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Determinants of Hospital Administrators' Choice of Anesthesia Practice Model

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Determinants of Hospital Administrators' Choice of Anesthesia Practice Model

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

by

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Abstract

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OF ANESTHESIA PRACTICE MODEL

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Hospital administrators are being held accountable by patients, insurers, and other stakeholders in evaluating their overall hospital performance to reduce costs and improve efficiency. With the move to alternative payment models and value-based purchasing, hospital administrators must understand the economic viability and value that their specialty services bring to their facility.

The purpose of this study was to identify the determinants New England acute care hospital administrators' utilize in making the choice of anesthesia practice model for their facility.

A quantitative, exploratory study of factors hospital administrators use when choosing an anesthesia practice model utilizing a non-experimental, correlational research design was completed. The research was descriptive in nature to determine the factors that influenced a hospital administrator when making decisions about the type of anesthesia practice model that would be the best for their hospital. This research examined seventeen independent variables that were hypothesized to determine hospital administrators' choice of anesthesia practice model. After the final logistic regression analysis, it was determined that the presence of a hospital being located in a medically underserved area (MUA) alone was a predictor of type of anesthesia practice model utilized. In light of the study limitations and prior literature on the CRNA-only model being present in almost 100% of rural facilities, more exploration is necessary to come to more robust conclusions on predictors of choice of anesthesia practice model determined by hospital administrators.

This study showed that there are definitive areas that hospital administrators identify as high importance to the healthy functioning of their facility. By addressing these needs, an anesthesia department could contribute to the overall stability of the hospital, while at the same time, making themselves a more valuable asset overall. Value-driven services offered by anesthesia departments may be the determining factor in choice of anesthesia practice model. By measuring and analyzing anesthesia provider and hospital demographics and hospital administrators' perceptions of anesthesia services, the objective data collected may assist in defining the most appropriate practice model for a hospital.

Chapter One: Introduction

Continuing debates on the United States health care system often highlight the escalating costs of the provision and delivery of healthcare services. National healthcare expenditures increased from 1.5 trillion in 1997 to 3 trillion in 2014, with more than a four percent increase in the healthcare sector of the Gross Domestic Product (GDP) (Centers for Disease Control and Prevention [CDC], 2016; Glied, Ma, & Solis-Roman, 2016). Health expenditures are predicted to be 20.1 % of the GDP by 2025, up from 17.5 % in 2014, growing at an average rate of 5.8% per year (Centers for Medicare and Medicaid Services [CMS] Office of the Actuary, 2016). This predicted increase is attributed to an improving economy, expansion of coverage with the Affordable Care Act (ACA), and the aging of the population (CMS, 2016). Published projections estimate health care expenditures to exceed 40 % of the GDP by 2050 (National Coalition on Health Care, 2015). Yet, according to the Institute of Medicine (IOM), approximately one-third of these expenditures are spent on the inefficient delivery and overuse of services with estimates on these items alone at approximately $315 billion per year (IOM, 2010). A thorough analysis of individual healthcare expenditures could lead to reductions in unnecessary costs, which could potentially cut out waste and offer stability to the fragile and uncertain healthcare environment.

Contributions to Hospital Costs

Costs related to healthcare expenditures have several definitions depending on the context and stakeholders. Cost to employers and the insured is often defined by the premiums paid for insurance coverage, deductibles, and copayments. To governmental agencies, health plans, and the uninsured, cost is representative of the cost from healthcare providers for services rendered and resources utilized. Lastly, to hospital administrators in charge of facilities, cost is related to the resources utilized to provide healthcare to individuals. The latter definition has not been addressed as much as the others and is a large contributor to overall hospital expenses (Massachusetts Hospital Association [MHA], 2010).

Hospital administrators are confronted with ever-increasing resource costs. Capital-related costs, such as hospital upkeep, account on average for less than 10% of overall costs. Patient medical supplies, instruments, drugs, and other patient care supplies account on average for 25% of overall costs. The remainder of costs is attributed to labor as the largest component of hospital costs, accounting for up to two-thirds of total hospital expenses (MHA, 2010).

In addition to calculating and reporting resource costs, hospital administrators calculate and report their profitability measures to the public and stakeholders on an annual basis. Lowering healthcare costs, especially labor costs, while providing high-quality care is instrumental to the viability of healthcare systems. Hospital profitability is often measured by operating margin as an overall proxy for hospital operating performance. Operating margin is defined as net patient revenues minus total operating expenses divided by total net income. Operating margin is representative of a hospital's service to patient care and is recognized as successful if costs and quality are maintained. Therefore, operating margin is one of the

performance trends that are analyzed by hospital administrators when assessing moves to lower healthcare costs (Jiang, Friedman, & Begun, 2006).

Hospital administrators analyze and participate in the decision-making of healthcare cost trends and drivers. They have a responsibility to choose appropriate resources for the most cost-effective delivery of care that is of high quality and assures access for patients to the system. It is important in the changing healthcare environment to analyze the informational factors they utilize to base their decisions. Factors related to the costs of delivery of care include provider salaries, supply and demand of providers, provider delivery models, and reimbursement (American Hospital Association [AHA], 2013).

One way to examine labor costs related to healthcare expenditures is to focus on specific costs related to specialty services. Hospital-based specialty services, such as anesthesia, pathology, radiology, and therapy services, are considered professional services provided to patients in a hospital. This means that the services are provided to patients by the hospital or by an external group where patients do not choose the providers of these services (U.S. Government Accountability Office, 2015). A 2011 report from the Healthcare Cost Institute (HCI) identified anesthesia services as the highest average payer cost per service for professional procedures, exceeding costs of services provided by pathologists, primary care physicians, radiologists, specialists, and surgeons (French, Guzman, Rubio, Frenzel, & Feeley, 2016).

Costs Related To Anesthesia Providers And Practice Models

Anesthesia personnel are one of the largest costs to hospital facilities, due to the high salaries of providers. These providers include anesthesiologists (ANs), Certified Registered Nurse Anesthetists (CRNAs), and Anesthesiologist Assistants (AAs). The median national salary for ANs is $357,000 and upwards to $450,000 with experience. The median national

salary for CRNAs is $170,000 and upwards to $200,000 with experience. AA salaries are comparable to median CRNA salaries in most facilities (CompAnalyst, 2016).

The anesthesia practice model that a hospital utilizes determines personnel costs by its inherent structure. There are three common anesthesia practice models utilized by health care facilities in the U.S.: AN- or CRNA-only model (independent anesthesia provision by provider), medical supervision model (one AN supervising more than four CRNAs concurrently), and medical direction model (one AN directing no more than four CRNAs or AAs). Medical direction is also known as the anesthesia care team (ACT), which provides anesthesia for up to four surgical cases in various locations in a hospital. AAs can only function in the medical direction model. In these instances, medical supervision and direction refer to a requirement for reimbursement from CMS rather than for reasons of safety and quality.

There is minimal research on the costs related to each anesthesia practice model. A 2010 study examined the cost effectiveness of the three predominant anesthesia practice models and the related implications of each in terms of patient outcomes and quality of care (Hogan, Seifert, Moore, & Simonson, 2010). After a review of the literature, the authors concluded that there were no significant differences in anesthesia complications or mortality rates between care that was delivered by ANs and CRNAs. To conduct the cost-effectiveness analysis, the researchers constructed a total of seven different simulation models of anesthesia practice. They utilized stochastic simulation modeling and claims data to simulate different anesthesia settings (inpatient, outpatient and ambulatory surgery settings) by specifying the distribution of average case numbers, base units, and time units associated with each setting. These figures were held constant in the computations of cost and revenue and the simulation models provided estimates of such for each anesthesia practice model in each setting (Hogan et al., 2010).

The researchers found that the independent CRNA model was the least costly, producing the greatest net revenue. The next most cost-effective model was the medical direction model in a 1:4 ratio though theses figures can be skewed by case delays adhering to the rules of the practice model (Hogan et al., 2010). To provide economic support to Hogan's findings, French et al. (2016) demonstrated that personnel costs were 79% of the overall costs incurred from providing anesthesia services in a hospital. They stated that a 'basic concept of care redesign is that each provider work to the highest level of their degree and training' (p.2). This supports the 2010 IOM Future of Nursing report statement that all nurses should practice to the full extent of their license and training. French et al. (2016) suggest mapping clinical processes across all specialties to ascertain cost savings across a hospital, evaluating the premise that less costly care does not diminish the quality of care provided to patients. The 2010 study by Hogan et al. supports this premise by concluding that increasing the number of CRNAs in an anesthesia practice model that allows full scope of practice is instrumental in containing costs while offering high quality anesthesia care to patients. Keeping anesthesia personnel costs in mind, restructuring CRNA and AN practice models with all providers practicing to their full scope may contribute to balancing a hospital's overall budget (French et al., 2016).

Costs Related to Anesthesia Services

Personnel costs will be further examined with payment system restructuring, such as bundling of payments, and in a renewed analysis of delivery model efficiency. With bundled payments, all costs for a specific surgical or diagnostic procedure are built into the reimbursement and paid in one lump sum to the healthcare provider and/or provider organization instead of in separate professional payments as is the current system. These alternative payment

models will be tied to healthcare provider accountability for outcomes and to the cost of care that is delivered to patients (French et al., 2016).

Payments relative to cost have much variation among hospital systems, depending on their mix of payers. Hospital administrators must be cognizant of their mix of Medicare and Medicaid patients, uncompensated care, and privately insured patients to balance the costs of providing care (AHA, 2015). Currently, costs incurred by hospital facilities, patients, and public and private insurers for anesthesia services are based on professional and facility charges. Anesthesia professional charges are billed separately from the hospital bill for the anesthesia professional. More specifically, billing for the anesthesia professional covers anesthesia services for an episode of care, which begins with the preoperative evaluation period and ends once care is transferred to a recovery nurse in the immediate postoperative period, though there are variations in this definition. This anesthesia professional charge includes three parts: base units, time units and special units.

- The base unit (BU) reimbursement amounts are published yearly in the American Society of Anesthesiologists (ASA) Relative Value Guide (RVG) and are based on the complexity of the procedure and expected complexity of workload for the anesthesia provider to deliver care during the case. For example, a knee arthroscopy may be billed 4 BUs, an upper gastrointestinal (GI) endoscopy 5 BUs, a cerebral aneurysm clipping 15 BUs, and a liver transplant 30 BUs (ASA RVG, 2016). Every case has a base unit assigned to it and is correlated with Current Procedural Terminology (CPT) codes located in the RVG. The preoperative evaluation and physical exam are also included in the base units.

- The time unit (TU) begins from the time the provision of anesthesia services start to the time the provision of anesthesia services are complete. TUs are usually billed in 15-minute increments.
- Special units (SUs) or modifiers, may also be billed, but are not mandatory, for special techniques or complicated conditions like extremes in age or physical status (PS) classification delineating high patient acuity.

  On the final bill, base units, time units and any special units are added together and the total number of units is multiplied by a conversion factor (CF) to determine the full amount billed to the patient (in dollars). CMS publishes an annual list of conversion factors specific to the geographic region that the service is provided and is utilized to account for regional differences in provider payment for contracted services. Private insurers negotiate a dollar per unit amount per conversion factor with each hospital or external anesthesia group and that amount is usually confidential (Young, 2015).

To better understand how charges are calculated, the following example is offered: Patient X is scheduled for an upper GI endoscopy, his medical history is complicated due to obesity, diabetes mellitus, and hypertension (PS 3), and the procedure will take 30 minutes. The professional charge to the patient for anesthesia services is: upper GI base units (5) + time units (2) + special units (1) x 2016 conversion factor for Richmond, VA (21.70) = $151.90. Billing for anesthesia services is unique because anesthesia is the only professional service that charges for time spent with the patient. All other specialty professional services are billed as straight visit or procedure charges (French et al., 2016).

This discussion is relevant because the patient also incurs charges related to resources used by anesthesia. The anesthesia facility charge includes items such as medications, supplies, equipment, time of technical support personnel, and overhead. It is determined by each facility and usually factors in anesthesia time and anesthesia service location, such as hospital, out of operating room location, or ambulatory surgery center (French et al., 2016). Figure 1 depicts the total anesthesia charges a patient may incur during an episode of care.

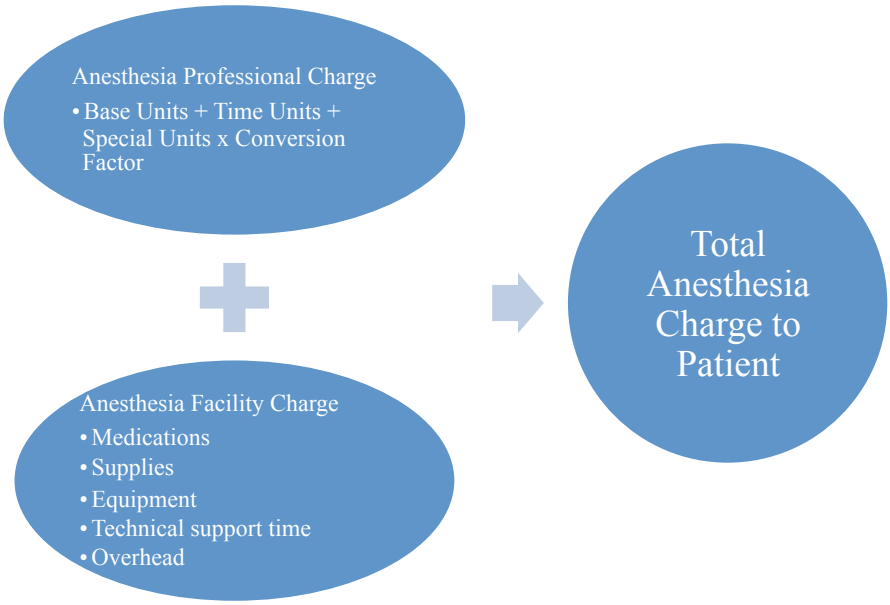

Figure 1. Anesthesia Patient Charge Schematic

If planned costing methodologies, such as bundled payments and value-based care requirements brought on by the ACA for all operating room services go into effect, the current professional and facility billing methodology will become obsolete (French et al., 2016). In order for hospital administrators to evaluate their facilities' costs of anesthesia services going forward, all components of direct costs must be quantified, such as personnel salaries and type of practice model, medications, supplies, equipment, and any external anesthesia group subsidy necessary.

Advantages and Disadvantages of Current Anesthesia Practice Models

Although every hospital administrator has several choices in type of anesthesia practice model to employ, the most predominant of these practice models is the medical direction model (Baird, Daugherty, Kumar, & Arifkhanova, 2014). The continued existence of this type of practice model is threatened because there is considerable evidence of an impending shortage of ANs over the next several years (Baird et al., 2014). Currently, there are relatively equal numbers of ANs and CRNAs at approximately 50,000 in each profession (AANA, 2016). Recent studies estimate that the number of physicians specializing in anesthesia is predicted to peak in 2017 and decrease thereafter while the number of CRNAs is predicted to continue increasing up to the year 2020. The 2013 Rand study estimated a 15% increase of a combination of CRNAs and AAs since 2007. The study did not differentiate quantity of each provider but did find that the ANs reported supervising AAs only 2% of their time, thus supervising higher numbers of CRNAs in the workforce on a daily basis (Baird et al., 2014). A deeper examination of the supply of anesthesia providers is necessary to assess if the medical direction model is sustainable in the near future.

Adding to the effects of the shortage of ANs is the prediction that hospital facilities will increase the number of anesthetizing locations by as much as 50% in the near future due to the growth of specialty services and the need for specialty procedure rooms, such as interventional suites. In addition, the aging population is increasing, which will increase the demand for anesthesia services due to an increasing number of surgeries on patients with long-standing, comorbid disease states (Baird et al., 2014). Because of these predicted supply and demand issues, a reassessment of the advantages and disadvantages of the various anesthesia practice

models is warranted to accommodate the anesthesia needs of hospital facilities for the patients they serve in the future.

Problem and Significance

Hospital administrators are being held accountable by patients, insurers, and other stakeholders in evaluating their overall hospital performance to reduce costs and improve efficiency. With the move to alternative payment models and value-based purchasing, hospital administrators must understand the economic viability and value that their specialty services bring to their facility. Personnel costs are generally assumed to be the most costly component of anesthesia care and one that has not been studied extensively (French et al., 2016). Decisions made by hospital administrators can affect the hospital's survival in the current competitive environment (Jiang et al., 2006).

Hospital administrators are responsible for scrutinizing the factors that make up their choice of anesthesia practice model to understand the true cost of anesthesia care.
The topic of studying hospital administrators' knowledge and perceptions of anesthesia services is a novel idea that has not been found in the scientific literature (Stiefel, 2016). Studies evaluating quality, access, and cost-effectiveness of anesthesia practice models are found in the literature but there is a lack of published information regarding the key determinants of how and why hospital administrators choose certain anesthesia practice models in their facilities.

Purpose of the Study

The purpose of this study was to identify the determinants New England acute care hospital administrators' utilize in making the choice of anesthesia practice model for their facility. Because there is limited scientific information about hospital administrators' knowledge and understanding of anesthesia practice model arrangements, this study was designed to gather

information that factors into choice of anesthesia services. The current literature related to this topic only shows anesthesia corporation surveys that were conducted in this area (Gooch, 2016). A better understanding of hospital administrators' knowledge and understanding of anesthesia practice models and the advantages and disadvantages of each model allows for a more substantive discussion of the issues of anesthesia practice in a given hospital among hospital decision-makers (CEOs, CFOs, CIOs, CMOs, CNOs, COOs).

This study was timely and important because hospitals need to identify departments that can decrease expenditures for a cost savings to the facility to regain (or maintain) profitability while providing value-added benefits to the system. The supposition was that more cost- and personnel-efficient anesthesia models could strengthen a hospital's budget by reducing overall anesthesia department expenditures. Areas of possible cost savings for hospital administrators to consider include more efficient use of anesthesia providers and removal of certain supervision and billing requirements (Hogan et al., 2010). The results of this study will be used to inform hospital administrators regarding the capabilities of various anesthesia practice models and the benefits that can be derived from finding the best fit for hospital facilities.

Objectives

The objectives of this study were to (1) identify the factors considered by hospital administrators in choosing anesthesia practice models, and (2) examine the perceptions of hospital administrators regarding the delivery of anesthesia services. Variables included number and type of anesthesia providers for hospital facilities, demographic information such as geographic location (rural vs. urban), medically underserved area (MUA), state opt-out status for CRNA practice, facility type, hospital bed size, number of anesthetizing locations, hospital operating margin and profit status, type of anesthesia practice model and employment model,

stipends requested from an external anesthesia group from a hospital, hospital bylaw limitations of anesthesia provider practice, and hospital administrators' educational and professional backgrounds.

The first objective identified factors hospital administrators considered when determining choice of anesthesia practice model. Factors that may impact anesthesia resource utilization were identified to examine how an institution functions at its optimal level. In addition, anesthesia provider, hospital, and hospital administrator demographics in New England hospital facilities were collected. The unit of analysis was the group of hospital administrators. The second objective examined the perceptions of hospital administrators regarding type of anesthesia practice model and value-based services their current anesthesia providers provide to their facility.

Theoretical Framework

By utilizing a theoretical approach, hospital administrators can make decisions about the selection, assessment, and viability of various anesthesia practice models in a hospital. Resource dependence theory (RDT) provides a foundation when trying to understand determinants that influence a hospital administrator's choice of an anesthesia practice model. RDT proposes that the environment an organization operates within is instrumental in the behavior and success of that organization (Vibert, 2004). To better understand the relationship between the effect of the external environment on a hospital and its internal strategies, structure, and/or performance, researchers have examined both uncertainty and resources (Yeager et al., 2014). Scarcity of resources or uncertainty in the current environment may influence hospital administrators to redesign their anesthesia practice models.

Based on RDT, the constructs of munificence, dynamism, and complexity of a hospital system can be used to analyze the current healthcare delivery system in anesthesia. Munificence is defined as the behavioral strategy a hospital utilizes to determine availability and accessibility of resources. In this study, the variables of anesthesia provider demographics will be explored. Dynamism is defined as the environmental structure that is established by hospital administrators in their facility. A certain geographic location (rural vs. urban) can have an effect on what type of anesthesia provider is available and what type of employment group model is utilized. Along with associated costs of the provider and group models, hospital bylaw mandates can be dependent on the constantly changing hospital and healthcare environment. Lastly, the construct of complexity is related to and indicative of the performance and success of the hospital (Yeager et al., 2014). Hospital administrators' perceptions of how to build their anesthesia departments based on their background and knowledge of the capabilities and values all providers add to the facility may affect the ultimate success of the organization. Therefore, the results of this study may be helpful in examining how anesthesia practice models are constructed at individual hospital facilities.

Definition of Key Terms

Definitions of key terms are included to provide clarity and are further described in the literature review. Unless otherwise noted, the anesthesia provider and practice definitions were derived from the 2013 CMS Anesthesia Billing Guide.

Anesthesia Practice Model.

- Anesthesiologist-only. AN administers anesthesia alone and bills 100 % of the physician fee schedule.

- Medical direction. AN and CRNA/AA each bill Medicare for 50 % of the available physician fee schedule. This is also called the Anesthesia Care Team (ACT) model and is the most common practice model currently in use. One AN can cover up to four concurrent rooms with a CRNA/AA administering anesthesia (1:4 model). The stipulation is that the AN must perform and document seven payment steps, according to the Tax Equity and Fiscal Responsibility Act of 1982, called the TEFRA regulations. If these stringent steps are not done by the AN, medical direction cannot be billed and the facility does not receive payment for that procedure.
- Medical supervision. One AN can function in a consultant role and supervise more than four CRNA's concurrently. In this case, under Medicare Part B, the CRNA bills 50 % of the physician fee schedule. The AN can bill for, on average, three to four base units/case, per the Medicare Resource-Based Relative Value Scale (RBRVS) plus time units.
- Non-medical direction. CRNA administers anesthesia without medical direction by an AN and bills 100 % of the physician fee schedule.

Anesthesiologist (AN). Physician who has completed a bachelor's degree, medical degree, 1 year internship, and 3 years anesthesia residency.

Anesthesiologist Assistant (AA). Non-physician anesthesia provider who is permitted by state law to administer anesthesia and has completed a bachelor's degree and a specialized two-year academic and clinical training program in anesthesia.

Certified Registered Nurse Anesthetist (CRNA). Qualified non-physician anesthetist who is an advanced practice registered nurse, who has completed a nursing degree/bachelor's degree, worked in an acute care setting for at least one year, and then a minimum of a master's degree or doctoral degree in nurse anesthesia (AANA, 2016).

Complexity. Range and quantity of components to be considered by an organization when making strategic decisions (Yeager et al., 2014).

Demographics. Size, structure, and/or distribution of populations used to define and represent sample characteristics of the population of study (Kaur, 2013).

Dynamism. Variation in resources or external factors that create a changing environment (Yeager et al., 2014).

Hospital administrator. Chief executive that determines and formulates policies, providing direction to a healthcare system. Plan and direct organizational activities, guided by a board of directors, with the assistance of subordinate executives and managers (Bureau of Labor Statistics, 2015).

Munificence. Availability and accessibility of resources needed for a particular organization (Yeager et al., 2014).

Rural. Counties with less than 2,500 people (U.S. Department of Agriculture, 2016).

Urban. Counties with at least 2500 people. This definition includes urban clusters (UCs) that have > 2500 but < 50,000 people and urbanized areas (UAs) that have > 50,000 people. (U.S. Department of Agriculture, 2016).

Value-based services. Services that enhance the delivery of anesthesia care provided by a group or department to include but not limited to meeting ACA mandates, tracking reimbursement measures, quality tracking, provision of specialty services such as obstetric coverage and a pain management service, and cost-effectiveness measures (Stiefel, 2016).

Chapter Summary

A key component of health care reform is to ensure quality, access, and cost-effectiveness measures are considered by hospital administrators to its stakeholders: patients,

community, hospital providers, Board of Trustees, and insurers. Government and private regulatory agencies are looking to hospitals to lower health care costs while maintaining high quality care and improved efficiency (Jiang et al., 2006). Additionally, as the need for surgical and procedural healthcare and concomitant anesthesia services continue to expand, hospital administrators need to find the right mix of anesthesia providers to provide services that will maintain quality of care and improve value to the stakeholders (French et al., 2016). Value-driven services offered by anesthesia departments may be the determining factor in choice of anesthesia practice model (Kain et al., 2014). By measuring and analyzing anesthesia provider and hospital demographics and hospital administrators' perceptions of anesthesia services, the objective data collected may assist in defining the most appropriate practice model for a hospital.

The remainder of this paper is divided into four chapters. Chapter Two provides an in-depth presentation of anesthesia provider models, patterns of utilization of anesthesia services, opportunities and barriers for hospital administrators that may impact anesthesia delivery model redesign, and resource dependence theory via a thorough review of the literature. Chapter Three provides an explanation of the study design, methodology, and statistical analyses utilized to address the research questions and hypotheses. Chapter Four presents an overview of the study results. Chapter Five provides an analysis of the results and summarizes the findings. Strengths and limitations of the study are presented as well as recommendations for future studies.

Chapter Two: Literature Review

The Institute of Medicine's (IOM) 2010 report, "The Future of Nursing: Leading Change, Advancing Health" offered recommendations for expanding nursing practice that could positively impact healthcare systems in the future. The report also discussed barriers that might inhibit these recommendations from being implemented. Some of the barriers might prevent or delay an overall transformation of healthcare systems that desperately need change. Regulatory restrictions to expanding advanced practice nurse's (APNs) scope of practice, physician resistance to expanded roles, continued fragmentation of the healthcare system, and archaic insurance regulations are some of these barriers (Ridge, 2011).

In the field of anesthesia, these barriers are accentuated by the complicated utilization system of anesthesia practice models. One of the major barriers noted in the IOM study was scope of practice limitations for APNs. A recent 2016 study investigated scope of practice laws and anesthesia complications and found that there was no evidence that the incidence of complications differed by scope of practice of anesthesia provider or delivery model (Negrusa, Hogan, Warner, Schroeder, & Pang, 2016).

At the forefront in the decision-making on scope of practice issues affecting hospital systems are hospital administrators. These healthcare leaders may be confronted with investigating these barriers and transforming current practices in order for their healthcare system to stay solvent. The decision-making process these administrators utilize to assure high-quality care is provided at their facilities while increasing access with a reduction in costs has not

been studied extensively in the literature. Identifying what determinants hospital administrators utilize in making decisions for anesthesia services is key in understanding current and future anesthesia practice models. Utilizing an evidence-based management approach has recently been studied in the healthcare literature (Guo, Farnsworth, & Hermanson, 2015). Evidence-based management (EBMgt) is defined as "making decisions about the management of employees and organizations thorough the conscientious, explicit, and judicious use of four sources of information" (Guo et al., p. 274, 2015). The four sources identified are scientific evidence, organizational data, experiential evidence, and stakeholders' values and concerns (Guo et al., 2016). To understand how hospital administrators utilize this evidence regarding anesthesia providers and delivery models, a thorough review of the literature from its historical perspective to current day benefits and limitations of anesthesia practice models will follow.

History of Anesthesia Practice

The field of modern anesthesia originated in the late 1700s with documentation of the profession occurring since the mid-1800s and the Civil War. Though the actual practice of alleviating human suffering predates much of recorded human history, the strides made beginning in the 1800s are what the specialty of anesthesia was built on. It is important to understand how modern day surgery and anesthesia specialties evolved in order to appreciate where the current practice is headed.

Anesthesia and anesthesia techniques.

Dating back to as early as 10,000 BC, archaeologists have found evidence of surgical procedures called trephinations in the human skull. These were holes that were drilled in a living person and the occurrence of this practice had several theories. Some historians thought that it was used for the entrance or exit of spirits that caused illness. Others thought it was as a cure for

seizures, headaches, infections, and fractures. Yet another theory suggests pieces of the skull were excised and used as charms or amulets. Unbeknownst to the surgeon who is thought to chew coca leaves during these procedures, some of the juices may have dribbled out and into the wound of the patient, inducing an analgesic effect. Evidence suggests that these procedures were successful due to skulls that show bone regrowth (Porter, 1996).

This practice continued in ancient Egypt and skull scrapings were used to make potions. Hieroglyphics display trephination as well as clubbing (a technique utilizing a weapon used to knock a person out) in many ancient cultures. During these times, alleviating pain was not looked on as having any importance because pain was thought of as an emotion rather than a sensation. Pain was under the purview of religious zealots in primitive cultures and relief was through prayers and chants. The word pain originated from the Greek language *poine,* meaning penalty. Therefore, pain was considered a consequence of committing sins and a form of religious suffering (Larsen, 2010).

Aristotle, Hippocrates and Galen wrote about trephination and the practice continued throughout the Middle Ages and the Renaissance (Porter, 1996). Aristotle surmised that pain was an emotion but Galen supposed that the brain activates pain, as he noted in animals. This was not scientifically confirmed until the 1700s when Albrecht von Haller concluded that nerves possess "sensibility" and transmit pain and thus the theory of pain was originated (Larsen, 2010). The term sensibility is defined in the Merriam-Webster dictionary as the ability to receive sensations or an awareness of and responsiveness to something (2016). If nerves possess "sensibility', it was felt that the necessity to produce "insensibility" during surgical procedures was a primary goal (Larsen, 2010).

Pedanius Dioscorides, a Greek surgeon who served under Nero, wrote the authoritative treatise on pharmacology in 77 A.D. He described the effects of plants, specifically mandragora and wine, to "produce anesthesia" in a patient undergoing surgery with a soporific sponge over the patient's nose. These discoveries continued through the Middle Ages, utilizing alcohol fumes, opium, scopolamine, and sulfuric ether to produce an anesthetic state (Larsen, 2010).

The modern era of general anesthesia has been defined by the use of inhaled anesthetics. Sulfuric ether had been around for centuries with differing accounts of who utilized it first. As far back as the eighth century, diethyl ether as it is now known, was compounded by alchemists. But there were many missed opportunities to incorporate it into the surgical realm and it remained a therapeutic and recreational agent for centuries. Paracelsus, Robert Boyle, Isaac Newton, and Michael Faraday all examined the compound but none found it that remarkable. Recreationally, both Europeans and Americans would either drink or inhale the ether, coining the term "ether frolics" (Jacob, Kopp, Smith, & Bacon, 2013).

