to determine whether there is a significant difference in percent change in the number of ACBS procedures performed in ACGHs and ASCs.

Independent sample t-tests have been conducted to determine if there are measurable differences in a continuous dependent variable across one categorical independent variable without using controls. T-tests were performed to determine whether the dependent variable, percent change in the utilization of laparoscopic ACBS surgical procedures, varies significantly by facility type. These analyses assume that laparoscopic ACBS surgical utilization is in part influenced by facility type. The researcher's hypothesis states that there is a significant difference in the percent change in the number of laparoscopic ACBS performed between acute care general hospitals and ambulatory surgery centers. The null hypothesis maintains that there is no difference between the groups.

Multivariate Regression Analysis

The analysis for the work occurs at the facility-level and seeks to understand the impact of disruptive innovation on ACBS utilization through analyses of facility types, states, surgical settings, and procedure and surgery types.

Multivariate regression analyses were employed for hypothesis testing (Suen, 2008). These procedures allow for the development of predictive models based on the linear relation between several independent variables and a continuous dependent variable. Multiple regression analysis was used to test *Hypotheses A* and *D* and determine the association between percent changes in open and laparoscopic ACBS performed in 2004 and 2009, holding all else constant. Regression analysis was applied to test *Hypothesis B* to determine the relationship between facility type and percent change in ambulatory laparoscopic ACBS performed in 2004 and 2009, holding all else constant. Multiple regression analysis also was employed to test *Hypothesis C* and determine whether there is an association between percent change in inpatient and ambulatory ACBS performed in 2004 and 2009, holding all else constant.

Outcome Measures

Outcome measures are formulated at the facility-level and reflect medical technology shifts, surgical-setting shifts, and shifts in medical facilities that focus on changing trends in the surgical utilization. The outcome measures are continuous, ratio-level variables that represent ACBS surgical utilization. Table 18: Variables and Operationalization, offers classifications for outcomes measures and other variables used in subsequent equations.

Table 18: Variables and Operationalization

Variables	Operationalization
Year (t)	0 = 2004; 1 = 2009
State (s)	0 = Wisconsin; 1 = Florida
Facility Type (f)	0 = Ambulatory Surgery Center (ASC); 1 = Acute Care General Hospital (ACGH)
Surgical Setting (s)	0 = Ambulatory (Outpatient); 1 = Inpatient
Procedure (p)	0 = Open; 1 = Laparoscopic
Abdominal Surgery Type (a)	0 = Bariatric Surgery; 1 = Appendectomy; 2 = Cholecystectomy

Technology Shift

The outcome measures for *Hypotheses A* and *D* are operationalized as a percent change in the number of laparoscopic ACBS performed from 2004 to 2009. The objective is to understand the relation between open and laparoscopic ACBS surgical procedures in ACGHs and ASCs in order to identify surgical volume shifts.

Equation 5 provides the formula for outcomes A and D: *Y%ΔLapACBS = Percentage Change in Number of Laparoscopic ACBS Procedures Performed between 2004 and 2009*. The dependent variable is operationalized as:

Equation 5

$$Y\%\Delta LapACBS = \frac{(LapACBS_{2009} - LapACBS_{2004})}{LapACBS_{2004}}$$

Surgical-Setting Shift

Surgical-setting shift is operationalized as a percent change in the number of ambulatory ACBS procedures from 2004 to 2009. The objective is to assess the impact of disruptive innovation on ambulatory ACBS performed in hospital outpatient departments (OPD) or

ambulatory surgery center settings in order to understand better shifts in surgical settings. Equation 2 formulates the outcome measure at the facility level.

Equation 6 provides the formula for outcome measures C at the facility level: *Y%ΔAmbACBS = Percentage Change in Number of Ambulatory ACBS Procedures Performed between 2004 and 2009*. The dependent variables are operationalized as:

Equation 6

$$Y\%\Delta AmbACBS = \frac{(AmbACBS_{2009} - AmbACBS_{2004})}{AmbACBS_{2004}}$$

Medical Facility Shift

The outcome for the medical facility shift is operationalized as: *Y%ΔAmbACBS = Percentage Change in Number of Ambulatory ACBS Procedures Performed between 2004 and 2009*. The objective is to assess the impact of disruptive innovation on medical facilities through the examination of shifts in ambulatory laparoscopic ACBS procedures between ACGHs and ASCs. Equation 7 formulates the outcome measure for medical facility shift.

Equation 7

$$Y\%\Delta AmbLapACBS = \frac{(AmbLapACBS_{2009} - AmbLapACBS_{2004})}{AmbLapACBS_{2004}}$$

With multiple regression analyses, control variables are employed to systematically reduce variation for a better understanding of the interplay between predictors and dependent variables, as well as surgical utilization patterns. ACGHs and ASCs vary by size, location, tax status, regional population changes, and more as a function of organizational and socioeconomic factors. Since it is possible for variation across facility and regions to masquerade as an influential yet unmeasured form of variation (Sampson et al., 1997), facility- and demographic-level variables are introduced to the equation to control for variations and the possibility of bias.

Summary

This chapter presents the methodologies employed for the study. The research questions and hypotheses that guide the inquiry were stated, followed by a discussion of the research design, data and data sources, sample and sampling procedure, and the analytic approach. The study employs a retrospective panel design to evaluate the impact of disruptive innovation in the hospital industry, and it assesses the effects of disruptive innovation on access to laparoscopic and ambulatory ACBS. The non-experimental research design identifies and compares surgical utilization trends between a six-year period, 2004 and 2009. The panel design allows for the assessment of influences on ACBS surgery utilization.

Data are derived primarily from Intellimed. Other sources were used to build the final dataset: the American Hospital Association (AHA), U.S. Census Bureau, and the Centers for Disease Control and Prevention. Information from these sources helped conduct descriptive analyses and create variables classified at facility- and demographic-levels.

The sample consists of 602 ACGHs and ASCs located in Florida and Wisconsin that performed appendectomy, cholecystectomy, and bariatric surgery procedures in 2004 and 2009. The data analysis plan consists of an exploratory and confirmatory phase. Findings from the exploratory phase will inform the development of procedures at the confirmatory stage. SPSS will be employed to conduct descriptive statistical analysis, bivariate analysis, and multiple regression analysis. These analyses are employed to understand better the relationship between predictors and changes in laparoscopic and ambulatory surgical utilization. The research design is formulated to examine the relationship between explanatory and dependent variables, controlling for select factors. Equations are formulated to determine the relationship between facility types and the shifts in laparoscopic and ambulatory, and open and inpatient, ACBS. The

lack of a pure experimental research design leaves findings open to several threats to internal validity. The results from the methodologies outlined in this chapter are presented in Chapter 5.

CHAPTER 5 – RESULTS

This chapter highlights empirical findings derived from quantitative analysis. Results are structured around the research questions and hypotheses discussed in earlier chapters. Throughout the chapter, the states of Florida and Wisconsin, and medical facilities (ASCs and ACGHs) are examined separately and in pooled datasets. The surgical procedures (i.e., appendectomy, cholecystectomy, and bariatric surgery) also are examined together as a group and separately by surgery type.

The chapter is divided into five sections. In the first section, results from univariate analyses are presented. Descriptive statistics (e.g., frequencies and percentages) from primary and secondary sources are discussed in a comparative analysis of states. ACBS procedure profiles are presented that provide insight into the number of facilities performing the different types of ACBS, annual procedure totals for 2004 and 2009, and facility averages. State profiles are outlined featuring population demographics, CBSA composition, socio-economic factors, and health indicators. The second section presents results from a crosstab analysis that features ACGH for-profit status by state. The third section is a compilation of t-test results, which are part of the exploratory phase of data analysis. The t-tests offer an examination of primary data using descriptive statistics (e.g., frequency, mean, and percent change) to better understand variables, formulate the characteristics of medical facilities (ASCs and ACGHs), and identify ACBS procedure trends. Section four employs bivariate and multivariate regression analyses for hypothesis testing (Suen, 2008). The objectives of this section are to determine: (1) whether significant shifts occurred in the provision of open and laparoscopic ACBS, and (2) whether a significant number of ACBS are moving from ACGHs to ASCs. This section also aims to

determine some of the factors that influence these relationships and estimate the influence of these factors on ACBS volume.

The fifth section focuses on ACGHs only and reports results from bivariate and multivariate regression analyses. The analyses test the hypotheses that focus on surgical setting and the type of technology used in performing ACBS. The objectives of this section are to identify: (1) whether significant shifts occurred in the provision of inpatient and ambulatory ACBS procedures within ACGHs, and (2) whether significant shifts occurred in the provision of open and laparoscopic ACBS procedures within ACGHs. The fifth section also seeks to identify factors that influence ACBS utilization.

State Profiles

State profiles provide the context for quantitative results derived from descriptive statistics and bivariate and multivariate analyses.

Comparative Overview of States

In 2004, the state of Florida had a resident population of 17,375,000 (U.S. Census Bureau, Population Division, 2009). By 2010, the population had risen to 18,801,000, an increase of 8.21% (U.S. Census Bureau, "Demographic Profiles: Census 2010,"). Whites comprised 75% of Florida's population in 2010, while blacks made up 16% and Asians 2.4%. The percentage of whites and blacks stood above the national average of 72.4% and 12.6%, respectively. The national average for the Asian population is 4.8% (U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171)). The Hispanic population[20] made up 22.5% of

[20] According to the U.S. Census Bureau, a person of Hispanic origin may be of any race. Hispanic origin is considered an ethnicity. Mexicans, Puerto Ricans, Cubans, and other persons identifying as Hispanic are included in this classification (U.S. Census Bureau, "Demographic Profiles: Census 2010").

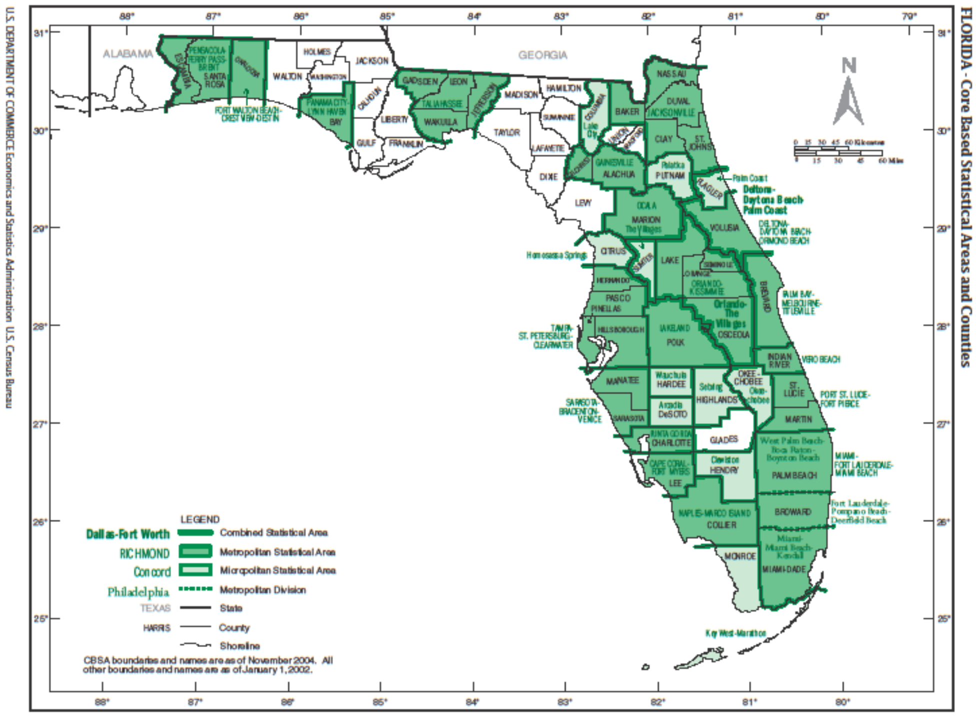
Florida's resident population in 2010, above the national average of 16.3% (U.S. Census Bureau, "Demographic Profiles: Census 2010"). The population of American Indians, Alaska Natives, and Native Hawaiians and other Pacific Islanders comprised less than 1% (U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171)). (*See Table 19*: Demographic (Population) Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin.)

In 2010, 94% of Florida's resident population resided in metropolitan areas, with 3.67% living in micropolitan areas, and 2.2% in rural regions outside of CBSAs. A larger proportion of Florida residents live in metropolitan areas than the national average (83.67%), with fewer residing in micropolitan and rural areas than the national averages, 10.02% and 6.3%, respectively (U.S. Census Bureau, 2010 Census Redistricting Data (P.L. 94-171)). (*See Map 1*: Florida Core-Based Statistical Areas and Counties.) The population per square mile of land area stood at 350.6 persons in 2010, compared to the national average of 87.4 persons per square mile (U.S. Census Bureau, United States Summary: 2000 (PHC-3-1)). (*See Table 20*: CBSA Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin.)

In 2010, about seventeen percent (17.3%) of the resident population were 65 years of age and over (U.S. Census Bureau, "Demographic Profiles: Census 2010"). Slightly more than half of Florida's population (51.1%) was female in 2011, above the national average of 50.8% (U.S. Census Bureau, State & County Quickfacts: Florida). In 2010, 81.1% of Florida's population age 18 to 24 had graduated from high school (CDC, National Center for Chronic Disease Prevention and Health Promotion Chronic Disease Indicators). This figure is slightly below the national average of 83.2%. Florida's median household income stood at $47,827, below the national average of $52,762; and 16.5% lived below the poverty level, slightly above the national figure of 15.3% (U.S. Census Bureau, State & County Quickfacts: Florida). (*See Table 21*: Socio-

Economic Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin.)

Map 1: Florida Core-Based Statistical Areas and Counties



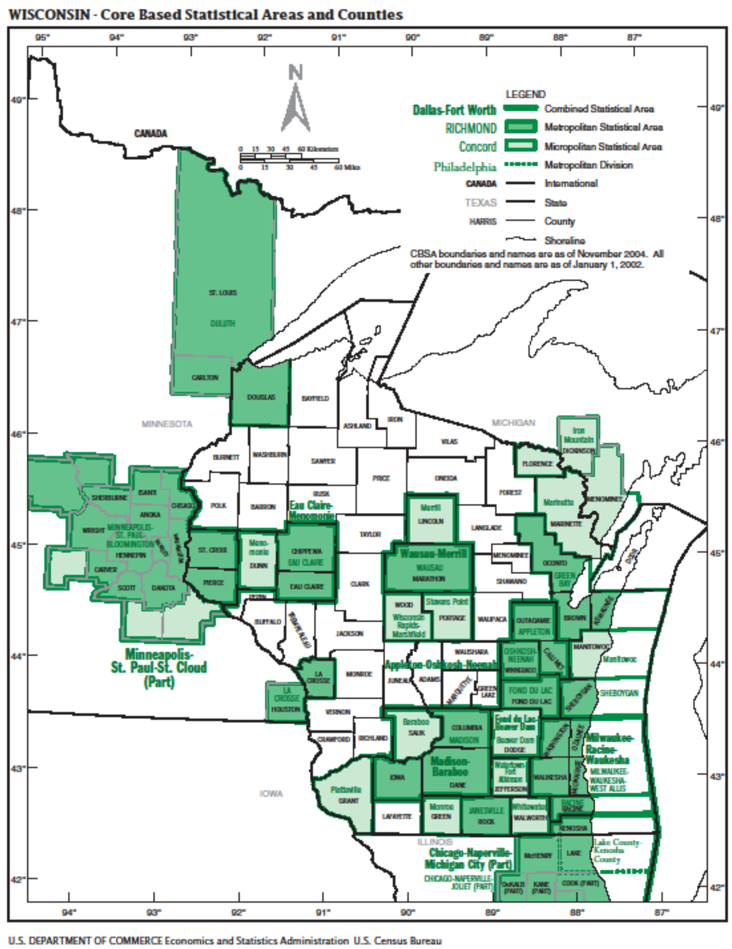
Wisconsin's resident population stood at 5,511,000 in 2004 (U.S. Census Bureau, Population Division, 2009). By 2010, the population had risen slightly to 5,687,000, reflecting a leap of 3.19% (U.S. Census Bureau, "Demographic Profiles: Census 2010,"). Whites comprised 86.2% of the state's population, with blacks making up 6.3% and Asians 2.3% (U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171)). The Hispanic population made up 5.9% of Wisconsin's resident population in 2010 (U.S. Census Bureau, "Demographic Profiles: Census 2010"). American Indians and Alaska Natives comprised 1% of the population, and Native Hawaiians and other Pacific Islanders less than .05% (U.S. Census Bureau, 2010

Census Redistricting Data (Public Law 94-171)). (*See Table 19*: Demographic (Population) Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin.)

In 2010, 72.8% of Wisconsin's resident population resided in metropolitan areas, while 13.54% lived in micropolitan areas and 13.6% in rural regions. Fewer Wisconsin residents live in metropolitan areas than the national average (83.67%), with more residing in micropolitan and rural areas than the national averages, 10.02% and 6.3%, respectively (U.S. Census Bureau, 2010 Census Redistricting Data (P.L. 94-171)). The population per square mile of land area stood at 105.0 persons in 2010, compared to the national average of 87.4 persons per square mile (U.S. Census Bureau, United States Summary: 2000 (PHC-3-1)). (*See Map 2*: Wisconsin Core-Based Statistical Areas and Counties.) (*See Table 20*: CBSA Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin.)

Almost fourteen percent (13.7%) of the resident population were 65 years of age and over (U.S. Census Bureau, "Demographic Profiles: Census 2010"). In 2011, half of Wisconsin's population (50.3%) was female, a figure slightly less than the national average of 50.8% (U.S. Census Bureau, State & County Quickfacts: Wisconsin). Among Wisconsin adults ages 18 – 24, high school graduates comprised 86.7% in 2010, a figure that is higher than the national average of 83.2% (CDC, National Center for Chronic Disease Prevention and Health Promotion Chronic Disease Indicators). Wisconsin's median household income stood at $52,374, slightly below the national average of $52,762. The percent of persons living below the poverty level in Wisconsin between 2007 and 2011 stood at 12.0%, below the national average of 14.3% (U.S. Census Bureau, State & County Quickfacts: Wisconsin). (*See Table 21*: Socio-Economic Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin.)

Map 2: Wisconsin Core-Based Statistical Areas and Counties



Using Behavioral Risk Factor Surveillance System (BRFSS) data, the CDC has developed a set of chronic disease indicators that affords a uniformed approach to state-level comparisons. The indicators are related to health conditions that present substantial challenges to public health, and they represent a broad array of conditions and risk factors (Source: http://www.cdc.gov/nccdphp/CDI/overview.htm). Findings indicate that a larger proportion of adult Florida residents currently lack health insurance compared to Wisconsin residents. Table 22 reveals that in 2010, 21.5% of Florida residents ages 18 to 64 indicated that they did not have health insurance. This figure is above the national average of 17.8%. Almost 13% of Wisconsin

residents indicated that they did not currently have health insurance. Seventeen percent (17.1%) of adult Florida residents rated their health status as fair or poor. The figure is above the national average, which stood at 16.1%. Almost fourteen percent (13.7%) of Wisconsin residents rated their health status as fair or poor. Nineteen percent (19.1%) of Wisconsin residents indicated that they are cigarette smokers, while 17.1% of Florida residents smoke (CDC, National Center for Chronic Disease Prevention and Health Promotion Chronic Disease Indicators).

Table 19: Demographic (Population) Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin

Demographic Indicators	**Measure**	**United States**	**Florida**	**Wisconsin**
Resident Population - 2004	Number	293,046,000	17,375,000	5,511,000
Resident Population - 2010	Number	308,746,000	18,801,000	5,687,000
Percent Change in Resident Population between, 2004 and 2010	Percent	5.36%	8.21%	3.19%
White Population - 2010	Percent	72.4%	75%	86.2%
Black Population - 2010	Percent	12.6%	16%	6.3%
Asian Population - 2010	Percent	4.8%	2.4%	2.3%
American Indian, Alaska Native, Native Hawaiian, and Other Pacific Islander - 2010	Percent	1.1%	.5%	<1.05%
Hispanic Population - 2010	Percent	16.3%	22.5%	5.9%

Sources: U.S. Census Bureau, "Demographic Profiles: Census 2010"; U.S. Census Bureau, Population Division, 2009; U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171); U.S. Census Bureau, United States Summary: 2000 (PHC-3-1); U.S. Census Bureau, State & County Quickfacts: Florida; U.S. Census Bureau, State & County Quickfacts: Wisconsin.

Table 20: CBSA Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin

CBSA Indicators	**Measure**	**United States**	**Florida**	**Wisconsin**
Metropolitan Area Residents - 2010	Percent	83.67%	94%	72.8%
Micropolitan Area Residents - 2010	Percent	10.02%	3.67%	13.54%
Rural/Outside CBSA Residents - 2010	Percent	6.3%	2.2%	13.6%
Population Density (Per Square Mile) - 2010	Number	87.4	350.6	105.0

Sources: U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171); U.S. Census Bureau, United States Summary: 2000 (PHC-3-1)

Table 21: Socio-Economic Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin

Socio-Economic Indicators	Measure	United States	Florida	Wisconsin
Population 65 Years of Age and Over -2010	Percent	13.0%	17.3%	13.7%
Female Population - 2011	Percent	50.8%	51.1%	50.3%
High school completion among adults 18-24 years - 2010	Percent	83.2%	81.1%	86.7%
Poverty - 2010	Percent	15.3%	16.5%	13.2%
Median Household Income - 2010	Percent	$52,762	$47,827	$52,374

Sources: U.S. Census Bureau, "Demographic Profiles: Census 2010"; (U.S. Census Bureau, State & County Quickfacts: Wisconsin); (U.S. Census Bureau, State & County Quickfacts: Florida); CDC, National Center for Chronic Disease Prevention and Health Promotion Chronic Disease Indicators. State/Area Profile: United States Compared with Florida, Wisconsin (Available online: http://apps.nccd.cdc.gov/cdi/).

Based on body mass index (BMI) calculated from their self-reported weight and height, respondents indicated whether they were obese or overweight. Examining BMI is significant because physical inactivity and unhealthy eating are associated with obesity, which is a risk factor for some cancers, cardiovascular disease, diabetes, and other chronic diseases (Source http://apps.nccd.cdc.gov/cdi/IndDefinition.aspx?IndicatorDefinitionID=11). The percentage of obese residents 18 years of age and older in both Florida and Wisconsin were below the national average of 27.5%. About 27% of Florida (27.2%) and Wisconsin (26.9%) residents indicated that they were obese. Sixty-five percent of Florida residents and 63.6% of Wisconsin residents indicated they were overweight and obese. Arthritis and diabetes were more prevalent among Florida adults, 27.1% and 10.4% respectively, than adults nationally. The arthritis prevalence was 25.2% in 2009 and diabetes prevalence 7.1% in 2010 in Wisconsin, below the national averages of 25.9% and 8.7%, respectively (CDC, National Center for Chronic Disease Prevention and Health Promotion Chronic Disease Indicators).

Table 22: Health Indicators: State/Area Profiles for United States Compared with Florida and Wisconsin

Health Indicators	Measure	United States	Florida	Wisconsin
Current lack of health insurance among adults aged 18-64 years - 2010	Prevalence (CI)	17.8%	21.5% (20.1-22.9)	12.8% (10.8-14.7)
Fair or poor self-rated health status among adults aged >= 18 years - 2010	Prevalence (CI)	16.1% (15.9-16.4)	17.1% (16.2-18.1)	13.7% (12.2-15.2)
	Age-adjusted Prevalence (CI)	15.4% (15.1-15.6)	15.1% (14.2-16.1)	13.5% (11.9-15.3)
Cigarette smoking among adults aged >= 18 years - 2010	Prevalence (CI)	17.3%	17.1% (16.1-18.1)	19.1% (17.0-21.1)
Obesity among adults aged >= 18 years - 2010	Prevalence (CI)	27.5%	27.2% (26.1-28.4)	26.9% (25.0-28.9)
Overweight or obesity among adults aged >= 18 years - 2010	Prevalence (CI)	64.5%	65.0% (63.8-66.2)	63.6% (61.3-65.9)
Arthritis among adults aged >= 18 years - 2009	Prevalence (CI)	25.9% (25.7-26.2)	27.1% (25.8-28.4)	25.2% (23.4-27.0)
Diabetes prevalence among adults aged >= 18 years - 2010	Prevalence (CI)	8.7%	10.4% (9.8-11.1)	7.1% (6.3-8.0)

Source: CDC, National Center for Chronic Disease Prevention and Health Promotion Chronic Disease Indicators. State/Area Profile: United States Compared with Florida, Wisconsin (Available online: http://apps.nccd.cdc.gov/cdi/).

Descriptive Analysis

Descriptive analyses summarize and organize data on appendectomy, cholecystectomy, and bariatric surgery performed at 602 medical facilities. There are 313 ACGHs and 289 ASCs featured in the dataset. The section discusses and compares surgical trends in Florida and Wisconsin for the years 2004 and 2009, and it seeks to answer the following questions:

(1) How has the utilization ACBS procedures changed over time?

(2) Do ACGHs and ASCs differ in ACBS utilization?

(3) How do states differ in the utilization of ACBS?

(4) Do findings support the application of disruptive innovation theory in the hospital industry?

Univariate Analysis

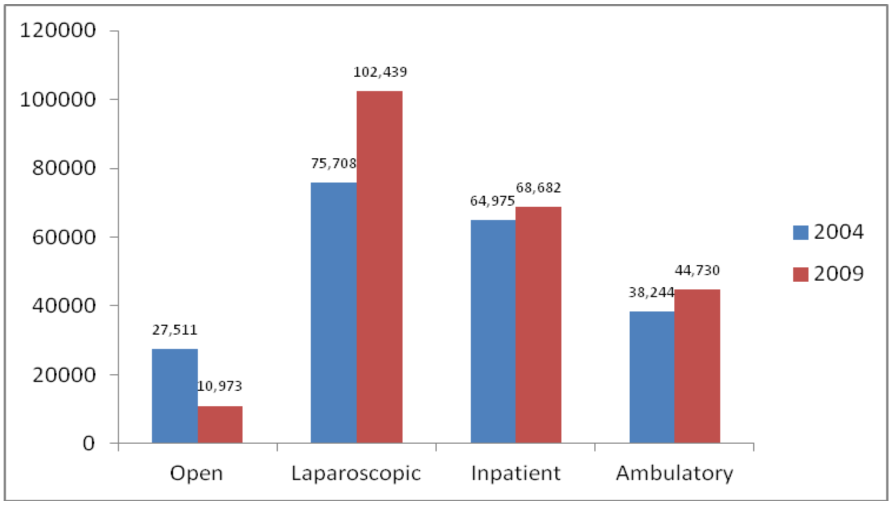
This section presents univariate data analysis, which examines the distribution of attributes of single variables. Specifically, the analysis focuses on the number of ASCs and ACGHs and how many ACBS procedures they provided on average in 2004 and 2009. The following summarizes the dispersion of facility output by surgery type. Along with the discussion of the frequency distribution, a measure of central tendency (i.e., mean) also will be highlighted. The standard deviation is presented to indicate the amount of variability in the data around the mean (Babbie, 2005). (Please see *Appendices C and D* for frequency tables and bar charts illustrating the dispersion of facility output.)

All ACBS Procedures: Pooled Dataset

The following tables are formulated based on ACBS annual totals. The number of procedures performed annually (sum), mean, standard deviation, and percentage and percent change based on 2004 and 2009 totals are presented. For comparative analysis of technology and surgical setting trends, each table pairs open and laparoscopic ACBS, or inpatient and ambulatory ACBS procedures. The sample consists of 27,511 open ACBS cases performed in 2004 and 10,973 open cases in 2009. There are 75,708 laparoscopic ACBS cases in 2004 and 102,439 in 2009. In 2004, there are 64,975 inpatient ACBS cases, and in 2009 there are 68,682 inpatient cases in the sample. The sample is also comprised of 38,244 ambulatory ACBS cases from 2004 and 44,730 from 2009. (*See Figure 9*: Open, Laparoscopic, Inpatient, and Ambulatory Surgical Procedure Totals.) The categories are not mutually exclusive. Since none of the ASCs in

the dataset performed inpatient surgeries, ASCs inpatient totals are reflected as zeros. Analyses of inpatient procedures focus solely on ACGHs.

Figure 9: Open, Laparoscopic, Inpatient, and Ambulatory Surgical Procedure Totals, 2004 & 2009



The number of facilities performing open, laparoscopic, inpatient, and ambulatory ACBS as a pooled dataset are compared in Tables 23 to 28. Table 23 examines all open and laparoscopic procedures by facility type. In 2004, 27,511 open ACBS procedures were performed by 546 medical facilities. There were 244 ASCs that performed 2,585 open ACBS procedures. ASCs comprised 45% of the facilities performing open ACBS procedures, and delivered 9% of the open procedures conducted. On average, ASCs performed 11 (s.d. = 10.063) procedures annually in 2004. In 2009, the number of ASCs performing open ACBS procedures dropped to 9 facilities that delivered 153 open operations, averaging 17 (s.d. = 40.268) procedures per facility. ASCs consisted of fewer than 3% of the facilities conducting open procedures in 2009. Between 2004 and 2009, ASCs witnessed a 96% decline in the number of facilities conducting open ACBS, and a 94% drop in the total number of procedures performed.

In 2004, 302 ACGHs performed 24,926 open ACBS procedures, representing 55% of the facilities and 91% of the procedures performed. ACGHs, on average, performed 83 (s.d. =

85.759) open procedures annually. In 2009, there was a slight drop of 0.3% to 301 ACGHs performing open ACBS procedures. Findings indicate that 97% of the medical facilities performing open ACBS procedures were ACGHs that conducted 99% of the procedures. While ACGHs continued to be the dominant medical facilities delivering open ACBS procedures, they experienced a 57% drop in the number of open surgeries performed. Overall, a comparison of 2004 and 2009 annual totals reveals a 43% decline in the number of medical facilities conducting open ACBS and a 60% drop in the total number of open ACBS procedures performed.

Laparoscopic ACBS procedures also are presented in Table 23. In 2004, 264 ASCs performed 6,764 laparoscopic procedures, averaging 26 (s.d. = 26.480) surgeries annually. ASCs represented 47% of the medical facilities in the sample and conducted 9% of the laparoscopic ACBS procedures in 2004. By 2009, the number of ASCs performing ACBS laparoscopically had fallen to 66, a 75% drop. The number of laparoscopic procedures administered at ASCs fell to 2,327, a decline of 66% from 2004 totals. Yet, the average number of laparoscopic procedures conducted by ASCs rose to 35 (s.d. = 53.187) in 2009. While ASCs witnessed a decline in laparoscopic ACBS volume, ACGHs experienced the opposite trend. The number of ACGHs delivering this service rose from 302 to 309 between 2004 and 2009—the slight rise of 7 facilities represented a 2% increase. The number of laparoscopic procedures performed by ACGHs jumped 45%, from 68,944 in 2004 to 100,112 in 2009. The average number of procedures performed by ACGHs rose from 228 (s.d. = 187.241) to 324 (s.d. = 271.158). Based on the overall sample, findings suggest that the number of facilities performing laparoscopic ACBS fell 34% between 2004 and 2009, while the number of procedures performed grew from 75,708 in 2004 to 102,439 in 2009, a jump of 35%. The average number of procedures per facility also rose from 134 (s.d. = 171.010) to 273 (s.d. = 270.491) over the same time period.

Findings for inpatient and ambulatory ACBS procedures are presented in Table 24. Only ACGHs performed inpatient ACBS; therefore, ASCs will not be discussed in reference to inpatient procedures. In 2004, 301 ACGHs conducted 64,975 inpatient ACBS procedures. By 2009, the number of ACGHs had risen to 306 that performed 68,682 surgeries, representing a 2% increase in the number of facilities and a 6% increase in inpatient ACBS. In 2004, ACGHs averaged 216 (s.d. = 181.998) inpatient ACBS procedures. By 2009, the average had risen slightly to 224 (s.d. = 200.546).

Ambulatory ACBS procedures were performed by both types of medical facilities as shown in 24. Yet, from 2004 to 2009 the number of ASCs and ACGHs indicating they performed ambulatory procedures declined 36%. The number of ASCs dropped from 269 to 68 facilities, reflecting a 75% decline in the number of ASCs performing ambulatory ACBS procedures and a 74% decline, from 9,349 to 2,480, in the number of procedures conducted. The remaining ASCs witnessed a very slight increase in the average number of ambulatory procedures performed, from 35 (s.d. = 31.772) to 36 (s.d. = 54.203). The number of ACGHs performing ambulatory ACBS fell slightly by 0.7%, from 299 in 2004 to 297 in 2009. Yet, these facilities witnessed a leap of 46% in the number of ambulatory ACBS procedures they performed, from 28,896 to 42,250. In 2004, ACGHs performed, on average, 97 (s.d. = 91.097) ambulatory ACBS annually. The figure rose to 142 (s.d. = 130.368) annually in 2009. Overall, medical facilities in the sample experienced a 17% rise in the number of ambulatory ACBS procedures performed.

Table 23: Descriptive Statistics - Open and Laparoscopic ACBS Procedures by Facility Type

ACBS Procedure Type	Open			Laparoscopic		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	244 (45%)	9 (3%)	**-96.3%**	264 (47%)	66 (18%)	**-75.0%**
Σ = Procedures	2585	153	**-94.1%**	6764	2327	**-65.6%**
	$\bar{x}$ = 10.59	$\bar{x}$ = 17.00		$\bar{x}$ = 25.62	$\bar{x}$ = 35.26	
	s.d. = 10.063	s.d. = 40.268		s.d. = 26.480	s.d. = 53.187	
ACGH						
N = Facilities (Annual %)	302 (55%)	301 (97%)	**-0.3%**	302 (53%)	309 (82%)	**2.3%**
Σ = Procedures	24926	10820	**-56.6%**	68944	100112	**45.2%**
	$\bar{x}$ = 82.54	$\bar{x}$ = 35.95		$\bar{x}$ = 228.29	$\bar{x}$ = 323.99	
	s.d. = 85.759	s.d. = 37.458		s.d. = 187.241	s.d. = 271.158	
Total						
N = Facilities (Annual %)	546 (100%)	310 (100%)	**-43.2%**	566 (100%)	375 (100%)	**-33.7%**
Σ = Procedures	27511	10973	**-60.1%**	75708	102439	**35.3%**
	$\bar{x}$ = 50.39	$\bar{x}$ = 35.40		$\bar{x}$ = 133.76	$\bar{x}$ = 273.17	
	s.d. = 73.408	s.d. = 37.608		s.d. = 171.010	s.d. = 270.491	

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Table 24: Descriptive Statistics - Inpatient and Ambulatory ACBS Procedures by Facility Type

ACBS Procedure Type	Inpatient			Ambulatory		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	0	0	.	269 (47%)	68 (19%)	**-74.7%**
Σ = Procedures	0	0	.	9349	2480	**-73.5%**
	$\bar{x}$ = .	$\bar{x}$ = .		$\bar{x}$ = 34.75	$\bar{x}$ = 36.47	
	s.d. = .	s.d. = .		s.d. = 31.772	s.d. = 54.203	
ACGH						
N = Facilities (Annual %)	301 (100%)	306 (100%)	**1.7%**	299 (53%)	297 (81%)	**-0.7%**
Σ = Procedures	64975	68682	**5.7%**	28895	42250	**46.2%**
	$\bar{x}$ = 215.86	$\bar{x}$ = 224.45		$\bar{x}$ = 96.64	$\bar{x}$ = 142.26	
	s.d. = 181.998	s.d. = 200.546		s.d. = 91.097	s.d. = 130.368	
Total						
N = Facilities (Annual %)	301 (100%)	306 (100%)	**1.7%**	568 (100%)	365 (100%)	**-35.7%**
Σ = Procedures	64975	68682	**5.7%**	38244	44730	**17.0%**
	$\bar{x}$ = 215.86	$\bar{x}$ = 224.45		$\bar{x}$ = 67.33	$\bar{x}$ = 122.55	
	s.d. = 181.998	s.d. = 200.546		s.d. = 76.126	s.d. = 126.739	

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Tables 25 to 28 show facility and procedure counts by state. Florida contributes most of the volume in the dataset. Yet, Wisconsin and Florida are witnessing similar trends in open, laparoscopic, and ambulatory ACBS provision. Both states experienced downward trends in open ACBS volume, and upward trends in laparoscopic and ambulatory ACBS provision. The

number of facilities conducting open ACBS procedures declined in both states, with the number of Florida facilities falling more rapidly than in Wisconsin. The number of laparoscopic and ambulatory ACBS procedures performed in Wisconsin and Florida rose, yet the number of facilities conducting these procedures increased slightly in Wisconsin but fell by almost half in Florida. Florida ACGHs experienced a subtle tick upward in the number of facilities offering inpatient ACBS procedures and the number of inpatient procedures performed. Wisconsin ACGHs, on the other hand, witnessed drops in both the number of facilities providing inpatient ACBS procedures and number of inpatient ACBS conducted. ASCs did not perform inpatient procedures in either state.

Table 25: Descriptives Statistics - Wisconsin Open and Laparoscopic ACBS Procedures by Facility Type

ACBS Procedure Type	Open			Laparoscopic		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC N = Facilities (Annual %) Σ = Procedures	4 (3%) 11 $\bar{x}$= 2.75 s.d. = 2.062	4 (3%) 7 $\bar{x}$= 1.75 s.d. = .957	**.0%** **-36.4%**	15 (11%) 917 $\bar{x}$= 61.13 s.d. = 63.397	18 (13%) 1000 $\bar{x}$= 55.56 s.d. = 56.337	**20.0%** **9.1%**
ACGH N = Facilities (Annual %) Σ = Procedures	116 (97%) 6008 $\bar{x}$= 51.79 s.d. = 59.990	111 (97%) 3046 $\bar{x}$= 27.44 s.d. = 28.642	**-4.3%** **-49.3%**	116 (89%) 18629 $\bar{x}$= 160.59 s.d. = 144.457	116 (87%) 24410 $\bar{x}$= 210.43 s.d. = 188.881	**0.0%** **31.0%**
Total N = Facilities (Annual %) Σ = Procedures	120 (100%) 6019 $\bar{x}$= 50.16 s.d. = 59.633	115 (100%) 3053 $\bar{x}$= 26.55 s.d. = 28.530	**-4.2%** **-49.3%**	131 (100%) 19546 $\bar{x}$= 149.21 s.d. = 141.080	134 (100%) 25410 $\bar{x}$= 189.63 s.d. = 184.563	**2.3%** **30.0%**

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Table 26: Descriptive Statistics - Wisconsin Inpatient and Ambulatory ACBS Procedures by Facility Type

ACBS Procedure Type	Inpatient			Ambulatory		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	0	0	.	15 (11%)	18 (13%)	**20.0%**
Σ = Procedures	0	0	.	928	1007	**8.5%**
	$\bar{x}$ = .	$\bar{x}$ = .		$\bar{x}$ = 61.875	$\bar{x}$ = 55.94	
	s.d. = .	s.d. = .		s.d. = 64.542	s.d. = 56.937	
ACGH						
N = Facilities (Annual %)	116 (100%)	114 (100%)	**-1.7%**	116 (89%)	116 (87%)	**0.0%**
Σ = Procedures	14226	12363	**-13.1%**	10411	15093	**46.0%**
	$\bar{x}$ = 122.64	$\bar{x}$ = 108.45		$\bar{x}$ = 89.75	$\bar{x}$ = 130.11	
	s.d. = 125.569	s.d. = 115.170		s.d. = 81.805	s.d. = 112.389	
Total						
N = Facilities (Annual %)	116 (100%)	114 (100%)	**-1.7%**	131 (100%)	134 (100%)	**2.3%**
Σ = Procedures	14226	12363	**-13.1%**	11339	16100	**42.0%**
	$\bar{x}$ = 122.64	$\bar{x}$ = 108.45		$\bar{x}$ = 86.56	$\bar{x}$ = 120.15	
	s.d. = 125.569	s.d. = 115.170		s.d. = 80.299	s.d. = 109.456	

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Table 27: Descriptive Statistics - Florida Open and Laparoscopic ACBS Procedures by Facility Type

ACBS Procedure Type	Open			Laparoscopic		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	240 (56%)	5 (3%)	**-97.9%**	249 (57%)	48 (20%)	**-80.7%**
Σ = Procedures	2574	146	**-94.3%**	5847	1327	**-77.3%**
	$\bar{x}$ = 10.73	$\bar{x}$ = 29.20		$\bar{x}$ = 23.48	$\bar{x}$ = 27.65	
	s.d. = 10.092	s.d. = 53.138		s.d. = 20.876	s.d. = 50.471	
ACGH						
N = Facilities (Annual %)	186 (44%)	190 (97%)	**2.2%**	186 (43%)	193 (80%)	**3.8%**
Σ = Procedures	18918	7774	**-58.9%**	50315	75702	**50.5%**
	$\bar{x}$ = 101.71	$\bar{x}$ = 40.92		$\bar{x}$ = 270.51	$\bar{x}$ = 392.24	
	s.d. = 93.631	s.d. = 41.016		s.d. = 198.506	s.d. = 290.013	
Total						
N = Facilities (Annual %)	426 (100%)	195 (100%)	**-54.2%**	435 (100%)	241 (100%)	**-44.6%**
Σ = Procedures	21492	7920	**-63.1%**	56162	77029	**37.2%**
	$\bar{x}$ = 50.45	$\bar{x}$ = 40.62		$\bar{x}$ = 129.11	$\bar{x}$ = 319.62	
	s.d. = 76.906	s.d. = 41.239		s.d. = 178.931	s.d. = 289.455	

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Table 28: Descriptive Statistics - Florida Inpatient and Ambulatory ACBS Procedures by Facility Type

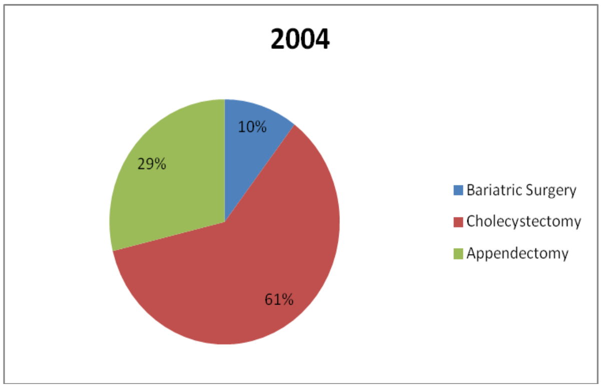
ACBS Procedure Type	Inpatient			Ambulatory		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	0	0	**.**	254 (58%)	50 (22%)	**-80.3%**
Σ = Procedures	0	0	**.**	8421	1473	**-82.5%**
	$\bar{x}$ = .	$\bar{x}$ = .		$\bar{x}$ = 33.15	$\bar{x}$ = 29.46	
	s.d. = .	s.d. = .		s.d. = 28.154	s.d. = 51.991	
ACGH						
N = Facilities (Annual %)	185 (100%)	192 (100%)	**1.7%**	183 (42%)	181 (78%)	**-1.1%**
Σ = Procedures	50749	56319	**5.7%**	18484	27157	**46.9%**
	$\bar{x}$ = 274.32	$\bar{x}$ = 293.33		$\bar{x}$ = 101.01	$\bar{x}$ = 150.04	
	s.d. = 187.712	s.d. = 208.747		s.d. = 96.488	s.d. = 140.438	
Total						
N = Facilities (Annual %)	185 (100%)	192 (100%)	**1.7%**	437 (100%)	231 (100%)	**-47.1%**
Σ = Procedures	50749	56319	**5.7%**	26905	28630	**6.4%**
	$\bar{x}$ = 274.32	$\bar{x}$ = 293.33		$\bar{x}$ = 61.57	$\bar{x}$ = 123.94	
	s.d. = 187.712	s.d. = 208.747		s.d. = 73.955	s.d. = 135.970	

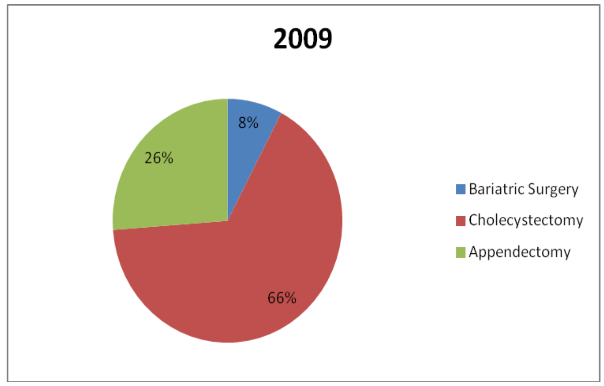
Procedure percent change is calculated based on 2004 and 2009 annual totals.

ACBS Procedures by Surgical Type

Tables 29 to 34 take a closer look at the trends of each specific type of surgery: bariatric, cholecystectomy, and appendectomy. The number of facilities and procedures for each of the three surgery types comprising the dataset are examined. Each set of tables highlights the number of facilities providing open and laparoscopic, or inpatient and ambulatory procedures. There are a total of 39,006 bariatric surgery cases in the sample, 21,414 in 2004 and 17,592 in 2009. Bariatric surgery cases comprise 9% of the sample. Cholecystectomy cases represent 63.6% of the sample: 125,504 cholecystectomy cases in 2004 and 149,824 cases in 2009. There are 118,892 appendectomy cases in the sample, representing 27.4% of the sample. There are 59,484 appendectomy cases from 2004 and 59,408 from 2009. Over the study period, the proportion of cholecystectomy cases increased, while bariatric surgery and appendectomy decreased as a percentage of the sample. (*See Figure 10*: Proportion of Bariatric Surgery, Cholecystectomy, and Appendectomy Procedure, 2004 & 2009.)

Figure 10: Composition of Sample by Surgery Type, 2004 & 2009





Bariatric Surgery

Table 29 features open and laparoscopic bariatric surgery. In 2004, 106 ASCs performed 609 open bariatric surgery procedures—approximately 7% of the open procedures that year. ASCs conducted, on average, 6 (s.d. = 8.782) open procedures annually in 2004. By 2009, all ASCs had shifted out of the administration of open bariatric surgery. Between 2004 and 2009, the number of ACGHs performing open bariatric procedures dropped 16%, from 191 to 160 facilities. The decrease in the number of ASCs and ACGHs performing open bariatric surgery is reflected in an overall 46% decline. Yet, while the overall number of open procedures fell from 8,555 to 814 (90%), the number of surgeries performed laparoscopically jumped 271%, from 2,152 to 7,982 procedures. The shift in laparoscopic bariatric surgery provision is moving toward ACGHs. In 2004, 103 ACGHs performed 1,859 procedures, averaging 18 (s.d. = 22.124) surgeries per facility. In 2009, 110 ACGHs completed 7,808 bariatric surgeries laparoscopically, with an average of 71 (s.d. = 105.928) procedures per facility. In 2004, 66 ASCs performed 293 laparoscopic bariatric procedures, averaging 4 (s.d. = 7.933) procedures annually. ASCs essentially represented 39% of the facilities and performed roughly 14% of the laparoscopic

bariatric procedures. By 2009, only 9 ASCs delivered 174 bariatric surgery procedures laparoscopically. These ASCs averaged 19 (s.d. = 31.177) procedures annually. ASCs fell to 7% of the facilities performing bariatric procedures laparoscopically and delivered 2% of the procedures in 2009.

Table 30 features findings on inpatient and ambulatory bariatric surgery procedures. In 2004, 182 ACGHs performed 9,133 inpatient bariatric procedures—averaging 50 (s.d. = 87.444) operations annually. In 2009, 175 ACGHs conducted inpatient bariatric procedures. The number of procedures performed had declined to 6,816, and the average annual total per facility had declined 39 (s.d. = 70.007). Yet, the number of ACGHs performing ambulatory bariatric surgery remained steady at 73, while the number of procedures delivered jumped 169%, from 672 in 2004 to 1,806 in 2009. The average number of ambulatory bariatric surgeries conducted annually per ACGH rose from 9 (s.d. = 13.782) to 25 (s.d. = 61.228). On the other hand, the number of ASCs performing ambulatory bariatric surgery fell by more than 90%, from 139 in 2004 to 9 in 2009. The number of procedures performed dropped 81%, from 903 to 174 during the same time period. The average number of procedures performed in ASCs rose from 6 (s.d. = 9.412) in 2004 to 19 (s.d. = 31.177) in 2009.

Table 29: Descriptive Statistics - Open and Laparoscopic Bariatric Surgery Procedures by Facility Type

ACBS Procedure Type	Open			Laparoscopic		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	106 (36%)	0 (0%)	**-100.0%**	66 (39%)	9 (8%)	**-86.4%**
Σ = Procedures	609	0	**-100.0%**	293	174	**-40.6%**
	$\bar{x}$ = 5.75	$\bar{x}$ = .		$\bar{x}$ = 4.44	$\bar{x}$ = 19.33	
	s.d. = 8.782	s.d. = .		s.d. = 7.933	s.d. = 31.177	
ACGH						
N = Facilities (Annual %)	191 (64%)	160 (100%)	**-16.2%**	103 (61%)	110 (92%)	**6.8%**
Σ = Procedures	7946	814	**-89.8%**	1859	7808	**320.0%**
	$\bar{x}$ = 41.60	$\bar{x}$ = 5.09		$\bar{x}$ = 18.05	$\bar{x}$ = 70.98	
	s.d. = 73.008	s.d. = 12.106		s.d. = 22.124	s.d. = 105.928	
Total						
N = Facilities (Annual %)	297 (100%)	160 (100%)	**-46.1%**	169 (100%)	119 (100%)	**-29.6%**
Σ = Procedures	8555	814	**-90.5%**	2152	7982	**270.9%**
	$\bar{x}$ = 28.80	$\bar{x}$ = 5.09		$\bar{x}$ = 12.73	$\bar{x}$ = 67.08	
	s.d. = 61.195	s.d. = 12.106		s.d. = 19.128	s.d. = 103.048	

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Table 30: Descriptive Statistics - Inpatient and Ambulatory Bariatric Surgery Procedures by Facility Type

ACBS Procedure Type	Inpatient			Ambulatory		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	0	0	**.**	139 (66%)	9 (11%)	**-93.5%**
Σ = Procedures	0	0	**.**	903	174	**-80.7%**
	$\bar{x}$ = .	$\bar{x}$ = .		$\bar{x}$ = 6.49	$\bar{x}$ = 19.33	
	s.d. = .	s.d. = .		s.d. = 9.412	s.d. = 31.177	
ACGH						
N = Facilities (Annual %)	182 (100%)	175 (100%)	**-3.8%**	73 (34%)	73 (89%)	**.0%**
Σ = Procedures	9133	6816	**-25.4%**	672	1806	**168.8%**
	$\bar{x}$ = 50.18	$\bar{x}$ = 38.95		$\bar{x}$ = 9.21	$\bar{x}$ = 24.74	
	s.d. = 87.444	s.d. = 70.007		s.d. = 13.782	s.d. = 61.228	
Total						
N = Facilities (Annual %)	182 (100%)	175 (100%)	**-3.8%**	212 (100%)	82 (100%)	**-61.3%**
Σ = Procedures	9133	6816	**-25.4%**	1574	1980	**25.8%**
	$\bar{x}$ = 50.18	$\bar{x}$ = 38.95		$\bar{x}$ = 7.42	$\bar{x}$ = 24.15	
	s.d. = 87.444	s.d. = 70.007		s.d. = 11.155	s.d. = 58.576	

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Cholecystectomy

In 2004, 302 ASCs delivered 738 procedures, about 4 surgeries per facility (s.d. = 3.337). (*See Table 31*: Descriptive Statistics – Open and Laparoscopic Cholecystectomy Procedures by Facility Type.) ASCs represented 61% of the facilities performing open cholecystectomy procedures, which amounted to about 12% of the operations completed. By 2009, ASCs represented about 3% of the facilities in the sample conducting open cholecystectomy procedures and 3.5% of the procedures delivered. By 2009, ASCs experienced a 97% decline in the number of facilities delivering open cholecystectomies, falling to 8 ASCs that performed 150 procedures. The number of procedures fell 80%. Between 2004 and 2009, the annual number of open cholecystectomy procedures per ASCs rose from about 4 to 19 (s.d. = 42.681).

ACGHs also experienced a decline in the number of open cholecystectomy procedures performed, although not as extreme as that witnessed by ASCs. In 2004, 291 ACGHs indicated that they performed 5,426 open cholecystectomy procedures, for a facility average of 19 (s.d. = 16.735) surgeries. In 2009, 209 ACGHs reported 4,196 open procedures, representing a 23% decline from the 2004 figure. The annual average number of procedures per ACGH also dropped to 14 (s.d. = 13.759). Based on these findings, there is an overall downward trend in the number of facilities conducting open cholecystectomies and a decline in the overall number of open cholecystectomy procedures performed.

Table 31 shows an upward trend in the overall number of laparoscopic cholecystectomy procedures performed across the study period. In 2004, 56,588 surgeries were performed laparoscopically. By 2009, this number rose to 70,566, reflecting a 25% increase. ACGHs were responsible for the bump. There were 7 more ACGHs delivering laparoscopic cholecystectomy between 2004 and 2009 for a total of 309 facilities, reflecting a 2% rise. The number of

procedures performed by ACGHs rose 32% from 51,846 to 68,449. The average number of procedures per ACGH increased from 172 (s.d. = 139.847) to 222 (s.d. = 182.740). Two hundred and sixty-one ASCs delivered 4,742 laparoscopic cholecystectomies, averaging 18 (s.d. = 21.985) per facility, in 2004. While the average per ASCs rose to 33 (s.d. = 45.550) annually by 2009, the number of facilities performing the procedure fell 76% to 64, and the number of cholecystectomies performed laparoscopically dropped 55% to 2,117. The number of open cholecystectomies decline precipitously. Findings indicate that fewer medical facilities performed more procedures, on average, as the number of laparoscopic procedures steadily rose.

Table 32 suggests a decrease in the number of ASCs performing ambulatory cholecystectomy procedures. In 2004, 265 ASCs—representing almost half of the facilities delivering ambulatory cholecystectomies—performed 5,480 procedures. By 2009, 66 ASCs represented 18% of the facilities in the sample conducting ambulatory cholecystectomies. The shift in the number of ASCs reflects a 75% decline that coincides with a 59% drop (5,480 to 2,267) in the number of cholecystectomies performed. Yet, over the study period, the average number of ambulatory cholecystectomies rose from 21 (s.d. = 23.327) to 34 (s.d. = 46.913). In 2004, 299 ACGHs represented 53% of the medical facilities in the sample performing cholecystectomies. By 2009, the number of ACGHs had fallen slightly to 297, although ACGHs comprised 81% of the facilities in the sample delivering the procedures in ambulatory settings. ACGHs witnessed a 44% increase in the number of ambulatory cholecystectomy procedures conducted and a rise in the average number of procedures per ACGH from 82 (s.d. = 81.561) to 118 (s.d. = 107.838). For ACGHs, findings suggest that inpatient and ambulatory cholecystectomy procedures are rising, albeit ambulatory procedures are increasing at a faster rate.

Table 32 shows the number of ACGHs performing inpatient cholecystectomies and the number of surgeries they performed. In 2004, 299 ACGHs conducted 32,895 inpatient procedures, averaging 110 (s.d. = 92.827) per facility. By 2009, the number of ACGHs providing inpatient cholecystectomies increased slightly to 304, a 2% increase. The number of procedures delivered rose to 37,550, reflecting a 14.2% increase. On average, ACGHs performed 124 (s.d. = 108.436) cholecystectomies per facility.

Table 31: Descriptive Statistics - Open and Laparoscopic Cholecystectomy Procedures by Facility Type

ACBS Procedure Type	Open			Laparoscopic		
Year Facility Type	2004	2009	% Change	2004	2009	% Change
ASC N = Facilities (Annual %) Σ = Procedures	203 (41%) 738 $\bar{x}$= 3.64 s.d. = 3.337	8 (3%) 150 $\bar{x}$= 18.75 s.d. = 42.681	**-97.4%** **-79.7%**	261 (46%) 4742 $\bar{x}$= 18.17 s.d. = 21.985	64 (17%) 2117 $\bar{x}$= 33.08 s.d. = 45.550	**-75.5%** **-55.4%**
ACGH N = Facilities (Annual %) Σ = Procedures	291 (59%) 5426 $\bar{x}$= 18.65 s.d. = 16.735	290 (97%) 4196 $\bar{x}$= 14.47 s.d. = 13.759	**-0.3%** **-22.7%**	302 (54%) 51846 $\bar{x}$= 171.68 s.d. = 139.847	309 (83%) 68449 $\bar{x}$= 221.52 s.d. = 182.740	**2.3%** **32.0%**
Total N = Facilities (Annual %) Σ = Procedures	494 (100%) 6164 $\bar{x}$= 12.48 s.d. = 14.965	298 (100%) 4346 $\bar{x}$= 14.58 s.d. = 15.087	**-39.7%** **-29.5%**	563 (100%) 56588 $\bar{x}$= 100.51 s.d. = 128.719	373 (100%) 70566 $\bar{x}$= 189.18 s.d. = 181.827	**-33.7%** **24.7%**

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Table 32: Descriptive Statistics - Inpatient and Ambulatory Cholecystectomy Procedures by Facility Type

ACBS Procedure Type	Inpatient			Ambulatory		
Year Facility Type	2004	2009	% Change	2004	2009	% Change
ASC N = Facilities (Annual %) Σ = Procedures	0 0 $\bar{x}$ = . s.d. = .	0 0 $\bar{x}$ = . s.d. = .	. .	265 (47%) 5480 $\bar{x}$ = 20.68 s.d. = 23.327	66 (18%) 2267 $\bar{x}$ = 34.35 s.d. = 46.913	**-75.1%** **-58.6%**
ACGH N = Facilities (Annual %) Σ = Procedures	299 (100%) 32895 $\bar{x}$ = 110.02 s.d. = 92.827	304 (100%) 37550 $\bar{x}$ = 123.52 s.d. = 108.436	**1.7%** **14.2%**	299 (53%) 24377 $\bar{x}$ = 81.53 s.d. = 81.561	297 (82%) 35095 $\bar{x}$ = 118.16 s.d. = 107.838	**-0.7%** **44.0%**
Total N = Facilities (Annual %) Σ = Procedures	299 (100%) 32895 $\bar{x}$ = 110.02 s.d. = 92.827	304 (100%) 37550 $\bar{x}$ = 123.52 s.d. = 108.436	**1.7%** **14.2%**	564 (100%) 29857 $\bar{x}$ = 52.94 s.d. = 68.558	363 (100%) 37362 $\bar{x}$ = 102.93 s.d. = 104.651	**-35.6%** **25.1%**

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Appendectomy

Appendectomy procedures are featured in Tables 33 and 34. Table 33 show trends in open and laparoscopic procedures. In 2004, 210 ASCs performed 1,238 open appendectomies. ASCs comprised about 41% of the facilities conducting these procedures. On average, an ASC performed 6 (s.d. = 4.947) surgeries annually. By 2009, only one ASC indicated that it performed 3 open procedures. Essentially, almost all open appendectomies were performed in ACGH settings. Yet, in 2004, 299 ACGHs conducted 11,536 open appendectomies, averaging 39 (s.d. = 40.690) per facility. By 2009, 287 ACGHs performed 5,810 open appendectomy procedures, averaging 20 (s.d. = 25.435) per facility. T shift represented a 50% drop in the number of surgeries conducted. Overall, the number of facilities in the sample delivering open appendectomies fell by 43%, and the number of procedures was reduced by 55% over the study period.

In 2004, ASCs performed 45% of laparoscopic appendectomies. These 224 ASCs conducted 1,729 procedures, averaging roughly 8 (s.d. = 8.539) annually per facility. By 2009, ASCs comprised 4% of the facilities performing laparoscopic appendectomies. These 14 ASCs performed 36 surgeries, and averaged almost 3 (s.d. = 2.209) surgeries per facility. Over the study period, ASCs witnessed a 94% drop in the number of facilities that performed appendectomies laparoscopically, and a 98% decline in the number of operations conducted annually. ACGHs, on the other hand, experienced increases in the number of facilities performing laparoscopic appendectomies, rising from 278 to 299—representing an 8% leap. The annual number of laparoscopic appendectomy procedures administered increased by 57%, from 15,239 to 23,855 surgeries. The annual number of procedures per ACGH rose from 55 (s.d. = 57.814) to 80 (s.d. = 78.727). Overall, the number of facilities conducting laparoscopic appendectomy declined; yet, the number of procedures performed rose sharply.

Findings in Table 34 show the number of facilities conducting inpatient appendectomies and the number of procedures performed. In 2004, 298 ACGHs conducted 22,929 inpatient procedures, averaging 77 (s.d. = 68.422) per facility. By 2009, the number of ACGHs providing inpatient appendectomies rose to 303 (2% increase), and the number of procedures rose to 24,316 (6% increase), for an average of 80 (s.d. = 82.645) per facility. ACGHs experienced growth in the number of facilities providing ambulatory appendectomies and the number of procedures performed.

In 2004, almost half of the facilities in the sample that provided ambulatory appendectomy procedures were ACGHs (244 facilities), which delivered 3,846 surgeries for an average of 16 (s.d. = 20.627) per facility. By 2009, the number of ACGHs increased to 264 facilities delivering 5,349 procedures, averaging 20 (s.d. = 26.571) per facility. The increase

represented an 8.2% increase in the number of ACGHs performing ambulatory appendectomies and a 39% rise in the number of ambulatory appendectomies performed. On average, ACGHs also witnessed a rise from 16 to 20 procedures per ACGH annually. In 2009, ACGHs conducted 95% of the ambulatory appendectomy procedures delivered.

Table 34 also shows dramatic decreases in the number of ASCs engaged in appendectomy delivery. In 2004, 252 ASCs delivered 51% of the appendectomies performed in ambulatory settings, for an average of 12 (s.d. = 11.207) surgeries per facility. By 2009, the number had fallen to 15 ASCs or 5% of the facilities delivering appendectomies in ambulatory settings. The facility average fell to 3 (s.d. = 2.131). The shift reflected a 94% decline. Simultaneously, the number of appendectomy procedures performed in ASCs fell 99%, from 2,967 to 39. Overall, findings suggest a declining trend in the number of facilities performing ambulatory appendectomies and in the number of procedures being performed.

Table 33: Descriptive Statistics - Open and Laparoscopic Appendectomy Procedures by Facility Type

ACBS Procedure Type	Open			Laparoscopic		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC						
N = Facilities (Annual %)	210 (41%)	1 (0%)	**-99.5%**	224 (45%)	14 (4%)	**-93.8%**
Σ = Procedures	1238	3	**-99.8%**	1729	36	**-97.9%**
	$\bar{x}$ = 5.90	$\bar{x}$ = 3.00		$\bar{x}$ = 7.72	$\bar{x}$ = 2.57	
	s.d. = 4.947	s.d. = .		s.d. = 8.539	s.d. = 2.209	
ACGH						
N = Facilities (Annual %)	299 (59%)	287 (100%)	**-4.0%**	278 (55%)	299 (96%)	**7.6%**
Σ = Procedures	11536	5810	**-49.6%**	15239	23855	**56.5%**
	$\bar{x}$ = 38.58	$\bar{x}$ = 20.24		$\bar{x}$ = 54.82	$\bar{x}$ = 79.78	
	s.d. = 40.690	s.d. = 25.435		s.d. = 57.814	s.d. = 78.727	
Total						
N = Facilities (Annual %)	509 (100%)	288 (100%)	**-43.4%**	502 (100%)	313 (100%)	**-37.6%**
Σ = Procedures	12774	5813	**-54.5%**	16968	23891	**40.8%**
	$\bar{x}$ = 25.10	$\bar{x}$ = 20.18		$\bar{x}$ = 33.80	$\bar{x}$ = 76.33	
	s.d. = 35.224	s.d. = 25.411		s.d. = 49.292	s.d. = 78.585	

Procedure percent change is calculated based on 2004 and 2009 annual totals.

Table 34: Descriptive Statistics - Inpatient and Ambulatory Appendectomy Procedures by Facility Type

ACBS Procedure Type	Inpatient			Ambulatory		
Year / Facility Type	2004	2009	% Change	2004	2009	% Change
ASC N = Facilities (Annual %) Σ = Procedures	0 0 $\bar{x}$ = . s.d. = .	0 0 $\bar{x}$ = . s.d. = .	**.** **.**	252 (51%) 2967 $\bar{x}$ = 11.77 s.d. = 11.207	15 (5%) 39 $\bar{x}$ = 2.60 s.d. = 2.131	**-94.0%** **-98.7%**
ACGH N = Facilities (Annual %) Σ = Procedures	298 (100%) 22929 $\bar{x}$ = 76.94 s.d. = 68.422	303 (100%) 24316 $\bar{x}$ = 80.25 s.d. = 82.645	**1.7%** **6.0%**	244 (49%) 3846 $\bar{x}$ = 15.76 s.d. = 20.627	264 (95%) 5349 $\bar{x}$ = 20.26 s.d. = 26.571	**8.2%** **39.1%**
Total N = Facilities (Annual %) Σ = Procedures	298 (100%) 22929 $\bar{x}$ = 76.94 s.d. = 68.422	303 (100%) 24316 $\bar{x}$ = 80.25 s.d. = 82.645	**1.7%** **6.0%**	496 (100%) 6813 $\bar{x}$ = 13.74 s.d. = 16.629	279 (100%) 5388 $\bar{x}$ = 19.31 s.d. = 26.155	**-43.8%** **-20.9%**

Procedure percent change is calculated based on 2004 and 2009 annual totals.