In the 18th century, Joseph Priestley discovered nitrous oxide in 1773. He was an English clergyman and scientist who examined other gases as well, such as ammonia, oxygen, carbon dioxide, carbon monoxide, and sulfur dioxide. At the closing of the eighteenth century, Europeans were investigating the use of mineral waters and gases for their healing properties. Humphrey Davy was an English scientist who conducted in-depth research at the famous Beddoes Pneumatic Institute in England in the use of nitrous oxide, even after it was considered dangerous and was thought to "spread the plague". His findings suggested that it should be used during surgery to alleviate pain but since he was not a surgeon, his claims were disregarded. He is now mainly remembered for developing the term "laughing gas" to describe its characteristic property (Jacob et al., 2013).

Other missed opportunities to revolutionize the use of inhaled anesthetics (and be credited as the discoverer of anesthesia) during surgery were by Hickman, Clarke, Long, Colton, and Wells in the nineteenth century. Henry Hill Hickman, an English surgeon, used carbon dioxide to produce insensibility in animals but was unsure if that was due to the analgesic effects or hypoxia. As a medical student, William Clarke is thought to have given the first ether anesthetic in January 1842, after experimenting with nitrous oxide and ether as a chemistry student. Though he purports that a tooth was extracted without pain due to the anesthetic, others have stated that the patient lost consciousness due to hysteria. Two months later, in March 1842, Crawford Long, a surgeon from Georgia, successfully administered ether soaked in a towel to a patient for tumor extractions with the absence of pain. He did not share his findings until 1849 and by then, ether anesthesia was well known (Jacob et al., 2013).

During the mid-19th century, dentists were trying to find ways to alleviate the pain of tooth extraction not only for their patient's benefit, but also for their own livelihood to bring business into the office. The idea of pain steered many patients away from having their rotten teeth removed. After observing scientist Gardner Colton experiment with nitrous oxide, dentist Horace Wells asked him to administer it to him the next day for a tooth extraction on December 11, 1844 and it was a painless procedure. He asked Colton to teach him how to prepare it. In January 1845, Wells himself planned to demonstrate the use of nitrous oxide to a patient for an amputation in what is now known as the Etherdome at Massachusetts General Hospital. When the scheduled patient refused, he instead demonstrated it on a medical student for a dental procedure. The patient cried out in pain after Wells did not have the technique mastered well and all in attendance criticized him. Documentation from the time states that Wells was so upset by this occurrence that he committed suicide three years later (Jacob et al., 2013).

As of 1846, opium and alcohol were the only agents generally regarded as having proven value in reducing surgical pain. A publication of the day, *New Elements of Operative Surgery,* also listed water of nightshade, henbane, lettuce, hypnosis, strapping, compression of nerve trunks (acupressure) and noise as the only other anesthetic alternatives then in use. Then came William Thomas Green Morton, a dentist that trained and worked with Horace Wells in Connecticut. Morton moved to Boston and received instruction from Charles T. Jackson, a physician and chemist. He learned that ether was more versatile compared to nitrous oxide and it had a better safety profile. In addition, he realized that ether could provide surgical anesthesia without the respiratory depression and hypoxia that came with other agents. After anesthetizing his dog and patients in his dental office successfully, Morton was invited to perform a demonstration on a patient for a neck lesion excision in the Bullfinch Amphitheater at Massachusetts General Hospital, the Etherdome, on October 16, 1846. This successful demonstration of the use of ether is often regarded as the greatest contribution to American medicine in the nineteenth century (Jacob et al., 2013).

Another inhaled anesthetic of note during the mid-1800s that was being experimented with was chloroform. James Young Simpson, an obstetrician from Scotland, initially used this agent experimentally for the relief of labor pain. During this time period, it was still controversial to relieve labor pain because it was looked on as God's will. Labor pain was viewed as punishment and atonement for the "Original Sin". Simpson pushed the boundaries with his research, explaining that the pain was due to real anatomic causes. This paved the way for John Snow, a physician interested in anesthesia, who administered chloroform to Queen Victoria during childbirth. The Queen endorsed the pain relief and that was enough to quench

the debate over the appropriateness of anesthesia for labor pain. But chloroform's use was limited due to hepatic and cardiac toxicity noted with continued use (Jacob et al., 2013).

After these events that transpired in the mid-1800s, it was thought that general anesthesia would explode. But that was not to be and the latter half of the nineteenth century and first-half of the twentieth century is often known as the "period of failed promise". Other compounds were experimented with as inhaled anesthetics but their properties were not suitable for safe administration. Ethyl chloride and ethylene were discovered but they were highly explosive and required high concentrations, leading to hypoxia. Cyclopropane was discovered in 1929 and vinethene (divinyl ether) in 1932 but these too were explosive. Introduced in 1935 and used during World War II, trichloroethylene was a nonflammable anesthetic but it was found that when decomposed in soda lime, it released dechloracetylene, a toxic nerve poison, and in the presence of electrocautery, it produced phosgene, a severe respiratory irritant (Jacob et al., 2013).

In the early 1950s, researchers were trying to develop inhaled anesthetics that were noncombustible. By adding a fluorine hydrocarbon to a vinyl ether compound, it lowered the boiling point, increased stability, and decreased toxicity of the compound. The first of these to be used on humans was fluroxene in 1954 and was the first fluorinated anesthetic. This research had been advanced by the secret needs for refined flurohydrocarbons and uranium since the advent of the Manhattan Project. Fluroxene was routinely used until 1974 when toxic effects in animals were discovered (Jacob et al., 2013).

This initial discovery of a fluorinated anesthetic was quickly followed by other fluorinated hydrocarbons. Halothane was created by Charles Suckling in 1953 and followed by methoxyflurane in 1960. By 1970, dose-related side effects were discovered. Methoxyflurane caused nephrotoxicity and Halothane caused hepatitis in some cases so the research continued

for inhaled anesthetics with a safer profile. Enflurane was released in the mid-1960s but its use was restricted due to cardiodepressant and convulsant effects. Isoflurane was not released until the mid-to-late 1970s due to the concern that it might be carcinogenic. This was the beginning of drug trials and no longer could new drug compounds be experimented without oversight. Not until another twenty years would new inhaled anesthetics be released. Desflurane was released in 1992 and Sevoflurane in 1994 and those remain in use today (Jacob et al., 2013).

Local anesthesia was initially "discovered" in prehistoric times by the administration of coca leaf juices on trephination wounds. It was first documented as a local anesthetic in the 1500s by Spanish Jesuit Bernabe Cobo who chewed it to relieve a toothache. It was not until 1856 when Albert Niemann of Germany isolated the alkaloid from the coca leaves and called it cocaine. It was not truly recognized as a local anesthetic causing insensibility to pain of a local area until Carl Koller was looking for an anesthetic that could be used during eye surgery that did not cause postoperative nausea and vomiting (PONV). PONV could cause the extrusion of the globe's contents and lead to blindness. It was Sigmund Freud that gave Koller a small packet of cocaine and found it to have cerebral stimulating effects. A small sample leaked on his finger and when he touched his tongue, it became numb. Koller instantly realized this was the anesthetic he had been looking for and utilized this with success during ophthalmic surgery starting in 1884. New applications for the use of cocaine were quickly developed as well as addictions to the drug (Jacob et al., 2013).

Spinal anesthesia was first described in 1899 with cocainization of the spinal cord by Heinrich Quincke of Germany and pioneered by August Bier. This procedure underwent many modifications through the years until the 1940s brought improvements in spinal needle size and shape and medications injected through it with an improved safety profile. Improved knowledge

of spinal cord anatomy also refined epidural anesthesia and the introduction of the continuous epidural catheter for postoperative pain relief (Jacob et al., 2013).

Physicians William Halsted and Alfred Hall studied direct injection of local anesthetics into nerve trunks extensively in the late 1800s and on into the twentieth century. In 1902, Harvey Cushing coined the phrase "regional anesthesia" for blocking the brachial or sciatic plexus from pain via this technique. Intravenous regional anesthesia was first performed in 1908 by Bier but was not widely used for procedures of the distal arm and hand until the 1960s. In 1911, G. Hirschel performed the first percutaneous technique on the brachial plexus via the axillary approach and D. Kulenkampff was the first to introduce the supraclavicular approach a few months later (Larson, 2010).

The development of regional anesthesia techniques continues today. Initially developed to avoid the negative side effects of the inhaled anesthetics utilized with general anesthesia, these techniques provided another mode of administration of medications to reduce sensibility to pain and provide proper operating conditions for the surgeon. Today, use of ultrasound-guided regional anesthesia for localization of nerve bundles and improved local anesthetics with safer toxicity profiles and longer duration of action make this a viable technique for many surgical procedures.

Evolution of anesthesia providers.

The discipline of anesthesia developed in response to requests of surgeons seeking a solution to the high morbidity and mortality associated with surgical procedures after Morton's demonstration of ether anesthesia in 1846. This period was named the "period of the failed promise" (Koch, 2015). Instead of improving societal woes, they were increased because surgery-related deaths were increasing even with advancements in care. Related to surgery, the

major cause of death was from infection. But it was also due to what was termed the "occasional anesthetist". The "occasional anesthetist" was a term coined by surgeons for physicians who were assigned the role of anesthesia, instead of surgery, and did not maintain continuous vigilance during the case. Nurses worked with surgeons to decrease both of these problems (Koch, 2010).

Starting during the Crimean War in the 1850s, Florence Nightingale and other nurses theorized that hospitals did not have to be "pest houses". This was supported by the work of Oliver Wendell Homes, a U.S. attorney and physician, and Ignaz Philipp Semmelweis, a physician, who theorized that infection was spread by the medical provider and was the major cause of maternal death. They observed that midwives simply washed their hands between patients but the medical students did not and the midwives had a much lower incidence of infection and death. It would not be until the 1880s when Koch, Pasteur, and Lister were able to confirm the germ theory and the use of antiseptics and sterilization to decrease the spread of infection (Jacob et al., 2013).

Certified registered nurse anesthetists.

In the mid-nineteenth century, when surgeries were increasing after Morton's demonstration of ether, the role of the anesthesia provider was frowned upon for several reasons. First, there was the low pay and limited prestige. Most importantly though was the fact that most physicians choose either medicine or surgery as their specialty and administered anesthesia just to have a good view of the surgical procedure. Vigilance was not maintained throughout the procedure because attention was directed towards the surgical field. Preferring to watch the surgery rather than balance the patient's needs of a safe anesthetic and maintenance of appropriate surgical conditions, surgical morbidity and mortality increased (Koch, 2010).

During the Civil War and latter half of the nineteenth century, surgeons saw nurses as a potential cadre of professionals who could give their undivided attention to patient care during surgical procedures. Virginia Thatcher, the first historian of CRNAs, wrote the following in the *History of Anesthesia With Emphasis on the Nurse Specialist* (1953) regarding the surgeon's view of the role of nurses in anesthesia:

1. Be satisfied with the subordinate role that the work required.

2. Make anesthesia their one absorbing interest.

3. Not look on the situation of the anesthetist as one that put them in a position to watch and learn from the surgeon's technique.

4. Accept the comparatively low pay.

5. Have the natural aptitude and intelligence to develop a high level of skill in providing the smooth anesthesia and relaxation that the surgeon demanded. (p.53)

The first documentation of nurse-administered anesthesia was by Catherine S. Lawrence, a Union Army nurse, in the Second Battle of Bull Run in 1862. She wrote an autobiography and chronicled her use of chloroform and tying arteries. Two other nurses were noted in her work as to have given chloroform during the Battle of Gettysburg in 1863. Reports from the Franco-Prussian War (1870-1871) also documented the use of male and female nurses who were used to administer anesthesia, setting in motion the history of nurses supplying health care needs in time of peace and war (Koch, 2010).

Because most hospitals at the time were staffed by Catholic and Protestant nuns, they became the first identifiable CRNAs. Sister Mary Bernard from St. Vincent's Hospital in Erie, Pennsylvania became the first of these Sisters to assume the CRNA role in 1878. Other orders of nurses followed and the 1890s found the surgeons very satisfied with having nurses in charge of

the anesthetic (Koch, 2010). Serving as pioneers in anesthesia, CRNAs became involved in the full range of specialty surgical procedures, as well as in the refinement of anesthesia techniques and equipment.

It was during this time period that the first surgeon-CRNA teams were developed. Drs. William W. Mayo, William J. Mayo, and Charles H. Mayo opened St. Mary's Hospital (Mayo Clinic) in Rochester, Minnesota in 1899. There, two early, groundbreaking CRNAs honed their skills and contributed greatly to the field of anesthesia. In 1893, Alice Magaw came to St. Mary's and adopted the German technique of gradually dripping ether onto a gauze-covered mask. This was an advance from the previous mode of ether administration, which was by pouring ether into a sponge in a cone and when the patient's breathed from the cone, they often became anesthetized but hypoxic. She perfected and published this technique and taught others that the patient did not have to have an uncomfortable, "choking, smothering" experience, which was practiced in many hospitals of the day. Her excellent practice prompted Charles H. Mayo to call her the "Mother of Anesthesia". The other nurse working at Mayo during this time was Florence Henderson, who joined the hospital in 1903. She had learned the technique of chloroform and ether administration in Nebraska and developed assessment criteria for the anesthetized patient. The vigilance inherent in both Magaw's and Henderson's practice contributed to the excellence known by the Mayo brothers and St. Mary's hospital (Koch, 2010).

In 1900, Agatha Hodgins, a Canadian nurse, moved from Boston to Cleveland, Ohio to work at Lakeside Hospital (now University Hospitals of Cleveland) as a CRNA. Surgeon George Crile chose her to become his personal CRNA in 1908 and she was one of the first to test early anesthesia machines using a nitrous oxide-oxygen combination. Hodgins served in France during World War I with Crile and staff from Lakeside Hospital. Not only did they perform

surgery on the wounded, they also taught countless physicians and nurses the art and science of anesthesia. After the War, she went on to become the founder of the American (National) Association of Nurse Anesthetists in 1931 and nurse anesthesia was recognized as the first anesthesia specialty (Koch, 2010).

Before World War I, CRNAs were highly sought after and nurse anesthesia programs were developed and then expanded greatly after the success of the nurses on the battlefield. CRNAs outnumbered ANs by a 17:1 ratio. After World War II, the Army Nurse Corps had educated more than 2000 CRNAs in a four-six month program. More CRNAs could have been educated but U.S. law prohibited male nurses from being commissioned into the Army and Navy Nurse Corps. They would not be allowed in as members until 1947, two years after the AANA accepted the first African-American CRNAs (Koch, 2010).

Other CRNAs helped shape the profession and advanced the practice of anesthesia as a whole in the mid-twentieth century. Olive Berger was the Chief CRNA at Johns Hopkins Medical Center. In 1948, she reported on 480 anesthetics administered to infants for cyanotic "blue baby" congenital heart disease procedures, most notably Tetralogy of Fallot, with CRNAs providing the majority of anesthesia for successful procedures. In 1952, Helen Lamb, AANA President from 1940-1942, was a proponent of accrediting nurse anesthesia schools and accomplished this to add credibility to the profession and also instituted certification by examination in 1945 (Bankert, 1989).

To comply with more stringent standards set forth by the U. S. Office of Education, the AANA established three autonomous councils in August 1975: the Council on Accreditation of Nurse Anesthesia Educational Programs (COA), the Council on Certification of Nurse

Anesthetists (COC), and the Council on Practice (COP) to serve as an appeals body to the other two. In 1979, the Council on Recertification (COR) was established (Koch, 2010).

During the next decades, nurse anesthesia education evolved and in 1998, all programs had to be at least 24 months in length and confer a Master's degree as the terminal degree. By 2025, all programs will be required to graduate students with a practice doctorate degree (Koch, 2010). These changes were mandated by the COA.

There are currently approximately 48,000 CRNAs who safely administer anesthetics to approximately 35 million patients each year in the United States, according to the AANA 2014 Practice Profile Survey, and there are 114 graduate nurse anesthesia programs. CRNAs are the primary anesthesia providers in rural America and in some states, the only rural anesthesia provider. These providers are able to offer obstetrical, surgical, and trauma stabilization services in medically underserved areas (AANA, 2015).

Physician anesthesiologists.

The initial grand discoveries by physicians of inhaled and local anesthetics to produce insensibility during surgical procedures during the mid-19th century segued into the refinement of the administration of these anesthetics by CRNAs in the latter half of the 19th and early 20th centuries. Surgeons preferred the vigilance of the CRNA administering the anesthetic, rather than the "occasional anesthetist" that was more concerned with the surgical procedure. There were however some who identified themselves as ANs early on. Dr. Mary Botsford is recognized as the first woman to establish an anesthesia practice. In 1897, she became an AN at a children's hospital in San Francisco. Dr. Isabella Herb practiced under the guidance of Dr. Charles Mayo in Minnesota from 1899-1904. Dr. Sydney Ormond Goldan of New York was the first to declare himself a specialist in anesthesia in the early 1900s. He also was the first to

publish his creation of an anesthesia chart to record pulse, pupils, and respirations. Others before him had recorded vital signs but he was the first to officially publish his record instrument. He also is credited to be the first to perform regional anesthesia via cocainization for spinal anesthesia (Jacob et al., 2013).

During the mid-1930s, medical and surgical specialties were created due to financial incentives proposed by the American Medical Association. Third-party payment was taking shape and the physicians recognized a lucrative endeavor.

Anesthesia was not recognized as a medical specialty until 1937 by the American Medical Association. This hampered the development of the specialty until the onset of World War II (Kane & Smith, 2004). Before World War II, there were only seven anesthesia residency programs involving one year of training. After the War, the number of anesthesia residency programs slowly increased, as did the number of practicing ANs. In 1940, there were 285 full-time ANs (30.2% certified) and in 1949 there were 1231 (38.3% certified). Even with this increase in numbers, there was still a severe shortage of anesthesia providers (Koch, 2010).

Despite this shortage, some physicians were intent in making anesthesia an all-physician specialty. They launched a public relations campaign in hopes to create mistrust in CRNAs and force surgeons to break apart their partnerships with the nurses and instead, favor the ANs in the operating room. This plan backfired on the ANs and the surgeons and hospital administrators came to the CRNAs support (Koch, 2010).

In the 1960s, medical schools rapidly expanded due to federal government programs as part of the Johnson administration public health system reform. Between 1970 and 1996, the number of ANs' tripled and the number of CRNAs increased by 75% (Kane & Smith, 2004). This shifted the supply and demand curve to an excess of providers.

There are currently approximately 48,000 physician ANs in the United States today, practicing in all specialty areas. The majority of ANs practice in teaching centers and community hospitals in and near large urban areas. Almost 75 % of ANs are board certified (ASA, 2016).

Anesthesiologist assistants.

The evolution of the Anesthesiologist Assistant (AA) is a fairly recent development and addition to the anesthesia team. In the 1960s, several prominent ANs developed the role of the AA. In 1962, Robert D. Dripps from the University of Pennsylvania was concerned with the shortage of ANs in the country and wondered who they could enlist "to supervise, to control" to assist them with anesthesia. He recognized the relationship between CRNAs and ANs was difficult and proposed to "solve the problem of additional personnel another way" (Koch, 2010, p.796).

Three ANs, Joachim S. Gravenstein, John E. Steinhaus, and Perry P. Volpitto, academic anesthesia chairs, said they were concerned with the shortage of ANs in the country also. They performed a workforce analysis and developed a provider that would be dependent on the ANs, based on the physician assistant model. The first AA training programs began in 1969 at Emory University in Atlanta, Georgia and Case Western Reserve University in Cleveland, Ohio (Gravenstein, Steinhaus, & Volpitto, 1970). Their professional association, American Academy of Anesthesiologist Assistants (AAAA), was formed in 1975.

The National Commission for Certification of Anesthesiologist Assistants was created in 1989 and the first certification exam was in 1992. There are currently 10 schools for these providers with approximately1500 AAs in practice. Approximately 180 new AAs are certified annually. This educational pathway encourages a pre-med background, though any bachelor's

degree is accepted, and culminates with a Master's degree. This practitioner requires supervision by an AN and can only practice in a medical direction model to this day. They have practice authority in 18 states: 14 states by statute and four states by delegatory authority (AAAA, 2016).

Evolution of anesthesia practice models.

Since the Civil War, CRNAs were practicing anesthesia under the supervision of the operating surgeon. The first nurses to administer anesthesia were of the religious order. Though the first publicly documented anesthetic was by Dr. William Morton in Boston in 1846, ANs did not often participate in the day-to-day actions of administering anesthesia until the mid-1930s since it was looked on as a "hand maiden role" by other physicians and did not generate a lot of interest in the medical community (Koch, 2010).

Some physicians claimed the field solely as a physician specialty and tried to force the CRNAs from practicing. Starting in 1911, Francis Hoeffer McMechan from Cincinnati, Ohio spent his life promoting physician anesthesia and denouncing nurse anesthesia. His actions may have alerted the Ohio Board of Medicine to question and notify George Crile at Lakeside Hospital (site of one of the first nurse anesthesia programs with Agatha Hodgins) that only a physician could administer anesthesia and the program had to cease in 1916. In 1917, a hearing was held that overturned the initial ruling and the program and CRNAs' were able to resume. In order to ensure this would not be overturned, Crile and other physicians petitioned the Ohio legislature to guarantee that CRNAs would practice anesthesia under the supervision and in the immediate presence of a physician (Koch, 2010). The concept of physician supervision of CRNAs was legally born.

Many court cases ensued from this. Most notable was Frank vs. South in 1917 in which an appeals court in Kentucky ruled that CRNA Margaret Hatfield was not engaged in the

practice of medicine when she gave anesthesia to surgeon Louis Frank's cases. Judge Hurt wrote the opinion of the court, which read: "We are of the opinion that …Hatfield, in the way, and under the circumstances agreed upon, as being the facts of the case, that she is not engaged in the practice of medicine within the meaning of the statute laws" (Koch, 2010, p. 5). This was one of the first legal battles that declared that anesthesia was not solely the practice of medicine.

Another landmark case was Chalmers-Francis vs. Dagmar Nelson in 1933. Nelson was a practicing CRNA in Cleveland and trained with Agatha Hodgins. She moved to California and was arrested for practicing medicine. She was convicted then won on appeal (Bankert, 1989). These debates, though in different forms, still continue on to this day.

Starting in the mid-1960s, current anesthesia practice models began taking shape. In 1966, the medical direction model was developed by the Offices of Medicare and Medicaid services, permitting the ANs to bill for up to four cases that they "supervised". This was viewed as a financial gain since they could pay the CRNA who often was a part of the anesthesia group practice and also pay themselves a wage.

In 1982, the Health Care Financing Administration (HCFA), now known as the Centers for Medicare and Medicaid (CMS), revised the Conditions of Participation (COPs) for ambulatory surgical centers (ASCs) to require physician supervision of CRNAs. As part of the Omnibus Reconciliation Act of 1986, the Conditions of Participation for hospitals to require supervision of CRNAs was revised. This tightened up the requirements for billing and delineated between medical direction and medical supervision. There are three parts to the COPs: Part A is for facilities such as ASCs, hospitals and critical access hospitals, Part B is for providers such as physicians, CRNAs and other providers that are allowed to bill Medicare directly and, Part D is for prescription drugs. These requirements were derived from the Tax Equity and Fiscal

Responsibility Act (TEFRA) and established conditions in Medicare Part B that an AN must fulfill the following criteria in order to be paid for services when medically directing up to four CRNAs:

1. Performed a pre-anesthetic examination and evaluation.
2. Prescribed the anesthesia plan.
3. Personally participated in the most demanding procedures in the anesthesia plan, including induction and emergence.
4. Ensured that any procedures in the anesthesia plan that he or she did not perform were performed by a qualified anesthetist.
5. Monitored the course of anesthesia administration at frequent intervals.
6. Remained physically present and available for immediate diagnosis and treatment of emergencies.
7. Provided indicated post-anesthesia care (AANA, 2015).

This was initially created to ensure payers received value for their money and not to ensure clinical quality. In Kane and Smith's article (2004), they note, "it was not immediately clear quite how clinical care implied by direction is different from mere supervision" (p. 796). Medical supervision occurs when the AN is involved in the care of more than four patients simultaneously. Payment is made under Medicare Part B. The CRNA can bill for 50 % of the physician fee schedule and the AN can bill for two to four base units per case (which characterize the complexity and difficulty of the case) plus time that they are involved (per the Medicare Resource-Based Relative Value Scale-RBRVS) and requires the AD modifier (AANA, 2015).

There have been many iterations of the Omnibus Budget Reconciliation Act since 1986 but what remains significant is that this was the first time CRNAs were allowed to bill directly for their services. In 1993, Medicare placed a cap on payment for a procedure to 120% of a solo AN fee and this was likely in response to excessive billing with CRNAs. In 1998, the cap was changed to 100% of a solo AN fee. These reduced financial benefits no longer were lucrative for the ANs working in a medical direction model. Many anesthesia groups turfed the CRNAs back to the hospital to be billed under Medicare Part A and formed AN-only group practices. Some of these practices tried to convince the hospital stakeholders that having only ANs provide anesthesia services would serve the hospital better in relation to finances, patient safety, and marketing to patients since they were a perceived higher level of care provider (Kane & Smith, 2004).

In 2001, HCFA published what is now known as the Medicare opt-out rule. This rule allows the governor of a state, after careful input from stakeholders, to allow CRNAs to practice without physician supervision. For a state to be exempt of the federal supervision requirement, the governor must send an attestation letter to CMS. The letter must state that the state's boards of medicine and nursing have been consulted regarding access to and quality of anesthesia services as well as state law and that in the best interest of the citizen's of the state, the opt out should go forward. Currently, seventeen states have opted out to date and they are: Iowa (2001), Nebraska (2002), Idaho (2002), Minnesota (2002), New Hampshire (2002), New Mexico (2002), Kansas (2003), North Dakota (2003), Washington (2003), Alaska (2003), Oregon (2003), Montana (2004-a new Governor reversed the opt-out but after understanding the opt-out better, restored it), South Dakota (2005), Wisconsin (2005), California (2009), Colorado (2010-the opt-out is for Critical Access Hospitals and specified rural hospitals), and Kentucky (2012)

(AANA, 2015).

To sum up the evolving history of medicine and other health care professionals, Barbara Safreit, associate dean of the Yale Law School, wrote in her 1992 book, *Health Care Dollars and Regulatory Sense: The Role of Advanced Practice Nursing*:

> In the mid-to-late 1800s, physicians rose from the ranks of previously undifferentiated occupations devoted to healing, and claimed preeminence through their highly organized effort to obtain the "exclusive right to practice". Having obtained that right, however, physicians also recognized their need for the services of other practitioners of healing, who were "useful to the physician and necessary to his practice, even if dangerous to his monopoly". To solve this dilemma, physicians obtained from "the state control over those occupations' activities" so as to limit what they could do and to supervise or direct their activities. (p. 442).

Since the last decade of the 20th century, some anesthesiology groups have tried to convince hospital administrators that it is more financially sound to only hire ANs. They state that if they are a private group, they reduce the hospital portion of the bill in addition to having superior training, which translates to higher quality care (Koch, 2010). To assess if this is in fact a true premise, one must look at the current practice of anesthesia models today.

Anesthesia Practice Models

In the current anesthesia practice environment, there are three groups that provide anesthesia services: CRNAs, ANs, and AAs. While AAs are required by law to be directly supervised by an AN, CRNAs and ANs have the same scope of practice and can function independently. CRNAs can practice under their own license and set of regulations under the

auspices of the state Board of Nursing in the same manner an AN can practice under their own license from the state Board of Medicine. Though CRNAs in non-opt out states must collaborate with a physician, dentist or podiatrist, they are not required by law in any state except New Jersey to work under the supervision of an AN (AANA, 2015). Local edicts and hospital bylaws may tighten the supervisory regulations of CRNAs and these practice implications may need to be considered in terms of overall anesthesia practice model efficiency at the institutional level.

The anesthesia practice and payment models that are still being utilized today may be considered outdated. Since 2003, private payers have been able to better identify the role and financial value of CRNA services due to the implementation of the Health Insurance Portability and Accountability Act which clarifies the differences between medical and nonmedical direction of CRNAs (CAER, 2008). Healthcare facilities may want to consider investigating other models of anesthesia and value-driven services offered, which could provide significant cost savings to the overall healthcare facility.

There are anesthesia practice models currently being utilized in United States healthcare facilities that are financially advantageous to providers and facilities when compared to medical direction and medical supervision models. A solo provider model being used in some facilities involves both CRNAs and ANs working in the same facility but independently of one another. Since some facility bylaws require an AN to be present, this model could serve well (AANA, 2015).

Anesthesia practice models are generally divided into medical direction, medical supervision, and non-medical direction or solo provider. Though these models were developed under the Medicare system, they were developed as payment models, not standard of care models. Many hospital administrators, with direction from the anesthesiology group, apply the

more supervisory models to all cases and make it the standard of care for anesthesia administration. The issue purported by anesthesiology groups is surgical patients' safety related to type of anesthesia provider. These groups continue to state that anesthesia is safer with an AN involved despite the fact that anesthesia-related deaths today are as low as 1 in 240,000 cases (Hogan, Seifert, Moore, & Simonson, 2010). These practice implications may increase anesthesia costs and decrease access to care to millions of Americans.

Medical direction (anesthesia care team).

Under medical direction, the CRNA or AA each bill Medicare for 50 % of the available physician fee schedule, using the QX modifier, with the AN claiming the other 50 % for up to four simultaneous cases. However, the AN must perform and document the TEFRA regulations. If these are not done, medical direction cannot be billed and the facility loses money (AANA, 2015).

Medical supervision.

The medical supervision model consists of one AN supervising more than four CRNAs at one time. This can be viewed as a "consultant" role for the AN. Under Medicare Part B, the CRNA can bill for 50% of the physician fee schedule and the AN can bill for two to four base units per case (which characterize the complexity and difficulty of the case) that they are involved (per the Medicare Resource-Based Relative Value Scale-RBRVS) and requires the AD modifier. The base unit guides are published by the Centers for Medicare and Medicaid Services (CMS) and assign a set billing value based on procedure, length of case (time units in 15-minute increments), and coexisting disease status of patient. This overall reimbursement is more than 50% but less than 100% of the physician fee schedule. ANs and hospital practices do not necessarily view this model favorably because they are reimbursed less (Commission on

Anesthesia Economics and Reimbursement [CAER], 2008). Because a hospital could choose to employ one AN and multiple CRNAs, this practice would decrease the overall salary costs of the medical direction model but it would also decrease the overall reimbursement the hospital may receive.

Non-medical direction (CRNA-only or AN-only).

The CRNA-only (non-medical direction) model states that CRNAs can perform anesthesia without the participation of an AN. The CRNA bills 100% of the Medicare Part B physician fee schedule, the same as an AN can. The modifier QZ identifies that this is a nonmedical direction case for billing purposes. The AN-only model is the AN performing anesthesia services without the participation of a CRNA or AA. The modifier AA is used for billing purposes. In the AN-only model, the AN administers anesthesia without the participation of a CRNA or AA. The AN bills 100% of the physician fee schedule. Some facilities utilize independent CRNAs and ANs working together but billing as non-medical direction as previously explained (AANA, 2015).

Characteristics of Various Practice Models

When looking at cost-effective solutions that could work best in varying practice environments, one must look at the entire landscape of healthcare. Changing rules, regulations and laws that can free and bind practice; proposals for sweeping changes to the current healthcare system; drastic reductions in payment; competing providers; and technological advances that may alter the nature of anesthesia practice must be considered (CAER, 2008). The constructs of quality, access, and cost must be analyzed to create a realistic picture of the healthcare environment and anesthesia services. Table 1 shows the most current and sentinel research studies that examined these constructs.

Table 1

Anesthesia Provider Studies of Quality, Access, and Cost-effectiveness

Study	Quality	Access	Cost
Lewis et al (2014)	X		
Dulisse & Cromwell (2010)	X		
Hogan et al. (2010)	X	X	X
Haller et al. (2009)	X		
Needleman (2008)	X		X
Simonson (2007)	X		X
Smith et al. (2004)	X		
Abenstein (2004)	X		X
Pine (2003)	X		X
Silber (2000)	X		
Abenstein & Warner (1996)	X		X
Forrest (1980)	X		
Beecher & Todd (1954)			X

Quality of practice models.

Quality of care indicators were initially developed in the manufacturing industry. The health care industry introduced them in 1982 as part of the Medicare program's Professional Review Organization. Originally, these clinical indicators were crafted as "flags", which triggered case reviews if problems with the quality of care provided led to undesirable occurrences.

Soon after, the Maryland Hospital Association and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) were involved in developing clinical indicators. Fourteen anesthesia-related indicators to measure organizational performance were developed by JCAHO between 1987 and 1993 and called the national Indicator Measurement

System. These were separated into two categories: sentinel event indicators and rate-based indicators. Sentinel event indicators identified unusual or isolated occurrences involving death or serious physical or psychological harm, like perioperative cardiac arrest. Rate-based indicators identified abnormal trends in a process or outcome of care documented on a regular basis. These were reported as a ratio such as annual rate of unplanned intensive care unit admissions after anesthesia. Eventually, the number of anesthesia-related indicators were reduced to five after reliability testing in hospitals. These were identified as perioperative central nervous system complications, peripheral nervous system complications, acute myocardial infarction, cardiac arrest, and death. They were also renamed to perioperative indicators since the occurrences could not be directly attributed to anesthesia care (Haller, Stoelwinder, Myles, & McNeil, 2009).

Clinical indicators of quality of care are most often measured in terms of patient outcomes since quality is a nonquantifiable construct. Perioperative morbidity and mortality as a marker of quality measured at defined intervals of time after surgery (24-hours, 48-hours, 30-days) has been studied with varying degrees of validity and reliability. Complications cannot always be attributed to anesthesia as noted by multiple organizations and experts. In addition, adequately defining, reporting, and tracking of perioperative complications is often ambiguous and unreliable (Haller et al., 2009).

Despite the challenges noted above, anesthesia researchers have been trying to quantify quality of care for decades now. Beecher and Todd published the first anesthesia outcomes study in the United States in 1954. Beecher was an AN in the war and worked with CRNAs. The five-year prospective study analyzed anesthesia outcomes in 10 University hospitals and 600,000 procedures. The results showed that CRNAs had a mortality rate of less than half the ANs, with

a sample size twice that of the ANs. Additionally, they concluded that there was no difference in Physical Status scores (coexisting disease risk stratification) of patients between the groups, oft a claim that ANs administer anesthesia to sicker patients. The ANs did not believe the results and disregarded this study (Beecher, 1954).

In 1994, Abenstein and Warner were commissioned by the Minnesota Commissioner of Health to report on the current state and future prospects for anesthesia services due to difficulty attracting CRNAs to practice in the state. They were charged with comparing patient outcomes related to anesthesia provider/practice model, costs of each model, and effects of competition. They utilized data from a previous study by the Minnesota Department of Health (DOH) that concluded "there are no studies, either national in scope or Minnesota-specific, which conclusively show a difference in patient outcomes based on type of anesthesia provider" (1995, p.1). At the time of this publication, the Minnesota Society of ANs urged the DOH to reach different conclusions but they refused. In the article *Anesthesia providers, patient outcomes, and costs* (1996) by Abenstein and Warner, they distorted the facts into a partisan advocacy piece that even the editor of Anesthesia and Analgesia cautioned as biased (AANA Quality of Care in Anesthesia, 2009; Smith, Kane, & Milne, 2004).

According to a 1999 report from the Institute of Medicine, anesthesia care is nearly 50 times safer than it was in the early 1980s. Numerous outcomes studies, in addition to those discussed previously, have confirmed that there is no difference in the quality of care provided by CRNAs and ANs (Dulisse & Cromwell, 2010; Forrest, 1980; Hogan, 2010; Needleman, 2008; Pine et al., 2003; Simonson, 2007; Smith et al., 2004). This research supports the fact that the anesthesia care delivered by CRNAs and ANs provides equal outcomes for all types of surgical procedures from the simplest to the most complex, either as solo providers or part of a team. In

addition, classic studies performed by the National Academy of Sciences (1977), Forrest (1980), Bechtoldt (1981), and Pine et al. (2003) concluded that between CRNAs and ANs, the type of anesthesia provider does not affect inpatient surgical mortality.

A 2007 study by Simonson in *Nursing Research* concluded obstetrical anesthesia services are safe and that there is no difference in safety between hospitals that use a CRNA-only model compared with those that use an AN-only model. This study was replicated by Needleman and Minnick in 2008 and supported the same conclusions.

A March 2010 study conducted by the Lewin group takes these issues one step further and examines anesthesia provider model, quality of care outcomes, cost comparisons, and availability of anesthesia providers to provide care and access for diagnostic and surgical procedures in rural and urban communities. The quality of care aspect of this study was researched by reviewing literature and databases over the past two decades to assess anesthesia-related mortality rates. National estimates show a rate of about one death for every 240,000 anesthetics. Furthermore, recent studies have found no significant differences in anesthetic complication rates between CRNAs and ANs or among the various anesthesia delivery models (Dulisse & Cromwell, 2010; Hogan et al., 2010; Needleman & Minnick, 2008; Simonson et al., 2007).

Dulisse & Cromwell's 2010 study entitled *No Harm Found When Nurse Anesthetists Work Without Supervision By Physicians* analyzed two outcome measures: inpatient mortality and complications. They divided the anesthesia complications into seven patient safety indicators as developed by the Agency for Healthcare Research and Quality Institute (AHRQ):

1. Complications of anesthesia.
2. Death in low-mortality diagnoses.

3. Failure to rescue from a complication of an underlying illness or medical care.
4. Iatrogenic pneumothorax.
5. Postoperative physiologic or metabolic derangements.
6. Postoperative respiratory failure.
7. Transfusion reaction.

Their results found that patients were not exposed to an increased surgical risk if CRNAs provided anesthesia services without physician supervision. This study translates not only to statistically significant equilibration of quality anesthesia care provided between models but also highlights the ability to increase access to anesthesia services to patients in a cost-effective model.

All anesthesia providers administer anesthesia in collaboration with surgeons, ANs, dentists, and podiatrists. Anesthesia is recognized as the practice of nursing when administered by a CRNA and as the practice of medicine when administered by an AN. Regardless of whether their educational background is in nursing or medicine, all anesthesia professionals provide the same high quality, safe anesthesia care (AANA, 2015). In fact, the Federal Centers for Disease Control had considered conducting a large scale analysis on the quality of anesthesia care but then decided against it since such a study would be costly and the evidence is overwhelming that anesthesia care provided by a CRNA or AN is equally safe. A recent systematic review (2014) conducted by the Cochrane Collaboration concluded "no definitive statement can be made about the superiority of one type of anesthesia provider over another" (Lewis, Nicholson, & Smith, p. 15). They deduced that case complexity, low anesthesia complication rates, and potential confounding effects of studies make it impossible to determine if there is a difference between CRNAs and ANs. Goodman (1998) summed it up when writing

about evidence-based medicine and anesthesia, "there is no evidence that evidence-based medicine leads to better medical care". He further surmised, " the debate will continue as most human debates do, on emotional and rhetorical grounds" (p. 357).

Access to practice models.

A common issue in discussing access to care is that there are several different conceptualizations of the phrase in the literature. Health care services research has looked at the determinants of access to care and utilization of services for years and has used different definitions. For purposes of this review, Aday and Anderson's model definitions will be utilized and built upon. In Aday and Anderson's sentinel work of studying access, their traditional model identified three individual determinants of utilization: predisposing factors, enabling factors, and need, as depicted in Figure 2. Predisposing characteristics include socioeconomic factors (race, gender, educational level, occupation) and individual health beliefs and attitudes. Enabling characteristics facilitate an individual's use of healthcare services, mainly financial resources. Lastly, need, which encompasses each individual's perception of their need for and value of medical care and a healthcare provider's estimation of their need for care (Phillips, Morrison, Anderson, & Aday, 1998). More recent work has expanded this model to include internal and external variables that describe the health care delivery system (policies, resources, organization supply), environmental variables (economic climate, wealth, politics, violence) and community level characteristics (availability of physicians) (Hall, Lemak, Steingraber, & Schaffer, 2008).

In discussing access to care, it is important to look at two different aspects of this topic: access to care for patients and access to cases by practitioners. Both are integral in any discussion regarding anesthesia practice models. Development of these terms will aid in

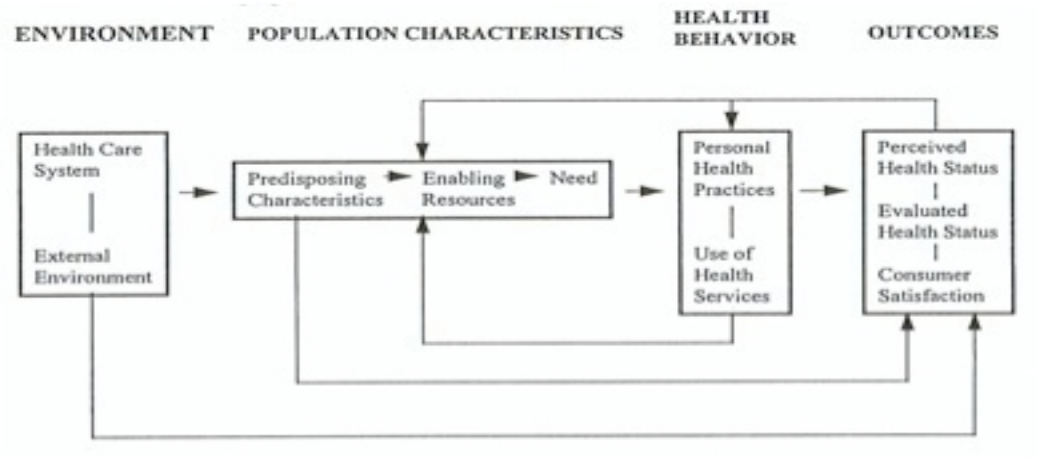

Figure 2. Behavioral Utilization Model Schematic Diagram. Reprinted from "Understanding the Context of Healthcare Utilization: Assessing Environmental and Provider-Related Variables in the Behavioral Model of Utilization," by K.A. Phillips, K.R. Morrison, R. Anderson, & L.A. Aday, 1998, *Health Services Research, 33:3,* p. 575. Copyright 1995 by the American Sociological Association.

clarifying the constructs to be studied.

Access to care for millions of Americans has been an oft discussed topic since the implementation of the Patient Protection and Affordable Care Act (PPACA) in 2010 and the Health Care Education and Reconciliation Act (HCERA), which together form the Affordable Care Act (ACA) and its resultant increase in demand for and offering of services. The full implementation is still uncertain. It could potentially add 30 to 33 million previously uninsured citizens for coverage but even if it merely expanded Medicaid, it will add 17 million to the insured by 2020. To assist in improving access for this increase in insured, the Institute of Medicine (IOM) of the National Academy of Sciences stated in its 2010 landmark report *The Future of Nursing* that "advanced practice registered nurses (APRN's) should be able to practice to the full extent of their education and training" (IOM, 2010, p. 1). At this time, regulatory barriers exist to prevent this from happening in many states.

These regulatory barriers affect anesthesia services provided by CRNAs. There are currently 17 states that have opted out of the need for supervision of CRNAs. This provision allows patients to remain in their communities and receive care nearby by non-medically

directed CRNAs rather than travel hundreds of miles to a hospital that is staffed with an AN. Some state AN and medical associations have fought to either have the opt-out decisions overturned or not enacted at all. They propose that they would rather have rural hospitals close due to the inability to hire an AN on staff rather than have anesthesia provided by a CRNA only. This is an example of physician-centric thinking over patient-centered care (Rowe, 2012).

The Federal Trade Commission has weighed in on some cases restricting APRN's scope of practice, which may be translated to limiting patient's access to cases and has found cases of anticompetitive practices protecting professional interests over consumers. This leads to antitrust issues and it affects both consumers and anesthesia providers. In the late 1970s to mid-1980s, many CRNAs were being fired from their jobs because the hospital and ANs group bonded together stating they wanted all-physician groups. Some called this antitrust but antitrust laws protect competition, not competitors. One must prove that competition for jobs is in a defined market and that market is adversely affected (Koch, 2010).

The Sherman Antitrust Act is a federal law dating back to 1890. It is essentially anti-monopolistic and supports economic competitiveness. Section One involves contracts, conspiracy, combinations, and restraint of trade. It states that two or more economic entities must be involved in an alleged illegal agreement for this section to apply. Section Two deals with prohibiting monopolies of a product or service in a single market area. In the anesthesia sector, this would apply if a single hospital or hospital system was in an agreement with a single anesthesia group which controlled more than 50% of the services and dominated the market in a defined community. Antitrust legislation is stiff and awards triple damages for a successful lawsuit. There are two ways to rule on antitrust behavior. The first is via the per se rule and states that actions obviously limiting competition in a defined market are automatically illegal.

This rule is rarely applied. The second and most commonly utilized violation is the rule of reason and this assesses the market and status of competition. This rule can be applied to the anesthesia community in the following example: if there was a small and large hospital in a community with two exclusive individual anesthesia practice groups, if the larger group bought out the smaller one and then did not let practitioners practice at either hospital if they are not part of that group, this could be viewed as anticompetitive behavior (Brown & Mirafzali, 2011).

Two significant cases were ruled that members of learned professions were not exempt from federal antitrust laws. These were U.S. Supreme Court decisions in the cases of *Goldfarb v. Virginia State Bar* (1976) and *National Society of Professional Engineers v. United States* (1978). What this did for the anesthesia profession is put anesthesia providers on alert that they were not exempt from antitrust laws and that they also could potentially use them if they were victims of a restriction of practice conspiracy (Wing, 1985). Though this may be true, antitrust cases are often difficult to prove.

In the 1980s, two CRNAs filed cases to fight for their right to practice. In 1985, Vinnie Bhan (*Bhan v. NME Hospitals)* filed an anticompetitive suit against his hospital for terminating his contract in favor of ANs. The defendants won in the lower court stating that a CRNA could not legally compete with physicians because of differences in their scopes of practice but it was reversed on appeal. The ruling stated that "the issue is not whether the two groups perform identical services, but whether there is a reasonable interchangeability of use or cross-elasticity of demand between the services provided by CRNAs and by ANs sufficient to constrain market power and affect competition" (Blumenreich, 1985, p. 527). Eventually, Bhan lost his case on another appeal because the courts ruled that NME Hospitals did not have significant market

share in the community to act as constraint on competition. Though this was a loss for Bhan, it set a precedent for CRNAs to sue ANs under antitrust laws (Blumenreich, 1985).

In 1988, Tafford Oltz (*Oltz v. St. Peters Community Hospital)* had his clinical privileges terminated when St. Peter's Hospital in Helena, Montana, gave an exclusive contract to an anesthesiology group. The court agreed that the hospital and ANs conspired against him so that the ANs would have access to his cases. Oltz offered regional anesthesia services, which the ANs did not, and he offered all of his services at a lower rate. Since St. Peters had a large market share, he was able to prove that this deal damaged competition. Though it was appealed twice, Oltz eventually won this judgment in 1994 (Koch, 2010).

In 1994, the Minnesota Association of Nurse Anesthetists (MANA) filed a lawsuit against Allina Health Systems Corp, several Allina hospitals, and their anesthesiology groups for Medicare fraud and antitrust violations. This Whistleblower lawsuit ended up being a 10-year legal battle with numerous appeals. This lawsuit was filed under the False Claims Act and charged that the ANs were submitting Medicare billing for cases they personally performed when, in fact, the CRNAs performed the cases. The CRNAs were hospital employees and ANs were part of an anesthesiology group. At this time, Medicare would not reimburse both a nurse and physician for anesthesia services. Since the CRNAs were hospital employees, the hospital did not receive any reimbursement for the cases they performed and several hundred CRNAs were terminated due to this reimbursement issue. During its investigation of this case, Medicare changed the anesthesia reimbursement regulations to provide a 50/50 split between the CRNA and AN when in the medical direction model. The case was eventually settled in November 2003 in favor of MANA with an undisclosed settlement though it was noted that 1.2 million was

paid back to CRNAs who contributed and many millions paid to attorney and other fees (Alford, 2014).

Efficiency of practice models.

CRNAs and ANs are best positioned to be the leaders in operating room efficiency since they are at the frontlines of perioperative management and functioning (Morgan, 2014). Operational anesthesia efficiency is often defined as the most efficient staffing model to provide anesthesia services that aligns with the hospital's actual volume and service demands. Anesthesia productivity has been declining nationally for years, resulting in increased costs to society. This is evidenced by anesthesia groups wanting to direct how the operating rooms and cases are run on their own instead of working collaboratively with nursing and surgery to troubleshoot the best arrangements possible. Anesthesia groups need to be sensitive to institutional expectations to get the best results (Morgan, 2014; Masursky, Dexter, & Nussmeier, 2008). Best practices dictate that anesthesia providers, surgeons, and nurses should not be pushing for full capacity or convenience at the expense of patient or provider safety.

Anesthesia, nursing, and surgery services need to work together to create the most efficient mix of services possible. Too often, these groups function in silos. In a well-run operating room, nursing and anesthesia can collaborate to improve the efficiency and increase relations with all involved. They all need to bring value-added services and resources to the table also. How these are defined is what sets highly functioning and efficient practice models apart from others (Masursky et al., 2008).

Operating room utilization is a metric that should be assessed and is defined as the number of anesthesia-covered/staffed hours divided by the number of billed or direct patient care hours. The nationally reported mean for hospital operating room utilization is approximately

63% (including turnover time). This most likely applies the same to anesthesia labor time. What this means is that anesthesia providers are underutilized close to 40% of the time at baseline (Morgan, 2014). This is not inclusive of delayed preoperative evaluations, delayed case starts, and delayed emergence times due to following the TEFRA regulations in a medical direction model.

The Perioperative Surgical Home (PSH) model adds to the performance and production aspect of the utilization of anesthesia services. This model is a paradigm shift in the continuum of patient care management. It is defined by the ASA as a "patient-centered and physician-led multidisciplinary and team-based system of coordinated care that guides the patient throughout the entire surgical experience" (Kain et al., 2014, p. 1126) and one in which the ANs have proposed to direct. The goal is to improve clinical outcomes at a lower cost all while improving the perioperative experience but there is currently a paucity of evidence on this model since it is relatively new to health services research. It utilizes some of the data from the enhanced recovery after surgery (ERAS) pathway which has been shown to result in improved patient satisfaction and postoperative outcomes, reduced length of stay, and reduced risk of hospital-acquired infections (Kain et al., 2014).

The PSH uses the guiding principles of the Patient-Centered Medical Home (PCMH) in concert with the Triple Aim Initiative to provide a framework for this model. The PCMH is a patient-centered, comprehensive, team-based primary care model that focuses on quality of care and safety. The PCMH has shown success in improving coordination of care, improving patient satisfaction and outcomes, and reducing costs. The Triple Aim has three goals: to improve the individual experience of care, to improve the health of populations, and to reduce per capita costs of care. Current anesthesia literature purports that ANs would like to be the specialist in the

PSH, coordinating best practices of care while involving the patient, family, and other healthcare stakeholders and providers. This is not definitively established yet because other clinicians see their role in this model. Surgeons, hospitalists, and advanced practice nurses have the skills and knowledge to operationalize this concept also (Vetter et al., 2014). If the chosen provider is either a CRNA or AN, a recalculation of anesthesia manpower and utilization resources will need to be conducted to assure a balance between supply and demand of all providers.

In addition to all of the resource utilization metrics and services, the participation in and reporting of newer quality measures will have an impact on the efficiency of anesthesia services in the operating room. Quality measures such as Pay for Performance have been around for years but the Physician Quality Reporting System (PQRS) and Value-Based Modifier (VBM) reporting programs are relatively new from Medicare. PQRS is a voluntary reporting program that used incentive payments (for years 2007-2014) and payment adjustments (starting in 2013) to encourage reporting of quality information measures by eligible professionals (EPs), including anesthesia professionals. As of 2015, those who do not elect to participate or who do not satisfactorily report the measures will be subject to a 2% penalty adjustment on services provided in 2017. There are no incentives after 2015. Providers must report in PQRS nine measures covering three National Quality Strategy domains for at least 50% of the EP's Medicare Part B patients. Adjustments can be made based on the size of a practice. Relevant domains for anesthesia PQRS measures can include Patient Safety (antibiotic administration timing; prevention of catheter-related bloodstream infections; perioperative temperature management) and Effective Clinical Care (preoperative beta-blocker in patients with prior open heart surgery) (AANA, 2015).

The VBM is a separate payment adjustment from PQRS. It affects anesthesia groups of two to nine EP's and solo practitioners with a 2% penalty if they fail to meet the PQRS measures and practices with greater than 10 EP's will receive a 4% penalty starting in 2016 if the measures are not met. CRNAs are not affected by the VBM adjustment in 2016 but will be after that. These metrics will affect how hospitals and systems are reimbursed or even penalized in the future (AANA, 2015).

In economic theory, these performance measures are a form of responding to moral hazard in the healthcare system. By definition, moral hazard is the tendency of an individual who is imperfectly monitored to engage in dishonest or undesirable behavior (Mankiw, 2007). In anesthesia, this problem arises when an agent (anesthesia provider) is performing a task on behalf of another entity called the principal (hospital, governmental agency-Medicare, etc.). There is not necessarily any malice or immorality on the agent's part and they may not even be aware of the undesirability of their behavior but their actions may be undesirable from the principal's standpoint. The moral hazard in the anesthesia profession is the risk for providers to not be as vigilant and responsible as they should be. Medicare has enacted the PQRS-VBM system to better monitor performance measures associated with high-quality patient care by enacting penalties if these measures aren't followed or reported correctly.

Efficiency can also be defined as the key element in the infrastructure of the perioperative environment. With new payment, reporting, and resource utilization requirements stemming from the ACA, anesthesia departments are analyzing their practice management strategies to demonstrate their value to a healthcare organization. Instead of looking at traditional staffing needs, anesthesia practices must look at the access and cost functions of the metrics also (Locke, 2015).

Economics of practice models.

The economic impact of burgeoning costs from all healthcare sectors might be lessened if best practice models were implemented. In the specialty of anesthesia, rearrangements in utilization and redistribution of manpower expenditures could cut waste if a strategic, organizational redesign occurred. In order to do this, manpower resources need to be defined.

Pressure to control health care costs has been present for decades. Cromwell has studied anesthesia practice patterns since the 1980's. He noted that 'attempts by government to tighten Medicare payments to become more efficient and equitable by decreasing the monies returned to the ANs over the years has only increased the hostility between CRNAs and ANs' (Cromwell, 1999, p.1331). Despite these intradepartmental conflicts, hospital administrators must calculate and report their profitability measures to the public and stakeholders on an annual basis. Lowering health care costs, especially labor costs, while providing high quality care is instrumental to the viability of healthcare systems. Hospital profitability is often measured by operating margin as an overall proxy for hospital operating performance. Operating margin is defined as net patient revenues minus total operating expenses divided by total net income. Operating margin is representative of a hospital's service to patient care and is recognized as successful if costs and quality are maintained. Therefore, operating margin is one of the performance trends that are analyzed by hospital administrators when assessing moves to lower healthcare costs (Jiang et al., 2006).

Because of the current move to control healthcare costs, is essential to discuss economical markets for related products and services. There are three key concepts related to the supply and demand of product and services: independent, complementary, and substitute goods and services. When two goods or services are unrelated, they are identified as independent. The

economic definition of complementary is two goods for which an increase in the price of one leads to a decrease in the demand for the other and vice versa (Mankiw, 2007, p.68). A good example of this is automobiles and gasoline. When the price per gallon of gasoline increases, it is more likely that people will use their automobiles less and may even decide to not purchase an automobile at all.

The economic definition of substitutes is 'two goods for which an increase in the price of one leads to an increase in the demand for the other' (Mankiw, 2007, p.68). A good example of this is frozen yogurt and ice cream. When the price of frozen yogurt increases, people are more likely to buy more ice cream and less frozen yogurt since they are similar deserts and satisfy similar desires.

Ostensibly, the same can be extrapolated to the utilization of anesthesia providers. CRNAs and ANs are considered by some as close substitutes for one another. The literature also labels these two provider groups as complementary, stating that 'CRNAs improve the effectiveness of anesthesiology by increasing staffing ratios and allowing ANs more time to spend in cases that require their presence' (Baird et al., 2014, p.32). These terms are reflected in economics as elasticity of supply and demand. Elasticity measures the responsiveness of a quantity that is demanded or supplied to consumers (Mankiw, 2007). Anesthesia provider elasticity of demand can be derived from the responsiveness of the market to the need for anesthesia providers in a local market. An increase in the salaries of ANs or subsidies for an anesthesia group may induce hospital administrators or anesthesia groups to utilize more CRNAs to provide anesthesia services. Because the price of ANs and the quantity of CRNAs moves in the same direction, the cross-price elasticity is positive.

With innovative measures like the PSH and restructuring of alternative anesthesia payment models, the cost variants may need to be analyzed to see the cost-benefit ratio of these innovations. For instance, where will the monies come from in establishing and piloting the PSH model? The private and governmental payer agencies are not set up for this type of funding so the economic implications will need to be studied including the potential for diseconomies of scale. Diseconomies of scale could arise due to coordination and production pressures such as adding in the PSH service for ANs and stretching the anesthesia team to a point that is not as efficient as possible. Anesthesia groups will need to demonstrate that though these innovations have increased cost, the increase is justified by the benefits the patient receives. This is known as having good cost utility, which can be reflected in quantity (cost) and quality (benefits) of care provided (Dexter & Wachtel, 2014).

The current school of thought is that the PSH groups will need to demonstrate and entice a health system and payers into purchasing this value-added service. Several University health systems have accomplished developing their own PSH, most notably University of Alabama at Birmingham and the University of Southern California Keck School of Medicine. If the PSH is developed with the AN as the PSH Specialist, innovative contracts will need to be created between the hospital systems and anesthesia management groups assuming varying degrees of financial responsibilities for funding this model (Vetter et al., 2014).

Effects of supply and demand are evidenced in anesthesia staff scheduling, case scheduling and staff assignments. Improved coordination of care, be it through a substantial reassessment of utilization of services in the operating room or via the PSH model, has the potential to provide opportunities in cost reductions in resource allocation. Since labor is the largest total variable cost of surgical care, it is the most likely place to look at cost reduction

interventions. Research utilizing an AN as an operating room (OR) Medical Director and using Automated Information Management Systems (AIMS) for scheduling has suggested that hiring more non-physician providers can decrease operating times and turnovers, thus increasing the number of cases that can be scheduled in a room daily by at least one and improving revenues conservatively by 33% (Dexter et al., 2014). But the most important concept that may be gained from the adaptation of the PSH is the improvement in quality for patients with this coordination of care. Two of the goals in the PSH literature, to reduce unnecessary interventions that do not have evidence-based benefit for patients and decreasing length of hospital stay, could possibly be achieved with this model (Dexter et al., 2014).

Benefits of Various Anesthesia Practice Models

When analyzing anesthesia delivery models, it is important to look at the advantages and disadvantages of each model. Each type of model, CRNA or AN-only, medical direction, and medical supervision model, each have benefits and limitations inherent in their makeup. Constructs to analyze include quality, access, efficiency, and economics. Each has been operationalized previously when reviewing the factors to consider when choosing an anesthesia practice model. Now each construct will be applied to these models.

Quality benefits of practice models.

With no good evidence that there are differences between the care provided by ANs and that provided by CRNAs, there is little support to favor one anesthesia practice model over another where quality is concerned. Of note, since 1996, the Harvard Medical School's standards in anesthesia have focused primarily on monitoring, since most anesthesia-related complications implicate lack of attention to patient monitoring and not educational pathway. It is purported that inattention and lack of vigilance adversely affect patient safety more so than the

type of education. In response to Harvard's standards focus, Attorney Gene Blumenreich surmised:

> Anesthesia seems to be an area where, beyond a certain level, outcome is only minimally affected by medical knowledge but is greatly affected by factors such as attention, concentration, organization, and the ability to function as part of a team; factors towards which all professions strive but which no profession may claim a monopoly. (1986, p. 539).

Access benefits of practice models.

Access to anesthesia care can be defined as availability of providers to deliver anesthesia services. A more robust definition was proposed by Hall et al. (2008) to include insurance acceptance, accessibility of contacting providers, appointment accessibility, and geographic accessibility. For purposes of this study, the initial definition will be utilized and focuses on geographic accessibility and surgical appointment accessibility. This is especially important in rural areas where it can be more difficult to recruit anesthesia providers due to the remoteness of the community. In addition, many rural areas are also designated as Medically Underserved Areas (MUAs). MUA are composed of four variables: ratio of primary medical care physicians per 1,000 population, infant mortality rate, percentage of the population with incomes below poverty level, and percentage of population age 65 and over (HRSA, 2016). Data from a 2009 RAND study found that only 5% of ANs worked in rural facilities (Daugherty, Fonseca, Kumar, & Michaud, 2010). The opposite is true of CRNAs working in rural hospitals with the majority of rural anesthesia care provided by non-medically directed CRNAs. Out of a total of 1,971 hospitals that are classified as rural community hospitals by the American Hospital Association (2015), 1,500 are staffed solely by non-medically directed CRNAs (AANA, 2015). Since

CRNAs provide the majority of anesthesia care in rural areas, the non-medically directed CRNA model benefits rural communities. This CRNA-only practice model is also supported by the National Rural Health Association (AANA, 2015).