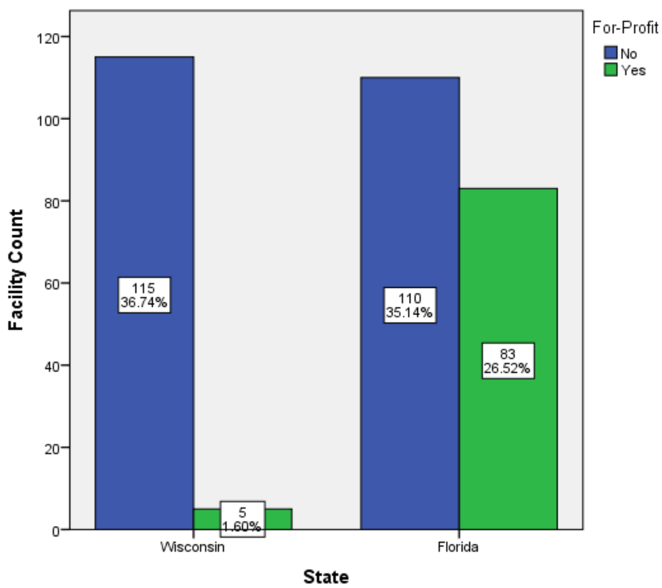
Results of Crosstab Analysis

The crosstab procedure was employed to examine the tax status of ACGHs by state. Information on tax status was not available for ASCs, and they are not included in this analysis. Findings indicate that the number of for-profit ACGHs differs significantly by state (χ^2 = 55.226; df = 1; p = .000). Almost 96% of the 120 Wisconsin ACGHs in the sample are non-profit. Florida ACGHs are more evenly split. Of the 193 Florida ACGHs in the sample, 57% are non-profit and 43% for-profit. (*See Table 35*: Crosstab Analysis of ACGH For-Profit Status by State. *See also Figure 11*: ACGH For-Profit Status by State (Bar Chart).)

Table 35: Crosstab Analysis of ACGH For-Profit Status by State

State		For-Profit		Facility
		No	Yes	Total
Wisconsin	Count	115	5	120
	% within state	95.8%	4.2%	100.0%
	% of total	36.7%	1.6%	38.3%
Florida	Count	110	83	193
	% within state	57.0%	43.0%	100.0%
	% of total	35.1%	26.5%	61.7%
Total	Count	225	88	313
	% of total	71.9%	28.1%	100.0%

Figure 11: ACGH For-Profit Status by State (Bar Chart)



Results of T-Tests

As the above descriptive analyses show, ASCs and ACGHs are different types of organizations, particularly in terms of size and capacity, which is based on surgical volumes. ASCs are smaller more specialized surgical facilities with no overnight beds. Acute care general hospitals are large generalist medical facilities that serve a broad population with a wide variety of medical conditions. The following t-test results compare medical facilities (i.e., ASCs and ACGHs) and states (i.e., Wisconsin and Florida). Percent change in annual ACBS procedure

totals between 2004 and 2009 is calculated based on individual facilities totals and is used as a standardized measure for comparison. The above descriptive statistics offered insight into trends based on annual figures. The following t-tests results are based on facility averages. Also, the above descriptive statistical analyses did not reveal whether findings were statistically different. The following t-tests indicate whether the differences in facility types and states are statistically significance. The discussion of t-tests results is divided into two sections comparing facility types and states. Each section is comprised of four subsections that examine procedures in total and as procedure groups, after discussing all ACBS combined, bariatric surgery, cholecystectomy, and appendectomy results presented and discussed separately. Each table presents findings on laparoscopic, ambulatory, open, and inpatient. The first part of the section on t-tests (Tables 36 to 47) presents comparative analyses of ACBS by facility type. The second part of the section on t-tests (Tables 48 to 59) presents a comparative analysis of ACBS procedures by state.

Comparative Analysis of ACBS by Facility Type

Tables 36 to 38 present findings on laparoscopic, ambulatory, open and inpatient ACBS procedures, with annual procedure counts and percent change figures are based on the years 2004 and 2009. Tables 36 to 38 focus on the pooled dataset of all ACBS procedures. Table 36 analyzes the pooled dataset that includes both Wisconsin and Florida facilities. Table 37 features Wisconsin data, and Table 38 highlights data on Florida facilities.

All ACBS: Laparoscopic, Ambulatory, Open, and Inpatient

Table 36 indicates that ASCs and ACGHs differ significantly in the provision of ACBS laparoscopic and ambulatory procedures in 2004 and 2009. A look at the average number of ACBS laparoscopic and ambulatory procedures performed per facility reveals that ACGHs outperformed ASCs. In 2004, 264 ASCs conducted laparoscopic ACBS procedures, and they averaged about 26 procedures per facility. During the same year, 302 ACGHs performed 228 laparoscopic ACBS procedures for an average of 228 per facility. In 2009, the number of ASCs performing laparoscopic ACBS procedures dropped to 66 facilities, a 75% decline. Yet, the average number of ACBS conducted per ASCs rose from 26 to 35. The number of ACGHs performing ACBS increased by 7 to 309 facilities, with the average number of ACBS procedures per facility rising from 228 to 324. These findings were statistically different at the $p < .05$ level. An examination of percent change in laparoscopic ACBS indicates that ASCs experienced a 79% decline, while ACGHs witnessed a 57% increase ($p = .000$).

Table 36 indicates that in 2004, 269 ASCs performed approximately 35 ambulatory ACBS procedures per facility. During the same year, 299 ACGHs performed about 97 ambulatory ACBS procedures, on average. ASC and ACGH facility averages differed significantly ($p = .000$). By 2009, the number of ASCs performing ambulatory ACBS procedures had fallen to 68 facilities, a 75% decline, while the average number of ACBS procedures conducted per facility remained around 35. The number of ACGHs performing ambulatory ACBS procedures fell by 2 to 297 facilities, with the average number of ambulatory ACBS procedures per ACGH rising from 97 to 142. ASCs experienced an 83% decline in ambulatory ACBS over the study period, while ACGHs saw a 127% increase in the number of ambulatory ACBS procedures performed. These percent changes are statistically significant ($p = .000$).

Table 36 also shows that in 2004, 244 ASCs performed, on average, about 11 open ACBS procedures per facility, while 302 ACGHs conducted almost 83 open ACBS procedures per facility. These figures indicate a difference that is statistically significant (p = .000). By 2009, the average number of open ACBS procedures performed in ASCs and ACGHs were no longer statistically different. Nine ASCs conducted, on average, 17 open ACBS procedure, while 301 ACGHs performed about 36 open ACBS procedures, on average (p = .137). A look at the change in the number of open ACBS procedures over the study period reveals a 96% drop in open surgeries performed at ASCs, and a 43% decline among ACGHs. The results differ significantly (p = .000). In 2004, 301 ACGHs performed about 216 inpatient ACBS procedures per facility. By 2009, 306 ACGHs performed 224 inpatient ACBS procedures, on average. An analysis of percent change reveals that ACGHs experienced a 2% increase in the number of inpatient ACBS procedures performed over the study period. ASCs do not perform inpatient ACBS procedures, and figures for this facility type are reflected as 0 (zero), and t-tests are not computed.

Table 37 examines laparoscopic, ambulatory, open, and inpatient ACBS trends in Wisconsin. In 2004, 15 ASCs conducted 61 laparoscopic ACBS procedures, on average. Wisconsin ACGHs, however, performed fewer laparoscopic ACBS procedures per facility than the average for the pooled dataset. In 2004, 116 ACGHs delivered 161 laparoscopic ACBS procedures, on average. By 2009, the number of ASCs performing laparoscopic ACBS procedures had risen from 15 to 18, and the average number of procedures performed had fallen from 61 to 56. While the number of ACGHs remained the same at 116, the average number of procedures per facility rose from 161 to 210 surgeries. Results in Wisconsin indicate that the average number of laparoscopic ACBS procedures performed in ASCs and ACGHs in 2004 (p =

.010) and 2009 (p = .001) differed significantly. Over the study period, ASCs witnessed a 13% decline in the number of laparoscopic ACBS performed, while ACGHs experienced a 32% increase (p = .007).

A comparison of ASC and ACGH ambulatory ACBS procedure averages for 2004 indicates the facilities did not differ significantly (p = .207). ASCs conducted about 62 ambulatory ACBS procedures per facility, while ACGHs performed approximately 90 procedures, on average. Yet, by 2009 ACGHs had outpaced ASCs, and the facility averages had become statistically different, with ASCs performed 56 ambulatory ACBS procedures per facility, and ACGHs performed 130 procedures (p = .007). Over the study period, the number of ambulatory ACBS procedures performed in ASCs dropped almost 13%, while the number for ACGHs rose by about 64% (p = .016).

Table 37 also features open and inpatient ACBS performed in Wisconsin. Four ASCs conducted open ACBS procedures in 2004 and 2009, averaging annually around 2 procedures per facility. In 2004, 116 ACGHs performed, on average, 52 open ACBS procedures. By 2009, the number of ACGHs performing open procedures had dropped to 111, and the per-facility average had declined to 27 procedures. In both 2004 and 2009, the per-facility averages were statistically different (p < .05). Over the study period, ASCs witnessed a 48% drop in open ACBS procedures, and ACGHs saw open ACBS procedures fall 34%. The percent changes recorded for open ACBS procedures in ASCs and ACGHs did not rise to the level of statistical significance (p = .651). In 2004, 116 Wisconsin ACGHs performed, on average, 123 inpatient ACBS procedures. In 2009, there was a slight decline to 114 ACGHs, and there also was a drop 108 inpatient ACBS procedures per facility. Over the study period, ACGHs witnessed a 24% decline in the number of inpatient ACBS procedures in Wisconsin.

Table 38 presents data on Florida laparoscopic, ambulatory, open, and inpatient ACBS procedure trends. In 2004, 249 ASCs performed 23 laparoscopic ACBS procedures, on average. The same year, 186 ACGHs conducted about 271 ACBS procedures laparoscopically. These findings differ significantly (p = .000). By 2009, the number of ASCs performing laparoscopic ACBS procedures had dropped to 48 facilities, a decline of 81%. In 2009, ASCs performed almost 28 laparoscopic ACBS procedures, on average, while 193 ACGHs performed slightly more than 392 procedures per facility (p = .000). Florida ASCs experienced an 83% decline in the number of laparoscopic ACBS procedures performed over the study period, while ACGHs witnessed a 73% increase in the number performed (p = .000).

Table 38 presents findings comparing the number of ambulatory ACBS procedures performed by Florida ASCs and ACGHs. ASCs and ACGHs differed significantly in the number of ambulatory ACBS procedures conducted in both 2004 and 2009. In 2004, 254 Florida ASCs performed, on average, 33 ambulatory ACBS procedures, while 183 ACGHs provided 101 procedures (p = .000). By 2009, the number of ASCs performing ACBS procedures had fallen from 254 to 50, an 80% decline. ASCs also witnessed a slight drop in the facility average from 33 to 29. While the number of ACGHs also fell slightly by 2 to 181, the number of procedures performed per ACGH rose from 101 to 150. Over the study period, ASCs experienced an 87% decline in the number of ambulatory ACBS procedures performed, while ACGHs witnessed a 166% increase (p = .000).

Results from Table 38 indicate that the average number of open ACBS procedures performed in ASCs and ACGHs in 2004 differed significantly (p =.000). By 2009, however, the facility averages for ASCs and ACGHs had lost statistical significance (p. = .532). In 2004, 240 ASCs performed annually about 11 open ACBS procedures per facility, and 186 ACGHs

performed about 102 open ACBS procedures, on average. By 2009, the number of ASCs had dropped to 5 facilities performing, on average, 29 open ACBS procedures, while the number of ACGHs rose to 190 facilities the facility average fell to 41 procedures. Over the study period, Florida ASCs experienced a 97% decline in the number of open ACBS procedures performed, while ACGHs witnessed a 48% decrease ($p = .000$). According to Table 38, in 2004, 185 ACGHs delivered 274 inpatient ACBS procedures, on average. Findings show an upward trend in the number of facilities performing inpatient ACBS. By 2009, 192 ACGHs performed, on average, 293 inpatient surgeries. Over the study period, Florida ACGHs conducted about 18% more inpatient ACBS procedures, on average.

Table 36: Independent Samples T-Test: Laparoscopic, Ambulatory, Open, and Inpatient ACBS Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Pooled Dataset: Both States)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic ACBS procedures were performed in 2004?	ASC ACGH	264 302	25.62 228.29	26.480 187.241	-17.433	.000**	ASC: -.7876 ACGH: .5742	.83341 1.15291	-15.900	.000**
How many laparoscopic ACBS procedures were performed in 2009?	ASC ACGH	66 309	35.26 323.99	53.187 271.158	-8.607	.000**				
How many ambulatory ACBS procedures were performed in 2004?	ASC ACGH	269 299	34.75 96.64	31.772 91.097	-10.577	.000**	ASC: -.8278 ACGH: 1.2685	.61466 3.71922	-9.132	.000**
How many ambulatory ACBS procedures were performed in 2009?	ASC ACGH	68 297	36.47 142.26	54.203 130.368	-6.557	.000**				
How many open ACBS procedures were performed in 2004?	ASC ACGH	244 302	10.59 82.54	10.063 85.759	-13.029	.000**	ASC: -.9581 ACGH: -.4272	.42983 .50591	-13.026	.000**
How many open ACBS procedures were performed in 2009?	ASC ACGH	9 301	17.00 35.95	40.268 37.458	-1.492	.137				
How many inpatient ACBS procedures were performed in 2004?	ASC ACGH	0 301	. 215.86	. 181.998	.[a]	.	. ACGH: .0194	. .58854	.[a]	.
How many inpatient ACBS procedures were performed in 2009?	ASC ACGH	0 306	. 224.45	. 200.546	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 37: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient ACBS Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Wisconsin)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic ACBS procedures were performed in 2004?	ASC ACGH	15 116	61.13 160.59	63.397 144.457	-2.627	.010**	ASC: -.1246 ACGH: .3168	.77347 .56029	-2.740	.007**
How many laparoscopic ACBS procedures were performed in 2009?	ASC ACGH	18 116	55.56 210.43	56.337 188.881	-3.445	.001**				
How many ambulatory ACBS procedures were performed in 2004?	ASC ACGH	15 116	61.87 89.75	64.542 81.805	-1.268	.207	ASC: -.1261 ACGH: .6392	.77445 1.17865	-2.443	.016**
How many ambulatory ACBS procedures were performed in 2009?	ASC ACGH	18 116	55.94 130.11	56.937 112.389	-2.739	.007**				
How many open ACBS procedures were performed in 2004?	ASC ACGH	4 116	2.75 51.79	2.062 59.990	-2.627	.010**	ASC: -.4750 ACGH: -.3374	.41130 .60020	-.454	.651
How many open ACBS procedures were performed in 2009?	ASC ACGH	4 111	1.75 27.44	.957 28.642	-3.445	.001**				
How many inpatient ACBS procedures were performed in 2004?	ASC ACGH	0 116	. 122.64	. 125.569	.[a]	.	. ACGH: -.2352	. .34250	.[a]	.
How many inpatient ACBS procedures were performed in 2009?	ASC ACGH	0 114	. 108.45	. 115.170	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 38: Inpatient Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient ACBS Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Florida)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic ACBS procedures were performed in 2004?	ASC ACGH	249 186	23.48 270.51	20.876 198.506	-19.501	.000**	ASC: -.8275 ACGH: .7347	.82136 1.37843	-14.726	.000**
How many laparoscopic ACBS procedures were performed in 2009?	ASC ACGH	48 193	27.65 392.24	50.471 290.013	-8.664	.000**				
How many ambulatory ACBS procedures were performed in 2004?	ASC ACGH	254 183	33.15 101.01	28.154 96.488	-10.602	.000**	ASC: -.8693 ACGH: 1.6673	.57975 4.62156	-8.657	.000**
How many ambulatory ACBS procedures were performed in 2009?	ASC ACGH	50 181	29.46 150.04	51.991 140.438	-5.952	.000**				
How many open ACBS procedures were performed in 2004?	ASC ACGH	240 186	10.73 101.71	10.092 93.631	-14.947	.000**	ASC: -.9661 ACGH: -.4833	.42632 .42928	-11.560	.000**
How many open ACBS procedures were performed in 2009?	ASC ACGH	5 190	29.20 40.92	53.138 41.016	-.626	.532				
How many inpatient ACBS procedures were performed in 2004?	ASC ACGH	0 185	. 274.32	. 187.712	.[a]	.	. ACGH: .1791	. .65186	.[a]	.
How many inpatient ACBS procedures were performed in 2009?	ASC ACGH	0 192	. 293.33	. 208.747	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Comparative Analysis of Bariatric Surgery by Facility Type

Tables 39 to 41 examine trends in bariatric surgery. Tables 39 to 41 feature bariatric surgery procedures—with Table 39 analyzing both states together, Table 40 spotlighting Wisconsin, and Table 41 focusing on Florida.

Bariatric Surgery: Laparoscopic, Ambulatory, Open, and Inpatient

Results featured in Table 39 are based on the pooled dataset. They indicate that in 2004, ASCs and ACGHs differ significantly in the provision of laparoscopic bariatric surgery. Sixty-six ASCs performed, on average, 4 laparoscopic bariatric surgery procedures per facility, while 103 ACGHs delivered, on average, 18 laparoscopic bariatric surgery procedures ($p = .000$). By 2009, the number of ASCs performing these procedures had fallen to 9, an 86% drop. The number of ACGHs rose by 7 to 110 facilities that performed on average 71 laparoscopic bariatric surgery procedures per facility. By 2009, the facility averages for ASCs and ACGHs were no longer statistically significant ($p = .149$). Over the study period, ASCs witnessed a 23% decline in the number of laparoscopic bariatric surgery procedures performed, while ACGHs experienced a 444% surge ($p = .012$).

Table 39 indicates that in 2004, 139 ASCs performed about 6 ambulatory bariatric surgery procedures per facility. During the same year, 73 ACGHs performed on average 9 bariatric surgery procedures in ambulatory settings. While the facility averages did not differ statistically at the $p < .05$ level, they did differ significantly at the $p < .10$ level ($p = .092$). By 2009, the number of ASCs performing ambulatory bariatric surgery procedures had dropped from 139 to 68 facilities, a 93% decline, while the average number of bariatric surgery procedures conducted per facility rose to 19. The number of ACGHs performing ambulatory bariatric surgery remained constant at 73, with the average number of procedures rising to about

25. Over the study period, ASCs experienced an 82% drop, while ACGHs witnessed 172% increase in the number of ambulatory bariatric surgery procedures performed. These percent changes are statistically significant (p = .000).

Table 39 also shows that in 2004, 106 ASCs performed, on average, 6 open bariatric surgery procedures, while 191 ACGHs delivered 42 open ACBS procedures per facility. The figures indicate statistically different results (p = .000). By 2009, ASCs did not perform any open bariatric surgery procedures, and 160 ACGHs conducted, on average, 5 procedures annually. Over the study period, ASCs discontinued the provision of open bariatric surgery, and ACGHs witnessed a 60% decline in volume (p = .000).

In 2004, 182 ACGHs performed, on average, 50 inpatient bariatric surgery procedures. By 2009, 175 ACGHs performed 39 inpatient bariatric procedures. An analysis of percent change calculated at the facility level reveals that ACGHs witnessed a 145% increase in the number of inpatient bariatric surgery procedures conducted over the study period.

Table 40 presents findings on bariatric surgery from Wisconsin. In 2004, ASCs did not deliver any bariatric surgery procedures. By 2009, 2 ASCs had entered the market, providing on average 8 laparoscopic bariatric surgeries annually per facility.

In 2004, 21 ACGHs performed on average 17 procedures. By 2009, 27 ACGHs delivered 56 procedures, on average. The 2009 facility averages for laparoscopic bariatric surgery performed in ASCs and ACGHs failed to differ significantly (p = .239). Over the six-year period, from 2004 to 2009, ACGHs witnessed laparoscopic bariatric surgery procedures soar 691%.

In 2004, 6 ACGHs performed, on average, 9 ambulatory bariatric surgery procedures per facility. By 2009, an addition 14 ACGHs had entered the market, for a total of 20 ACGHs that averaged 9 surgeries per facility. During this same year, 2 ASCs performed almost 8 ambulatory bariatric surgery procedures, on average. The 2009 facility averages for ASCs and ACGHs did not differ significantly ($p = .821$). Only ACGHs performed open and inpatient bariatric surgery procedures in 2004 and 2009. Results in Table 40 show that in 2004, 47 ACGHs delivered on average 39 open bariatric surgeries annually. The number of ACGHs fell slightly to 43 facilities in 2009 that delivered on average 5 open bariatric surgery procedures. Over the study period, Wisconsin ACGHs witnessed a 61% decline in the number of open bariatric surgery procedures performed. In 2004, 47 ACGHs performed, on average, 46 inpatient bariatric procedures. By 2009, the number of ACGHs had dropped slightly to 45 facilities that performed, on average, 34 inpatient bariatric surgeries. Over the study period, ACGHs experienced a 29% reduction in inpatient bariatric surgery procedures.

Table 41 focuses on bariatric surgery in Florida. In 2004, 66 ASCs performed 4 laparoscopic bariatric surgery procedures on average, and 82 ACGHs performed 20 bariatric surgery procedures, on average ($p = .000$). By 2009, the number of ASCs performing these procedures had dropped to 7, an 89% declined. Yet, the average number of procedures per facility rose from 4 to 23 annually. The number of ACGHs performing laparoscopic bariatric surgery increased slightly to 83 facilities that experienced a jump from 18 to 76 procedures per facility annually. By 2009, the facility averages for ASCs and ACGHs were no longer statistically significant ($p = .240$), indicating no difference in the facility averages. Over the study period, ASCs witnessed a 23% decline, while ACGHs experienced a 381% surge, in the number of laparoscopic bariatric surgery procedures conducted ($p = .024$).

In 2004, 139 ASCs performed 6 ambulatory bariatric surgery procedures, on average, while 67 ACGHs performed 9 ambulatory bariatric surgeries ($p = .101$). The facility averages did not differ statistically. By 2009, the number of ASCs conducting ambulatory bariatric surgery had fallen to 7 facilities performing 23 procedures, on average; and the number of ACGHs had dropped to 53 facilities performing, on average, 31 ambulatory bariatric surgeries ($p = .772$). These findings lacked statistical significance. Over the study period, ASCs witnessed an 81% decline in the number of ambulatory bariatric surgery procedures performed, while ACGHs experienced a 191% jump ($p = .000$).

Table 41 shows that in 2004, 106 ASCs conducted, on average, 6 open bariatric surgery procedures, and 144 ACGHs performed, on average, 42 open surgeries. By 2009, the number of ASCs performing ambulatory bariatric surgery procedures had dropped to zero, and the number of ACGHs to 117 facilities performing 5 open bariatric surgeries, on average. Over the study period, ASCs experienced a 100% plunge in open bariatric surgery procedures, while ACGHs witnessed a 60% decline in the number of open bariatric surgeries performed ($p = .000$). These percent changes are statistically significant.

In 2004, 135 Florida ACGHs performed, on average, 52 inpatient bariatric surgery procedures. By 2009, the number had dropped to 130 ACGHs that conducted an average of 41 inpatient surgeries. Over the study period, Florida ACGHs witnessed a 206% jump in the number of inpatient bariatric surgery procedures performed.

Table 39: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Bariatric Surgery Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Pooled Dataset: Both States)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic bariatric surgery procedures were performed in 2004?	ASC ACGH	66 103	4.44 18.05	7.933 22.124	-4.799	.000**	ASC: -.2348 ACGH: 4.4446	6.21612 14.07407	-2.545	.012**
How many laparoscopic bariatric surgery procedures were performed in 2009?	ASC ACGH	9 110	19.33 70.98	31.177 105.928	-1.452	.149				
How many ambulatory bariatric surgery procedures were performed in 2004?	ASC ACGH	139 73	6.49 9.21	9.412 13.782	-1.692	.092*	ASC: -.8147 ACGH: 1.7201	2.14179 7.36468	-3.772	.000**
How many ambulatory bariatric surgery procedures were performed in 2009?	ASC ACGH	9 73	19.33 24.74	31.177 61.228	-.260	.796				
How many open bariatric surgery procedures were performed in 2004?	ASC ACGH	106 191	5.75 41.60	8.782 73.008	-5.033	.000**	ASC: -1.0000 ACGH: -.5971	.00000 .76152	-5.444	.000**
How many open bariatric surgery procedures were performed in 2009?	ASC ACGH	0 160	. 5.09	. 12.106	.[a]	.				
How many inpatient bariatric surgery procedures were performed in 2004?	ASC ACGH	0 182	. 50.18	. 87.444	.[a]	.	. ACGH: 1.4521	. 10.63988	.[a]	.
How many inpatient bariatric surgery procedures were performed in 2009?	ASC ACGH	0 175	. 38.95	. 70.007	.[a]	.				

*P<0.10 **P<0.05

[a]. t cannot be computed because at least one of the groups is empty.

Table 40: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Bariatric Surgery Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Wisconsin)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic bariatric surgery procedures were performed in 2004?	ASC ACGH	0 21	. 17.33	. 18.421	.[a]	.	.	.	.[a]	.
How many laparoscopic bariatric surgery procedures were performed in 2009?	ASC ACGH	2 27	7.50 56.30	2.121 56.366	-1.204	.239	ACGH: 6.9154	16.97851		
How many ambulatory bariatric surgery procedures were performed in 2004?	ASC ACGH	0 6	. 8.83	. 7.139	.[a]	.	.	.	.[a]	.
How many ambulatory bariatric surgery procedures were performed in 2009?	ASC ACGH	2 20	7.50 9.00	2.121 9.038	-.229	.821	ACGH: -.4414	.41491		
How many open bariatric surgery procedures were performed in 2004?	ASC ACGH	0 47	. 39.47	. 52.873	.[a]	.	.	.	.[a]	.
How many open bariatric surgery procedures were performed in 2009?	ASC ACGH	0 43	. 4.63	. 4.796	.[a]	.	ACGH: -.6088	.65054		
How many inpatient bariatric surgery procedures were performed in 2004?	ASC ACGH	0 47	. 46.09	. 63.955	.[a]	.	.	.	.[a]	.
How many inpatient bariatric surgery procedures were performed in 2009?	ASC ACGH	0[a] 45	. 34.20	. 48.931	.[a]	.	ACGH: -.2922	.69876		

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 41: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Bariatric Surgery Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Florida)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic bariatric surgery procedures were performed in 2004?	ASC ACGH	66 82	4.44 18.23	7.933 20.074	-4.638	.000**	ASC: -.2348 ACGH: 3.8119	6.21612 13.27658	-2.282	.024**
How many laparoscopic bariatric surgery procedures were performed in 2009?	ASC ACGH	7 83	22.71 75.76	35.146 117.532	-1.184	.240				
How many ambulatory bariatric surgery procedures were performed in 2004?	ASC ACGH	139 67	6.49 9.24	9.412 14.260	-1.649	.101	ASC: -.8147 ACGH: 1.9137	2.14179 7.66117	-3.903	.000**
How many ambulatory bariatric surgery procedures were performed in 2009?	ASC ACGH	7 53	22.71 30.68	35.146 70.920	-.291	.772				
How many open bariatric surgery procedures were performed in 2004?	ASC ACGH	106 144	5.75 42.30	8.782 78.617	-4.763	.000**	ASC: -1.0000 ACGH: -.5932	.00000 .79645	-5.255	.000**
How many open bariatric surgery procedures were performed in 2009?	ASC ACGH	0 117	. 5.26	. 13.873	.[a]	.				
How many inpatient bariatric surgery procedures were performed in 2004?	ASC ACGH	0 135	. 51.61	. 94.427	.[a]	.	. ACGH: 2.0594	. 12.30072	.[a]	.
How many inpatient bariatric surgery procedures were performed in 2009?	ASC ACGH	0[a] 130	. 40.59	. 76.049	.[a]	.				

*P<0.10 **P<0.05

[a]. t cannot be computed because at least one of the groups is empty.

Comparative Analysis of Cholecystectomy by Facility Type

Tables 42 to 44 present findings on laparoscopic, ambulatory, open and inpatient cholecystectomies. Tables 42 to 44 examine cholecystectomy procedures—with Table 42 analyzing both states together, Table 43 presenting findings on Wisconsin, and Table 44 focusing on Florida.

Cholecystectomy: Laparoscopic, Ambulatory, Open, and Inpatient

Table 42 reflects findings from the pooled dataset, and it reveals that ASCs and ACGHs differ significantly in the provision of laparoscopic and ambulatory procedures. In 2004, 261 ASCs performed, on average, 18 laparoscopic cholecystectomy procedures, while 302 ACGHs performed 172, on average ($p = .000$). By 2009, the number of ASCs performing laparoscopic cholecystectomy procedures dropped to 64 facilities. Yet, the average number of cholecystectomies conducted per ASCs rose from 18 to 33. The number of ACGHs performing cholecystectomy procedures increased by 7 to 309 facilities, and the average number of surgeries per ACGH rose from 172 to 222. These findings were statistically different at the $p < .05$ level. Findings reveal that ASCs experienced a 65% decline in laparoscopic cholecystectomies, while ACGHs witnessed a 44% increase ($p = .000$).

Table 42 indicates that in 2004, 265 ASCs performed almost 21 ambulatory cholecystectomies per facility. During the same year, 299 ACGHs performed about 82 ambulatory cholecystectomy procedures, on average. In 2004, ASCs and ACGHs differed significantly ($p = .000$). By 2009, the number of ASCs performing ambulatory cholecystectomy procedures had fallen to 66 facilities, performing on average 34 surgeries—an increase over the 20 per facility average in 2004. In 2009, the number of ACGHs performing ambulatory

cholecystectomies fell by 2 to 297 facilities conducting, on average, 118 surgeries. Over the study period, ASCs experienced a 67% decline in ambulatory chloecystectomy procedures, and ACGHs witnessed a 170% jump in the number of ambulatory cholecystectomy procedures performed. These percent changes are statistically significant (p = .000).

Table 42 shows that in 2004, 203 ASCs performed almost 4 open cholecystectomy procedures per facility; while 291 ACGHs conducted almost 19 open cholecystectomies per facility. These figures indicate a difference that is statistically significant (p = .000). By 2009, the average number of open cholecystectomy procedures performed in ASCs and ACGHs were no longer statistically different (p = .429). The number of ASCs conducting cholecystectomies had fallen to 8, with the average number of surgeries performed by ASCs rising from 4 to 19. Over the study period, the number of open cholecystectomy procedures performed at ASCs declined 87% and at ACGHs declined 13%. The results differ significantly (p = .000).

In 2004, 299 ACGHs performed 110 inpatient cholecystectomy procedures per facility. By 2009, the number had risen to 304 ACGHs performing 124 inpatient cholecystectomies, on average. Over the study period, ACGHs experienced a 14% increase in the number of inpatient cholecystectomy procedures performed.

Table 43 examines laparoscopic, ambulatory, open, and inpatient cholecystectomy trends in Wisconsin. In 2004, 15 ASCs conducted 60 laparoscopic cholecystectomies, on average. The same year, 116 ACGHs delivered 118 laparoscopic cholecystectomy procedures, on average. By 2009, the number of ASCs performing laparoscopic cholecystectomy procedures had risen from 15 to 18, and the average number of surgeries performed had fallen slightly from 59 to 54. While the number of ACGHs remained at 116, the average number of procedures per facility rose from 118 to 140 surgeries. Results indicate that the average number of laparoscopic cholecystectomy

procedures performed in ASCs and ACGHs in 2004 ($p = .031$) and 2009 ($p = .004$) differed significantly. Over the study period, ASCs witnessed a 12% decline in the number of laparoscopic cholecystectomy procedures performed, while ACGHs experienced a 19% increase ($p = .007$).

A comparison of facility averages for ASCs and ACGHs performing ambulatory cholecystectomy procedures in 2004 indicates no statistical difference in findings ($p = .398$). In 2004, 15 ASCs conducted about 60 ambulatory cholecystectomies per facility, while 116 ACGHs performed 75 procedures, on average. By 2009, the number of ASCs had risen by 3 to 18, and the facility average had dropped from 60 to 54. During the same year, the number of ACGHs remained at 116, but the facility average for ambulatory cholecystectomy procedures rose to 98. In 2009, ASC and ACGH facility averages differed significantly ($p = .039$). Over the study period, the number of ambulatory cholecystectomy procedures performed in ASCs dropped by 12%, while the number for ACGHs rose by 45% ($p = .069$).

Table 43 also features open and inpatient cholecystectomy procedures performed in Wisconsin. Four ASCs conducted open cholecystectomies in 2004 and 2009—averaging annually about 3 surgeries per facility in 2004, and fewer than 2 per facility in 2009. In 2004, 106 ACGHs performed, on average, 11 open cholecystectomies. By 2009, 105 ACGHs perform, on average, around 10 open cholecystectomy procedures. In both 2004 and 2009, the per-facility averages of ASCs and ACGHs lacked significance ($p < .05$). Over the study period, ASCs witnessed a 48% drop in open cholecystectomies, and ACGHs saw open cholecystectomies fall about 9% ($p = .044$).

In 2004, 114 Wisconsin ACGHs performed, on average, 53 inpatient cholecystectomy procedures. In 2009, there was a slight decline to 112 ACGHs performing these surgeries, while

the average number of inpatient cholecystectomy procedures performed remained steady at 53. Over the study period, ACGHs witnessed a 6% decline in the number of inpatient cholecystectomy procedures in Wisconsin.

Table 44 presents data on laparoscopic, ambulatory, open, and inpatient Cholecystectomy procedure trends in Florida. In 2004, 246 ASCs performed 16 laparoscopic cholecystectomies, on average. The same year, 186 ACGHs conducted 205 cholecystectomy procedures laparoscopically. These findings differ significantly (p = .000). By 2009, the number of ASCs performing laparoscopic cholecystectomies had dropped to 46 facilities. In 2009, ASCs performed almost 25 laparoscopic cholecystectomy procedures, on average, while 193 ACGHs performed slightly about 272 surgeries per facility (p = .000). Over the study period, Florida ASCs experienced an 68% decline in the number of laparoscopic cholecystectomy procedures performed, while ACGHs witnessed a 60% increase in the number performed (p = .000).

Results in Table 44 also present findings that compare the number of ambulatory cholecystectomy procedures performed in Florida. ASCs and ACGHs differed significantly in the number of ambulatory cholecystectomy procedures conducted in both 2004 and 2009. In 2004, 250 Florida ASCs performed, on average, 18 ambulatory cholecystectomy procedures, while 183 ACGHs provided 85 procedures (p = .000). By 2009, the number of ASCs performing cholecystectomy procedures had fallen from 250 to 48, an 81% drop. Yet, the average number of procedures for ASCs rose from 18 to 27. In 2009, the number of ACGHs fell by 2 to 181 facilities, performing 131 cholecystectomies, on average. Over the study period, ASCs experienced a 70% decline in the number of ambulatory cholecystectomies, while ACGHs witnessed a 250% increase (p = .000).

Results from Table 44 indicate that in 2004, the average number of open cholecystectomy procedures performed in ASCs and ACGHs differed significantly (p =.000). In that year, 199 ASCs performed, on average, about 4 open cholecystectomies, and 185 ACGHs delivered 23 open cholecystectomy procedures. By 2009, the number of ASCs had dropped to 4 facilities performing 36 open cholecystectomies, on average. The number of ACGHs remained the same at 185 facilities, averaging 17 open cholecystectomy procedures. In 2009, the facility averages remained statistically significant (p. = .023). Over the study period, Florida ASCs experienced an 88% decline in the number of open cholecystectomy procedures performed, while ACGHs witnessed a 16% decrease (p = .000). According to Table 38, 185 ACGHs delivered 145 inpatient cholecystectomies in 2004. Findings show an upward trend in the number of ACGHs performing inpatient cholecystectomies. By 2009, 192 ACGHs performed, on average, 165 inpatient cholecystectomies. Over the study period, Florida ACGHs conducted about 26% more inpatient cholecystectomy procedures, on average.

Table 42: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Cholecystectomy Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Pooled Dataset: Both States)

Procedure Counts							Percent Change			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic cholecystectomy procedures were performed in 2004?	ASC ACGH	261 302	18.17 171.68	21.985 139.847	-17.545	.000**	ASC: -.6451 ACGH: .4401	1.56357 1.09080	-9.647	.000**
How many laparoscopic cholecystectomy procedures were performed in 2009?	ASC ACGH	64 309	33.08 221.52	45.550 182.740	-8.189	.000**				
How many ambulatory cholecystectomy procedures were performed in 2004?	ASC ACGH	265 299	20.68 81.53	23.327 81.561	-11.726	.000**	ASC: -.6702 ACGH: 1.7035	1.43836 4.64874	-7.980	.000**
How many ambulatory cholecystectomy procedures were performed in 2009?	ASC ACGH	66 297	34.35 118.16	46.913 107.838	-6.180	.000**				
How many open cholecystectomy procedures were performed in 2004?	ASC ACGH	203 291	3.64 18.65	3.337 16.735	-12.603	.000**	ASC: -.8698 ACGH: -.1310	1.17548 .71513	-8.667	.000**
How many open cholecystectomy procedures were performed in 2009?	ASC ACGH	8 290	18.75 14.47	42.681 13.759	.791	.429				
How many inpatient cholecystectomy procedures were performed in 2004?	ASC ACGH	0 299	. 110.02	. 92.827	.[a]	.	. ACGH: .1350	. .71072	.[a]	.
How many inpatient cholecystectomy procedures were performed in 2009?	ASC ACGH	0 304	. 123.52	. 108.436	.[a]	.				

*P<0.10 **P<0.05

[a]. t cannot be computed because at least one of the groups is empty.

Table 43: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Cholecystectomy Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Wisconsin)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic cholecystectomy were performed in 2004?	ASC ACGH	15 116	59.47 117.60	61.672 100.567	-2.182	.031**	ASC: -.1193 ACGH: .1886	.77966 .51630	-2.037	.044**
How many laparoscopic cholecystectomy procedures were performed in 2009?	ASC ACGH	18 116	53.78 139.98	54.330 123.895	-2.902	.004**				
How many ambulatory cholecystectomy procedures were performed in 2004?	ASC ACGH	15 116	60.20 75.35	62.816 65.421	-.848	.398	ASC: -.1211 ACGH: .4485	.78018 1.16658	-1.836	.069*
How many ambulatory cholecystectomy procedures were performed in 2009?	ASC ACGH	18 116	54.17 97.60	54.930 85.357	-2.089	.039**				
How many open cholecystectomy procedures were performed in 2004?	ASC ACGH	4 106	2.75 11.02	2.062 11.217	-1.467	.145	ASC: -.4750 ACGH: -.0889	.41130 .79536	-2.037	.044**
How many open cholecystectomy procedures were performed in 2009?	ASC ACGH	4 105	1.75 9.50	.957 11.349	-1.360	.177				
How many inpatient cholecystectomy procedures were performed in 2004?	ASC ACGH	0 114	. 53.24	. 51.880	.[a]	.	. ACGH: -.0624	. .65736	.[a]	.
How many inpatient cholecystectomy procedures were performed in 2009?	ASC ACGH	0 112	. 52.80	. 56.039	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 44: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Cholecystectomy Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Florida)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic cholecystectomy were performed in 2004?	ASC ACGH	246 186	15.65 205.40	13.594 150.188	-19.716	.000**	ASC: -.6772 ACGH: .5969	1.59428 1.30608	-8.876	.000**
How many laparoscopic cholecystectomy procedures were performed in 2009?	ASC ACGH	46 193	24.98 270.52	39.384 194.795	-8.495	.000**				
How many ambulatory cholecystectomy procedures were performed in 2004?	ASC ACGH	250 183	18.31 85.44	15.980 90.267	-11.520	.000**	ASC: -.7031 ACGH: 2.4990	1.46288 5.73451	-8.464	.000**
How many ambulatory cholecystectomy procedures were performed in 2009?	ASC ACGH	48 181	26.92 131.34	41.779 118.412	-6.003	.000**				
How many open cholecystectomy procedures were performed in 2004?l	ASC ACGH	199 185	3.65 23.02	3.358 17.801	-15.060	.000**	ASC: -.8777 ACGH: -.1552	1.18486 .66591	-7.292	.000**
How many open cholecystectomy procedures were performed in 2009?	ASC ACGH	4 185	35.75 17.29	58.982 14.230	2.288	.023**				
How many inpatient cholecystectomy procedures were performed in 2004?	ASC ACGH	0 185	. 145.01	. 95.259	.[a]	.	. ACGH: .2566	. .71673	.[a]	.
How many inpatient cholecystectomy procedures were performed in 2009?	ASC ACGH	0 192	. 164.77	. 110.388	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Comparative Analysis of Appendectomy by Facility Type

Tables 45 to 47 show findings on appendectomy procedures. Table 45 analyzes both states together. Table 46 highlights Wisconsin, and Table 47 focuses on Florida.

Appendectomy: Laparoscopic, Ambulatory, Open, and Inpatient

Table 45 highlights laparoscopic, ambulatory, open, and inpatient appendectomy procedures performed in both states together. Results indicate that in 2004, 224 ASCs performed, on average, 8 laparoscopic appendectomies. During the same year, 278 ACGHs averaged 55 laparoscopic appendectomy procedures per facility. By 2009, the number of ASCs performing laparoscopic appendectomies had fallen 14 facilities, about a 94% decline. The average number of laparoscopic appendectomy procedures conducted per ASCs also declined from about 8 to 3. The number of ACGHs performing laparoscopic appendectomy procedures increased to 299 facilities, with the average of 80 per facility. The average facility output for 2004 and 2009 differed significantly at the $p < .05$ level. An examination of percent change over the study period indicates that ASCs saw a 97% drop in laparoscopic appendectomy procedures performed, while ACGHs witnessed a 139% increase ($p = .000$).

In 2004, 252 ASCs performed, on average, 12 ambulatory appendectomies procedures per facility. During the same year, 244 ACGHs performed about 16 ambulatory appendectomy procedures, on average. ASC and ACGH procedure totals differed significantly in 2004 ($p = .007$). By 2009, the number of ASCs performing ambulatory appendectomy procedures had fallen to 15 facilities, a 94% decline. The average number of appendectomies conducted per ASC dropped to less than 3 surgeries. In 2009, the number of ACGHs performing ambulatory appendectomy procedures increased by 20 to 264 facilities, that averaged 20 procedures per ACGH. ASCs experienced a 98% plunge in ambulatory appendectomy procedures over the study

period, while ACGHs witnessed a 154% increase. These percent changes are statistically significant (p = .000).

Table 45 also shows that in 2004, 210 ASCs performed, on average, about 6 open appendectomies per facility, while 299 ACGHs performed almost 39 open appendectomy procedures per facility. These figures indicate a difference that is statistically significant (p = .000). By 2009, the average number of open appendectomy procedures performed in ASCs and ACGHs were no longer statistically different (p = .499). Only 1 ASCs conducted open appendectomies, performing 3 annually. There were 287 ACGHs administering 20 appendectomy procedures, on average. A look at the change in the number of open ACBS procedures over the study period reveals a 99% plunge in open surgeries performed at ASCs, and a 43% decline among ACGHs (p = .000). These results differ significantly. In 2004, 298 ACGHs performed about 77 inpatient appendectomy procedures per facility. By 2009, the number of ACGHs had increased to 303 performing 80 inpatient appendectomy procedures, on average. An analysis of percent change reveals that ACGHs experienced a 1% decrease in the number of inpatient appendectomy procedures performed over the study period.

Table 46 examines laparoscopic, ambulatory, open, and inpatient appendectomy procedures in Wisconsin. In 2004, 7 ASCs conducted about 4 laparoscopic appendectomy procedures, on average. Wisconsin had 102 ACGHs deliver an average of 45 laparoscopic appendectomy procedures. The facility averages for ASCs and ACGHs were statistically different (p = .031). By 2009, the number of ASCs performing laparoscopic appendectomy procedures had dropped slightly from 7 to 6 facilities delivering fewer than 3 surgeries, on average. During this same year, the number of ACGHs rose to 111 that delivered 60 laparoscopic appendectomies, on average. Wisconsin results indicate that the average number of laparoscopic

appendectomies in ASCs and ACGHs in 2009 differed significantly (p = .021). Over the study period, ASCs witnessed a 50% decline in the number of laparoscopic ACBS performed, while ACGHs experienced a 168% increase (p = .007).

A review of ambulatory appendectomy procedures shows that in 2004, 7 ASCs conducted fewer than 4 ambulatory appendectomies per facility, while 88 ACGHs performed approximately 18 procedures, on average (p = .126). These facility averages lacked significance, indicating that they are not statistically different from one another. Yet, by 2009 ACGHs had outpaced ASCs, and the facility averages had gained statistical significance. Six ASCs performed 3 ambulatory appendectomies per facility, and 109 ACGHs performed, on average, 33 procedures (p = .028). Over the study period, the number of ambulatory appendectomy procedures performed in ASCs dropped by 50%, while the number for ACGHs soared 331% (p = .036).

Table 46 reveals that Wisconsin ASCs did not perform any open or inpatient appendectomy procedures in 2004 or 2009. In 2004, 115 ACGHs performed, on average, 26 open appendectomies. By 2009, the number of ACGHs performing open appendectomy procedures dropped to 107 facilities that delivered 17 surgeries, on average. Over the study period, ACGHs experienced a 30% decline in the number of procedures performed. In 2004, 116 ACGHs performed, on average, 52 inpatient appendectomy procedures. In 2009, there was a slight decline to 113 ACGHs that performed, on average, 43 inpatient appendectomy procedures. Over the study period, ACGHs witnessed a 29% decline in the number of inpatient appendectomies procedures in Wisconsin.

Table 47 examines Florida laparoscopic, ambulatory, open, and inpatient appendectomy procedure trends. In 2004, 217 ASCs performed 8 laparoscopic appendectomies, on average.

The same year, 176 ACGHs conducted about 60 appendectomies laparoscopically. These findings differ significantly ($p = .000$). By 2009, the number of ASCs performing laparoscopic appendectomies had dropped to 8 facilities, a 96% plunge. The annual facility average for ASCs performing laparoscopic appendectomies also dropped to 2 procedures. That same year, the number of ACGHs performing laparoscopic appendectomies rose to 188, with a facility average of 92 procedures. For 2009, the facility averages for ASCs and ACGHs differed significantly ($p = .004$). Over the study period, Florida ASCs experienced a 99% drop in laparoscopic appendectomy procedures, while ACGHs witnessed an increase of 122% ($p = .002$).

Table 47 also shows the 245 Florida ASCs performed, on average, 12 ambulatory appendectomies in 2004. The same year, 156 Florida ACGHs delivered, on average, 17 appendectomies in ambulatory settings. In 2004, the facility averages for ASCs and ACGHs did not differ significantly ($p = .112$). By 2009, the facility averages differed at the $p < .10$ level. The number of ASCs performing ambulatory appendectomy procedures had declined from 245 to 9, a 96% drop. ASCs also witnessed a decline from 12 to 2 in the per facility average. While the number of ACGHs basically remained the same at 155 facilities, the average number of ambulatory appendectomy procedures per facility fell by 90%, from 114 to 11. Over the study period, ASCs experienced almost a 100% decline in the number of ambulatory appendectomies, while ACGHs witnessed a 54% increase ($p = .000$).

Results from Table 47 also indicate that the average number of open appendectomies performed in ASCs and ACGHs in 2004 differed significantly ($p =.000$), but by 2009, the facility averages lost statistical significance (p. = .508). In 2004, 210 ASCs performed annually about 6 open appendectomy procedures per facility, while 184 ACGHs performed about 47 procedures, on average. By 2009, the number of ASCs had dropped to 1 facility performing 3 open

appendectomies, while the number of ACGHs dropped slightly to 180 facilities performing 22 open appendectomies, on average. Over the study period, Florida ASCs experienced almost a 100% plunge in the number of open appendectomy procedures performed. ACGHs witnessed a 51% decrease over the same period ($p = .000$). According to Table 47, in 2004, 182 ACGHs performed 93 inpatient appendectomy procedures, on average. Findings show an upward trend in the number of facilities performing inpatient appendectomies. By 2009, the number of ACGHs performing inpatient appendectomies had risen from 182 to 190, with the facility average rising to 102 inpatient appendectomy procedures.

Table 45: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Appendectomy Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Pooled Dataset: Both States)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic appendectomy procedures were performed in 2004?	ASC ACGH	224 278	7.72 54.82	8.539 57.814	-12.084	.000**	ASC: -.9786 ACGH: 1.3908	.15285 2.92155	-12.122	.000**
How many laparoscopic appendectomy procedures were performed in 2009?	ASC ACGH	14 299	2.57 79.78	2.209 78.727	-3.664	.000**				
How many ambulatory appendectomy procedures were performed in 2004?	ASC ACGH	252 244	11.77 15.76	11.207 20.627	-2.687	.007**	ASC: -.9827 ACGH: 1.5416	.14028 4.47277	-8.955	.000**
How many ambulatory appendectomy procedures were performed in 2009?	ASC ACGH	15 264	2.60 20.26	2.131 26.571	-2.569	.011**				
How many open appendectomy procedures were performed in 2004?	ASC ACGH	210 299	5.90 38.58	4.947 40.690	-11.578	.000**	ASC: -.9984 ACGH: -.4331	.02300 .54202	-15.100	.000**
How many open appendectomy procedures were performed in 2009?	ASC ACGH	1 287	3.00 20.24	. 25.435	-.677	.499				
How many inpatient appendectomy procedures were performed in 2004?	ASC ACGH	0 298	. 76.94	. 68.422	.[a]	.	. ACGH: -.0132	. .56423	.[a]	.
How many inpatient appendectomy procedures were performed in 2009?	ASC ACGH	0 303	. 80.25	. 82.645	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 46: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Appendectomy Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Wisconsin)

Procedure Counts							Percent Change			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic appendectomy procedures were performed in 2004?	ASC ACGH	7 102	3.57 45.32	1.718 50.258	-2.188	.031**	ASC: -.5024 ACGH: 1.6816	.71882 3.85389	-1.491	.139
How many laparoscopic appendectomy procedures were performed in 2009?	ASC ACGH	6 111	2.83 59.93	2.639 59.440	-2.343	.021**				
How many ambulatory appendectomy procedures were performed in 2004?	ASC ACGH	7 88	3.57 18.38	1.718 25.233	-1.544	.126	ASC: -.5024 ACGH: 3.3147	.71882 4.71841	-2.128	.036**
How many ambulatory appendectomy procedures were performed in 2009?	ASC ACGH	6 109	2.83 32.94	2.639 32.951	-2.228	.028**				
How many open appendectomy procedures were performed in 2004?	ASC ACGH	0 115	. 25.89	. 27.210	.[a]	.	. ACGH: -.3048	. .61250	.[a]	.
How many open appendectomy procedures were performed in 2009?	ASC ACGH	0 107	. 17.28	. 18.845	.[a]	.				
How many inpatient appendectomy procedures were performed in 2004?	ASC ACGH	0 116	. 51.58	. 47.753	.[a]	.	. ACGH: -.2851	. .36734	.[a]	.
How many inpatient appendectomy procedures were performed in 2009?	ASC ACGH	0 113	. 43.45	. 48.386	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 47: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Appendectomy Procedure Counts by Facility Type and Percent Change, 2004 - 2009 (Florida)

Procedure Counts							**Percent Change**			
Variable	Facility Type	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic appendectomy procedures were performed in 2004?	ASC ACGH	217 176	7.85 60.32	8.638 61.237	-12.472	.000**	ASC: -.9939 ACGH: 1.2223	.04671 2.20468	-14.808	.000**
How many laparoscopic appendectomy procedures were performed in 2009?	ASC ACGH	8 188	2.38 91.51	1.996 86.177	-2.918	.004**				
How many ambulatory appendectomy procedures were performed in 2004?	ASC ACGH	245 156	12.01 114.29	11.276 17.424	-1.591	.112	ASC: -.9964 ACGH: .5413	.02701 4.00944	-6.007	.000**
How many ambulatory appendectomy procedures were performed in 2009?	ASC ACGH	9 155	2.44 11.34	1.878 15.814	-1.682	.094*				
How many open appendectomy procedures were performed in 2004?	ASC ACGH	210 184	5.90 46.52	4.947 45.500	-12.853	.000**	ASC: -.9984 ACGH: -.5133	.02300 .47737	-14.709	.000**
How many open appendectomy procedures were performed in 2009?	ASC ACGH	1 180	3.00 22.01	. 28.547	-.664	.508				
How many inpatient appendectomy procedures were performed in 2004?	ASC ACGH	0 182	. 93.11	. 74.551	.[a]	.	. ACGH: .1602	. .59919	.[a]	.
How many inpatient appendectomy procedures were performed in 2009?	ASC ACGH	0 190	. 102.14	. 90.748	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Comparative Analysis of ACBS by State

Tables 48 to 59 examine the dataset from a different perspective by focusing on state comparisons. Each table presents state comparisons of laparoscopic, ambulatory, open and inpatient procedures for 2004 and 2009. The first set of tables, 48 to 50, examine all ACBS procedures pooled together, with Table 48 presenting both ASCs and ACGHs combined, Table 49 highlighting ASCs only, and Table 50 ACGHs only.

ACBS: Laparoscopic, Ambulatory, Open, and Inpatient

Table 48 indicates that Wisconsin and Florida did not differ significantly in the provision of laparoscopic ACBS procedures in 2004, based on facility averages (p = .239). In 2004, 131 Wisconsin medical facilities conducted laparoscopic ACBS procedures, averaging about 149 procedures per facility. During the same year, 435 Florida medical facilities performed an average of 129 laparoscopic ACBS procedures. In 2009, 134 Wisconsin medical facilities performed, on average, 190 laparoscopic ACBS procedures. That same year, Florida's 241 medical facilities delivered 320 laparoscopic ACBS procedures, on average. By 2009, the average ACBS facility output for Wisconsin and Florida medical facilities differed significantly (p = .000). Over the study period, the states experienced opposite trends in laparoscopic ACBS: Wisconsin experienced a 27% increase in the number of laparoscopic ACBS procedures performed, while Florida witnessed a 16% reduction in laparoscopic procedures (p = .000).

Table 48 also indicates that in 2004, 131 Wisconsin medical facilities performed approximately 87 ambulatory ACBS procedures per facility. During the same year, 437 Florida medical facilities performed about 62 ambulatory ACBS procedures, on average. Based on these findings, Wisconsin and Florida differed significantly in 2004 (p = .001). The facility averages for both states increased by 2009. In that year, the number of Wisconsin medical facilities

performing ambulatory ACBS procedures rose slightly to 134, performing 120 surgeries, on average. While the number of Florida medical facilities performing ACBS procedures dropped almost 50% to 231 facilities in 2009, the facility average increased 101% to 124 procedures in 2009. Wisconsin did not differ significantly from Florida based on facility averages ($p = .783$). Over the study period, both states experienced upward trends in the number of ambulatory ACBS procedures performed. Wisconsin medical facilities experienced a 55% jump in the number of ambulatory ACBS procedures performed, and Florida medical facilities witnessed a 19% increase in the number of ambulatory ACBS procedures performed.

In 2004, 120 Wisconsin medical facilities performed, on average, 50 open ACBS procedures. During the same year, 426 Florida medical facilities performed 50 open ACBS procedures, on average. These findings lack statistical significance ($p = .969$). By 2009, however, the facility averages differed significantly ($p = .001$). Wisconsin's 115 medical facilities delivered, on average, 27 open ACBS procedures; while Florida's 195 medical facilities performed 41 open ACBS procedures, on average. Over the study period, both states experienced declining trends in the number of open ACBS procedures performed. Wisconsin's open ACBS procedures fell by 34% and Florida's by 76%.

In 2004, 116 Wisconsin medical facilities performed 123 inpatient ACBS procedures, on average, compared to 185 Florida medical facilities averaging 274 inpatient ACBS procedures. By 2009, the number of medical facilities delivering inpatient ACBS declined slightly in Wisconsin and increased in Florida. The 114 Wisconsin facilities performed 108 inpatient ACBS procedures, on average, while Florida's 192 facilities averaged 293 ACBS procedures. Over the study period, medical facilities in Wisconsin experienced opposite trends in inpatient ACBS

from those in Florida. Wisconsin witnessed a 24% drop in the number of inpatient ACBS procedures performed, while Florida experienced a 17% rise (p = .000).

Table 49 focuses on ASCs only in both Wisconsin and Florida. Results show that Wisconsin and Florida differed significantly in the provision of laparoscopic ACBS procedures in 2004, based on ASC facility averages (p = .000). In 2004, 15 Wisconsin ASCs delivered 61 laparoscopic ACBS procedures, on average. During the same year, 249 Florida ASCs performed an average of 23 laparoscopic ACBS procedures. By 2009, 18 Wisconsin ASCs performed, on average, 56 laparoscopic ACBS procedures. That same year, Florida's 48 ASCs delivered 28 laparoscopic ACBS procedures, on average. In 2009, the average ACBS output in Wisconsin and Florida ASCs differed significantly at the p < .10 level (p = .057). Over the study period, both states experienced downward trends in laparoscopic ACBS: Wisconsin ASCs experienced a 12% decrease in the number of laparoscopic ACBS procedures performed, while Florida ASCs witnessed a 83% drop laparoscopic ACBS (p = .000).

Table 49 also indicates that in 2004, 15 Wisconsin ASCs performed approximately 62 ambulatory ACBS procedures per facility. During the same year, 254 Florida ASCs performed about 33 ambulatory ACBS procedures, on average. Based on these findings, Wisconsin and Florida differed significantly in 2004 (p = .001). By 2009, the states continued to differ significantly, but at the p < .10 level. In 2009, 18 Wisconsin ASCs performed 56 ACBS procedures, on average, while 50 Florida ASCs delivered 29, on average. Over the study period, both states experienced declining trends in the number of ambulatory ACBS procedures performed: Wisconsin ASCs experienced a 12% decline and Florida ASCs an 87% plunge.

In 2004, 4 Wisconsin ASCs performed, on average, 3 open ACBS procedures. During the same year, 240 Florida ASCs performed 11 open ACBS procedures, on average. These findings

lack statistical significance (p = .116), and ASCs in both states continued to differ significantly in 2009 (p = .342). By 2009, Wisconsin's 4 ASCs performed, on average, 2 open ACBS procedures; while Florida's 5 ASCs delivered 29 open ACBS procedures, on average. Over the study period, both states experienced downward trends in the number of open ACBS procedures performed. Wisconsin's open ACBS procedures fell by 48% and Florida's by 97%.

ASCs did not perform any inpatient ACBS procedures in 2004 or 2009 in either state, as shown in Table 49.

Table 50 focuses on ACGHs only. In 2004, 116 Wisconsin ACGHs conducted 161 laparoscopic ACBS procedures, on average. During the same year, 186 Florida ACGHs performed an average of 271 laparoscopic ACBS procedures. Based on ACGH facility averages, Wisconsin and Florida differed significantly in the provision of laparoscopic ACBS procedures administered in 2004 (p = .000). In 2009, the facility averages in both states increased. The 116 Wisconsin ACGHs performed, on average, 210 laparoscopic ACBS procedures. That same year, Florida's 193 ACGHs delivered 392 laparoscopic ACBS procedures, on average. By 2009, the average ACBS facility output for Wisconsin and Florida ACGHs differed significantly (p = .000). Over the study period, both states experienced upward trends in laparoscopic ACBS. Wisconsin experienced a 32% increase in the number of laparoscopic ACBS procedures performed, while Florida witnessed a 73% surge in laparoscopic procedures (p = .002).

Table 50 also indicates that in 2004, 116 Wisconsin ACGHs performed approximately 90 ambulatory ACBS procedures per facility. During the same year, 183 Florida ACGHs performed about 101 ambulatory ACBS procedures, on average. Based on these findings, Wisconsin and Florida did not significantly differ in 2004 (p = .299). The states also did not differ significantly in 2009 (p = .199). The 116 Wisconsin ACGHs performing ambulatory ACBS procedures

performed 130 surgeries, on average; while the 181 Florida ACGHs performed 150 ambulatory ACBS procedures. Over the study period, both states experienced upward trends in ambulatory ACBS procedures. Wisconsin ACGHs experienced a 64% jump in the number of ambulatory ACBS procedures performed, and Florida ACGHs witnessed at 166% surge in ambulatory surgeries.

In 2004, 116 Wisconsin ACGHs performed, on average, 52 open ACBS procedures. During the same year, Florida's 186 ACGHs performed 102 open ACBS procedures, on average. These findings are statistically significant ($p = .000$). By 2009, the facility averages in both states had dropped. Wisconsin's 111 ACGHs delivered, on average, 27 open ACBS procedures; while Florida's 190 ACGHs performed 41 open ACBS procedures, on average. These findings also are statistically significant ($p = .002$). Over the study period, both states experienced declining trends in the number of open ACBS procedures performed. Wisconsin's open ACBS procedures dropped by 34% and Florida's by 48%.

In 2004, 116 Wisconsin ACGHs performed 123 inpatient ACBS procedures, on average, compared to 185 Florida ACGHs averaging 274 inpatient ACBS procedures. By 2009, the number of ACGHs delivering inpatient ACBS declined slightly in Wisconsin and increased in Florida. The 114 Wisconsin ACGHs performed 108 inpatient ACBS procedures, on average, while Florida's 192 ACGHs averaged 293 inpatient ACBS procedures. Over the study period, Wisconsin and Florida ACGHs experienced opposite trends in inpatient ACBS procedures. Wisconsin witnessed a 24% drop in the number of inpatient ACBS procedures performed, while Florida experienced an 18% increase ($p = .000$).

Table 48: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient ACBS Procedure Counts by State and Percent Change, 2004 - 2009 (Pooled Dataset: Both Facility Types)

Procedure Counts							**Percent Change**			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic ACBS procedures were performed in 2004?	Wisconsin Florida	131 435	149.21 129.11	141.080 178.931	1.180	.239	WI: .2663 FL: -.1595	.60170 1.33946	3.531	.000**
How many laparoscopic ACBS procedures were performed in 2009?	Wisconsin Florida	134 241	189.63 319.62	184.563 298.455	-4.577	.000**				
How many ambulatory ACBS procedures were performed in 2004?	Wisconsin Florida	131 437	86.56 61.57	80.299 73.955	3.325	.001**	WI: .5516 FL: .1930	1.16334 3.26812	1.232	.218
How many ambulatory ACBS procedures were performed in 2009?	Wisconsin Florida	134 231	120.15 123.94	109.456 135.970	-.275	.783				
How many open ACBS procedures were performed in 2004?	Wisconsin Florida	120 426	50.16 50.45	59.633 76.906	-.039	.969	WI: -.3420 FL: -.7553	.59415 .48981	7.775	.000**
How many open ACBS procedures were performed in 2009?	Wisconsin Florida	115 195	26.55 40.62	28.530 41.239	-3.230	.001**				
How many inpatient ACBS procedures were performed in 2004?	Wisconsin Florida	116 185	122.64 274.32	125.569 187.712	-7.689	.000**	WI: -.2352 FL: .1791	.34250 .65186	-6.318	.000**
How many inpatient ACBS procedures were performed in 2009?	Wisconsin Florida	114 192	108.45 293.33	115.170 208.747	-8.699	.000**				

*P<0.10 **P<0.05

Table 49: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient ACBS Procedure Counts by State and Percent Change, 2004 - 2009 (ASCs Only)

Procedure Counts							**Percent Change**			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic ACBS procedures were performed in 2004?	Wisconsin Florida	15 249	61.13 23.48	63.397 20.876	5.654	.000**	WI: -.1246 FL: -.8275	.77347 .82136	3.229	.001**
How many laparoscopic ACBS procedures were performed in 2009?	Wisconsin Florida	18 48	55.56 27.65	56.337 50.471	1.938	.057*				
How many ambulatory ACBS procedures were performed in 2004?	Wisconsin Florida	15 254	61.87 33.15	64.542 28.154	3.470	.001**	WI: -.1261 FL: -.8693	.77445 .57975	4.728	.000**
How many ambulatory ACBS procedures were performed in 2009?	Wisconsin Florida	18 50	55.94 29.46	56.937 51.991	1.807	.075*				
How many open ACBS procedures were performed in 2004?	Wisconsin Florida	4 240	2.75 10.73	2.062 10.092	-1.577	.116	WI: -.4750 FL: -.9661	.41130 .42632	2.286	.023**
How many open ACBS procedures were performed in 2009?	Wisconsin Florida	4 5	1.75 29.20	.957 53.138	-1.019	.342				
How many inpatient ACBS procedures were performed in 2004?	Wisconsin Florida	0 0	. .	. .	.[a]	.	. .	. .	.[a]	.
How many inpatient ACBS procedures were performed in 2009?	Wisconsin Florida	0 0	. .	. .	.[a]	.				

*P<0.10 **P<0.05

[a]. t cannot be computed because at least one of the groups is empty.

Table 50: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient ACBS Procedure Counts by State and Percent Change, 2004 - 2009 (ACGHs Only)

Procedure Counts							Percent Change			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic ACBS procedures were performed in 2004?	Wisconsin Florida	116 186	160.59 270.51	144.457 198.506	-5.170	.000**	WI: .3168 FL: .7347	.56029 1.37843	-3.107	.002**
How many laparoscopic ACBS procedures were performed in 2009?	Wisconsin Florida	116 193	210.43 392.24	188.881 290.013	-6.025	.000**				
How many ambulatory ACBS procedures were performed in 2004?	Wisconsin Florida	116 183	89.75 101.01	81.805 96.488	-1.041	.299	WI: .6392 FL: 1.6673	1.16439 4.51483	-2.347	.020**
How many ambulatory ACBS procedures were performed in 2009?	Wisconsin Florida	116 181	130.11 150.04	112.389 140.438	-1.287	.199				
How many open ACBS procedures were performed in 2004?	Wisconsin Florida	116 186	51.79 101.71	59.990 93.631	-5.122	.000**	WI: -.3374 FL: -.4833	.60020 .42928	2.458	.015**
How many open ACBS procedures were performed in 2009?	Wisconsin Florida	111 190	27.44 40.92	28.642 41.016	-3.053	.002**				
How many inpatient ACBS procedures were performed in 2004?	Wisconsin Florida	116 185	122.64 274.32	125.569 187.712	-7.689	.000**	WI: -.2352 FL: .1791	.34250 .65186	-6.318	.000**
How many inpatient ACBS procedures were performed in 2009?	Wisconsin Florida	114 192	108.45 293.33	115.170 208.747	-8.699	.000**				

*P<0.10 **P<0.05

Comparative Analysis of Bariatric Surgery by State

Tables 51 to 53 highlight bariatric surgery procedures. Table 51 examines both ASCs and ACGHs together. Table 52 focuses only on ASCs, and Table 53 analyzes ACGHs.

Bariatric Surgery: Laparoscopic, Ambulatory, Open, and Inpatient

Table 51 indicates that based on facility averages, Wisconsin and Florida did not differ significantly in the provision of laparoscopic bariatric surgery procedures in 2004 ($p = .240$) or in 2009 ($p = .398$). In 2004, 21 Wisconsin medical facilities conducted laparoscopic bariatric surgeries, averaging about 17 procedures per facility. During the same year, 148 Florida medical facilities performed an average of 12 laparoscopic bariatric surgery procedures. By 2009, the number of facilities providing bariatric surgery increased in Wisconsin and decreased in Florida. The 29 Wisconsin medical facilities performed, on average, 53 laparoscopic bariatric surgery procedures in 2009. That same year, Florida's 90 medical facilities delivered 72 laparoscopic bariatric surgery procedures, on average. Over the study period, both states experienced upswings in the number of laparoscopic bariatric surgery procedures performed: Wisconsin experienced a 692% surge and Florida a 200% increase ($p = .076$).

Table 51 also indicates that in 2004, 6 Wisconsin medical facilities performed, on average, 9 ambulatory bariatric surgery procedures. During the same year, 206 Florida medical facilities performed about 7 ambulatory bariatric surgery procedures, on average. Based on these findings, Wisconsin and Florida did not differed significantly in 2004 ($p = .754$). The facility averages increased in Florida by 2009, but not in Wisconsin. In 2009, 22 Wisconsin medical facilities averaged 9 ambulatory bariatric surgery procedures, while the 60 Florida medical facilities performed 30 ambulatory bariatric surgery procedures, on average. Wisconsin did not differ significantly from Florida based on facility averages ($p = .154$). Over the study period, the

states experienced opposite trends: Wisconsin medical facilities experienced a 44% reduction in the number of ambulatory bariatric surgery procedures performed, and Florida medical facilities witnessed a 7% increase in the number of ambulatory bariatric surgery procedures performed ($p = .796$). The shifts, however, lacked statistical significance.

In 2004, 470 Wisconsin medical facilities performed, on average, 39 open bariatric surgery procedures. During the same year, 250 Florida medical facilities performed 27 open bariatric surgery procedures, on average. These findings lack statistical significance ($p = .193$). By 2009, the facility averages dropped to 5 open bariatric procedures in both states, which did not differed significantly ($p = .772$). In 2009, 43 Wisconsin and 117 Florida medical facilities performed open bariatric surgery procedures. Over the study period, both states experienced declining trends in the number of open bariatric surgery procedures performed. Wisconsin's experienced a 61% decline and Florida a 76% drop.

In 2004, 47 Wisconsin medical facilities performed 46 inpatient bariatric surgery procedures, on average, compared to 135 Florida medical facilities averaging 52 inpatient bariatric surgery procedures ($p = .710$). These findings lacked statistical significance. In 2009, the number of medical facilities delivering inpatient bariatric procedures and the facility averages declined slightly in Wisconsin and Florida. The 45 Wisconsin facilities performed 34 inpatient bariatric surgery procedures, on average, while Florida's 130 facilities averaged 40 bariatric surgery procedures ($p = .599$). These findings did not significantly differ. Over the study period, medical facilities in Wisconsin experienced opposite trends in inpatient bariatric surgery from those in Florida. Wisconsin witnessed a 29% drop in the number of inpatient bariatric surgery procedures performed, while Florida experienced a 205% surge ($p = .193$). Yet, there is statistically no difference between these findings.

Table 52 focuses on ASCs only in both Wisconsin and Florida. Results show that Wisconsin ASCs did not perform any laparoscopic bariatric surgery procedures in 2004. During the same year, 66 Florida ASCs performed an average of 4 laparoscopic bariatric surgery procedures. By 2009, 2 Wisconsin ASCs had entered the market and performed, on average, 8 laparoscopic bariatric surgery procedures. That same year, Florida witnessed a decline in the number of ASCs performing laparoscopic bariatric surgery. Florida's 7 ASCs delivered 23 surgeries, on average. These findings lacked statistical significance ($p = .578$). Over the study period, Florida ASCs experienced a 23% decrease in the number of laparoscopic bariatric surgery procedures.

Table 52 also indicates that in 2004, Wisconsin ASCs did not perform any ambulatory bariatric surgery procedures. During the same year, 139 Florida ASCs performed about 6 ambulatory bariatric surgery procedures, on average. By 2009, 2 Wisconsin ASCs performed 8 bariatric surgery procedures, on average, while 7 Florida ASCs delivered 23, on average. Over the study period, Florida experienced an 81% decline in bariatric surgery procedures.

In 2004, Wisconsin ASCs did not perform any open bariatric surgery procedures. During the same year, 106 Florida ASCs performed 6 open bariatric procedures, on average. By 2009, not one ASCs performed open bariatric surgery procedure. Florida experienced a 100% decline. ASCs did not provide inpatient surgery during the study period.

Table 53 focuses on ACGHs in Florida and Wisconsin. In 2004, 21 ACGHs provided, on average, 17 laparoscopic bariatric surgery procedures, while 82 Florida ACGHs average 18 laparoscopic bariatric surgeries. There is no statistical difference between the average output of Florida and Wisconsin ACGHs ($p = .869$). In 2009, ACGHs in both states continued to differ significantly ($p = .409$). By 2009, Wisconsin's 27 ACGHs performed an average of 56

laparoscopic bariatric surgery procedures, while Florida's 83 ACGHs delivered 276 laparoscopic bariatric surgeries. Over the study period, both states experienced upswings in the number of laparoscopic bariatric surgery procedures performed. The number of Wisconsin's procedures soared 692% and Florida's 381%.

Table 53 also indicates that in 2004, 6 Wisconsin ACGHs performed approximately 9 ambulatory bariatric surgery procedures per facility. During the same year, 67 Florida ACGHs performed 9 ambulatory bariatric procedures, on average. Based on these findings, Wisconsin and Florida did not significantly differ in 2004 ($p = .946$). The states also did not differ significantly in 2009 ($p = .179$). The 20 Wisconsin ACGHs performing ambulatory bariatric surgery procedures performed 9 surgeries, on average; while the 53 Florida ACGHs performed 31 ambulatory bariatric surgery procedures. Over the study period, Wisconsin experienced a 44% decline in the number of ambulatory bariatric surgeries, while Florida witnesses a 191% rise in the procedures,

In 2004, 47 Wisconsin ACGHs performed, on average, 39 open bariatric surgery procedures. During the same year, Florida's 144 ACGHs performed 42 open bariatric procedures, on average. These findings, however, lack statistical significance ($p = .818$). By 2009, the facility averages in both states had dropped. Wisconsin's 43 ACGHs and Florida's 117 ACGHs delivered an average of 5 open bariatric surgery procedures each. These findings lack statistically significance ($p = .772$). Both states experienced downward trends in the number of open bariatric procedures performed over the study period. Wisconsin witnessed a 61% decline and Florida a 60% drop.

Over the study period, Wisconsin and Florida ACGHs did not differ significantly in the provision of inpatient bariatric surgery. Table 53 shows that in 2004, 47 Wisconsin ACGHs

averaged 46 inpatient bariatric surgery procedures, compared to 135 Florida ACGHs averaging 51 inpatient bariatric procedures ($p = .710$). By 2009, the number of ACGHs delivering inpatient bariatric surgery declined slightly in Wisconsin and Florida. The 45 Wisconsin ACGHs performed 34 inpatient bariatric surgery procedures, on average, while Florida's 130 ACGHs averaged 41 bariatric surgeries. Over the study period, Wisconsin and Florida ACGHs experienced opposite trends in inpatient bariatric surgery. Wisconsin witnessed a 29% drop in the number of inpatient bariatric surgery procedures performed, while Florida experienced a 206% increase ($p = .193$). These state trends lacked statistical significance.

Table 51: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Bariatric Surgery Procedure Counts by State and Percent Change, 2004 - 2009 (Pooled Dataset: Both Facility Types)

Procedure Counts							**Percent Change**			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic bariatric surgery procedures were performed in 2004?	Wisconsin Florida	21 148	17.33 12.08	18.421 19.197	1.179	.240	WI: 6.9154 FL: 2.0072	16.97851 10.87596	1.788	.076*
How many laparoscopic bariatric surgery procedures were performed in 2009?	Wisconsin Florida	29 90	52.93 71.63	55.756 114.082	-.849	.398				
How many ambulatory bariatric surgery procedures were performed in 2004?	Wisconsin Florida	6 206	8.83 7.38	7.139 11.259	.313	.754	WI: -.4414 FL: .0727	.41491 4.86068	-.258	.796
How many ambulatory bariatric surgery procedures were performed in 2009?	Wisconsin Florida	22 60	8.86 29.75	8.621 67.566	-1.440	.154				
How many open bariatric surgery procedures were performed in 2004?	Wisconsin Florida	47 250	39.47 26.80	52.873 62.528	1.304	.193	WI: -.6088 FL: -.7657	.65054 .63629	1.546	.123
How many open bariatric surgery procedures were performed in 2009?	Wisconsin Florida	43 117	4.63 5.26	4.796 13.873	-.290	.772				
How many inpatient bariatric surgery procedures were performed in 2004?	Wisconsin Florida	47 135	46.09 51.61	63.955 94.427	-.372	.710	WI: -.2922 FL: 2.0594	.69876 12.30072	- 1.308	.193
How many inpatient bariatric surgery procedures were performed in 2009?	Wisconsin Florida	45 130	34.20 40.59	48.931 76.049	-.527	.599				

*P<0.10 **P<0.05

Table 52: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Bariatric Surgery Procedure Counts by State and Percent Change, 2004 - 2009 (ASCs Only)

Procedure Counts							**Percent Change**			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic bariatric surgery procedures were performed in 2004?	Wisconsin Florida	0 66	. 4.44	. 7.933	.[a]	.	. FL: -.2348	. 6.21612	.[a]	.
How many laparoscopic bariatric surgery procedures were performed in 2009?	Wisconsin Florida	2 7	7.50 22.71	2.121 35.146	-.583	.578				
How many ambulatory bariatric surgery procedures were performed in 2004?	Wisconsin Florida	0 139	. 6.49	. 9.412	.[a]	.	. FL: -.8147	. 2.14179	.[a]	.
How many ambulatory bariatric surgery procedures were performed in 2009?	Wisconsin Florida	2 7	7.50 22.71	2.121 35.146	-.583	.578				
How many open bariatric surgery procedures were performed in 2004?	Wisconsin Florida	0 106	. 5.75	. 8.782	.[a]	.	. FL: -1.0000	. .00000	.[a]	.
How many open bariatric surgery procedures were performed in 2009?	Wisconsin Florida	0 0	. .	. .	.[a]	.				
How many inpatient bariatric surgery procedures were performed in 2004?	Wisconsin Florida	0 0	. .	. .	.[a]	.	. .	. .	.[a]	.
How many inpatient bariatric surgery procedures were performed in 2009?	Wisconsin Florida	0 0	. .	. .	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 53: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Bariatric Surgery Procedure Counts by State and Percent Change, 2004 - 2009 (ACGHs)

Procedure Counts							Percent Change			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic bariatric surgery procedures were performed in 2004?	Wisconsin Florida	21 82	17.33 18.23	18.421 20.074	-.165	.869	WI: 6.9154 FL: 3.8119	16.97851 13.27658	.901	.370
How many laparoscopic bariatric surgery procedures were performed in 2009?	Wisconsin Florida	27 83	56.30 75.76	56.366 117.532	-.828	.409				
How many ambulatory bariatric surgery procedures were performed in 2004?	Wisconsin Florida	6 67	8.83 9.24	7.139 14.260	-.069	.946	WI: -.4414 FL: 1.9137	.41491 7.66117	-.748	.457
How many ambulatory bariatric surgery procedures were performed in 2009?	Wisconsin Florida	20 53	9.00 30.68	9.038 70.920	-1.357	.179				
How many open bariatric surgery procedures were performed in 2004?	Wisconsin Florida	47 144	39.47 42.30	52.873 78.617	-.230	.818	WI: -.6088 FL: -.5932	.65054 .79645	-.121	.904
How many open bariatric surgery procedures were performed in 2009?	Wisconsin Florida	43 117	4.63 5.26	4.796 13.873	-.290	.772				
How many inpatient bariatric surgery procedures were performed in 2004?	Wisconsin Florida	47 135	46.09 51.61	63.955 94.427	-.372	.710	WI: -.2922 FL: 2.0594	.69876 12.30072	-1.308	.193
How many inpatient bariatric surgery procedures were performed in 2009?	Wisconsin Florida	45 130	34.20 40.59	48.931 76.049	-.527	.599				

*P<0.10 **P<0.05

Comparative Analysis of Cholecystectomy by State

Tables 54 to 56 focus on cholecystectomy. Tables 54 analyze both types of medical facilities combined. Tables 55 and 56 feature procedures performed in ASCs and ACGHs, respectively.

Cholecystectomy: Laparoscopic, Ambulatory, Open, and Inpatient

Table 54 shows that in 2004, Wisconsin and Florida did not differ significantly in the provision of laparoscopic cholecystectomy procedures, based on facility averages (p = .290). In 2004, 131 Wisconsin medical facilities delivered laparoscopic cholecystectomies, averaging about 111 procedures per facility. During the same year, 432 Florida medical facilities performed an average of 97 laparoscopic cholecystectomy procedures. By 2009, the number of Wisconsin facilities providing increased slightly, while those in Florida decreased. The 134 Wisconsin medical facilities performed, on average, 128 laparoscopic cholecystectomy procedures in 2009. That same year, Florida's 239 medical facilities delivered 223 laparoscopic cholecystectomies, on average. By 2009, the facility averages for the two states differed significantly (p = .000). Over the study period, the states experienced opposite trends in the provision of laparoscopic cholecystectomy: Wisconsin experienced a 15% increase and Florida a 13% decrease (p = .049). These findings are statistically different.

Table 54 also indicates that in 2004, 131 Wisconsin medical facilities performed, on average, 74 ambulatory cholecystectomy procedures, while 433 Florida medical facilities performed 47 ambulatory cholecystectomies, on average. Based on these findings, Wisconsin and Florida differed significantly in 2004 (p = .000). The facility averages increased in Wisconsin and Florida by 2009, although Florida saw a drop in the number of facilities delivering ambulatory cholecystectomies. In 2009, 134 Wisconsin medical facilities averaged 92

ambulatory choleccystectomy procedures, while 229 Florida medical facilities performed 109 ambulatory cholecystectomies, on average. In 2009, Wisconsin did not differ significantly from Florida based on facility averages (p = .120). Over the study period, both states experienced upward trends in ambulatory cholecystectomies: Wisconsin medical facilities experienced a 38% increase, and Florida's facilities witnessed a 65% (p = .472). The shifts, however, lacked statistical significance.

In 2004, 110 Wisconsin medical facilities performed, on average, 11 open cholecystectomies. During the same year, 384 Florida medical facilities performed 13 open cholecystectomy procedures, on average. These findings lack statistical significance (p = .162). By 2009, the facility averages differed significantly (p = .000). In 2009, 109 Wisconsin medical facilities delivered 9 open cholecystectomies, and 189 Florida medical facilities performed 18 open cholecystectomy procedures, on average. Over the study period, both states experienced declining trends in the number of open cholecystectomies performed: Wisconsin a 10% drop and Florida a 53% drop (p = 000). These findings are statistically different.

In 2004, 114 Wisconsin medical facilities performed 53 inpatient cholecystectomy procedures, on average, compared to 185 Florida medical facilities averaging 145 inpatient cholecystectomies (p = .000). These findings are statistically significant. In 2009, the number of medical facilities delivering inpatient cholecystectomies remained steady in Wisconsin but increased in Florida. The facility averages declined slightly in Wisconsin but increased in Florida. The 112 Wisconsin facilities performed 53 inpatient cholecystectomy procedures, on average, while Florida's 192 facilities averaged 165 cholecystectomy procedures (p = .000). These findings significantly differed. Over the study period, medical facilities in Wisconsin and Florida experienced opposite trends in inpatient cholecystectomy provision: Wisconsin

witnessed a 6% reduction and Florida a 25% increase (p = .000). These findings are statistically difference.

Table 55 focuses on ASCs only. No inpatient cholecystectomy procedures were performed in either state. Results in Table 55 show that 15 Wisconsin ASCs performed on average 59 laparoscopic cholecystectomies in 2004. During the same year, 246 Florida ASCs performed an average of 16 laparoscopic cholecystectomy procedures (p = .000). These findings are statistically significant. By 2009, 18 Wisconsin ASCs averaged 54 laparoscopic cholecystectomy procedures, and Florida's 46 ASCs delivered 24, on average. The number of Florida ASCs fell by 81% between 2004 and 2009. These findings are statistically significant (p = .022). ASCs in both states experienced declining trends in laparoscopic cholecystectomy provision: Wisconsin dropped 12% and Florida 68%.

Table 55 indicates that ASCs facility averages for ambulatory cholecystectomy procedures differed significantly in Wisconsin and Florida in 2004 and 2009. Wisconsin's 15 ASCs averaged 60 cholecystectomies in 2004. That same year, 250 Florida ASCs performed 18 ambulatory cholecystectomy procedures, on average. By 2009, 18 Wisconsin ASCs performed 54 ambulatory cholecystectomies, on average, while 48 Florida ASCs delivered 27, on average. The number of Florida ASCs performing ambulatory choolecystectomies fell by 81% between 2004 and 2009. Over the study period, both states witnessed declining trends in ambulatory cholecystectomy provision: Wisconsin experienced a 12% decline and Florida a 70% drop.

In 2004, 4 Wisconsin ASCs performed an average of 3 open cholecystectomies. During the same year, 199 Florida ASCs performed 4 open cholecystectomy procedures, on average. These findings lack statistical significance (p = .593), indicating no difference in facility averages by state. By 2009, both states had 4 facilities that performed open cholecystectomy

procedures. Wisconsin ASCs averaged 2 open cholecystectomies, and Florida ASCs 36, on average. The facility averages did not differ by state (p = .293). Both states witnessed downward trends in open cholecystectomy provision: Wisconsin a 48% decline and Florida an 88% drop (p = .499). These state trends lacked statistical significance, indicating no difference between states.

Table 56 focuses on ACGHs only. In 2004, 116 Wisconsin ACGHs conducted 118 laparoscopic cholecystectomies, on average. During the same year, 186 Florida ACGHs performed an average of 205 laparoscopic cholecystectomy procedures. Based on ACGH facility averages, Wisconsin and Florida differed significantly in the provision of laparoscopic cholecystectomy procedures administered in 2004 (p = .000). In 2009, the facility averages in both states increased. The 116 Wisconsin ACGHs performed, on average, 140 laparoscopic cholecystectomy procedures. The same year, Florida's 193 ACGHs delivered 271 laparoscopic cholecystectomies, on average. In 2009, the average facility output of cholecystectomies in Wisconsin and Florida ACGHs differed significantly (p = .000). Over the study period, both states experienced upward trends in laparoscopic cholecystectomy procedures: Wisconsin experienced a 19% increase, and Florida witnessed a 60% rise (p = .001).

Table 56 also indicates that in 2004, 116 Wisconsin ACGHs performed approximately 75 ambulatory cholecystectomies per facility, and 183 Florida ACGHs performed 85 ambulatory cholecystectomy procedures, on average. Based on these findings, Wisconsin and Florida did not significantly differ in 2004 (p = .298). By 2009, the facility averages had increased in both states. The 116 Wisconsin ACGHs performing ambulatory cholecystectomy procedures performed 98 surgeries, on average; while the 181 Florida ACGHs performed 131 ambulatory cholecystectomy procedures. In 2009, the states differed significantly (p = .008). Over the study period, both states experienced upward trends in ambulatory cholecystectomy procedures. Wisconsin ACGHs

experienced a 45% increase in the number of ambulatory cholecystectomy procedures performed, and Florida ACGHs witnessed a 255% surge in ambulatory cholecystectomies (p = .000). These findings are statistically significant, indicating that statistical differences in state trends.

In 2004, 106 Wisconsin ACGHs performed, on average, 11 open cholecystectomy procedures, and 185 Florida ACGHs performed 23 open cholecystectomy procedures, on average. These findings are statistically significant (p = .000). By 2009, Wisconsin's 105 ACGHs delivered, on average, 10 open cholecystectomy procedures; while Florida's 185 ACGHs performed 17 open cholecystectomy procedures, on average. These findings are statistically significant (p = .000). Over the study period, both states experienced declining trends in the number of open cholecystectomy procedures: Wisconsin witnessed a 9% decline and Florida a 16% drop (p = .447). These findings lack statistical significance, indicating no statistical difference between the states.

In 2004, 114 Wisconsin ACGHs performed 53 inpatient cholecystectomies, on average, compared to 185 Florida ACGHs averaging 145 inpatient cholecystectomy procedures (p = .000). These averages differed significantly. By 2009, 112 Wisconsin ACGHs delivered 53 inpatient cholecystectomies, and 192 Florida ACGHs averaged 165 inpatient cholecystectomy procedures (p = .000). In 2009, the averages remained statistically significant. Over the study period, Wisconsin and Florida ACGHs experienced opposite trends in the provision of inpatient cholecystectomy procedures. Wisconsin witnessed a 6% drop in the number of inpatient cholecystectomy procedures performed, while Florida experienced a 26% increase (p = .000).

Table 54: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Cholecystectomy Procedure Counts by State and Percent Change, 2004 - 2009 (Pooled Dataset: Both Facility Types)

Procedure Counts							Percent Change			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic cholecystectomy procedures were performed in 2004?	Wisconsin Florida	131 432	110.95 97.35	98.498 136.510	1.059	.290	WI: .1534 FL: -.1286	.55764 1.60498	1.974	.049**
How many laparoscopic cholecystectomy procedures were performed in 2009?	Wisconsin Florida	134 239	128.40 223.26	120.500 200.785	-4.987	.000**				
How many ambulatory cholecystectomy procedures were performed in 2004?	Wisconsin Florida	131 433	73.62 46.68	65.073 68.427	3.992	.000**	WI: .3833 FL: .6502	1.14131 4.19470	-.720	.472
How many ambulatory cholecystectomy procedures were performed in 2009?	Wisconsin Florida	134 229	91.77 109.45	83.105 115.082	-1.557	.120				
How many open cholecystectomy procedures were performed in 2004?	Wisconsin Florida	110 384	10.72 12.98	11.124 15.872	-1.400	.162	WI: -.1029 FL: -.5296	.78697 1.03415	4.007	.000**
How many open cholecystectomy procedures were performed in 2009?	Wisconsin Florida	109 189	9.22 17.68	11.234 16.149	-4.833	.000**				
How many inpatient cholecystectomy procedures were performed in 2004?	Wisconsin Florida	114 185	53.24 145.01	51.880 95.259	-9.454	.000**	WI: -.0624 FL: .2566	.65736 .71673	-3.856	.000**
How many inpatient cholecystectomy procedures were performed in 2009?	Wisconsin Florida	112 192	52.80 164.77	56.039 110.388	-10.004	.000**				

*P<0.10 **P<0.05

Table 55: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Cholecystectomy Procedure Counts by State and Percent Change, 2004 - 2009 (ASCs Only)

Procedure Counts							**Percent Change**			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic cholecystectomy were performed in 2004?	Wisconsin Florida	15 246	59.47 15.65	61.672 13.594	8.447	.000**	WI: -.1193 FL: -.6772	.77966 1.59428	1.344	.180
How many laparoscopic cholecystectomy procedures were performed in 2009?	Wisconsin Florida	18 46	53.78 24.98	54.330 39.384	2.355	.022**				
How many ambulatory cholecystectomy procedures were performed in 2004?	Wisconsin Florida	15 250	60.20 18.31	62.816 15.980	7.414	.000**	WI: -.1211 FL: -.7031	.78018 1.46288	1.526	.128
How many ambulatory cholecystectomy procedures were performed in 2009?	Wisconsin Florida	18 48	54.17 26.92	54.930 41.779	2.160	.035**				
How many open cholecystectomy procedures were performed in 2004?	Wisconsin Florida	4 199	2.75 3.65	2.062 3.358	-.535	.593	WI: -.4750 FL: -.8777	.41130 1.18486	.678	.499
How many open cholecystectomy procedures were performed in 2009?	Wisconsin Florida	4 4	1.75 35.75	.957 58.982	-1.153	.293				
How many inpatient cholecystectomy procedures were performed in 2004?	Wisconsin Florida	0 0	. .	. .	.[a]	.	. .	. .	.[a]	.
How many inpatient cholecystectomy procedures were performed in 2009?	Wisconsin Florida	0 0	. .	. .	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 56: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Cholecystectomy Procedure Counts by State and Percent Change, 2004 - 2009 (ACGHs Only)

Procedure Counts							**Percent Change**			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic cholecystectomy were performed in 2004?	Wisconsin Florida	116 186	117.60 205.40	100.567 150.188	-5.564	.000**	WI: .1886 FL: .5969	.51630 1.30608	-3.212	.001**
How many laparoscopic cholecystectomy procedures were performed in 2009?	Wisconsin Florida	116 193	139.98 270.52	123.895 194.795	-6.471	.000**				
How many ambulatory cholecystectomy procedures were performed in 2004?	Wisconsin Florida	116 183	75.35 85.44	65.421 90.267	-1.042	.298	WI: .4524 FL: 2.5548	1.17093 5.78620	-3.799	.000**
How many ambulatory cholecystectomy procedures were performed in 2009?	Wisconsin Florida	116 181	97.60 131.34	85.357 118.412	-2.657	.008**				
How many open cholecystectomy procedures were performed in 2004?	Wisconsin Florida	106 185	11.02 23.02	11.217 17.801	-6.261	.000**	WI: -.0889 FL: -.1552	.79536 .66591	.761	.447
How many open cholecystectomy procedures were performed in 2009?	Wisconsin Florida	105 185	9.50 17.29	11.349 14.230	-4.802	.000**				
How many inpatient cholecystectomy procedures were performed in 2004?	Wisconsin Florida	114 185	53.24 145.01	51.880 95.259	-9.454	.000**	WI: -.0624 FL: .2566	.65736 .71673	-3.856	.000**
How many inpatient cholecystectomy procedures were performed in 2009?	Wisconsin Florida	112 192	52.80 164.77	56.039 110.388	-10.004	.000**				

*P<0.10 **P<0.05

Comparative Analysis of Appendectomy by State

Tables 57 to 59 present findings on appendectomy procedures. Table 57 examines both facility types together, while Table 58 looks at ASCs only. Table 59 focuses on ACGHs only.

Appendectomy: Laparoscopic, Ambulatory, Open, and Inpatient

Table 57 shows that in 2004 Wisconsin and Florida medical facilities differed significantly in the provision of laparoscopic, ambulatory, and inpatient appendectomy procedures, based on facility averages. In 2004, 109 Wisconsin medical facilities delivered 43 laparoscopic appendectomies, on average; while the same year, 393 Florida medical facilities performed an average of 31 laparoscopic appendectomy procedures ($p = 034$). By 2009, the number of Wisconsin facilities providing increased, while those in Florida decreased. The 117 Wisconsin medical facilities performed, on average, 57 laparoscopic appendectomy procedures in 2009. That same year, Florida's 196 medical facilities delivered 88 laparoscopic appendectomies, on average. In 2009, the facility averages for the two states differed significantly ($p = .001$). Over the study period, the states experienced opposite trends in the provision of laparoscopic appendectomy: Wisconsin experienced a 154% increase and Florida a .14% decrease ($p = .000$). These findings are statistically different.

Table 57 also indicates that in 2004, 95 Wisconsin medical facilities performed, on average, 17 ambulatory appendectomy procedures, while 401 Florida medical facilities performed 13 ambulatory appendectomies, on average. Based on these findings, Wisconsin and Florida differed significantly in 2004 ($p = .021$). By 2009, the facility averages had increased in Wisconsin but decreased in Florida. The 115 Wisconsin medical facilities averaged 31 ambulatory appendectomy procedures, while 164 Florida medical facilities performed 11 ambulatory cholecystectomies, on average ($p = 000$). These findings are statistically different.

Over the study period, Wisconsin experienced a 303% upswing in ambulatory appendectomies, while Florida witnessed a 40% decline (p = .000). The shifts are statistically significant, indicating the trends in the states are statistically different.

In 2004, 115 Wisconsin medical facilities performed, on average, 26 open appendectomy procedures. During the same year, 394 Florida medical facilities performed 25 open appendectomies, on average. These findings lack statistical significance (p = .785), indicating no statistical difference between the states. In 2009, 107 Wisconsin medical facilities delivered 17 open appendectomies, and 181 Florida medical facilities performed 22 open appendectomy procedures, on average. The facility averages in 2009 lacked statistical significance (p = .136). Over the study period, both states experienced declining trends in the number of open appendectomies performed: Wisconsin a 31% drop and Florida a 77% drop (p = 000). These findings are statistically different.

In 2004, 116 Wisconsin medical facilities performed 52 inpatient appendectomy procedures, on average, compared to 182 Florida medical facilities averaging 93 inpatient appendectomies (p = .000). These findings are statistically significant. In 2009, the facility averages declined in Wisconsin but increased in Florida. The 113 Wisconsin facilities performed 43 inpatient appendectomy procedures, on average, while Florida's 190 facilities averaged 102 appendectomy procedures (p = .000). These findings significantly differed. Over the study period, medical facilities in Wisconsin and Florida experienced opposite trends in inpatient appendectomy provision: Wisconsin witnessed a 28% reduction and Florida a 16% increase (p = .000). These findings are statistically difference.

Table 58 focuses on ASCs only. No inpatient appendectomy procedures were performed in either state. Results in Table 58 show that 7 Wisconsin ASCs performed on average about 4

laparoscopic appendectomies in 2004. During the same year, 217 Florida ASCs performed an average of 8 laparoscopic appendectomy procedures (p = .192). These findings lacked statistical significance. By 2009, 6 Wisconsin ASCs averaged 3 laparoscopic appendectomy procedures, and Florida's 8 ASCs delivered 2, on average. The number of Florida ASCs performing laparoscopic appendectomy procedures fell by 96% between 2004 and 2009. These findings also lacked statistical significance (p = .717), indicating no difference between the facility averages in 2009. ASCs in both states experienced declining trends in laparoscopic appendectomy provision: Wisconsin witnessed a 50% drop and Florida 99% plunge.

Table 58 indicates that Wisconsin ASCs did not perform open appendectomies in 2004 or 2009. In 2004, 210 Florida ASCs performed 6 open appendectomy procedures, on average. By 2009, only 1 Florida ASC performed 3 open appendectomy procedures. Florida ASCs essentially left the market of open appendectomy provision, as witnessed by an almost 100% decline in these procedures.

Table 59 focuses on ACGHs only. In 2004, 102 Wisconsin ACGHs conducted 45 laparoscopic appendectomy procedures, on average. During the same year, 176 Florida ACGHs performed an average of 60 laparoscopic appendectomy procedures. Based on ACGH facility averages, Wisconsin and Florida differed significantly in the provision of laparoscopic appendectomy procedures performed in 2004 (p = .037). By 2009, the facility averages in both states increased. The 111 Wisconsin ACGHs performed, on average, 60 laparoscopic appendectomy procedures, and year, Florida's 188 ACGHs delivered 92 laparoscopic appendectomies, on average. In 2009, the average facility output of appendectomies in Wisconsin and Florida ACGHs differed significantly (p = .001). Over the study period, both states experienced upward trends in laparoscopic appendectomy procedures: Wisconsin

experienced a 168% increase, and Florida witnessed a 122% rise ($p = .207$). These findings lack statistical significance, indicating no difference between Florida and Wisconsin volume shifts.

Table 59 also indicates that in 2004, 88 Wisconsin ACGHs performed 18 ambulatory appendectomies per facility, and 156 Florida ACGHs performed 14 ambulatory appendectomy procedures, on average. Based on these findings, Wisconsin and Florida did not significantly differ in 2004 ($p = .138$). By 2009, the facility averages increased in Wisconsin but declined in Florida. The 109 Wisconsin ACGHs performing ambulatory appendectomy procedures performed 33 surgeries, on average; while the 155 Florida ACGHs performed 11 ambulatory appendectomy procedures ($p = .000$). Based on these findings, the states differed significantly. Over the study period, both states experienced upward trends in ambulatory appendectomy procedures. Wisconsin ACGHs experienced a 331% increase in the number of ambulatory appendectomy procedures performed, and Florida ACGHs witnessed a 54% surge in ambulatory appendectomies ($p = .000$). These findings are statistically significant, indicating a statistical difference between the trends in Wisconsin and Florida.

In 2004, 115 Wisconsin ACGHs performed, on average, 26 open appendectomy procedures, and 184 Florida ACGHs performed 47 open appendectomy procedures, on average. These findings are statistically significant ($p = .000$), indicating that the facility averages are statistically different. By 2009, Wisconsin's 107 ACGHs delivered, on average, 17 open appendectomy procedures; while Florida's 180 ACGHs performed 22 open appendectomy procedures, on average ($p = .128$). By 2009, the facility averages were no longer statistically significant, indicating no statistical difference in results. Over the study period, both states experienced declining trends in the number of open appendectomy procedures: Wisconsin

witnessed a 30% decline and Florida a 51% drop (p = .001). These findings are statistically significant, indicating a statistical difference in state trends.

In 2004, 116 Wisconsin ACGHs performed 52 inpatient appendectomies, on average, compared to 182 Florida ACGHs averaging 93 inpatient appendectomies (p = .000). These averages differed significantly. By 2009, 113 Wisconsin ACGHs delivered 43 inpatient appendectomies, and 190 Florida ACGHs averaged 102 inpatient appendectomy procedures (p = .000). In 2009, the averages remained statistically significant. Over the study period, Wisconsin and Florida ACGHs experienced opposite trends in the provision of inpatient appendectomy procedures. Wisconsin witnessed a 28% drop in the number of inpatient appendectomy procedures performed, while Florida experienced a 16% increase (p = .000).

Table 57: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Appendectomy Procedure Counts by State and Percent Change, 2004 - 2009 (Pooled Dataset: Both Facility Types)

Procedure Counts							**Percent Change**			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic appendectomy procedures were performed in 2004?	Wisconsin	109	42.64	49.679	2.124	.034**				
	Florida	393	31.35	48.965			WI: 1.5413	3.76932	5.956	.000**
How many laparoscopic appendectomy procedures were performed in 2009?	Wisconsin	117	57.00	59.250	-3.419	.001**	FL: -.0014	1.84086		
	Florida	196	87.87	86.224						
How many ambulatory appendectomy procedures were performed in 2004?	Wisconsin	95	17.28	24.589	2.323	.021**				
	Florida	401	12.90	14.015			WI: 3.0334	4.65226	9.697	.000**
How many ambulatory appendectomy procedures were performed in 2009?	Wisconsin	115	31.37	32.780	6.983	.000**	FL: -.3982	2.60637		
	Florida	164	10.85	15.511						
How many open appendectomy procedures were performed in 2004?	Wisconsin	115	25.89	27.210	.273	.785				
	Florida	394	24.87	37.267			WI: -.3048	.61250	9.564	.000**
How many open appendectomy procedures were performed in 2009?	Wisconsin	107	17.28	18.845	-1.494	.136	FL: -.7719	.40634		
	Florida	181	21.90	28.503						
How many inpatient appendectomy procedures were performed in 2004?	Wisconsin	116	51.58	47.753	-5.341	.000**				
	Florida	182	93.11	74.551			WI: -.2851	.36734	-7.188	.000**
How many inpatient appendectomy procedures were performed in 2009?	Wisconsin	113	43.45	48.386	-6.355	.000**	FL: .1602	.59919		
	Florida	190	102.14	90.748						

*P<0.10 **P<0.05

Table 58: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Appendectomy Procedure Counts by State and Percent Change, 2004 - 2009 (ASCs Only)

Procedure Counts							Percent Change			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic appendectomy procedures were performed in 2004?	Wisconsin Florida	7 217	3.57 7.85	1.718 8.638	-1.308	.192	WI: -.5024 FL: -.9939	.71882 .04671	10.092	.000**
How many laparoscopic appendectomy procedures were performed in 2009?	Wisconsin Florida	6 8	2.83 2.38	2.639 1.996	.371	.717				
How many ambulatory appendectomy procedures were performed in 2004?	Wisconsin Florida	7 245	3.57 12.01	1.718 11.276	-1.975	.049**	WI: -.5024 FL: -.9964	.71882 .02701	11.254	.000**
How many ambulatory appendectomy procedures were performed in 2009?	Wisconsin Florida	6 9	2.83 2.44	2.639 1.878	.335	.743				
How many open appendectomy procedures were performed in 2004?	Wisconsin Florida	0 210	. 5.90	. 4.947	.[a]	.	. FL: -.9984	. .02300	.[a]	. .
How many open appendectomy procedures were performed in 2009?	Wisconsin Florida	0 1	. 3.00	. .	.[a]	.				
How many inpatient appendectomy procedures were performed in 2004?	Wisconsin Florida	0 0	. .	. .	.[a]	.	. .	. .	.[a]	. .
How many inpatient appendectomy procedures were performed in 2009?	Wisconsin Florida	0 0	. .	. .	.[a]	.				

*P<0.10 **P<0.05
[a]. t cannot be computed because at least one of the groups is empty.

Table 59: Independent Samples T-Tests: Laparoscopic, Ambulatory, Open, and Inpatient Appendectomy Procedure Counts by State and Percent Change, 2004 - 2009 (ACGHs Only)

Procedure Counts							Percent Change			
Variable	State	N (Facilities)	Mean (Procedures per Facility)	Std. Dev.	t	Sig. (2-tailed)	Mean (Percent Change in Procedures, 2004 & 2009)	Std. Dev.	t	Sig.
How many laparoscopic appendectomy procedures were performed in 2004?	Wisconsin Florida	102 176	45.32 60.32	50.258 61.237	-2.097	.037**	WI: 1.6816 FL: 1.2223	3.85389 2.20468	1.265	.207
How many laparoscopic appendectomy procedures were performed in 2009?	Wisconsin Florida	111 188	59.93 91.51	59.440 86.177	-3.410	.001**				
How many ambulatory appendectomy procedures were performed in 2004?	Wisconsin Florida	88 156	18.38 14.29	25.233 17.424	1.490	.138	WI: 3.3147 FL: .5413	4.71841 4.00944	4.863	.000**
How many ambulatory appendectomy procedures were performed in 2009?	Wisconsin Florida	109 155	32.94 11.34	32.957 15.814	7.086	.000**				
How many open appendectomy procedures were performed in 2004?	Wisconsin Florida	115 184	25.89 46.52	27.210 45.500	-4.394	.000**	WI: -.3048 FL: -.5133	.61250 .47737	3.290	.001**
How many open appendectomy procedures were performed in 2009?	Wisconsin Florida	107 180	17.28 22.01	18.845 28.547	-1.525	.128				
How many inpatient appendectomy procedures were performed in 2004?	Wisconsin Florida	116 182	51.58 93.11	47.753 74.551	-5.341	.000**	WI: -.2851 FL: .1602	.36734 .59919	-7.188	.000**
How many inpatient appendectomy procedures were performed in 2009?	Wisconsin Florida	113 190	43.45 102.14	48.386 90.748	-6.355	.000**				

*P<0.10 **P<0.05

Results of Regression Analysis

Descriptive statistics and t-tests results show laparoscopic, ambulatory, open and inpatient trends by states and medical facilities. These analyses did not analyze relations between procedure types, medical facilities, or surgical settings. T-test findings suggest opposite trends occurring between laparoscopic and open ACBS procedures in ACGHs, but not in ASCs. T-test results appear to point to faster growth in ambulatory ACBS provision than inpatient ACBS provision. Also ACGHs, on average, seem to show an increasing number of procedures being performed in Florida and Wisconsin, while ASCs witnessed an overall decline in the number of ACBS procedures performed. It is unclear whether these and other trends remain after controlling for facility and demographic factors. To examine further the association between open and laparoscopic ACBS provision, inpatient and ambulatory ACBS provision, and whether ACGHs differ from ASCs in the provision of ambulatory laparoscopic ACBS procedures, bivariate and multivariate regression analyses were employed. Results are presented based on the four hypotheses outlined earlier in Chapter 4. The regression analyses feature results using the pooled dataset—combining all three surgeries, as well as the three surgical types separately. The analyses performed in Tables 60 to 67 are derived from a dataset consisting of both ASCs and ACGHs. The analyses used to compile Tables 68 to 75 are based on an ACGH-only dataset.

Technology Shift

Tables 60 to 63 seek to answer questions about technology shifts. Table 60 focuses on all surgery types combined. Table 61 highlights bariatric surgery. Table 62 presents cholecystectomy, and Table 63 appendectomy. Hypothesis A asserts that compared to open ACBS procedures, there will be larger percent increases in the number of laparoscopic ACBS

procedures performed. Equation 8 has been constructed to illustrate variables featured in regression analyses in Tables 60 to 63.

Equation 8

$$Y\%\Delta LapACBS = b_0 + b_1\%\Delta OpenACBS + b_2 ACGH + b_3 FLORIDA + b_3 POP\%\Delta + b_4 METRO + \varepsilon$$

$Y\%\Delta LapACBS$ represents *Percentage Change in Number of Laparoscopic ACBS Procedures Performed in 2004 and 2009*. Coefficients are b_0, b_1, b_2, to b_n. The independent variable, $Y\%\Delta OpenACBS$, represents *Percent Change in Number of Open ACBS Procedures Performed in 2004 and 2009*. *ACGH* (facility type), *FLORIDA* (state); *POP%* Δ (CBSA population change); and *METRO* (CBSA area) represent a series of control variables. The control variables are categorized at the facility- and demographic-levels. The error term is represented as ε. It is assumed that the set of all errors for facility level analyses are correlated with each other. The error of measurement, ε, is assumed to be independent, homoscedastic, and have equal standard deviations.

The bivariate analysis in table 60 shows a significant positive relationship between open and laparoscopic ACBS procedures. Findings suggest that, on average, for every additional unit of the percent change for open ACBS, laparoscopic ACBS procedures increased by 61.8% (p = .000). Findings are significant at the p <.05 level. Overall, descriptive statistics revealed that the number of open ACBS performed fell by 68.2%, on average. Based on the bivariate equation below, laparoscopic ACBS declined 10%, on average.

Equation 9

$$Y\ (\%\Delta\ lapACBS) = .321 + .618\ (\%\Delta\ openACBS)$$

In other words, while the number of procedures for both types of surgeries declined over the study period, open ACBS declined at a faster rate than laparoscopic ACBS. The explanatory power of the model is weak, explaining almost 11% of the variation in the dependent variable (R^2 = .105).

After controlling for facility and state differences, changes in CBSA population size, and whether or not the facility is located in a metropolitan area, the relationship between open and laparoscopic ACBS became statistically insignificance (see model 5). Findings suggests that, on average, for every additional unit in the percent change for open ACBS, laparoscopic ACBS procedures increased by 5% (p = .508). An assessment of the influence of control variables reveals that medical facility remained strong and statistically significant. ACGHs, on average, can expect to perform almost 138% more laparoscopic ACBS procedures than ASCs (p = .000). Florida, on average, can expect to perform about 29% more laparoscopic ACBS procedures than Wisconsin. The explanatory power of model 5 is moderately strong, explaining 43% of the variation in the dependent variable (R^2 = .428).

Table 61 focuses on the association between percent changes in open and laparoscopic bariatric surgery. It is expected that laparoscopic bariatric surgery procedures will experience larger percent increases than open procedures. Bivariate analysis shows that, on average, for every additional unit of the percent change for open bariatric surgery, laparoscopic bariatric surgery increased 16% (p = .942). The findings failed to reach the level of statistical significance. Descriptive statistics reveal that the average percent change for open bariatric surgery declined by 80.8%. Based on the bivariate equation below, the average percent change in laparoscopic bariatric surgery rose 368.5%.

Equation 10

$$Y\ (lapbariatric\%\Delta) = 3.814 + .160\ (openbariatric\%\Delta)$$

The number of laparoscopic bariatric surgery procedures increased, while the number of open bariatric surgery procedures declined. The independent variable in model 1 has no explanatory power ($R^2 = .000$). After controlling for facility and state differences, changes in CBSA population size, and whether or not the facility is located in a metropolitan area, the relationship between open and laparoscopic bariatric surgery remains insignificant across all models. Metropolitan CBSA has a significant relation with laparoscopic bariatric surgery. Based on model 5, facilities located in metropolitan CBSAs, on average, can expect to perform 1196% (p = .023) fewer laparoscopic bariatric surgery procedures than medical facilities located outside of metropolitan CBSAs. The explanatory power of model 5 in table 38 is weak, indicating that the independent variables in the models explain almost 8% of the variation in the dependent variables ($R^2 = .075$).

Table 62 highlights the significant positive relation between open and laparoscopic cholecystectomy procedures. Bivariate analysis reveals that, on average, for every additional unit of the percent change in open cholecystectomy, laparoscopic cholecystectomy increased by 23.2% (p = .000). Overall, open cholecystectomy declined 45.2%, on average. Based on the bivariate equation below, laparoscopic cholecystectomy fell 7.6%.

Equation 11

$$Y\ (\%\Delta lapcholecystectomy) = .029 + .232(\%\Delta opencholecystectomy)$$

The number of open and laparoscopic cholecystectomy procedures declined over the study period, with open cholecystectomy procedures falling at a faster rate. The R^2 for model 1 is

weak at .042. The relationship between open and laparoscopic cholecystectomy procedures, however, loses significance after controlling for facility, state, population change, and metropolitan area factors. Facility and state factors remain significant. Model 5 suggest that ACGHs, on average, can expect to perform 116.4% (p = .000) more laparoscopic cholecystectomy procedures than ASCs. Florida, on average, can expect to perform about 23.4% (p = .087) more laparoscopic cholecystectomy procedures than Wisconsin. The explanatory power of model 5 strengthens over that of model 1. The independent variables in the model explain almost 26% of the variation in the dependent variable (R^2 = .255).

Table 63 examines the association between open and laparoscopic appendectomy. The bivariate analysis between the variables suggests a significant positive relationship. On average, for every additional unit of the percent change of open appendectomy, laparoscopic appendectomy increased by 101.3% (p = .000). Descriptive statistics indicate that, on average, open appendectomy procedures declined 67% over the study period. Based on the bivariate equation below, the number of laparoscopic appendectomy procedures performed increased by 28.5%, on average. The explanatory power for model 1 is weak (R^2 = .059).

<u>Equation 12</u>

$$\mathrm{Y}\,(\%\,\Delta\, lapappendectomy) = .964 + 1.013(\%\,\Delta\, openappendectomy)$$

After considering facility, state, population change, and metropolitan area factors, the relationship between open and laparoscopic appendectomy becomes negative and loses significance. In model 5, facility type and metropolitan CBSA are significant. ACGHs, on average, can expect to perform 237.5% (p = .000) more laparoscopic appendectomy procedures than ASCs. Medical facilities located in metropolitan CBSAs, on average, can expect to perform

about 129.4% ($p = .000$) fewer laparoscopic appendectomies than facilities located outside of metropolitan areas. The independent variables in model 5 explain about 30% of the variation in the dependent variable ($R^2 = .295$).

Bivariate analyses in Tables 60, 62 and 63 show significant positive relations between open and laparoscopic ACBS, cholecystectomy, and appendectomy procedures, respectively. The relationship between open and laparoscopic bariatric surgery in Table 61, is positive but lacks significance. Yet, after controlling for select variables, these relationships lose statistical significance. With control variables added to the models, R^2 results for Tables 60 to 63 range 7.5% to 43%, indicating that the variables in the models have weak to moderate strong explanatory power. Collinearity diagnostics revealed no problems with multicollinearity. While trends indicate faster growth among laparoscopic ACBS procedures, compared to open ACBS procedures; after controlling for select variables, the percent change in open procedures did not differ significantly from the percent change in laparoscopic procedures. These finding are contrary to Hypotheses A.

Table 60: Linear Regression Analysis - Percent Change in the Number of Open ACBS Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic ACBS Cases in 2004 and 2009 (N = 496) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Percent Change Open ACBS	.618**	.025	.049	.050	.050
	.324	.013	.026	.026	.026
	(.000)	(.736)	(.517)	(.505)	(.508)
Acute Care General Hospital		1.325**	1.385**	1.376**	1.376**
		.641	.760	.666	.666
		(.000)	(.000)	(.000)	(.000)
Florida			.247**	.287**	.288**
			.090	.104	.105
			(.017)	(.009)	(.009)
% Change in CBSA Population				-1.066	-1.063
				-.042	-.042
				(.251)	(.255)
Metropolitan Area					-.007
					-.002
					(.958)
Constant	.321	-.775	-.995	-.958	-.953
	(.000)	(.000)	(.000)	(.000)	(.00)
R^2	.105	.420	.427	.428	.428

*P<0.10 **P<0.05

Table 61: Linear Regression Analysis - Percent Change in the Number of Open Bariatric Surgery Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic Bariatric Surgery Cases Performed in 2004 and 2009 (N = 130) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Percent Change Open Bariatric Surgery	.160	-.580	-.391	.278	.539
	.006	-.023	-.016	.011	.022
	(.942)	(.794)	(.862)	(.904)	(.813)
Acute Care General Hospital		4.377	3.745	3.091	2.444
		.143	.123	.101	.080
		(.113)	(.192)	(.289)	(.396)
Florida			-2.693	-1.350	-.493
			-.075	-.037	-.014
			(.416)	(.700)	(.887)
% Change in CBSA Population				-44.876	-39.226
				-.116	-.101
				(.245)	(.302)
Metropolitan Area					-11.957**
					-.203
					(.023)
Constant	3.814	-.050	2.833	5.331	16.293
	(.075)	(.988)	(.554)	(.310)	(.022)
R^2	.000	.020	.025	.035	.075

*P<0.10 **P<0.05

Table 62: Linear Regression Analysis - Percent Change in the Number of Open Cholecystectomy Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic Cholecystectomy Cases Performed in 2004 and 2009 (N = 454) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Percent Change Open Cholecystectomy	.232**	.029	.030	.030	.030
	.206	.026	.027	.027	.027
	(.000)	(.554)	(.540)	(.542)	(.543)
Acute Care General Hospital		1.100**	1.164**	1.163**	1.164**
		.489	.518**	.517	.518
		(.000)	(.000)	(.000)	(.000)
Florida			.229*	.236*	.234*
			.079	.082	.081
			(.071)	(.080)	(.087)
% Change in CBSA Population				-.177	-.187
				-.007	-.007
				(.882)	(.876)
Metropolitan Area					.017
					.004
					(.918)
Constant	.029	-.685	-.909	-.903	-.916
	(.608)	(.000)	(.000)	(.000)	(.000)
R^2	.042	.250	.255	.255	.255

*P<0.10 **P<0.05

Table 63: Linear Regression Analysis - Percent Change in the Number of Open Appendectomy Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic Appendectomy Cases Performed in 2004 and 2009 (N = 426) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Percent Change Open Appendectomy	1.013**	-.245	-.240	-.243	-.342
	.243	-.059	-.057	-.058	-.082
	(.000)	(.239)	(.259)	(.252)	(.105)
Acute Care General Hospital		2.351**	2.359**	2.369**	2.375**
		.548	.550	.552	.553
		(.000)	(.000)	(.000)	(.000)
Florida			.035	-.016	-.215
			.006	-.003	.039
			(.891)	(.952)	(.433)
% Change in CBSA Population				1.321	1.963
				.026	.038
				(.568)	(.389)
Metropolitan Area					-1.294**
					-.172
					(.000)
Constant	.964	-1.237	-1.267	-1.313	-.430
	(.000)	(.000)	(.000)	(.000)	(.286)
R^2	.059	.268	.268	.269	.295

*P<0.10 **P<0.05

Medical Facility Shift

Tables 64 to 67 are formulated to address questions related to Hypotheses B, which asserts that ASCs will experience a larger percentage increase in the number of ambulatory laparoscopic ACBS performed compared to ACGHs. The relationship will be tested using the following equation:

<u>Equation 13</u>

$$Y\%\Delta AmbLapACBS = b_0 + b_1 ACGH + b_2 FLORIDA + b_3 POP\%\Delta + b_4 METRO + \varepsilon$$

Bivariate analysis in Table 64 shows a significant positive relationship between ACGH and shifts in ambulatory laparoscopic ACBS cases. Results suggest that an ACGH can expect to

perform, on average, 246.7% (p = .000) more ambulatory laparoscopic ACBS cases than ASCs over the course of the study period. Based on the bivariate equation below, ACGHs experienced a 125% increase in the number of ambulatory laparoscopic ACBS performed, compared to a 78.6% decline for ASCs, on average. The explanatory power of model 1 is weak (R^2 = .117).

<u>Equation 14</u>

$$\text{Y}\ (\%\,\Delta\, ambulatorylaparoscopicACBS) = -.786 + 2.467(ACGH)$$

After controlling for state differences, changes in CBSA population size, and metropolitan area variations in model 4, the relationship between ACGH and ambulatory laparoscopic ACBS remained significant. Results suggest that an ACGH can expect to perform, on average, 278.7% (p = .000) more ambulatory laparoscopic ACBS cases than ASCs over the course of the study period. Florida, on average, can expect to perform about 101.3% (p = .022) more ambulatory laparoscopic ACBS procedures than Wisconsin. With control variables added to the models, the explanatory power improves slightly (R^2 = .136).

The bivariate analysis in table 65 shows that an ACGH, on average, can expect to perform 829.2% (p = .078) more ambulatory laparoscopic bariatric surgery cases than ASCs. The findings are significant at the $p < .10$ level. Based on the bivariate equation below, ACGHs witnessed an 806% increase in the number of ambulatory laparoscopic bariatric surgery performed, on average, compared to that for ASC which fell by 23.5%. The explanatory power of model 1 is very weak (R^2 = .027).

Equation 15

$$Y\,(\%\,\Delta\,ambulatorylaparoscopicbariatric) = -.235 + 8.292(ACGH)$$

After controlling for state differences, changes in CBSA population size, and metropolitan area variations, the relationship between medical facility type and percent change in the number of ambulatory laparoscopic bariatric surgery cases remained significant. These findings are significant at the $p < .05$ level. Model 4 shows that an ACGH performed, on average, 973.9% more ambulatory laparoscopic bariatric surgery procedures than ASCs, holding all else constant ($p = .050$). Although these findings are significant, the explanatory power of model 4 remained extremely weak ($R^2 = .037$).

Table 66 highlights the association between ACGH and ambulatory laparoscopic cholecystectomy. The bivariate analysis shows a significant positive relationship and reads: an ACGH performed an average of 267.5% ($p = .000$) more ambulatory laparoscopic cholecystectomies than ASCs. Based on the bivariate equation below, the average ACGH experienced a 203% increase in the number of ambulatory laparoscopic cholecystectomy procedures, compared to that for the average ASC, which declined by 64.3%.

Equation 16

$$Y\,(\%\,\Delta\,ambulatorylaparoscopiccholecystectomy) = -.643 + 2.675(ACGH)$$

The explanatory power of model 1 is weak ($R^2 = .087$). After controlling for state differences, changes in CBSA population size, and metropolitan area variations, Model 4 shows that the relationship between ACGH and percent change in the number of ambulatory laparoscopic cholecystectomy cases strengthens, based on changes in the beta weight, and remains significant. Model 4 results suggest that an ACGH can expect to perform, on average,

317.6% ($p = .000$) more ambulatory laparoscopic cholecystectomy cases than ASCs over the course of the study period. Florida, on average, can expect to perform about 158.1% ($p = .005$) more ambulatory laparoscopic cholecystectomies than Wisconsin. The explanatory power in model 4 improved slightly ($R^2 = .114$).

The relation between facility type and ambulatory laparoscopic appendectomy is the focus of table 67. The bivariate analysis in Model 1 reveals a significant positive relationship between the independent and dependent variables. Findings indicate that compared to ASCs, an ACGH performed 302.6% more ambulatory laparoscopic appendectomy procedures on average ($p = .000$). Based on the bivariate equation below, the percent change in ambulatory laparoscopic appendectomy procedures for the average ACGH is 205%, compared to that for ASC, which fell by 97.8%. The explanatory power of model 1 is weak ($R^2 = .115$).

Equation 17

$$Y\,(\%\,\Delta\, \mathit{ambulatorylaparoscopicappendectomy}) = -.978 + 3.026(\mathit{ACGH})$$

After controlling for state differences, changes in CBSA population size, and metropolitan area variations, Model 4 shows that the relationship between ACGH and percent change in the number of ambulatory laparoscopic appendectomy cases remains significant. Findings suggest that an ACGH can expect to perform, on average, 230.6% ($p = .000$) more ambulatory laparoscopic appendectomy cases than ASCs over the course of the study period. Florida, on average, can expect to perform about 254.5% ($p = .000$) fewer ambulatory laparoscopic appendectomy procedures than Wisconsin. The explanatory power improved slightly ($R^2 = .157$).

The findings in table 64 to 67 are statistically significant but contrary to Hypothesis B. These findings fail to support Hypothesis B, and they do not allow for the rejection of the null hypothesis. ASCs did not experience a larger percentage increase in the number of ambulatory laparoscopic ACBS procedures, compared to ACGHs. Results show that ACGHs experienced larger percent changes in the number of ambulatory laparoscopic ACBS procedures than did ASCs. There were no multicollinearity problems identified for any of the models.

Table 64: Linear Regression Analysis - Facility Type on Percent Change in the Number of Ambulatory Laparoscopic ACBS Cases Performed in 2004 and 2009 (N = 519) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Acute Care General Hospital	2.467**	2.770**	2.813**	2.787**
	.341	.383	.389	.386
	(.000)	(.000)	(.000)	(.000)
Florida		1.191**	.952**	1.013**
		.127	.102	.108
		(.004)	(.028)	(.022)
% Change in CBSA Population			6.142	6.363
			.070	.073
			(.118)	(.106)
Metropolitan Area				-.443
				-.036
				(.405)
Constant	-.786	-1.909	-2.109	-1.757
	(.000)	(.000)	(.000)	(.005)
R^2	.117	.131	.135	.136

*p < 0.10 **p < 0.05

Table 65: Linear Regression Analysis - Facility Type on Percent Change in the Number of Ambulatory Laparoscopic Bariatric Surgery Cases Performed in 2004 and 2009 (N = 114) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4
Acute Care General Hospital	8.292*	9.260*	9.315*	9.739**
	.166	.185	.186	.194
	(.078)	(.058)	(.058)	(.050)
Florida		9.289	8.311	9.000
		.077	.069	.075
		(.427)	(.493)	(.461)
% Change in CBSA Population			21.034	18.070
			.031	.027
			(.747)	(.783)
Metropolitan Area				7.908
				.059
				(.538)
Constant	-.235	-9.524	-10.065	-18.329
	(.938)	(.430)	(.411)	(.314)
R^2	.027	.033	.034	.037

*p < 0.10 **p < 0.05

Table 66: Linear Regression Analysis - Facility Type on Percent Change in the Number of Ambulatory Laparoscopic Cholecystectomy Cases Performed in 2004 and 2009 (N = 516) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4
Acute Care General Hospital	2.675**	3.140**	3.194**	3.176**
	.296	.347	.353	.351
	(.000)	(.000)	(.000)	(.000)
Florida		1.836**	1.541**	1.581**
		.157	.132	.136
		(.000)	(.005)	(.005)
% Change in CBSA Population			7.577	7.727
			.069	.070
			(.130)	(.124)
Metropolitan Area				-.298
				-.019
				(.659)
Constant	-.643	-2.372	-2.618	-2.382
	(.017)	(.000)	(.000)	(.003)
R^2	.087	.110	.114	.114

*p < 0.10 **p < 0.05

Table 67: Linear Regression Analysis - Facility Type on Percent Change in the Number of Ambulatory Laparoscopic Appendectomy Cases Performed in 2004 and 2009 (N = 436) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4
Acute Care General Hospital	3.026**	2.294**	2.331**	2.306**
	.339	.257	.261	.258
	(.000)	(.000)	(.000)	(.000)
Florida		-2.515**	-2.691**	-2.545**
		-.214	-.229	-.216
		(.000)	(.000)	(.000)
% Change in CBSA Population			4.553	4.762
			.042	.044
			(.381)	(.360)
Metropolitan Area				-.719
				-.045
				(.337)
Constant	-.978	1.457	1.302	1.840
	(.001)	(.018)	(.041)	(.031)
R^2	.115	.154	.155	.157

*p < 0.10 **p < 0.05

Surgical-Setting Shift within Acute Care General Hospital

Tables 68 to 71 are designed to answer questions related to Hypothesis C, which claims that the number of procedures performed in ambulatory settings will increase faster than those in inpatient environments. Since ASCs do not provide inpatient services, the analysis focuses solely on ACGHs, which allows for the inclusion of two additional control variables have been added to the models: log bed size and for-profit. These data are not available for ASCs. The following equation models the regression analyses used in this section.

<u>Equation 18</u>

$$Y\%\Delta AmbACBS = b_0 + b_1\%\Delta InpatientACBS + b_2 FLORIDA + b_3 POP\%\Delta + b_4 METRO + b_5 LogBEDSIZE + b_6 FORPROFIT + \varepsilon$$

Table 68 examines the relationship between all inpatient and ambulatory ACBS procedures performed in ACGHs. Bivariate analysis suggests an insignificant positive relationship between changes in the provision of ambulatory and inpatient ACBS procedures. The findings suggest that for every additional unit of the percent change of inpatient ACBS, ambulatory ACBS procedures increases 28.7% (p = .494), on average. The findings, however, lack statistical significance.

Descriptive statistics indicate that, on average, the number of inpatient ACBS procedures increased 5.6%. Based on the bivariate equation below, model 1 predicts that ambulatory ACBS procedures rose by 122%, on average. The explanatory power for model 1 is very weak (R^2 = .002).

Equation 19

$$Y\ (\%\,\Delta\, ambulatoryACBS) = 1.206 + .287(\%\,\Delta\, inpatientACBS)$$

Even after taking into account state, population change, metropolitan, and facility variations (bed size and for-profit status), the association between inpatient and ambulatory ACBS procedures remains insignificant. Model 5 shows that within ACGHs, for every additional unit of the percent change of inpatient ACBS, ambulatory ACBS procedures decreased by 5.2% (p = .906), on average, all else being equal. Model 5 also shows that the state influence is significant at the $p < .10$ level. Findings suggest that Florida, on average, can expect to perform about 122.2% (p = .063) more ambulatory ACBS procedures than Wisconsin, all else being equal.

Table 69 highlights the negative association between percent changes in inpatient and ambulatory bariatric surgery. It is expected that ambulatory bariatric surgery procedures will

experience larger percent increases than inpatient bariatric surgery procedures. The findings suggest that for every additional unit of the percent change of inpatient bariatric surgery, ambulatory bariatric surgery procedures decreased 1.9% ($p = .835$), on average. The average percent change for inpatient bariatric surgery is 186%. Based on the bivariate equation below, the average percent change in ambulatory bariatric surgery rose 169%. The explanatory power of model 1 is very weak ($R^2 = .001$).

Equation 20

$$Y\ (\%\,\Delta\, ambulatorybariatric) = 1.720 + -.019\ (\%\,\Delta\, inpatientbariatric)$$

After controlling for state differences, changes in CBSA population size, whether or not the facility is located in a metropolitan area, bed size, and for-profit status, in model 5, the relationship between inpatient and ambulatory bariatric surgery remains insignificant. The findings suggest that within ACGHs, for every additional unit of the percent change of inpatient bariatric surgery, ambulatory bariatric surgery procedures decreased 3.3% ($p = .714$), on average, all else being equal. The explanatory power strengthens slightly but remains weak ($R^2 = .075$).

Table 70 focuses on the association between percent changes in inpatient and ambulatory cholecystectomy procedures. It is expected that ambulatory cholecystectomy procedures will experience larger percent increases than inpatient cholecystectomy procedures. The findings suggest that for every additional unit of the percent change of inpatient cholecystectomy procedures, ambulatory cholecystectomy procedures increased 30.7% ($p = .509$), on average, within ACGHs. The relationship lacks statistical significance. Descriptive statistics reveal that the average percent change for inpatient cholecystectomy is 14.7%. Based on the bivariate equation below, ambulatory cholecystectomy rose 172%, on average. The explanatory power of model 1 is very weak ($R^2 = .002$).

Equation 21

$$Y\,(\%\,\Delta\,ambulatorycholecystectomy) = 1.671 + .307(\%\,\Delta\,inpatientcholecystectomy)$$

After controlling for state differences, changes in CBSA population size, whether or not the facility is located in a metropolitan area, bed size, and for-profit status, in model 5, the relationship between inpatient and ambulatory cholecystectomy remains insignificant. The findings suggest that, on average, for every additional unit of the percent change of inpatient cholecystectomy procedures, ambulatory cholecystectomy procedures decreased 22.1% (p = .639), holding all else constant. State and for-profit influences, however, are statistically significant. Findings suggest that Florida, on average, can expect to perform about 238.4% (p = .004) more ambulatory cholecystectomy procedures than Wisconsin, all else being equal. For-profit ACGHs, on average, can expect to perform 154.5% (p = .024) fewer ambulatory cholecystectomy procedures than non-profit ACGHs, holding all else constant. The explanatory power increases slightly over model 1 but remains weak (R^2 = .085).

Table 71 focuses on the negative association between percent changes in inpatient and ambulatory appendectomy procedures. It is expected that ambulatory appendectomy procedures will experience larger percent increases than inpatient procedures. The findings in model 1 suggest that for every additional unit of the percent change of inpatient appendectomy procedures, ambulatory appendectomy procedures decreased by 148.5% (p = .029), on average. Bivariate relationship is statistically significance. The average percent change for inpatient appendectomy procedures is .4%. Based on the bivariate equation below, ambulatory appendectomy procedures rose 136%, on average. The explanatory power of model 1 is very weak (R^2 = .022).

<u>Equation 22</u>

$$Y\ (\%\,\Delta\, ambulatoryappendectomy) = 1.364 + -1.485(\%\,\Delta\, inpatientappendectomy)$$

After controlling for state differences, changes in CBSA population size, whether or not the facility is located in a metropolitan area, bed size, and for-profit status in model 5, the relationship between inpatient and ambulatory appendectomy became insignificant. Findings suggest that for every additional unit of the percent change of inpatient appendectomy procedures, ambulatory appendectomy procedures decreased by 37.9% ($p = .614$), on average. The state factor, however, is statistically significant. Findings suggest that Florida, on average, can expect to perform about 260.8% ($p = .002$) more ambulatory appendectomy procedures than Wisconsin, all else being equal. With control variables added to the model, the explanatory power improves slightly ($R^2 = .082$).