Recent labor market analyses show two distinct trends regarding anesthesia services availability. The first is that hospital labor forces in rural areas show more stability than urban areas. Second, urban hospitals have an increased shortage of anesthesia providers with greater staffing needs than rural areas (Byrd & Peterson, 2009).

Recognizing that non-medically directed CRNAs provide anesthesia services to patients who might otherwise have to travel long distances for care is an important benefit of this model (AANA, 2015).

Access to anesthesia services also benefits from the medical supervision model. In this model, more CRNAs can be employed (at a lower cost) in a facility with one AN acting as a consultant. OR productivity can be increased with increased manpower, meeting surgical service demands and improving access to anesthesia services for more cases (Hill & Evers, 2012). In addition, increased staffing enables an anesthesia group to cover more anesthetizing locations in a facility, thereby possibly improving and strengthening relations with surgeons and administrators as well as patient satisfaction (Scurlock, Dexter, Reich, & Galati, 2011).

Efficiency benefits of practice models.

Efficiency as it relates to anesthesia delivery models is defined as operating or procedural room productivity (Masursky et al., 2008). The medical direction (with a CRNA or AA) or hybrid medical supervision/consultation models can increase efficiency of room turnover times if the AN is completing all of the preoperative evaluations and obtaining consent in a timely manner. In this case, when the CRNA/AA is done with the previous case, he or she can perform

a concise assessment of the patient and bring them back to the operating room quicker than if they had to do the full preoperative evaluation and consent themselves, as might occur with the CRNA-or-AN-only model. Another benefit of the medical direction or hybrid supervision/consultation models is the ability to have more manpower to comply with other value-added services like performance measures set forth in PQRS/VBM, which could decrease the likelihood of receiving penalties if not done or not recorded correctly (Vetter et al., 2014).

Advantages can be seen in a medical supervision and non-medical direction model where the scope of practice of all anesthesia providers can be utilized most efficiently due to no requirements to follow the TEFRA regulations, improving manpower arrangements. This could assist in maintaining on-time case starts with increased productivity throughout the perioperative period. There are more challenges in efficiently running an operating room than staffing rooms. CRNAs or ANs with expertise and interest in quality improvement and business management initiatives, appointment to various hospital committee leadership positions, education, regional anesthesia and pain management services, and research should be utilized in these areas to serve the overall surgical and patient services better (Vetter et al., 2013).

A study published in the journal *Anesthesiology* concluded that supervision lapses in on-time first case starts occurred with medical direction supervision ratios with first case starts at a rate of 35% of days even with a 1:2 model (Epstein & Dexter, 2012). The authors recommended that operating rooms should institute staggered starts or have additional ANs working at the start of the day. Decreasing the supervision ratio in either the medical direction or medical supervision model (for example, from 1:2 to 1:4 at the least) would increase provider availability in allowing each individual to practice to their full scope and bring value-added productivity to

the operating room environment (Epstein & Dexter, 2012). Without the required regulations, more cases would start on time.

Economic benefits of practice models.

Under CMS guidelines, anesthesia services are billed for in accordance with the anesthesia practice model utilized. Medical direction models can be beneficial to a system over medical supervision models from a purely reimbursement revenue standpoint. The CMS billing requirements dictate that more than four cases receiving anesthesia services concurrently are billed under Part A, the hospital portion of the bill, as opposed to medical direction being billed with four or less cases under Medicare Part B, physicians services. Because of this billing requirement with Medicare Part A COPs, many anesthesia group practices limit the number of cases supervised by the AN to be four or less cases because it benefits both the hospital and the anesthesia group in terms of reimbursement. Since medical direction is paid under Part B, physicians services, the hospital does not incur costs for anesthesia and passes these costs to the payer and the anesthesia group can still bill for up to four cases simultaneously with the CRNA and receive payment for the cases (Hill & Evers, 2012).

For rural and critical access hospitals, there is a lower volume of cases that require anesthesia services compared to larger community and urban hospital counterparts due to a smaller overall population and referral of larger cases to the tertiary and community hospitals. In addition, it is more difficult to attract ANs to rural areas due to the financial disincentive but CRNAs are available to provide anesthesia services since they accept a lower salary on average (Baird et al., 2014). Because of this, since 1983, Medicare Part A allows qualifying hospitals to utilize reasonable cost pass- through payments for CRNA services. A hospital qualifies for this rural pass-through funding program if they provide fewer than 800 inpatient and outpatient

procedures per year and are located in a rural area. The Medicare Part A reasonable cost pass-through program was created to ensure anesthesia services could be provided by CRNAs in rural hospitals for Medicare beneficiaries where the hospital's volume could not support Part B payment. This is also important for the provision of obstetrical, emergency surgical, and trauma stabilization services (AANA, 2015).

Currently, a lump-sum payment is allocated to a hospital if the hospital chooses to participate in the rural pass-through program. The CRNA and hospital must agree that they will not bill Medicare Part B for CRNA anesthesia services when treating Medicare patients since the monies 'pass through' Medicare Part B billing. Instead, the cost is included in the annual Medicare Cost Report for the CRNA services. The hospital is then paid a lump sum for one full-time equivalent CRNA and their anesthesia services and related expenses during the next year. This lump sum includes provider (CRNA) salaries and equipment and facility costs incurred while treating Medicare patients. Pass-through hospitals are also incentivized to continue to provide care in rural areas by receiving additional funding, in addition to the pass-through calculation, and may choose to use it for increasing salaries for provider retention and improvements in the facility and equipment. The rural pass-through program is advantageous to smaller volume hospitals so they can still provide services for their community while avoiding increased costs (AANA, 2015).

Cost benefits of practice models.

Reimbursement to the facility is important to consider when assessing the costs related to the provision of anesthesia services. Approximately half of US healthcare services are covered through employer benefit private insurance plans and the rest is through government plans such as Medicare, Medicaid, and the Children's Health Insurance Plan (CHIP). Payment for CRNA

and AN services is made through reimbursement via most of these plans. Currently, there are 36 states that directly reimburse CRNAs under Medicaid, 38 Blue Shield groups, and 22 states that mandate direct private insurance reimbursement for CRNA services. Inconsistent reimbursement for these private and government insurance providers are driving hospitals to adopt bundled or episode of care payments, much like fee-for-service each time a patient receives anesthesia services (AANA, 2015).

Many private insurance carriers expect CRNA services to be billed under the AN for ease of billing. If an anesthesia group employs a CRNA, CRNAs and their employers can agree to assign their claims over to that group and they will do the billing. Because of the continued confusion over reporting separately for CRNA services resulting in claim denial or improper payment, hospital billing and reimbursement specialists claim that it is more advantageous to bill for the AN only, even with the Medicare 50:50 split of the medical direction model, since most of the above plans will pay for the ANs services and may pay secondary coverage for the CRNA. Even if they reject the claim for the CRNA, the facility receives approximately 75% if not 100% of the payment this way (Dennis, 2014). Ultimately, all anesthesia providers and facility billing specialists should be knowledgeable about billing in order to claim the most reimbursement allowed.

Payment of anesthesia services through government plans includes Medicare, Medicaid, CHIP, and Tricare. As an overview, Medicare is divided into four parts. Medicare Part A provides hospital coverage, governs COP's and interpretative guidelines that influence CRNA practice in hospitals and ambulatory surgical centers (ASC's), and manages the rural pass-through funding program for CRNA services. Medicare Part B provides physician and CRNA anesthesia services. Medicare Part C is the health maintenance organization (HMO) Medicare

Advantage Plan. Medicare Part D was authorized by Congress in 2003 and is the Medicare pharmaceutical benefit program (AANA, 2015).

Medicare Part B reimburses non-medically directed CRNA services at 100 % via the anesthesia fee schedule. Utilization of a medically directed CRNA model reimburses at 100 % by Medicare Part B through the anesthesia fee schedule in a 50:50 payment with the AN directing four or less cases and complying with the TEFRA regulations. Medicare Part B reimburses medically supervised CRNA services at more than 50 % but less than 100 % through the anesthesia fee schedule. The AN is reimbursed two or three base units per case when supervising more than four CRNAs concurrently or when they are involved in four or less cases but have not met all of the TEFRA regulations. Since this model yields less than 100 % reimbursement, most practices choose to submit claims under the non-medically directed CRNA model and receive 100 % of the fee (AANA, 2015).

Tricare, the military heath plan, and the Federal Employees Health Benefits Plan (FEHBP) typically reimburse CRNAs and ANs at the same rates, using a payment system similar to Medicare Part B. Most private health insurance plans directly reimburse for CRNA and AN services. Medicaid reimbursement also varies from state to state and either reimburses CRNAs directly for their services or reimburses the facility where they are providing the service (AANA, 2015).

The monies that a facility can recoup and pay out best illustrate benefits to a facility with the nonmedical direction model. Reimbursement claims paid in full to a facility, as noted previously, are more likely that the billing department bills non-medically directed rather than medically supervised due to the confusion of the practice model. In addition, calculating the annual salary of all providers that are paid by a facility shows the amount of dollars that are paid

to fully provide anesthesia services. The median national salary for ANs in June 2015 was almost $350,000 and upwards to $450,000 with experience. The median national salary for CRNAs is $166,000 and upwards to $190,000 with experience (CompAnalyst, 2015).

Take, for instance, a conservative picture of a community hospital that utilizes the medical direction anesthesia practice model. They have six operating rooms that operate daily. They currently are staffed with a 1:4 model (50% AN, 50% CRNA billing) of AN to CRNA (though most groups staff 1:2 or 1:3). This hospital would require a minimum of six CRNAs/day Monday-Friday and two more for night and weekend call. The hospital would also require at least five ANs to comply with TEFRA billing regulations and to provide adequate coverage (two to cover the rooms during the week and one available for backup plus two more for night and weekend coverage). Utilizing the above conservative end of the salary ranges, the total annual salary expenditure for the CRNAs is $1,328,000 and the ANs is $1,750,000, totaling $3,078,000. If this same hospital went to a non-medical direction model but still employed ANs for consultation, they could increase the number of CRNAs to nine (to cover breaks, vacations, emergencies) while decreasing the ANs to three to cover weekdays, and night and weekend coverage. This saves the hospital over half a million dollars per year (savings of $534,000) while increasing manpower resources.

Supply and demand benefits of practice models.

Variables involving supply and demand of anesthesia providers are continually changing and are complex. The theory of supply and demand considers how buyers and sellers behave and how they interact with one another. Supply and demand determine the quantity of each good or service available and the price at which the market clears. In turn, the theory shows how prices are determined and allocated in any economy or market (Mankiw, 2007).

Elasticity is described as a measure of the responsiveness of quantity demanded or quantity supplied to one of its determinants. One variety of elasticity is the price elasticity of demand, which is a measure of how much the quantity demanded of a good, responds to a change in the price of the good, computed in percentage changes (Mankiw, 2007). An example of this responsiveness is when a war breaks out in the Middle East, the supply of gasoline available from the oil-producing countries decreases and the price of gasoline demanded rises in the United States. This is a leftward shift in the supply curve and the shift, in turn, influences the overall price or quantity of gasoline.

When analyzing supply and demand applicable to anesthesia services, several factors influence both sides of these market forces. Supply variables to consider include input prices of demands of anesthesia providers (not only salaries but also benefit packages, work hours desired, and services agreed to cover), technology (services anesthesia providers offer such as ultrasound-guided regional anesthesia), expectations of the facility in use of anesthesia provider model (including surgeons and patients preferences), and number of anesthesia providers available to deliver anesthesia services for a facility at any given time. Demand variables to consider include income for services provided in relation to all anesthesia providers (substitutes), preference of anesthesia practice model at a facility, expectation of services to be provided by anesthesia providers (coverage of normal anesthesia services with the addition of pain management, obstetrics, endoscopy, etc.), and the number of providers needed by a facility at any given time (Baird et al., 2014; Hill & Evers, 2012; Mankiw, 2007).

As the demand for healthcare services increases as suggested in the establishment of the ACA, the health care system may require more fluidity in its providers. CRNAs are experienced intensive care unit nurses that complete either a master's or doctoral degree program in

anesthesia lasting 24-36 months on average. ANs, whose post-baccalaureate education is on the average of eight years, have a longer educational pathway to provide independent anesthesia services. AAs complete a 24-month master's degree program in anesthesia but do not have the prior health care experience that both the CRNAs and ANs have starting in an anesthesia practice. By mandating supervision of AAs, they are able to provide anesthesia services safely with an AN immediately available. There remains considerable debate on the use of nonphysician providers as substitutes for ANs in terms of cost and safety. In relation to supply and demand variables, nonphysician providers can increase manpower availability in staffing ratios while commanding a lower salary from the facility, satisfying both sides of the supply and demand curve (Baird et al., 2014). Anesthesia practice models that would benefit a facility in relation to these variables include medical direction, medical supervision, and nonmedically directed CRNAs.

In addition to the above benefits, one must look at the fair market value (or service) of anesthesia providers. Fair market value is the amount of compensation paid to other like providers under similar circumstances. Fair market value is determined by supply and demand forces and may be influenced by caseload requirements, expertise, and geographic location. Most anesthesia providers are trained in all general and specialty areas of anesthesia management for surgical services. Those anesthesia providers willing and able to provide anesthesia for a larger variety of services and avoiding a high degree of specialization in their practice may be viewed as having higher market value and thus, may be more valuable to a hospital or other entity (Hill & Evers, 2012).

When assessing supply and demand of anesthesia providers and benefits of various anesthesia practice models, an accurate assessment may be informed by projections of the

anesthesia provider workforce. The ASA commissioned the RAND Corporation to update a labor market analysis entitled *The ANs Workforce in 2013,* which projected provider supply and demand for the coming years. First, they suggested that the current demand for ANs is variable throughout the country. Figure 3 (Current Demand for ANs) depicts the proportion of ANs reporting that there is a current need for more ANs, mainly in the Midwest and western states. One of the issues with the 2014 study is that they did not access CRNA data as they did in the 2010 study. Their projections do state that by 2018, there may be a shortage of approximately 3000 ANs (Figure 4 Predicted Supply of Future ANs). They surmised that the following factors may influence the number of ANs in the future and lead to a shortage: increase in retirements, increased proportion of female ANs working fewer hours and aging population coupled with increased coverage via the ACA, increasing anesthesia workload (Baird et al., 2014). The opposite is predicted for CRNAs with a predicted surplus of providers due to increased enrollment in nurse anesthesia programs and increased number of schools (Daugherty et al., 2010). Therefore, it is difficult to predict what practice model may be most beneficial in the future based on supply and demand of anesthesia providers.

Determinants of demand benefits of practice models.

The aging population, number of insured patients, and disease burden to the community all contribute to the number of providers needed in a given community. The substitutability of CRNAs for ANs is a sensitive subject due to the quality of care debate between providers. Previous court cases (Bhan, Oltz) have shown success in advocating for the interchangeability of CRNAs and ANs (Koch, 2010). Based on the evidence that is supported by the literature and assuming that quality of care is commensurate between providers, interchangeability between a CRNA and an AN may comes down to a cost-minimization issue (Baird et al., 2014).

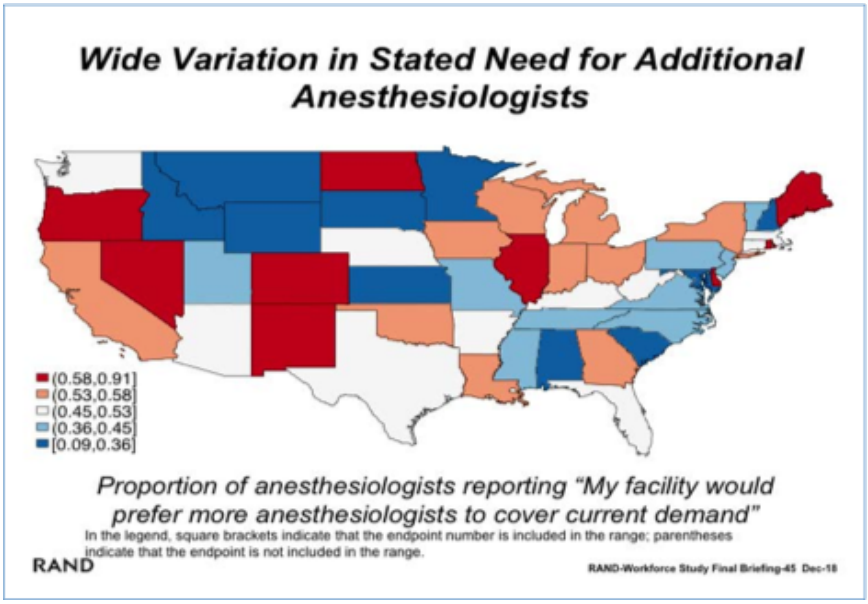

Figure 3. Current Demand for ANs. Reprinted from "The ANs Workforce in 2013," by M. Baird, L. Daugherty, K.B. Kumar, & A. Arifkhanova, 2014, *RAND Report,* p. 59. Copyright 2014 by the RAND Corporation.

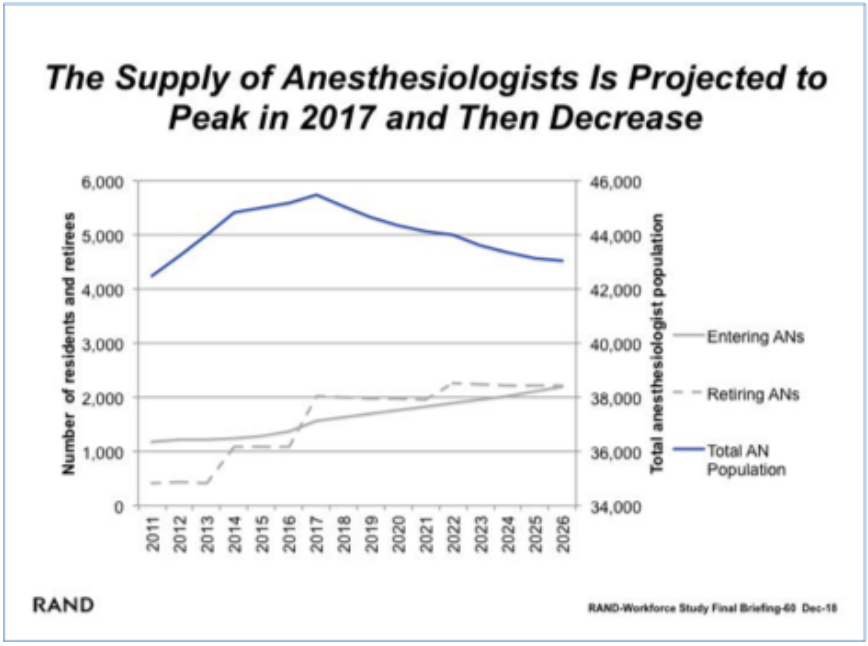

Figure 4. Predicted Supply of Future ANs. Reprinted from "The ANs Workforce in 2013," by M. Baird, L. Daugherty, K.B. Kumar, & A. Arifkhanova, 2014, *RAND Report,* p. 59. Copyright 2014 by the RAND Corporation.

Limitations of Various Anesthesia Practice Models

As the various anesthesia practice models have benefits, there are limitations associated with some of the models also. This section will review what some of those limitations may be

and build on the constructs previously presented. It is prudent to note that studies conducted by affiliated practitioner groups are often critiqued by the competing group of providers, be it in related benefits or limitations of practice.

Quality limitations of practice models.

Since study after study suggests no differences between the quality of care provided by ANs and CRNAs, there is no evidence to support one anesthesia practice model over another from a quality perspective. According to a 1999 IOM report, it is recognized that anesthesia care is 50 times safer than it was in the early 1980s. There are several studies that refute the equality between CRNA-only and ANs working with CRNAs quality of care (Silber et al., 2000; Abenstein & Warner, 1996) but the results have been scrutinized because of study design limitations (Smith et al, 2004; Fleisher & Anderson, 2002). One study researched the effects of the CMS opt-out rule of November 2001, which allows the governor of a state, in consultation with the State's Boards of Medicine and Nursing, to exempt physician supervision of CRNAs. ANs opposed this rule claiming they provide superior anesthesia care to that of CRNAs, despite the fact that adverse events related to anesthesia are rare, regardless of provider. The findings from the study led the authors to recommend that CMS allow CRNAs to practice without the supervision of a surgeon or AN in every state (Dulisse et al., 2010). This study does not support the need for an AN-only or ACT model in every practice setting.

Access limitations of practice models.

Access to care to anesthesia services is an ongoing issue in rural America. The reasons are multifactorial, involving insurance reimbursement, salaries, and lifestyle choices. Rural areas generally have an older population compared to urban and suburban areas, which equates to increased Medicare beneficiaries and lower reimbursement to anesthesia providers, with less

of a gap between Medicare and private payment. The Government Accountability Office (GAO) reported in 2007 that CRNAs are the predominant anesthesia provider in locations with more Medicare beneficiaries (Jordan, 2011). A 2010 analysis of labor markets by the RAND Corporation supported the GAO's findings that CRNAs are more likely to reside in nonmetropolitan areas than ANs (Daugherty et al., 2010). Thus, hospital staffing in rural areas is primarily with CRNAs and less likely with ANs, limiting the use of the medical direction model due to decreased numbers of ANs.

Another factor possibly contributing to the variation in number of anesthesia providers is the average number of hours worked and facility preference. Daugherty and authors (2010) found that more females are entering the anesthesia work force and prefer to work fewer hours. They are also tend to work in larger urban facilities and specialize in pediatrics. Not only females but also male ANs are also reporting that work-life balance is becoming increasingly important. In the RAND 2010 survey, only 36.9% of ANs reported that they would increase their work hours with the rational for not working more hours being work-life balance (Daugherty et al., 2010).

Still another factor is wage reimbursement. On top of a lower gap between Medicare and private insurance reimbursement, are the lower salaries that will be provided in rural facilities. The Accountable Care Organizations (ACO's), much like Health Maintenance Organizations (HMO's), along with pay for service arrangements, will look to pay at a market-clearing wage, requesting more hours worked for market salary. The incentives are not enough for many ANs and they will not work in these arrangements (Daugherty et al., 2010). Thus, these factors decrease the availability of providers and access to anesthesia services in rural locations, accordingly.

Studies on the determinants of healthcare utilization conducted in the last decade have analyzed community-level variables into the Aday and Anderson access to care framework (Teach et al., 2006; Kirby et al., 2005). Provider/physician supply is one variable of a community's ability to provide access to care for patients. These studies looked primarily at primary care physicians but this may be generalizable to ANs because studies in the anesthesia literature show a related decrease in willingness to work in more rural areas (Jordan, 2011; Daugherty et al., 2010). In addition, issues with excessive paperwork and limited reimbursement associated with CMS programs are not attractive in bringing anesthesia providers to these rural areas (Hall, 2008). These factors make the medical direction model of anesthesia difficult to support in rural facilities.

Another issue currently limiting the ability to incorporate the medical direction model in rural facilities is related to CMS payment through the rural pass-through program for anesthesia services. The rural pass-through incentive program is a mechanism that was created in the early 1980s to attract anesthesia providers to practice in rural facilities. Under the pass-through program, eligible hospitals may use reasonable-cost based CMS Part A funds instead of the conventional CMS Part B fee schedule to retain non-physician providers to provide anesthesia services in small rural hospitals and critical access facilities. Reasonable costs include costs that are common and accepted in a provider's everyday activity of anesthesia administration, such as average salary dispensation in rural facility and medication and equipment expenses. In order to be eligible to receive this funding, surgical volume at the facility must not exceed 800 cases annually. Currently, these incentive payments only apply if a non-physician provider is providing anesthesia services in a rural hospital. The Medicare Access to Rural Anesthesiology Act was introduced in 2013 in the Senate and in 2014 in the House of Representatives to include

ANs in the rural pass-through incentive program of which they are currently excluded by law to receive this funding. To date, this Act has not gone into effect. In support of including ANs in the rural pass-through program, ANs state that if this were to pass, more physician providers would work in rural areas that typically have lower Medicare reimbursement and low patient volume. This inclusion could increase recruitment and retention of ANs to rural facilities that typically have a shortage of physician health care providers. Currently, rural and critical access hospitals are sufficiently staffed with CRNAs and the need to extend this to ANs has not proven necessary (AANA, 2015).

Recent research has focused on the Perioperative Surgical Home (PSH) (Kash, Spaulding, Johnson, & Gamm, 2014; Maccioli & Johnstone, 2010). The PSH is defined by the ASA as a "patient-centered and physician-led multidisciplinary and team-based system of coordinated care that guides the patient throughout the entire surgical experience" (Kain et al., 2014, p. 1126). The goal of this practice model is to provide improved clinical outcomes and perioperative service at a reduced cost. ANs support this model and propose that they are best suited to become the perioperativist or Perioperative Surgical Home Specialist (PSHS) (Vetter et al., 2014). If this is the case and hospital systems utilize this model, it may decrease the numbers of ANs in the operating room providing anesthesia for patients since they will become the PSHS and have responsibilities other than providing direct anesthesia care. In turn, the number of CRNAs or AAs will have to increase to staff the anesthetizing locations (Vetter et al., 2014). The above factors may require a reassessment of physician anesthesia services and practice models in rural and urban areas.

Efficiency limitations of practice models.

Operating room (OR) efficiency is often defined in the literature in terms of performance metrics. First-case (entering the operating room before 0800) anesthesia-related delays are a frequently tracked metric and may be due to extended preoperative interview, performance of placing regional anesthesia block or invasive lines, or type of anesthesia practice model utilized (Saunders, 2010). Since part of the TEFRA regulations state that the ANs must personally perform the preoperative examination and evaluation, prescribe the anesthesia plan, and be present for induction, if four rooms staffed with CRNAs are all scheduled to start at 0730, three out of the four rooms will be behind already. Staggered first-case start times are a solution to improving the outcomes of this performance metric. A staggered first-case start time means that, in the medical direction model, each of the up to four rooms that an AN may medically direct a CRNA in, would start at staggered times. One study done by Epstein et al. (2012) showed that the average release time to finish the induction on one case and start the next was 22 minutes. If the facility and OR administration (including surgeons) agree to this, instead of starting every first case at 0730, for example, the first case in a medically directed model would start at 0730, the next at 0755, and so on. These would be considered as on-time starts. Most facilities do not utilize staggered first-case start times though, which lead to anesthesia-related delays in the medical direction model. Reasons for not utilizing staggered start times include surgeon discontent and the perception of administration that they do not accept that the cases cannot start on time. Another option to improve on the performance metric of first-case start times is making additional ANs available at the start of the day and at other busy times in the OR but this approach may nullify the economic benefit of the medical direction model (Epstein et al., 2012).

Another limitation of the medical direction model is the potential for CMS fraud, which is usually unintentional. Fraud can occur when, in a medical direction model, the AN instructs the CRNA to do the preoperative evaluation and start the case without him or her being present because he or she is busy in other rooms. Both anesthesia providers try to maintain efficiency in adhering to the operating room schedule but if the AN does not follow the seven TEFRA regulations (in this example, did not perform the preoperative evaluation and plan and present for induction) and the billing department codes the case with the QX modifier (medical direction of one AN directing up to four CRNAs), fraud is discoverable. This complex billing regimen can lead to a False Claims Act case, even if all parties' intentions were good (Silberman, 2014).

Economic limitations of practice models.

The current economic changes associated with the ACA could provide financial disincentives for some providers in the anesthesia sector. These economic changes may be propelled by lower reimbursements from private and governmental insurance entities and include health care cost containment measures such as changes in anesthesia provider models, hours required to work for unchanged salary, and penalties related to pay for performance measures (Baird et al., 2014). Significant increases in the coverage of the previously uninsured and underinsured populations could not only change the numbers of those seeking surgical services and concomitant anesthesia services but challenge hospitals to deliver these services in a cost-efficient manner. More CRNAs and ANs are moving to anesthesia management groups, which appear to be beneficial to facilities if the stipends are reasonable. Though this will be discussed later in this chapter, as an overview, larger anesthesia management groups are growing throughout the United States. Hospitals are looking to unload anesthesia services to these external groups due to monies needed to properly operate such a group and the requirements

imposed by external agencies, such as The Joint Commission, on anesthesia services. These groups provide everything that is required to offer anesthesia services, including resources, equipment, billing, scheduling, and operational management in turn for a stipend from the facility to offer these services (Maccioli et al., 2010). The stipend is an agreed upon sum that encapsulates the four fundamental areas of anesthesia services: fair market value of anesthesia providers, number of anesthetizing locations, staffing matrix, and billing/contract performance (Stiefel & Dietrich, 2009).

Once mainly composed of ANs, these anesthesia management groups are increasing the number of CRNAs they employ to create a more cost-effective portfolio with increased manpower resources for their clients. This change in anesthesia management group composition to include CRNAs along with ANs may cause some disruption in the overall anesthesia workforce due to a redesign in traditional hierarchical anesthesia practice models (Fleischer & Lee, 2015). It is hypothesized that these changes may cause ANs to retire earlier than expected due to lower reimbursement for services from the group model (not only from the group maximizing their profit margin but also from decreased reimbursement from the increased numbers of patients entering the now insured population). Financial changes with lower salaries and increased work hours may also decrease the number of medical students interested in anesthesiology due to the potential decrease in their return on investment (ROI) (the cost of medical school) (Baird et al., 2014).

In addition to the change in anesthesia management group design and related financial changes, costs to society of available anesthesia providers can be a limitation to certain anesthesia practice models. Hogan et al. (2010) calculated the marginal direct and indirect costs of CRNAs and ANs education in 2008 dollars. The total cost for a CRNA education (including

room and board) was approximately $161,809 as compared to an ANs educational costs of approximately $1,083,795. These figures include undergraduate and graduate education dollars. Overall, it is approximately one-fourth the tuition cost to educate a CRNA compared to an AN. In addition, federal funding from taxpayer dollars goes towards providing graduate medical education (GME) stipends while the anesthesia medical resident is in training. These stipends range from $47,000 to $68,000 dollars (average from multiple academic teaching residency program websites, 2015) and increase per year of training. On the other hand, nurse anesthesia graduate students do not receive stipends and the only federal funds they receive are from HRSA Nurse Anesthesia Traineeship grants if their programs apply for these grants, which usually only provide less than two thousand dollars at the most throughout their education (HRSA, 2015). Thus it costs society more to educate ANs as compared to CRNAs while ANs are not available to provide services to a community for an increased period of time.

Cost limitations of practice models.

The medical direction model increases expenses incurred from anesthesia services due to the salary differential between ANs and CRNAs. The example depicted in the previous benefits section is one way to analyze the situation. The AN can be viewed as a duplicated provider because they bring an added expense to the healthcare facility, insurance industry, and ultimately, back to the patient's pocket (CAER, 2008). This can be refuted though if ANs show their ability to provide value-added services, such as becoming the PSHS, in addition to providing anesthesia in the OR. It is a limitation that can be overcome and provides strategic added value while maintaining the high quality of anesthesia services with an innovative expansion of the anesthesiology specialty (Vetter et al., 2013).