Contrary to Hypothesis C, after controlling for select variables, the percent change in inpatient ACBS procedures did not differ significantly from the percent change in ambulatory ACBS procedures. No problems with multicollinearity were identified with Tables 68 to 71.

Table 68: Linear Regression Analysis - Percent Change in the Number of Inpatient ACBS Cases Performed in 2004 and 2009 on Percent Change in the Number of Ambulatory ACBS Cases Performed in 2004 and 2009 (N = 257) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Change Inpatient ACBS	.287	.036	-.071	-.072	-.052
	.043	.005	-.011	-.011	-.008
	(.494)	(.935)	(.872)	(.871)	(.906)
Florida		.993*	.674	.707	1.222*
		.126	.086	.090	.153
		(.054)	(.218)	(.203)	(.063)
% Change in CBSA Population			9.724*	9.988*	8.333
			.114	.117	.097
			(.097)	(.091)	(.165)
Metropolitan				-.248	-.108
				-.024	-.010
				(.710)	(.877)
Log Bed Size					-.141
					-.035
					(.624)
For-Profit					-.879
					-.112
					(.108)
Constant	1.206	.537	.255	.431	1.036
	(.000)	(.197)	(.569)	(.509)	(.437)
R^2	.002	.016	.027	.028	.038

*P<0.10 **P<0.05

Table 69: Linear Regression Analysis - Percent Change in the Number of Inpatient Bariatric Surgery Cases Performed in 2004 and 2009 on Percent Change in the Number of Ambulatory Bariatric Surgery Cases Performed in 2004 and 2009 (N = 59) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Percent Change Inpatient Bariatric Surgery	-.019	-.024	-.024	-.028	-.033
	-.028	-.036	-.036	-.041	-.049
	(.835)	(.787)	(.791)	(.762)	(.714)
Florida		2.425	2.241	2.341	1.813
		.114	.106	.110	.086
		(.394)	(.471)	(.454)	(.571)
% Change in CBSA Population			4.320	4.968	2.842
			.022	.026	.015
			(.878)	(.861)	(.920)
Metropolitan				3.161	1.763
				.089	.050
				(.512)	(.718)
Log Bed Size					1.039
					.112
					(.432)
For-Profit					3.597
					.219
					(.113)
Constant	1.720	-.447	-.563	-3.742	-8.255
	(.051)	(.867)	(.841)	(.505)	(.317)
R^2	.001	.014	.014	.022	.075

*P<0.10 **P<0.05

Table 70: Linear Regression Analysis - Percent Change in the Number of Inpatient Cholecystectomy Cases Performed in 2004 and 2009 on Percent Change in the Number of Ambulatory Cholecystectomy Cases Performed in 2004 and 2009 (N = 257) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Percent Change Inpatient Cholecystectomy	.307	-.062	-.217	-.208	-.221
	.041	-.008	-.029	-.028	-.030
	(.509)	(.896)	(.646)	(.660)	(.639)
Florida		2.011**	1.396**	1.508**	2.384**
		.199	.138	.149	.236
		(.002)	(.042)	(.030)	(.004)
% Change in CBSA Population			18.231**	19.117**	16.398**
			.166	.174	.149
			(.014)	(.010)	(.029)
Metropolitan				-.856	-.650
				-.064	-.049
				(.308)	(.457)
Log Bed Size					-.189
					-.037
					(.599)
For-Profit					-1.545**
					-.154
					(.024)
Constant	1.671	.340	-.165	.443	1.260
	(.000)	(.512)	(.764)	(.586)	(.450)
R^2	.002	.039	.062	.066	.085

*P<0.10 **P<0.05

Table 71: Linear Regression Analysis - Percent Change in the Number of Inpatient Appendectomy Cases Performed in 2004 and 2009 on Percent Change in the Number of Ambulatory Appendectomy Cases Performed in 2004 and 2009 (N = 222) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Change Inpatient Appendectomy	-1.485**	-.289	-.338	-.334	-.379
	-.147	-.029	-.033	-.033	-.037
	(.029)	(.695)	(.649)	(.654)	(.614)
Florida		-2.374**	-2.553**	-2.562**	-2.608**
		-.261	-.281	-.282	-.287
		(.000)	(.000)	(.001)	(.002)
% Change in CBSA Population			5.242	5.205	4.849
			.052	.052	.049
			(.466)	(.472)	(.516)
Metropolitan				.045	-.110
				.004	-.009
				(.957)	(.899)
Log Bed Size					.288
					.060
					(.423)
For-Profit					-.323
					-.034
					(.638)
Constant	1.364	2.984	2.831	2.801	1.596
	(.000)	(.000)	(.000)	(.001)	(.355)
R^2	.022	.076	.078	.078	.082

*P<0.10 **P<0.05

Technology Shift within Acute Care General Hospital

Tables 72 to 75 are designed to test Hypothesis D and focuses on ACGHs only. Hypothesis D claims that the number of ACBS procedures performed laparoscopically will increase faster than open ACBS procedures. Since the analysis focuses solely on ACGHs, the control variables log bed size and for-profit will remain in the models.

Equation 23

$$Y\%\Delta LapACBS = b_0 + b_1\%\Delta OpenACBS + b_2 FLORIDA + b_3 POP\%\Delta + b_4 METRO + b_5 LogBEDSIZE + b_6 FORPROFIT + \varepsilon$$

Table 72 examines the relationship between all open and laparoscopic ACBS procedures. Bivariate analysis suggests an insignificant positive relationship between percent changes in the provision of open and laparoscopic ACBS procedures performed in ACGHs. Findings suggest that within ACGHs, for every additional unit of the percent change of open ACBS procedures, laparoscopic ACBS procedures increases .1% (p = .988), on average. The findings lack statistical significance. Descriptive statistics indicate that, on average, the percent change in the number of open ACBS procedures declined 43%. Based on the bivariate equation below, model 1 predicts that, on average, laparoscopic ACBS procedures rose by 122%. The independent variable has no explanatory power for model 1 ($R^2 = .000$).

Equation 24

$$Y\,(\%\Delta\, laparoscopicACBS) = .540 + .001(\%\Delta\, openACBS)$$

After taking into account state, population change, metropolitan, and facility variations (bed size and for-profit status), the association between open and laparoscopic ACBS procedures remains insignificant. Model 5 shows that within ACGHs, for every additional unit of the percent

change of open ACBS, laparoscopic ACBS procedures increase 1.2% ($p = .896$), on average, all else being equal. The only significant variable in model 5 is for-profit. Results show that for-profit ACGHs, on average, can expect to perform about 21.8% ($p = .039$) fewer laparoscopic ACBS procedures than non-profit ACGHs, all else being equal.

Table 73 focuses on the association between percent changes in open and laparoscopic bariatric surgery. It is expected that laparoscopic bariatric surgery procedures will experience larger percent increases than open bariatric surgery procedures. The findings suggest that for every additional unit of the percent change of open bariatric surgery, laparoscopic bariatric surgery procedures decrease 58% ($p = .811$), on average, within ACGHs. The findings lack statistical significance. The average percent change for open bariatric surgery over the study period fell 74.3%. Based on the bivariate equation below, laparoscopic bariatric surgery rose 476%. The explanatory power of model 1 is very weak ($R^2 = .001$).

<u>Equation 25</u>

$$\text{Y}\,(\%\,\Delta\,laparoscopicbariatric) = 4.327 + -.580(\%\,\Delta\,openbariatric)$$

After controlling for state differences, changes in CBSA population size, whether or not the facility is located in a metropolitan area, bed size, and for-profit status, in model 5, the relationship between open and laparoscopic bariatric surgery turns positive but remains insignificant. The findings suggest that within ACGHs, for every additional unit of the percent change of open bariatric surgery, laparoscopic bariatric surgery procedures increase 40.5% ($p = .714$), on average, all else being equal. The explanatory power strengthens slightly but remains weak ($R^2 = .090$).

Table 74 focuses on the association between percent changes in open and laparoscopic cholecystectomy procedures. It is expected that laparoscopic cholecystectomy procedures will experience larger percent increases than open cholecystectomy procedures. Findings in model 1 suggest that for every additional unit of the percent change of open cholecystectomy procedures, laparoscopic cholecystectomy procedures increased 8.2% (p = .231), on average, within ACGHs. The relationship lacks statistical significance. Descriptive statistics reveal that the average percent change for open cholecystectomy declined 13.4%. Based on the bivariate equation below, laparoscopic cholecystectomy rose 41%. The explanatory power of model 1 is very weak ($R^2 = .006$).

<u>Equation 26</u>

$$\text{Y}\ (\%\,\Delta\, laparoscopiccholecystectomy) = .422 + .082(\%\,\Delta\, opencholecystectomy)$$

After controlling for state differences, changes in CBSA population size, whether or not the facility is located in a metropolitan area, bed size, and for-profit status in model 5, the relationship between open and laparoscopic cholecystectomy remains insignificant. The findings suggest that, on average, for every additional unit of the percent change of open cholecystectomy procedures, laparoscopic cholecystectomy procedures increased 6.9% (p = .292) within ACGHs, holding all else constant. State, log bed size, and for-profit influences, however, are statistically significant. Findings suggest that Florida, on average, can expect to perform about 50.3% (p = .000) more laparoscopic ACBS procedures than Wisconsin, all else being equal. Also for every additional unit in log bed size, the number of laparoscopic cholecystectomy procedures declined 13.9%, on average. For-profit ACGHs, on average, can expect to perform 33.1% (p = .0001) fewer laparoscopic cholecystectomy procedures than non-profit ACGHs, holding all else

constant. The explanatory power strengthens slightly over model 1 but remains weak (R^2 = .125).

Table 75 focuses on the association between percent changes in open and laparoscopic appendectomy procedures. It is expected that laparoscopic appendectomy procedures will experience larger percent increases than open ACBS procedures. The findings in model 1 suggest that for every additional unit of the percent change of open appendectomy procedures, laparoscopic appendectomy procedures decrease by 24.5% (p = .371), on average. Bivariate relationship is statistically insignificance. Open appendectomy procedures fell 43%, on average, over the study period. Based on the bivariate equation below, laparoscopic appendectomy procedures rose 122%. The explanatory power of model 1 is extremely weak (R^2 = .003).

Equation 27

$$\text{Y}\,(\%\,\Delta\,laparoscopicappendectomy) = 1.114 + -.245(\%\,\Delta\,openappendectomy)$$

After controlling for state differences, changes in CBSA population size, whether or not the facility is located in a metropolitan area, log bed size, and for-profit status in model 5, the relationship between percent changes in open and laparoscopic appendectomy remained insignificant. Findings suggest that for every additional unit of the percent change of open appendectomy procedures, laparoscopic appendectomy procedures decrease 38% (p = .179), on average. The metropolitan factor, however, is statistically significant. Findings suggest that CBSAs designated as metropolitan areas, on average, can expect to perform about 156% (p = .002) fewer laparoscopic appendectomy procedures than CBSAs classified as micropolitan and rural, all else being equal. With control variables added to the model, the explanatory power improves slightly (R^2 = .051).

Contrary to Hypothesis D, after controlling for select variables, the percent change in open ACBS procedures did not differ significantly from the percent change in laparoscopic ACBS procedures within ACGHs. No problems with multicollinearity were identified with tables 72 to 75.

Table 72: Linear Regression Analysis - Percent Change in the Number of Open ACBS Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic ACBS Cases Performed in 2004 and 2009 (N = 259) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Change Open ACBS	.001	.046	.039	.033	.012
	.001	.032	.027	.023	.008
	(.988)	(.604)	(.660)	(.707)	(.896)
Florida		.341**	.288**	.300**	.436**
		.218	.185	.192	.279
		(.000)	(.006)	(.005)	(.001)
% Change in CBSA Population			1.397	1.500	1.102
			.082	.088	.065
			(.217)	(.189)	(.338)
Metropolitan				-.094	-.051
				-.045	-.025
				(.474)	(.707)
Log Bed Size					-.051
					-.064
					(.368)
For-Profit					-.218**
					-141
					(.039)
Constant	.540	.324	.284	.348	.559
	(.000)	(.000)	(.002)	(.007)	(.032)
R^2	.000	.047	.052	.054	.072

*P<0.10 **P<0.05

Table 73: Linear Regression Analysis - Percent Change in the Number of Open Bariatric Surgery Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic Bariatric Surgery Cases Performed in 2004 and 2009 (N = 97) (beta coefficient, beta weight, and significance level)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Percent Change Open Bariatric Surgery	-.580	-.391	.328	.545	.405
	-.025	-.017	.014	.023	.017
	(.811)	(.873)	(.898)	(.829)	(.874)
Florida		-2.693	-1.249	-.480	-2.100
		-.077	-.036	-.014	-.060
		(.457)	(.751)	(.902)	(.608)
% Change in CBSA Population			-48.254	-39.685	-26.575
			-.110	-.090	-.061
			(.354)	(.439)	(.606)
Metropolitan				-11.953**	-12.959**
				-.215	-.233
				(.039)	(.026)
Log Bed Size					3.844
					.170
					(.104)
For-Profit					2.533
					.080
					(.462)
Constant	4.327	6.578	8.562	18.752	-2.016
	(.066)	(.088)	(.053)	(.005)	(.888)
R^2	.001	.006	.016	.061	.090

*P<0.10 **P<0.05

Table 74: Linear Regression Analysis - Percent Change in the Number of Open Cholecystectomy Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic Cholecystectomy Cases Performed in 2004 and 2009 (N = 257) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Change Open Cholecystectomy	.082	.082	.079	.079	.069
	.075	.075	.072	.073	.063
	(.231)	(.222)	(.236)	(.233)	(.292)
Florida		.320**	.242**	.250**	.503**
		.212	.160	.165	.333
		(.001)	(.016)	(.014)	(.000)
% Change in CBSA Population			2.117*	2.191**	1.472
			.130	.135	.090
			(.051)	(.045)	(.172)
Metropolitan				-.068	.040
				-.034	.020
				(.591)	(.758)
Log Bed Size					-.139**
					-.180
					(.008)
For-Profit					-.331**
					-.222
					(.001)
Constant	.422	.199	.142	.192	.773
	(.000)	(.011)	(.086)	(.123)	(.002)
R^2	.006	.050	.065	.066	.125

*P<0.10 **P<0.05

Table 75: Linear Regression Analysis - Percent Change in the Number of Open Appendectomy Cases Performed in 2004 and 2009 on Percent Change in the Number of Laparoscopic Appendectomy Cases Performed in 2004 and 2009 (N = 246) (beta coefficient, beta weight, and significance level)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Change Open Appendectomy	-.245	-.240	-.246	-.368	-.381
	-.057	-.056	-.057	-.086	-.089
	(.371)	(.392)	(.381)	(.185)	(.179)
Florida		.035	-.052	.204	.107
		.007	-.010	.039	.021
		(.918)	(.890)	(.586)	(.805)
% Change in CBSA Population			2.227	3.683	4.002
			.040	.066	.071
			(.575)	(.347)	(.314)
Metropolitan				-1.573**	-1.561**
				-.221	-.220
				(.001)	(.002)
Log Bed Size					-.053
					-.019
					(.793)
For-Profit					.284
					.055
					(.433)
Constant	1.114	1.092	1.032	2.094	2.311
	(.000)	(.000)	(.001)	(.000)	(.015)
R^2	.003	.003	.005	.048	.051

*P<0.10 **P<0.05

The findings derived in this chapter are interpreted and discussed in chapter 6. Study implication and research limitations are presented as well. Based on these discussions, suggestions for future research are proposed.

Table 76: Summary Hypothesis Chart (mean percent change, beta coefficient, beta weight, and significance)

	Hypothesis	**Average Percent Change**		**Hypothesis Supported?**	
Table #	**Hypothesis A Technology Shift:**	**Open**	**Laparoscopic**	**Bivariate**	**Multivariate (Model 5)**
60	Compared to open ACBS procedures, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed.	-68.2%	-10.0%	.618** .324 (.000)	.050 .026 (.508)
61	Compared to open bariatric surgery procedures, there will be a larger increase in the percentage of laparoscopic bariatric surgery procedures performed.	-80.8%	368.5%	.160 .006 (.942)	.539 .022 (.813)
62	Compared to open Cholecystectomy procedures, there will be a larger increase in the percentage of laparoscopic Cholecystectomy procedures performed.	-45.2%	-7.6%	.232** .206 (.000)	.030 .027 (.543)
63	Compared to open appendectomy procedures, there will be a larger increase in the percentage of laparoscopic appendectomy procedures performed.	-67.0%	28.5%	1.013** .243 (.000)	-.342 -.082 (.105)
Table #	**Hypothesis B Medical Facility Shift**	**ACGH**	**ASC**	**Bivariate**	**Multivariate (Model 4)**
64	Compared to ACGHs, ASCs will experience a larger percentage increase in the number of ambulatory laparoscopic ACBS procedure performed.	168%	78.6%	2.467** .341 (.000)	2.787** .386 (.000)
65	Compared to ACGHs, ASCs will experience a larger percentage increase in the number of ambulatory laparoscopic bariatric surgery procedures performed.	806%	-23.5%	8.292* .166 (.078)	9.739** .194 (.050)
66	Compared to ACGHs, ASCs will experience a larger percentage increase in the number of ambulatory laparoscopic cholecystectomy procedures performed.	203%	-64.3%	2.675** .296 (.000)	3.176** .351 (.000)
67	Compared to ACGHs, ASCs will experience a larger percentage increase in the number of ambulatory laparoscopic appendectomy procedures performed.	205%	-97.8%	3.026** .339 (.000)	2.306** .258 (.000)

Table 76 (Continued): Summary Hypothesis Chart (mean percent change, beta coefficient, beta weight, and significance)

Table #	Hypothesis C Surgical-Setting Shift Within-ACGH	Inpatient	Ambulatory	Bivariate	Multivariate (Model 5)
68	Compared to inpatient ACBS procedures, ambulatory ACBS procedures will experience a larger percentage increase in the number performed. (ACGH Only)	5.6%	122%	.287 .043 (.494)	-.052 -.008 (.906)
69	Compared to inpatient bariatric surgery procedures, ambulatory bariatric surgery procedures will experience a larger percentage increase in the number of procedures performed. (ACGH Only)	186%	169%	-.019 -.028 (.835)	-.033 -.049 (.714)
70	Compared to inpatient cholecystectomy procedures, ambulatory cholecystectomy procedures will experience a larger percentage increase in the number of procedures performed. (ACGH Only)	14.7%	172%	.307 .041 (.509)	-.221 -.030 (.639)
71	Compared to inpatient appendectomy procedures, ambulatory appendectomy procedures will experience a larger percentage increase in the number of procedures performed. (ACGH Only)	.4%	136%	-1.485** -.147 (.029)	-.379 -.037 (.614)
Table #	**Hypothesis D Technology Shift Within-ACGH**	**Open**	**Laparoscopic**	**Bivariate**	**Multivariate (Model 5)**
72	Compared to open ACBS procedures, there will be a larger increase in the percentage of laparoscopic ACBS procedures performed. (ACGH Only)	-43%	54%	.001 .001 (.998)	.012 .008 (896)
73	Compared to open bariatric surgery procedures, there will be a larger increase in the percentage of laparoscopic bariatric surgery procedures performed. (ACGH Only)	-74.3%	476%	-.580 -.025 (.811)	.405 .017 (874)
74	Compared to open Cholecystectomy procedures, there will be a larger increase in the percentage of laparoscopic Cholecystectomy procedures performed. (ACGH Only)	-13.4%	41%	.082 .075 (.231)	.069 .063 (.292)
75	Compared to open appendectomy procedures, there will be a larger increase in the percentage of laparoscopic appendectomy procedures performed. (ACGH Only)	-43%	122%	-.245 -.057 (.371)	-.381 -.089 (.179)

CHAPTER 6 – DISCUSSION AND CONCLUSIONS

As stated in Chapter 1, the main purposes of this study are to: (1) test disruptive innovation theory in health care, and (2) examine the effects of disruptive innovation on the utilization of appendectomy, cholecystectomy, and bariatric surgery. The panel study uses disruptive innovation theory to formulate a theoretical framework that guides the exploration of ACBS utilization trends. This chapter summarizes the results presented in Chapter 5 and interprets findings. The chapter also discusses the limitations of this study and makes suggestions for future research.

Summary and Interpretation of Results

Innovative medical technology is altering the way many abdominal surgeries are being performed. As hospitals and ambulatory surgery centers compete for patients, an increasing number of less invasive surgical procedures are taking place in outpatient settings. The utilization of ambulatory and laparoscopic appendectomy, cholecystectomy, and bariatric surgery is on the rise, fueling shifts between surgical technologies, surgical settings, and medical facilities. Yet, competition in the hospital industry is like no other industry. These shifts are informed and influenced by clinical judgment, prevailing practices, third party reimbursement schemes, and regulatory policies—just to name a few of the factors affecting the manner in which, and location where, ACBS procedures are performed.

In the following sections, findings are discussed based on the results derived from univariate, bivariate, and multivariate analyses. Research questions and hypotheses presented in Chapter 1 also will be addressed.

Descriptive Statistics

The descriptive statistics show how the utilization of appendectomy, cholecystectomy, and bariatric surgery procedures change over this time. A review of comparative analyses reveals an overall downward trend in open ACBS. Since 2004, ASCs have decreased significantly the number of open ACBS performed. The trend suggests that very few—if any—ASCs will perform these procedures in the future. Findings indicate that the number of ACGHs performing open ACBS also is declining, although the drops are not as severe as those for ASCs. Results also show that ACGHs are conducting fewer open ACBS procedures per facility. The downward trend in open ACBS is witnessed in both Florida and Wisconsin, where the number of facilities performing open ACBS, the annual number of procedures performed, and the average number performed per facility all declined—with one exception. The few Florida ASCs that continued to perform open ACBS experienced an increase in the average number of surgeries per facility. Comparative analyses also reveal dramatic reductions in the number of open surgeries performed across all three procedure types. Fewer ASCs and ACGHs are performing open appendectomy, cholecystectomy, and bariatric surgery procedures. Unlike open bariatric surgery where ASCs witnessed a 100% decline over the study period, a few ASCs continue to perform open cholecystectomy procedures.

There has been a dramatic increase in the number of laparoscopic ACBS administered. While the number of facilities performing these procedures has declined, the average number of procedures per facility continues to rise. Over the study period, Wisconsin witnessed an increase in the number of ASCs performing laparoscopic ACBS, while the number of ACGHs remained steady at 116 facilities. The numbers of laparoscopic ACBS administered by both facility types rose in Wisconsin, along with facility averages. Conversely, Florida ASCs experienced dramatic

decreases in the number of facilities performing laparoscopic ACBS and the number of procedures performed, while ACGHs saw a slight increase in the number of facilities performing laparoscopic ACBS and dramatic increase in the number of surgeries performed.

Although ASCs were expected to experience upward trends in the number of laparoscopic procedures they performed, this was not the case. Across all three surgery types, ASCs witnessed steady declines in the number of facilities performing ACBS laparoscopically, and in the overall number of laparoscopic procedures performed. While, in general, there appears to be an overall reduction in ACBS volume across ASCs, the facilities that are performing bariatric surgery and cholecystectomy procedures are experiencing increases in the average number of procedures performed per facility. For ACGHs, findings suggest growth in the number of facilities providing laparoscopic ACBS and an overall upward trend in the number of procedures performed. Findings also indicate that the annual number of laparoscopic procedures performed per ACGH is rising.

Overall, in the pooled dataset, the number of ACGHs performing inpatient ACBS is subtly rising; yet, a closer look within states reveal that this is disproportionately a Florida trend. In Wisconsin, both the number of facilities performing inpatient ACBS procedures fell, as well as the facility average and number of procedures performed annually. A look at the specific procedures reveals that the number of ACGHs performing inpatient bariatric surgery procedures is declining, along with the number of inpatient bariatric surgeries conducted. Yet, results suggest upticks in the number of ACGHs performing inpatient cholecystectomy and appendectomy procedures, as well as slight upswings in the average number of inpatient procedures performed per ACGH.

Overall, the number of ambulatory ACBS rose in the pooled dataset, but a closer look reveals that ASCs and ACGHs are experiencing opposite trends. The number of ASCs conducting ambulatory ACBS fell, along with the annual number of procedures performed. While the number of ACGHs performing ambulatory ACBS dropped slightly, the number of procedures performed annually increased dramatically. Wisconsin witnessed an overall rise in the number of facilities conducting ambulatory ACBS and the number of procedures performed annually. The number of ASCs increased, as well as the number of procedures they performed. While the number of ACGHs remained steady, the number of procedures performed annually rose 46%. Florida ASCs, on the other hand, witnessed dramatic decreases in the number of facilities performing ambulatory ACBS and the annual number of surgeries performed, while a steady number of ACGHs experienced a 47% rise in the annual number of surgeries performed.

An overall look at the three procedures separately reveals downward trends in the number of facilities performing ambulatory surgery, but upward trends in the number of bariatric surgery and cholecystectomy procedures conducted. Yet, findings reveal that the numbers of ambulatory bariatric and cholecystectomy procedures are shifting away from ASCs to ACGHs. Conversely, the number of ambulatory appendectomies performed annually declined overall, with ASCs experiencing the entire drop. ACGHs witnessed a rise in the number of facilities performing ambulatory appendectomies and the number of procedures performed annually.

Independent Sample T-Tests

Independent sample t-test procedures were designed to show how states and medical facilities differ in ACBS utilization. A review of independent sample t-test results show different trends occurring among medical facilities and between states. An examination of the three surgery types combined reveals significant differences in laparoscopic, ambulatory, and open

trends by facility type, and significant differences in laparoscopic, open, and inpatient trends by state. The investigation shows an overall shift in laparoscopic and ambulatory ACBS procedures away from ASCs toward ACGHs. Yet, the ASCs that continued to provide ACBS experienced increases in facility averages from 2004 to 2009. Results also indicate that ASCs and ACGHs in both states are reducing open ACBS procedure volumes, while ACGHs are experiencing a slight increase in inpatient ACBS volume. In Wisconsin, laparoscopic and ambulatory ACBS procedure volumes continue to expand, while open and inpatient ACBS procedures contract. A closer examination of Wisconsin medical facilities shows that ASCs experienced downward trends in laparoscopic, ambulatory, and open ACBS volume. Wisconsin ACGHs, on the other hand, saw increases in laparoscopic and ambulatory ACBS but not in open or inpatient ACBS procedures. In Florida, overall laparoscopic and open ACBS declined, while ambulatory and inpatient ACBS procedure volumes rose over the study period. A closer look at Florida medical facilities indicate that ASCs experienced significant downward trends in laparoscopic, ambulatory, and open ACBS, while Florida ACGHs witnessed expansion in laparoscopic, ambulatory, and inpatient ACBS. Open ACBS procedures, however, are the only surgery type where Florida ACGHs experienced a declining trend.

An analysis of bariatric surgery procedures shows significantly different trends occurring among medical facilities but not between states. Laparoscopic bariatric surgery was the only procedure type that indicated a state difference, and this was at the $p < .10$ level. Ambulatory, open, and inpatient bariatric trends did not differ significantly by state. A look at bariatric trends reveals that this type of surgery has, in large, part shifted away from open procedures. Results also indicate that there is movement away from laparoscopic and ambulatory bariatric surgery procedures performed in ASCs, although the ASCs that continued to perform these procedures

experienced an increase in the average number of surgeries conducted annually. An increasing numbers of laparoscopic and ambulatory bariatric surgery procedures are being performed in ACGHs. While ACGHs have reduced open bariatric surgery volume, inpatient bariatric surgery procedures are on the rise in ACGHs. A closer look at the states reveal that laparoscopic bariatric surgery in Wisconsin experienced a tremendous surge over the study period, while ambulatory, open, and inpatient bariatric surgery contracted. Almost all of the growth in laparoscopic bariatric surgery occurred in Wisconsin ACGHs. Wisconsin ASCs conducted very few bariatric surgery procedures over the study period. While Wisconsin ACGHs experienced downward trends in ambulatory, open, and inpatient bariatric surgery, the growth that occurred in laparoscopic bariatric procedures appears to have been performed in inpatient settings. Florida medical facilities experienced volume growth in laparoscopic, ambulatory, and inpatient bariatric surgery. The number of open bariatric surgery procedures fell in Florida. ASCs in Florida witnessed downward trends in laparoscopic, ambulatory, and open bariatric surgery procedures. Findings suggest that the growth in laparoscopic bariatric surgery volume occurred in both ambulatory and inpatient ACGH settings in Florida.

T-test results show that ASCs and ACGHs experienced significantly different trends in the number of laparoscopic, ambulatory, and open cholecystectomy procedures performed over the study period. State trends also differed in the number of laparoscopic, open and inpatient cholecystectomy procedures provided over the study period, but they did not differ in the provision of ambulatory cholecystectomy. An examination of trends in cholecystectomy volumes reveals an overall shift away from open cholecystectomy procedures in ASCs and ACGHs, however, even with the downward trend a large number of ACGHs continue to perform open cholecystectomies. Nevertheless, the upward trend is moving towards more laparoscopic

cholecystectomy procedures performed in both outpatient and inpatient settings in ACGHs. In Wisconsin, ASCs witnessed a downward trend in laparoscopic, ambulatory, and open cholecystectomy procedures, while ACGHs saw expansions in the number of laparoscopic and ambulatory cholecystectomy but not in open or inpatient cholecystectomy. Florida ASCs experienced more dramatic declines in the number of laparoscopic, ambulatory, and open cholecystectomy procedures performed. Yet, in every case, facility averages rose. ACGHs experienced increases in laparoscopic and ambulatory cholecystectomy volumes, with significant growth in ambulatory cholecystectomies. Inpatient cholecystectomy procedures performed in Florida ACGHs also continued rise.

A review of appendectomy procedures indicates significantly different trends among medical facilities and between states. Overall findings suggest that ASCs experienced a downward shift in laparoscopic, ambulatory, and open appendectomies, while laparoscopic and ambulatory appendectomy procedures performed in ACGHs continued to rise. The number of open appendectomies performed in ACGHs declined. Wisconsin ASCs witnessed an increase in laparoscopic and ambulatory appendectomy procedures over the study period, while the number of open and inpatient appendectomies declined. Florida ASCs experienced significant declines in laparoscopic, ambulatory, and open appendectomy procedures. A closer look within each state reveals that very few ASCs in Wisconsin performed appendectomies, and those ASCs that conducted laparoscopic and ambulatory appendectomies experienced a downward shift in the number of procedures performed over the study period. Wisconsin ACGHs, on the other hand, experienced dramatic increases in laparoscopic and ambulatory appendectomy procedures and facility averages, but decreases in the number of open and inpatient appendectomies and facility averages. Florida ACGHs expanded the number of laparoscopic, ambulatory, and inpatient

appendectomy procedures performed, while open appendectomies declined between 2004 and 2009. Facility averages for Florida ASCs performing appendectomy fell over the study period, but facility averages for Florida ACGHs performing laparoscopic and inpatient appendectomies rose.

In conclusion, Florida and Wisconsin medical facilities have experienced sizable decreases in open ACBS. In Florida, there has been a reduction in the number of ASCs performing ACBS, yet the output per ASCs continues to rise. Florida ACGHs have experienced growth in the number of laparoscopic ACBS performed, and these procedures are being conducted in both outpatient and inpatient settings. ASCs in Wisconsin also have witnessed overall declines in ACBS volumes, although the trend has not been as dramatic as the reductions in Florida. Wisconsin ACGHs continue to witness increases in laparoscopic and ambulatory ACBS procedures. While the trend in inpatient ACBS is declining in Wisconsin ACGHs, facility averages remain relatively high, averaging over 100 inpatient procedures annually.

Regression Analyses

Descriptive analyses and t-test results show differences between surgery types, surgical settings, state and medical facilities. Regression analyses are specifically formulated to determine whether the claims of disruptive innovation theory are evident in the hospital industry. Based on a review of the descriptive analyses and t-test results, overall negative correlations might be assumed between open and laparoscopic ACBS, inpatient and ambulatory ACBS, and ASCs and ACGHs. The statistical significance of these associations, however, could not be determined until multivariate regression analyses had been performed. Hypothesis A, B, C, and D were tested and each failed to support the hypotheses stated in Chapter 3.

Hypothesis A: Technology Shift

The regression analyses, performed in Tables 60 to 63, focus on *Hypothesis A*. Bivariate analyses suggest significant positive relations between ACBS pooled as a group, and cholecystectomy and appendectomy separately. Findings indicate that an additional unit of percent change in open ACBS is associated with a 61.8% increase in laparoscopic ACBS (Table 60, Model 1). Similar results were found between open and laparoscopic cholecystectomy and appendectomy (Tables 62 and 63). These findings, however, became insignificant after controlling for facility and demographic factors in multivariate analyses. Bivariate analysis in Table 61 shows a positive but insignificant relation between the percent change in open and percent change laparoscopic bariatric surgery. The findings, however, remained insignificant across all models in Table 61. After controlling for facility and demographic factors in Model 5 of Tables 60 to 63, findings do indicate an overall shifting trend away from open and towards laparoscopic ACBS. These findings, however, are insignificant, indicating that the null hypotheses cannot be rejected.

Prior to the introduction of less invasive laparoscopic techniques, open surgical procedures were the "gold standard" for many procedures (De, 2004; Society of American Gastrointestinal and Endoscopic Surgeons, 2004; www.medicinenet.com/cholecystectomy/article.htm). This shift toward laparoscopy that occurred for cholecystectomy and bariatric surgery was not the case for appendectomy, which shows an insignificant negative association in Table 63, Model 5. The insignificant findings could, in part, reflect that during the study period the benefits of laparoscopic appendectomy were still being debated. Many physicians continue to question the benefits of laparoscopic appendectomy. Consequently, open appendectomies remain acceptable and continue to be

performed (Marzouk et al., 2003; Nguyen et al., 2004). Marzouk and colleagues write: "Whereas the advantages of laparoscopic cholecystectomy are clear, the benefits of laparoscopic appendectomy are not obvious" (Marzouk et al., 2003: 721).

The insignificant findings in Model 5 of Tables 61 (bariatric surgery) and 62 (cholecystectomy) may reflect different indications based on the health condition of the patient population. While laparoscopic cholecystectomy has grown in popularity, it is not deemed suitable for all patients, which may in part explain results in Table 62. Open cholecystectomies may be required for extremely obese patients, those who have undergone previous abdominal surgery, or those with complicating medical problems (http://www.win.niddk.nih.gov/publications/gastric.htm).

The weaker insignificant findings in Table 61 regarding bariatric surgery may in part reflect the lack of evidence-based research on the effectiveness of this treatment modality. Although open bariatric procedures experienced rapid increases during the late 1990s and early 2000s, by the mid-2000s, open bariatric procedures, such as such as high gastric bypass surgery, had decreased dramatically (http://home.thomsonhealthcare.com/News/view/?id=1241). Laparoscopic bariatric procedures had emerged as the most popular inpatient weight loss procedure, but concerns around the quality and outcomes of bariatric surgery continued to place downward pressures on the utilization of these procedures (Aday et al., 2004).

As shown in the central tendency analyses in *Appendix C* and *D*, most medical facilities in the sample conducted very few bariatric surgery procedures in 2004 and 2009. Over the study period, demand rose for bariatric surgery, which led an increasing number of hospitals to offer the procedures, resulting in a wide variety of quality and surgery outcomes (HealthGrades, 2009). Yet, few insurers covered open or laparoscopic bariatric procedures. Between 1998 and

2003, the proportion of patients that underwent bariatric surgery with private insurance rose from 75% to 83%, while those with Medicaid or Medicare fell from 9% to 6% (Santry et al., 2005). Few public insurance beneficiaries had access to bariatric surgery, in part, due to restrictive medical coverage guidelines and long wait times (Robertson, 2003). Beginning in the early 2000s, Medicare began to gradually relax long-standing policies that determined whether or not obese beneficiaries could access bariatric procedures.

Tables 60 highlights that laparoscopic ACBS volume grew faster in ACGHs than in ASCs, even after controlling for state, population change, and metropolitan factors. This trend occurs separately across all three surgery types. Bariatric surgery, however, lacks statistical significance.

Hypothesis B: Medical Facility Shift

The findings that tests *Hypothesis B* are featured in Tables 64 to 67. Results are statistically significant but contrary to those expected, indicating that the null hypothesis cannot be rejected. Both bivariate and multivariate analyses indicate significant positive relations between ACGHs and ambulatory laparoscopic ACBS. In fact, regression findings strongly indicate that ACGHs experienced larger percent increases, than ASCs in the provision of ambulatory laparoscopic ACBS as a group, as well as each surgery type separately. ACGH provision of bariatric surgery has weaker significance than cholecystectomy and appendectomy.

Results suggest significant differences between Florida and Wisconsin in the provision of ambulatory laparoscopic ACBS pooled together, as well as cholecystectomy and appendectomy separately. Compared to Wisconsin, Florida medical facilities experienced larger percent increases in ACBS grouped together and in ambulatory laparoscopic cholecystectomy provision separately. The trend in appendectomy provision stands out as different from cholecystectomy

and bariatric surgery. There is a negative but significant association between Florida and Wisconsin in the provision of ambulatory laparoscopic appendectomy, with Wisconsin experiencing a larger percent increase than Florida. Across all models in Table 65, Florida is experiencing a higher percent increase than Wisconsin in the provision of ambulatory laparoscopic bariatric surgery; however, the states do not significantly differ.

Drawing upon disruptive innovation theory, this research assumes that smaller, more specialized and flexible ASCs—that are disproportionately owned by entrepreneurial physicians—had adopted innovative technology and would capture market share from general hospitals. The study hypothesized that ASCs would experience a larger percent increase in ACBS than ACGHs would experience. During the 2000s, ASCs experienced tremendous growth, reflecting increased specialization (Hannan & Freeman, 1977, 1983, 1988; Stevens, 2006) and growing demand for lower cost surgical options (Scott et al., 2000). ASCs facility and procedure growth also has been more widespread because they require less capital to develop, are not as complex to establish because they typically have only two to four operating rooms, and are less likely to be regulated (Casalino et al., 2003).

As discussed in Chapter 3, the study theorizes that ACGHs had succumbed to inertial pressures that had restricted their ability to meet environmental demands (Hannan & Freeman, 1977; Porter, 1980) because of the disadvantages that dominant organizations face with managerial processes and organizational dynamics when new technologies emerge. Disruptive innovation theory contends that established firms often lag behind new market entrants because they overlook, or are reluctant to adopt new technologies, which leave dominant firms at a competitive disadvantage compared to new innovative business models (Christensen & Rosenbloom, 1995; Christensen et al., 2009).

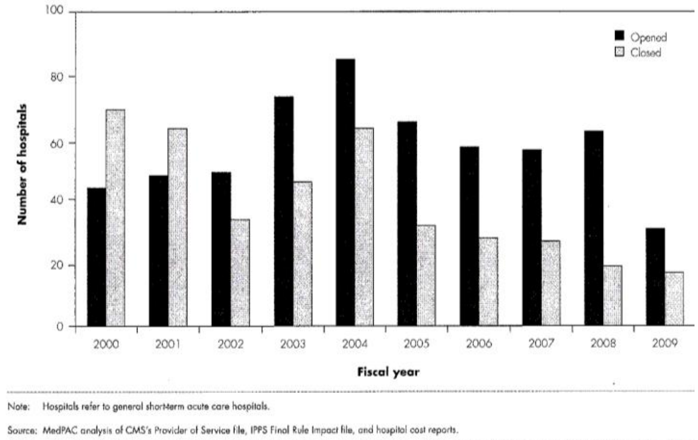
A number of factors may have contributed to the significant findings regarding the larger percent increase in ambulatory laparoscopic ACBS in ACGHs than in ASCs. This work highlights three possibilities: competitive pressures, payer coverage determinations, and reimbursement payment rates.

Explanatory Factor: Competitive Pressure

The first factor, competitive pressure, is observed in the reactions of ACGHs to the rapid expansion of physician-owned ASCs. Growth in the number of ASCs signifies the diversion of critical revenue streams away from full-service general acute care hospitals. The dominance that hospitals once had over profitable specialty service lines is threatened by more aggressive service line competition. The loss—or potential loss—of revenue streams compromises "the ability of general hospitals to provide the broad range of services communities expect from their hospitals, including emergency departments, mental health services, educational programs, and care for the uninsured" (Washington State Hospital Association, 2003). As a growing number of specialists—who traditionally would have practiced in hospitals—focus on high-tech, profitable service lines, hospitals anticipate that more new firms will enter the marketplace and more intense competition for inpatient and outpatient services will ensue. New competitors in the hospital industry, such as physician-owned ASCs, "have triggered general acute care hospitals and systems to add, expand, or enhance services and systems in order to retain market share and revenues" (Devers et al., 2003: 463). Research on Medicare-participating acute care hospitals indicates that more hospitals opened than closed their doors during the first decade of the twenty-first century (*See Figure 12*: More Hospitals Opened than Closed Each Year From 2000 to 2009). In 2009, there was a net increase of 14 acute care general hospitals (17 closures compared to 31 openings), which represented an increase of about 1,600 acute care beds (MedPAC, 2011:

38). Nationwide construction activity among hospitals is rising, and perhaps the upward trends witnessed in Tables 64 to 67 reflect ACGHs efforts to protect profits through supply-driven demand (Berwick et al, 2008).

Figure 12: More Hospitals Opened than Closed Each Year from 2000 to 2009



Source: MedPAC, 2011.

The changing competitive environment in the hospital industry is a key factor for the accelerated pace in the expansion and development of new and aging hospitals, as well as the expansion of existing general hospital and specialty capacity (Bazzoli et al., 2006). In fact, the pervasive development of medical facilities has contributed to excess capacity in the hospital industry, fueled in large part by a "medical arms race" (Devers et al., 2003; Bazzoli et al., 2006; Berenson et al., 2006).

Explanatory Factor: CMS Coverage Determinations

The second factor, CMS coverage determinations, may have contributed to the larger percent increase in ambulatory laparoscopic ACBS performed in ACGHs than in ASCs. Two important CMS coverage decisions occurred during the study period that relate to laparoscopic ACBS. The first has to do with bariatric surgery. In 2004, CMS began recognizing obesity as a disease (Roehr, 2004). Prior to February 2006, Medicare excluded hospital and physician

services for specific types of bariatric surgery from coverage. Concerned with improving the quality of bariatric surgery, maximizing fairness in accessing bariatric medical facilities, and addressing disparities in the utilization of bariatric surgical procedures among all Medicare beneficiaries, CMS concluded that a broader range of bariatric surgery procedures should be covered medical procedures in February 2006 (Aday et al., 2004). The CMS determined that bariatric surgery procedures, including open and laparoscopic Roux-en-Y gastric bypass (RYGBP), laparoscopic adjustable gastric banding (LAGB), and open and laparoscopic biliopancreatic diversion with duodenal switch (BPD/DS), are “a reasonable and necessary medical treatment[s] for Medicare beneficiaries who have a body-mass index (BMI) ≥ 35, at least one co-morbidity related to obesity, and have been previously unsuccessful with other medical treatments for obesity” (Phurrough et al., 2006). The CMS, however, ruled that these newly approved bariatric surgery procedures would only be covered when performed in facilities certified by the American College of Surgeons (ACS) as a Level 1 Bariatric Surgery Center or by the American Society for Metabolic & Bariatric Surgery as a Bariatric Surgery Center of Excellence (Phurrough et al., 2006). A Center of Excellence designation may be awarded to a medical facility or a physician. The designation and “Excellence” program aim to improve the safety and efficiency of bariatric surgery through the standardization of surgical procedures (CMS, 2013a). The Surgical Review Corporation requires applicant facilities to perform at least 80 qualifying bariatric surgery procedures in the preceding 12 months, and requires applicant surgeons to perform at least 125 qualifying bariatric surgery procedures during their lifetimes, with a minimum of at least 50 cases performed in the preceding 12 months (Available online: http://www.surgicalreview.org/coembs/requirements/). The 2006 CMS decision also stipulated that most bariatric surgery procedures be performed in inpatient settings at hospitals designated

as Centers of Excellence (American Society for Metabolic & Bariatric Surgery. Available online: http://asmbs.org/2012/03/medicare-removes-cpt-code-43770-placement-of-gastric-band-from-the-inpatient-only-list/).

The 2006 CMS decision opened the door for an increasing number of Medicare recipients to gain access to bariatric surgery (Nguyen et al., 2010). Following the 2006 decision, access to bariatric surgery was also afforded to patients with private insurers that offered similar coverage (Ginsburg, 2007; Merlis, 2009; Luna et al., 2009). While the intention of the 2006 CMS decision allowed for the creation of a standardized surgical program that enhanced the safety and efficiency of bariatric surgery procedures, the decision intervened in the competitive marketplace, spurring shifts in bariatric surgery volume from ASCs to ACGHs. Tables 77 and 78 show annual state-level totals for laparoscopic bariatric surgery procedures performed in Florida from 2004 to 2009. A review of Table 77 reveals that from 2004 to 2006, ASCs comprised over 50% of the laparoscopic bariatric surgeries performed in ASCs and ACGHs. After 2006, the percentage of ASCs performing bariatric surgery dropped to 29% in 2007, 17% in 2008, and 10% in 2009. Between 2006 and 2007, ASCs witnessed a decline of 69% in the number of laparoscopic bariatric surgery procedures performed, and the percentage continued to decline through 2009. (*See Figures 13*: Line Chart of Annual Florida Totals for Laparoscopic Bariatric Surgery Procedures Performed in ASCs and ACGHs, 2004-2009.)

Table 77: Annual Florida Totals for Laparoscopic Bariatric Surgery Procedures Performed in ASCs and ACGHs, 2004-2009

Year Facility Type	2004	2005	2006	2007	2008	2009
ASC	298	605	978	303	207	159
ACGH	271	465	723	745	1026	1455
Total	569	1070	1701	1048	1233	1614
ASC as a percent of total	52.4%	56.5%	57.5%	28.9%	16.8%	9.9%

Data Source: Intellimed, Inc.

Table 78: Annual Percent Change for Florida Laparoscopic Bariatric Surgery, 2004-2009 (State-level Data)

Facility Type	% change 04-05	% change 05-06	% change 06-07	% change 07-08	% change 08-09
ASC	103.0%	61.7%	-69.0%	-31.7%	-23.2%
ACGH	71.6%	55.5%	3.0%	37.7%	41.8%
Percent change in total	88.0%	59.0%	-38.4%	17.7%	30.9%

Data Source: Intellimed, Inc.

Figure 13: Line Chart of Annual Florida Totals for Laparoscopic Bariatric Surgery Procedures Performed in ASCs and ACGHs, 2004-2009

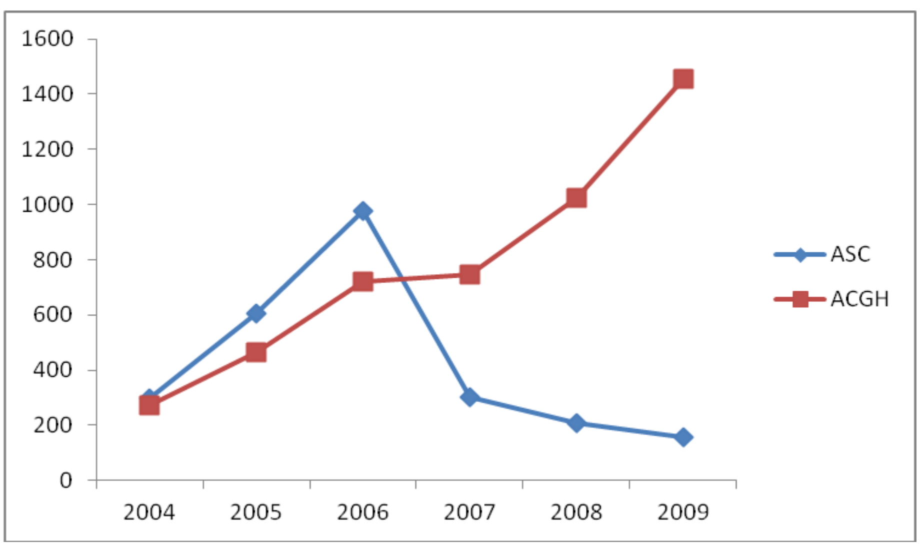


Table 79 shows that annual state-level figures from Wisconsin are similar trends in Florida. Although ASCs did not performed any bariatric surgery procedures in 2004 or 2005, in 2006 they comprised slightly more than 25% of the medical facilities (ASCs and ACGHs) providing these procedures. After 2006, the percentage that ASCs comprised fell to 7% in 2007, 6% in 2008, and stood at 8% in 2009. Between 2006 and 2007, ASCs experienced a 44% declined in the number of laparoscopic bariatric surgery procedures performed. (*See also Table 80*: Percent Change for Wisconsin Laparoscopic Bariatric Surgery, 2004-2009 (State-level Data) and *Figure 14*: Line Chart of Annual Wisconsin Totals for Laparoscopic Bariatric Surgery Procedures Performed in ASCs and ACGHs, 2004-2009.)

In both states, following the 2006 CMS bariatric surgery coverage decision ASCs witnessed a decline in laparoscopic bariatric surgery volume, albeit the fall in Florida was more dramatic than in Wisconsin. And while ASCs witnessed a decline, ACGHs saw laparoscopic bariatric surgery volume rise.

Table 79: Annual Wisconsin Totals for Laparoscopic Bariatric Surgery Procedures Performed in ASCs and ACGHs, 2004-2009

Year Facility Type	2004	2005	2006	2007	2008	2009
ASC	0	0	27	15	19	15
ACGH	50	137	79	200	301	166
Total	50	137	106	215	320	181
ASC as a percent of total	0.0%	0.0%	25.5%	7.0%	5.9%	8.3%

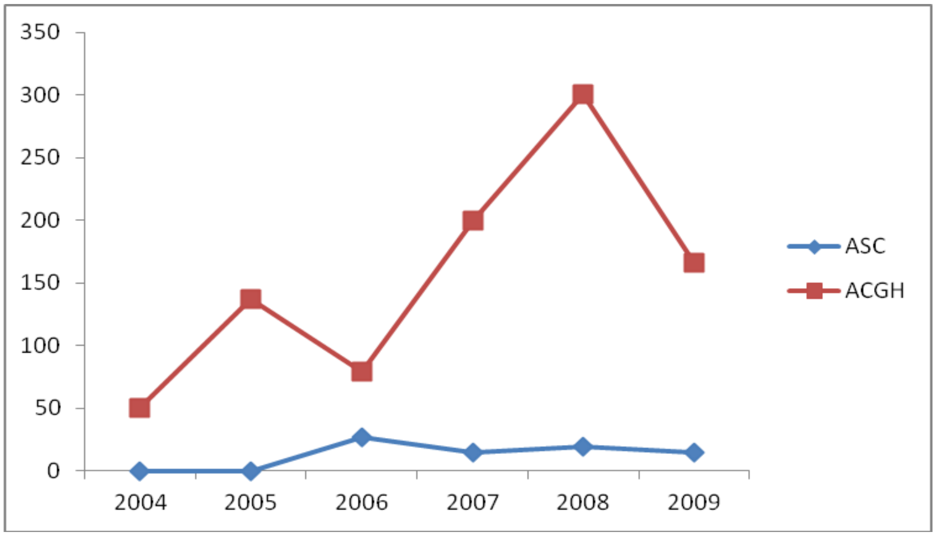
Data Source: Intellimed, Inc.

Table 80: Annual Percent Change for Wisconsin Laparoscopic Bariatric Surgery, 2004-2009 (State-level Data)

Facility Type	% change 04-05	% change 05-06	% change 06-07	% change 07-08	% change 08-09
ASC	.	.	-44.4%	26.7%	-21.1%
ACGH	174.0%	-42.3%	153.2%	50.5%	-44.9%
Percent change in total	174.0%	-22.6%	102.8%	48.8%	-43.4%

Data Source: Intellimed, Inc.

Figure 14: Line Chart of Annual Wisconsin Totals for Laparoscopic Bariatric Surgery Procedures Performed in ASCs and ACGHs, 2004-2009



The second important coverage decision occurred in August 2006, CMS recommended to exclude from ASC payment those surgical procedures that “pose a significant safety risk or are expected to require an overnight stay” (CMS, 2007b: 42486). Laparoscopic appendectomy and laparoscopic cholecystectomy both were included on a list of proposed surgical procedures that should be “excluded from ASC facility fee payment because they require an overnight stay” (CMS, 2007a: 447). Based on CMS’s review of a surgical procedure’s clinical characteristics, utilization data, and prevailing medical practices, several disqualifying criteria were formulated, such as the surgery being emergent in nature or having the potential to cause extensive blood loss (CMS, 2007b: 42487).

In 2007, when the CMS added 793 new surgical procedures to its ASC list of covered procedures for 2008, it excluded approximately 269 surgical procedures from ASC payment because they posed "a significant risk to beneficiary safety or [were] expected to require an overnight stay" (CMS, 2007b: 42488). Although laparoscopic appendectomy and laparoscopic cholecystectomy were both included on the 2006 proposed list, when the payment exclusions were enacted in 2008 only laparoscopic appendectomy remained on the list among others (CMS, 2007b). Laparoscopic appendectomy was among the excluded surgical procedures under the Outpatient Prospective Payment System (OPPS), and no ASC facility fees were paid if these procedures were performed in ASCs. In other words, when laparoscopic appendectomies were performed in hospital outpatient departments they were covered procedures, but they were not covered if administered in ASCs. CMS had covered laparoscopic cholecystectomy in ambulatory settings since November 1991 (CMS, 2000).

The following tables and charts show 2004 to 2009 annual state-level totals for laparoscopic appendectomy and laparoscopic cholecystectomy procedures. Both laparoscopic appendectomies and cholecystectomies were placed on the 2006 list of surgical procedures proposed for exclusion from the ASC facility fee payment because they require an overnight stay. In 2007, when CMS announced its final list of surgical procedures payable under the OPPS, but that had been excluded from the ASC facility payment because they pose a significant safety risk or are expected to require an overnight stay, laparoscopic cholecystectomy was not on the list.

According to Table 81, in 2006 Florida ASCs performed 2,837 laparoscopic appendectomy procedures, over half (57.8%) of the surgeries performed by ACGHs and ASCs. The next year, in 2007, ASCs performed only 22 laparoscopic appendectomies, reflecting a little

less than 2% of the laparoscopic appendectomies performed by ASCs and ACGHs. For a visual representation of these shifts see Figure 15: Line Chart of Annual Florida Totals for Laparoscopic Appendectomy Procedures Performed in ASCs and ACGHs, 2004-2009. Table 82 shows that between 2006 and 2007, ASCs experienced a 99% downturn in the number of laparoscopic appendectomy procedures performed. The decline in laparoscopic appendectomy volume continued through 2008, as reflected in the 13.6% drop between 2007 and 2008. While Florida ACGHs also experienced a decline of 45% between 2006 and 2007, the change in volume rose in subsequent years, as shown in Tables 81 and 82.

Table 83 shows that Wisconsin ASCs also witnessed a decline in laparoscopic appendectomies, although its drop was not as severe as that of Florida ASCs. In 2006, ASCs made up 2.7% of the medical facilities delivering laparoscopic appendectomies, and by 2007 the percentage of ASCs had dropped to 0.9%. Table 84 shows that between 2006 and 2007, Wisconsin ASCs witnessed a 29% reduction in the number of laparoscopic appendectomy procedures performed. During this same period, ACGHs experienced a 113% surge in these procedures. For a visual representation of the shifts, see *Figure 16*: Line Chart of Annual Wisconsin Totals for Laparoscopic Appendectomy Procedures Performed in ASCs and ACGHs, 2004-2009.

Table 81: Annual Florida Totals for Laparoscopic Appendectomy Procedures Performed in ASCs and ACGHs, 2004-2009

Year Facility Type	2004	2005	2006	2007	2008	2009
ASC	1763	1891	2837	22	19	19
ACGH	1161	1434	2069	1139	1162	1322
Total	2924	3325	4906	1161	1181	1341
ASC as a percent of total	60.3%	56.9%	57.8%	1.9%	1.6%	1.4%

Data Source: Intellimed, Inc.

Table 82: Annual Percent Change for Florida Laparoscopic Appendectomy, 2004-2009 (State-level Data)

Facility Type	% change 04-05	% change 05-06	% change 06-07	% change 07-08	% change 08-09
ASC	7.3%	50.0%	-99.2%	-13.6%	0.0%
ACGH	23.5%	44.3%	-44.9%	2.0%	13.8%
Percent change in total	13.7%	47.5%	-76.3%	1.7%	13.5%

Data Source: Intellimed, Inc.

Figure 15: Line Chart of Annual Florida Totals for Laparoscopic Appendectomy Procedures Performed in ASCs and ACGHs, 2004-2009

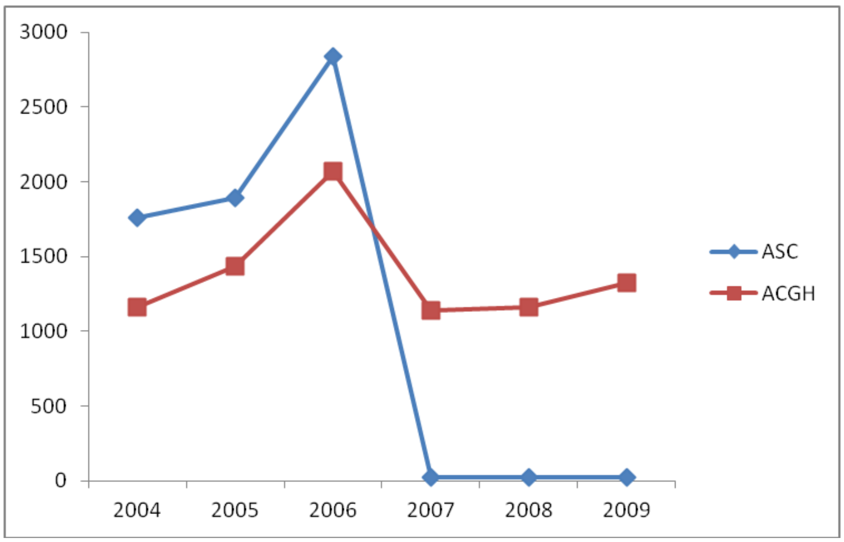


Table 83: Annual Wisconsin Totals for Laparoscopic Appendectomy Procedures Performed in ASCs and ACGHs, 2004-2009

Year Facility Type	2004	2005	2006	2007	2008	2009
ASC	25	21	24	17	16	17
ACGH	1183	1470	871	1855	2045	2598
Total	1208	1491	895	1872	2061	2615
ASC as a percent of total	2.1%	1.4%	2.7%	0.9%	0.8%	0.7%

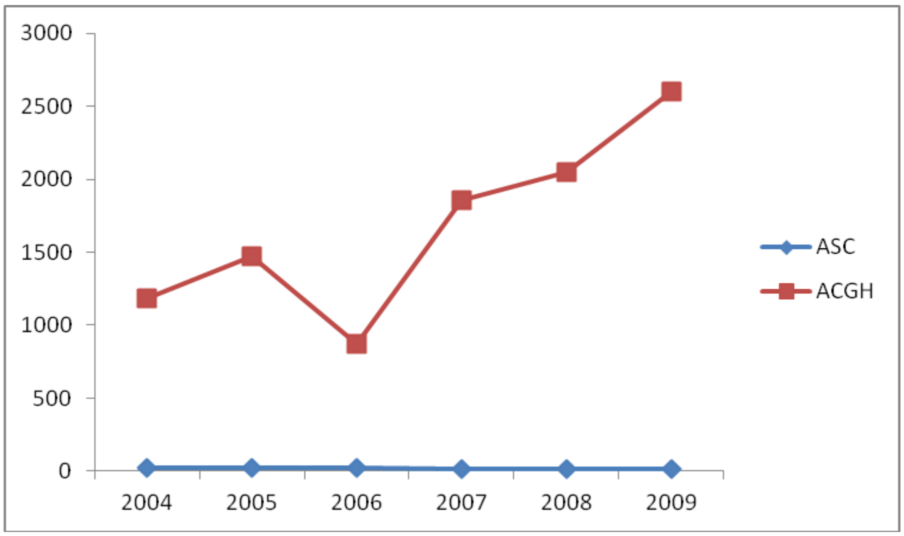
Data Source: Intellimed, Inc.

Table 84: Annual Percent Change for Wisconsin Laparoscopic Appendectomy, 2004-2009 (State-level Data)

Facility Type	% change 04-05	% change 05-06	% change 06-07	% change 07-08	% change 08-09
ASC	-16.0%	14.3%	-29.2%	-5.9%	6.3%
ACGH	24.3%	-40.7%	113.0%	10.2%	27.0%
Percent change in total	23.4%	-40.0%	109.2%	10.1%	26.9%

Data Source: Intellimed, Inc.

Figure 16: Line Chart of Annual Wisconsin Totals for Laparoscopic Appendectomy Procedures Performed in ASCs and ACGHs, 2004-2009



Tables 85 to 88 show the effect of the 2006 CMS announcement placing laparoscopic cholecystectomy procedures on the list of procedures being considered for exclusion from the ASC facility fee. Table 85 shows that Florida ASCs performed 5,799 laparoscopic cholecystectomies in 2006. By 2007, the number of procedures had fallen to 709. Florida ASCs dropped from 23% of the total of number of procedures performed by ASCs and ACGHs in 2006 to 3.6% in 2007. After CMS announced in 2007 that laparoscopic cholecystectomies would remained a covered ASCs procedure, ASCs volume recovered only slightly as seen in the percentage of ASCs rising to 5.5% in Table 85. Table 86 also shows these shifts in volume. As shown in Table 86, between 2006 and 2007, the number of laparoscopic cholecystectomies

performed by Florida ASCs dropped 87.8%. The following year, between 2007 and 2008, Florida ASCs witnessed an increase of 57.5% in laparoscopic cholecystectomy volume. (*See Figure 17*: Line Chart of Annual Florida Totals for Laparoscopic Cholecystectomy Procedures Performed in ASCs and ACGHs, 2004-2009.)

Table 87 shows that laparoscopic cholecystectomy volumes remained steady in Wisconsin ASCs. While the number of procedures performed by ASCs declined slightly from 12.3% to 10.1% as a percentage of total procedures performed in ASCs and ACGHs, the number of procedures performed remained around 900 annually. Table 88 indicates that the number of laparoscopic cholecystectomy performed in Wisconsin ASCs declined slightly more than 4% between 2006 and 2007, and 4.5% between 2007 and 2008. Between 2008 and 2009, the trend had turned positive again. Between 2006 and 2009, ACGHs experienced upward trends in laparoscopic cholecystectomy volumes (*See Figure 18*: Line Chart of Annual Wisconsin Totals for Laparoscopic Cholecystectomy Procedures Performed in ASCs and ACGHs, 2004-2009.)

Table 85: Annual Florida Totals for Laparoscopic Cholecystectomy Procedures Performed in ASCs and ACGHs, 2004-2009

Year Facility Type	2004	2005	2006	2007	2008	2009
ASC	4094	4682	5799	709	1117	1135
ACGH	12825	17729	19356	18771	19370	19859
Total	16919	22411	25155	19480	20487	20994
ASC as a percent of total	24.2%	20.9%	23.1%	3.6%	5.5%	5.4%

Data Source: Intellimed, Inc.

Table 86: Annual Percent Change for Florida Laparoscopic Cholecystectomy, 2004-2009 (State-Level Data)

Facility Type	% change 04-05	% change 05-06	% change 06-07	% change 07-08	% change 08-09
ASC	14.4%	23.9%	-87.8%	57.5%	1.6%
ACGH	38.2%	9.2%	-3.0%	3.2%	2.5%
Percent change in total	32.5%	12.2%	-22.6%	5.2%	2.5%

Data Source: Intellimed, Inc.

Figure 17: Line Chart of Annual Florida Totals for Laparoscopic Cholecystectomy Procedures Performed in ASCs and ACGHs, 2004-2009

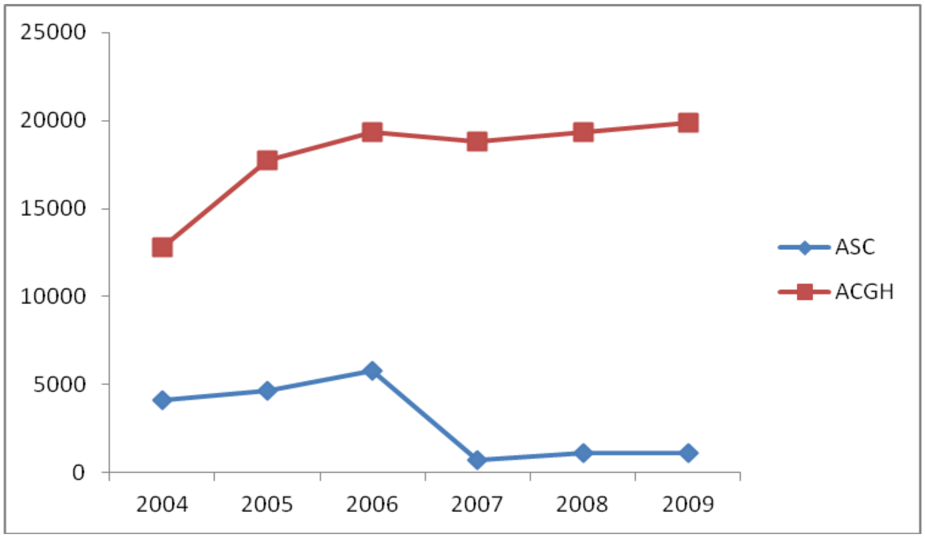


Table 87: Annual Wisconsin Totals for Laparoscopic Cholecystectomy Procedures Performed in ASCs and ACGHs, 2004-2009

Year Facility Type	2004	2005	2006	2007	2008	2009
ASC	892	839	943	904	863	968
ACGH	7094	7222	6703	8027	8528	9282
Total	7986	8061	7646	8931	9391	10250
ASC as a percent of total	11.2%	10.4%	12.3%	10.1%	9.2%	9.4%

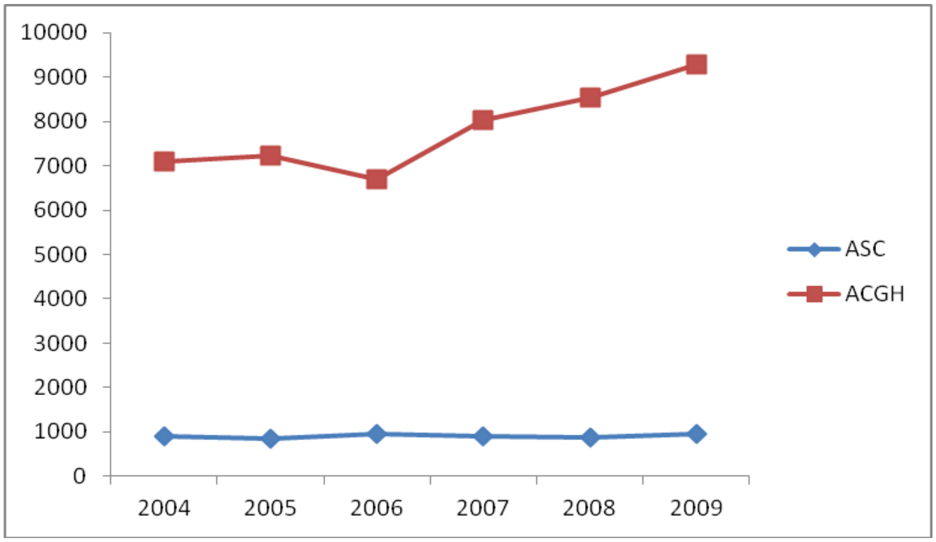
Data Source: Intellimed, Inc.