In the journal *Nursing Economics* (2010), a study entitled "Cost Effectiveness Analysis of Anesthesia Providers" found that CRNAs providing anesthesia services independently generated the lowest economic cost in dollars while generally bringing in positive net revenues to a hospital. The medical supervision model was found to be the second lowest net cost but reimbursement policies limit profitability, as discussed below. They also found that the medical direction model often was not financially sustainable without subsidies. In hospitals that have high and reliable scheduled case demand, the medical direction 1:4 model can approach the net revenue benefits of the independent CRNA model. But keep in mind that case efficiency must be factored in also and it may be difficult for the ANs to follow the TEFRA regulations completely without having delayed case starts throughout the day. Per this 2010 study, adopting a non-medical direction model with AN consultation if needed could alleviate this issue (Hogan et al., 2010).

In January 2015, administrators from the Health and Human Services announced that they set a goal of tying 30% of traditional, fee-for-service Medicare payments to a more value-driven system through alternative payment models of bundled payment arrangements by the end of 2016 and 50% by the end of 2018. In the bundled payment model, all providers involved on a case are reimbursed together for the entire cost of an episode of care. Examples of episodes of care include surgery for a hip replacement or hospitalization for pneumonia (Burwell, 2015). This change in payment model could further exacerbate the financial ramifications associated with the medical direction model since monies for two qualified providers on one case will most likely not be reflected as a value-added model. This is not to say that the solution is eliminating AN positions. What this move in payment models does support is more of a non-medical direction model with AN consultation if warranted and supporting the evolution of the PSHS.

The PSH carries the promise of streamlining the perioperative continuum but it does come with an expense. Currently, the additional services that would be provided by anesthesia providers are not recognized as reimbursable within the existing payment system. If future alternative medical payment models continue to move towards bundled payments, as is the plan, the PSH model could be incorporated into them. At this time though, if a hospital agreed to go forward with the PSH model, it appears that the anesthesia department or management group would have to absorb the costs and demonstrate value for it to be adopted by the payer in the future (Vetter et al., 2014).

From the current literature on the PSH model subject, it appears that ANs are well positioned to be the leaders in this new care delivery model. Again, the limitations of utilizing a medical direction or medical supervision model are accentuated by this move since CRNAs will need to be in greater supply to provide the care to patients in the operating room since the ANs, already predicted to be in a declining number, are establishing themselves in operational management throughout the perioperative continuum. The authors of "The Perioperative Surgical Home as a Future Perioperative Practice Model" stated "We see the PSH as a way for ANs to move beyond the operating rooms and the traditional conflict with health care extenders to play a critical role in the changing environment" (Kain et al., 2014, p. 1129).

One of the most compelling financial limitations with modern day anesthesia practice models is with the medical supervision model, which is not as financially lucrative as the other anesthesia practice models. Under Medicare Part B, the CRNA can bill for 50% of the physician fee schedule and the AN can bill for two to four base units per case that they are involved (per the Medicare Resource-Based Relative Value Scale-RBRVS) plus time units and requires the AD modifier. The base unit guides are published by the CMS and assign a set billing value

based on procedure complexity and coexisting disease status of the patient. CMS billing schemes also utilize time units (15 minutes equals one unit) multiplied by a dollar-value anesthesia conversion factor. This overall reimbursement is more than 50% but less than 100% of the physician fee schedule. ANs and hospital practices do not view this model favorably because they are reimbursed less for each case they provide anesthesia services for in comparison to the other anesthesia practice models (CAER, 2008).

Community stakeholders such as hospital administrators should evaluate the available data, looking at the costs of all anesthesia practice models, to ascertain the most cost-effective model for their facility. The equivalent safety profiles of each provider group and changes in anesthesia practice models occurring throughout the country should provide valuable information for this analysis (Byrd & Peterson, 2009). Other variables could also be examined to assure that the cost savings were accurate and that all other value-based services were considered. Anesthesia services that add value to a hospital from a stakeholder perspective include pain management services, PSH specialists, obstetrics coverage, and regional administration expertise.

Supply and demand limitations of practice models.

Supply and demand imbalances of anesthesia providers continue to this day and are heightened by potentially inefficient anesthesia staffing models, which may not take advantage of the full cadre of providers available. A 2009 study by the RAND Corporation found that an increased number of anesthetizing and manpower locations including Ambulatory Surgery Centers (ASC's), offices, pain management clinics, and introduction of the PSH Specialist, make the imbalances more profound. The study also found that the number of physicians specializing in anesthesia was predicted to decrease by one-third by 2019. This trend is thought to stem from

the Accreditation Council for Graduate Medical Education (ACGME) rules for limiting in-hospital hours of anesthesia residents and caps on residency slots. In the same time frame, the number of CRNAs is expected to increase upwards of 20 % (Daugherty et al., 2010). Again, during this same time frame, nurse anesthesia programs have increased the number of students accepted into programs (Daugherty et al., 2010).

In a follow-up study entitled *The ANs Workforce in 2013* by the RAND Corporation, the overall supply of ANs seems to have reached equilibrium. There remain some concerns going forward with the actual number of ANs in the workforce, that being aging ANs and increased women in the workforce. The study mentions that instead of a shortage though there may be a surplus because the aging ANs (55 and older) have experienced a decline in earnings, which may delay retirement. Predictions though have the ANs supply peaking in 2017 and decreasing thereafter to a shortage of approximately 3000 by 2025 (Baird et al., 2014).

Indicators from the RAND study (2013) looked at the elasticity of the labor supply, which is defined as the percentage increase in hours an anesthesia provider would be willing to work if wages were increased by 1%. A low elasticity of supply is indicative of a shortage. The results from this study found there was not a shortage of ANs as evidenced by an increase in elasticity from the 2007 to 2013 surveys of the AN workforce. The researchers also supposed that since ANs' salaries were decreasing rather than increasing that this was another indicator that a shortage was not present. The results from this study were mixed though because other indicators did identify a shortage of ANs. The positive shortage indicators were the number of facilities who preferred to have more ANs to cover current and increased case volume and the facility vacancy rate for ANs (Baird et al., 2014).

Another manpower challenge with the current supply of anesthesia providers is that many CRNAs and ANs enter the profession due to finding personal value in the ability to work part-time, no-call, and other flexible arrangements in anesthesia (Maccioli & Johnstone, 2010). This is a benefit for the anesthesia providers and may work for larger anesthesia groups that can cover the cases due to a variety of staffing ratios but smaller practices may find it difficult to cover all shifts. This will also decrease the number of anesthesia providers overall and needs to be factored in when analyzing supply and demand models (Baird et al., 2014).

Not only has there been and will continue to be an increase in the number of anesthetizing locations, other value-added services, such as the PSHS, will increase anesthesia manpower needs also. For example, several clinical specialty providers could serve as the PSHS, including the surgeon, internal medicine hospitalists, ANs, and advanced practice nursing (Vetter et al., 2014). Instituting such a program at hospitals will increase the human resources required to not only staff the operating rooms for cases daily but will also increase the need for more practitioners in the postoperative care for pain management. A big focus of the PSH and ERAS is timely, focused, pain management services. Currently, many hospitals have an acute pain team staffed largely by ANs. One of the operational challenges with instituting the PSH and the AN as the PSHS will be the need to identify more designated practitioners trained to manage and coordinate the acute pain service (Kain et al., 2014). Overall, the increased utilization of the PSH model has the potential to improve patient and facility outcomes throughout the perioperative continuum but its implementation also presents operational and fiscal barriers to a facility (Kain et al., 2014). As noted, trends in increased anesthetizing locations and the advent of the PSHS reflect the need for an analysis of anesthesia workforce issues by facilities to assure patients have access to high quality cost-effective anesthesia services for elective and emergency

procedures. Looking to the future, it will be important to determine how to address the needs for improved management of patient care across the continuum and overcoming resource issues along the way.

Determinants of demand limitations of practice models.

Demand for anesthesia services continues to increase with the graying of the population and its associated comorbidities requiring increased surgical and procedural interventions and anesthesia services. Steepening is a term that describes the growth of elderly patients per capita health care expenditures and reveals this growth is higher than in other age groups. Not only will older patients have more procedures, the government payer contribution will increase through CMS, translating to decreased revenues back to providers and institutions. In addition, a larger increase in anesthetizing locations than ever before are being utilized, necessitating more anesthesia providers in these areas (Gregersen, 2014).

An economic limitation of utilizing CRNAs and AAs versus ANs is reimbursement from Medicare. As the rules currently stand, CMS reimburses 50% of a case for a CRNA/AA and 50% for an AN in the medical direction model in 1:1 through 1:4 ratios (Figures 5 and 6).

According to the 2015 Medicare Interpretive Guidelines, Medicare does not require an AN be involved in the care of the patient in order for a CRNA to be reimbursed but in non-opt out states, a CRNA must be supervised by another collaborating physician (surgeon, dentist, podiatrist, proceduralist). This supervision entails medical staff to follow the bylaws or rules and regulations set forth in that facility according to the type and complexity of procedures that practitioner may supervise.

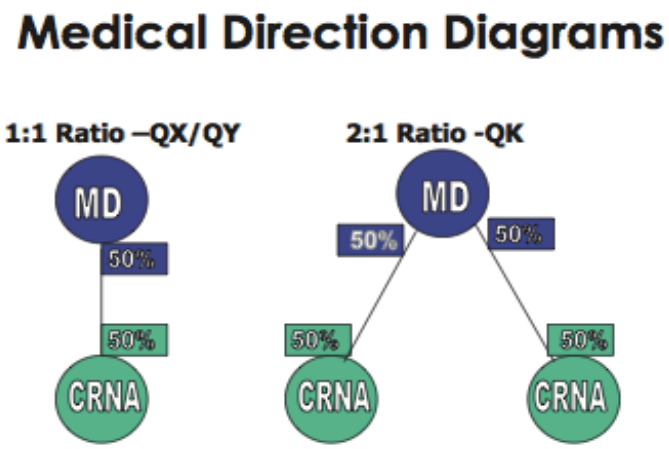

Figure 5. Medical Direction Practice Model with 1:1 and 1:2 Ratios. Reprinted from the *AANA* by R. Gelb-Zimmer, October 1, 2015, Retrieved from http://www.aana.com/myaana/Advocacy/fedgovtaffairs/Pages/CRNA-Reimbursement.aspx . Copyright 2015 by AANA. Reprinted with permission.

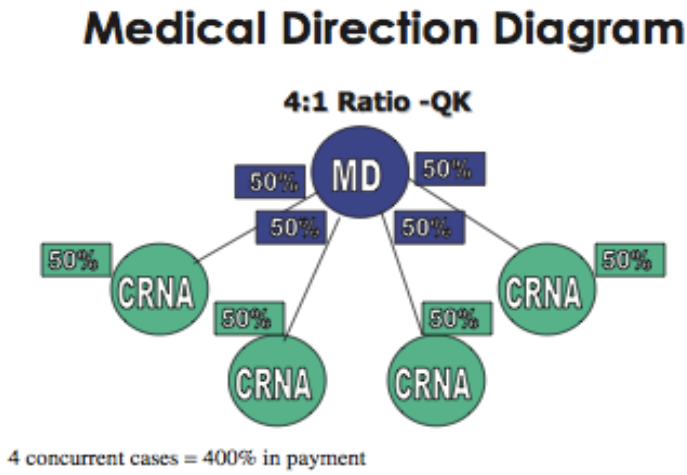

Figure 6. Medical Direction Practice Model with1:4 Ratio. Reprinted from the *AANA* by R. Gelb-Zimmer, October 1, 2015, Retrieved from http://www.aana.com/myaana/Advocacy/fedgovtaffairs/Pages/CRNA-Reimbursement.aspx. Copyright 2015 by AANA. Reprinted with permission.

are not required to receive specific privileges to supervise CRNAs though. If a surgeon or proceduralist does not want to collaborate with the CRNA on anesthesia services, the services can still be provided by the CRNA so coverage and access is not an issue, but the hospital will not get paid for Medicare cases under Medicare Part A in non-opt-out states.

Though it does not happen often, the CRNA supervision requirement may cause the collaborating physician to prefer AN services due to the concern of vicarious liability for the CRNA. Hospitals stand to lose reimbursement making the utilization of CRNAs less favorable. Potential for non-reimbursement of services is not the case with private insurance nor in opt-out states, which endorse reimbursement of 100 % of anesthesia services for non-medically directed CRNAs (Figure 7) (AANA Federal Government Affairs, 2016).

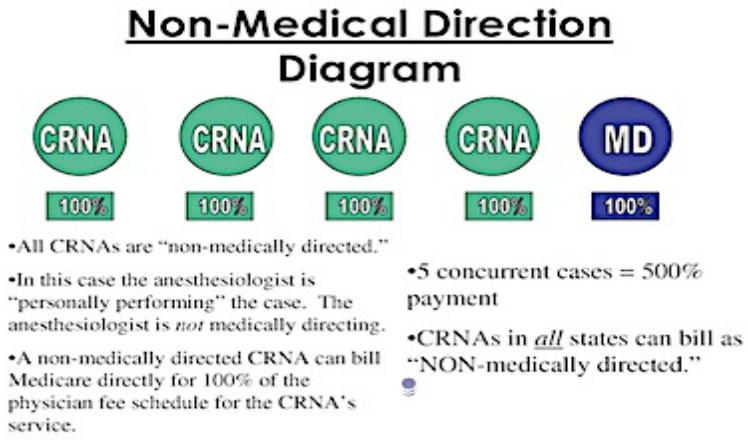

Figure 7. Non-Medical Direction Practice Model with1:4 ratio. Reprinted from the *AANA* by R. Gelb-Zimmer, October 1, 2015, Retrieved from http://www.aana.com/myaana/Advocacy/fedgovtaffairs/Pages/CRNA-Reimbursement.aspx . Copyright 2015 by AANA. Reprinted with permission.

An issue related to substitutability is if the anesthesia practice model changed from an AN-only model to either a medical direction model with CRNAs and/or AAs or a CRNA-only model, there could be some reluctance from hospital stakeholders if they perceive that this is a lesser level of care provided to patients. Educating the public and hospital stakeholders about the safe delivery of anesthesia care, cost-effectiveness of provider model, and access to anesthesia services is important since ANs and CRNAs are interchangeable providers with the same scope of practice (Hogan et al., 2010).

Benefits and limitations of individual anesthesia practice models have been reviewed to identify factors a facility should consider in developing their anesthesia services department (Table 2). Hospital administrators' ability to objectively choose the best anesthesia practice model for their facility is based on a variety of conditions, including patient acuity and caseload, geographic location, provider skill set, operating room productivity, and financial circumstances. Administrators should also consider the added value each anesthesia practice model brings to their institution. Competing forces related to institutional tradition, surgical preferences, and provincial interests continue to exert influence in the OR environment (Hill & Evers, 2012). Analyzing the benefits and limitations of anesthesia practice models may aid in redefining operational processes to increase OR efficiency and overall performance goals of a facility.

Employment and Payment Arrangements

Anesthesia providers practice in various employment arrangements across the U.S. These include practice as a hospital employee, practice for an anesthesia management group, or practice as a locum tenens. Use and size of these employment arrangements have vacillated over the decades due to supply of anesthesia providers, operating room caseload efficiency, operational costs, and fluctuating insurance reimbursement (Locke, 2011).

Employment with the hospital.

When hospital facilities were initially developed, most practitioners (physicians and nurses) were employees of the hospital. This was especially true of CRNAs since they were recruited into the field of anesthesia by surgeons, trained at the same hospital, then employed with the surgeon that originally recruited them into practice (Koch, 2010). Hospital employees receive a salary and benefit package from the facility/health system they are employed. The facility incorporates billing into their corporate system. In addition, the provider's work

Table 2

Overview of Benefits and Limitations of Various Anesthesia Practice Models

Benefits	**Quality**	**Access**	**Efficiency**	**Economics**
Medical Direction	No evidence to support higher quality compared to any other model	Minimal evidence to support increased access to services compared to any other model	Increased room turnover times; Increased ability to comply with performance measures	Four or less cases billed under Medicare Part B Physicians services rather than billed to hospital; hospital does not incur costs and anesthesia groups handle billing; approaches economic viability of non-medical direction model if 1:4 model maintained with high and reliable case load
Medical Supervision	No evidence to support higher quality compared to any other model	Increased use of CRNAs to ANs will increase available anesthesia providers for cases	Same as medical direction	Second lowest net cost model overall
Non-medical Direction	No evidence to support higher quality compared to any other model	CRNA presence already prominent in rural areas	No requirement to follow TEFRA regulations: decreases incidence of fraud; increased manpower ratios; more available personnel to provide value-added services; potential for improved patient and surgeon satisfaction with on time starts and increased productivity	Lower overall salary costs for CRNAs decreases hospital overhead and increases number of anesthesia providers that can be employed; increased fluidity in resources with CRNAs; substitutability of providers; lowest overall net cost bringing positive revenues to hospital
Limitations	**Quality**	**Access**	**Efficiency**	**Economics**
Medical Direction	No evidence to support higher quality compared to any other model but perception by patients and hospital stakeholders may be higher level of care	Inadequate use of resources; move towards PSHS will further limit available ANs to cover this model	TEFRA regulations decrease efficiency; potential for Medicare fraud	Increased overall salary expenses with more ANs employed; usually requires subsidy to sustain; if utilizing alternative payment models like bundled payments, may be decreased revenues and less reimbursement for duplication of providers; prediction of decreased supply of ANs overall coupled with increased anesthetizing areas, steepening, and movement into PSHS
Medical Supervision	No evidence to support higher quality compared to any other model	Same as medical direction	Minimal evidence to support increased efficiency of services compared to any other model	Even though second lowest net cost, reimbursement policies limit profitability
Non-medical direction	No evidence to support higher quality compared to any other model	Minimal evidence to support increased access to services compared to any other model	Less providers to perform preoperative evaluations and performance measures	In non-opt out states, if a surgeon or proceduralist does not want to "supervise" a CRNA, the hospital will not be paid for Medicare cases→ non-substitutable per Medicare

schedule and caseload is usually determined by the facility. Prior to the 1990s, facility anesthesia services were viewed as a support specialty along with other hospital-based disciplines such as radiology, pathology, and emergency medicine by hospital systems. These specialties were viewed as primarily providing clinical support of patient management and most were hospital-based employees (Merritt, 2014).

There are various institutional reasons for some hospitals to hire ANs and CRNAs (and AAs) as employees. Some benefits for hospitals to have anesthesia as in-house employees include more control over staffing needs and the lack of the need to pay a subsidy to the private practice anesthesia group. Anesthesia providers in academic teaching centers are more commonly hospital employed and the faculty practice plan shares the costs between the University and the individual hospital (Eichorn, 2009). The faculty practice plan provides a hospital employee with a salary and benefit package agreed upon by the academic teaching center and affiliated University in a cost-sharing arrangement. For example, the hospital agrees to pay a set dollar amount in the cost-sharing arrangement for an agreed amount of productivity hours worked in exchange (i.e.: 40 hours/week administering anesthesia). In addition, the University will agree to pay a set dollar amount for the amount of teaching or research hours the employee contributes to the mission of the teaching institution (Hill & Evers, 2012).

Most ANs work for independent private anesthesia practice groups and are independent from the hospital whereas more CRNAs are employed by hospitals (Greenfield & Stiefel, 2011). Employment arrangements have vacillated between these independent private anesthesia group arrangements and in-house employees. One of the most significant challenges for any health care system that provides anesthesia services is balancing facility anesthesia coverage and productivity with surgical utilization and declining reimbursement. Also, the overall

management challenges of an anesthesia department are extensive and may be better managed by an independent private anesthesia group rather than as hospital employees (Locke, 2011).

Employment with an anesthesia group.

The formation of anesthesia groups originated in hospitals throughout the mid-twentieth century as ANs came together to purchase equipment and supplies to support their work, create policy and procedure manuals, and organize schedules to meet hospital needs. In the 1980s, anesthesia groups branched out to provide anesthesia services in ambulatory surgery centers and the 1990s saw the proliferation of anesthesia management groups that offered services other than clinical anesthesia such as billing, credentialing, scheduling, and other practice management services. This expansion of value-added services made the ability to increase anesthesia group facility coverage via mergers across state boundaries less complicated. These anesthesia groups were motivated to expand provider numbers and facility coverage in order to follow surgeons from other facilities that requested their services and to protect their market share and leverage business operations (Maccioli & Johnstone, 2010).

At the end of the 1990s, anesthesia services outside of the traditional operating room increased due to requests for coverage in other areas such as obstetrics and anesthesia outside of the operating room (Hill & Evers, 2012; Maccioli & Johnstone, 2010). At the same time, changes in payments for anesthesia services shifted the delivery and payment systems to promote the utilization of CRNAs in part due to the findings from a Government Accounting Office (GAO) study. The study found that, under the medical direction model, payments for anesthesia services were 120% to 140% greater than the CRNA- or AN-only models. This was enough of an economic incentive to employ and utilize more CRNAs (Koch, 2010). The increase in the utilization of CRNAs in anesthetizing locations was further attributed to declining numbers of

medical students entering and completing anesthesiology residency programs, probably due to a decline in graduate medical education funding (Koch, 2010). Academic teaching hospitals that had not utilized CRNAs for 20 - 25 years began employing them and by the early 2000s, CRNAs were in high demand in order to cover facility contracts to provide anesthesia services (Koch, 2010).

Because of the decreased supply of anesthesia providers towards the end of the 1990s and early 2000s, some facilities put out requests for proposals (RFP's) to competing anesthesia groups to cover their needs. Several anesthesia groups developed management expertise and grew. Some of the local, smaller groups resisted the entry of these groups into their practices while others rolled their groups into the larger corporations, in return, for lucrative benefits. With the proliferation of these larger anesthesia groups, anesthesia providers realized that the larger anesthesia management group better handled governmental and regulatory requirements, such as compliance, privacy, quality improvement, accounting, and public reporting. Now the mission for these anesthesia management groups that are consolidating anesthesia practices is to increase efficiency and accountability in covering facility anesthesia needs (Maccioli & Johnstone, 2010).

A common issue with facilities contracting with anesthesia practice groups is the amount of stipend that is charged to make up for the decline in reimbursement and increase in workload for the anesthesia providers. In the late 1980s, anesthesia reimbursement began its 40% decline over the next decade. Hospital providers did not feel the effects of this reduction at first since they were hospital employees and were well compensated. During this period, Medicare cases began taking up a larger share of the caseload (currently 40% of hospital revenue) and private payers began reimbursing even less. At the same time, ambulatory surgery centers (ASC's) were thriving and in turn, taking better paying cases from the hospitals. This culminated in hospital-

based anesthesia groups treating a combination of poor payers and less patients and thus, suffering financially. A cycle of anesthesia providers moving their practices to ASC's, accepting higher compensation packages and a decreased workload had begun. This caused the hospital-based anesthesia groups to have fewer employees with a greater workload, which was becoming unsustainable. In the early 2000s, anesthesia departments began requesting subsidies from their hospitals to make up the difference in lower salary and increased workload. The hospitals were forced to pay them in order to keep operating rooms open. This catapulted the percentage of hospitals paying anesthesia groups subsidies from 15% in the early 2000s to their current level of 75% (Callan, 2015).

The literature shows that anesthesia groups who receive a stipend from the hospital average a total annual amount from one to three million dollars, with 10% of the practices receiving over three million dollars. The average amount allotted per each full-time equivalent (FTE) is between $120,000 to $140,000 with an annual cost to a facility that exceeds $2 million, according to a Medical Group Management Association survey (Morgan, 2014). Anesthesia practice groups can be CRNA-owned, AN-owned, or have dual ownership. They can be small (local), medium-sized (regional), or large and cover multistate practices (refer to Table 3).

Most small anesthesia practice groups (CRNA- or AN-owned) are owned by one to ten providers. These groups usually provide service to a local geographic region. The advantages of this size group include a degree of autonomy and well-developed relationships between stakeholders (anesthesia providers, surgeons, nurses, hospital executives) where needs are known. The staffing matrix may be more flexible with structured work hours and a set call schedule compared to larger anesthesia practice groups (Pease & Harris, 2012). This flexibility is often due to less corporate involvement and rules. A disadvantage of a smaller practice group

Table 3

Descriptions of Anesthesia Practice Groups.

Type	Ownership	Number of providers	Number of facilities	Location of facilities	Advantages	Disadvantages
Small/Local	CRNA or AN	<100	< 10	Local	Autonomy; Close stakeholder relationships; Flexible staffing; Less bureaucracy	Smaller financial base; Less negotiation leverage; Potential threat for larger group acquisition
Midsize/Regional	CRNA/AN/Dual; Non-clinician	Up to 500	10 – 50	Entire states; Across state lines	Ability to respond quickly to issues; More financial stability; increased staffing flexibility	More layers of bureaucracy; stakeholder relationships may be financially motivated
Large/National	CRNA/AN/Dual; Non-clinician; Private equity; Publicly traded	100's – 1000's	> 50	Multiple states; National	More financial stability d/t large financial base to spread expenditures; greater access to capital; best payer contracts	Potential financial issues d/t rapid growth and acquisition; appearance of main concern with making profit over employee and facility satisfaction; decreased morale d/t bureaucratic corporate culture

is that its smaller financial base can cause issues during lean times, coupled with less leverage for negotiating with insurance carriers, there can be difficulty covering salaries and bills. In addition, there is always the potential for take over from larger groups with more financial and staffing resources (Young, 2014).

Midsize, regional groups are usually owned by a group of providers (CRNA, AN, or dual ownership (CRNA and AN) or they can be owned by non-clinician business owners. These groups typically provide coverage to a larger geographic area, including entire states or crossing state lines to serve10 – 50 facilities. They can have upwards of 500 providers. The advantages of this size group are that they may be able to respond to issues more quickly than a larger group since they have a smaller Board of Directors. They are also usually more financially stable and have more flexibility of staffing resources compared to a smaller group. This is because of the larger number of providers employed. One disadvantage is more layers of management bureaucracy compared to the smaller, local groups, which may make the relationships with administrators not as strong as compared with the smaller group practices. These provider-administrator relationships may also be more financially motivated rather than relationship motivated if leadership is not hands-on as they often are in the smaller groups (Young, 2014).

Large, multispecialty groups are owned by anesthesia providers (CRNA- or AN-only or dual ownership), non-clinicians, private equity firms, or publicly traded companies. These groups typically have contracts with over 50 facilities and employ hundreds to thousands of providers. They often have anesthesia group practices across a large geographical area of many states. Private equity firms have moved into anesthesia practices over the last decade and this has been the impetus for increased merger and acquisition activity (Young, 2014). This merger and acquisition activity has increased since 2013 partially due to the changes in healthcare reform. Fee-for-service payment arrangements are being replaced by bundled and capitated payment systems. Because of these payment changes, the acquisition of smaller groups by larger ones appears to be a trend continuing in the future (Vaidya, 2014).

Nationally, there are approximately ten large anesthesia groups owned by ANs and/or corporate partners. They are American Healthcare Partners, AmSurg/Sheridan, Anesthetix (TeamHealth), Cleveland Clinic, EmCare, Mayo Clinic, Mednax (American Anesthesiology), North American Partners Association (NAPA), Somnia, and U.S. Anesthesia Partners (a larger subsidiary of Greater Houston Anesthesiology formed by JLR Medical Group and Pinnacle Anesthesia Consultants) (Maccioli & Johnstone, 2010). The largest dual ownership group is NorthStar Anesthesia. In 2014, they purchased Anesthesia Management Solutions (AmSol), an anesthesia management group that did business in the south and Midwest, which expanded their facility and provider share greatly.

The advantages of these companies are that they are usually financially stable since they have a larger practice base to spread expenses across. They have the ability to leverage their larger base and obtain better discounts with suppliers as well as greater access to capital with a robust infrastructure and operational resources (Agres, 2015). Because of having more resources, the group can provide a variety of services and cross privilege practitioners to enhance vacation and sickness coverage as well as access to superior employee benefits (Young, 2014). They also may have the best payer contracts with insurance companies since they are considered top-tier providers, with reimbursement rates much higher than what smaller or mid-sized practices can negotiate on their own (Agres, 2015). One disadvantage is potential financial issues due to rapid growth and acquisitions. A fear may be that of acquiring and merging too many smaller sized groups quickly and the inability to get funding initially for those groups. Another disadvantage is that of impersonal relationships, with many layers between the anesthesia providers and facilities and the top levels of administration. Because of this disconnect, the bottom line is often perceived as making profit over employee and at times,

facility satisfaction (Young, 2014). In addition, with a loss of autonomy and control felt by the providers, the culture of the anesthesia group is often subject to the larger management group's style of governance and operational and organizational culture. This is important to assess for long-term group survivability since culture fit is critical for a successful continued affiliation (Agres, 2015).

Employment as locum tenens.

Locum tenens is a Latin term meaning "to take the place of, to substitute for, or to hold the place of". It most commonly references medical professionals who fill temporary needs at a hospital or healthcare facility, lasting one day to long-term positions (Anesthesiazone, 2015). It was initially developed in the early 1970s after a federal grant was awarded to the University of Utah for the need of increasing physician services to rural health clinics in medically under-served areas of the western United States. The program was so successful that many hospital administrators turned to locum tenens staffing assistance for all medical professionals (Locumtenens, 2015).

CRNAs and ANs find this employment arrangement beneficial because it allows them to work in a variety of geographic locations and provide anesthesia for a variety of surgical specialties in varied practice settings. They also typically make anywhere from 33% to 50% more than the staff salary at the individual facility. This arrangement is lucrative and independent contractor status allows the practitioner to certain tax advantages (Anesthesiazone, 2015).

This employment arrangement is usually sought after by three groups of providers: practitioners who are "trying out" different locations and practice settings before they decide on a permanent position; semi-retired providers who do not want to completely give up anesthesia

and like the flexibility these positions offer; and, those providers that are between more permanent positions. Most often, professional liability insurance, housing, and travel are included for the practitioner. Healthcare facilities typically look to this type of anesthesia provider for several reasons: they are able to fill an immediate vacancy; they can provide coverage for an anesthesia provider who is out on vacation, sick leave, or extended leave of absence; and, they provide supplement seasonal staffing needs (Locumtenens, 2015).

Based on the employment arrangement, salary and benefits are derived from the practice arrangements discussed. No matter the employment arrangement, however, the same payment reimbursement structures to private insurers, governmental agencies (primarily Medicare and Medicaid), and quality measure systems apply. Each state and region may have varying payment reimbursement structures established for different private insurance companies (Blue Cross Blue Shield, Aetna, etc.) so it is important to check what the state regulations are for payment reimbursement per provider. Medicare services have the same rules nationwide since it is a federal program so all anesthesia practitioners are reimbursed the same depending on the anesthesia practice model that they are employed (AANA, 2015).

It is difficult to predict how anesthesia departments will be organized in the near future and this uncertainty may be due to the future of the insurance payment system. For example, since the ACA was launched in 2010, there have been continued discussions about bundling of payments and capitation via alternative payment models. A bundled payment is a single payment provided to a facility that covers all services rendered for a specified condition or episode of care, such as a specific medical process or surgical procedure. Anesthesia services would be covered in this payment model (Quraishi & Legaspi, 2015). Payment bundling appears advantageous to healthcare facilities but it has the potential to adversely affect both CRNAs and

ANs: if all services are bundled together, some formula must be delineated for each provider of service (surgery, anesthesia, nursing, etc.) to receive a certain amount of reimbursement for their services. The question then is: Who would decide what portion of the payment went to each service, including anesthesia services?

Another payment model that is already utilized today in some plastic surgery practices is up-front payment from self-pay patients for anesthesia services. In this model, the anesthesia providers would negotiate with the patient for payments at a reduced rate from standard insurance pricing and the patients would pay out of pocket at the lower, transparent price (Mira, 2014). An advantage of this model is that it would eliminate waiting on payments from an insurance carrier or nonpayment by the patient and it would also relieve the burden on the facility for collections for anesthesia services via Medicare Part A. A disadvantage with this model is that facilities may not feel in control of the monies the anesthesia provider is receiving from the patient and how much they are contributing to the facility and thus, being distrustful of the system (MGMA, 2007). Hospital administrators and all providers when constructing best practice models for the future could consider this payment model, constructed on the premise of value-based reimbursement.

Determinants of Anesthesia Practice Model Utilization

It is valuable to understand the decision-making strategies that influence the use of various anesthesia practice models in facilities. There has been some progress made in understanding what informs business principles in health care facilities but some residual gaps in knowledge remain. One framework that has been utilized in assessing the economics of industry and infrequently the health care industry is Porter's Five Forces Analysis (Maresova & Kuca, 2014). Michael Porter is a Harvard professor and economist who developed a competitive

strategy analysis in 1979 and has become an expert in this area. Porter's Analysis is a framework that analyzes economic indicators to assess the competitive environment of an industry or company and ultimately, its potential for growth and profitability (Maresova & Kuca, 2014). Porter described five competitive forces that affect a business' strategic management and they are: threat of new entrants, bargaining power of suppliers, bargaining power of customers/buyers, threat of substitute products or services, and jockeying for position among competitors (industry rivalry) (Scurlock, Dexter, Reich, & Galati, 2011).

These forces can be applied to the anesthesia practice realm. The threat of new entrants is concerned with one anesthesia group being replaced by another. This usually occurs from external competition. An example of this is a large anesthesia group taking over a smaller, hospital anesthesia practice. Bargaining power of suppliers assesses a supplier that has a unique product or service that is integral for the industry. In anesthesia, the suppliers are anesthesia medical or nurse anesthesia residency programs. It can also be extrapolated to anesthesia practice groups. Bargaining power of customers/buyers focuses on a number of consumers of anesthesia services to include the patient foremost but also surgeons, facilities and administrators, payers, and employer and governmental agencies that administer insurance benefits. The threat of substitute products/services in anesthesia are ANs being replaced by CRNAs or AAs and vice versa. It can also be applied to others who are providing services which once were in the domain of strictly CRNAs and ANs such as registered nurse-administered sedation and robotic delivery of anesthetics like the Sedasys machine, which is a computer-assisted personalized sedation machine that administers a sedative for simple procedures. Lastly, industry rivalry is an internal constraint between competitors, such as CRNAs and ANs. It can also include competition between anesthesia practice groups in a defined region (Scurlock et al., 2011).

A needs assessment was conducted by Scurlock and colleagues (2011) and analyzed the business strategies of academic anesthesiology groups' practices utilizing Porter's Five Forces Analysis (Figure 8) to assess issues potentially affecting anesthesia business practice. The researchers found that of the five forces, three placed anesthesia group practices in jeopardy: threat of new entrants, bargaining power of suppliers, and threat of substitute products or services. These five forces and their subcomponents can be applied in this study in assessing hospital administrators' perceptions of anesthesia services.

Figure 8. Porter's Five Forces Analysis. Reprinted from "How Competitive Forces Shape Strategy", by Michael E. Porter, March 1979, *Harvard Business Review*. Copyright 1979 Harvard Business Review.

Porter's Five Forces Analysis can be further explored in the following areas: public perception of CRNA and physician leadership roles in the health care setting, professional power of the physician and its traditional influence, and culture of the hospital.

Public perception.

A common belief among health care practitioners is that the public does not completely understand the role of specialty providers. In the anesthesia profession, studies show that the public often confuses CRNAs with ANs (Talbert, 2008). A 2008 survey by Talbert of the

public's view of anesthesia providers in West Virginia revealed only 19 % understood what CRNAs actually do.

Historically, nurses have had to fight against misconstrued image perceptions by the public (Robach, 1992). Through the years, there have been limited studies on the public's perception of CRNAs and ANs. The 2008 study by Talbert and a 1992 study by Lebeck demonstrated a lack of knowledge of the nurse anesthesia profession. Most studies of the public perception of ANs have been conducted internationally (Lee et al., 2014; Saul, Heidegger, Nuebling, & Germann, 2011; Hariharan, Merritt-Charles, & Chen, 2006; Baji, Takrouri, Hussein, & Al, 2006; Irwin, Fung, & Tivey, 1998). Even though the results of these studies demonstrate some lack of knowledge on the public's part of everything an AN does, the public does have a greater understanding of their role as compared to a CRNA (Lee et al., 2014).

Previous Gallup polls have concluded that U.S. adults consider the nursing specialty to be among the most ethical and honest professions. The same is not true when assessing nursing's influence on healthcare reform and policy and factors that influence operating room efficiency (Blizzard, Khoury, & McMurray, 2010). A Robert Wood Johnson Foundation/Gallup poll from 2010 found some interesting results regarding opinion leaders' perceptions from insurance, corporate, health services, government, and industry sectors. They found nurses ranked behind six other stakeholders at 14% on their potential to effect healthcare reform during the next five to ten years: government officials (75%), insurance executives (56%), pharmaceutical executives (46%), healthcare executives (46%), physicians (37%), and patients (20%). Many of these opinion leaders recognized that nurses have a unique role in the healthcare system and are well qualified to shape healthcare policy and enact changes in delivery systems for the best possible healthcare outcomes. The poll showed that nurses were not being perceived as important

decision makers compared to physicians (69%) and not perceived as revenue generators compared to physicians (68%) (Blizzard et al., 2010). Priorities identified and now funded nationally from this 2010 poll for advancing nursing's role in the future of health care and eliminating barriers to leadership roles for advanced practice nurses are to develop nurse leaders on hospital Board of Directors, instituting evidence-based nurse-led models of care that reduce cost and improve access as well as maintaining or improving quality of care, and supporting the integration of all stakeholders, including nurses, in interdisciplinary healthcare delivery (Barclay, 2010).

Professional power of the physician.

Research demonstrates that collaboration between health care professionals is essential to provide high quality, safe, and cost-effective health care services (Coeling & Cukr, 2000). Furthermore, collaboration between advanced practice registered nurses (APRN's) and physicians has been shown to improve the cost and quality of health outcomes (Coeling & Cukr, 2000). Traditionally though, a hierarchical arrangement has been in existence and still exists in health care settings to this day with the physician in a dominant position at the top of the health system and APRN's in a more subordinate role (Maylone, Ranieri, Griffin, McNulty, & Fitzpatrick, 2009).

Recently though, here have been some new challenges for the physician's place in the health care hierarchy. Challenges of increasing advanced practice nurse autonomy, while increasing access to care for patients and cost savings, has gained traction with the public. The findings of the 2010 IOM report stating that nurses should be allowed to practice to their full scope of education and practice has challenged the traditional physician power hierarchy (Fairman, Rowe, Hassmiller, & Shalala, 2011). Some physicians' organizations contend though

that since physicians undertake a longer and more rigorous training period than APRN's, these nurse practitioners, including CRNAs, are not capable of delivering the same high quality and safe level of care as physicians (Hain & Fleck, 2014; Fairman et al, 2011). Health economist Joanne Spetz from the University of California, San Francisco counters this argument with the following statement: "There's a limited amount of money out there, and physicians have done a great job of maintaining professional authority and controlling the health care system. This idea of protecting the profession is essentially protecting the money." (Hoban, 2015, para. 32). A philosophy such as this continues to support barriers for broadening the scope of advanced nursing practice and limits the ability to move health care transformation forward in a positive manner (Hain & Fleck, 2014).

Related to the anesthesia profession, a study by Torgersen & Chamings published in the AANA Journal found that "the physician-nurse relationship has been characterized by an enduring pattern of physician dominance and nurse deference with increasing conflict" (1994, p. 140). This can create a less than ideal collaborative atmosphere for patient care. This type of relationship between physicians and nurses is reflective in the captain-of-the-ship mentality that has been intrusive in the operating room for years (Van Nest, 2010). Simply defined, captain-of the-ship refers to situations when a surgeon, obstetrician, dentist, or attending physician is held liable for negligence of another healthcare provider but that surgeon et al is not negligent at all. When anesthesia was the practice of nursing in the 1800s, the surgeon did direct the anesthetic course and was considered responsible for the patient outcome. Those days have passed and no longer are surgeon's considered liable for the negligence of a CRNA (Blumenreich, 1993).

The Captain of the Ship doctrine was initially identified in a Pennsylvania court case in 1949 (McConnell v. Williams). An intern mistakenly placed too much silver nitrate ointment in

an infant's eye causing blindness and the obstetrician was found liable, even though he did not participate in these actions. There have been many court cases trying to hold a surgeon liable for anesthesia mishaps over the years involving both CRNAs and ANs and very few have been successful because the doctrine did not hold up in court. But in the mid-1980s, when competition between CRNAs and ANs increased, some ANs would tell the surgeon or dentist that it was better to work with ANs to avoid the liability associated with CRNAs (Blumenreich, 2007). Liability is based on who has the locus of control but when surgeons supervise CRNAs, control is not exerted unless the surgeon or acting physician intentionally directs the ways and means to an end result. There is a significant difference between having final control of the ways and means (leading to liability) and having control over the end result (leading to no liability) (Blumenreich, 2007). As an example: if a CRNA independently determines the course of an anesthetic to achieve a certain end result that the surgeon has requested, an independent contractor relationship exists with the surgeon and the rule of agency or *respondeat superior* (vicarious liability) oft equated with the captain of the ship doctrine does not apply. CRNAs and ANs alike are held liable for their own actions and one is not "less liable" than the other to a surgeon (Blumenreich, 2007).

Though the captain of the ship mentality has actively been debunked, some of the same misinformation continues to this day (Achor & Ahn, 2014). In a 2014 publication in the *Journal of Orthopedic Trauma,* an article entitled 'Becoming the Captain of the Ship in the OR' discussed how the surgeon IS the captain of the ship and they need to act like one. Though the article was discussing the surgeon as the leader of the operating team, they used an ill suited phrase from the past to show the power they continue exert in the operating room (Achor & Ahn, 2014).

Misinformation has been promulgated throughout the healthcare system and public that some level of physician involvement is required in the delivery of anesthesia care. The facts are that 40 states do not require physician supervision of CRNAs in nursing or medical board statutes or regulations. Forty-nine states do not require any AN participation in cases provided by CRNAs. Seventeen states have opted-out from the Medicare requirement for physician supervision of CRNAs and Medicare does not require an AN in CRNA-only cases (AANA, 2015).

Culture of hospital.

Hospital culture pertains to the organizational underpinnings and norms that a hospital system has developed and sustained over the years, which defines the organization as a social system (Meyer & O'Brien-Pallas, 2010). Often, hospital culture is driven by institutional tradition, surgical convenience, and provincial interests that govern the functioning of the operating room. Many studies have investigated the mechanics of operating room productivity and efficiency but seldom have researchers looked at the internal constructs that motivate hospital stakeholders to make decisions (Hill & Evers, 2012). There is a paucity of published information addressing the motivational forces that steer individual and group behavior in a healthcare setting.

A 2014 qualitative study documented success factors for strategic change initiatives from the hospital administrators' perspective (Kash et al.). They found that there were ten themes of specific success factors identified with the top three listed as culture and values, business processes, and people and engagement. They noted that prior research of healthcare strategic change initiatives attempted to evaluate how the initiatives were implemented, how leaders promote organizational success, and how culture affects organizational performance but did not

correlate them together (Kash et al. 2014). Tying these constructs together may provide more insight into today's complex healthcare system.

Another published study did look at these issues focusing on academic anesthesiology departments. They looked at redefining existing relationships, collaborating on shared decision-making processes, and developing incentives that aligned with performance goal measures to increase economic and operational stability. They identified that not only would an improved understanding of anesthesia services be economically advantageous to a hospital, it would also be a way to resolve the discord between the hospital and the anesthesiology department (or group) (Hill & Evers, 2012).

The primary reason for this discord is the potential misunderstanding by hospital stakeholders what the actual anesthesia service requirements and associated costs stem from. Many hospital stakeholders view anesthesia as a line item service that costs the hospital more than the value it delivers. An interesting distinction made by this study distinguished between productivity-based and availability-based services. They defined productivity-based services as elective OR and out-of-OR (remote) anesthetizing locations. They defined availability-based services as either services not reimbursed (preoperative evaluation) or those that require increased manpower but are not utilized enough to cover costs (trauma, code, or obstetrics call). They stated that it is appropriate for anesthesia departments to bear the responsibility for costs related to elective productivity-related services but that remote productivity and availability-based services should be cost-shared with the hospital since they provide benefits to the hospital and medical community. Legitimate points were concluded from their study in support of anesthesia groups assuming responsibility for the productivity-based services. If efficient scheduling practices that optimize productivity during normal operating hours are followed,

these groups will increase or at least maintain revenue to cover labor costs and reduce the need for stipends from the hospital for these types of services (Hill & Evers, 2012).

Productivity-based services in remote locations (interventional radiology, MRI, radiation, acute pain service, etc.) and availability-based services are another issue. These may be intermittent or infrequently utilized services and thus, not as productive as elective, scheduled cases. That makes these cases or services more complicated to staff but they are often desirable from the hospitals perspective in attracting surgeons and patients involved with strategic and innovative procedures. Thus, there is a disparity between what services an anesthesia department can effectively provide and services that attract clientele and surgeons to a hospital, all with underlying motivations for successful implementation. What appears as a needed change is creating a collaborative and cooperative environment, which may be a culture paradigm shift in changing relationships for all hospital stakeholders, in order to promote a more cost-effective and innovative anesthesia delivery model. Incentivization, utilization of cost-effective anesthesia practice models, and realistic calculation of resources needed are necessary to achieve these goals (Hill & Evers, 2012).

One delineation the study did not make though was who is staffing the operating rooms and in what type of model. They primarily were applying their conceptual framework to academic anesthesiology departments but most hospitals with anesthesia residency programs also utilize CRNAs in a medical direction model (Hill & Evers, 2012). Replication of their study by applying their principles of anesthesia services and factoring in anesthesia provider costs with the different practice models could provide more detailed information than previously explored. This could provide an operational framework for increasing productivity while decreasing costs and increasing available resources.

Change from the traditional approach of an anesthesia department structure can be threatening to the traditional vertical hierarchical chain of power and authority. In addition, many hospital bylaws have language and regulations in place that define how physician and non-physician providers must practice in that institution (Hain & Fleck, 2014). In order for innovative change to occur in a hospital environment, ANs and CRNAs must meet with hospital administrators to assess what is best for moving forward. This could possibly necessitate the changing of hospital bylaws to be more inclusive of all providers by decreasing restrictions on CRNAs by removing the term "supervision" if it exists and increasing the flexibility of anesthesia resources throughout the hospital (Kalist et al., 2011). The recent *Future of Nursing: Leading Change, Advancing Health* IOM report supports changes in restrictions of advanced practice nurses by stating that they should be utilized to their full scope of practice (2010).

In analyzing the public perception of anesthesia providers, the traditional power of the physician, and the culture of the hospital, it becomes clearer to understand how changing institutional norms can be very difficult, despite evidence that a change may help institutional solvency with no expense in quality. At some institutions, there may be a disconnect between the level of anesthesia care that CRNAs can actually provide and the perception of hospital stakeholders, including administrators, insurers, surgeons/physicians, and the public regarding that level of care. Expectations of the public and hospital stakeholders may dictate that the physician is the highest-level provider and create hesitancy in utilizing CRNAs for anesthesia services. Beliefs and preferences of a particular hospital or other setting can dictate which type of anesthesia delivery model is utilized possibly without referencing the current evidence or being open to a new cultural norm.

Important organizational resource issues to analyze in anesthesia are staffing numbers, operating/procedure rooms that can be utilized during normal and off hours, and overall cost to the institution. Traditionally, physicians hold the majority of control in these negotiations due to the vertical hierarchal ladder. Occupational conflict aside, stakeholders and practitioners must avoid politicizing these issues in order to restructure a more cost- and productivity-efficient workplace.

Theoretical Framework: Resource Dependence Theory

Resource dependence theory (RDT) is an organizational behavior theory often intertwined with agency theory, institutional theory and transaction costs economics theory (Davis & Cobb, 2009). Agency theory (AT) studies the contractual relationships among parties. Institutional theory (IT) focuses on the deeper and more robust aspects of social structure. Scott (1995) indicates that, in order to survive, organizations must conform to the rules and belief systems prevailing in the environment. Processes considered with IT include development of schemas, rules, norms, and routines that become authoritative guidelines for social behavior. Incorporating IT could support continuing the current vertical hierarchy of physician-led and controlled hospital systems. Transaction costs economics (TCE) theory involves costs incurred in making an economic exchange, including search and information costs, bargaining costs, and policing and enforcement costs (Shafritz, Ott, & Yang, 2011). In relation to the scope of this study and focusing on RDT, the other theories have a purpose but the focus of this study will be on the effect of external and internal resources for the strategic planning and management of the efficient provision of anesthesia services.

Background.

The concepts that ultimately led to modern day RDT originated with Adam Smith, known as the Father of Economics (1723-1790). His premise was that to reach equilibrium in a society, you had to adjust for 'trust, hardship, and labor' (Shafritz et al., 2011). Today that still holds true but may be more applicable to "quality, access, and cost".

RDT infers that resources are "differentially valuable" in dealing with threats from the external environment (Mudambi & Pedersen, 2007). The threat that exists currently is the financial crisis that cuts in Medicare, Medicaid, and private payer reimbursements will create. Studies and insurance claim reports show that there is no correlation nor is there evidence of a difference in quality of care rendered by a CRNA or AN. Even the leadership of the American Society of ANs recognizes this and realizes it may be time to "lessen the reliance on medical direction" models (Lema, 2007).

RDT proposes that organizations cannot supply all of their needs internally and therefore, require resources from their working environment. The interdependence that is created "often leads to a complex set of relationships where one organization attempts to influence its resources, while in return its resources attempt to influence the organization" (Vibert, 2004). Finding a way to survive is vital to the success of the organization and the need to reduce uncertainty forces those organizations to rely on their resources for stability.

There are two basic assumptions in utilizing RDT: first, organizations are externally constrained, and second, organizations attempt to manage their external dependencies. According to Pfeffer (1982), organizations will and should respond to the demands for critical resources on which they are dependent. Some competitors, allies, and others will be more important at different times in the history of the organization (anesthesia groups, locums, etc.).

Those groups in control will be first in line to be vetted and have the most influence and power over their vettors.

The second premise of the theory is that organizations, focusing on managing their own external dependencies, seek to gain more autonomy and freedom from others and attempts to have others more dependent on them in return, thus remaining in control of power, stability, and adaptability (Pfeffer, 1982).

Most organizations will not be so subservient in relation to the constraints placed on them. There is often a complicated interplay between the varying degrees of power in an organization. Power players may utilize a variety of strategies to gain ownership of the current situation. Some of those strategies include restricting the flow of information about the firm; denying the legitimacy of the constraints imposed by the resource; merging, diversifying, or expanding to alter interdependence; negotiating a new relationship with the environment through interlocking directorates; and, undertaking political action, such as lobbying (Pfeffer and Salancik, 1978). Those organizations that triumph usually have the most power and know how to utilize it to the best extent.

RDT as a theory that deals with power relationships within organizations can provide useful insights into why hospital stakeholders decide to utilize various anesthesia delivery models. This can be further analyzed by the cost-effectiveness of anesthesia practice and concomitant economic implications of hospital stakeholder perceptions of anesthesia services. The theoretical structure for analyzing these constructs with RDT is driven by the potential financial gains, or reduction in losses, a healthcare facility can realize.

In an effort to understand the relationships between a hospital's external pressures and its internal structure, strategies, and processes, it is helpful to look at the basic tenets of RDT:

uncertainty and resources. Barnard, in 1938, was one of the first scholars to discuss organizational survival and he supposed that it was based on the harmony between the external environment and the internal decisions and processes of an organization (Yeager et al, 2014). Others built on this work after that, including those most influential: Pfeffer and Salancik, who in 1978, argued that organizations actually depend on resources within their environment to operate and survive.

In analyzing the most recent studies to utilize RDT in organizations, Yeager (2014) in a systematic literature review surmised that though RDT and the uncertainty perspective were commonly used in analyses of health care organizations, they were never operationalized nor applied to health care management. Twenty studies were identified in which 13 focused on hospitals, five on long-term care facilities, one on medical practices, and one on public health agencies. Eleven of the studies described their use of RDT in selection of environmental variables (munificence, dynamism, complexity). Most of the studies examined the impact of the environment on a dependent variable, either strategy, structure, or performance of the organization. The studies date back to 1992 with only three being completed since 2010 and only four utilizing all three RDT constructs since 1997. Yeager states that the current use of the RDT perspective may be more relevant than ever before in health care studies due to the dynamic healthcare environment and the representative constructs of munificence, dynamism, and complexity.

The only study that was found to use RDT in a group practice studied the environmental market characteristics related to physicians' electronic medical record adoption. It utilized both RDT and the information uncertainty perspective. RDT has been previously discussed. The information uncertainty perspective postulates that decision makers do not have all the

information needed about the environment to make decisions. They utilized the constructs of munificence, dynamism, and complexity (Menachemi, Mazurenko, Kazley, Diana, & Ford, 2012).

One additional recent study utilizing the constructs of RDT in health care was published in the *Journal of Hospital Administration* in 2013. The study examined the environmental dimensions affecting organizational entrepreneurship in Iranian public hospitals. The constructs of RDT previously mentioned were operationalized and environmental struggle was added to the features observed in the external environment. The purpose was to determine what affects these constructs had on organizational performance and to what extent they could be manipulated to encourage innovation in a health care environment (Nasiripour, Raeissi, & Hosseini-Fahraji, 2013).

Constructs.

The three constructs of RDT (munificence, dynamism, and complexity) can explain strategies and the performance of an organization. The fourth construct, environmental struggle, that was only identified in the Iranian study closely mimics complexity and will be explored under that construct measure. In order to operationalize RDT, the constructs of munificence, dynamism, and complexity will be developed in a hospital setting for this study.

Munificence.

Munificence is defined as the availability and accessibility of resources needed for a particular organization (Yeager, 2014). Because resources are dynamic and can become abundant or in short supply over time, the RDT perspective predicts that in order for an organization to be successful, they must develop strategies that capitalize on munificence in their setting. These strategies are aimed at making the organization more viable (Yeager, 2014). The

availability of resources is integral to survival because human resources and capital give an organization more flexibility in pursuing various strategies (Menachemi et al. 2012). For example, a rural hospital is in a community with limited financial and professional resources and this would be characterized as a low munificent organization. On the other hand, an urban center has many financial and professional resources and would be considered a high munificent environment. This does not mean that a low munificent organization cannot be successful; they just need to learn to adapt their resources and develop strategies to function with the resources they currently have. The constructs of dynamism and complexity often mirror the level of uncertainty and changing conditions in a given market.

Dynamism.

Dynamism means a situation is constantly changing, leading to uncertainty for stakeholders. Any variations in either resources (munificence) or external factors create a more dynamic environment. This construct can be measured in time increments to assess if an effect is happening immediately or it is evolving over a period of time. Explained by the information uncertainty perspective, stakeholders do not possess all of the information about their situation to make the best decisions. Because of this, the decision-making process is steered mostly by their perceptions about an organization's environment. Dynamism, the rate of change in the environment, increases the stakeholder's level of uncertainty and impacts their choices. The more dynamic an environment, the more anxiety present, which can delay strategic initiatives. This can cause an organization to pursue short-term, less risky solutions or maintain the status quo (Menachemi et al., 2012).

Meyer & O'Brien-Pallas (2010) suggest viewing hospitals as open systems since they are defined as those facing uncertainty in both their internal and external environments. This applies

to the construct of dynamism also in today's complex healthcare environment. It can include the uncertainty of competitors in anesthesia practice models, developing relationships with outside entities, and benchmarking for performance and need (Kash et al., 2014).

Several factors play an integral role in operationalizing this construct. The changing regulations of the Affordable Care Act affect the overall question of resource utilization for hospital administrators. Newer quality payment initiatives, alternative payment models such as bundling of services, and anesthesia group consolidation all can increase the level of uncertainty in a hospital or hospital system.

Complexity.

The construct of complexity is related to dynamism in that it is related to the uncertain changes in the environment. It reflects the range and quantity of components that need to be considered by an organization when making strategic decisions (Layman & Bamberg, 2005). Previous studies have shown that the more complex environment an organization operates in, the increased probability that defensive strategies will be employed rather than proactive, forward-thinking ones. The level of intricacy in a situation affects the decision-making of those involved in making decision of strategic importance (Menachemi et al., 2012). The more complex a problem is, the more uncertainty is present in predicting potential change in the future. In the anesthesia environment, effects of the ACA, the multifaceted payer system, CMS regulations, hospital bylaws, and the perceptions of the enforcement of them adds to the complexity of anesthesia practice.

Chapter Summary

Since the mid-nineteenth century, anesthesia has been evolving, not only in a scientific realm but also in its organizational framework. This has been acknowledged in recent anesthesia

literature as a "historic refocusing" with a need to "take a broad, pro-active, and forward-looking perspective… to demonstrate what it means to redesign care to improve outcomes and efficiency…with a cost savings" (Fleisher, 2015, p.63). Improvements have been made in the safety of the anesthetics administered as well as how they are administered and by whom. It is unproductive to pit ANs against CRNAs in quality of care assertions, since the literature supports the safety of anesthesia administered by all practitioners. The goal is to assess individual institution's needs and provide the best fit of providers for the most efficient and cost-effective anesthesia practice model.

This research explored a significant gap in the literature regarding what factors are important to hospital administrators regarding the strategy, structure, and performance of anesthesia practice models. Internal and external environmental variables were assessed in hopes to elucidate barriers and, in the future, implement strategies for improving the use of organizational resources in the delivery of anesthesia services via an innovative paradigm shift. Interestingly, none of the previously mentioned studies in RDT cited Aday and Anderson's sentinel work on utilizing environmental variables in a utilization model. This study refashioned their model to present an innovative approach to anesthesia services utilization and the behaviors that surround it. By adapting Aday and Anderson's behavioral utilization model and basing it in RDT, the constructs of munificence, dynamism, and complexity were examined and operationalized through the relationship between anesthesia services and hospital stakeholder's perceptions of need.

As explained in this literature review, there are opportunities for anesthesia departments to restructure their design and resource allocation to strengthen the budget and provide an increase in value-based services. The goal is to maximize a hospital's ROI of anesthesia

services. Hospital administrators' perceptions about the ability to undergo an anesthesia services redesign and what is necessary to accomplish it were addressed in this study.

Chapter Three: Methodology

This chapter presents an overview of the problem and purpose of the study followed by a discussion of the study's research design as well as the sample size and power analysis, data collection, methods of data collection, and data analysis plan. A variety of research studies have previously addressed the quality, access, and cost paradigm related to anesthesia services (quality: Lewis et al., 2014; Dulisse & Cromwell, 2010; Needleman & Minnick, 2009; Simonson et al., 2007; Pine et al., 2003; Bechtoldt, 1981; access: Jordan, 2011; Kalist et al., 2011; Merwin et al., 2009; Merwin & Jordan, 2006; and, cost: Hogan et al., 2010; Neddleman et al., 2008; Simonson, 2007; Abenstein, 2004; Pine, 2003; and Beecher & Todd, 1954). This study examined factors related to the delivery of anesthesia services and type of practice models utilized to describe how anesthesia services are chosen and perceived by hospital administrators. Knowing what hospital administrators understand regarding structure of the anesthesia team and their value of anesthesia services provided allow the administration to direct their attention to the efficient and cost-effective functioning of the anesthesia group to meet the needs of the future for their healthcare facility.

Problem and Purpose Overview

The purpose of this study was to identify the determinants New England acute care hospital administrators' utilize in making the choice of anesthesia practice model for their facility. Because there is limited scientific information about hospital administrators' knowledge and understanding of anesthesia practice model arrangements, this study was designed to gather

information that factors into choice of anesthesia services. The current literature related to this topic only shows anesthesia corporation surveys that were conducted in this area (Gooch, 2016). A better understanding of hospital administrators' knowledge and understanding of anesthesia practice models and the advantages and disadvantages of each model allows for a more substantive discussion of the issues of anesthesia practice in a given hospital among hospital decision-makers (CEOs, CFOs, CIOs, CMOs, CNOs, COOs).

Research Questions

This chapter describes the research design, data collection methods and statistical analyses used to answer research questions for this study. Providing data derived from these questions will be useful for further quantitative and qualitative studies in the future. The following primary research question was explored in this study: "What factors are considered by hospital administrator's when making the choice of anesthesia practice model?" The secondary research question was: "Is there is a relationship between hospital administrators' knowledge of services each type of anesthesia practice model offers and type of anesthesia practice model employed?" and "Is there is a relationship between hospital administrators' perceptions of services each type of anesthesia practice model offers and type of anesthesia practice model employed?"

Objectives

The objectives of this study were to: (1) identify the factors considered by hospital administrators in choosing anesthesia practice models, and (2) examine the perceptions of hospital administrators regarding the delivery of anesthesia services.