Table 88: Annual Percent Change for Wisconsin Laparoscopic Cholecystectomy, 2004-2009 (State-Level Data)

Facility Type	% change 04-05	% change 05-06	% change 06-07	% change 07-08	% change 08-09
ASC	-5.9%	12.4%	-4.1%	-4.5%	12.2%
ACGH	1.8%	-7.2%	19.8%	6.2%	8.8%
Percent change in total	0.9%	-5.1%	16.8%	5.2%	9.1%

Data Source: Intellimed, Inc.

Figure 18: Line Chart of Annual Wisconsin Totals for Laparoscopic Cholecystectomy Procedures Performed in ASCs and ACGHs, 2004-2009



<u>Explanatory Factor: Reimbursement Payment Rates</u>

The third factor that may have influenced the behavior of the medical facilities in the sample is the disparity between ASC and hospital outpatient department payment rates for the same services rendered. It is possible that the ACBS procedure trends among ASCs and ACGHs witnessed in multivariate regression analysis Tables 64 to 67, and descriptive analysis Tables 81 to 88, reflect the influence of reimbursement policy decisions. For instance, CMS has identified a positive correlation between payment rate and volume, and the policy making organization aims to influence surgical volumes and surgical settings through its reimbursement decisions.

CMS writes:

> In our analyses of the effects of the new payment rates, we found that the ASC payment rates for many of the procedures performed most frequently in ASCs are equal to or greater than the OPPS rates for the same procedures. Conversely, procedures for which the current ASC payment rates are lower than the OPPS rates for the same procedures tend to be performed less frequently in ASCs (2007a: 627).

Through its revised payment scheme, CMS aims to encourage ASCs to offer a broader scope and greater variety of surgical procedures. CMS also hopes to foster greater efficiency among ASCs. As a result, CMS expects that

> there would be changes in the mix of procedures provided in ASCs under the proposed revised payment system because the revised payment system would encourage ASCs to expand their service mix beyond the handful of the most lucrative procedures which comprise the bulk of ASC utilization under the current Medicare payment system (CMS, 2007a: 627-628).

CMS tinkers with the payment scheme to influence organizational behavior and surgical volumes. In the case that there are procedures with equivalent ASC and HOPD payment rates, CMS will lower the amount paid to ASCs to initiate shifts in ASC surgical provision and encourage increases in outpatient and inpatient hospital volume. CMS writes: "To the extent that ASCs determine that the new rates for specific services or types of procedures are inadequate relative to the costs of those services, we would expect a change in the mix of services the ASC provides" (CMS, 2007a: 628). CMS proposes to lower the payment rates for some high volume procedures in its revised payment system to reduce ASC output and increase the rates for other procedures to generate new high volume procedures under the revised system (CMS, 2007a: 628-629). The following is a partial list of high volume procedures that are performed in ASCs and expected percent changes for procedures performed under the proposed payment scheme. Table 89 shows that CMS expects a slight decrease of 2% in the rate for cataract surgery, but a 30% increase in the rate for carpal tunnel surgery under the proposed payment scheme. These expected rate changes will spur ASC volume shifts.

Table 89: Partial List of Aggregate Payments for Selected High Volume Procedures under the 50/50 Blend

HCPCS Code	**Description**	**Allowed Charges (in millions)**	**CY 2008 Percent Change (50/50 Blend)***
66984	Cataract surg w/iol, 1 stage	$1,062	-2%
43239	Upper gi endoscopy, biopsy	$166	-13%
45378	Diagnostic colonoscopy	$147	-11%
62311	Inject spine l/s (cd)	$78	-12%
64721	Carpal tunnel surgery	$17	30%

Source: CMS Proposed Rule (2007).CMS-1506-P; CMS-4125-P, pgs. 626 - 627.
*The percent change is calculated based on comparison between the 2007 and proposed 2008 payment rates. The percent change figure incorporates "a 50/50 blend of the ASC payment under the current system and the ASC payment under the revised system" (CMS, 2007: 626).

CMS recognizes that payment revisions may negatively impact the revenue potential of some ASCs. The policy making body writes:

> an ASC may earn less from providing a service that has been its highest volume (and best paid) procedure under the current system because the payment rate for that procedure is lower under the revised payment system, that ASC may more than offset the reduction in revenues by beginning to perform other services for which the proposed rates under the revised system are significantly higher (CMS, 2007a: 629).

In 2004, for example, the Medicare fee-for-service payment rate for laparoscopic appendectomy procedures performed in HOPDs was $1,788.09. Six years later, in 2009, the payment rate had risen 71% to $3,060.10. CMS had increased the payment rate for laparoscopic cholecystectomies from $2,226.44 in 2004 to $3,060.10 in 2009, an increase of 37.4% (*See Table 90*: Medicare Fee-For-Service Payment Rates for Laparoscopic Appendectomy and Laparoscopic Cholecystectomy for Hospital Outpatient Prospective Payment System (PPS)). By 2009, the payments for laparoscopic appendectomy and laparoscopic cholecystectomy procedures were equivalent.

Table 90: Medicare Fee-For-Service Payment Rates for Laparoscopic Appendectomy and Laparoscopic Cholecystectomy for Hospital Outpatient Prospective Payment System (PPS)

Year	HCPCS Code	Descriptor	Relative Weight	Payment Rate	Percent change between 2004 and 2009
2004	44970	Laparoscopy, appendectomy	32.7724	$1,788.09	71.1%
2009	44970	Laparoscopy, appendectomy	46.3238	$3,060.10	
2004	47562	Laparoscopic cholecystectomy	40.8064	$2,226.44	37.4%
2009	47562	Laparoscopic cholecystectomy	46.3238	$3,060.10	

During the study period, not only did CMS exclude laparoscopic appendectomy from receiving the ASC facility fee payment, it also increased its hospital OPD payment rate 71%. The exclusion from the ASC facility fee may have ignited changes in ASC volume as entrepreneurial physicians-owners of ASCs sought to offset the decline in revenues by

performing other services with higher payment rates. Simultaneously, the increase in the payment rate for laparoscopic appendectomies performed in HOPD may have encouraged hospitals to acquire ASCs and convert them into HOPDs. The Ambulatory Surgery Center Association writes: "Even if an ASC is not physically located next to a hospital, once it is part of a hospital, it can terminate its ASC license and become a unit of the hospital" (source: http://www.ascassociation.org/AdvancingSurgicalCare/ASCPolicyFocus/ASCtoHOPD).

Based on the above Medicare payment rates, it would seem that Florida would have performed more ambulatory laparoscopic appendectomies than Wisconsin. What might account for the opposite state trends in ambulatory laparoscopic bariatric surgery and cholecystectomy compared to ambulatory laparoscopic appendectomy, as shown in Tables 65 to 67? CMS payment rates implemented in 2008 may have influenced Florida ASCs specializing in ACBS differently than Wisconsin ASCs. In 2006, CMS ASC reimbursements were not tied to the payment rates of hospital outpatient departments. Medicare payments to ASCs fluctuated depending on the procedure, but they averaged about 69 percent of what was paid to hospitals for outpatient services (O'Connor, 2006). The ASC Association and other ASC industry special interest groups lobbied Medicare in an effort to improve the financial viability of ASCs. They had hoped that Medicare would revise its payment policy and pay ASCs 75 percent of the hospital outpatient fee. In 2008, CMS finalized an ASC payment rate of about 65 percent of the rate paid to hospital outpatient departments for the same surgical procedures in its Revised Ambulatory Surgical Center (ASC) Payment System (source: http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/ASCPayment/downloads/ASC_QAs_03072008.pdf.). MedPAC explains the reason for

the lack of equity between the payment rates for ASCs and hospital outpatient departments as follows:

> It is appropriate to pay OPDs more than ASCs because OPDs treat patients who are more medically complex on average than ASCs, and OPDs on the same campus as the main hospital are able to offer emergency services and access to onsite specialists if complications arise during a procedure (Medicare Payment Advisory Commission 2003, Medicare Payment Advisory Commission 2004, Wynn et al. 2011). . . . There are likely additional costs associated with treating sicker patients and maintaining emergency standby capacity. By contrast, ASCs treat healthier patients on average and do not maintain the same capacity as hospitals to treat emergencies. These factors, in addition to the specialized staffing and customized surgical environments of ASCs, probably contribute to the shorter time and lower cost of ASC procedures relative to OPD services (MedPAC, 2012).

Research suggests that medical facilities with higher exposure to the effects of CMS reimbursement changes (e.g., a higher share of Medicare patients) respond differently to OPPS-induced fee changes than medical facilities with less exposure (He & Mellor, 2012). While testing the effects of the OPPS on medical facilities is beyond the scope of this paper, one wonders in particular what might account for different state trends in ambulatory laparoscopic cholecystectomy and appendectomy in Tables 66 and 67, respectively? Both cholecystectomy and appendectomy were on the proposed list in 2006/2007, but only laparoscopic appendectomy was excluded in 2008. A look at Tables 26 and 28 may shed some light on the influences that contributed to these shifts. In 2004, 11 percent of the facilities in Wisconsin performing laparoscopic ACBS were ASCs. The 917 ASCs performed 61 laparoscopic procedures annually. Wisconsin's 116 ACGHs that performed laparoscopic ACBS comprised 89% of the facilities delivering these procedures in the state and performed, on average, 18,629 surgeries. In 2009, 18 ASCs performed 1,000 laparoscopic ACBS procedures and made up 13% of the facilities performing these surgeries in Wisconsin. On average, ASCs conducted 56 surgeries per facility in 2009. Table 26 reveals that the same year, 116 ACGHs performed 24,410 laparoscopic procedures, averaging 210 annually. Florida had a higher percentage of ASCs conducting

laparoscopic ACBS in 2004, compared to Wisconsin. Findings indicate that ASCs comprised 57% of the facilities administering laparoscopic ACBS in Florida. In 2004, the 249 ASCs performed 5,847 laparoscopic surgeries, with the annual average of 23 procedures. By 2009, ASCs comprised 20% of the facilities performing laparoscopic ACBS procedures. They administered 1,327 laparoscopic surgeries annually and averaged 28 annually. Over the study period, Florida ACGHs that performed laparoscopic ACBS rose from 43% to 80% of the total facilities performing laparoscopic ACBS. Results in Table 28 show that the number of laparoscopic procedures delivered increased from 50,315 to 75,702 surgeries, while the annual facility average jumped from 271 to 392.

Tables 43 and 44 affords a closer look at the two states and shows that Wisconsin ASCs experienced a 12% decline in laparoscopic cholecystectomy (Table 43), while Florida ASCs witnessed a 68% drop in the procedures (Table 44). At the same time, Wisconsin ACGHs saw laparoscopic cholecystectomy rise 19%, while Florida ACGHs experienced a 60% jump. Also in terms of ambulatory cholecystectomy, Wisconsin ASCs experienced a 12% reduction in ambulatory cholecystectomy, while Florida ASCs administered 70% fewer procedures. The number of ambulatory cholecystectomies rose 45% in Wisconsin ACGHs, and 70% in Florida ACGHs. Inpatient cholecystectomies also jumped 26% in Florida, while Wisconsin experienced a slight fall of 6% in the number of inpatient cholecystectomies performed.

Wisconsin and Florida ASCs experienced sharper declines in laparoscopic appendectomy than laparoscopic cholecystectomy. Table 46 shows a 50% drop in the number of laparoscopic appendectomies in Wisconsin, and Table 47 shows a 99% plunge in Florida. Yet, while the number of laparoscopic appendectomies was declining in ASCs in both states, they were rising in ACGHs: Wisconsin ACGHs witnessed a 168% jump, and Florida ACGHs a 122% rise. Table

46 also shows that Wisconsin ASCs saw a 50% decline in ambulatory appendectomy procedures, while Wisconsin ACGHs witnessed a 331% surge. Table 47 shows that Florida ASCs also experienced a dramatic decline of almost 100% in ambulatory appendectomy, while Florida ACGHs witnessed a 54% increase in ambulatory appendectomies. In Florida, it appears that a portion of laparoscopic appendectomies shifted to inpatient settings as reflected in the 16% increase in Table 47.

Results in Tables 55 and 58 show similar downward trends in the provision of laparoscopic and ambulatory cholecystectomies and appendectomies among ASCs. While Table 55 suggests no statistical difference between the trends in laparoscopic and ambulatory cholecystectomy performed in ASCs, Table 58 shows the downward trends in Florida are statistically different from Wisconsin in the provision of laparoscopic and ambulatory appendectomy. ACGH clearly benefitted from the losses experienced by ASCs. Findings in Tables 56 and 59 show upward trends in laparoscopic and ambulatory cholecystectomy and appendectomy in both Florida and Wisconsin performed in ACGHs. What might account for the significant differences between ASCs and ACGHs in the provision of laparoscopic and ambulatory cholecystectomy and appendectomy across all models in Tables 66 and 67? Why does Florida differ significantly from Wisconsin across all models in Tables 66 and 67?

The percentage of for-profit to non-profit ACGHs may shed some light on state differences in the provision of appendectomy procedures. As shown in Table 36, 4.2% of Wisconsin's ACGHs were for-profit and 95.8% non-profit, while Florida had 43% of it ACGHs classified as for-profit and 57% non-profit. It is possible that Wisconsin ASCs were more integrated into hospital systems than those in Florida (Luke et al., 2004; National Research Council, 2001), which made Florida ASCs and ACGHs more responsive to regulatory changes.

It is possible that with the Medicare rate increases and CMS coverage decisions, Florida ACGHs began viewing laparoscopic appendectomies as more profitable and began acquiring ASCs with this specialization.

Hypotheses C and D: Surgical Settings and Technology Shifts within ACGHs

The following section focuses on results from Tables 68 to 75. Tables 68 to 71 test *Hypothesis C*, which expects a larger percent increase in ambulatory ACBS than inpatient settings within ACGHs. Tables 72 to 75 assess *Hypothesis D*, which assumes that laparoscopic ACBS would experience a larger percent increase than open ACBS within hospitals. The analyses use a dataset comprised of only ACGHs in an effort to identify significant associations within hospitals. While almost all of the findings analyzing surgical settings and technology shifts are statistically insignificant, the results do point to interesting shifts within ACGHs.

In general, across all models from Tables 68 to 71 findings show that the percent change in all inpatient ACBS within ACGHs did not differ significantly from the percent change in ambulatory ACBS, except in one case. Model 1 in Table 71 had the only significant finding comparing inpatient and ambulatory shifts. Results found that for every additional unit of percent change in the number of inpatient appendectomy, ambulatory appendectomy declined 148.5% ($p = .029$). After controlling for facility and demographic variables, this finding lost significance. Nevertheless, these insignificant findings may also signify shifts that occurred in response to CMSs announcement and exclusion of laparoscopic appendectomy from the ASC payment list. Given the growing disparity in ASCs and HOPD payment rates, discussed in the prior section, it appears that increasing number of laparoscopic appendectomy procedures once performed in ASCs shifted to ACGHs. Consequently, significantly larger percent increases in ambulatory and laparoscopic appendectomy procedures should be evident in findings. Tables 71 and 75,

however, reveal different findings. In Table 71, Models 2 to 5, the relation between percent changes in inpatient and ambulatory appendectomy are statistically insignificant. Also the association between the percent changes in open and laparoscopic, in Table 75, also lack statistical significance. These findings may imply that once laparoscopic appendectomy procedures once performed in ASCs shifted to ACGHs, hospitals did not channeling patients to hospital outpatient departments for laparoscopic appendectomies. Instead, hospitals dispersed these patients to inpatient and outpatient departments for open as well as laparoscopic appendectomies. Inpatient and open procedures command higher reimbursement rates and are more profitable surgical settings and procedures for the hospitals.

In summary, the findings for *Hypotheses A*, *C*, and *D* were not statistically significant. Hypothesis B was statistically significant, but the findings were contrary to what was expected. In other words, for *Hypothesis A*, the percent change in laparoscopic ACBS was not significantly larger than the percent change in open ACBS. For *Hypothesis C*, the percent change in ambulatory ACBS within ACGHs was not significantly larger than the percent change in inpatient ACBS. And for Hypothesis D, the percent change in laparoscopic ACBS within ACGHs was not significantly larger than the percent change in open ACBS. For *Hypothesis B*, the percent change experienced by ASCs was not significantly larger than that of ACGHs. For all four hypotheses, the null hypothesis could not be rejected. (*See Table 79*: Summary Table of Hypothesis Tests.)

Table 91: Summary Table of Hypothesis Tests

Hypothesis	Determinant	Supported?		
		Technology Shift (Larger Percent Increase in Laparoscopic ACBS)	Facility Shift (Larger Percent Increase in Ambulatory Laparoscopic ACBS in ASCs)	Setting Shift (Larger Percent Increase in Ambulatory ACBS)
A	Percent Change Open ACBS	**No**		
B	Percent Change in ACGHs		**No**	
C	Percent Change Inpatient ACBS within ACGHs			**No**
D	Percent Change Open ACBS within ACGHs	**No**		

Implications of Findings

This study analyzes ACBS trends by comparing 2004 and 2009 procedure totals from ACGHs and ASCs located in Florida and Wisconsin. The primarily data are derived from hospital discharge data. The findings from this research failed to support the stated hypotheses. Nevertheless, this work finds that disruptive innovation theory is transferable to the health care sector and serves as an appropriate framework for analyzing the hospital industry. In an environment of rapidly rising health care spending, disruptive innovation theory is heralded for its ability to transform industries, improve product and service quality, reduce prices, and increase access to goods and services (Christensen et al., 2009). The idea of innovative business models matching with innovative technology to transform the hospital industry by capturing large segments of the market from established high cost hospitals is provocative. Yet, this work demonstrates the intervening power of government regulation in the marketplace and its ability to curb the productivity of ASCs and shifting volume to ACGHs (Brown, 1992). As the

government continues to set “payment rates, [make] coverage decisions and [determine] through other public mechanisms the amount of resources going into the health sector” (Nichols et al., 2004), there will be growing doubts about the ability of disruptive innovation to drive the hospital industry towards lower costs, greater efficiency, and improved access to ACBS.

Policy Implications

Public and health policy decision-makers across the country are engaging in debates over how to influence the competitive environment in which hospitals and ASCs operate. Many are torn over whether to regulate or encourage competition (Anderson et al., 1993). Based on the findings in this work, there are limitations on the ability of disruptive innovation theory to transform theory into practice in the health care industry. This work finds that government policies play an integral role in structuring and regulating how and where surgical procedures are performed through coverage decisions, reimbursement rates, and other policies, which generate barriers to disruptive transformations in the hospital industry. Although ASCs with the latest technological advances offer patients less expensive alternatives to hospital outpatient departments, CMS formulates policies that present “growing financial incentives to treat patients in HOPDs rather than in the more economical ASC setting. These incentives [encouraged] hospitals to start acquiring and converting ASCs into HOPDs” (source: http://www.ascassociation.org/AdvancingSurgicalCare/ASCPolicyFocus/ASCtoHOPD). Berwick and colleagues write: “Under current market dynamics and payment incentives, it is entirely rational for hospitals to try to fill beds and expand services” (2008: 761).

This research informs health policy decision-making by evaluating tenets of disruptive innovation as they apply to the health care industry. The work sheds light on the applicability of

disruptive innovation theory in health care, and highlights the degree to which technology, surgical settings, and medical facility shifts occurred in ACBS delivery.

Methodological Implications

Few quantitative studies have focused on disruptive innovation theory in health care. This research has methodologically significance because it takes a quantitative approach to testing disruptive innovation in the hospital industry through an examination of ACBS utilization patterns in ACGHs and ASCs. Until recently, standardized data on ambulatory surgery centers were difficult to access. The ability to analyze shifts between hospitals and ASCs was almost impossible to perform several years ago. The inclusion of ambulatory surgery data in hospital discharge databases, allows for better control of extraneous variables in order to reduce problems of confounding, and also affords greater opportunities to investigate exogenous and endogenous factors that influence technology, surgical settings, and medical facility shifts in the hospital industry (U.S. GAO, 2009).

The methodological implications of this work are significant given that most disruptive innovation research is descriptive nature. This work further demonstrates the values of data-driven quantitative approaches to testing the application of theories and understanding better broad industry trends. Quantitative findings offer strong support for corroborating or refuting theoretical claims, particularly when theories and frameworks have been generated from outside of a field.

Theoretical Implications

The findings of this research calls to mind the three core tenets of population ecology theory highlighted in Chapter 3: structural inertia, liability of smallness, and niche width

dynamics. These tenets resonate with disruptive innovation theory and provide a lens for interpreting findings. First is structural inertia. Although proving the presents of structural inertia is beyond the scope of this paper, findings seem to suggest the presence of structural inertia among some ACGHs prior to 2006 in ACBS provision. In the competitive hospital environment, forces from outside the hospital industry played a significant role in altering the dynamics between ASCs and ACGHs. The work demonstrates the different ways in which the medical facilities responded to these forces (Porter, 1980). Structural inertia may have initially limited ACBS output in ACGHs, creating opportunities for the emergence of ASCs, which may in part explain the increased diversity of organizational forms (Blau & Scott, 1962; Hannan & Freeman, 1977). The 2006 and 2007 regulatory interventions seem to eliminate some of the downward pressures on ACBS output in ACGHs, facilitating organizational change in the hospital industry (Christensen et al., 2009). After 2006, laparoscopic appendectomy, cholecystectomy, and bariatric surgery volumes in ACGHs took an even greater upward trajectory.

The second tenet of population ecology is the *liability of smallness*. Both disruptive innovation theory and organizational ecology are concerned with the influence of environmental factors on organizations of different sizes. Both hold that organizational size affects failure rates (Baum & Shipilov, 2004; Christensen et al., 2009). Disruptive innovation theory highlights flexibility, agility, and low overhead as attributes of small innovative firms; while population ecology, on the other hand, emphasizes their limitations: the inability to raise capital, meet expenses, and comply with government regulations (Baum & Shipilov, 2004; Christensen et al., 2009). Disruptive innovation theory contends that larger organizations are more likely to fail due to inertial pressures, while population ecology assumes larger organizations are less likely to fail because of their ability to generate resources, build steady reliable relationship, have establish

track records and legitimacy (Hannan & Freeman, 1984; Baum & Shipilov, 2004). The determination of whether an ASCs or ACGH actually fail or not during the study period is beyond the scope of this work. Nevertheless, findings indicate that some medical facilities that performed appendectomy, cholecystectomy or bariatric surgery procedures in 2004 did not perform one or more of these types of surgeries in 2009. It can be assumed, therefore, that government intervention may have contributed to a change in the mix of surgical procedures offered, or the closure or acquisition of some ASCs by ACGHs. Since this work focuses on service line competition, the failure of ACGHs (Christensen et al., 2009) is unlikely given the broad array of services they provide. Nevertheless, this work highlights the market share that ASCs had gained in ACBS provision between 2004 and 2006, and the impact that ASCs collectively can have in the hospital industry. Government interventions, essentially, alter the dynamics of the hospital industry. With government intervention, ACGHs were in fact able to reduce their chances of failure, and maintain their dominance of ACBS service provision (Baum & Shipilov, 2004).

The third tenet is niche width theory. Disruptive innovation theory and population ecology theory both highlight differential survival patterns between generalist and specialist organizations. Hannan and Freeman (1977, 1983, 1988) explain that the strategic focus of organizations determined whether or not they are classified as specialist and generalist, which are features of niche width theory. Disruptive innovation theory contends that large size can be a liability for generalist firms that are well-organized because they may be unable to respond quickly enough to market shifts. Smaller, more agile and specialized business models, such as ASCs, may be better able to capitalize on new technologies by quickly entering the marketplace

and capture market share from larger firms, such as ACGHs (Christensen et al., 2009; Burns et al., 2011).

According to niche width theory, there are a set of environmental conditions that influences the likelihood of organizational survival based on the strategic focus or niche position of organizations. ACGHs have organizational structures based on generalist strategies, which aim for mass appeal. These generalist firms are able to tolerate more varied environments because they have the capacity to withstand a variety of environmental conditions (Baum & Shipilov, 2004). In essence, ACGHs accept "a lower level of exploitation in return for greater security" (Hannan & Freeman, 1977: 948). Conversely, ASCs, known for their specialization, maximize their "exploitation of [a narrower] environment and accepts the risk of having that environment change" (Hannan & Freeman, 1977: 948). Since ASCs possess fewer slack resources than ACGHs and focus on a narrow range of customers, ASCs are most productive in stable, certain environments. ACGHs are more likely to be productive when markets fluctuate (Hannan & Freeman, 1977). However, ASCs with organizational strategies that fit environmental demands are able to "ride out the fluctuations" and "out-compete generalists" (Baum & Shipilov, 2004: 81).

This work is theoretically significant because it places disruptive innovation theory within an organization theory framework to elucidate competitive dynamics in the health care industry. The interdisciplinary work features a business management theory that is contextualized in organizational theory and applied to the health care industry, which also has public policy implications. The research is significant because of its interdisciplinary and multi-level analytical approaches to examining change in the hospital industry. Few studies have investigated medical technology, surgical settings, and medical facilities simultaneously.

Additionally, numerous studies have presented findings on trends in, and the benefits and outcomes of, laparoscopic surgery (Legoretta et al., 1993; Orlando et al., 1993; Steiner et al., 1994; Bennett et al., 1997; Garbutt et al., 1999); but, few have used quantitative methods to analyze laparoscopic procedures and ambulatory surgery in the context of disruptive innovation.

Limitations of Study

This study offers insight into trends in ACBS provision, the association between ASCs and ACGHs in the provision of ambulatory laparoscopic ACBS, and the applicability of disruptive innovation theory in the hospital industry. The study, however, suffers from several limitations. The first limitation relates to the lack of a pure experimental research design. There are challenges to implementing controlled experiments in public and health policy research. While this quasi-experimental study, which used quantitative administrative data, benefits from multiple observations over time and non-equivalent comparison groups, the research design leaves findings open to several threats to internal validity. The natural settings in which medical facilities operate and compete, and in which public and health policies are enacted, also make randomizing to a control group and implementing interventions extremely costly endeavors.

The second limitation relates to the dataset. The research design observes ACBS output in two years, 2004 and 2009, which allows for the comparison of annual totals over time. While the availability of repeated measurements from hospital discharge data for two years makes this panel design appropriate for a system-level analysis of the hospital industry, the internal validity of findings could be strengthened if additional observations were included in the dataset. Annual observations for an extended period of time, such as ten or more years, would prove beneficial in drawing more robust conclusions.

Third, the sample is comprised of medical facilities from two states, which affords limited insight into state and regional differences. The inclusion of more states in the analysis could improve the external validity of the findings. Additionally, the inclusion of a greater variety of medical facilities and different surgical procedures also would enhance the generalizability of results. Fourth, there is a dearth of covariates in the study, particularly related to ASCs. This shortcoming restricts the ability to limit bias, identify associations, and control for confounding factors in multivariate analyses. More detailed information on ASCs was not readily available in the hospital discharge data used for this study.

Fifth, while the quantitative approach to this study is appropriate for identifying significant trends and associations, and testing hypotheses, the research methodology is ill-equipped to capture the complexity of factors that influence technology, surgical settings, and medical facilities shifts in the hospital industry. Combining a qualitative component with the quantitative study has numerous benefits. Qualitative research takes an exploratory stance that makes it ideal for suggesting new hypotheses and emergent—often unanticipated—constructs that can be studied through quantitative methods and hypothesis testing. Qualitative findings inform quantitative research. For example, the research conducted in the Community Tracking Study, where comprehensive site visits to twelve communities were conducted, contributes to understanding better how public policy affects health systems and local health care market (Solomon, 1998). Qualitative research also can contribute to the development and inclusion of more accurate measures, and improve the predictive value of quantitative models.

Suggestions for Future Study

This study's findings and limitations point to several areas for future research. Much remains to be understood regarding the application and impact of disruptive innovation theory in

the health care industry. First, more research is needed to understand disruptive innovation theory and service-line competition. This work yields results contrary to the tenets of disruptive innovation theory. This study reveals that competitive pressures, reimbursement rates and policies, and other environmental factors affect service-lines differently. Service-line competition has emerged as a competitive strategy in the new hospital marketplace. Hospitals are upgrading and developing single specialty inpatient and outpatient services inside existing facilities and in new buildings, (Bazzoli et al., 2006; Berenson et al., 2006). Hospitals also are acquiring and erecting outpatient centers for ambulatory surgery as substitutes for inpatient care. In an effort to "increase their market presence and flow of referral volume, [hospitals and hospital] systems have been extending their outpatient locations across ever-wider geographic areas" (Devers et al., 2003: 459). It is this competitive environment in which hospitals and ASCs operate that CMS has intervened to influence (CMS, 2007a). Future research is needed in the health care industry to identify products and services that function in accordance with and contrary to the tenets of disruptive innovation theory.

This study suggests that trends in ACBS utilization vary by state. More research is needed to tests the tenets of disruptive innovation theory through state comparisons and regional analysis. Such work should allow for greater control of disease prevalence, socio-economic and demographic factors, and market characteristics that vary by region (Martin et al., 2002; Schaeffer & McMurtry, 2005).

This research implies that payer type influences ACBS utilization (Wenneker et al., 1990; Hadley et al., 1991). Boxer and associates (2003) found that insurance type is a predictor of timely access to health care. More specifically, the authors suggest that compared to patients with private insurance, those with Medicaid or no insurance are less likely to access treatment.

Braveman and colleagues (1994) found a significant association between having a ruptured appendix and the type of insurance coverage a patient had. Insurance coverage is related to the number of barriers individuals encounter in accessing medical care and treatment. Future research is needed to examine how payer type influences the applicability of disruptive innovation theory in the hospital industry.

Finally, future research is needed to understand how volume shifts in ASCs affect organizational efficiency and quality in ACBS (Kraus et al., 2005). This research found that while the number of ASCs performing ACBS procedures declined over time, the average number of procedures performed per facility rose for those ASCs continuing to performed ACBS procedures. More research is needed to understand whether or not quality is improving among the remaining ASCs and whether they are benefitting from a focused factory approach to ACBS provision (Casalino et al., 2003; Devers, 2003).

Conclusions

This research explores the impact of disruptive innovation theory through the examination of ACBS utilization and tests its application in the health care industry. The study uses hospital discharge data from 2004 and 2009. ACBS utilization patterns are identified and compared. The primary significant finding reveals a downward trend in the number of ambulatory surgery centers performing ACBS procedures, compared to acute care general hospitals. This finding proved contrary to *Hypothesis B*. The absorption of laparoscopic ACBS volume once performed in ASCs into hospitals contributes to a fundamental problem in the operation of general hospitals, according to Christensen and colleagues. They contend that the "general hospital is not a viable business model" because it is burdened by costs tied to overhead that is a consequence of its mission to diagnose and treat every patient that enters its doors

(Christensen et al., 2009: 420). Christensen et al., argue that a primary reason general hospitals would collapse without cross-subsidies and restraints on competition is because they are weighed down in their attempt to bring solution shops, value-adding process businesses, and facilitated networks under the one roof (Christensen et al., 2009). The inability to efficiently integrate these three business models within the general hospital has prompted Christensen and others to assert that if costs, quality, and access problems are to be seriously addressed in the health care industry then "[h]ospitals need to disrupt themselves . . . , or they must be disrupted by others" (2009: 421).

This work finds that disruptive innovation theory is an effective model for assessing the hospital industry. The theory provides a useful framework for analyzing the interplay between ACGHs and ASCs. While findings did not support the stated hypotheses, government interventions into the competitive hospital marketplace proved one aspect of disruptive innovation theory. Intervening CMS regulation facilitates interaction between ASCs and ACGHs, reducing the number of ASCs and altering the direction of ACBS volume shifts between the medical facilities. Christensen and colleagues place regulations and standards that facilitate organizational changes at the center of the three enabling elements of disruptive innovation (*See Exhibit 3*). Christensen writes that there are "a host of regulatory reforms and new industry standards that facilitate or lubricate interactions among the participants in the new disruptive industry" (Christensen et al., 2009: xx-xxi).

This work suggests, however, that Christensen's conceptualization of disruptive innovation theory as it applies to the hospital industry is too simplistic and fails to capture the complexity of the health care sector. Regulations, such as coverage decisions, and reimbursement schemes, such as the Hospital Outpatient Prospective Payment System (HOPPS),

appear to moderate the disruptive effects of disruptive innovation processes (*See Figure 19*: Revised Conceptual Model of Disruptive Transformation in the Hospital Industry.) Hannan and Freeman (1977) explain: "When . . . regulations are applied to the full range of organizations in broad areas of activity they undoubtedly alter the size distributions of organizations. . . . Besides altering size distributions, such regulations undoubtedly affect the diversity of organizational arrangements in other ways" (Hannan & Freeman, 1977: 945).

Innovative technologies, such as laparoscopy, have increase productivity and efficiency among highly-trained autonomous surgeons; yet, government regulations continue to place downward pressures on surgical reimbursements (Hoballah et al., 2008). Research suggests that while most surgeons are committed to patient care and advances in medicine and research, others place patients at risk by performing unnecessary surgical procedures (Fuchs, 1978; Pauly, 1979; Leape, 1989, 1992; Pham et al., 2004). Write Leape and Berwick:

> This [culture of medicine] is technically audacious and productive; many of today's most powerful drugs and treatments were not available as recently as 2 decades ago. However, these advances created challenges to safety not faced by other hazardous industries that have succeeded far better than medical care in becoming safe, even ultra–safe. The first such challenge is complexity. Modern health care technology is almost certainly more complex than that of other industries (2005: 2387).

The findings in this research suggest caution in the application of disruptive innovation theory to the health care industry. Caution is particularly pertinent when applying disruptive innovation theory to the hospital industry where clinical indications require different surgical treatments for patients with different conditions, where high risk surgical procedures can jeopardize the lives of patients. While reducing the disparity in HOPD and ASC reimbursement rates may lower the cost of providing some surgical procedures, there are legitimate concerns regarding the motives of entrepreneurial-physician owners of ASCs, whose service mix and output may reflect more of their concern for profits than their concern for patients. Disruptive

innovation theory in a health care context should factor into its framework patient safety. In addition to highlighting the regulations and standards that facility change and the interactions in the hospital industry, the model must not undervalue the role of physician influence and autonomy (*See Exhibit 7*: Revised Elements of Disruptive Innovation).

Figure 19: Revised Conceptual Model of Disruptive Transformation in the Hospital Industry

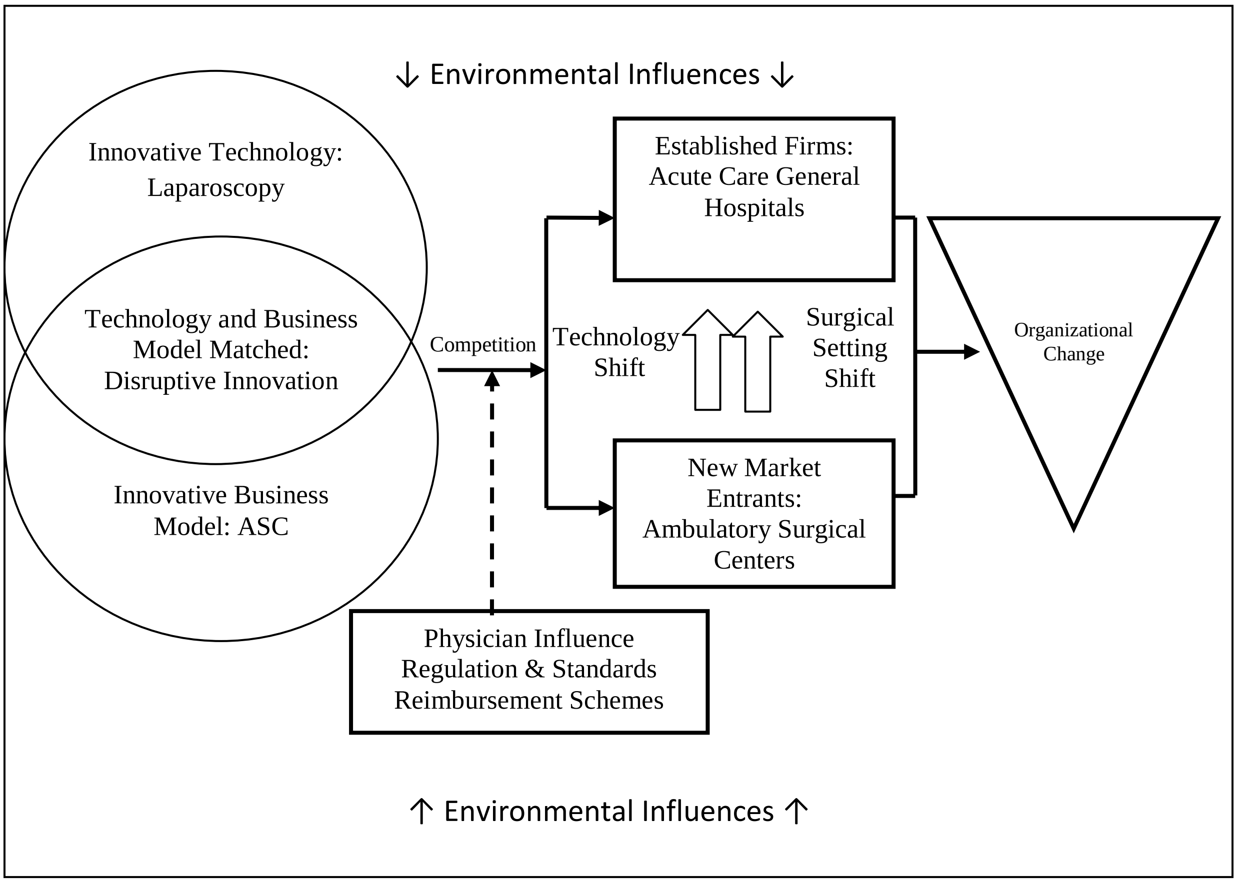
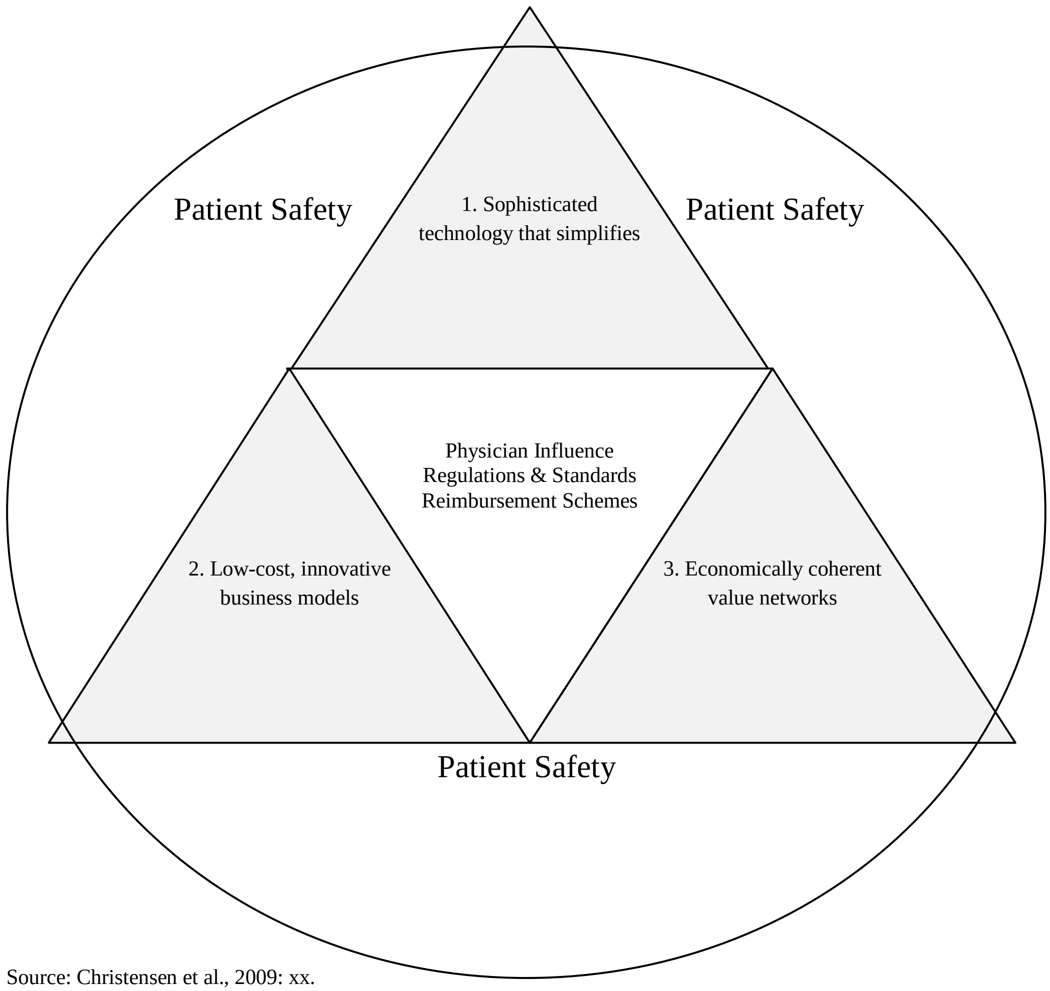


Exhibit 7: Revised Elements of Disruptive Innovation



Source: Christensen et al., 2009: xx.

To my knowledge, this is the first quantitative study to investigate the application of disruptive innovation theory in the hospital industry, through an examination of ambulatory and laparoscopic appendectomy, cholcystectomy, and bariatric surgery performed in ASCs and acute care general hospitals. While further investigations are needed to test the applicability of disruptive innovation in the hospital industry, this study has policy, theoretical, and methodological significance for public policy and administration, health policy and health administration, and business administration, despite its limitations.

APPENDICES

Appendix A: Number of Medicare-Certified Ambulatory Surgery Centers, 2000-2007

Year	2000	2001	2002	2003	2004	2005	2006	2007
Number of centers	3,028	3,371	3,597	3,887	4,136	4,506	4,707	4,964
New centers	295	446	309	365	315	467	261	267
Existing centers	53	103	83	75	66	97	60	10
Net growth from previous year	8.7%	11.3%	6.7%	8.1%	6.4%	8.9%	4.5%	5.5%
Medicare payment (in billions)	$1.4	$1.6	$1.9	$2.2	$2.5	$2.7	$2.9	$2.9
For-profit	94%	94%	95%	95%	96%	96%	96%	96%
Nonprofit	6%	5%	5%	5%	4%	4%	4%	4%
Urban	88%	88%	87%	87%	87%	87%	88%	88%
Rural	12%	12%	13%	13%	13%	13%	12%	12%

Source: Medicare Payment Advisory (MedPAC) Commission. (2008). A data book: Healthcare spending and the Medicare program. Ambulatory surgery in the United States, 2006. National Center for Health Statistics, Centers for Disease Control and Prevention. Available online: http://www.amednews.com/article/20090330/government/303309971/4/.

Appendix B: Measures, Descriptions, and Sources

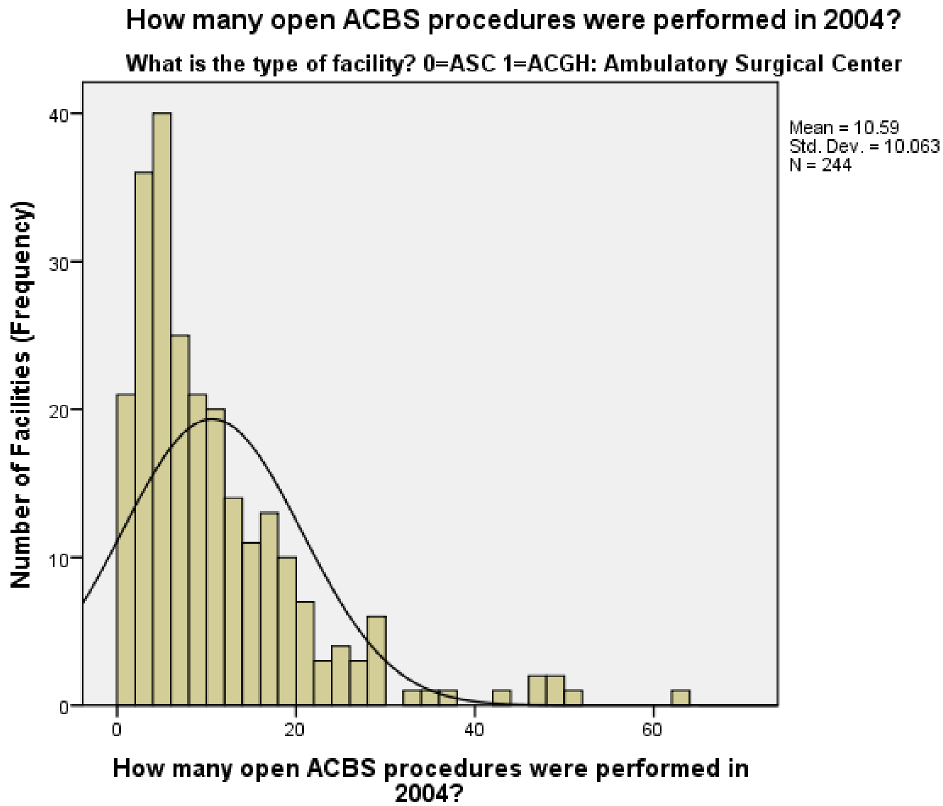
Variable	Description	Source	Level of Measure
	DEPENDENT VARIABLES		
PERCENTCHANGELAPAROSCOPICACBS	(Total 2009 Laparoscopic ACBS Cases – Total 2004 Laparoscopic ACBS)/Total 2004 Laparoscopic ACBS	INTEL	Ratio (Continuous)
PERCENTCHANGEAMBULATORY LAPAROSCOPICACBS	(Total 2009 Ambulatory Surgery Laparoscopic ACBS Cases - Total 2004 Ambulatory Surgery Laparoscopic ACBS Cases)/ Total 2004 Ambulatory Surgery Laparoscopic ACBS Cases	INTEL	Ratio (Continuous)
PERCENTCHANGEAMBULATORYACBS	(Total 2009 Ambulatory Surgery ACBS Cases - Total 2004 Ambulatory Surgery ACBS Cases)/ Total 2004 Ambulatory Surgery ACBS Cases	INTEL	Ratio (Continous)
	INDEPENDENT VARIABLES		
PERCENTCHANGEOPENACBS	(Total 2009 Open ACBS Cases – Total 2004 Open ACBS)/Total 2004 Open ACBS	INTEL	Ratio (Continuous)
PERCENTCHANGEINPATIENTACBS	(Total 2009 Inpatient ACBS Cases - Total 2004 Inpatient ACBS Cases)/ Total 2004 Inpatient ACBS Cases	INTEL	Ratio (Continuous)
FACILITY	Acute Care General Hospital, Ambulatory Surgery Center	INTEL	Nominal
	CONTROL VARIABLES		
FACILITY VARIABLES			
YEAR	Year: 2004, 2009	INTEL	Nominal
STATE	Florida, Wisconsin	INTEL	Nominal
FACILITY	Acute Care General Hospital, Ambulatory Surgery Center	INTEL	Nominal
METRO	Metropolitan, Micropolitan, Undefined	INTEL, U.S. Census	Nominal
LOGBEDSIZE	Number of Operational Hospital Beds	AHA	Ratio
FORPROFIT	For-Profit, Non-Profit, Other	INTEL	Nominal
DEMOGRAPHIC VARIABLE			
POPCHANGE	Percent Change in CBSA Population	US Census	Ratio

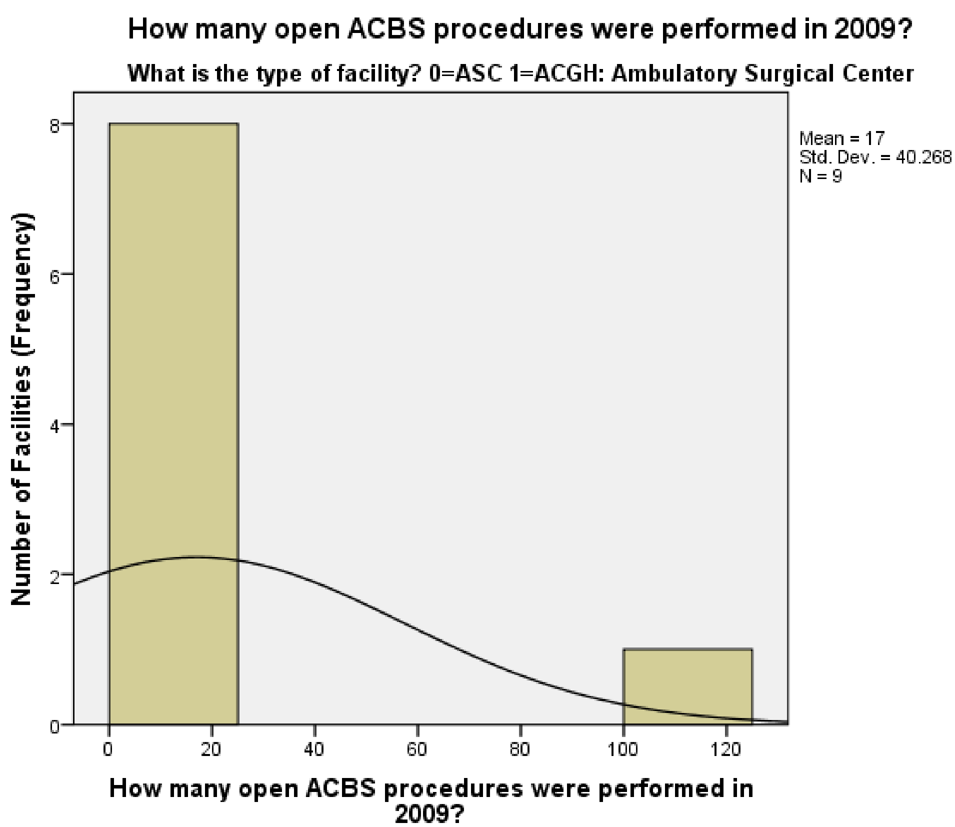
Appendix C: Univariate Analysis for Ambulatory Surgery Centers (Frequency Tables and Bar Charts)

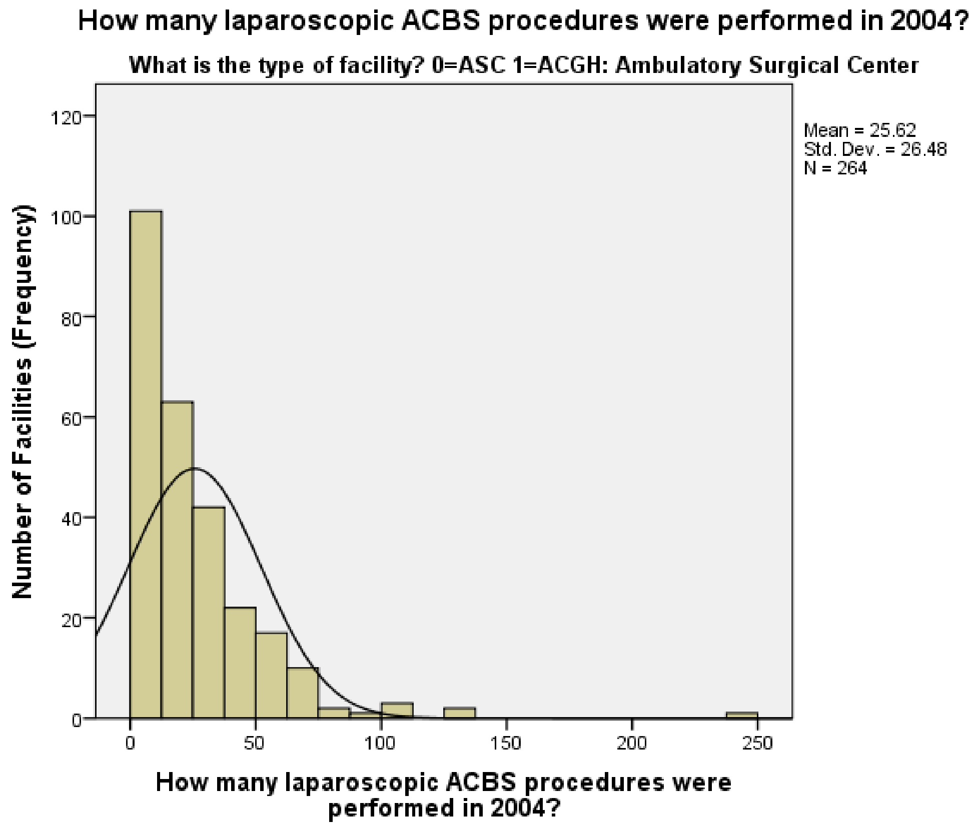
Frequency Table: Ambulatory Surgical Centers - ACBS

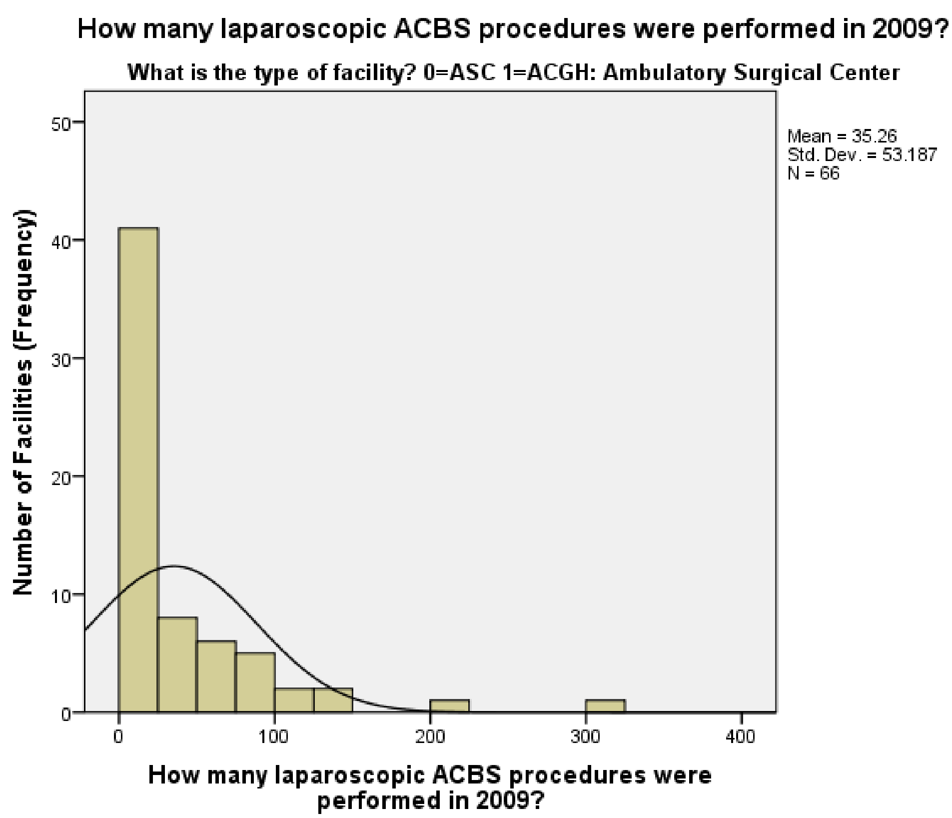
		How many open ACBS procedures were performed in 2004?	How many open ACBS procedures were performed in 2009?	How many laparoscopic ACBS procedures were performed in 2004?	How many laparoscopic ACBS procedures were performed in 2009?	How many inpatient ACBS procedures were performed in 2004?	How many inpatient ACBS procedures were performed in 2009?	How many ambulatory ACBS procedures were performed in 2004?	How many ambulatory ACBS procedures were performed in 2009?
Facilities (N)	Valid	244	9	264	66	0	0	269	68
	Missing	45	280	25	223	289	289	20	221
Mean		10.59	17	25.62	35.26			34.75	36.47
Median		7.5	3	17	12.5			27	12.5
Mode		5	1b	10	1			5	1
Std Dev		10.063	40.268	26.480	53.187			31.772	54.203
Min		1	1	1	1			1	1
Max		62	124	246	308			250	313

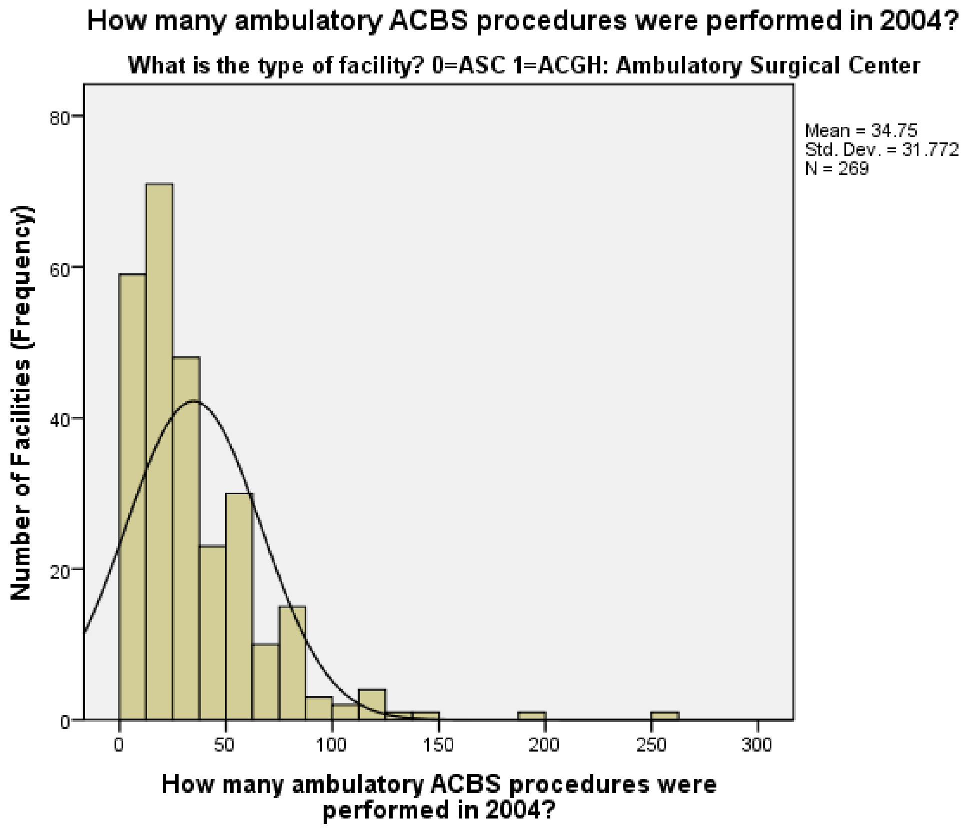
a What is the type of facility? 0=ASC 1=ACGH = Ambulatory Surgery Center
b Multiple modes exist. The smallest value is shown

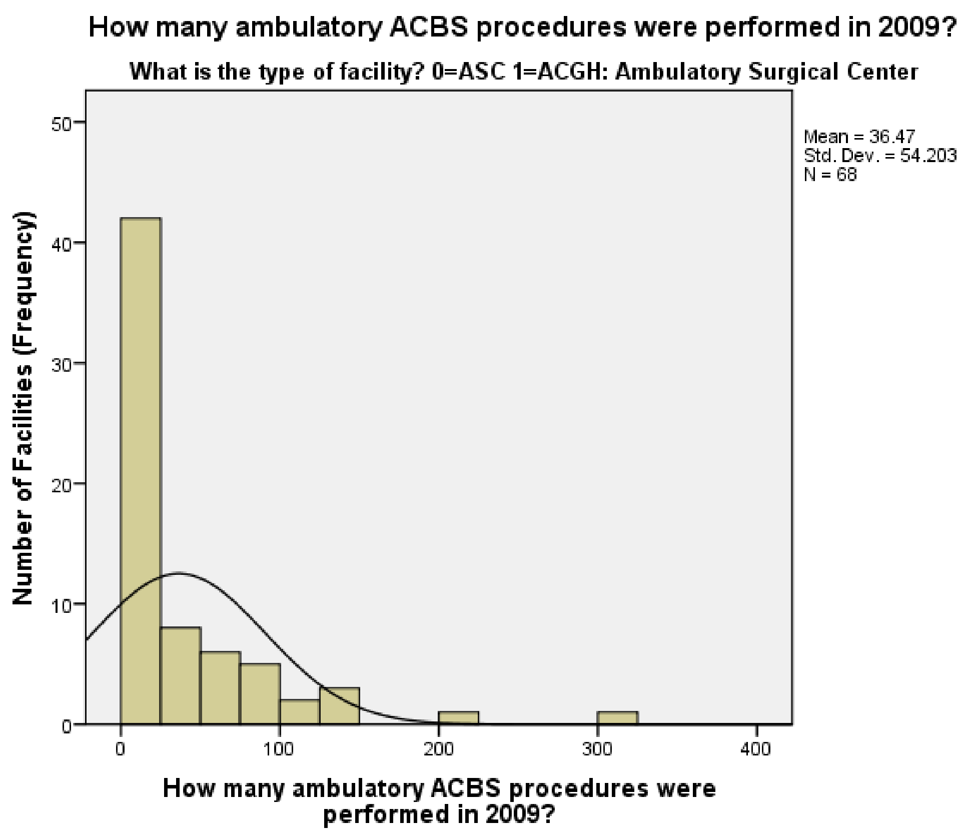

How many open ACBS procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 10.59
Std. Dev. = 10.063
N = 244
Number of Facilities (Frequency)
0
10
20
30
40
0
20
40
60
How many open ACBS procedures were performed in 2004?


How many open ACBS procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 17
Std. Dev. = 40.268
N = 9
Number of Facilities (Frequency)
0
2
4
6
8
0
20
40
60
80
100
120
How many open ACBS procedures were performed in 2009?


How many laparoscopic ACBS procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 25.62
Std. Dev. = 26.48
N = 264
Number of Facilities (Frequency)
0
20
40
60
80
100
120
0
50
100
150
200
250
How many laparoscopic ACBS procedures were performed in 2004?


How many laparoscopic ACBS procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 35.26
Std. Dev. = 53.187
N = 66
Number of Facilities (Frequency)
0
10
20
30
40
50
0
100
200
300
400
How many laparoscopic ACBS procedures were performed in 2009?

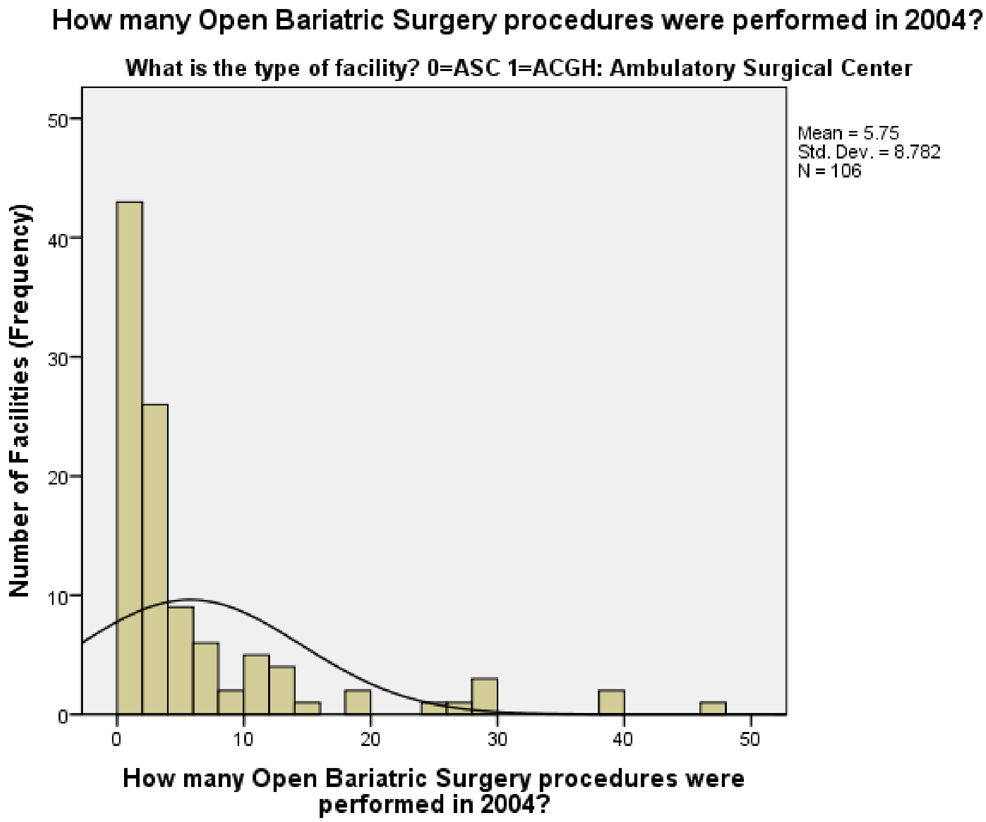

How many ambulatory ACBS procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 34.75
Std. Dev. = 31.772
N = 269
Number of Facilities (Frequency)
0
20
40
60
80
0
50
100
150
200
250
300
How many ambulatory ACBS procedures were performed in 2004?