Operationalization of Hypotheses

Recent studies on sustaining and improving hospital performance have focused on organizational and market forces that guide hospital administrator's decision-making (Brand et al., 2012; French et al., 2016; Guo et al., 2015; Jiang et al., 2006). Yeager et al. (2014) summarized empirical studies under the resource dependence framework that looked at the constructs of munificence, dynamism, and complexity in an attempt to find variables to operationalize these constructs for healthcare organizations. Hill & Evers (2012) studied performance pressures on hospitals and anesthesiology departments. But no scientific study in the current literature has assessed all of the factors together and applied it to hospital administrator's decision-making related to choosing specific anesthesia practice models for their facility. This study utilized the common constructs of munificence (strategy), dynamism (structure), and complexity (performance) identified throughout previous studies and identified what factors influenced hospital administrators choice of their anesthesia practice model. It also explored any relationship between the administrators' knowledge and perceptions about anesthesia services and type of practice model employed.

The following hypotheses guided the evaluation of relationships between the outcome variable, choice of anesthesia practice model, and seventeen predictor variables: number of anesthesia provider (FTE CRNAs, ANs, and AAs), geographic location of facility, facility in medically underserved area (MUA), opt-out status of state, hospital type, hospital bed size, number of anesthetizing locations, hospital financial status (operating margin-2014 data), hospital profit status, type of anesthesia employment model, anesthesia subsidy, hospital bylaw limitations on anesthesia provider practice, current position, years in current position, total years in senior management, and education and professional background of hospital administrator.

These variables were chosen based on results from previous studies that showed they contributed to decisions made by hospital administrators and formed the basis for the hypotheses in this study. The following equation displays these variables:

Choice of Anesthesia Pr. Model f(y) = (# CRNAs + # ANs + #AAs) + geographic loc + MUA + opt-out + facility type + # beds + # of anesthetizing locations + hospital operating margin + profit status + employment model + subsidy + bylaw limitations + current position + # years in current position + total years in senior management + administrator education + administrator professional background.

The following four hypotheses were explored in this study in an effort to elucidate the factors that hospital administrators considered when choosing an anesthesia practice model at their facility:

- H1: There is a higher number of CRNAs working as anesthesia providers in medically underserved areas compared to ANs and AAs combined.
- H2: Hospital facilities with operating margins (2014 data) greater than 2.2% utilize more CRNAs compared to ANs and AAs combined.
- H3: There is a relationship between hospital administrators' knowledge of anesthesia services provided at their facility and anesthesia practice model utilized.
- H4: There is a relationship between hospital administrators' perceptions of the value of anesthesia services provided at their facility and the anesthesia practice model utilized.

Constructs.

The hypotheses are operationalized in Figure 9 and the narrative that follows. The hypotheses were based on constructs associated with resource dependence theory and their concomitant measurable variables.

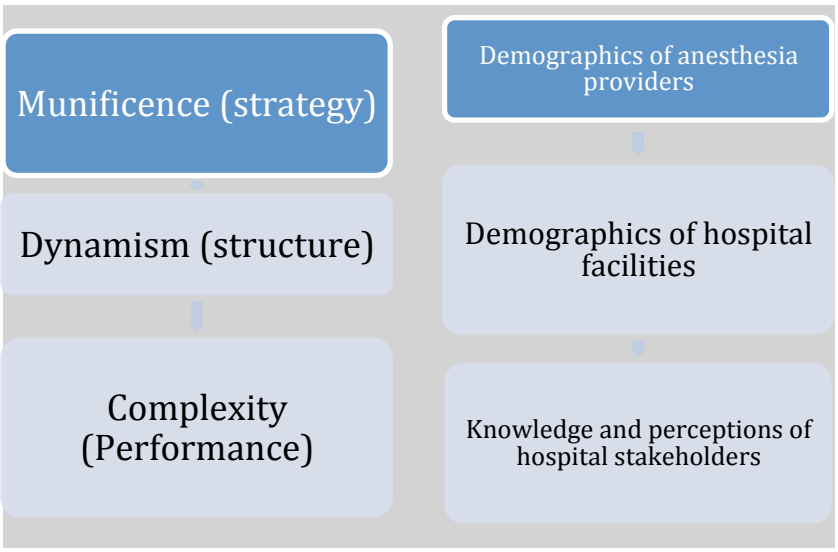

Figure 9. Application of Constructs. Adapted from "Using resource dependency theory to measure the environment in health care organizational studies: A systematic review of the literature", by V.A. Yeager, N. Menachemi, G.T. Savage, P.M. Ginter, B.P. Sen, & L.M. Beitsch, 2014, *Health Care Management Review, 39* (1). Copyright 2014 Wolters Kluwer Health.

From the literature review, the construct of munificence was defined as the availability and accessibility of resources needed for a particular organization (Yeager, 2014). In this study, munificence was represented by the number of anesthesia providers in a given location based on their availability. The variables used in this study to represent munificence were the demographics of anesthesia providers. This was measured by assessing the number of FTE CRNAs, ANs, and AAs in a hospital, geographic location of the hospital (rural vs. urban), if the facility was in a medically underserved area, and opt-out status per state.

The construct of dynamism defines a situation that is constantly changing. Any variation in resources or external influences has the potential to create uncertain and dynamic environment (Yeager, 2014). The variables used in this study to represent dynamism were the demographics associated with the hospital facilities. These included hospital type, hospital bed size, number of anesthetizing locations, hospital operating margin, hospital profit status, type of anesthesia employment model, and anesthesia subsidy.

With both constructs of munificence and dynamism the variables were operationalized with the term demographics. In this study, demographics were used to define and represent sample characteristics of the population of study, such as the size, structure, and distribution of populations (Kaur, 2013). Demographic variables such as type of anesthesia provider and hospital characteristics were collected to describe the sample. They were used to determine if they was any relationship to the population of interest: hospital administrators.

Lastly, the construct of complexity, though related to dynamism, covers a more global picture of the environment. It emphasizes strategic decision- making in an organizational structure related to the performance of the organization. The variables used to represent complexity were the hospital administrator's educational background as well as their administrative experience, calculated as number of current and total years in a hospital administrator position, and any hospital bylaw limitations on anesthesia provider clinical practice. A key aspect of this study examined hospital administrators' (HAs) knowledge and perceptions of anesthesia services in their hospital. In this study, knowledge was defined as facts, information or skills acquired by an individual based on experience or education (Merriam-Webster, 2016). This concept was operationalized in this study by obtaining each hospital administrators' understanding of their hospital characteristics as well as understanding the anesthesia services offered at their facility. If they were not aware of what services were offered and/or were unsure of what type of APM or employment model was used at their facility, this was factored into the logistic regression model. Perception is defined as a way of regarding, understanding, or interpreting something through a mental impression (Merriam-Webster, 2016). This concept was operationalized in this study by evaluating what value hospital administrators place on anesthesia services and management oversight by anesthesia providers. Table 4 displays

Table 4

Relationship of Objectives, Constructs, Independent Variables, and Hypotheses

Objective	Construct	Independent Variable	Hypotheses
(1) Factors utilized by HAs when choosing practice models	Munificence	• # of CRNAs • # of ANs • # of AAs • Rural vs. urban • MUAs • Opt-out status	• There is a higher number of CRNAs working as anesthesia providers in MUAs areas compared to ANs and AAs combined.
(1) Factors utilized by HAs when choosing practice models	Dynamism	• Facility type • Bed size • # of anesthetizing locations • Operating margin • Profit status • Employment model • Anesthesia subsidy	• Hospital facilities with operating margins greater than 2.2% utilize more CRNAs compared to ANs and AAs combined. • There is a relationship between HAs knowledge of anesthesia services provided at their facility and type of anesthesia practice model utilized.
(1) Factors utilized by HAs when choosing practice models (2) Perceptions of HAs in choosing anesthesia services	Complexity	• Hospital Bylaws • Hospital administrator education • Hospital administrator professional background • Hospital administrator current position • # years in current position • # years total in senior management	• There is a relationship between HA knowledge of anesthesia services provided at their facility and type of anesthesia practice model utilized. • There is a relationship between HA perceptions of anesthesia services provided at their facility and the anesthesia practice model utilized.

the relationships between the objectives, constructs, independent variables, and hypotheses to the outcome variable, choice of anesthesia practice model.

Research Design

This quantitative, exploratory study of factors hospital administrators use when choosing an anesthesia practice model utilized a non-experimental, correlational research design. The research was descriptive in nature to determine the factors that influenced a hospital administrator when making decisions about the type of anesthesia practice model that would be best for their system. This research was vital in documenting the choice of anesthesia practice model and advancing the understanding of why each model is utilized in a hospital. Correlational research examines relationships between variables with no manipulation of the independent variable (Polit & Beck, 2008). This correlational study was designed to explore the strength of the relationship between the independent variables and dependent variable, which was anesthesia practice model. One aspect of exploring the relationship was to ascertain the educational background of the hospital administrator. A null hypothesis was that no relationship exists between choice of anesthesia practice model utilized in a hospital and the background of the hospital administrator. Recognizably, one administrator may not be the sole decision-maker in a hospital so a survey question asked who was responsible for making the final decisions for the facility.

This research was descriptive in nature due to the fact that it was designed to describe relationships and identify factors related to provider and facility demographics in relation to type of anesthesia practice model utilized at a hospital. The inherent aim of descriptive correlational research is to simply describe the relationships among variables and not allude to the cause and effect among noted variables (Polit & Beck, 2008). The information that was gleaned from this

research will potentially lead to future research utilizing a rich, qualitative approach to obtain information related to this topic. Utilizing the topic themes derived from the factors that were found to influence choice of anesthesia practice model, a qualitative study could be utilized to delve deeper in the knowledge and perceptions of hospital administrators.

Population, Recruitment, and Sampling Methods

The population consisted of hospital administrators located in New England hospital facilities. The number and location of hospital facilities included: Connecticut (30), Maine (34), Massachusetts (68), New Hampshire (27), Rhode Island (15), and Vermont (15). Appendix A displays a list of New England hospitals per state. These hospitals offer a variety of medical and surgical services to their communities and range from critical access hospitals to community regional hospitals to academic tertiary care teaching centers. Hospital administrators that received the survey included the following executives: Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Information Officer (CIO), Chief Medical Officer (CMO), Chief Nursing Officer (CNO), and Chief Operational Officer (COO). Inclusion criteria included hospital administrators in acute care hospital facilities. The facilities were identified as members in the state hospital association directory that perform surgical and diagnostic procedures requiring anesthesia services in the New England region. This population was included due to geographic location and knowledge of hospital demographics by the researcher. Exclusion criteria included hospital administrators in New England hospital facilities that do not perform surgical procedures, such as behavioral health hospitals, clinics, long-term care facilities, and urgent care centers as well as ambulatory surgery centers and office-based practices. This population was excluded because information gathering was not as accessible as it was for hospital administrators in acute care hospital facilities.

A convenience sample was utilized based on the ability to obtain email addresses for the hospital administrators at each hospital selected. Convenience sampling involves enlisting the most easily available participants for a study (Polit & Beck, 2008). It is the most commonly used form of sampling in many research studies due to the ease and accessibility of obtaining the information. This type of nonprobability sampling is the weakest form of sampling though due to the risk of sampling bias (Polit & Beck, 2008). This research strived to enhance the sample's representativeness though by identifying extraneous variables that may have affected variation in the dependent variable. For example, if a hospital administrator's primary profession was as either an AN or CRNA, professional bias may skew the survey results in that professions' favor. Data collected from participants who completed the survey was originally going to be restricted to hospital administrators that were not anesthesia providers. Due to the small sample size obtained in this survey, the decision was made to keep those participants in the survey pool and note this in the limitations section.

Sample Size and Power

Ideally, the goal is to utilize statistical hypothesis testing that will allow the researcher to make educated decisions about whether the results of the study reflect sample differences because of chance or true differences in the sample population. The preferable outcome with the use of testing is to reject the null hypothesis because it means it was not supported by data. If the null hypothesis is accepted from the statistics, it means that there is no relationship between variables (Polit & Beck, 2008). Statistical errors are possible if they are not controlled for and are identified as Type I and Type II errors. Type I (alpha) error occurs when a researcher rejects the null hypothesis when it is actually true. Researchers can attempt to control for the risk for Type I errors by selecting a level of significance called alpha. The minimum acceptable level of

alpha is usually 0.05 and that was utilized in this study. Type II (beta) error occurs when a researcher accepts the null hypothesis and it is actually false (Polit & Beck, 2008). This can be controlled for by selecting an adequate power level with a medium effect size, alpha level of 0.05, and for this study, an a priori power of 0.80, the conventional standard, was chosen.

The sample size for this study was one of its limitations due to the fact that it was dependent on the response rate of the survey participants. Creating a properly designed survey can decrease nonresponse bias but it may still exist. A logistic regression model of statistical testing was used and the sample size was calculated using power analysis software. One model by Agresti (2007) states a 'rule of thumb' in estimating sample size for logistic regression is a minimum of 10 'cases' for every independent variable. In this study, that would have been a minimum of 170 because there were a total of seventeen independent variables. This 1:10 rule is most commonly applied for linear regression and it becomes more complex when applied to logistic regression. There are strategies for addressing the complexities such as combining or dropping independent variables and this was addressed in the data analysis phase to make the inferences derived from the results worthwhile (Agresti, 2007). Based on the number of variables that will be tested, a simple calculation for multiple regression calculates a sample size of 131 after conducting a power analysis with a small to moderate effect size of R^2 of .10 and power of .80, which was hard to achieve based on the number of hospitals and hospital administrators that were included in the study region. To address this limitation, the number of independent variables was decreased after data analysis.

Human Subjects

Institutional Review Board (IRB) approval was sought from the Virginia Commonwealth University (VCU) prior to deployment of the survey for the research study. Exempt approval

was awarded, which ensured ethical standards would be met and institutional policies for human subjects would be followed, according to 45 CFR 46.101 (b), category 2. This category includes surveys, interviews or focus groups, educational tests, or observations of public behavior (Virginia Commonwealth University, 2017). All information collected from the surveys was de-identified and presented only minimal risk to the participants, thus qualifying for exempt status. Appendix B provides a copy of the VCU IRB approval letter.

Data Collection

The survey was deployed using Research Electronic Data Capture (REDCap) from VCU after IRB approval. REDCap is a secure web application that is used to capture data from online surveys. It was sent via email to all hospital administrators (CEOs, CROs, CIOs, CMOs, CNOs, and COOs) at hospitals in the New England region. After it had been established that the number of respondents was complete, the information was loaded into SPSS statistical software for data analysis. Assistance from a biostatistician was available for questions regarding data entry.

Instrumentation

After IRB approval, an electronic survey was sent to an expert panel of practitioners to review for content validity. Appendix C provides a copy of the full survey, including the expert panel section. The survey was sent to a convenience sample of eight experts in the area of health services research and/or administration familiar with anesthesia practice models and anesthesia services. These participants were external and they were not included in the actual study. Based on the literature regarding survey deployment in health services research, it is suggested that five participants are adequate to evaluate the survey so a survey response of 100% was successful for

this part of the study (Francis, Eccles, Johnston, Walker, Grimshaw, Foy, Kaner, Smith, & Bonetti, 2004).

Since there have not been any known surveys conducted in this topic area except for anesthesia corporation surveys, piloting the survey with the expert panel before full deployment helped identify any issues with survey language and design. The pilot survey played an important role in the overall success of this study and provided an opportunity to create a new survey. The overall goal of the pilot survey was to evaluate if participants were able to answer questions to fulfill the purpose of the study, thus strengthening content validity.

An introduction email was sent to the panel of experts to invite them to participate in the pilot survey while awaiting IRB approval. The letter contained the purpose of the study as well as definitions of the constructs and measurement of variables to be used in the study. After IRB approval, the pilot survey was deployed for one week after which the researcher reviewed the feedback. A content validity instrument was sent to all the expert panel members along with the survey link to assess question relevance and succinctness. The instrument was developed based on Lynn's sentinel work (1986) titled *Determination and Quantification of Content Validity*. The author defines content validity as the determination of the representativeness or relevance of the instrument elements. It quantifies content validity as the index of content validity (CVI). Each item on the survey instrument was rated for content relevance on a 4-point Likert scale with the following connotations: 1, item not relevant; 2, unable to assess item relevance without revision; 3, relevant but needs minor revisions; and 4, very relevant and succinct. All expert panel participants rated all items were rated as 4, very relevant and succinct. Appendix D provides a copy of the Content Validity Instrument.

Feedback from the panel of experts was used to strengthen the adequacy of the survey instrument, appropriateness and clarity of the wording of each question, and representativeness of the scaling used (Polit & Beck, 2008). There was a fourth section for the expert panel to complete entitled Expert Panel Participant Evaluation. Clarification of instructions was solicited and accuracy of questions reflecting constructs and variables was elucidated. This section was removed when the main survey was deployed. Questions asked in this section helped guide the final draft of the main survey and strengthen face, content, context, and construct validity. The expert panel participants suggested several clarification changes and the survey was resent to the panel for a final review with a one-week approval turn-around.

After the expert panel review, the electronic survey was finalized and emailed to hospital administrators at identified hospitals throughout the New England region. A comprehensive list of hospital administrators and emails for each state was available from each hospital association directory. The hospital administrators received an introduction letter via email inviting them to take and consent to the survey as well as describing the purpose and aims of the study. Appendix E provides a copy of the survey invitation email to participants. The solicitation included an explanation of the purpose of the survey as well as the risks and consent if the survey is completed. The survey was launched for a three-week time period. This open survey length of time was decided based on results collected from the Survey Monkey corporation that showed 80% of respondents answered within seven days of receiving the survey (Survey Monkey, 2016). A reminder email was sent to those who had not responded every seven days for two weeks after the launch. At the end of the three-week period, a sufficient number of respondents had not been obtained, so another email reminder was distributed and the survey deadline date was extended by another week.

One of the issues with survey research is response rate and specifically, non-response bias. Non-response bias is the difference between survey participants and those who declined to participate (Polit & Beck, 2008). Response rates to email/internet surveys have decreased over the last two decades. Response rates of 25-30% may be quite acceptable, though introductory letters and follow-up reminder emails can increase the response rate (Finchman, 2008). External surveys, those that are not directly affiliated with individuals solicited, can elicit response rates as low as 10 - 15%, on average. Keeping the time to complete the survey to less than 10 minutes improves success. Most respondents can complete five closed-ended questions per minute (Fryrear, 2015). The survey had a total of 26 multiple choice/multiple answer questions. It also had three Likert scale questions ranking hospital administrator's knowledge and perceptions of anesthesia services from least to highest importance. It was estimated by the expert panel that it should take no longer than seven minutes to complete the survey, theoretically increasing the response rate.

Since the minimum calculated number of respondents was not obtained by the end of the survey deployment, this is a significant limitation of the study. The reasonableness of the survey results may be flawed thus making it less generalizable to the population. Since this was the case, the study could be replicated in the future to gather more robust results. This will be further elucidated on in the Discussion chapter.

Other tests could have been undertaken in an attempt to strengthen the validity and reliability of the study results even with a lower end response rate. Weighted adjustments can be made if the response rate is low such as post-stratification or non-response adjustments (NRA). Post-stratification relies on the data that was collected from the survey itself and adjusts the weights allocated to each variable to that of the known population. NRA can align the sample

available with the population wished to study. By modeling response propensity, the dependent variable can be weighted 0 for non-response and 1 for response. A logistic regression could then be run on the rest of the variables as explanatory variables. Both techniques provide more robust results if there are at least 50 respondents available. Logistic regression models can handle this type of post-hoc weighting and can be assessed if they would be viable if the response rate is lower than anticipated for a study (Kolenikov, 2016). There were only 35 respondents in this survey so these tests will not be used in this study but could be considered for future studies.

Survey development.

The main survey was divided into three parts. The first part was composed of five close-ended demographic questions related to the individual hospital administrator completing the survey. The second part was composed of six close-ended demographic questions related to the facility where the hospital administrator is employed. The third part was a combination of closed-ended and Likert scale questions to evaluate hospital administrators' perceptions and understanding of anesthesia services in their institution. There were 15 closed-ended and 3 Likert scale questions in this section to evaluate their understanding of and value attributed to anesthesia services. Refer to Appendix C for a copy of the survey.

Likert scale questions are the most commonly used scaling technique, especially to quantify attitudes and behaviors. Results from these scales can allow the researcher to make fine distinctions among respondents (Polit & Beck, 2008). This survey tool utilized Likert scale measurement based on item response theory, which can differentiate error more closely than classical measurement theory. The intensity of the wording was similar on the questions in order to aid in discrimination. The survey utilized a scale with five options ranging from least importance, minimal importance, moderate importance, significant importance, and highest

importance to elicit hospital administrator's perceptions of the value of anesthesia services. An odd number of choices provide respondents with the option to be neutral or ambivalent (Polit & Beck, 2008).

Validity.

It is important to enhance the rigor of quantitative research by minimizing biases and controlling for extraneous variables as much as possible. Though validity is not a property of the research design, inferences are, and by considering threats to the validity of a study during the design phase, the results of the study may be strengthened (Polit & Beck, 2008). Analyzing the correlation between the independent and dependent variables utilizing logistic regression methods assessed statistical conclusion validity as well as assuring adequate statistical power (.80) and an alpha of .05. Developing strategies to rule out the possibility that something other than the independent variable caused the relationship assessed internal validity. Assuring that the dependent variable was operationalized clearly strengthened construct validity. And lastly, generalizability and representativeness to other hospital facilities and regions aided in enhancing external validity. Validity was especially important in developing the survey instrument to assess how well the measurement represents the constructs and variables in a study.

Construct validity.

Construct validity is essential for evaluating the quality of a study and can be addressed by assessing measurement in a survey. It refers to how well an individual measurement operationalizes a construct. Though it can be difficult to establish construct validity, if a researcher is able to strengthen content validity, construct validity will be strengthened also (Polit & Beck, 2008). During the statistical analysis, construct validity was further evaluated when assessing convergent and discriminant validity. Convergent validity tests that constructs

that are suppose to be related are related and discriminant validity tests that constructs that should not have relationships do not (Polit & Beck, 2008). These subtypes of validity can be essential in reducing the threat of Type I and Type II errors.

Content validity.

Content validity examines the degree to which the survey instrument represents the variables for the construct being measured. It can be evaluated for affective as well as cognitive measures. Though some degree of subjectivity is present in establishing adequate content in a survey, by using a panel of experts to pilot the survey, the amount of subjectivity may have been decreased (Polit & Beck, 2008).

Criterion validity.

Criterion validity measures the degree to which a measurement correlates with an external criterion. For this measure to be valid, it is important for the survey instrument to be a useful predictor of other behaviors or experiences. Two types of validity exist in this category: predictive and concurrent. Predictive validity is the ability of the instrument to predict an outcome. Concurrent validity is the ability of a survey to distinguish between individuals who differ on current criterion (Polit & Beck, 2008). Table 5 lists validity concerns and control measures addressed in this study.

Reliability.

In addition to validity concerns, it is essential to assess the quality and adequacy of the quantitative instrument utilized in a study and, in this case, it was the survey instrument. The survey's reliability is explained by its consistency and accuracy and has three elements to consider: stability, internal consistency, and equivalence. This survey was a needs assessment via a key informant approach. The informants were hospital administrators who were decision-

Table 5

Validity Concerns, Descriptions, and Control Measures for the Survey Instrument

Validity Concern	Description	Control Measures
Construct validity	Refers to degree of adequate measurement of the variables representing the construct and theoretical framework	Demonstrated using hypothesized relationships derived from previous studies in relation to resource dependence theory
Content Validity	Refers to the degree of representativeness of the survey questions	Questions derived from previous studies strengthens this survey; expert panel verified that survey questions were relevant and succinct
Criterion validity	Determines relationship between survey and external criterion	Pilot study assessed validity of questions representing variables/constructs; Statistical analysis of variables in this study will provide future researchers criterion to base like studies on
Face Validity	Ability of the instrument to measure what it is suppose to measure; 'face value'	Survey cover letter explained purpose of study; pilot survey helped increase representativeness of questions related to variables
External validity	Extent inferences about observed relationships in study can be generalized to similar populations	Using large pool of New England acute care hospitals enhanced generalizability to this region; low response rate lessened this generalizability though
Hawthorne effect	Alteration of responses of study participants due to their awareness of study purpose and population studied (ie: multiple HAs completing survey during meeting)	Anonymity of returned surveys ensured; reminded participants to complete survey on their own in private space

makers in their facilities. Internal consistency was established with the summing of Likert scale scores. Reliability of internal consistency is the most common reliability approach used in nursing research (Polit & Beck, 2008). Since this was the first known time that this combination of questions was asked on a survey instrument, it was important to reassess the tool after data collection and analysis to get a better idea if it actually measured the target variables. This will be further explored in the Discussion chapter.

Data Analysis

Several statistical techniques were utilized to analyze the data. The data collection source for all variables was from the survey instrument. Descriptive analysis provided information on the demographics and attributes of the hospital administrators as study participants as well as the institutions that they work. Frequency distributions were calculated and plotted on bar charts and frequency tables. Chi squared analysis was utilized to assess if there were any relationships between the outcome variable and each independent variable. Logistic regression was utilized since the research question related to prediction of group membership. A prediction of a discrete outcome, such as hospital administrators' choice of anesthesia practice model, was answered with logistic regression utilizing a set of variables that were discrete, dichotomous, or a mixture (Tabachnick & Fidell, 2007). The goal of this analysis was to accurately predict if there was a relationship between the predictors and outcome variable. Since one was found, attempts were made to simplify the model by eliminating some of the variables and maintaining a strong predictive relationship (Tabachnick & Fidell, 2007). In this study, the dependent variable was the hospital administrators' choice of anesthesia practice model utilized at their hospital. This was a categorical, discrete variable. Seventeen categorical/dichotomous, discrete independent variables were utilized in this study: number of anesthesia provider (FTE CRNAs, ANs, and

AAs), geographic location, MUA, opt-out status, operating margin, facility type, number of beds, number of anesthetizing locations, hospital profit status, type of employment model, anesthesia subsidy, hospital bylaw limitations, current position, years in current position, total years in senior management, education and professional background of hospital administrator. Table 6 provides a summary of hypotheses, objectives, variables, statistical technique, unit of analysis, and measurements. In addition, survey questions elicited hospital administrators' knowledge and perceptions of anesthesia services utilizing a Likert scale. After the data was collected, this was factored into the statistical analysis. It can also be utilized in a qualitative review of comments and drive future research recommendations.

Table 6

Summary of Hypotheses, Objectives, Variables, Unit of Analysis, Measurement, and Statistical Technique

Objective	Variables	Type of variable	Unit of analysis	Measurement	Statistical Technique
	DV: Choice of anesthesia practice model	Categorical, discrete	Group	-Independent CRNA-only -AN involvement	Logistic regression
	H1: There is a higher number of CRNAs working as anesthesia providers in MUAs compared to ANs and AAs combined.				
#1	**IV:** Number of anesthesia providers	Categorical	Individual	Number of FTEs: -AA -AN -CRNA	Descriptive statistics; Chi squared
#1	**IV:** Facility geographic location	Categorical, discrete	Group	-Rural -Urban -Unsure	Descriptive statistics ; Chi squared
#1	**IV:** Medically underserved area (MUA)	Categorical, discrete	Group	-Yes -No -Unsure	Descriptive statistics; Chi squared
#1	**IV:** Opt-out status	Categorical, discrete	Group	-Yes -No -Unsure	Descriptive statistics; Chi squared

Table 6: Continued					
	H2: Hospital facilities with operating margins (2014 data) greater than 2.2% utilize more CRNAs compared to ANs and AAs combined.				
#1	**IV:** Operating margin	Categorical, discrete	Group	-< 2.2% ->2.2%	Descriptive statistics; Chi squared
	H3: There is a relationship between hospital administrators' knowledge of anesthesia services provided at their facility and anesthesia practice model utilized. **H4: There is a relationship between hospital administrators' perceptions of the value of anesthesia services provided at their facility and the anesthesia practice model utilized.**				
#1	**IV:** Facility type	Categorical, discrete	Group	-Community Hospital-small -Community Hospital-med -Community Hospital-large -Critical Access Hospital -Teaching hospital -Tertiary Care Hospital -Other -Unsure	Descriptive statistics; Chi squared
#1	**IV:** Number of licensed beds in facility	Categorical, discrete	Group	-<25 -26-99 -100-249 -250-399 ->400 -Unsure	Descriptive statistics; Chi squared
#1	**IV:** Number of anesthetizing locations	Categorical, discrete	Group	-1-5 -6-10 -11-15 -16-20 ->20 -Unsure	Descriptive statistics; Chi squared
#1	**IV:** Hospital profit status	Categorical, discrete	Group	-Government -Non-profit -Profit -Other	Descriptive statistics; Chi squared

Table 6: Continued					
#1	**IV:** Type of employment model	Categorical, discrete	Group	-Hospital employee -Small group -Regional group -Large group -Unsure -None	Descriptive statistics; Chi squared
#1	**IV:** Anesthesia subsidy	Categorical, discrete	Group	-$0 -$1-$50,000 -$50,001-$100,000 -$100,001-$500,000 -$500,001-$1,000,000 -$1,000,001-$3,000,000 -$3,000,001-$5,000,000 ->$5,000,000 -Unsure	Descriptive statistics; Chi squared
#1,2	**IV:** Aware of Bylaw limitations of anesthesia provider practice	Categorical, discrete	Group	-Yes -No -Unsure	Descriptive statistics; Chi squared
#1,2	**IV:** Current position	Categorical, discrete	Group	-CEO -CFO -CIO -CMO -CNO -COO -Other	Descriptive statistics; Chi squared
#1,2	**IV:** Professional background of hospital administrator	Categorical, discrete	Group	-Allied Health, other than anesthesia -Allied health, AA -Business -Finance -Healthcare admin -Law -Medicine, other than Anesthesia -Medicine, AN -Nursing other than Anesthesia -Nursing, CRNA -Other	Descriptive statistics; Chi squared
#1,2	**IV:** Years in current position	Categorical, discrete	Group	-<1 year -1-5 years -5-10 years > 10 years	Descriptive statistics; Chi squared
#1,2	**IV:** Total years in senior management	Categorical, discrete	Group	-<1 year -1-5 years -5-10 years > 10 years	Descriptive statistics; Chi squared

Table 6: Continued				
#1,2	**IV:** Educational degree	Categorical, discrete	Group	-Associate -Bachelor -Master's in Allied Health -Master's in Business -Master's in Healthcare Admin -Master's in Nursing -Master's in Nurse Anesthesia -Master's in other field -Clinical Doctorate: JD -Clinical Doctorate: MD -Clinical Doctorate: DNAP -Clinical Doctorate: DNP -Clinical Doctorate: DO -Clinical Doctorate: PharmD -Clinical Doctorate: DPT -Clinical Doctorate: Other -Research Doctorate: EdD -Research Doctorate: PhD -Research Doctorate: ScD -Research Doctorate: Other

During the data analysis phase, data cleaning was necessary and will be discussed in the following chapters.