How many ambulatory ACBS procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 36.47
Std. Dev. = 54.203
N = 68
Number of Facilities (Frequency)
0
10
20
30
40
50
0
100
200
300
400
How many ambulatory ACBS procedures were performed in 2009?

Frequency Table: Ambulatory Surgical Centers - Bariatric Surgery

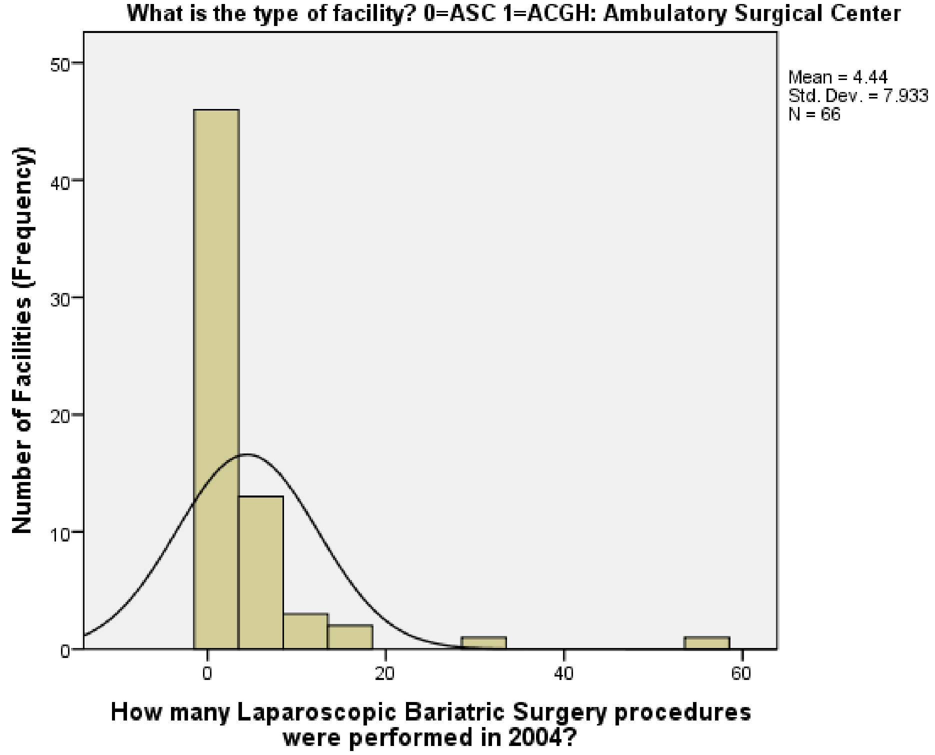
		How many Open Bariatric Surgery procedures were performed in 2004?	How many Open Bariatric Surgery procedures were performed in 2009?	How many Laparoscopic Bariatric Surgery procedures were performed in 2004?	How many Laparoscopic Bariatric Surgery procedures were performed in 2009?	How many Inpatient Bariatric Surgery procedures were performed in 2004?	How many Inpatient Bariatric Surgery procedures were performed in 2009?	How many Ambulatory Bariatric Surgery procedures were performed in 2004?	How many Ambulatory Bariatric Surgery procedures were performed in 2009?
Facilities (N)	Valid	106	0	66	9	0	0	139	9
	Missing	183	289	223	280	289	289	150	280
Mean		5.75		4.44	19.33			6.49	19.33
Median		2		2	9			3	9
Mode		1		1	5			1	5
Std Dev		8.782		7.933	31.177	.	.	9.412	31.177
Min		1		1	1			1	1
Max		47		55	101			56	101

a What is the type of facility? 0=ASC 1=ACGH = Ambulatory Surgery Center


How many Open Bariatric Surgery procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 5.75
Std. Dev. = 8.782
N = 106
Number of Facilities (Frequency)
0
10
20
30
40
50
How many Open Bariatric Surgery procedures were performed in 2004?

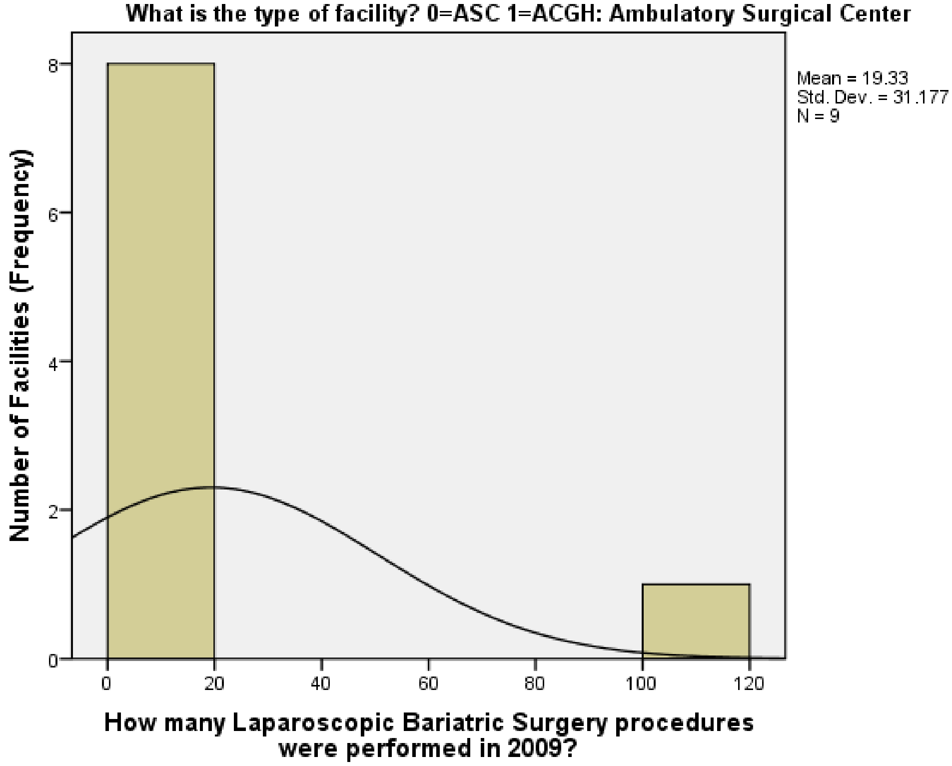
How many Laparoscopic Bariatric Surgery procedures were performed in 2004?

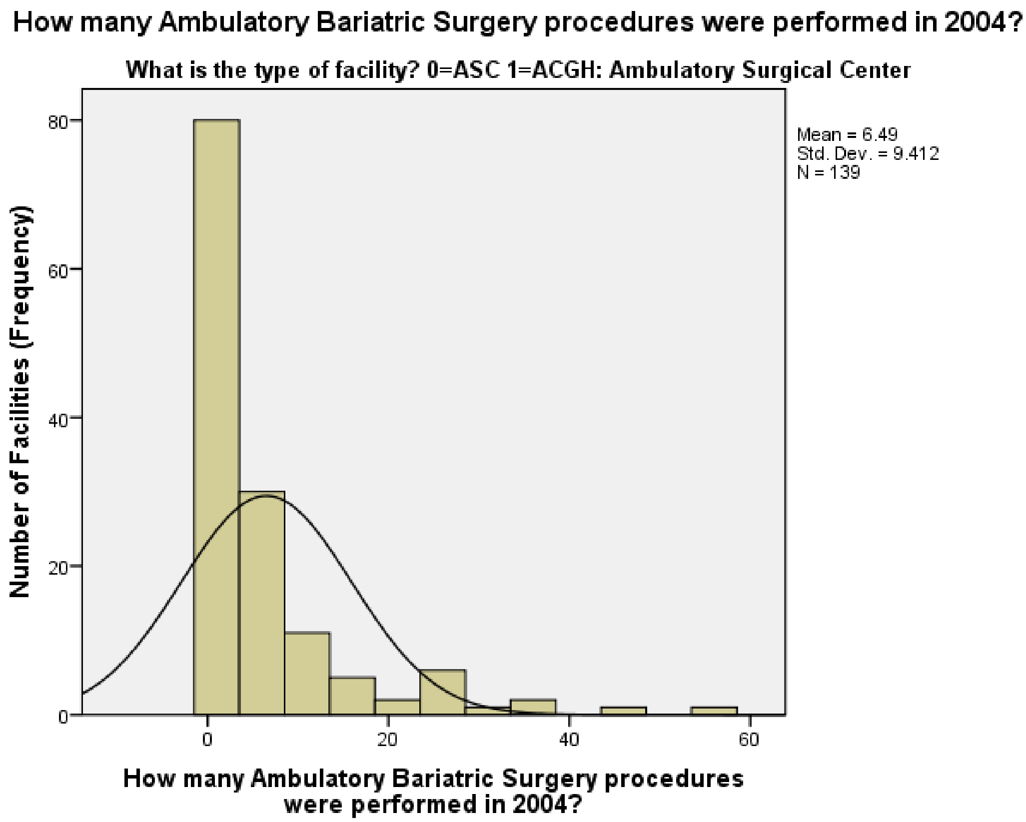
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center

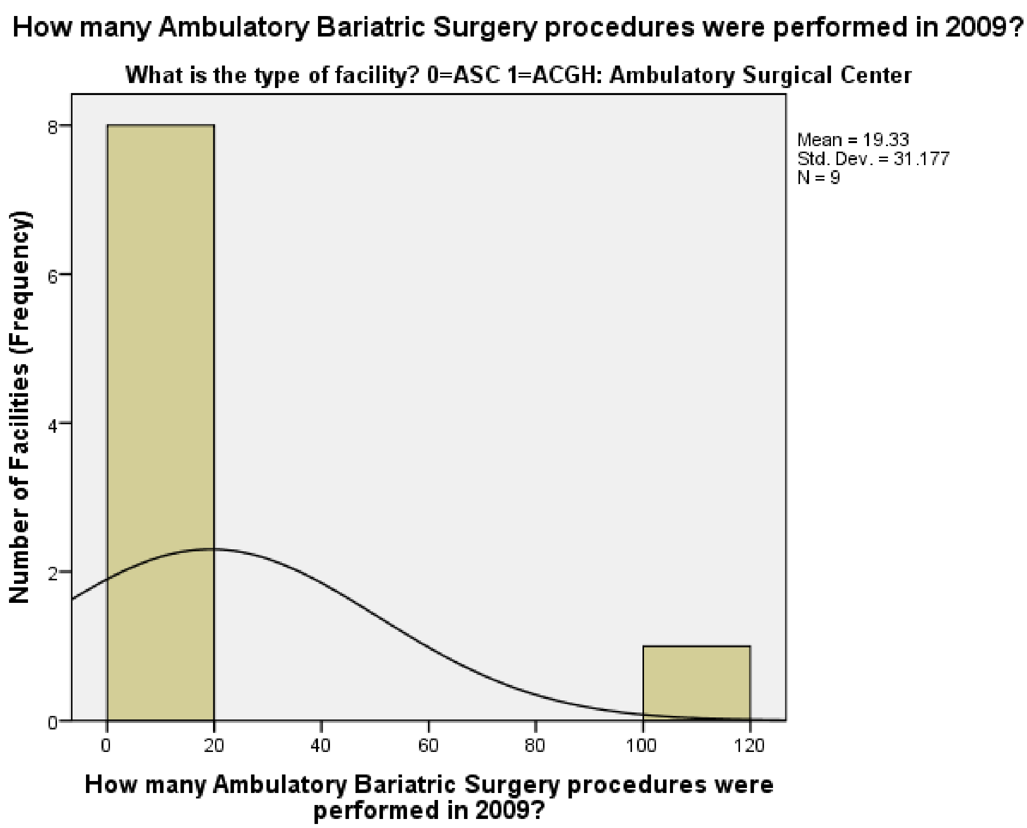


How many Laparoscopic Bariatric Surgery procedures were performed in 2009?

What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center



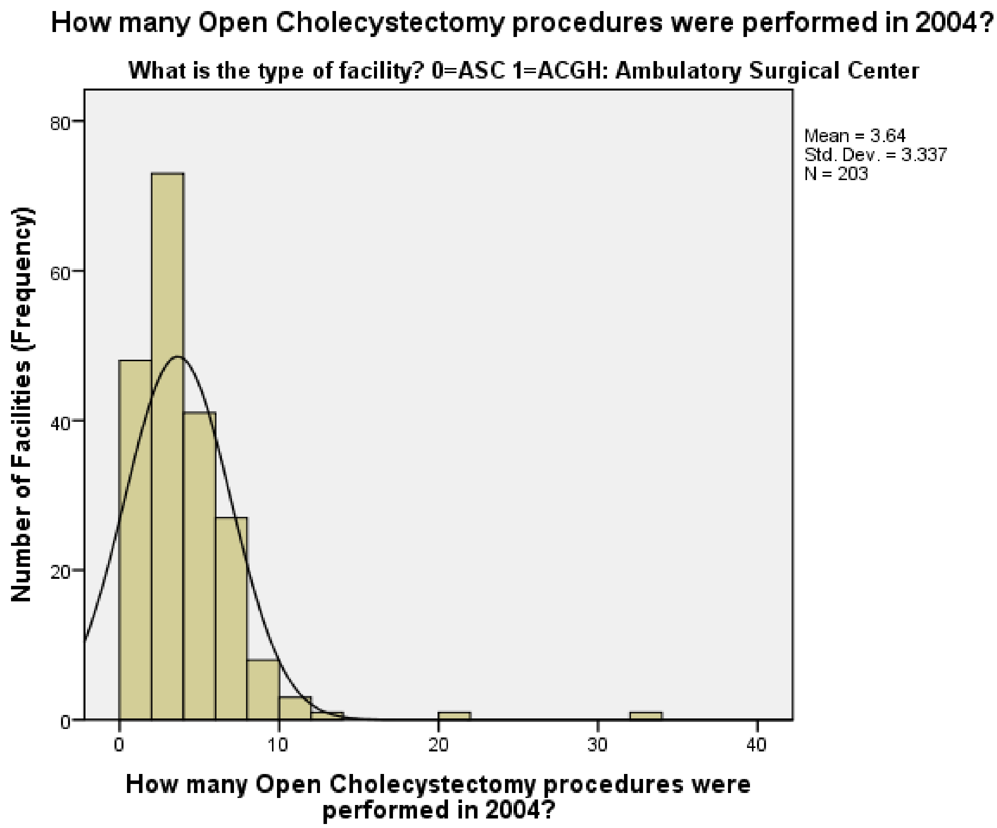

How many Ambulatory Bariatric Surgery procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 6.49
Std. Dev. = 9.412
N = 139
Number of Facilities (Frequency)
0
20
40
60
80
0
20
40
60
How many Ambulatory Bariatric Surgery procedures were performed in 2004?

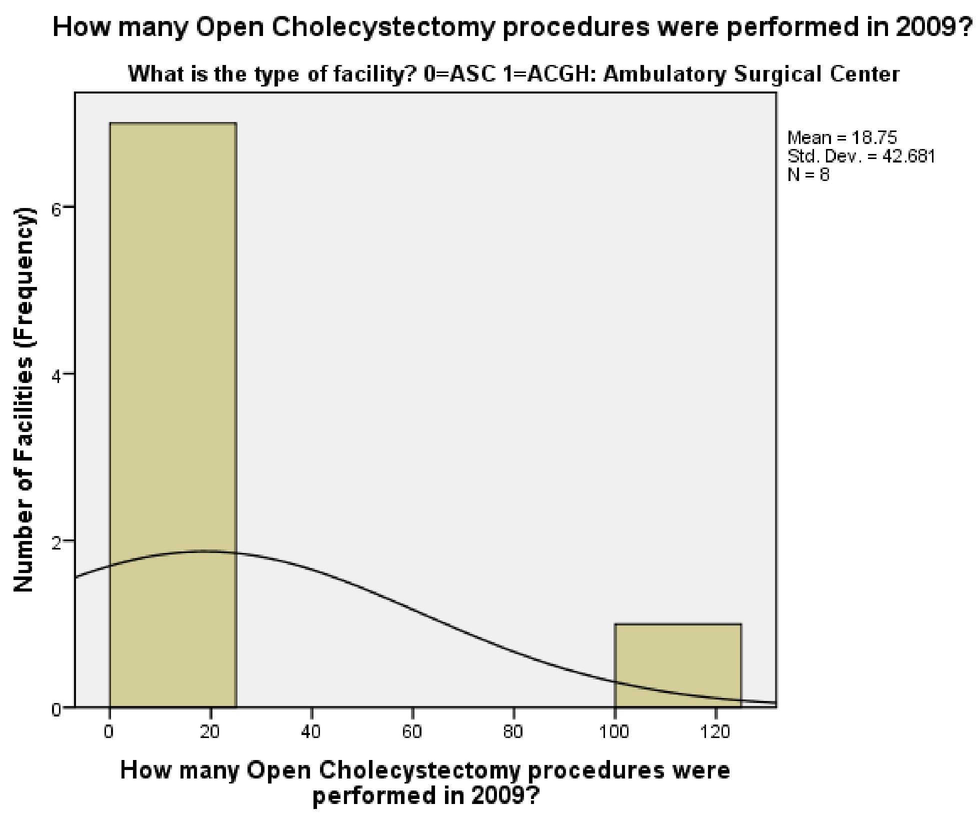

How many Ambulatory Bariatric Surgery procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 19.33
Std. Dev. = 31.177
N = 9
Number of Facilities (Frequency)
0
2
4
6
8
0
20
40
60
80
100
120
How many Ambulatory Bariatric Surgery procedures were performed in 2009?

Frequency Table: Ambulatory Surgical Centers - Cholecystectomy

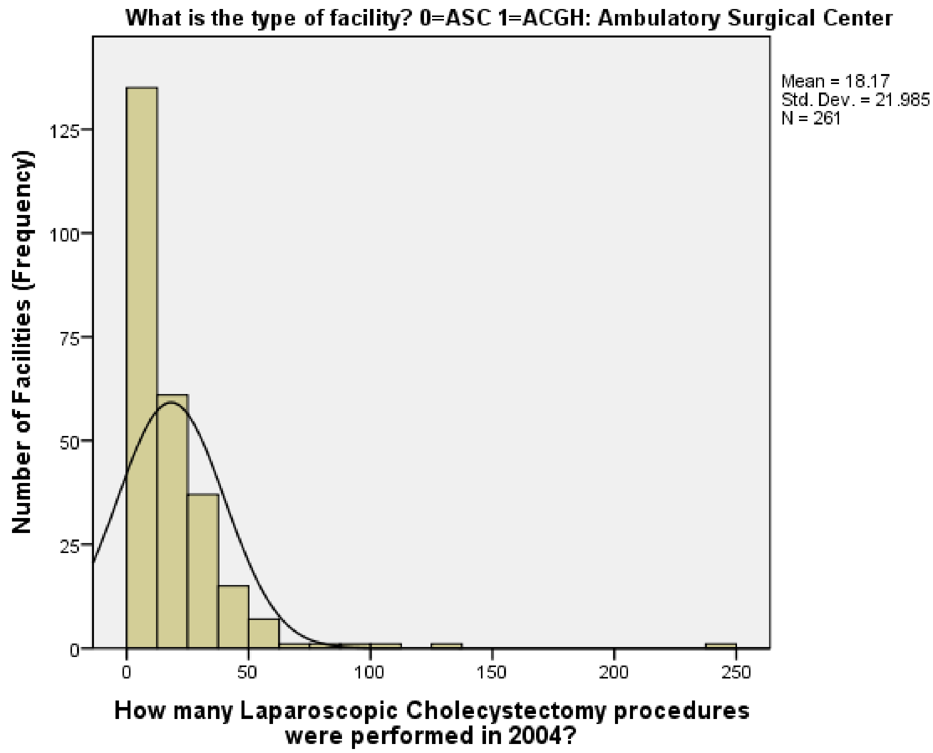
		How many Open Cholecystectomy procedures were performed in 2004?	How many Open Cholecystectomy procedures were performed in 2009?	How many Laparoscopic Cholecystectomy procedures were performed in 2004?	How many Laparoscopic Cholecystectomy procedures were performed in 2009?	How many Inpatient Cholecystectomy procedures were performed in 2004?	How many Inpatient Cholecystectomy procedures were performed in 2009?	How many Ambulatory Cholecystectomy procedures were performed in 2004?	How many Ambulatory Cholecystectomy procedures were performed in 2009?
Facilities (N)	Valid	203	8	261	64	0	0	265	66
	Missing	86	281	28	225	289	289	24	223
Mean		3.64	18.75	18.17	33.08			20.68	34.35
Median		3	2.5	12	12.5			14	12.5
Mode		1b	1b	4b	1			6	1
Std Dev		3.337	42.681	21.985	45.550	.	.	23.327	46.913
Min		1	1	1	1			1	1
Max		32	124	240	205			244	207

a What is the type of facility? 0=ASC 1=ACGH = Ambulatory Surgery Center
b Multiple modes exist. The smallest value is shown

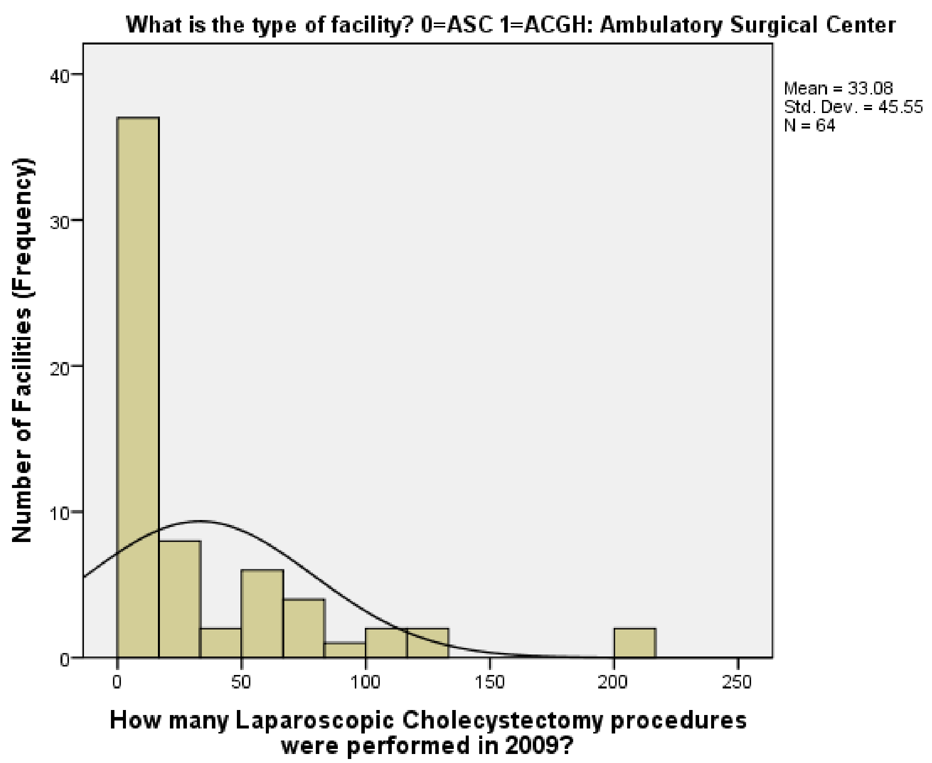

How many Open Cholecystectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 3.64
Std. Dev. = 3.337
N = 203
Number of Facilities (Frequency)
0
20
40
60
80
0
10
20
30
40
How many Open Cholecystectomy procedures were performed in 2004?


How many Open Cholecystectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 18.75
Std. Dev. = 42.681
N = 8
Number of Facilities (Frequency)
0
2
4
6
0
20
40
60
80
100
120
How many Open Cholecystectomy procedures were performed in 2009?

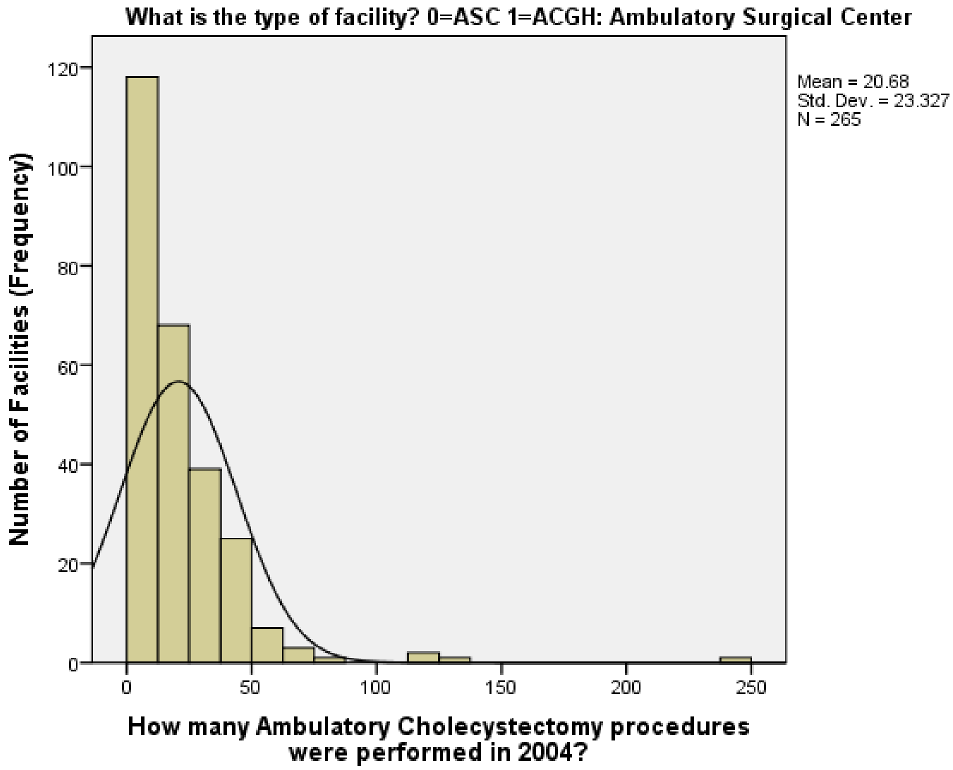
How many Laparoscopic Cholecystectomy procedures were performed in 2004?



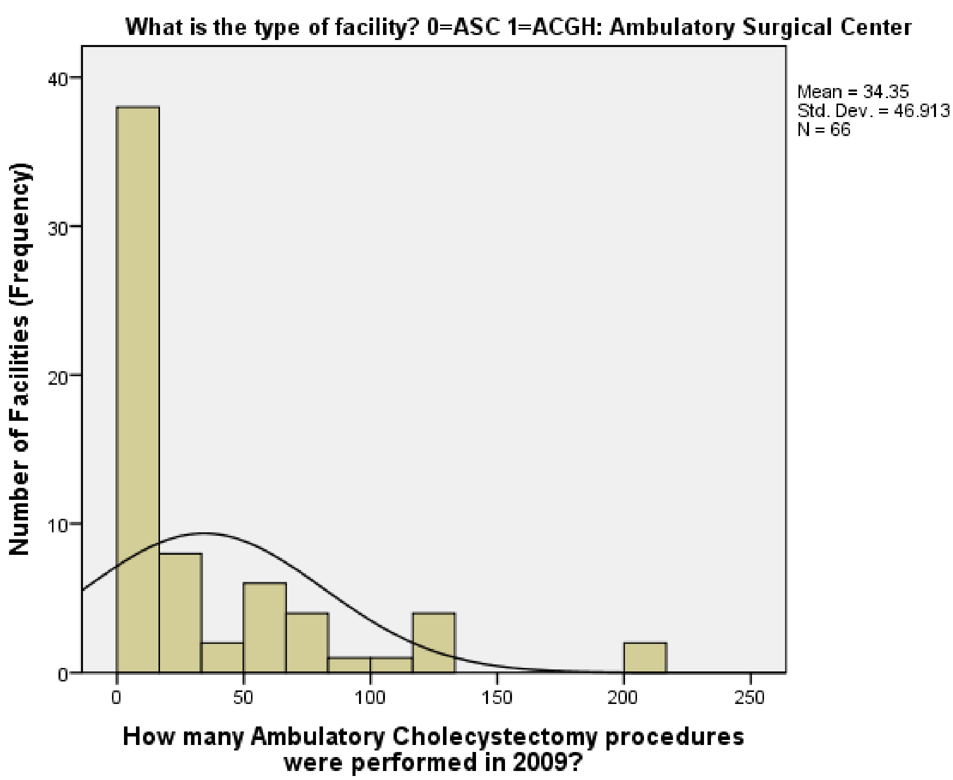
How many Laparoscopic Cholecystectomy procedures were performed in 2009?



How many Ambulatory Cholecystectomy procedures were performed in 2004?



How many Ambulatory Cholecystectomy procedures were performed in 2009?

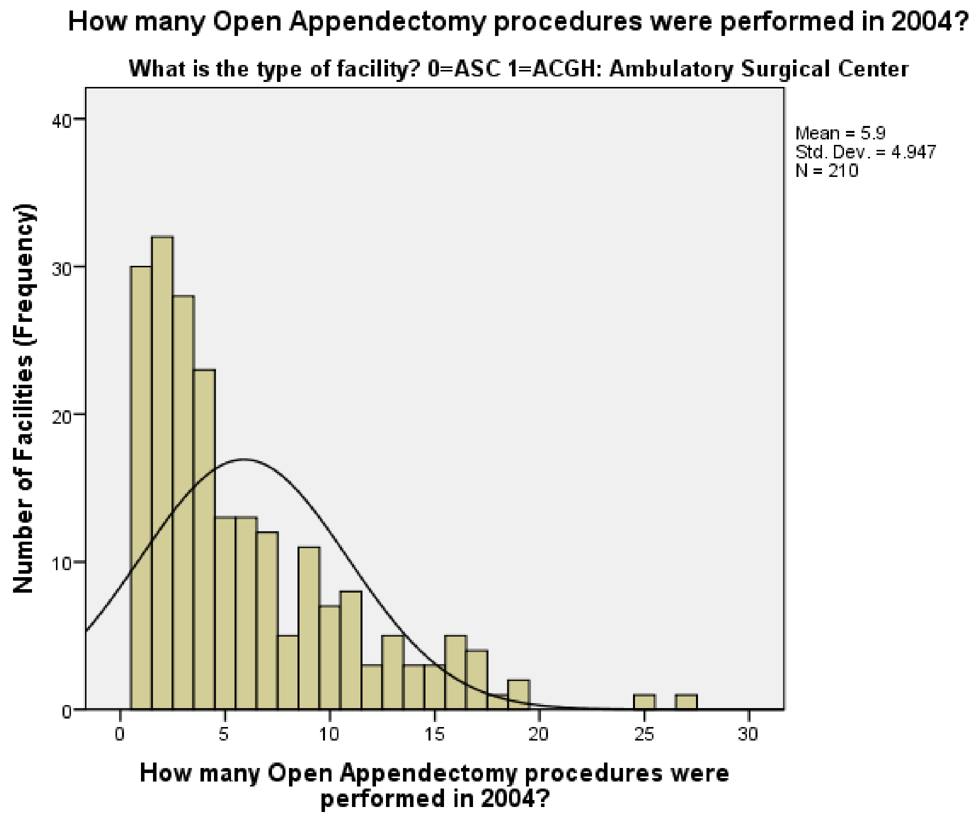


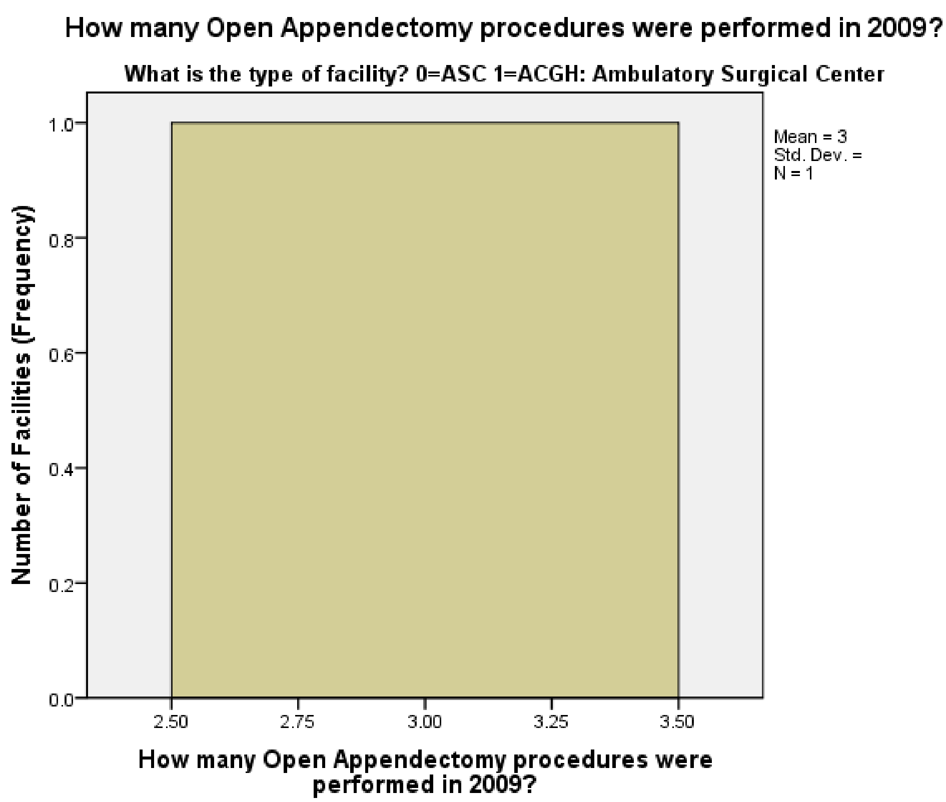
Frequency Table: Ambulatory Surgical Centers - Appendectomy

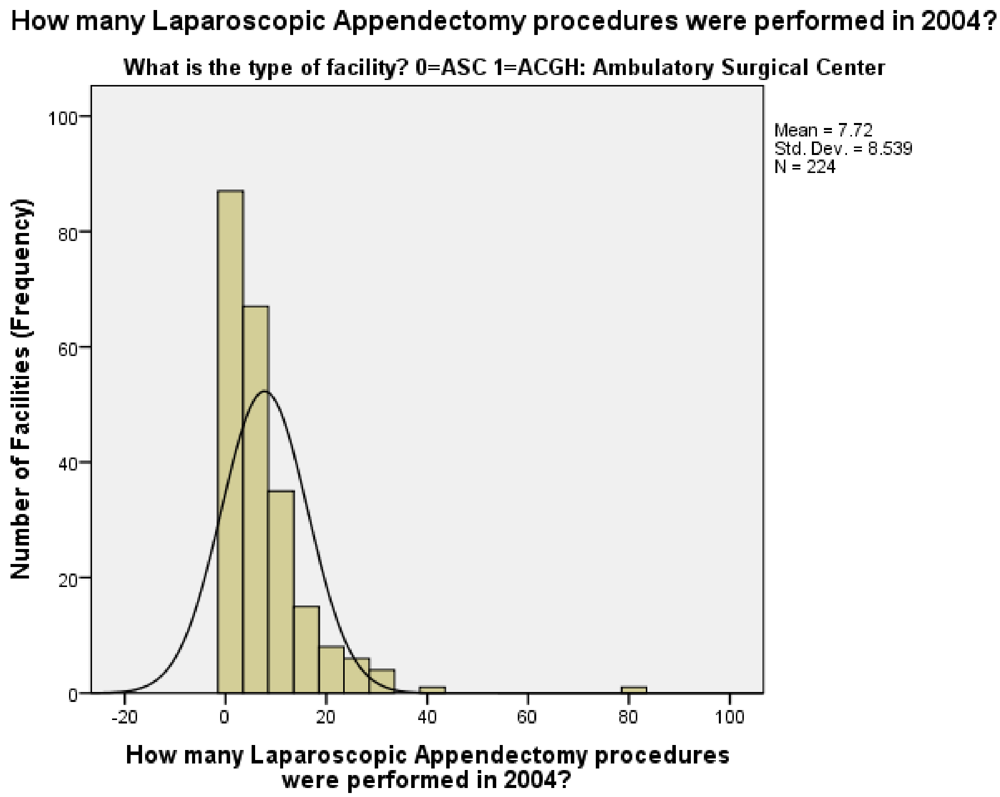
		How many Open Appendectomy procedures were performed in 2004?	How many Open Appendectomy procedures were performed in 2009?	How many Laparoscopic Appendectomy procedures were performed in 2004?	How many Laparoscopic Appendectomy procedures were performed in 2009?	How many Inpatient Appendectomy procedures were performed in 2004?	How many Inpatient Appendectomy procedures were performed in 2009?	How many Ambulatory Appendectomy procedures were performed in 2004?	How many Ambulatory Appendectomy procedures were performed in 2009?
Facilities (N)	Valid	210	1	224	14	0	0	252	15
	Missing	79	288	65	275	289	289	37	274
Mean		5.9	3	7.72	2.57			11.77	2.6
Median		4	3	5	2			8	2
Mode		2	3	1b	1			1	1
Std Dev		4.947	.	8.539	2.209	.	.	11.207	2.131
Min		1	3	1	1			1	1
Max		27	3	81	8			95	8

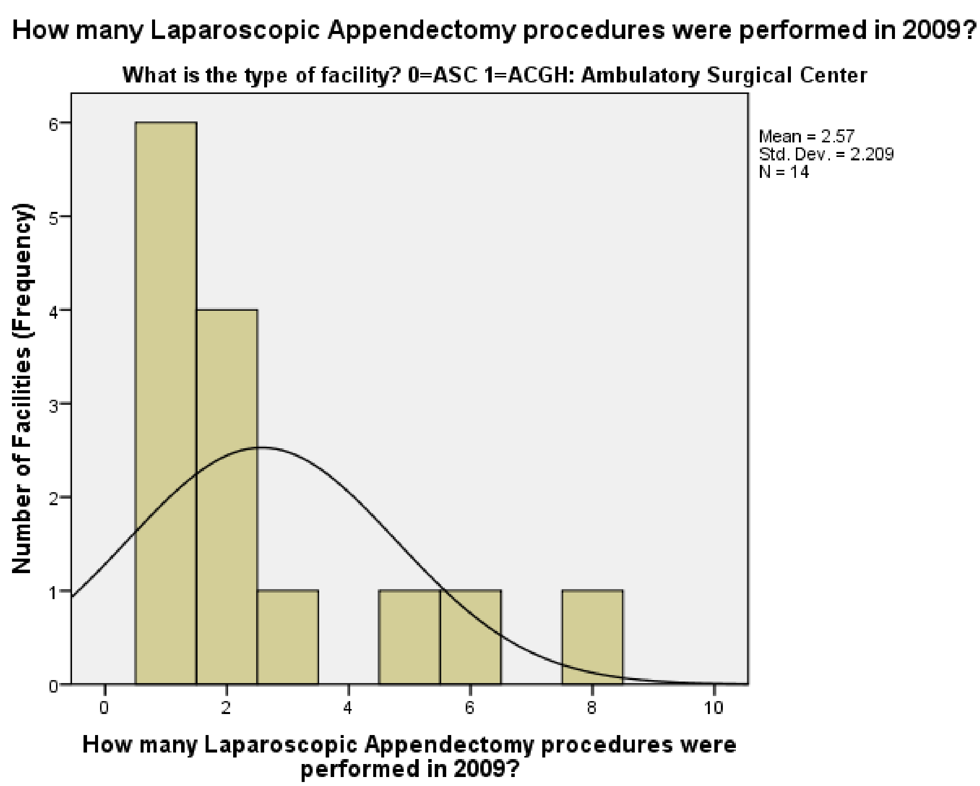
a What is the type of facility? 0=ASC 1=ACGH = Ambulatory Surgery Center

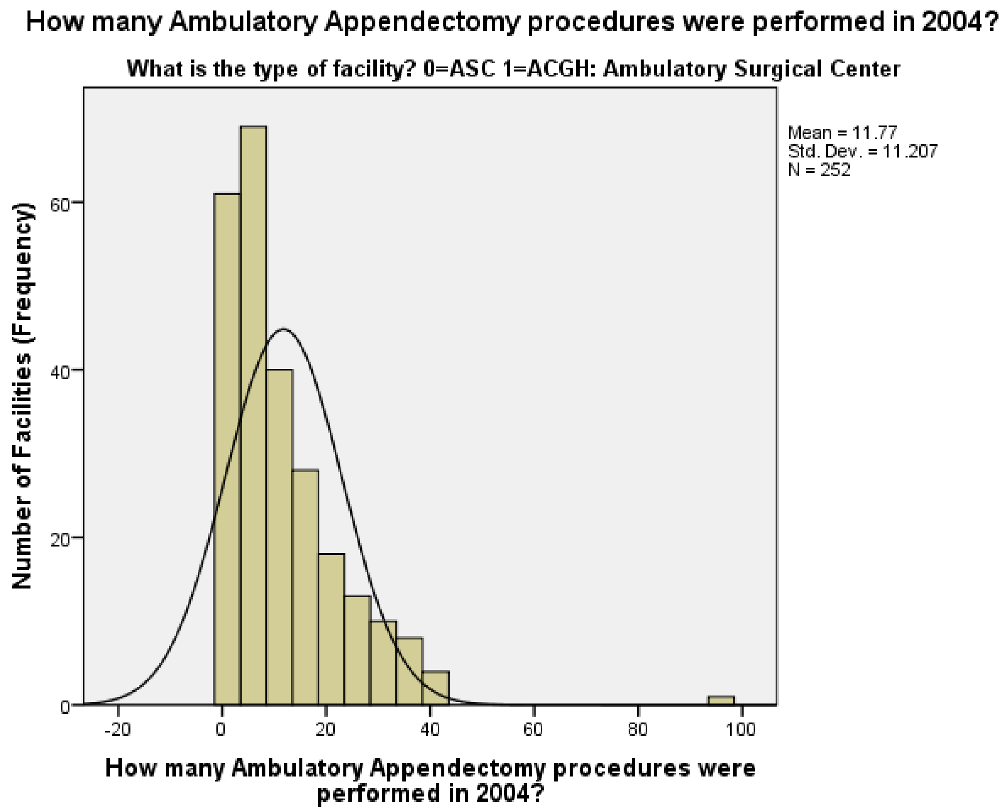
b Multiple modes exist. The smallest value is shown

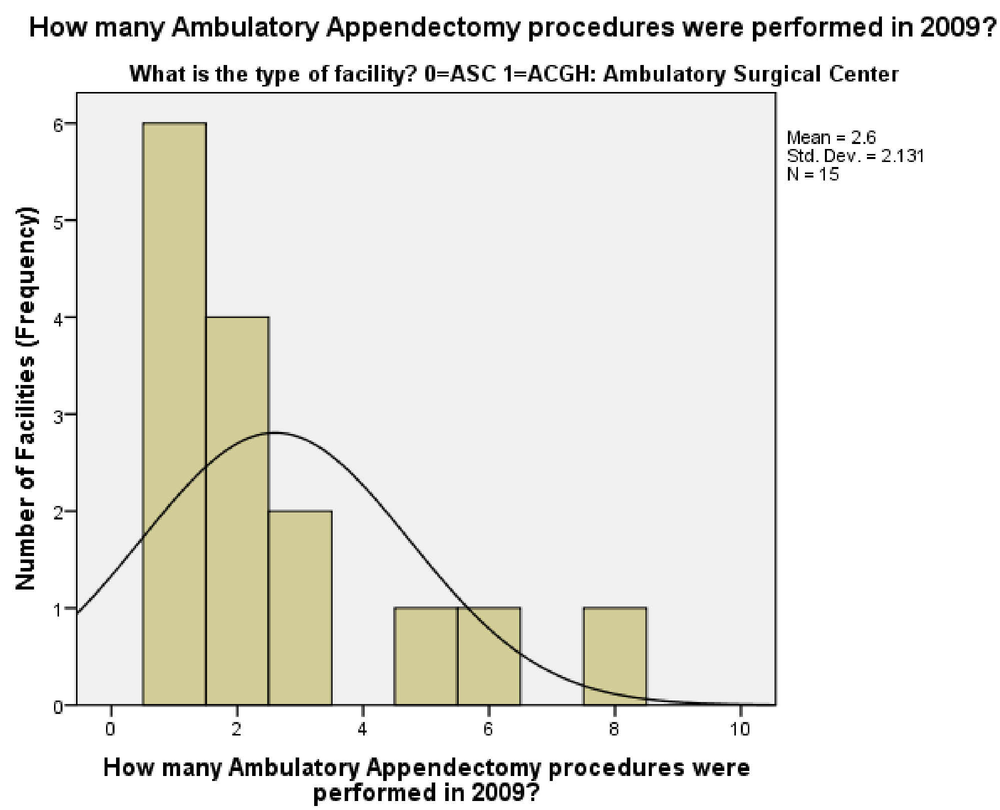

How many Open Appendectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 5.9
Std. Dev. = 4.947
N = 210
Number of Facilities (Frequency)
0
10
20
30
40
0
5
10
15
20
25
30
How many Open Appendectomy procedures were performed in 2004?


How many Open Appendectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 3
Std. Dev. =
N = 1
Number of Facilities (Frequency)
0.0
0.2
0.4
0.6
0.8
1.0
2.50
2.75
3.00
3.25
3.50
How many Open Appendectomy procedures were performed in 2009?


How many Laparoscopic Appendectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 7.72
Std. Dev. = 8.539
N = 224
Number of Facilities (Frequency)
How many Laparoscopic Appendectomy procedures were performed in 2004?


How many Laparoscopic Appendectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 2.57
Std. Dev. = 2.209
N = 14
Number of Facilities (Frequency)
How many Laparoscopic Appendectomy procedures were performed in 2009?


How many Ambulatory Appendectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 11.77
Std. Dev. = 11.207
N = 252
Number of Facilities (Frequency)
0
20
40
60
-20
0
20
40
60
80
100
How many Ambulatory Appendectomy procedures were performed in 2004?

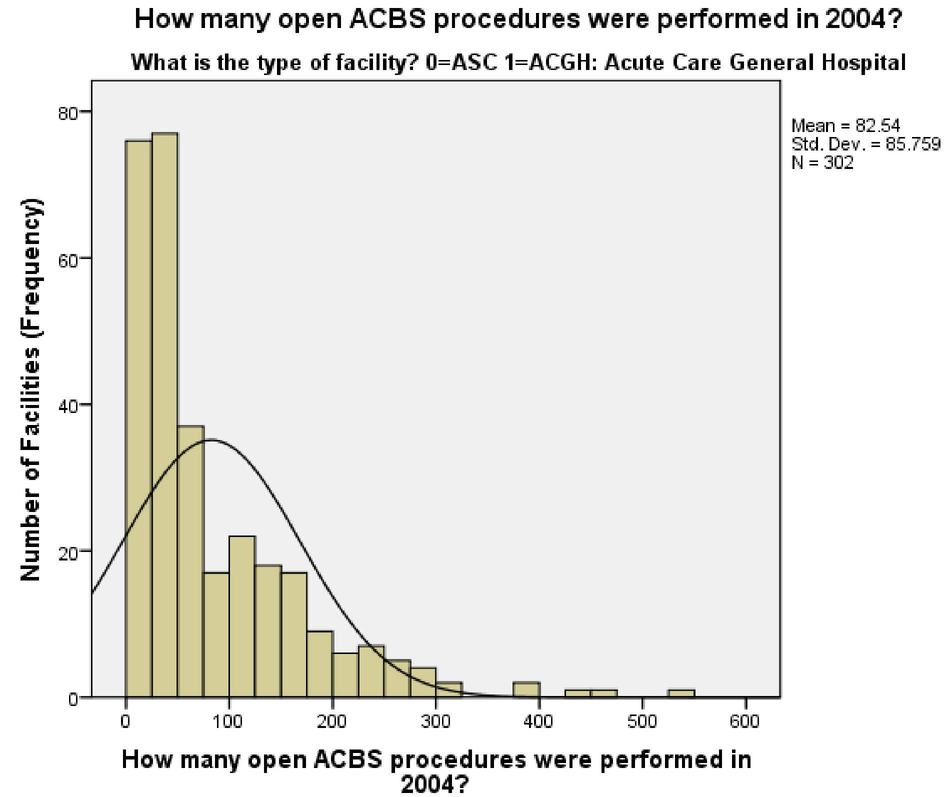

How many Ambulatory Appendectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Ambulatory Surgical Center
Mean = 2.6
Std. Dev. = 2.131
N = 15
Number of Facilities (Frequency)
0
1
2
3
4
5
6
0
2
4
6
8
10
How many Ambulatory Appendectomy procedures were performed in 2009?

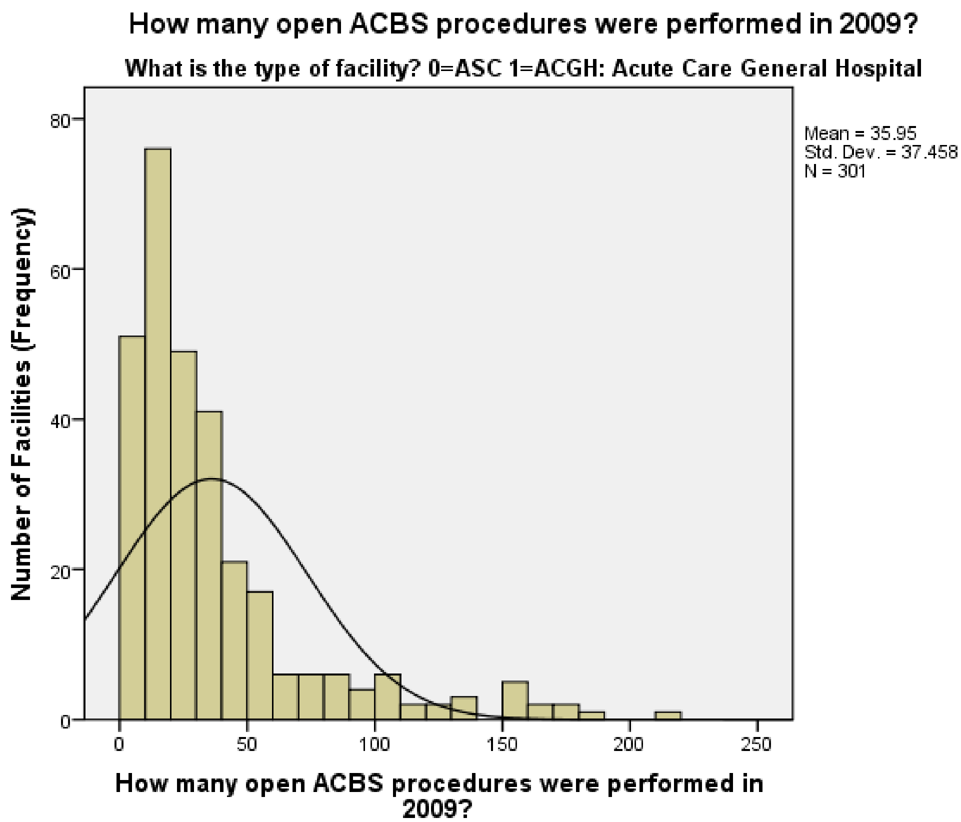
Appendix D: Univariate Analysis for Acute Care General Hospital (Frequency Tables and Bar Charts)

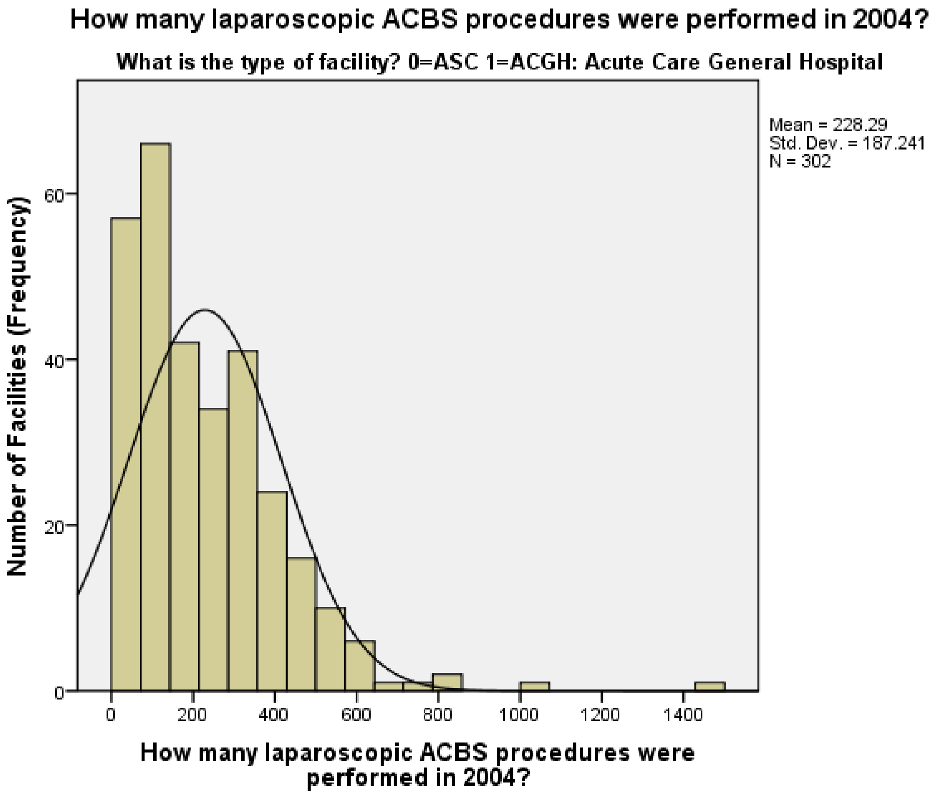
Frequency Table: Acute Care General Hospitals - ACBS

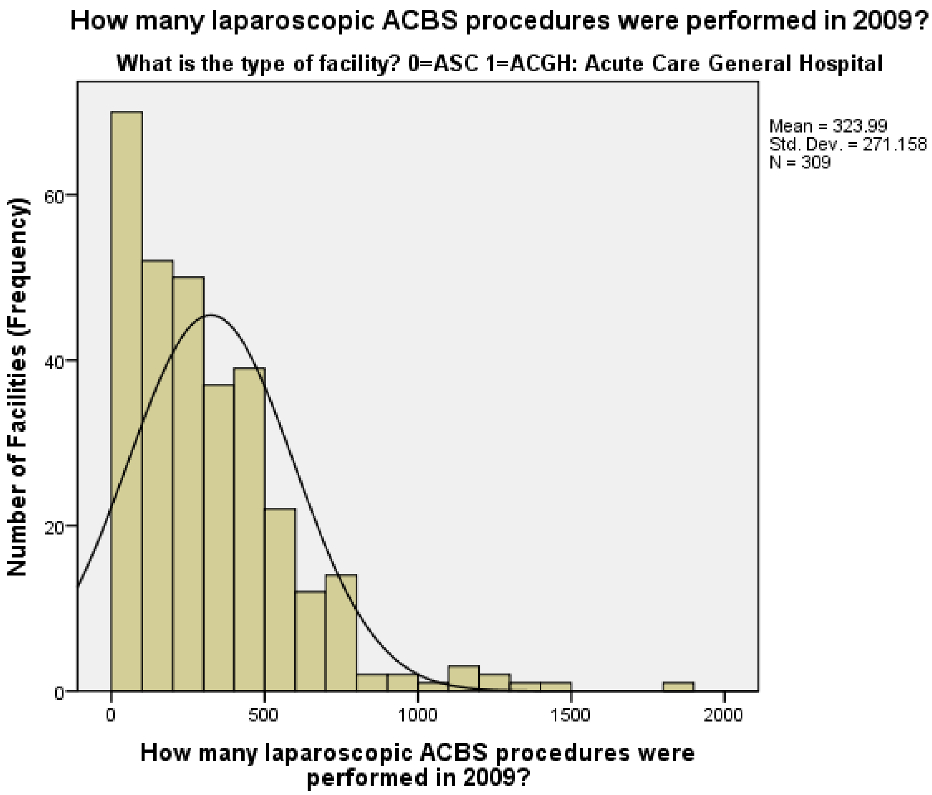
		How many open ACBS procedures were performed in 2004?	How many open ACBS procedures were performed in 2009?	How many laparoscopic ACBS procedures were performed in 2004?	How many laparoscopic ACBS procedures were performed in 2009?	How many inpatient ACBS procedures were performed in 2004?	How many inpatient ACBS procedures were performed in 2009?	How many ambulatory ACBS procedures were performed in 2004?	How many ambulatory ACBS procedures were performed in 2009?
Facilities (N)	Valid	302	301	302	309	301	306	299	297
	Missing	11	12	11	4	12	7	14	16
Mean		82.54	35.95	228.29	323.99	215.86	224.45	96.64	142.26
Median		48.5	24	182.5	270	170	175.5	66	109
Mode		23	13b	24b	22	20	2b	7b	66
Std Dev		85.759	37.458	187.241	271.158	181.998	200.546	91.097	130.368
Min		1	1	1	1	1	1	1	1
Max		547	218	1469	1851	1201	1380	506	831

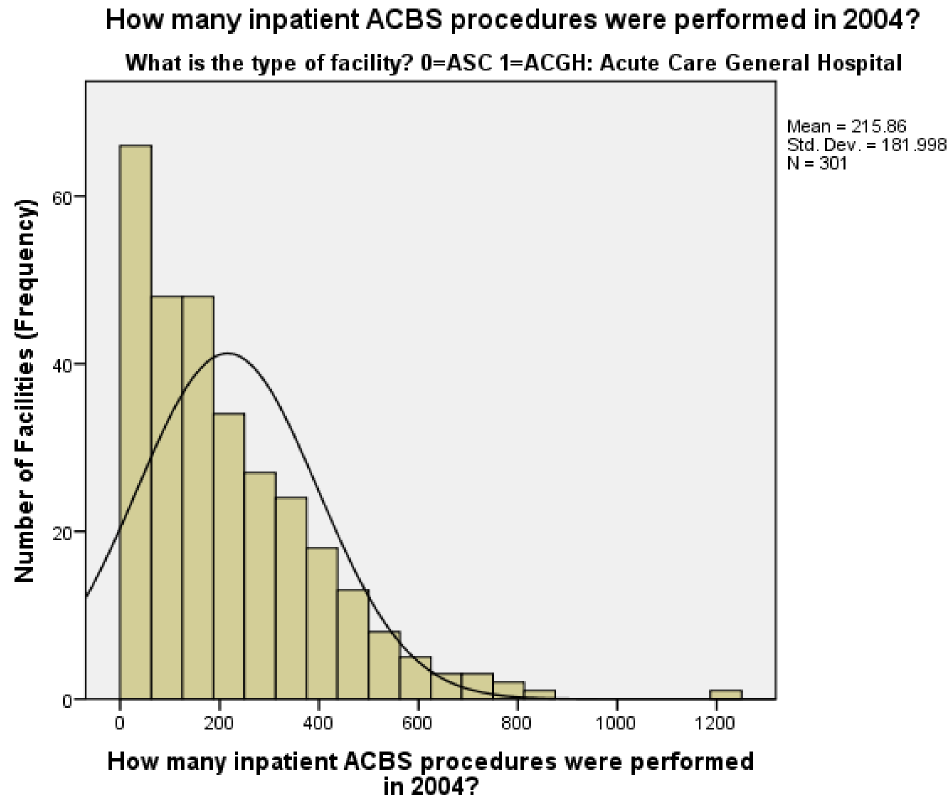
a What is the type of facility? 0=ASC 1=ACGH = Acute Care General Hospital
b Multiple modes exist. The smallest value is shown

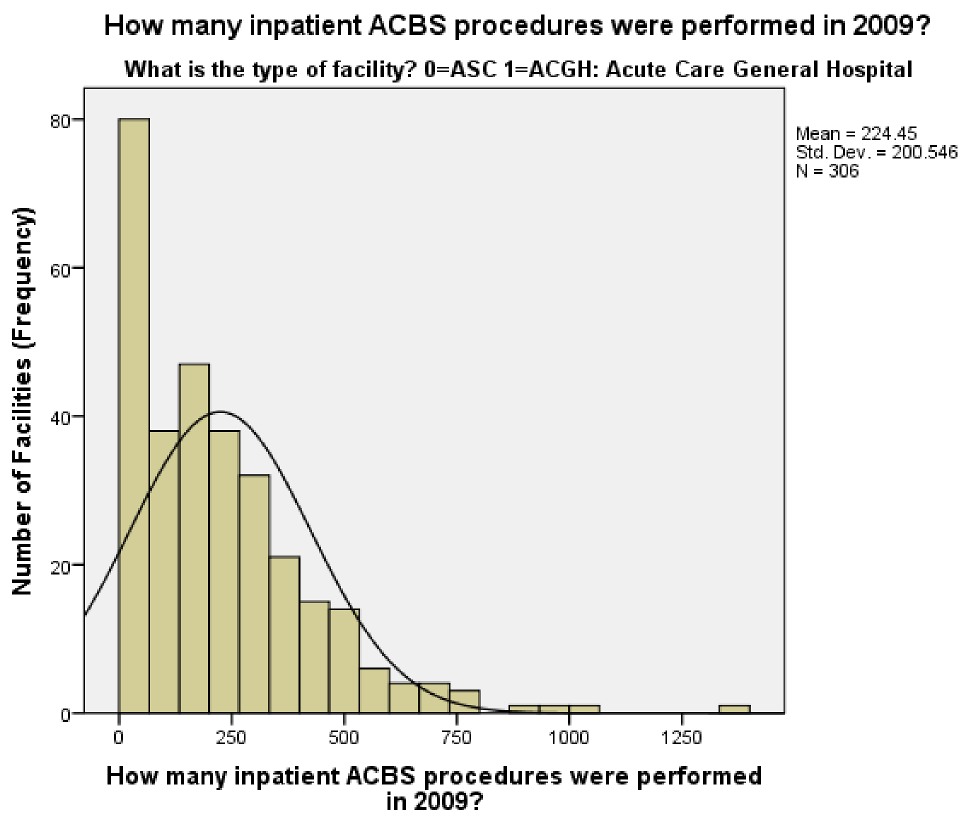

How many open ACBS procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 82.54
Std. Dev. = 85.759
N = 302
Number of Facilities (Frequency)
0
20
40
60
80
0
100
200
300
400
500
600
How many open ACBS procedures were performed in 2004?

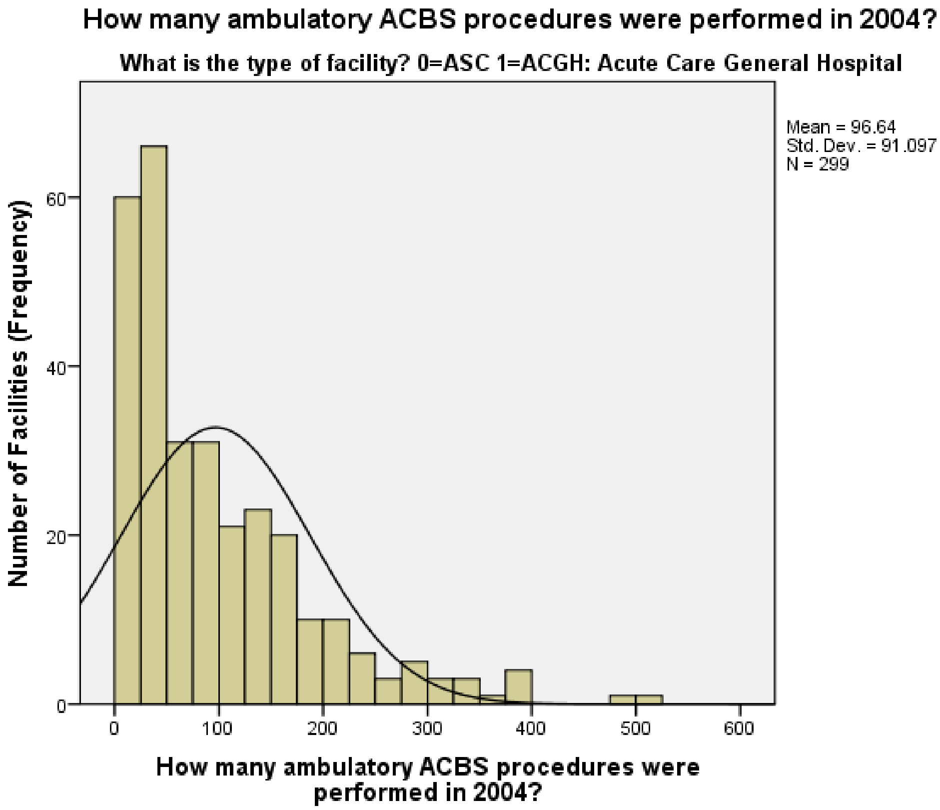

How many open ACBS procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 35.95
Std. Dev. = 37.458
N = 301
Number of Facilities (Frequency)
0
20
40
60
80
0
50
100
150
200
250
How many open ACBS procedures were performed in 2009?

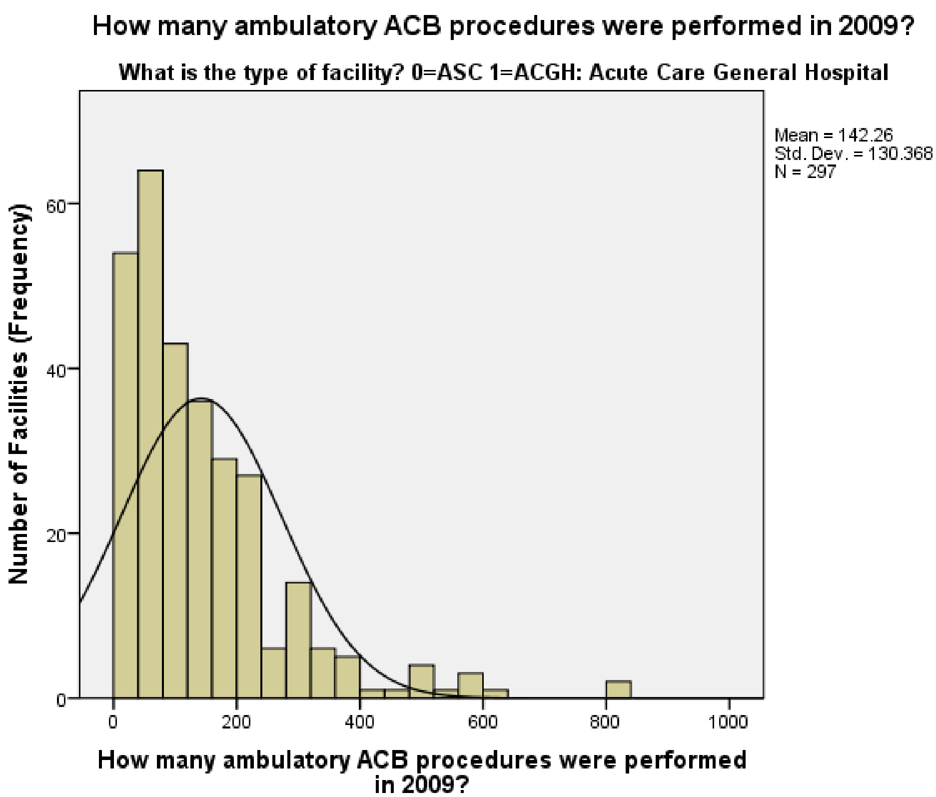

How many laparoscopic ACBS procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 228.29
Std. Dev. = 187.241
N = 302
Number of Facilities (Frequency)
0
20
40
60
0
200
400
600
800
1000
1200
1400
How many laparoscopic ACBS procedures were performed in 2004?


How many laparoscopic ACBS procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 323.99
Std. Dev. = 271.158
N = 309
Number of Facilities (Frequency)
0
20
40
60
0
500
1000
1500
2000
How many laparoscopic ACBS procedures were performed in 2009?


How many inpatient ACBS procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 215.86
Std. Dev. = 181.998
N = 301
Number of Facilities (Frequency)
0
20
40
60
0
200
400
600
800
1000
1200
How many inpatient ACBS procedures were performed in 2004?


How many inpatient ACBS procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 224.45
Std. Dev. = 200.546
N = 306
Number of Facilities (Frequency)
0
20
40
60
80
0
250
500
750
1000
1250
How many inpatient ACBS procedures were performed in 2009?

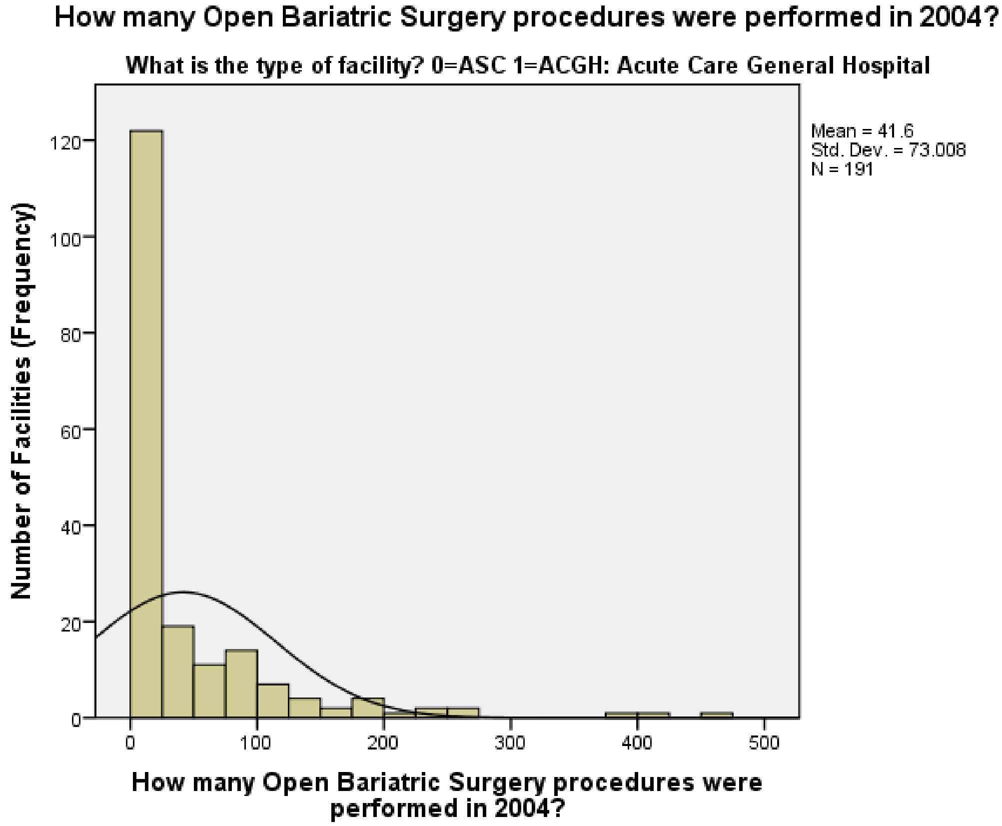

How many ambulatory ACBS procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 96.64
Std. Dev. = 91.097
N = 299
Number of Facilities (Frequency)
0
20
40
60
0
100
200
300
400
500
600
How many ambulatory ACBS procedures were performed in 2004?

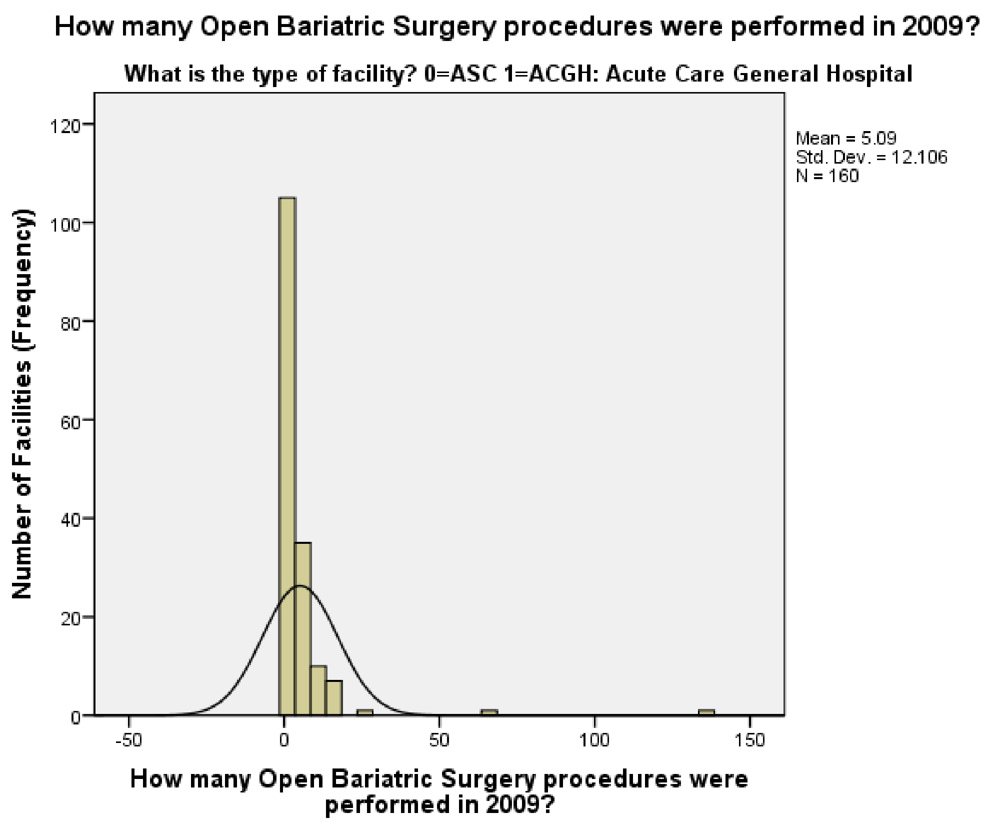

How many ambulatory ACB procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 142.26
Std. Dev. = 130.368
N = 297
Number of Facilities (Frequency)
0
20
40
60
0
200
400
600
800
1000
How many ambulatory ACB procedures were performed in 2009?

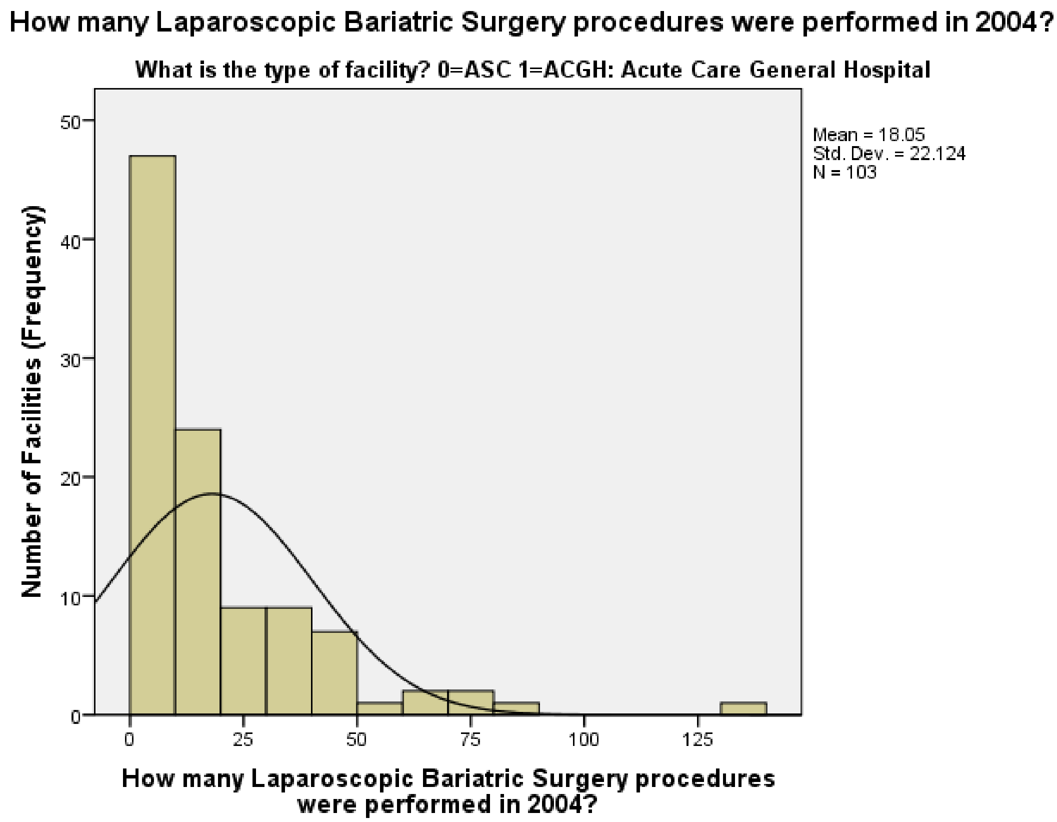
Frequency Table: Acute Care General Hospitals - Bariatric Surgery

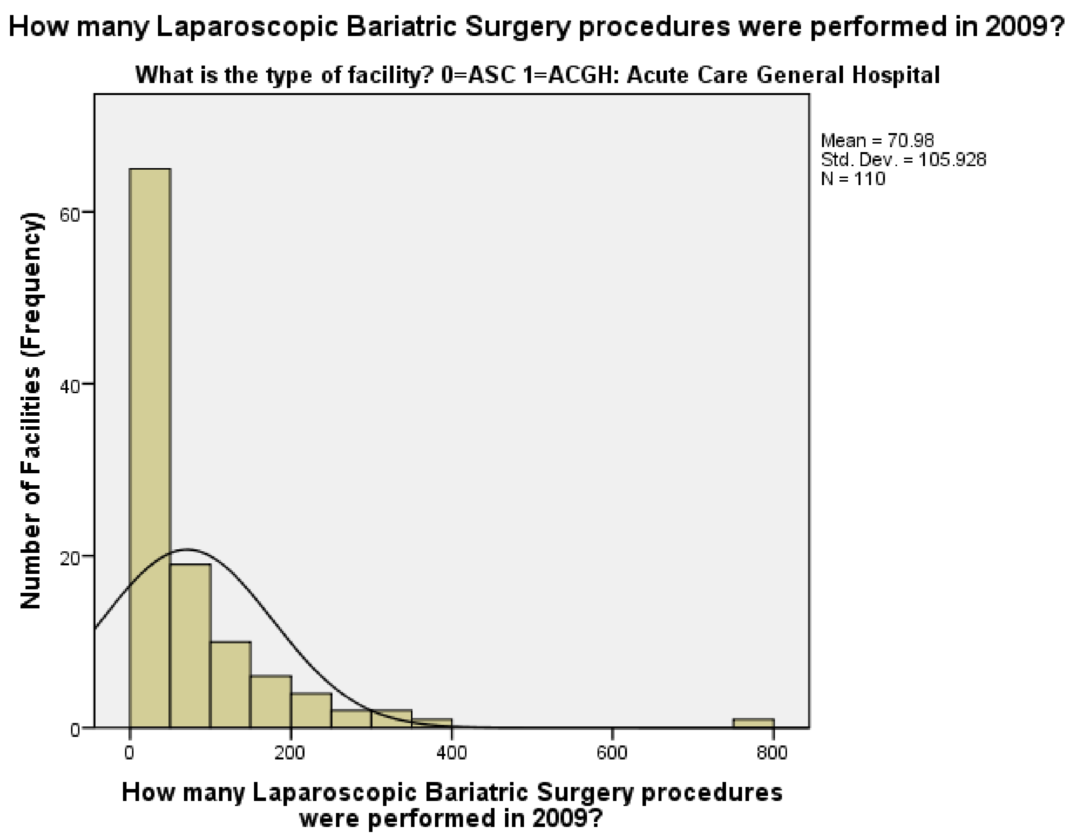
		How many Open Bariatric Surgery procedures were performed in 2004?	How many Open Bariatric Surgery procedures were performed in 2009?	How many Laparoscopic Bariatric Surgery procedures were performed in 2004?	How many Laparoscopic Bariatric Surgery procedures were performed in 2009?	How many Inpatient Bariatric Surgery procedures were performed in 2004?	How many Inpatient Bariatric Surgery procedures were performed in 2009?	How many Ambulatory Bariatric Surgery procedures were performed in 2004?	How many Ambulatory Bariatric Surgery procedures were performed in 2009?
Facilities (N)	Valid	191	160	103	110	182	175	73	73
	Missing	122	153	210	203	131	138	240	240
Mean		41.6	5.09	18.05	70.98	50.18	38.95	9.21	24.74
Median		7	2	10	36	6.5	5	4	10
Mode		1	1	1	1	1	1	1	1
Std Dev		73.008	12.106	22.124	105.928	87.444	70.007	13.782	61.228
Min		1	1	1	1	1	1	1	1
Max		469	135	137	782	551	353	77	502

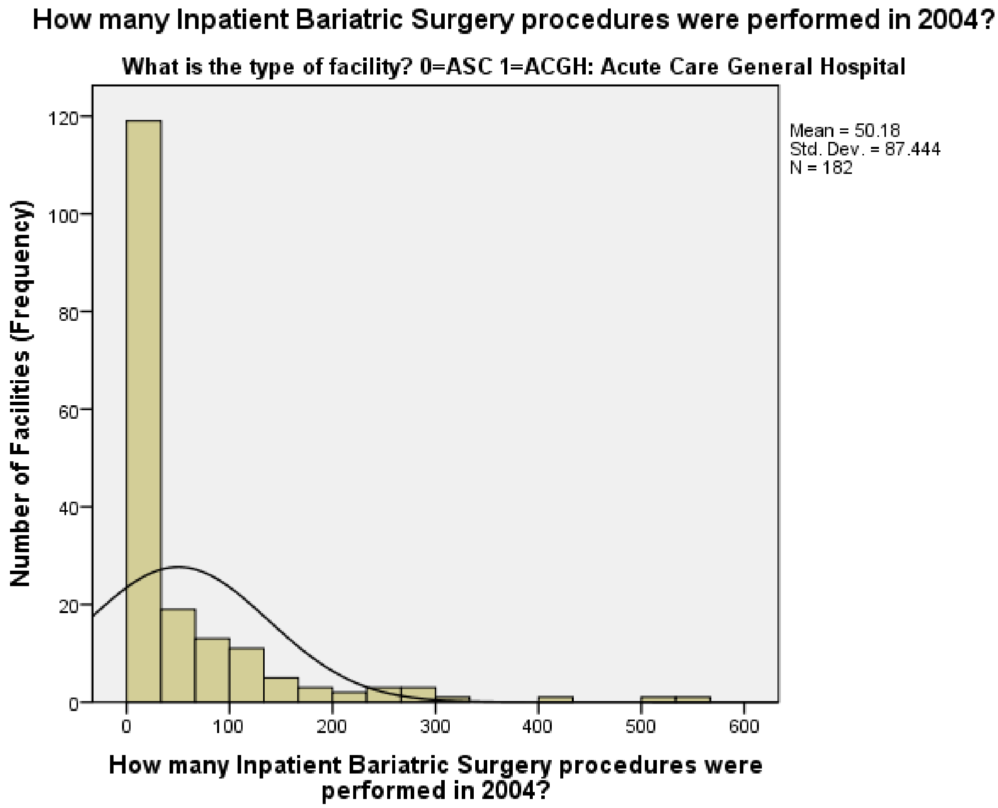
a What is the type of facility? 0=ASC 1=ACGH = Acute Care General Hospital

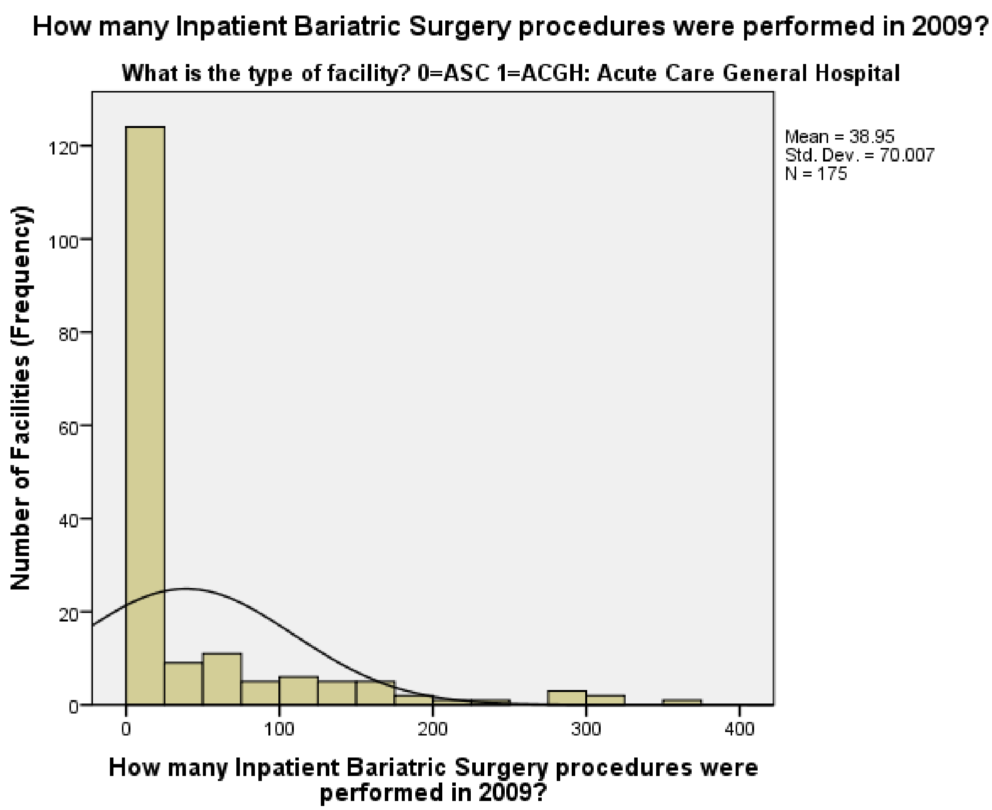

How many Open Bariatric Surgery procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 41.6
Std. Dev. = 73.008
N = 191
Number of Facilities (Frequency)
0
20
40
60
80
100
120
0
100
200
300
400
500
How many Open Bariatric Surgery procedures were performed in 2004?


How many Open Bariatric Surgery procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 5.09
Std. Dev. = 12.106
N = 160
Number of Facilities (Frequency)
0
20
40
60
80
100
120
-50
0
50
100
150
How many Open Bariatric Surgery procedures were performed in 2009?

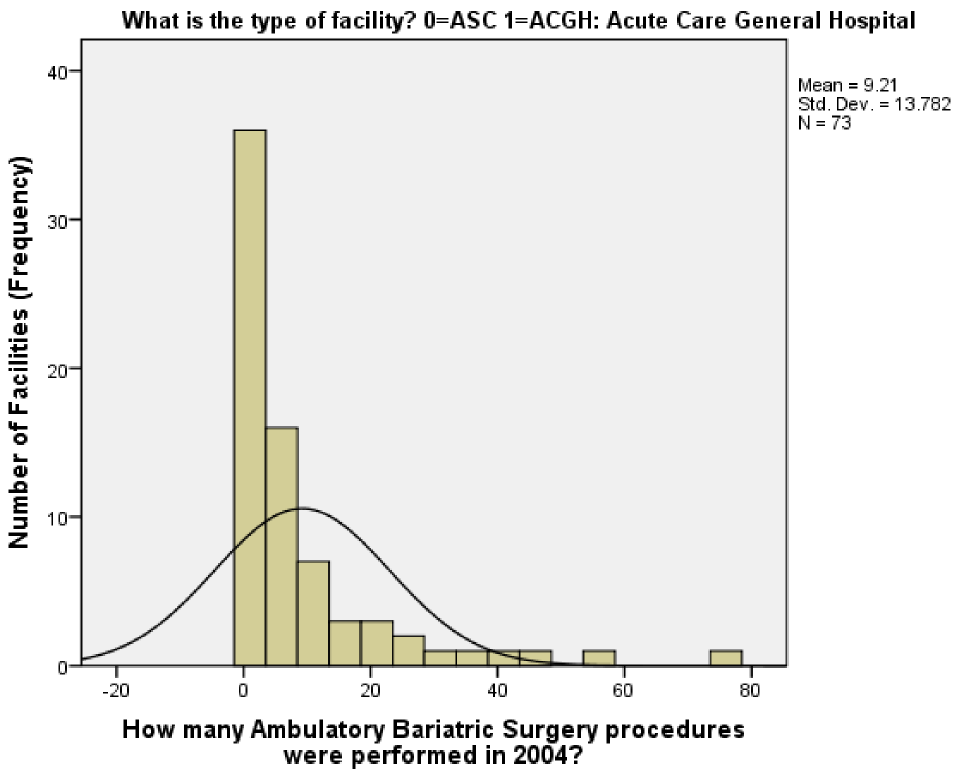

How many Laparoscopic Bariatric Surgery procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 18.05
Std. Dev. = 22.124
N = 103
Number of Facilities (Frequency)
0
10
20
30
40
50
0
25
50
75
100
125
How many Laparoscopic Bariatric Surgery procedures were performed in 2004?


How many Laparoscopic Bariatric Surgery procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 70.98
Std. Dev. = 105.928
N = 110
Number of Facilities (Frequency)
0
20
40
60
0
200
400
600
800
How many Laparoscopic Bariatric Surgery procedures were performed in 2009?

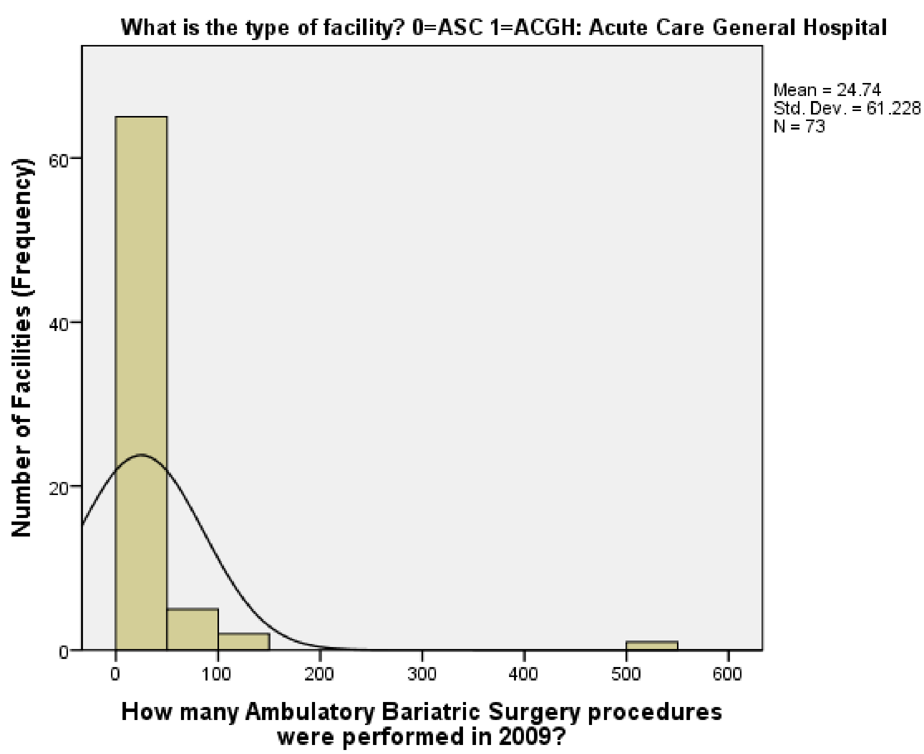

How many Inpatient Bariatric Surgery procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 50.18
Std. Dev. = 87.444
N = 182
Number of Facilities (Frequency)
0
20
40
60
80
100
120
0
100
200
300
400
500
600
How many Inpatient Bariatric Surgery procedures were performed in 2004?


How many Inpatient Bariatric Surgery procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 38.95
Std. Dev. = 70.007
N = 175
Number of Facilities (Frequency)
0
20
40
60
80
100
120
0
100
200
300
400
How many Inpatient Bariatric Surgery procedures were performed in 2009?

How many Ambulatory Bariatric Surgery procedures were performed in 2004?



How many Ambulatory Bariatric Surgery procedures were performed in 2009?

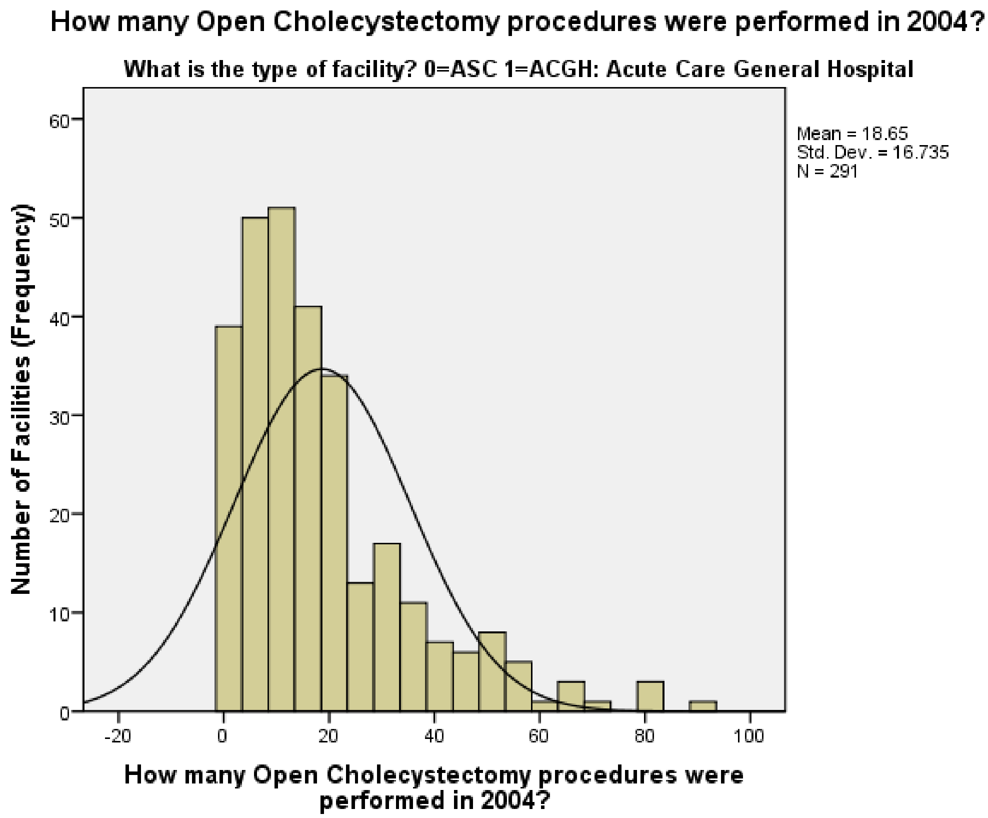


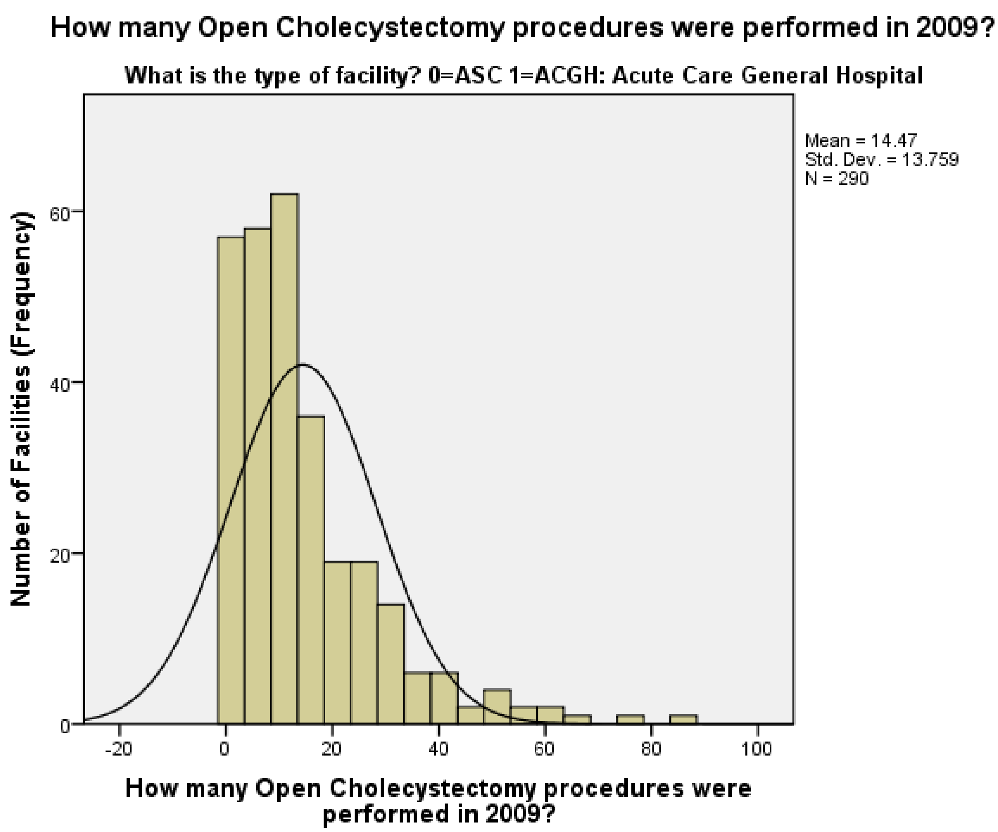
Frequency Table: Acute Care General Hospitals - Cholecystectomy

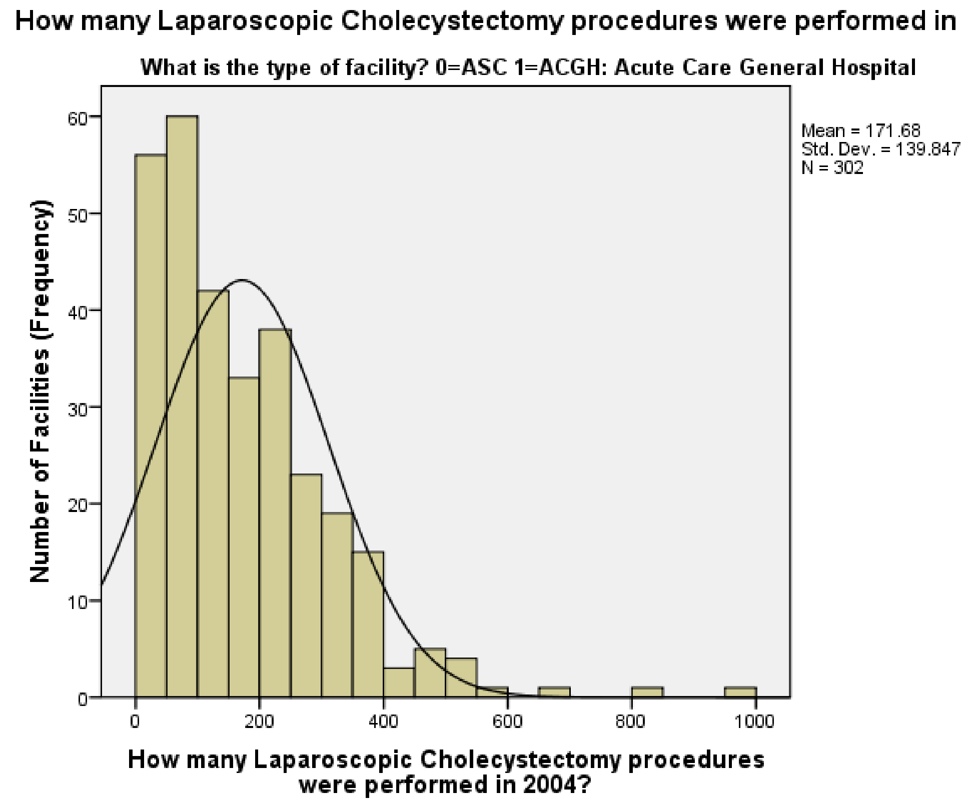
		How many open cholecystectomy procedures were performed in 2004?	How many open cholecystectomy procedures were performed in 2009?	How many laparoscopic cholecystectomy procedures were performed in 2004?	How many laparoscopic cholecystectomy procedures were performed in 2009?	How many inpatient cholecystectomy procedures were performed in 2004?	How many inpatient cholecystectomy procedures were performed in 2009?	How many ambulatory cholecystectomy procedures were performed in 2004?	How many ambulatory cholecystectomy procedures were performed in 2009?
Facilities (N)	Valid	291	290	302	309	299	304	299	297
	Missing	22	23	11	4	14	9	14	16
Mean		18.65	14.47	171.68	221.52	110.02	123.52	81.53	118.16
Median		14	11	135	180	96	97.5	51	91
Mode		1	2	61b	22b	9	9	24	24b
Std Dev		16.735	13.759	139.847	182.74	92.827	108.436	81.561	107.838
Min		1	1	1	1	1	1	1	1
Max		93	86	971	1161	564	690	480	738

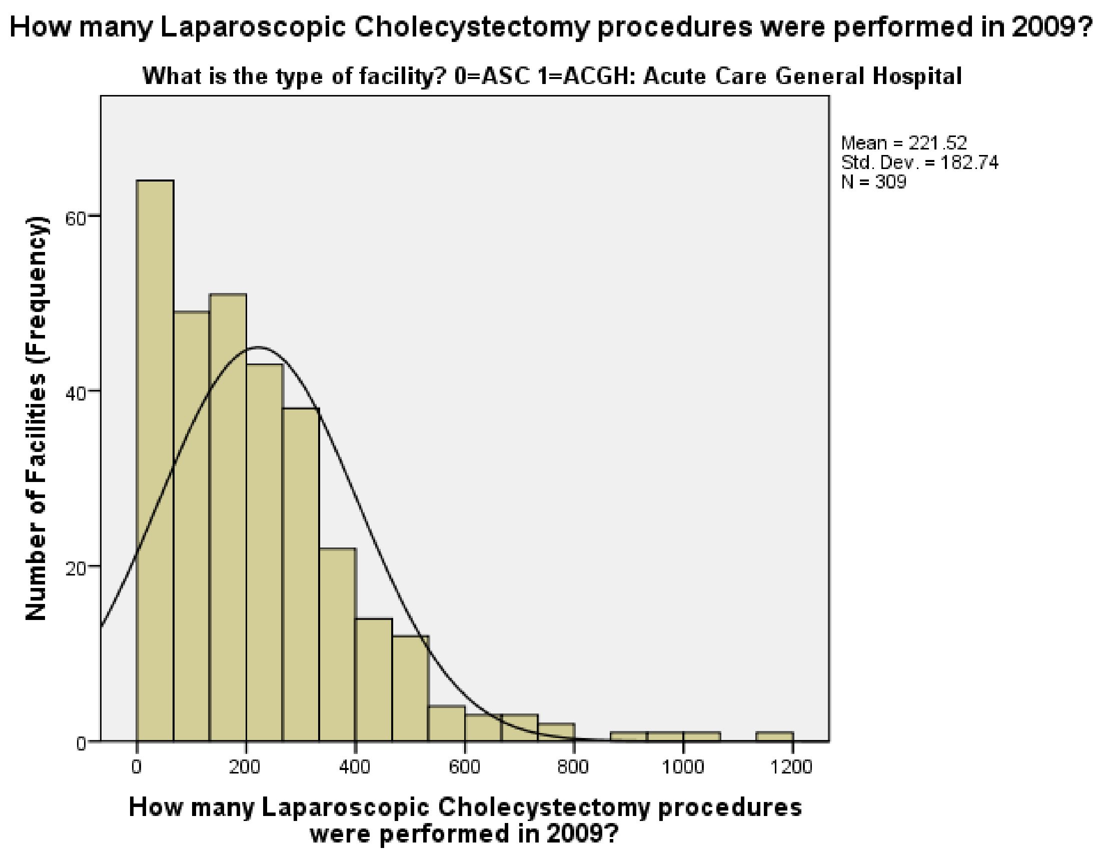
a What is the type of facility? 0=ASC 1=ACGH = Acute Care General Hospital

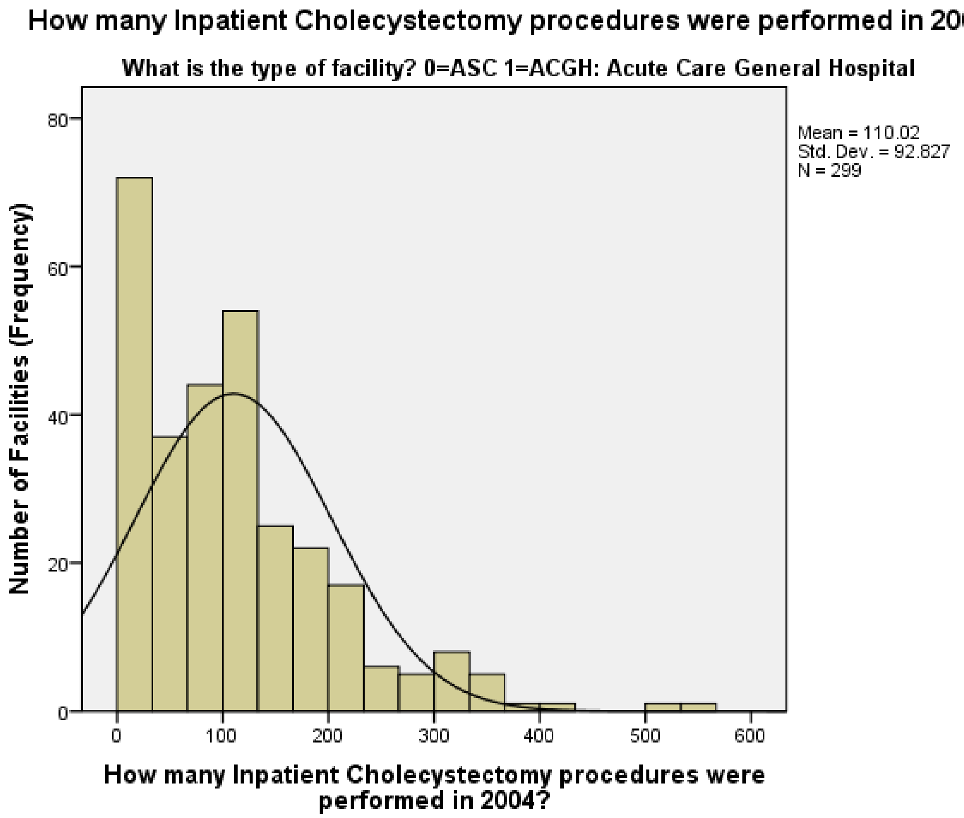
b Multiple modes exist. The smallest value is shown

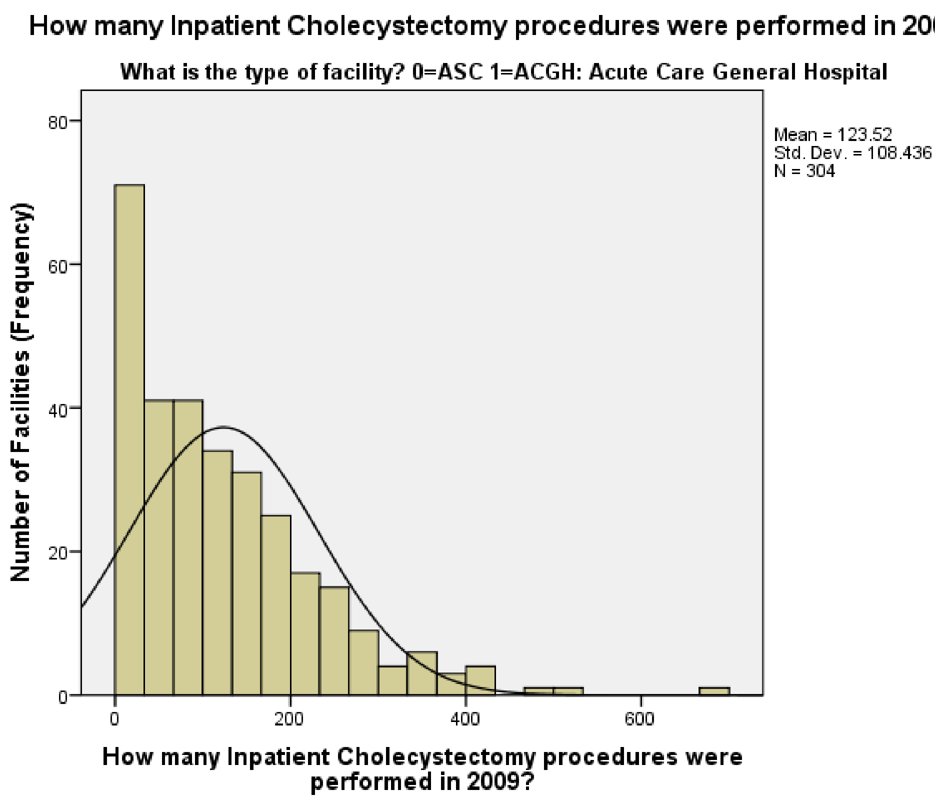

How many Open Cholecystectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 18.65
Std. Dev. = 16.735
N = 291
Number of Facilities (Frequency)
60
50
40
30
20
10
0
-20
0
20
40
60
80
100
How many Open Cholecystectomy procedures were performed in 2004?

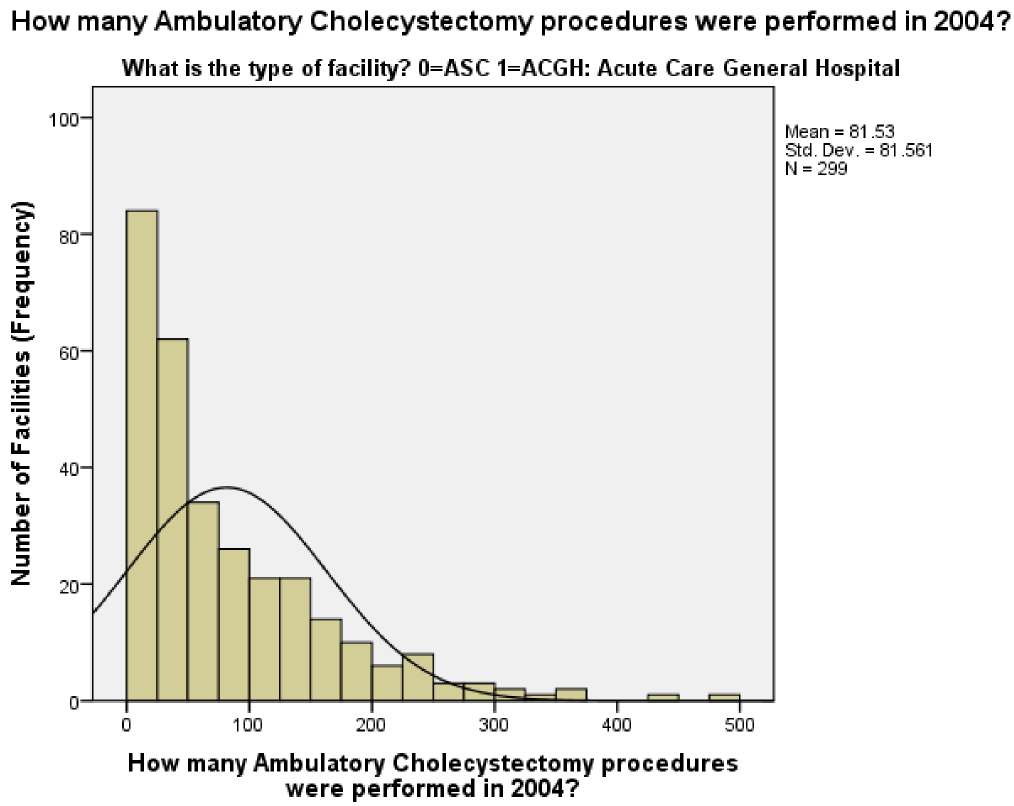

How many Open Cholecystectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 14.47
Std. Dev. = 13.759
N = 290
Number of Facilities (Frequency)
60
40
20
0
-20
0
20
40
60
80
100
How many Open Cholecystectomy procedures were performed in 2009?

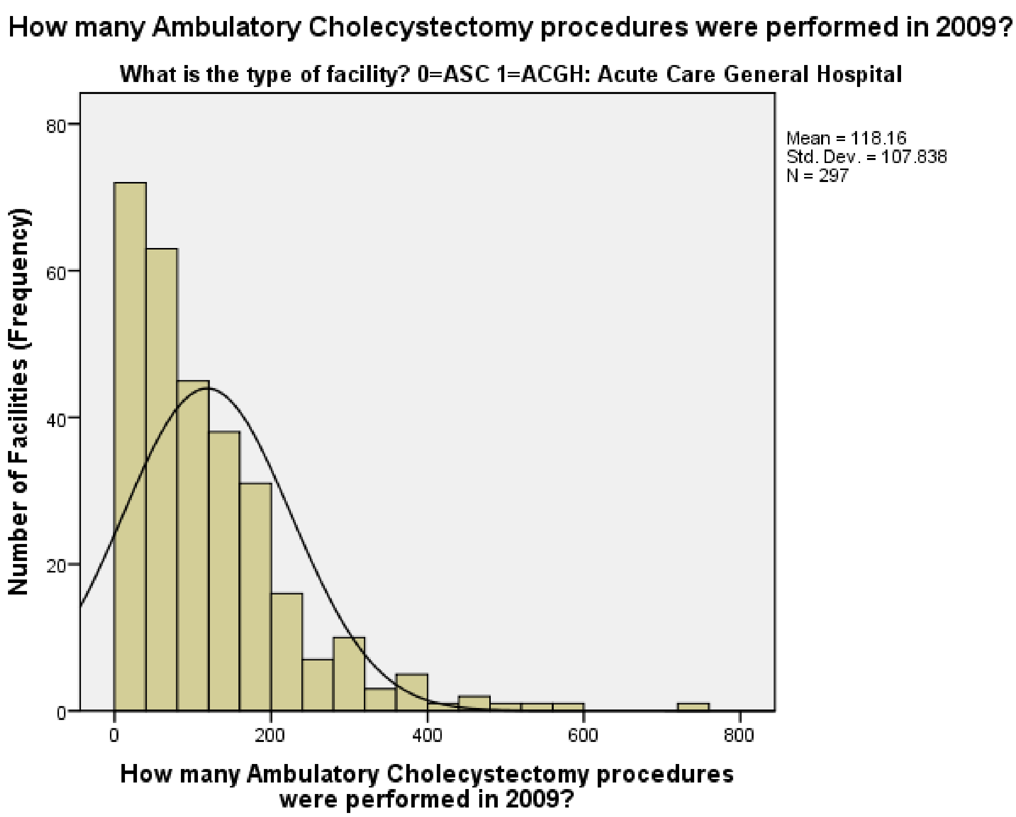

How many Laparoscopic Cholecystectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 171.68
Std. Dev. = 139.847
N = 302
Number of Facilities (Frequency)
0
10
20
30
40
50
60
0
200
400
600
800
1000
How many Laparoscopic Cholecystectomy procedures were performed in 2004?


How many Laparoscopic Cholecystectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 221.52
Std. Dev. = 182.74
N = 309
Number of Facilities (Frequency)
0
20
40
60
0
200
400
600
800
1000
1200
How many Laparoscopic Cholecystectomy procedures were performed in 2009?


How many Inpatient Cholecystectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 110.02
Std. Dev. = 92.827
N = 299
Number of Facilities (Frequency)
0
20
40
60
80
0
100
200
300
400
500
600
How many Inpatient Cholecystectomy procedures were performed in 2004?


How many Inpatient Cholecystectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 123.52
Std. Dev. = 108.436
N = 304
Number of Facilities (Frequency)
0
20
40
60
80
0
200
400
600
How many Inpatient Cholecystectomy procedures were performed in 2009?


How many Ambulatory Cholecystectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 81.53
Std. Dev. = 81.561
N = 299
Number of Facilities (Frequency)
0
20
40
60
80
100
0
100
200
300
400
500
How many Ambulatory Cholecystectomy procedures were performed in 2004?


How many Ambulatory Cholecystectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 118.16
Std. Dev. = 107.838
N = 297
Number of Facilities (Frequency)
0
20
40
60
80
0
200
400
600
800
How many Ambulatory Cholecystectomy procedures were performed in 2009?

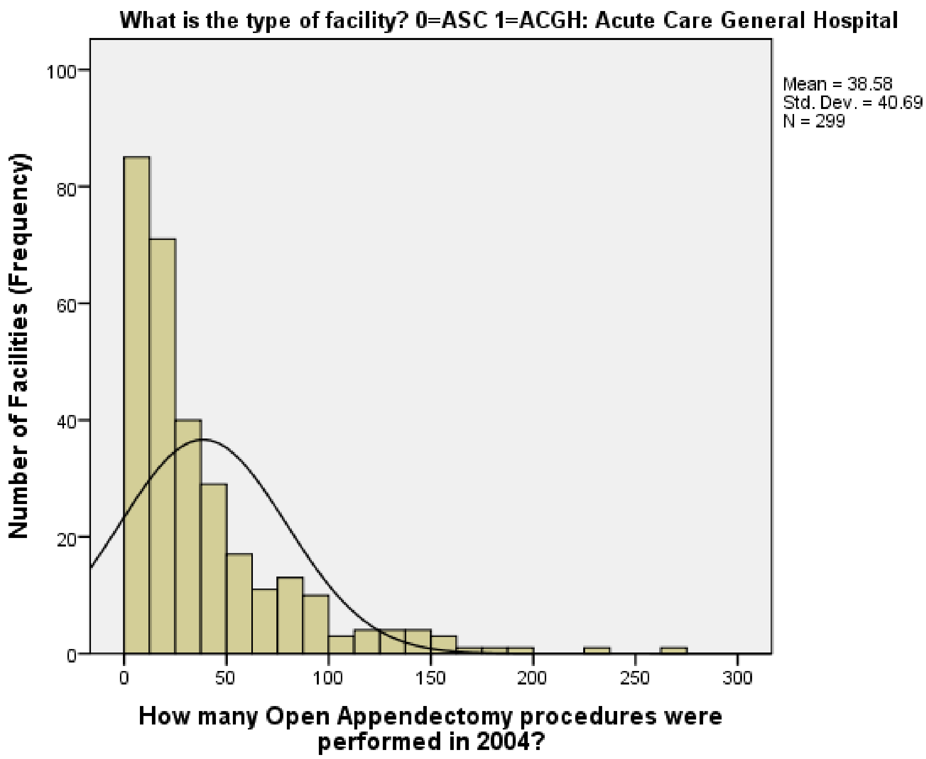
Frequency Table: Acute Care General Hospitals - Appendectomy

		How many open appendectomy procedures were performed in 2004?	How many open appendectomy procedures were performed in 2009?	How many laparoscopic appendectomy procedures were performed in 2004?	How many laparoscopic appendectomy procedures were performed in 2009?	How many inpatient appendectomy procedures were performed in 2004?	How many inpatient appendectomy procedures were performed in 2009?	How many ambulatory appendectomy procedures were performed in 2004?	How many ambulatory appendectomy procedures were performed in 2009?
Facilities (N)	Valid	299	287	278	299	298	303	244	264
	Missing	14	26	35	14	15	10	69	49
Mean		38.58	20.24	54.82	79.78	76.94	80.25	15.76	20.26
Median		24	11	38.5	59	60	59	9	11
Mode		8b	3b	1	1b	18b	49	3	1
Std Dev		40.69	25.435	57.814	78.727	68.422	82.645	20.627	26.571
Min		1	1	1	1	1	1	1	1
Max		265	159	460	685	459	677	147	197

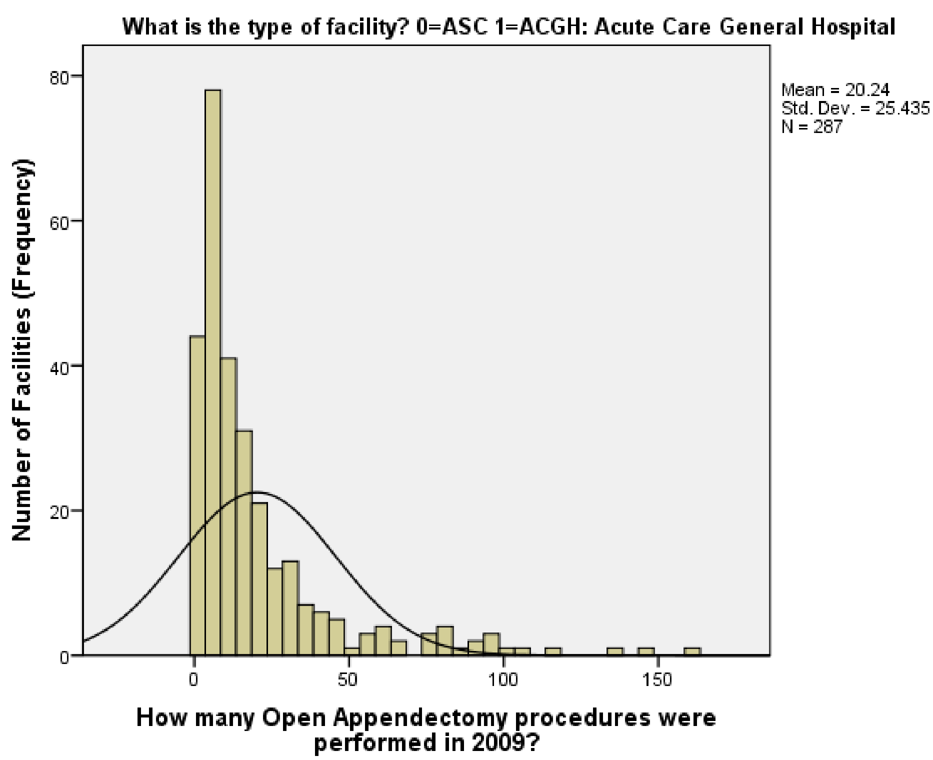
a What is the type of facility? 0=ASC 1=ACGH = Acute Care General Hospital

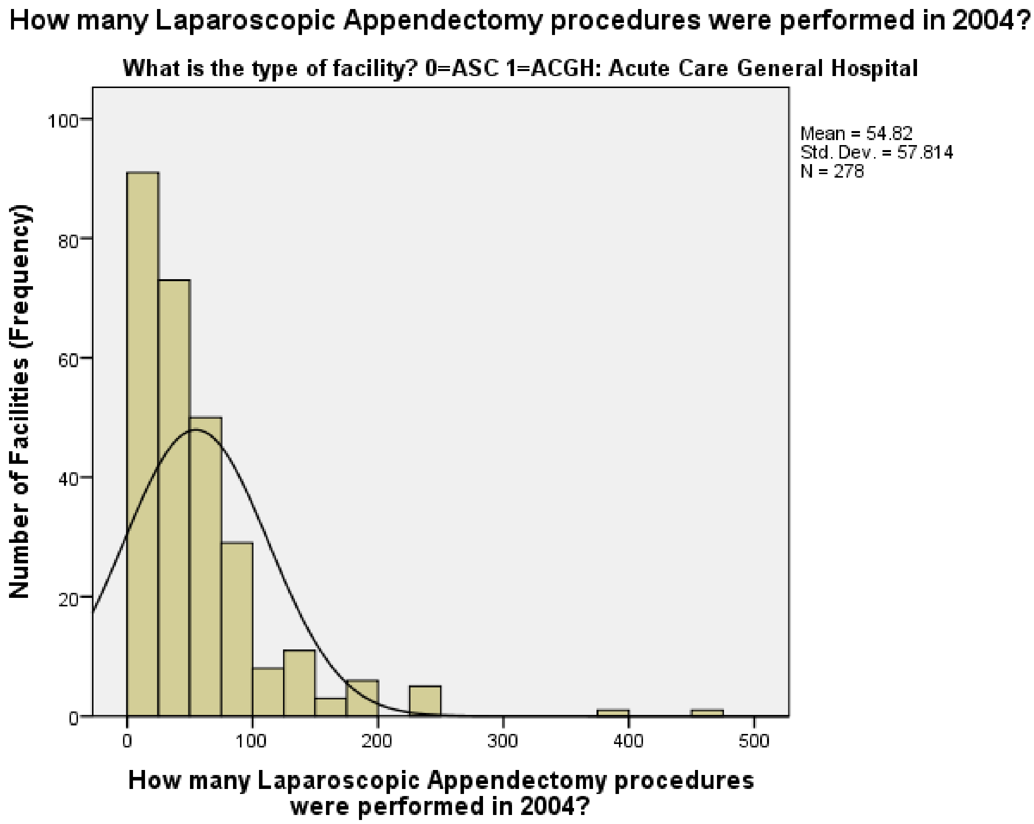
b Multiple modes exist. The smallest value is shown

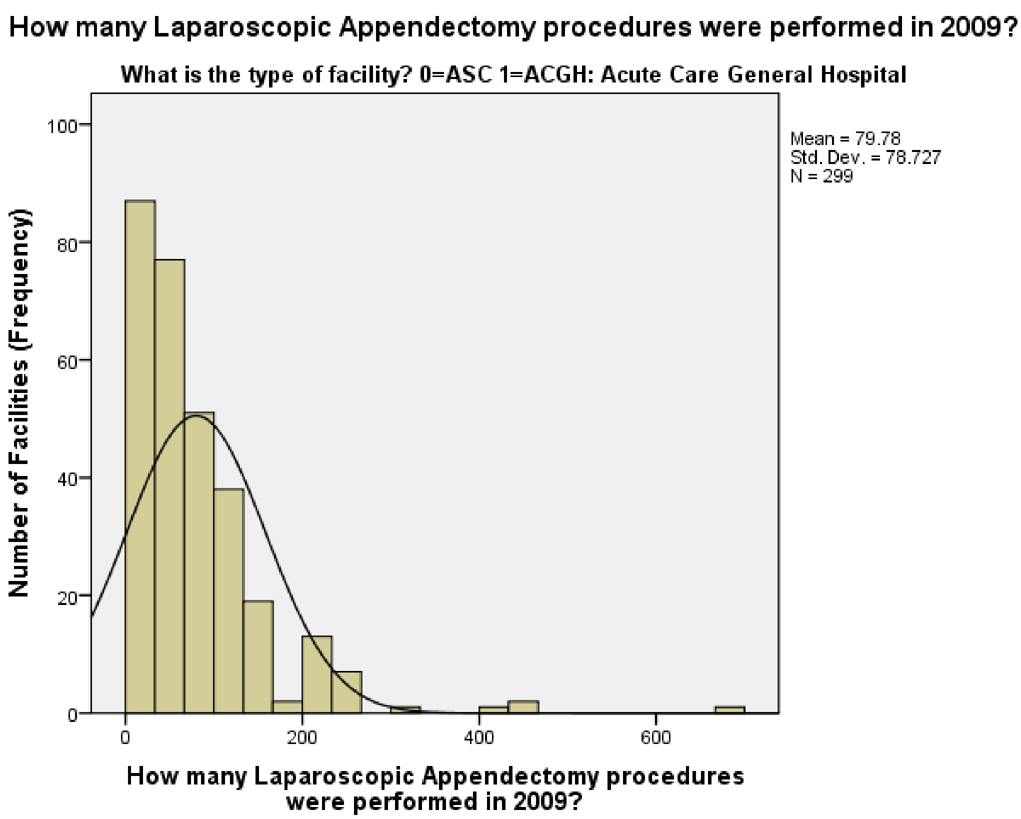
How many Open Appendectomy procedures were performed in 2004?

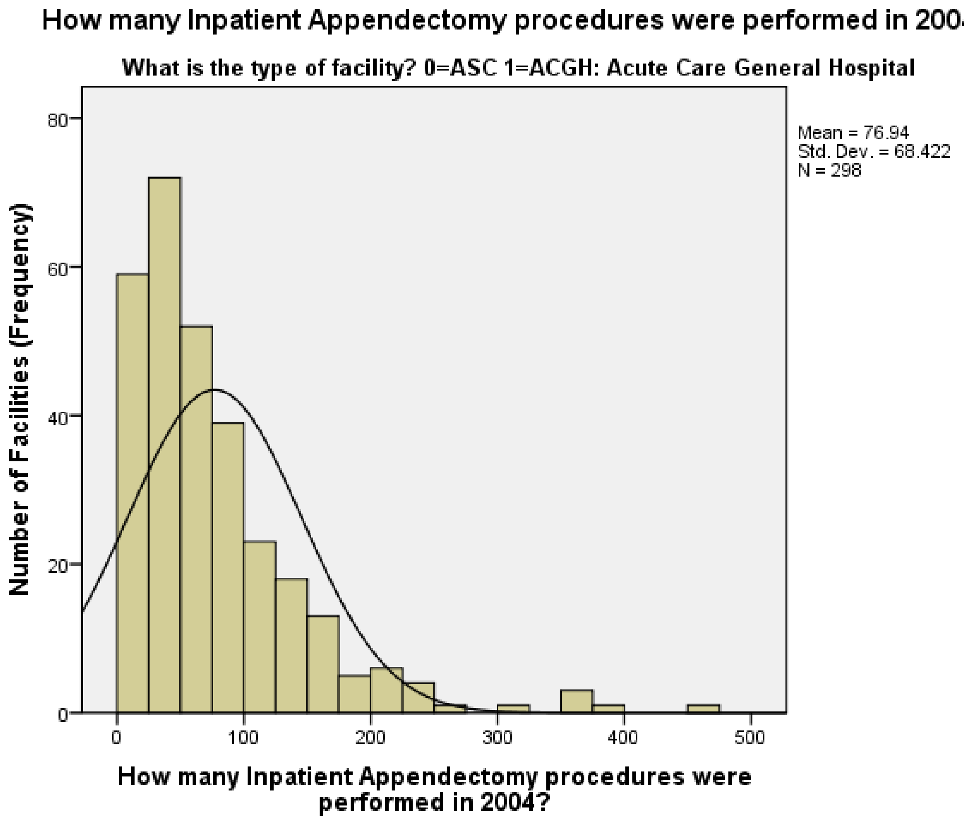


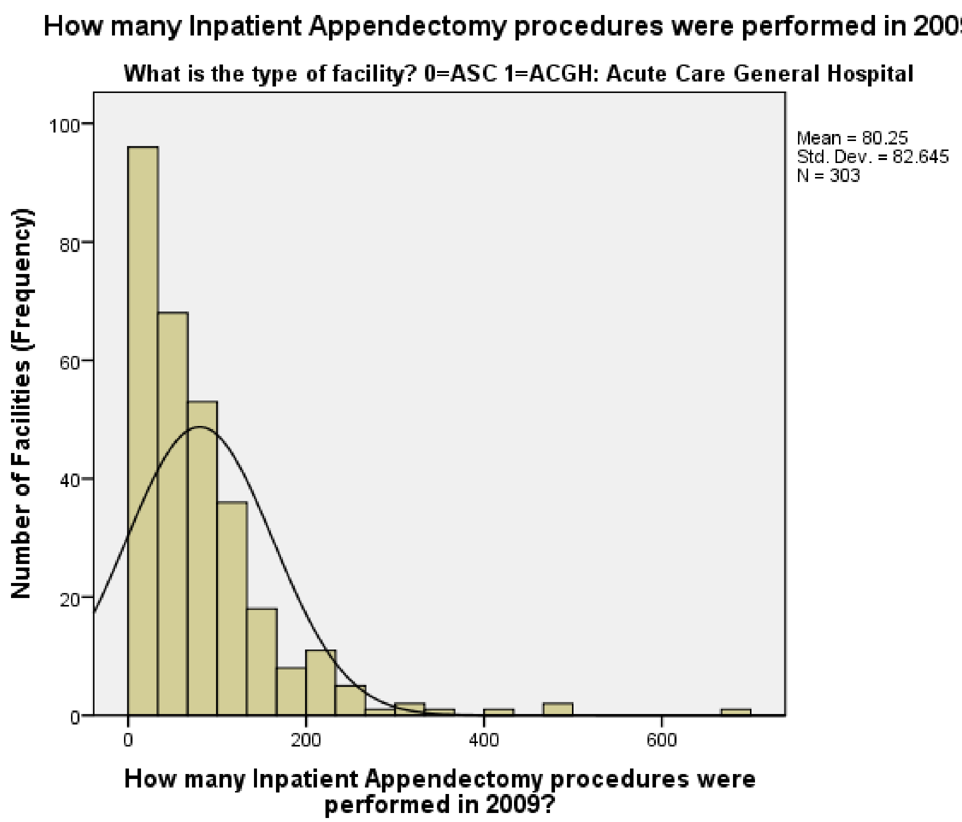
How many Open Appendectomy procedures were performed in 2009?

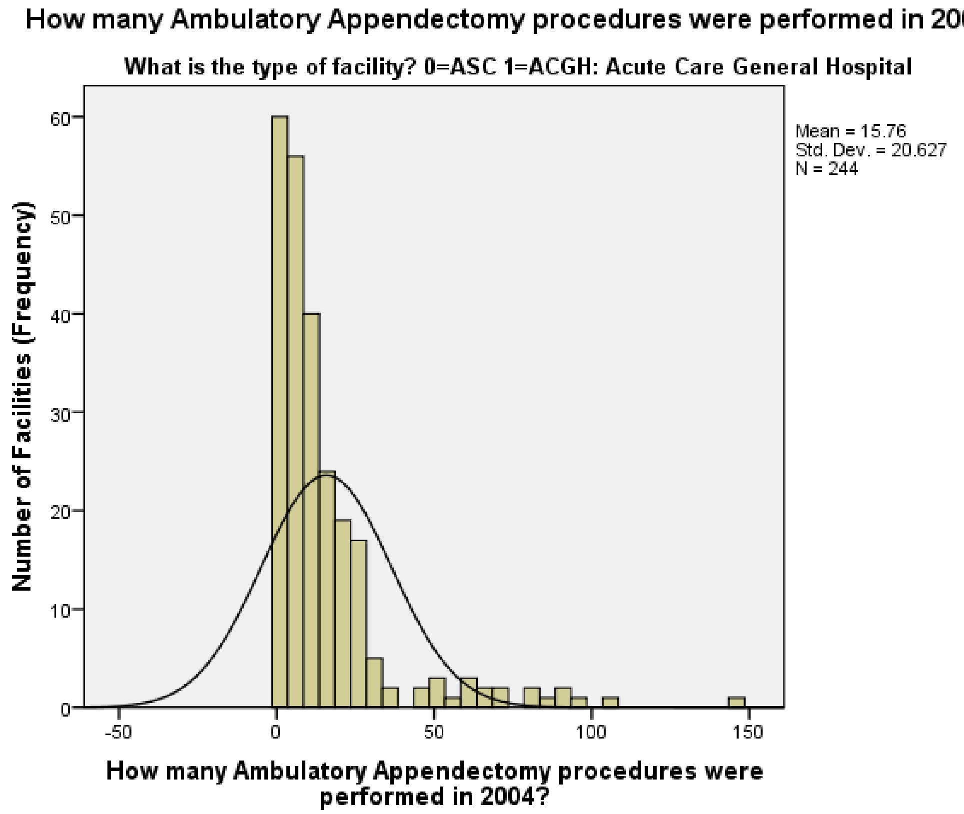


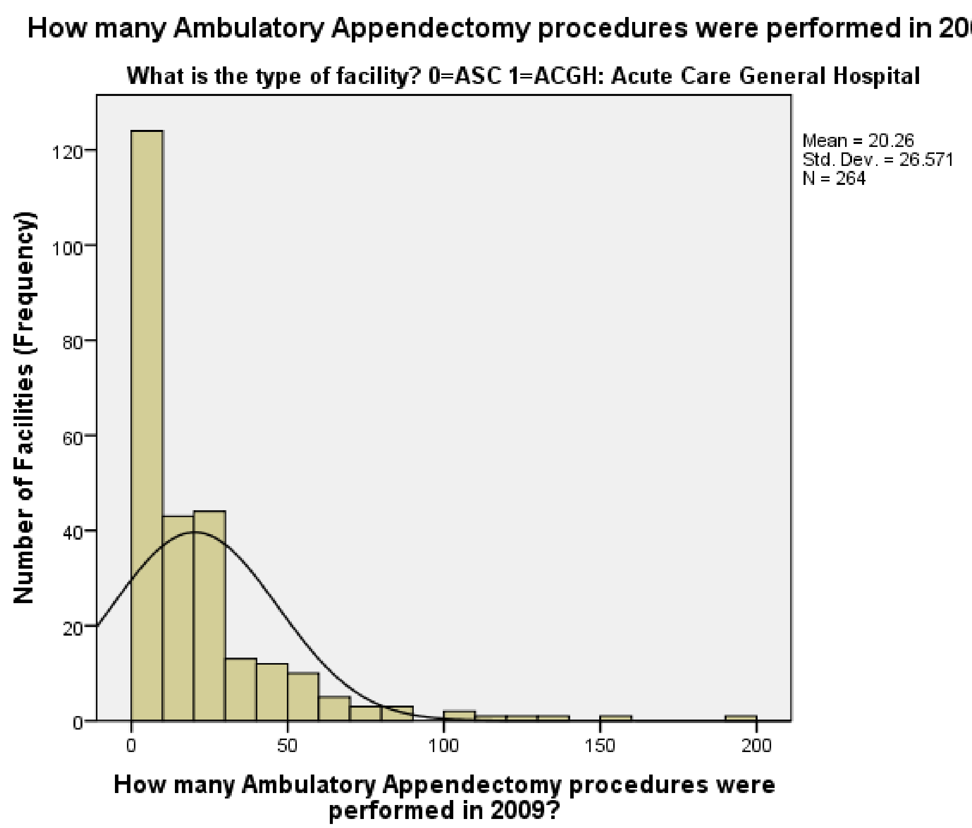

How many Laparoscopic Appendectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 54.82
Std. Dev. = 57.814
N = 278
Number of Facilities (Frequency)
0
20
40
60
80
100
0
100
200
300
400
500
How many Laparoscopic Appendectomy procedures were performed in 2004?


How many Laparoscopic Appendectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 79.78
Std. Dev. = 78.727
N = 299
Number of Facilities (Frequency)
0
20
40
60
80
100
0
200
400
600
How many Laparoscopic Appendectomy procedures were performed in 2009?


How many Inpatient Appendectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 76.94
Std. Dev. = 68.422
N = 298
Number of Facilities (Frequency)
0
20
40
60
80
0
100
200
300
400
500
How many Inpatient Appendectomy procedures were performed in 2004?


How many Inpatient Appendectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 80.25
Std. Dev. = 82.645
N = 303
Number of Facilities (Frequency)
0
20
40
60
80
100
0
200
400
600
How many Inpatient Appendectomy procedures were performed in 2009?


How many Ambulatory Appendectomy procedures were performed in 2004?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 15.76
Std. Dev. = 20.627
N = 244
Number of Facilities (Frequency)
0
10
20
30
40
50
60
-50
0
50
100
150
How many Ambulatory Appendectomy procedures were performed in 2004?


How many Ambulatory Appendectomy procedures were performed in 2009?
What is the type of facility? 0=ASC 1=ACGH: Acute Care General Hospital
Mean = 20.26
Std. Dev. = 26.571
N = 264
Number of Facilities (Frequency)
0
20
40
60
80
100
120
0
50
100
150
200
How many Ambulatory Appendectomy procedures were performed in 2009?

Appendix E: Partial List of CPT Surgical Procedure Codes Proposed for Exclusion from ASC Facility Fee Payment Because They Require an Overnight Stay

HCPCS/CPT	Code Short Descriptor
21175	Reconstruct orbit/forehead
25170	Extensive forearm surgery
27220	Treat hip socket fracture
28360	Reconstruct cleft foot
31040	Exploration behind upper jaw
31293	Nasal/sinus endoscopy, surg
39400	Visualization of chest
42225	Reconstruct cleft palate
42842	Extensive surgery of throat
42844	Extensive surgery of throat
43020	Incision of esophagus
43130	Removal of esophagus pouch
43280	Laparoscopy, fundoplasty
43510	Surgical opening of stomach
44970	**Laparoscopy, appendectomy**
47562	**Laparoscopic cholecystectomy**
60252	Removal of thyroid
63030	Low back disk surgery

Source: CMS. (2007a). 42 CFR Parts 410, 414, 416, 419, 421, 485, and 488. [CMS-1506-P; CMS-4125-P]. Washington, D.C. Department of Health and Human Services. Available online: http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/downloads/CMS1506P.pdf.

Appendix F: Partial List of Surgical Procedures Payable under the OPPS That Are Excluded From ASC Payment Because They Pose a Significant Safety Risk or Are Expected to Require an Overnight Stay

HCPCS/CPT	Code Short Descriptor
21175	Reconstruct orbit/forehead
22612	Lumbar spine fusion
25170	Extensive forearm surgery
27524	Treat kneecap fracture
28360	Reconstruct cleft foot
31600	Incision of windpipe
34203	Removal of leg artery clot
38120	Laparoscopy, splenectomy
43020	Incision of esophagus
43280	Laparoscopy, fundoplasty
44970	**Laparoscopy, appendectomy**
50080	Removal of kidney stone
59409	Obstetrical care
60252	Removal of thyroid
61720	Incise skull/brain surgery
62000	Treat skull fracture
63075	Neck spine disk surgery
63030	Low back disk surgery

Source: CMS. (2007b). Federal Register Volume 72 Number 148 Thursday, August 2. Rules and Regulations, Pages 42470-42626. Available online: http://www.gpo.gov/fdsys/pkg/FR-2007-08-02/html/07-3490.htm

REFERENCES

Aday, L. A., Begley, C. E., Lairson, D. R., & Balkrishnan, R. (2004). *Evaluating the healthcare system: Effectivess, efficiency, and equity*. Chicago, IL. Health Administration Press.

Aldrich, H. E. (1979). *Organizations and Environments*. Englewood Cliffs, NJ. Prentice-Hall.

Aldrich, H. E. (1999). *Organizations evolving*. Thousand Oaks, CA: Sage.

Aldrich, H. E., & Auster, E. R. (1986). Even dwarfs started small: Liabilities of age and size and their strategic implications. *Research in Organizational Behavior*, 8, 165–98.

Aldrich, H. E., & Pfeffer, J. (1976). Environments of organizations. *Annual Review of Sociology*, 2, 79-105.

Ambulatory Surgery Center Association. The history of ASCs. Available online: http://www.ascassociation.org/faqs/aschistory/. Downloaded: August 1, 2009

Ambulatory Surgery Center Association. (2011). Ambulatory surgery centers: A positive trend in health care. Available online: https://higherlogicdownload.s3.amazonaws.com/ASCACONNECT/ASCs%20-%20A%20Positive%20Trend%20in%20Health%20Care.pdf?AWSAccessKeyId=AKIAJH5D4I4FWRALBOUA&Expires=1360712951&Signature=0ltTcJV2Mr%2FwN8XkdIa%2FTp8vcsI%3D. (Posted October 08, 2011)

American College of Surgeons. *Cholecystectomy*. Patient education website. Available online: http://www.facs.org/public_info/operation/cholesys.pdf.

American Hospital Association (AHA). (2009). *TrendWatch - Geographic variation in health care spending: A closer look*. Washington, D.C. American Hospital Association.

American Society for Metabolic & Bariatric Surgery (ASMBS). (2005). Story of Obesity Surgery – Introduction: Brief History and Summary of Bariatric Surgery. Available online: http://asmbs.org/story-of-obesity-surgery-introduction/).

American Society for Metabolic & Bariatric Surgery (ASMBS). (2009). New risk management system reduces bariatric surgery complication rate by 65%, hospital readmissions by 80%: Knowing risk potential helps doctors and patients reduce complications and costs. Available online: http://www.asmbs.org/Newsite07/resources/asmbs_riskcomplicate_release.pdf. Downloaded: May 13, 2010.

American Society for Metabolic & Bariatric Surgery (ASMBS). Medicare removes CPT code 43770 (placement of gastric band) from the inpatient-only list. Available online: http://asmbs.org/2012/03/medicare-removes-cpt-code-43770-placement-of-gastric-band-from-the-inpatient-only-list/).

Anderson, G., Heyssel, R., & Dickler, R. (1993). Competition versus regulation: Its effect on hospitals. *Health Affairs*, 12(1), 70-80.

Andrews, R., & Elixhuaser, A. (2000) Use of major therapeutic procedures: Are Hispanics treated differently than non-Hispanics whites. *Ethnicity & Disease*, 10, 384-394.

Babbie, E. (2001). *The practice of social research*. Belmont, CA. Thomson Wadsworth.

Babbie, E. (2005). *The basics of social research*. Belmont, CA. Thomson Wadsworth.

Baker, L. C. & Atlas, S. W. (2004). Relationship between HMO market share and the diffusion and use of advanced MRI technologies. *Journal of American College of Radiology*, 1(7), 478-487.

Ballantyne, G. H., Leahy, P. F., & Modlin, I. M. (1994). *Laparoscopic surgery*. Philadelphia. W. B. Saunders Company.

Baum, J. A. C., & Amburgey, T. L. (2002) Organizational ecology. In J.A.C. Baum (ed.), *Blackwell Companion to Organizations*. Hoboken, NJ. John Wiley & Sons.

Baum, J. A. C., & Shipilov. (2004). Ecological approaches to organizations. In Stewart R. Clegg, Cynthia Hardy, Tom Lawrence, and Walter Nord (eds.), *Handbook of Organizations Studies* (2e): 55-110. London: Sage Publications.

Bazzoli, G. J., Gerland, A., & May, J. (2006). Construction activity in U.S. Hospitals. *Health Affairs*, 25(3), 783-791.

Becker's ASC Review. (2008a). Trending Growth of Hospitals and Surgery Centers Over Last Seven Years. Available online: http://www.beckersasc.com/news-analysis/trending-growth-of-hospitals-and-surgery-centers-over-last-seven-years.html.

Becker's ASC Review. (2008b). Distribution of Surgery Centers and Hospitals by Population Levels. Available online: http://www.beckersasc.com/news-analysis/distribution-of-surgery-centers-and-hospitals-by-population-levels.html.

Bennett, C. L., Stryker, S. J., Ferreira, R., Adams, J., & Beart, R. W., (1997). The learning curve for laparoscopic colorectal surgery. *Archives of Surgery*, 132, 41-44.

Berenson, R. A., Bodenheimer, T., & Pham, H. H. (2006). Specialty-service lines: Salvos in the new medical arms race. *Health Affairs*, 25, w337-w343.

Berliner, H. S. (2008). Regulating institutions in the U.S. health care market: The movement of services out of the hospital. *International Journal of Health Services*, 38(4) 625.

Berman, D. E., & Gertman, P. M. (1982). Variations in hospital use, inappropriate use, and public-policy consequences. In David L Rothberg (ed.), *Regional variation in hospital*

use: Geographic and temporal patterns of care in the United States. Lexington, MA. Lexington Books.

Berwick, D. M., Nolan, T. W., & Whittington, J. (2008). The triple aim: Care, health, and cost. *Health Affair*s, 27(3), 759-769.

Bian, J., & Morrisey, M. A. (2007). Free-Standing Ambulatory Surgery Centers and Hospital Surgery Volume. *Inquiry*, 44, 200-210.

Birkmeyer, J. D., Stukel, T. A., Siewers, A. E., Goodney, P. P., Wennberg, D. E., & Lucas, F. L. (2003). Surgeon volume and operative mortality in the United States. *New England Journal of Medicine*, 349(22), 2117-2127.

Blau, P. M., & Scott, W. R. (1962). *Formal Organizations*. San Francisco. Chandler.

Bower, J. L., & Christensen, C. M. (1995). Disruptive technologies: Catching the wave. *Harvard Business Review*, 73(1), 43-53.

Boxer, L. K., Dimick, J. B., Wainess, R. M., Cowan, J. A., Henke, P. K., Stanley, J. C., & Upchurch, G. R. (2003). Payer status is related to differences in access and outcomes of abdominal aortic aneurysm repair in the United States. *Surgery*, 134, 142-145.

Braveman, P., Schaaf, V. M., Egerter, S., Bennett, T., & Schecter, W. (1994). Insurance-related differences in the risk of ruptured appendix. *The New England Journal of Medicine*, 331, 444-449.

Brown, L. D. (1992). Political evolution of federal health care regulation. *Health Affairs*, 11(4), (1992), 17-37.

Buchwald, H. (2007). Surgical Intervention for the Treatment of Morbid Obesity and the Dyslipidemias. Future Lipidology, 2(5), 513-525. Available online: http://www.medscape.com/viewarticle/564952_3.

Buchwald, H. (2010). Metabolic surgery: a brief history and perspective (Editorial). *Surgery for Obesity and Related Diseases*, 6, 221−222. Available online: http://www.metacure.com/wp-content/uploads/2011/03/1.-Buchwald-H-Mar-2010.pdf.

Buchwald, H., & Buchwald, J. N. (2002). Evolution of Operative Procedures for the Management of Morbid Obesity 1950-2000. *Obesity Surgery*, 12, 705-715.

Buchwald, B., & Buchwald, J. N. (2008). Evolution of surgery for morbid obesity. In Pitombo, C., Jones, K. B., Higa, K. D., & Pareja, J. C. (eds.) *Obesity surgery: Principles and practice*. New York. The McGraw-Hill Companies, Inc.

Buechner, J. S. (2001). Trends in inpatient cholecystectomies, 1991-2000. *Medicine and Health, Rhode Island*, 85(5), 176-177.

Burns, L. R., David, G., & Helmchen, L. A. (2011). Strategic response by providers to specialty hospitals, ambulatory surgery centers, and retail clinics. *Population Health Management*, 14(2), 69-77.

Byrne, D. S. & Bell, G. (1994). Appendectomy: Laparoscopic procedure or open surgery? In F. M. Steichen & R. Welter (eds.), *Minimally invasive surgery and new technology*. St. Louis, MO. Quality Medical Publishing, Inc.

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research*. Boston, MA. Houghton Mifflin Company.

Casalino, L. P., Devers, K. J., & Brewster, L. R. (2003). Focused factories? Physician-owned specialty facilities. *Health Affairs*, 22(6), 56-67.

Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion Chronic Disease Indicators. State/Area Profile. United States Compared with Florida, Wisconsin. Available online: http://apps.nccd.cdc.gov/cdi/.

Centers for Medicare & Medicaid Services (CMS). (2000). Medicare Coverage Issues Manual. Transmittal 127, October 6. pgs. 5-6. Washington, D.C. Department of Health and Human Services. Available online: http://www.cms.gov/Regulations-and-Guidance/Guidance/Transmittals/downloads/R127CIM.pdf.

Centers for Medicare & Medicaid Services (CMS). (2004). Medicare Fee-For Service Payment, Hospital Outpatient PPS, Addendum B Update. Available online: http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/Addendum-A-and-Addendum-B-Updates-Items/CMS061151.html

Centers for Medicare & Medicaid Services (CMS). (2007a). 42 CFR Parts 410, 414, 416, 419, 421, 485, and 488. [CMS-1506-P; CMS-4125-P]. Washington, D.C. Department of Health and Human Services. Available online: http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/downloads/CMS1506P.pdf.

Centers for Medicare & Medicaid Services (CMS). CMS. (2007b). Federal Register Volume 72 Number 148 Thursday, August 2. Rules and Regulations, Pages 42470-42626. Available online: http://www.gpo.gov/fdsys/pkg/FR-2007-08-02/html/07-3490.htm.

Centers for Medicare & Medicaid Services (CMS). (2008). Final rule: [CMS-1390-F]; [CMS-1531-IFC1]; [CMS-1531-IFC2] [CMS-1385-F4] RIN 0938-AP15; RIN 0938-AO35; RIN

0938-AO65. Federal Register, 73(161). Available online: http://www.gpo.gov/fdsys/pkg/FR-2008-08-19/html/E8-17914.htm.

Centers for Medicare & Medicaid Services (CMS). (2009). Medicare Fee-For Service Payment, Hospital Outpatient PPS, Addendum B Update http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/Addendum-A-and-Addendum-B-Updates-Items/CMS1246836.html.

Centers for Medicare & Medicaid Services (CMS). (2012). Medicare Benefit Policy Manual. Chapter 6 - Hospital Services Covered Under Part B. Available online: http://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/bp102c06.pdf.

Centers for Medicare & Medicaid Services (CMS). (2013a). Decision Memo for Bariatric Surgery for the Treatment of Morbid Obesity (CAG-00250R)). Available online: http://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=160&ver=32&NcaName=Bariatric+Surgery+for+the+Treatment+of+Morbid+Obesity+(1st+Recon)&bc=BEAAAAAAEAgA&.

Centers for Medicare & Medicaid Services (CMS). (2013b). Ambulatory Surgical Center Fee Schedule. Washington, D. C. Department of Health And Human Services, The Medicare Learning Network. Available online: http://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/downloads/AmbSurgCtrFeepymtfctsht508-09.pdf.

Chandler, A. D. (1962). *Strategy and structure: Chapters in the history of the American industrial enterprise*. Cambridge, MA. Massachusetts Institute of Technology Press.

Chernew, M. E., Jacobson, P. D., Hofer, T. P., Aaronson, K. D., & Fendrick, A. M. (2004). Barriers to constraining health care cost growth. *Health Affairs*, 23(6), 122-128.

Choudhry, S., Choudhry, N. K., & Brennan, T. A. (2005). Specialty versus community hospitals: What role for the law? *Health Affairs – Web Exclusive*, August 9, W5-361 – W5-372. Available online: http://content.healthaffairs.org/cgi/reprint/hlthaff.w5.361v1.

Christensen, C. M. (2003). *The Innovator's Dilemma.* New York. HarperBusiness.

Christensen, C. M. (2008). Disruptive innovation: Dilemmas persist. *Innovation Zen*, 86(1), 98-105, 137.

Christensen, C. M., Bohmer, R., & Kenagy, J. (2000). Will disruptive innovations cure health care? *Harvard Business Review*, 78(5), 102-12, 199.

Christensen, C. M., & Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal*, 17(3), 197-218.

Christensen, C. M., Grossman, J. H., & Hwang, J. (2009). *The innovator's prescription: A disruptive solution for health care*. New York. McGraw-Hill.

Christensen, C. M., & Rosenbloom, R. S. (1995). Explaining the attacker's advantage: Technological paradigms, organizational dynamics, and the value network. *Research Policy*, 24, 233-257.

Clancy, T. E., & Brooks, D. C. (2004). Minimally invasive surgery. *Encyclopedia of gastroenterology*, 653-659. Elsevier (USA).

Coddington, D. C., Palmquist, L. E., & Trollonger, W. V. (1985). Strategies for survival in the hospital industry. *Harvard Business Review*, May-June, 129-138.

Cram, P., Rosenthal, G. E., & Vaughan-Sarrazin, M. S. (2005). Cardiac revascularization in specialty and general hospitals, *New England Journal of Medicine*, 352 (14), 1454–1463.

Cram, P., Vaughan-Sarrazin, M. S., Wolf, B., Katz, J. N., & Rosenthal, G. E. (2007). A comparison of total hip and knee replacement in specialty and general hospitals. *Journal of Bone and Joint Surgery*, 89 (8), 1675–1684.

Cullen, K.A., Hall, M.J., & Golosinskiy, A. (2009). Ambulatory Surgery in the United States. 2006. National health statistics reports; no 11. Revised. Hyattsville, MD: National Center for Health Statistics. Available online: http://www.cdc.gov/nchs/data/nhsr/nhsr011.pdf.

Cutler, D. M. & McClellan, M. (1996). The determinants of technological change in heart attack treatment. Working Paper 5751 (Working Paper Series). Cambridge, MA. National Bureau of Economic Research (NBER).

Cutler, D. M., & McClellan, M. (2001). Is technological change in medicine worth it? *Health Affairs*, 20(5), 11-29.

Dalziel, P. & Shah, T. (2010). Disruptive innovation. *The Jefferson Medicine Forum*, 12(1), 4-7.

Damanpour, F. (1992). Organization size and innovation. *Organization Studies*, 13(3), 375.

Danneels, E. (2004). Disruptive technology reconsidered: A critique and research agenda. *Journal of Product Innovation Management*, 21(4), 246-258.

Daviglus, M. L., Liu, K., Pirzada, A., Yan, L. L., Garside, D. B., Greenland, P., Manheim, L. M., Dyer, A. R., Wang, R., Lubitz, J., Manning, W. G., Fries, J. F., & Stamler, J. (2005). Cardiovascular risk profile earlier in life and Medicare costs in the last year of life. *Archives of Internal Medicine*, 165(9), 1028-1034.

Davis, C. J. (1984). A history of endoscopic surgery. *Surgery, Gynecology & Obstetrics*, 158(2), 181-189.

Davis, K. & Russell, L. B. (1972). The substitution of hospital outpatient care for inpatient care. *The Review of Economics and Statistics*, 54(2), 109-120.

De, U. Evolution of cholecystectomy: A tribute to Carl August Langenbuch. *Indian Journal of Surgery*, 66(2), 97-100.

Deloitte Center for Health Solutions. (2008). The medical home: Disruptive innovation for a new primary care model. Available online: http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us_chs_MedicalHome_w.pdf.

Deloitte Center for Health Solutions. (2009). Retail clinics: Updates and implications. Available online: http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us_chs_RetailClinics_111209.pdf.

Deloitte Center for Health Solutions. (2010). Social networks in health care: Communication, collaboration and insights. Available online: http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/US_CHS_2010SocialNetworks_070710.pdf.

Devers, K. (2003). Specialty hospitals: focused factories or cream skimmers? Center for Studying Health System Change, Conference transcript (April 15). Available online: http://hschange.org/CONTENT/555/?id_conf=13.

DiMaggio, P. J. & Powell, W. W. (2004). The iron cage revisited: Institutional isomorphism and collective rationality in organization fields. In Dobbin, F. (ed.) *The New Economic Sociology*, Princeton. Princeton University Press. (Chapter 4, 111-134).

Dranove, D., Shanley, M., & Simon, C. (1992). Is hospital competition wasteful? *The RAND Journal of Economics*, 23(2), 247-262.

Easter, D. W. (1993). The diagnosis and treatment of acute appendicitis with laparoscopic methods. In John G. Hunter & Jonathan M. Sackier (eds.), *Minimally Invasive Surgery*. New York. McGraw-Hill, Inc.

Encinosa, W. E., Bernard, D. M., Steiner, C. A., & Chen, C. (2005). Use and costs of bariatric surgery and prescription weight-loss medications. *Health Affairs*, 24(4), 1039-1046.

Evans, M. (2012). Empty threat. *Modern Healthcare*, 42(13), 6-16.

Federal Trade Commission & Department of Justice. (2004). *Improving health care: A dose of competition*. A report by the Federal Trade Commission and the Department of Justice. Available online: http://www.ftc.gov/reports/healthcare/040723healthcarerpt.pdf.

Fendrick, A. M., Escarce, J. J., McLane, C., Shea, J. A., & Schwartz, J. S. (1994). Hospital adoption of laparoscopic cholecystectomy. *Medical Care*, 32(10), 1058-1063.

Fennell, M. L., & Alexander, J. A. (1993). Perspectives on organizational change in the US medical care sector. *Annual Review of Sociology*, 19, 89-122.

Frankfort-Nachmias, C. & Nachmias, D. (2008). *Research methods in the social sciences*. New York. Worth Publishers.

Freidson, E. (1989). *Medical work in America: Essays on health care*. New Haven, CT. Yale University Press.

Fuchs, V. R. (1978). The supply of surgeons and the demand for operations. *The Journal of Human Resources*, 13, 35-56.

Garber, A., Goldman, D. P., & Jena, A. P. (2007). The promise of health care cost containment. *Health Affairs*, 26(6), 1545-1547.

Garbutt, J. M., Soper, N. J., Shannon, W. D., Botero, A., & Littenberg, B. (1999). Meta-analysis of randomized controlled trials comparing laparoscopic and open appendectomy. *Surgical Laparoscopy & Endoscopy*, 9(1), 17-26.

Gelijns, A. C., & Halm, E. A. (1991). *The changing economics of medical technology*. Institute of Medicine. Washington, D.C. National Academy of Sciences.

Ginsburg, P. B. (2005). Competition in health care: Its evolution over the past decade. *Health Affairs*, 24(6), 1512-1522.

Ginsburg, P. B. (2007). Private payer roles in moving to more efficient health spending. In Alice M. Rivlin and Joseph R. Antos (eds.), *Restoring Fiscal Sanity*. Washington, D. C. The Brookings Institution.

Girotto, J. A., Koltz, P. F., & Drugas, G. (2010). Optimizing your operating room: Or, why large, traditional hospitals don't work. *International Journal of Surgery*, 8, 359-367.

Glabman, M. (2009). Disruptive Innovations That Will Change Your Life in Health Care. *Managed Care*, 18, 12-21.

Goldman, D. P., Shang, B., Bhattacharya, J., Garber, A. M., Hurd, M., Joyce, G. F., Lakdawalla, D. N., Panis, C., & Shekell, P. G. (2005). Consequences of health trends and medical innovation for the future elderly. *Health Affairs – Web Exclusive*, September 26, W5-R5

– W5-R17. Available online: http://content.healthaffairs.org/cgi/content/full/hlthaff.w5.r5/DC1.

Goldstein, J. M. & Horgan, C. M. (1988) Inpatient and outpatient psychiatric services: substitutes or complements? *Hospital and Community Psychiatry*, 39(6), 632-635.

Goldstein, M. M., & Rothstein, M. A. (2010). Information technology is considered a potentially transformative element in the field of health care by purchasers, regulators, providers, vendors, and consumers alike. *Journal of Law, Medicine & Ethics*, 38(1): 6.

Goldstein, S. M., Ward, P. T., Leong, G. K., & Butler, T. W. (2002). The effect of location, strategy, and operations technology on hospital performance, *Journal of Operations Management* 20, 63 - 75.

Govindarajan, V., Kopalle, P. K. (2006). The usefulness of measuring disruptiveness of innovations ex post in making ex ante predictions. *Journal of Product Innovation Management*, 23, 12-18.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, 91(3), 481-510.

Guerin-Calvert, M. E., & Israilevich, G. (2011). *Assessment of cost trends and price differences for U. S. hospitals*. Compass Lexecon. Washington, D.C. Available online: http://www.aha.org/content/11/11costtrendspricediffreport.pdf.

Guller, U., Hervey, S.,Purves, H., Muhlbaier, L. H., Peterson, E. D., Eubanks, S., Pietronbon, R. (2004). Laparoscopic versus open appendectomy: Outcomes comparison based on a large administrative database. *Annals of Surgery*, 239(1), 43- 52.

Hackbarth, G. M. (2005). Physician-owned specialty hospitals. Testimony before the Committee on Finance, U.S. Senate March 8. Available online: www.medpac.gov/publications/congressional_testimony/030805_TestimonySpecHosp-Sen.pdf .

Hadley, J., Steinberg, E. P., & Feder, J. (1991). Comparison of uninsured and privately insured hospital patients: Condition on admission, resource use, and outcome. *JAMA*, 265(3), 374-379.

Hadley, J. Zuckerman, S., & Iezzoni, L. I. (1996). Financial pressure and competition: Changes in hospital efficiency and cost-shifting behavior. *Medical Care*, 34(3), 205-219.

Hall, M. J., DeFrances, C. J., Williams, S. N., Golosinskly, A., & Schwartzman, A. (2010). National hospital discharge survey: 2007 summary. *National Health Statistics Report*, 29.

Washington, D. C. Center for Disease Control and Prevention. Available online: http://www.cdc.gov/nchs/data/nhsr/nhsr029.pdf.

Halm, E. A., & Gelijns, A. C. (1991). An introduction to the changing economics of technological innovation in medicine. In Annetine C. Gelijns, Ethan A. Halm (eds.), *The changing economics of medical technology*. Washington, D.C. National Academy Press.

Hannan, M. T. & Freeman, J. (1977). The population ecology of organizations. *The American Journal of Sociology*, 82(5), 929-964.

Hannan, M. T. & Freeman, J. (1984). Structural inertia and organizational change. *American Sociological Review*, 49(2), 149-164.

Hannan, M. T., & Freeman, J. H. (1988). The ecology of organizational mortality: American labor unions, 1836–1985. *American Journal of Sociology*, 94: 25–52.

Hannan, M. T., & Freeman, J. H. (1989). *Organizational Ecology*. Cambridge, MA. Harvard University Press.

Hansen, E., & Bozic, K.J. (2009). The impact of disruptive innovations in orthopaedics. *Clinical Orthopaedics and Related Research*, 467(10), 2512-20. Available online: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2745460/pdf/11999_2009_Article_865.pdf.

Harrisson, L. E., French, T. S., & Caushaj, P. F. (1994). Appendectomy. In Garth H. Ballantyne, Patrick F. Leahy, & Irvin M. Modlin (eds.), *Laparoscopic surgery*. Philadelphia. W. B. Saunders Company.

Haveman, H. A. (1993). Organizational size and change: Diversification in the savings and loan industry after deregulation. *Administrative Science Quarterly*, 38(1), 20-50.

He, D., & Mellor, J. M. (2012), Hospital volume responses to Medicare's Outpatient Prospective Payment System: Evidence from Florida. *Journal of Health Economics*, 31, 730-743.

HealthGrades (2009). The fourth annual HealthGrades bariatric surgery trends in American hospitals study. Available online: http://www.healthgrades.com/media/DMS/pdf/HealthGradesBariatricSurgeryTrendsStudy2009.pdf.

Heard, D. N. (2005). The specialty hospital debate: The difficulty of promoting fair competition without stifling efficiency. *Houston Journal of Health Law & Policy*, 6-1, 215-243. Available online: http://www.law.uh.edu/hjhlp/Issues%5CVol_61%5CHeard.pdf.

Hoballah, J. J., Liao, J., Salameh, M., & Weigel, R. J. (2008). Physician reimbursement for general surgical procedures in the last century: 1906-2006. *Journal of the American College of Surgeons*, 206(4), 670-677.

Hume, D. J. & Simpson, J. (2006). Acute Appendicitis. *British Medical Journal*, 333, 530-534.

Hunkar, D. (2009). Comparing U.S. healthcare spending with other OECD countries. Available online: http://seekingalpha.com/article/146992-comparing-u-s-healthcare-spending-with-other-oecd-countries.

Hunter, J. G. & Sackier, J. M. (1993). *Minimally invasive surgery*. New York. McGraw-Hill, Inc.

Hutter, M. M., Randall, S., Khuri, S. F., Henderson, W. G., Abbott, W. M., & Warshaw, A. L. (2006). Laparoscopic versus open gastric bypass for morbid obesity: A multicenter, prospective, risk-adjusted analysis from the national surgical quality improvement program, *Annals of Surgery*, 243(5), 657–666.

Hwang, J. (2011). Innovation is alive and well in health care. Future of innovation: A CNBC special report. Available online: http://www.cnbc.com/id/44905039.

Hwang, J. & Christensen, C. M. (2008). Disruptive innovation in health care delivery: A framework for business-model innovation. *Health Affairs*, 27(5), 1329-1335.

Iglehart, J. (2005). The emergence of physician-owned specialty hospitals, *The New England Journal of Medicine*, 352(1), 78-84.

Joyce, G. F., Keeler, E. B., Shang, B., & Goldman, D. P. (2005). The Lifetime Burden Of Chronic Disease Among The Elderly. *Health Affairs – Web Exclusive*, September 26, R18-R29. Available online: http://content.healthaffairs.org/cgi/reprint/hlthaff.w5.r18v1?maxtoshow=&hits=10&RESULTFORMAT=&fulltext=Joyce+Keeler+The+Lifetime+Burden&searchid=1&FIRSTINDEX=0&resourcetype=HWCIT.

Kaluzny, A., Alexander, J., Hurley, R., & Galloway, R. (1987). Competition and survival of Health service organizations: A population ecology approach. *International Journal of Health Planning and Management*, 2, 3-14.

Katkhouda, N. (2010). *Advanced laparoscopic surgery: Techniques and tips*. New York. Springer.

Keehan, S., Sisko, A., Truffer, C., Smith, S., Cowan, C., Poisal, J., Clemens, M. K., & the National Health Expenditure Accounts Projections Team. (2008). Health spending projections through 2017: The baby boom generation is coming to Medicare. *Health Affairs*, 27(2), w145-w155.

Kerlinger, F. N. & Lee, H. B. (2000). *Foundations of behavioral research*. London. Wadsworth Thomson Learning.

Kimberly, J. R. (1976). Organizational size and the structuralist perspective: A review, critique, and proposal. *Administrative Science Quarterly*, 21(4), 571-597.

Kraus, T. W., Büchler, M. W., & Herfarth, C. (2005). Relationships between volume, efficiency, and quality in surgery—A delicate balance from managerial perspectives. *World Journal of Surgery*, 29, 1234-1240.

Ladapo, J. A., Horwitz, J. R., Weinstein, M. C., Gazelle, G. S., & Cutler, D. M. (2009). Adoption and spread of new imaging technology: A case study. *Health Affairs*, 28(6), w1122-w1132.

Lakdawalla, D. N., Goldman, D. P., & Shang, B. (2005). The health and cost consequences of obesity among the future elderly. *Health Affairs—Web Exclusive,* September 26, W5-R30—W5-R41.

Leape, L. L. (1989). Unnecessary surgery. A Pew Memorial trust policy synthesis: 7 HSR: *Health Services Research*, 24(3), 351-407.

Leape, L. L. (1992). Unnecessary surgery. *Annual Review of Public Health*, 13, 363-383.

Leape, L.L., & Berwick, D. M. (2005). Five years after to err is human: What have we learned? *Journal of the American Medical Association*, 293(19), 2384–2390.

Lee, J. S., Sheer, J. L. O., Lopez, N., & Rosenbaum, S. (2010). Coverage of Obesity Treatment: A State-by-State Analysis of Medicaid and State Insurance Laws. Public Health Reports, 25(4), 596–604.

Legorreta, A. P. Silber, J. H., Costantino, G. N. Kobylinski, R. W., & Zatz, S. L. (1993). Increased cholecystectomy rate after the introduction of laparoscopic cholecystectomy. *JAMA*, 270(12), 1429- 1432.

Levit, K. R., Lazenby, H. C., Cowan, C. A. & Letsch, S. W. (1993). Health spending by state: New estimates for policy making. *Health Affairs*, 12(3): 7-26.

Lubitz, J. (2005). Health, technology, and medical care spending. *Health Affairs*, *Web-Exclusive*, September 26, W5-R81—W5-R85.

Luke, R., Begun, J. W., & Walston, S. (1999). Strategy Making in Health Care Organizations. In A. D. Kaluzny & S. M. Shortell (eds.), *Health care management: Organization design and behavior*. New York. Delmar.

Luke, R. D., Walston, S. L., & Plummer, P. M. (2004). *Healthcare strategy in pursuit of competitive advantage*. Association of University Programs in Health Administration. Washington, D.C.

Luna, J. M., Thurman, P. W., Wolfe, M., Yagoda, D., Reed, E., & Figg, W. D. (2009). Private practice administrative costs influenced by insurance payer mix. *Journal of Oncology Practice*, 5(6), 291-297.

Makar, S. D. (1991). Antitrust immunity under Florida's Certificate of Need program. *Florida State University Law Review*, 19, 149-190).

Martin, L. F. (2004). The evolution of surgery for morbid obesity. In Martin, L. F. (ed.) *Obesity surgery*. New York. The McGraw-Hill Companies, Inc.

Martin, A., Whittle, L., Levit, K., Won, G., & Hinman, L. (2002). Health care spending during 1991–1998: A fifty-state review. *Health Affairs*, 21(4), 112-126.

Marzouk, M., Khater, M., Elsadek, M., & Abdelmoghny, A. (2003). Laparoscopic vs. open appendectomy. *Surgical Endoscopy*, 17, 721-724.

Mathews, J. E. (1993). The physician self-referral dilemma: Enforcing antitrust law. *American Journal of Law & Medicine*, 19, 523-546.

Mattioli, F. (1994). Philosophy and rationale in the development of surgical techniques. In F. M. Steichen & R. Welter (eds.), *Minimally invasive surgery and new technology*. St. Louis, MO. Quality Medical Publishing, Inc.

McCarthy, E. G. & Finkel, M. L. (1980). Surgical utilization in the U.S. A. *Medical Care*, 18(9), 883-892.

McFarland, D. A. (1987). *Patterns of strategic responses by hospitals to changes in the competitive environment of the hospital industry: A study in strategic groups*. Dissertation: The University of Tennessee.

McKernan, J. B. (1994). Essential concepts and skills in laparoscopic surgery. In F. M. Steichen & R. Welter (eds.), *Minimally invasive surgery and new technology*. St. Louis, MO. Quality Medical Publishing, Inc.

Medicare Payment Advisory (MedPAC) Commission. (2008). A data book: Healthcare spending and the Medicare program. Ambulatory surgery in the United States, 2006. National Center for Health Statistics, Centers for Disease Control and Prevention. Available online: http://www.amednews.com/article/20090330/government/303309971/4/.

Medicare Payment Advisory (MedPAC) Commission (2011). *Report to the Congress: Medicare Payment Policy*. Washington, D.C. MedPAC. Available online: http://www.medpac.gov/chapters/Mar11_Ch03.pdf.

Medicare Payment Advisory (MedPAC) Commission (2012). *Report to the Congress: Medicare Payment Policy*. Washington, D.C. MedPAC. Available online: http://www.medpac.gov/documents/Mar12_EntireReport.pdf.

Mendelson, D. N., & Schwartz, W. B. (1993). The effects of aging and population growth on health care costs. *Health Affairs*, 12(1), 119-125.

Merlis, M. L. (2009). Health care cost containment and coverage expansion. Social Science Research Network. Available online: http://ssrn.com/abstract=1338344 or http://dx.doi.org/10.2139/ssrn.1338344.

Miles, R. E., & Snow, C. C. (1978). *Organizational Strategy, Structure, and Process*. New York. McGraw-Hill.

Miller, D. C., Wei, J. T., Dunn, R. L., & Hollenbeck, B. K. (2006). Trends in the diffusion of laparoscopic nephrectomy. *Journal of the American Medical Association*, 295(21), 2480-2481.

Mitchell, J. B., & Cromwell, J. (1982). Variations in surgery rates and the supply of surgeons. In David L Rothberg (ed.), *Regional variation in hospital use: Geographic and temporal patterns of care in the United States*. Lexington, MA. Lexington Books.

Mitchell, J. M. (2005). Effects of physician-owned limited-service hospitals: Evidence from Arizona. *Health Affairs*, W5, 481-490.

Morton, J., Ahmed, S., Gwaltney, D. & Bajaj, C. (2011). New research shows gastric bypass may have new role for less obese patients. ASMBS. Available online: http://s3.amazonaws.com/publicASMBS/GuidelinesStatements/Press%20Releases/LowBMIDiabeesSurgery6-16-11.pdf.

National Center for Health Statistics (2010). Health, United States, 2009: With Special Feature on Medical Technology. Hyattsville, MD. 2010. Available online: http://www.cdc.gov/nchs/data/hus/hus09.pdf.

National Conference of State Legislatures (NCSL). (2011) Certificate of Need: State Health Laws and Programs. Available online: http://www.ncsl.org/default.aspx?tabid=14373).

National Research Council. (2001). *New horizons in health: An integrative approach*. Committee on Future Directions for Behavioral and Social Sciences Research at the National Institutes of Health, Burton H. Singer & Carol D. Ryff (eds.). Washington, DC. National

Academy Press. Available online: http://www.ncbi.nlm.nih.gov/books/NBK43788/pdf/TOC.pdf.

New Jersey Commission on Rationalizing Health Care Resources. (2008). *Final Report*. Available online: http://nj.gov/health/rhc/index.shtml.

Nguyen, N. T., Zainabadi, K., Mavandadi, S., Paya, M., Stevens, M., Root, J., & Wilson, S. E. (2004). Trends in utilization and outcomes of laparoscopic versus open appendectomy. *The American Journal of Surgery*, 188, 813-820.

Nguyen, N. T., Hohmann, S., Slone, J., Varela, E., Smith, B. R., & Hoyt, D. (2010). Improved bariatric surgery outcomes for Medicare beneficiaries after implementation of the Medicare national coverage determination**.** *Archives of Surgery*, 145 (1): 72-78.

Nichols, L. M., Ginsburg, P. B., Berenson, R. A., Christianson, J., & Hurley, R. E. (2004). Are market forces strong enough to deliver efficient health care systems? Confidence is waning. *Health Affairs*, 23(2), 8–21.

Nissley, E. L. (2012). Hospital jobs shifting to outpatient clinics. *The Scranton Times Tribune* (March 11). Available online: http://thetimes-tribune.com/news/business/hospital-jobs-shifting-to-outpatient-clinics-1.1282600.

Nohria, N. & Gulati, R. (1994). Firms and their environments. In Neil J. Smelser & Richard Swedberg (eds.), *The handbook of economic and sociology*. Princeton University Press.

O'Connor, D. (2006). New ASC payment system: Is that all there is? *Outpatient Surgery Magazine*, Available online: http://www.outpatientsurgery.net/issues/2006/09/print&id=4159.

O'Donovan, T. R. (1976). *Ambulatory surgical centers*: *Development and management*. Germantown, MD: Aspen Systems.

Obesity Education Initiative. (2000). *Practical Guide to the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*. National Heart, Lung, and Blood Institute's (NHLBI). Available online: http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_b.pdf.

Oh, E., Imanaka, Y., & Evans, E. (2005). Determinants of the diffusion of computed tomography and magnetic resonance imaging. *International Journal of Technology Assessment in Health Care*, 21(1), 73-80.

Olmi, S., Magnone, S., Bertolini, A., & Croce, E. (2005). Laparoscopic vs. open appendectomy in acute appendicitis. *Surgical Endoscopy*, 19, 1193-1195.

Olshansky, S. J. (2005). Projecting the future of U.S. health and longevity. *Health Affairs—Web Exclusive*, September 26, W5-R86—W5-R89.

Organization for Economic Cooperation and Development (OECD). (2009). *OECD health data 2009: statistics and indicators for 30 countries*. Paris, France: Organization for Economic Cooperation and Development: 2009. Available from: http://www.ecosante.org/index2.php?base=OCDE&langh=ENG&langs=ENG&sessionid.

Orlando, R., Russell, J. C., Lynch, J., & Mattie, A. (1993). Laparoscopic cholecystectomy: A statewide experience. *Archives of Surgery*, 128, 494-499.

Orszag, P. R. (2008). *The overuse, underuse, and misuse of health care*. Testimony before the Committee on Finance, U.S. Senate. July 17.

Palanivelu, C. (2008). *Laparoscopic surgery atlas* (Vol. 1). New York. The McGraw-Hill.

Pauly, M. V. (1979). What is unnecessary surgery? *The Millbank Memorial Fund Quarterly, Health and Society*, 57(1), 97-117.

Payer, L. (1996). *Medicine & culture*. New York. Henry Holt and Company, LLC.

Pfeffer, J. (1981). *Power in organizations*. Boston. Pitman.

Pfeffer, J. & Salancik, G. R. (1978). *The External Control of Organizations: A Resource Dependence Perspective*. New York. Harper & Row.

Pham, H.H., Devers, K. J., May, J. H., & Berenson, R. (2004). Financial pressures spur physician entrepreneurialism. *Health Affairs*, 23(2), 70-81.

Phurrough, S., Salive, M. E., Brechner, R. J., Tillman, K., Harrison, S., & O'Connor, D. (2006). Decision memo for bariatric surgery for the treatment of morbid obesity. Available online: http://www.cms.hhs.gov/mcd/viewdecisionmemo.asp?from2=viewdecisionmemo.asp&id=160&.

Porter, M. E. (1979). How competitive forces shape strategy. *Harvard Business Review*. March/April.

Porter, M. E. (1980). *Competitive Strategy*. New York. Free Press.

Porter, M. E. (1985). *Competitive Advantage*. New York. Free Press.

Porter, M. E., & Teisberg, E. O. (2004). *Redefining competition in health care*. Boston, MA. Harvard Business School Press

Porter, M. E. & Teisberg, E. O. (2006). *Redefining heath care: Creating value-based competition on results*. Boston, MA. Harvard Business School Press.

Prince, T. R. (1994). Operating performance and financial constraints of Catholic community hospitals. *Health Care Management Review*, 19 (4), 38–48.

Pyrek, K. M. (2005). MedPAC recommends extending specialty hospital moratorim; ASHA continues to advocate through its 'truth' campaign. *Surgistrategies.com*. (Copyright 2009 by Virgo Publishing.) Available online: http://www.vpico.com/articlemanager/printerfriendly.aspx?article=108720.

Ranji, U., Lundy, J., & Salganicoff, A. (2010). U.S. health care costs: Background brief. Kaiser Family Foundation. Available online: http://www.kaiseredu.org/topics_im.asp?imID=1&parentID=61&id=358.

Rapoport, J., Chaulk, P., Kuropatwa, R., & Wright, M. (2011). Game changing or disruptive innovation: Analytical framework and background study. Institute of Health Economics. Alberta, Canada. Available online: http://www.ihe.ca/documents/2011%2002%2023%20IHE%20Disruptive%20Innovations%20Paper%20FINAL.pdf.

Reissman, P., Salky, B. A., Pfeifer, J., Edye, M., Jagelman, D. G., & Wexner, S. D. (1996). Laparoscopic surgery in the management of inflammatory bowel disease. *The American Journal of Surgery*, 171, 47-51.

Renshaw, L. R., Kimberly, J. R ., & Schwartz, J. S. (1990). Technology diffusion and ecological analysis: the case of magnetic resonance imaging. In S. S. Mick (ed), *Innovations in Health Care Delivery: Insights for Organization Theory*. San Francisco. Jossey-Bass.

Riley, J. G., & Brehm, H. P. (1989). Technological innovations and their impact on care delivery. In Henry P. Brehm & Ross M. Mullner (eds.), *Health care technology, and the competitive environment*. New York. Praeger Publishers.

Robertson, K. (2003). Demand jumps for fat surgery, but capacity is thin. *Sacramento Business Journal*, April 21. Available online: http://www.bizjournals.com/sacramento/stories/2003/04/21/focus9.html. Downloaded November 26, 2008.

Robinson, J.C., & Luft, H.S. (1985). The impact of hospital market structure on patient volume, average length of stay, and the cost of care. *Journal of Health Economics*, 4(4), 333-356.

Roehr, B. (2004). Medicare recognizes obesity as disease entity: Designation is prelude to benefit coverage, setting standard for health plans and insurers. *DOC News*, 1(2), 3. Available online:

http://docnews.diabetesjournals.org/cgi/content/full/1/2/3?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=obesity&searchid=1109685367953_46&stored_search=&FIRSTINDEX=0&sortspec=relevance&journalcode=docnews.

Downloaded November 28, 2008.

Rohrer, J. E., Angstman, K. B., & Bartel, G. A. (2009). Impact of retail medicine on standard costs in primary care: A semi-parametric analysis. *Population Health Management*, 12(6), 333-5.

Roth, J. A. (1971). Utilization of the hospital emergency department. Journal of Health and Social Behavior, 12(4), 312-320.

Rothberg, D. L. (1982). Regional variations in hospital use: Introduction and overview. In David L Rothberg (ed.), *Regional variation in hospital use: Geographic and temporal patterns of care in the United States*. Lexington, MA. Lexington Books.

Russell, L. B. (1977). The diffusion of hospital technologies: Some econometric evidence. *The Journal of Human Resources*, 12(4), 482-502.

Russell, L. B. (1979). Regulating the diffusion of hospital technologies. *Law and Contemporary Problems*, 43(1), 26-42.

Russo, C. A., Owens, P., Steiner, C., Josephsen, J. (2007) *Ambulatory surgery in U.S. hospitals, 2003*. Agency for Healthcare Research and Quality. HCUP Fact Book No. 9. AHRQ Publication No. 07-0007. ISBN 1-58763-228-4.

Rutkow, I. M. (1989a). *Socioeconomics of surgery*. Baltimore, MD. The C. V. Mosby Company.

Rutkow, I. M. (1989b). Determining the rates of surgical operations. In Ira M. Rutkow (ed.), *Socioeconomics of surgery*. Baltimore, MD. The C. V. Mosby Company.

Sagness, J. (2007). Certificate of Need Laws: Analysis and recommendations for the Commission on Rationalizing New Jersey's Health Care Resources. Available online: http://www.nj.gov/health/rhc/documents/con_laws.pdf.

Sandelands, L., & Drazin, R. (1989). On the language of organization theory. *Organization Studies*, 10(4), 457.

Santry, H. P., Gillen, D. L., & Lauderdale, D. S. (2005). Trends in bariatric surgical procedures. *JAMA*, 294, 1909-1917.

Satava, R. M. (2003). Disruptive visions: The operating room of the future. *Surgical Endoscopy*, 17, 104-107.

Schaeffer, L. D., & McMurtry, D. E. (2005). Variation in medical care: Time for action. *Health Affairs – Web Exclusive*, November 16, W5-552 – W5-554. Available online: http://content.healthaffairs.org/cgi/reprint/hlthaff.w5.552v1.

Schappert, S.M., & Burt, C.W. (2006). Ambulatory care visits to physician offices, hospital outpatient departments, and emergency departments: United States, 2001–02. National Center for Health Statistics. Vital Health Stat 13(159). Available online: http://www.cdc.gov/nchs/data/series/sr_13/sr13_159.pdf.

Schragg, J. (2005). Another hill to climb for specialty hospitals. Surgistrategies.com. (Copyright 2009 by Virgo Publishing.) Available online: http://www.vpico.com/articlemanager/printerfriendly.aspx?article=108721.

Schragg, J. (2006). Specialty Hospital Update 2006. Surgistrategies.com. (Copyright 2009 by Virgo Publishing.) Available online: http://www.surgistrategies.com/articles/6b1feat4.html#.

Scott, M. (2004). Mixed effects models. Course: Advanced Quantitative Methods I (E10.2081), New York University, November 30.

Scott, W. R., Ruef, M., Mendel, P. J., & Caronna, C. A. (2000). *Institutional change and healthcare organization*. Chicago, IL. The University of Chicago Press.

Scott, W. R. (2003). *Organizations: Rational, natural, and open system*. Upper Saddle River, NJ. Prentice Hall.

Scott, W. R., & Davis, G. F. (2007). *Organizations and organizing*: *Rational, natural, and open system perspectives*. Upper Saddle River, NJ. Prentice Hall.

Scott, W. R., Ruef, M., Mendel, P. J., & Caronna, C. A. (2000). *Institutional change and healthcare organization*. Chicago, IL. The University of Chicago Press.

Shactman, D. (2005). Specialty hospitals, ambulatory surgery centers, and general hospitals: Charting a wise public policy course. *Health Affairs*, 24(3), 868-873.

Sherwinter, D. A., Roberts, K. E., Windle, M. L., Adler, H. L., Macura, J. M., Fink, S. L., Malit, M. F., Cummings, L. S., Subramanian, S. R. (2011). Laparoscopic Cholecystectomy. Available online: http://emedicine.medscape.com/article/1582292-overview.

Shih, G., Lakhani, P., & Nagy P. (2010). Is android or iPhone the platform for innovation in imaging informatics? Journal of Digital Imaging, 23(1), 2-7. Available online: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2809941/pdf/10278_2009_Article_9242.pdf.

Short, A. C., Christianson, J. B., Draper, D. A., Brewster, L. R., Hurley, R. E., Sorian, R., Brown, L. D., & Liu, G. Y. (2003). Population growth, economic downturn stress Phoenix's health care capacity. Community Report 10 of 12. Washington DC. Center for Studying Health System Change.

Shortell, S.M., & Rundall, T.G. (2003). Physician-organization relationships: Social networks and strategic intent. In S. S. Mick & M. E. Wyttenbach (eds.), *Advances in health care organization theory*. San Francisco, CA. Jossey-Bass.

Simonoff, J. S. (2004). Checking assumptions of regression. Course: Regression and Multivariate Data Analysis (B90.2301), New York University. April 8.

Society of American Gastrointestinal and Endoscopic Surgeons. (2004). Patient information from your surgeon & SAGES: Laparoscopic gall bladder removal. Los Angeles, CA. SAGES.

Solomon, L. S. (1998). Rules of the game: How public policy affects local health care markets. *Health Affairs*, 17(4), 140-148.

Solomon, C. G., & Dluhy, R. G. (2004). Bariatric surgery — Quick fix or long-term solution? *The New England Journal of Medicine*, 351(26), 2751-2753.

Soltesz, E. G. & Brooks, D. C. (2004). Laparoscopy. *Encyclopedia of gastroenterology*, 487-495. Elsevier (USA).

Sorrel, A. L. (2009). With success comes scrutiny: ASCs face legal obstacles. *amednews.com*. Available online: http://www.ama-assn.org/amednews/2009/03/03/gvsa0330.htm.

Starr, P. (1982). *The social transformation of American medicine: The rise of a sovereign profession and the making of a vast industry*. New York, Basic Books.

Steen, J. (2006). Policy perspective: Specialty hospitals. Available online: http://www.ahpanet.org/files/POLICY_PERSPECTIVE,_9-06.pdf.

Steichen, F. M., & Welter, R. (1994). *Minimally invasive surgery and new technology*. St. Louis, MO. Quality Medical Publishing, Inc.

Steiner, C. A., Bass, E. B., Talamini, M. A., Pitt, H. A., & Steinberg, E. P. (1994). Surgical rates and operative mortality for open and laparoscopic cholecystectomy in Maryland. *The New England Journal of Medicine*, 330(6), 403-408.

Stevens, R. A., (2006). Medical specialization as American health policy. In Stevens, R. A., Rosenberg, C. E., & Burns, L. R. (eds.), *History & health policy in the United States*. New Brunswick, NJ. Rutgers University Press.

Stevens, R. A., (1989). *In sickness and in wealth: American hospitals in the twentieth century*. Baltimore, MD. The Johns Hopkins University Press.

Stevens, R. A., (1971). *American medicine and the public interest*. New Haven, CT. Yale University Press.

Suen, I. (2008). Introduction to Multiple Regression. Course: Survey of Data Analysis Techniques for Public Policy and Administration (PPAD 722). Richmond, VA. Virginia Commonwealth University. January 23 & January 30.

Talpur, K. A. H., Malik, A. M., Sangrasi, A. K., Memon, A. I., Leghari, A. A., Qureshi, J. N. (2011). Comparative study of conventional open versus laparoscopic cholecystectomy for symptomatic cholelithiasis. *Pakistan Journal of Medical Sciences*, 27(1), 33-37.

Tellis, G. J. (2006). Disruptive technology or visionary leadership? *Journal of Product Innovation Management*, 23, 34-38.

Teplensky, J. D., Pauly, M. V., Kimberly, J. R., Hillman, A. L., & Schwartz, S. (1995). Hospital adoption of medical technology: an empirical test of alternative models. *Health Services Research*, 30(3), 437-465.

The Southern Surgeons Club, Moore, M. J., & Bennett, C. L. (1995). The learning curve for laparoscopic cholecystectomy. *The American Journal of Surgery*, 170, 55-59.

Thorpe, K. E. (2005). The rise in health care spending and what to do about it. *Health Affairs*, 24(6), 1436-1445.

Thorpe, K. E., Florence. C. S., Howard, D. H., & Joski, P. (2005). The rising prevalence of treated disease: Effects on private health insurance spending. *Health Affairs - Web Exclusive*, June 27, W5-317 – W5-325. Available online: http://content.healthaffairs.org/cgi/reprint/hlthaff.w5.317v1.

Thorpe, K. E., Florence. C. S., & Joski, P. (2004). Which medical conditions account for the rise in health care spending? *Health Affairs - Web Exclusive*, August 25, W4-437 – W4-445. Available online: http://content.healthaffairs.org/cgi/reprint/hlthaff.w4.437v1.

Thorpe, K. E., & Howard, D. H. (2006). The rise in spending among Medicare beneficiaries: The role of chronic disease prevalence and changes in treatment intensity. *Health Affairs - Web Exclusive*, August 22, w378-w388. Available online: http://content.healthaffairs.org/cgi/reprint/25/5/w378.

Tian, W. (2006). *The determinants of hospital adoption and expansion of bariatric procedures: A resource dependence perspective*. Dissertation. Richmond, VA. Virginia Commonwealth University.

U.S. Census Bureau. (2009). Population Division, "Table 1: Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2000 to July 1, 2009 (NST-EST2009-01)," December 2009, Available online: http://www.census.gov/popest/states/NST-ann-est.html.

U.S. Census Bureau. (2000). United States Summary: 2000 (PHC-3-1), http://www.census.gov/prod/cen2000/phc3-us-pt1.pdf

U.S. Census Bureau. (2010). Census Redistricting Data (P.L. 94-171) Summary File, Available online: http://www.census.gov/rdo/data/2010_census_redistricting_data_pl_94-171_summary_files.html.

U.S. Census Bureau. (2010). "Demographic Profiles: Census 2010". Available online: http://2010.census.gov/news/press-kits/demographic-profiles.html.

U.S. Census Bureau. (2010). Census Redistricting Data (Public Law 94-171) Summary File, Table P1. Available online: www.census.gov/prod/cen2010/doc/pl94-171.pdf.

U.S. Census Bureau. (2010). Census Redistricting Data (P.L. 94-171) Summary File, and Census 2000. Available online: www.census.gov/prod/cen2010/cen2010/doc/pl94-171.pdf.

U.S. Census Bureau, State & County Quickfacts: Florida. Available online: http://quickfacts.census.gov/qfd/states/12000.html.

U.S. Census Bureau, State & County Quickfacts: Wisconsin. Available online: http://quickfacts.census.gov/qfd/states/55000.html. **

U.S. Census Bureau, Population Division. (2010). Table 1. Annual Estimates of the Population of Metropolitan and Micropolitan Statistical Areas: April 1, 2000 to July 1, 2009 (CBSA-EST2009-01). Washington, D.C. U.S. Department of Commerce.

U. S. Department of Health and Human Services (HHS). National Action Plan to Prevent Healthcare-Associated Infections: Roadmap to Elimination. Available online: http://www.hhs.gov/ash/initiatives/hai/ambulatory_surgical_centers.html.

U.S. General Accounting Office (GAO). (2003). *Specialty hospitals: Geographic location, services provided, and financial performance*, GAO-04-167. Washington, D.C. Available online: http://www.gao.gov/assets/250/240210.pdf.

U.S. Government Accountability Office (GAO). (2009). Healthcare-associated infections: HHS action needed to obtain nationally representative data on risk in ambulatory surgical centers [GAO-09-213]. Available online: http://www.gao.gov/new.items/d09213.pdf.

Uzzi, B. (1997). Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness. *Administrative Science Quarterly*, 42(1), 35-67.

Vladeck, B. C., & Rice, T. (2009). Market failure and the failure of discourse: Facing up to the power of sellers. *Health Affairs*, 28(5), 1305-1315.

Vijayaraghavan, V. (2011). Disruptive innovation in integrated care delivery systems. Available online: http://www.innosightinstitute.org/innosight/wp-content/uploads/2011/10/Disruptive-Innovation-in-Integrated-Care-Delivery-Systems.pdf.

Washington State Hospital Association. (2003). *Specialty hospitals: Implications for Washington State*. Seattle, WA. Available online: http://www.wsha.org/files/62/SpecialtyHospitals.pdf

Wennberg, J. E. (1989). Small area variation and the practice style factor. In Ira M. Rutkow (ed.), *Socioeconomics of surgery*. Baltimore, MD. The C. V. Mosby Company.

Wennberg, J. E., Brownlee, S., Fisher, E. S., Skinner, J. S., & Weinstein, J. N. (2008). *An agenda for change - Improving quality and curbing health care spending: Opportunities for the Congress and the Obama Administration*. Lebanon, NH. The Dartmouth Atlas Institute for Health Policy & Clinical Practice.

Wennberg, J. E., Fisher, E. S., & Skinner, J. S. (2002). Geography and the debate over medicare reform. *Health Affairs – Web Exclusive*, February 13, W96 – W114. Available online: http://content.healthaffairs.org/cgi/reprint/hlthaff.w2.96v1?maxtoshow=&hits=10&RESULTFORMAT=&fulltext=Wennberg+Fisher+Geography+and+the+Debate+2002&searchid=1&FIRSTINDEX=0&resourcetype=HWCIT.

Wennberg, J. E., Fisher, E. S., & Stukel, T. A., & Sharp, S. M. (2004). Use of Medicare claims data to monitor provider-specific performance among patients with severe chronic illness. *Health Affairs – Web Exclusive*, October 7, VAR-5 – VAR-18. Available online: http://content.healthaffairs.org/cgi/reprint/hlthaff.var.5v1.

Wennberg, J. E., Freeman, J. L., Shelton, R. M., & Bubolz, T.A. (1989). Hospital use and mortality among Medicare beneficiaries in Boston and New Haven. *The New England Journal of Medicine*, 321(17), 1168-1173.

Wennberg, J. E. & Gittelsohn (1982). Variations in medical care among small areas. *Scientific American*, 246(4), 120- 134.

Wennberg, D. E., & Wennberg, J. E. (2003). Addressing variations: Is there hope for the future? *Health Affairs-Web Exclusive*, December 10, W3- 614—W3-617. Available online: http://content.healthaffairs.org/content/early/2003/12/10/hlthaff.w3.614.citation.

Wenneker, M. B., Weissman, J. S., & Epstein, A. M. (1990). The association of payer with utilization of cardiac procedures in Massachusetts. *JAMA*, 264(10), 1255-1260.

White, R. E. (2008). Health information technology will shift the medical care paradigm. *Journal of General Internal Medicine*, 23(4), 495-499. Available online: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2359518/pdf/11606_2007_Article_394.pdf.

Yu, D., & Hang, C. C. (2010). A reflective review of disruptive innovation theory. *International Journal of Management Review*, 12(4), 435-452.

Zajac, E. J., & Shortell, S. M. (1989). Changing generic strategies: Likelihood, direction, and performance implications. *Strategic Management Journal*, 10, 413-430.

Ziegler, M. M. (2009). The innovation of success: The pediatric surgery and APSA response to "disruptive technologies". *Journal of Pediatric Surgery*, 44(1), 1-12.

VITA

D. Pulane Lucas holds a Bachelor of Science degree in Business Administration from California State University, Hayward; a Master of Business Administration degree from Harvard Business School; and a Master of Theological Studies degree from Harvard Divinity School. In August of 2007, she enrolled in the doctoral program at Virginia Commonwealth University's L. Douglas Wilder School of Government and Public Affairs. Ms. Lucas completed the requirements for the Doctor of Philosophy in Public Policy and Administration, with a concentration in Health Policy, in May 2013.