Assumptions and Limitations

Inherent in correlational research is the limitation of the inability to infer a cause and effect relationship between variables and susceptibility to inaccurate interpretations of the results (Polit & Beck, 2008). For this study, it sufficed to describe and document the information received in an attempt to understand the reality of hospital administrators' perceptions of anesthesia services. The inherent aim of descriptive correlational research is to simply describe the relationships among variables and not allude to the cause and effect among noted variables (Polit & Beck, 2008).

Chapter Summary

This study was timely and relevant not only due to the changes from the ACA and its effects on hospital budgets but also since this topic has been identified as an area of research that

has gaps in knowledge and research potential by the AANA in its 2016 research agenda (AANA Health Services Research Ad-Hoc Committee, personal communication, January 20, 2016). The information collected from this study may explain the determinants and provide rationale regarding how decision makers in hospital facilities choose their anesthesia practice model. It may also help identify if a different practice model may be more advantageous to the practice at their hospital.

Chapter Four: Results

The purpose of this study was to identify the determinants New England acute care hospital administrators' utilize in making the choice of anesthesia practice model for their facility. Because there is limited evidence-based information about hospital administrators' knowledge and understanding of anesthesia practice model arrangements, this study was designed to gather information that factors into choice of anesthesia services.

This quantitative, exploratory study of factors hospital administrators use when choosing an anesthesia practice model utilized a non-experimental, correlational research design. The research was descriptive in nature to determine the factors that influenced a hospital administrator when making decisions about the type of anesthesia practice model that would be best for their system. This research was vital in documenting the choice of anesthesia practice model and advancing the understanding of why each model is utilized in a hospital.

The objectives of this study were to: (1) identify the factors considered by hospital administrators in choosing anesthesia practice models, and (2) examine the perceptions of hospital administrators regarding the delivery of anesthesia services. Seventeen independent variables were utilized to gather information to address the outcome variable, type of anesthesia practice model, in an attempt to answer the following research questions: "What factors are considered by hospital administrator's when making the choice of anesthesia practice model?", "Is there is a relationship between hospital administrators' knowledge of services each type of anesthesia practice model offers and type of anesthesia practice model employed?", and "Is there

is a relationship between hospital administrators' perceptions of services each type of anesthesia practice model offers and type of anesthesia practice model employed?" An analysis of survey responses was conducted to see if there were any relationships between the type of anesthesia practice model utilized in a hospital and factors that might influence hospital administrators in choice of practice model. To answer the research questions, the following hypotheses were proposed:

- H1: There is a higher number of CRNAs working as anesthesia providers in medically underserved areas compared to ANs and AAs combined.
- H2: Hospital facilities with operating margins (2014 data) greater than 2.2% utilize more CRNAs compared to ANs and AAs combined.
- H3: There is a relationship between hospital administrators' knowledge of anesthesia services provided at their facility and anesthesia practice model utilized.
- H4: There is a relationship between hospital administrators' perceptions of the value of anesthesia services provided at their facility and the anesthesia practice model utilized.

This chapter will present the results of the study based on feedback from the survey deployed to hospital administrators in acute care New England hospital facilities. Data collection, preparation, and cleaning processes will be described for the demographic information analyzed of the variables. Statistical analysis data will be presented in relation to each variable. In addition, an evaluation of the relationship between hospital administrators' knowledge and perceptions of anesthesia services between statistically significant variables will be presented.

Sample Characteristics

A total of 774 survey invitations were emailed to hospital administrators at acute care hospital facilities in the following states: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. Approximately 264 were returned to the email server as either undeliverable or with out of office replies. Survey reminders were sent after the initial invitation. A final total of 35 completed surveys were received at the completion of the survey deployment period. This resulted in a response rate of 6.9%, which was lower than preferred but not unexpected: Fryrear (2015) found that external surveys, those that are not directly affiliated with individuals solicited, can elicit response rates as low as 10 - 15%, on average. Despite awareness of these limitations, this is a threat to external validity and weakens the generalizability of the study results.

Power analysis.

A power analysis was performed prior to data collection to estimate the minimal sample size required. Based on the number of variables that were tested, a simple calculation for multiple logistic regression calculates a sample size of 131 after conducting a power analysis with a small to moderate effect size of R^2 of .10 and power of .80, which was not possible to achieve based on the number of respondents. To address this limitation, the number of overall independent variables was decreased after data analysis.

Since there were too few cases relative to the number of predictor variables, categories were collapsed and a decreased number of variables were entered into the logistic regression. Two statistically significant predictor variables were entered into the final logistic regression model. In utilizing Agresti's (2007) rule of thumb of a minimum of '10' cases for every

independent variable, this makes a minimum of 20 cases which fits with our final sample size of 35 respondents.

Review of Data Collection

After a successful dissertation proposal defense, the study project was submitted to the Virginia Commonwealth University (VCU) Institutional Review Board (IRB) and received exempt approval in March 2017. The survey was then developed in the VCU Research Electronic Data Capture (REDCap) online secure web application to capture data via survey method. This service allows the researcher to build and manage survey data and exports the information for data analysis when complete. After the initial survey invitation was sent, weekly reminder emails were sent for the following three weeks to potential participants. The survey link was deactivated at the end of the four-week period and no further data was collected.

Data Preparation and Cleaning

At the conclusion of the survey, all de-identified data was downloaded and exported to Excel and Statistical Package for Social Sciences (SPSS) 24.0 for MAC data management programs for analysis. This direct download assured no data transfer or data entry mistakes. All respondents submitted complete surveys and there were no missing values present. Some categorical variables required recoding from string to numeric values.

During the data analysis phase, it was found that, due to the small sample size, some initial variable categories needed to be collapsed to produce more robust results. In logistic regression (LR), failure of convergence can occur when a combination of discrete variables result in too many cells with no cases (Tabachnick & Fidell, 2007). In this study, there were several cells with no cases so the categories were collapsed. The variables were collapsed and recategorized after analyzing their frequency distributions per cell and creating a natural split in

the categories. Table 7 displays the initial variable categories and the collapsed variable categories that were recoded and reanalyzed for the final results. In addition, several variables were deleted from the final logistic regression model analysis because of poor statistical significance and those are noted in the table.

Table 7

Initial and Collapsed Variable Categories/Deleted Variables

Dependent variable	**Variable abbreviation**	**Initial categories**	**Collapsed categories/Deletions**
Anesthesia Practice Model	current_apm	1=AN only 2=CRNA only 3=Medical direction 4=Medical supervision 5=Independent CRNA and AN 6=Unsure	0=CRNA only 1=AN involvement
Independent variable	**Variable abbreviation**	**Initial categories**	**Collapsed categories**
Current position	Current_position	1=CEO 2=CFO 3=CIO 4=CMO 5=CNO 6=COO 7=Other	1=Chief Business Officer 2=Chief Clinical Officer
Years in current position	Years_in_current_position	1=<1 2=1-5 3=5-10 4=>10	Variable deleted from LR model in lieu of next variable
Total years in senior management	Total_years_senior_mgmt	1=<1 2=1-5 3=5-10 4=>10	1=≤5 2=>5
Professional background	Professional_background	1=Allied Health, other than anesthesia 2=Allied health, AA 3=Business 4=Finance 5=Healthcare administration 6=Law 7=Medicine, other than Anesthesia 8=Medicine, AN 9=Nursing other than Anesthesia 10=Nursing, CRNA 11=Other	1=Clinical background only 2=Business background only 3=Combined background

Table 7: Continued			
Educational degree	Educational_degree	1=Associate 2=Bachelor 3=Master's in Allied Health 4=Master's in Business 5=Master's in Healthcare Admin 6=Master's in Nursing 7=Master's in Nurse Anesthesia 8=Master's in other field 9=Clinical Doctorate: JD 10=Clinical Doctorate: MD 11=Clinical Doctorate: DNAP 12=Clinical Doctorate: DNP 13=Clinical Doctorate: DO 14=Clinical Doctorate: PharmD 15=Clinical Doctorate: DPT 16=Clinical Doctorate: Other 17=Research Doctorate: EdD 18=Research Doctorate: PhD 19=Research Doctorate: ScD 20=Research Doctorate: Other	Variable deleted from LR model due to increased likelihood to skew results since participant was asked to select all; suggest separating into several questions: undergraduate, graduate, highest degree
Hospital type	Facility_type	1=Community Hospital-small (26-99 beds) 2=Community Hospital-medium (100-249 beds) 3=Community Hospital-large (>250 beds) 4=Critical Access Hospital (≤ 25 beds) 5=Teaching hospital 6=Tertiary Care Hospital 7=Other 8=Unsure	1=Community hospital 2=Critical access hospital 3=Tertiary care hospital
Number of licensed beds	Number_of_beds	1=≤25 2=26-99 3=100-249 4=250-399 5=>400 6=Unsure	1=≤100 2=101-399 3=>400
Profit status	Profit_status	1=Government 2=Non-profit 3=Profit 4=Other	1=Non-profit 2=Profit
Medically Underserved Area	MUA	1=Yes 2=No 3=Unsure	1=Yes 2=No
Geographic location	Geo_location	1=Rural 2=Urban 3=Unsure	1=Rural 2=Urban

Table 7: Continued			
Operating margin	Oper_margin	1=<5% 2=-5% 3=-4% 4=-3% 5=-2% 6=-1% 7=0% 8=1% 9=2% 10=2.2% 11=3% 12=4% 13=5% 14=>5% 15=Unsure	0=<2.2% 1=≥2.2%
Anesthetizing locations	Anesthetizing_locations	1=1-5 2=6-10 3=11-15 4=16-20 5=>20 6=Unsure	0=≤5 1=>5
FTE anesthesia providers	Anesthesia_providers: An_ft, aa_ft, crna_ft	1=None 2=1-5 3=6-10 4=11-20 5=21-40 6=41-60 7=61-80 8=81-100 9=>100 10=Unsure	0=None 1=≤5 2=>5 Attempted to run in LR model but since some cells zero ending up deleting
Employment model	Employment_model: An_em, aa_em, crna_em	1=Hospital employee 2=Small external anesthesia group 3=Regional external anesthesia group 4=Large external anesthesia group 5=Unsure 6=None	1=Hospital employee 2=Small/regional group 3=Large external group
Anesthesia subsidy	Subsidy	1=None 2=-$1-$50,000 3=$50,001-$100,000 4=$100,001-$500,000 5=$500,001-$1,000,000 6=$1,000,001-$3,000,000 7=$3,000,001-$5,000,000 8=>$5,000,000 9=Unsure	0=None 1=$1-$500,000 2=$500,001->$5,000,000 3=Unsure
Opt-out status	Opt_out	1=Yes 2=No 3=Unsure	Unchanged
Aware of Bylaw limitations	Bylaws	1=Yes 2=No 3=Unsure	Unchanged

Data Analysis

The first step in the data analysis was to run frequency tables then cross tabulate each variable to test the Pearson chi-square (χ^2) analysis or Fisher's exact test. These similar statistics test associations between the dependent and independent variables and assess variances in proportions between variables. The variables must be independent of each other, an independent random sample, and nominal or ordinal with limited categories. The chi-square statistic is the most commonly reported nonparametric statistic. It compares observed frequencies and expected frequencies. Observed frequencies are the data collected from the survey and expected frequencies are the computed data in the cells that would be found if there were no relationship between the dependent and independent variable. One assumption of the chi-square is that there are at least 10 expected frequencies in each cell of the contingency table. If this assumption is not met, then a Fisher's exact test would be used if there are fewer than five expected cases in any cell. Another assumption is that there are no cells with expected frequencies of zero (Kellar & Kelvin, 2013; Polit & Beck, 2008).

Cell size was an issue in this study because several of the independent variables did have cells with an expected frequency of less than five and a few had zero. Some researchers use the rule of thumb that no more than 20% of cells should have frequencies of less than five (Kellar & Kelvin, 2013). In this study, if the cells did not contain adequate numbers, they were recategorized and collapsed into fewer categories. The independent variables of years in current position, educational degree, FTEs of individual anesthesia providers, and opt-out status had several cells of zero and those variables did not meet the assumptions for the statistical tests. They were removed from the statistical modeling and used for demographic purposes only. The

way the questions were written contributed greatly to the inability to capture the data and fulfill the assumptions of the statistical tests.

To begin the analysis for this study, demographic frequencies were calculated and the independent variables were tested with the dependent variable via the chi-square analysis or Fisher's exact test and the results follow in Table 8.

Table 8

Statistics of Dependent and Independent Variables from Survey Participants

Variable	**Categorical Percentage and Frequency**	**Statistical test**	**Results**
DV: Anesthesia Practice Model	CRNA only: 20% (7) AN involvement: 80% (28)		
IV: Current position	Chief Business: 68.6% (24) Chief Clinical: 31.4% (11)	Fisher's exact test	p = .171
IV: Years in current position	<1: 20% (7) 1-5: 28.6% (10) 5-10: 25.7% (9) >10: 25.7% (9)		For demographics only
IV: Total years in senior management	≤5: 17.1% (6) >5: 82.9% (29)	Fisher's exact test	p = .576
IV: Professional background	Clinical background only: 45.7% (16) Business background only: 34.3% (12) Combined background: 20% (7)	Pearson chi-square	df 2, **8.010, p = .018**
IV: Educational degree	MBA: 25.7% (9) MHA: 17.1% (6) MSN: 11.4% (4) MSNA: 3% (1) MS (other): 9% (3) MD: 11.4% (4) DNP: 9% (3) Clinical Doctorate (other): 3% (1) EdD: 5.7% (2) PhD: 5.7% (2)		For demographics only; Manually coded to highest degree
IV: Hospital type	Community hospital: 62.9% (22) Critical access hospital: 22.9% (8) Tertiary care hospital: 14.3% (5)	Pearson chi-square	df 2, **6.307, p = .043***
IV: Number of licensed beds	≤100: 31.4% (11) 101-399: 45.7% (16) >400: 22.9% (8)	Pearson chi-square	df 2, **6.626, p = .036***
IV: Profit status	Non-profit: 91.4% (32) Profit: 8.6% (3)	Fisher's exact test	p = 1.00

Table 8: Continued			
IV: Medically Underserved Area	Yes: 28.6% (10) No: 71.4% (25)	Fisher's exact test	**p = .033***
IV: Geographic location	Rural: 34.3% (12) Urban: 65.7% (23)	Fisher's exact test	**p = .021***
IV: Operating margin	<2.2%: 68.6% (24) ≥2.2%: 31.4% (11)	Fisher's exact test	p = 1.00
IV: Anesthetizing locations	≤5: 45.7% (16) >5: 54.3% (19)	Fisher's exact test	p =.207
IV: FTE anesthesia providers	AN: None: 11.4% (4) ≤5: 34.3 % (12) >5: 54.3% (19) AA: None: 77.1% (27) ≤5: 14.3% (5) >5: 8.6% (3) CRNA: None: 0% (0) ≤5: 43% (15) >5: 57.1% (20)		For demographics only
IV: Employment model	AN: None: 20% (7) Hospital employee: 34.3% (12) Small/regional group: 37.1% (13) Large external group: 8.6% (3) AA: None: 77.1% (27) Hospital employee: 20% (7) Small/regional group: 2.9% (1) Large external group: 0% (0) CRNA: None: 0% (0) Hospital employee: 45.7% (16) Small/regional group: 40% (14) Large external group: 14.3% (5)	Pearson chi-square	df 2, **7.683, p = .021*** df 2, 5.833, p = .054 df 2, 1.908, p = .385
IV: Anesthesia subsidy	None: 14.3% (5) $1-$500,000: 28.6% (10) $500,001->$5,000,000: 40% (14) Unsure: 17.1% (6)	Pearson chi-square	df 3, 3.363, p = .339
IV: Opt-out status	Yes: 22.9% (8) No: 57.1% (20) Unsure: 20% (7)		For demographics only
IV: Aware of Bylaw limitations	Yes: 14.3% (5) No: 60% (21) Unsure: 25.7% (9)	Pearson chi-square	df 2, 2.659, p = .265

Note. * Statistically significant; df = degrees of freedom

Analysis of dependent variable and independent variables.

The dependent variable in this study was type of anesthesia practice model utilized in a hospital. The respondents from the survey stated that 20% of their facilities utilized an

independent CRNA-only model while the remainder utilized some mixed model with AN involvement. The original data collected collated numbers of each model type (independent CRNA- or AN-only facility, medical direction, medical supervision, or independent CRNA and AN working independently in same facility) but due to the small sample size obtained in this study, the sample was collapsed as noted.

Descriptive analysis of the independent variables was divided into two parts: demographics of hospital administrator and hospital. In relation to the demographics of the hospital administrators, over 69% (n = 24) of the respondents had a hospital administrator position that they described as being on the business side of administration (CEO, CFO, CIO, COO) though only 34% (n = 12) described their professional background as being in strictly business. When comparing this to highest educational degree (recoded), 42.8% (n = 15) of respondents had an advanced degree in business (MBA, MHA). This is compared to 57% (n = 20) of the respondents having either a clinical or research academic advanced degree (MSN, MSNA, MS, MD, DNP, EdD, PhD). 46% (n = 16) of respondents had a clinical professional background while only 31% (n = 11) of them holding a clinical executive position in the hospital (CMO, CNO). In addition, though years in their current position and overall years in a senior management position was not statistically significant, almost 83% (n = 29) of respondents had a significant amount of experience in administrator positions.

Demographics of the hospital facilities showed that over 62% (n=21) of the respondents were located in community or critical access hospitals with licensed beds below 400 with 54.3% (n=19) of facilities having more than five anesthetizing locations. The majority of facilities were located in urban areas (65.7%, n = 23) and non-MUAs (71.4%, n = 25). Financial demographics of the facilities show that the majority of facilities were non-profit hospitals (91.4%, n = 32),

below the operating margin of 2.2% for fiscal solvency (68.6%, n = 24)), in addition to providing an anesthesia subsidy to the anesthesia department or group in almost 70% (= 24) of the facilities of up to $5,000,000.

Anesthesia provider characteristics have both ANs and CRNAs in close to equal numbers in hospitals with more than five providers of each, 54.3% (n = 19) to 57.1% (n = 20) respectively, whereas at facilities with less than five providers of each specialty, CRNAs have approximately 10% more coverage than ANs. CRNAs were part of the anesthesia team in all hospitals reporting but ANs were not part of the team in 11.4% (n = 4) of those facilities. AAs were not present in 77.1% (n = 27) of the hospitals reporting but it must be noted that only New Hampshire and Vermont allow AAs to practice in New England, which were 22.9% (n = 8) of the sample. In terms of hospital administrators' awareness of any bylaw limitations on anesthesia providers practice, 60% (n = 21) reported not being aware of any restrictions, 14.3 % (n = 5) were aware of some limitations, and 25.7% (n = 9) were unsure of any stipulations.

After the demographics were analyzed, each independent variable was analyzed with the dependent variable identified at the hospital of the administrator respondent. Of the seventeen original independent variables, four were excluded from the final logistic regression model due to small cell size. There were also other issues related to capturing the data appropriately. Educational degree data was skewed due to the way in which the survey question was worded. The questions asked 'What education degrees have you earned? Select all that apply.' Multiple respondents answered with several degrees and it was difficult to ascertain how to include them in the statistical analysis. The variables of FTEs of individual providers and opt-out status had multiple cells of zero by virtue of the basic tenet of the questions asked so these were removed from the model also.

After chi-squared and Fisher's exact test statistics were run, a model for logistic regression was chosen based on the independent variables demonstrating statistical significance. Logistic regression analysis is a multivariate regression process that analyzes relationships between one or more independent variables and a categorical dependent variable. This analysis yields a predictive equation, modeling the probability of an outcome via an odds ratio rather than predicting group membership. It is robust against multivariate normality and well suited to smaller sample sizes (Polit & Beck, 2008). This study was developed to assess the probability of certain independent variables predicting the choice of a hospital administrator to choose either an independent CRNA-only practice model or one with AN involvement.

Several significance tests help to assess the performance of the logistic regression analysis. A basic concept of logistic regression is the maximum likelihood index (MLI) (or estimation). The main goal of MLI is to find the best linear combination of independent variables to maximize the likelihood of obtaining the observed outcome frequencies. In SPSS, the program provides an iterative history, starting with arbitrary coefficient values for the independent variables, determines the direction and size of change in the coefficients, and undergoes more iterations until the change in coefficient values is very little and convergence is reached. If the model fits the data perfectly, the MLI will be 1.0. The MLI is usually a small decimal so the SPSS program is used to transform the dependent variable using a logit transformation, multiplying it by -2 times the log of the likelihood (-2LL). When the fit is good, this transformed index (-2LL) will be a small number; if it is a perfect fit, the value will be zero (Kellar & Kelvin, 2013; Polit & Beck, 2008)

Generated from SPSS, the omnibus tests of model coefficients table provides the model chi-square statistic and its p-value. The model chi-square is used to determine the statistical significance of the overall logistic regression model. It is estimated from the -2LL. There can be three chi-squares: one if the variables were entered stepwise, as a block, or model. If variables are entered all together, the values will be the same throughout (Kellar & Kelvin, 2013).

There are several measures to calculate R^2 in logistic regression but SPSS reports Cox & Snell R^2 and Nagelkerke R^2 statistics in the full model summary. These are both regression coefficients that explain the overall amount of variance in the dependent variable explained by the independent variables in the model. The Cox & Snell R^2 statistic is based on the -2LL and takes sample size into account. The Nagelkerke R^2 adjusts the Cox & Snell so that a value of 1 could be achieved and also is the power (effect size) of the explanation of the model (Tabachnick & Fidell, 2007).

The Hosmer-Lemeshow test is a goodness-of-fit statistic that determines the overall fit of the model to the data. This statistic compares the observed probabilities to the predicted probabilities of the model by examining the residuals for all cases in the analysis. It is another mechanism for evaluating the fit of the predictive model (Polit & beck, 2008). It also utilizes a chi-square statistic and associated p-value. If the significance is large for the Hosmer-Lemeshow test, the researcher does not reject the null hypothesis. For this statistic, a non-significant result indicates the model fits; a statistically significant result indicates it does not fit, meaning there is no difference between the observed and predicted probabilities (Kellar & Kelvin, 2013).

The final step in logistic regression is to determine what variables affect the probability of the outcome. Logistic regression analysis transforms the ratio of two probabilities occurring

and is reflected in the odds ratio (OR) and adjusted odds ratio (Exp(B)). The odds ratio (B) is the regression coefficient associated with each independent variable and the signs associated with the beta weights indicate the direction of the relationship. The adjusted odds ratio (Exp(B)) provides an estimate of a variable having an effect on another and 95% confidence intervals are built around this estimate. It estimates the ratio of one probability to another (Kellar & Kelvin, 2013).

Understanding the tests of significance in logistic regression allows one to interpret the results of the final model. The first step in building the final logistic regression model is to create dummy variables for the independent variables that have more than two categories. This variable conversion allows the researcher to express nominal variables with multiple categories by a series of dichotomous variables, comparing one category to another that serves as a reference. In this way, statements can be made about the differences in outcome for each category relative to one of the groups (the reference category). In creating the dummy variables, there will be one less number of categories of variables since one will be used as the reference for the others (Kellar & Kelvin, 2013). In this study, the researcher utilized the SPSS program to recode the variables; in each instance, the first category was used as the dummy variable.

Full entry of variables was initially done with the independent variables to capture an initial model of all of the predictors as a group. Four of the original independent variables were excluded due to reasons previously noted. Several different 'best fit' models were tested with the remaining 13 variables and after analysis, it was determined that all variables except five were statistically insignificant, meaning it did not add to the model. One variable had statistical significance, AN employment model ($p = .021$), but was irrelevant to the inclusion in the model so was not added. It was deemed irrelevant due to the fact that the model was looking at the

probability of a hospital administrator choosing a CRNA-only model versus an AN involved model and seven cells had zero cases for the AN employment model.

The five most statistically significant variables from the chi-square or Fisher's exact test were then entered into the equation together: professional background (p = .018), hospital type (p = .043), number of licensed beds (p = .036), MUA (p = .033), and geographic location (p = .021). All statistics were analyzed and the final model contained the variables that were not only significant but with practical application to a final logistic regression, using backward elimination. Facility type was the first to be excluded because there were no CRNA-only models in the tertiary hospital setting (cells with zero), skewing the results and having poor statistical significance in the model. The second variable to be excluded was licensed number of beds because the logistic regression results had poor statistical significance and the adjusted odds ratio (Exp(B)) was not included within the confidence intervals. The last variable to be excluded was professional background. Though this variable had the most statistically significant chi-square p-value of .018, it continually received error codes when the model was run. The assumption for the error codes was not only because the sample size was too small, but also because some categories (cells) had zero cases and couldn't fit into the model. Thus, the final independent variables that remained and included in the model were geographic location and medically underserved area.

The final logistic regression model statistical analysis is shown in Tables 9 through 12. From the chi-square values in Table 9, the Omnibus tests of model coefficients, it demonstrates that the variables were entered all together since the values are the same. The p = value of .008 tells the model is statistically significant. In Table 10, the amount of variance in the dependent variable (type of anesthesia practice model) when explained by the independent variables of

Table 9

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	9.589	2	.008
	Block	9.589	2	.008
	Model	9.589	2	.008

Note. df = degrees of freedom; Sig. = significance (p-value)

Table 10

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	25.439[a]	.240	.379

Table 11

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	.060	2	.970

Note. df = degrees of freedom; Sig. = significance (p-value)

Table 12

Variables in the Equation

					95% C.I. for EXP(B)	
		df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	MUA(1)	1	.042	7.989	1.079	59.152
	geolocation(1)	1	.132	4.715	.628	35.431
	Constant	1	.001	.049		

Note. df = degrees of freedom; Sig. = significance (p-value); Exp(B) = adjusted odds ratio; C.I. = confidence interval

MUA and geographic location is between 24% and 38%. This is a moderate effect size for this model. Table 11 displays the results from the Hosmer-Lemeshow test. This goodness-of-fit statistic shows this is a good model since it has produced a non-significant result ($p = .970$). These statistics show a degree of model parsimony. The original complex model was pared down to a much simpler model that can be generalized in new future data sets.

Table 12 displays the significance, adjusted odds ratios and 95% confidence intervals for the final model. The data shows statistical significance ($p = .042$) that the presence of an independent CRNA-only anesthesia practice model is almost eight times more likely to be present in hospital facilities located in medically underserved areas compared with practice models with AN involvement. The adjusted odds ratio is within the 95% confidence intervals of 1.079 – 59.152. On the other hand, the data shows the independent variable of geographic location as not statistically significant ($p = .132$) despite the adjusted odds ratio results that suggest an independent CRNA-only model is present almost five times more often in rural areas compared to urban areas. This result is within the 95% confidence intervals of .628 – 35.431. These results will be discussed further in the next chapter.

Hypothesis testing.

Statistical hypothesis testing is used to assist in deciding if hypotheses are supported by data. The goal in research is to seek data through statistical tests to reject the null hypothesis (Polit & Beck, 2008). After reviewing the descriptive statistics and results of the significance tests for logistic regression, the four research hypotheses were tested.

Hypothesis one.

The first hypothesis postulated that there would be a higher number of CRNAs working in MUAs compared to ANs and AAs combined.

- H1: There is a higher number of CRNAs working as anesthesia providers in medically underserved areas compared to ANs and AAs combined.

This hypothesis could not be tested after the data from the survey results was analyzed. The initial categorization and then subsequent collapsing of categories for the final data entry did not allow the actual numbers of anesthesia providers to be calculated. In order for this hypothesis to be tested, the variable should be continuous instead of categorical. Though the final logistic regression model results support the probability of a CRNA-only practice model being present in medically underserved areas more frequently than models with AN involvement, a scientific-based conclusion cannot be reached for this hypothesis.

Hypothesis two.

The second hypothesis postulated that hospital facilities utilizing more CRNAs than other anesthesia providers combined would be more fiscally solvent.

- H2: Hospital facilities with operating margins (2014 data) greater than 2.2% utilize more CRNAs compared to ANs and AAs combined.

The proportion of hospital facilities that were operating above and below the operating margin of 2.2% was tested. Twenty-four hospitals (68.6%) reported that they are operating below the 2.2% operating margin of fiscal solvency while 11 hospitals (31.4%) are operating above the margin. The second hypothesis could not be fully tested. The initial categorization and then subsequent collapsing of categories for the final data entry did not allow the actual numbers of anesthesia providers to be calculated. In order for this hypothesis to be tested, the variable should be continuous instead of categorical.

Hypothesis three.

The third hypothesis postulated that there is a relationship between knowledge of hospital administrators' regarding anesthesia services offered and the type of practice model at their facility.

- H3: There is a relationship between hospital administrators' knowledge of anesthesia services provided at their facility and anesthesia practice model utilized.

The aim of this hypothesis was to ascertain if hospital administrators were aware of the internal demographics of their facility as well as anesthesia demographics. This hypothesis was tested with the logistic regression model but it was found to be insignificant overall. The five variables that were proposed to be tested in this model were: facility type, number of licensed beds, number of anesthetizing locations, type of employment model, and amount of anesthesia subsidy. Of these variables, facility type ($p = .043$) and number of licensed beds ($p = .036$) were entered into one of the final iterations of the logistic regression model but were found to be statistically insignificant in adding to the final model and were removed. Of the other variables that were considered in this hypothesis, three had insignificant p-values from the Pearson chi-square tests: number of anesthetizing locations ($p = .207$), type of employment model for CRNAs ($p = .385$), and anesthesia subsidy ($p = .339$). Of note, the type of employment model was separated for the three categories of anesthesia providers: ANs, AAs, and CRNAs. As stated, the CRNA model was insignificant but both the AN and AA models showed statistical significance with p-values of .021 and .054 (approaching significance) respectively. Both were initially entered in one of the first iterations of the logistic regression as well as on their own. When entered into the model, they too had error codes as others previously removed did and this was assumed to be due to some cells having zero cases.

After the data was collected, it was noted that other variables could have been included in this hypothesis, specifically professional background of hospital administrator ($p = .018$), years in senior management ($p = .576$), and awareness of bylaw limitations ($p = .265$). These were entered into the initial logistic regression model and all but the professional background variable was statistically insignificant from the initial chi-square testing as p-values noted above.

In terms of complete testing of the hypothesis of knowledge of anesthesia services, the original data sample had the choice of 'unsure' in most survey questions to capture data for this hypothesis. With the need to collapse the categories due to the sample size, the choice of 'unsure' was removed from most and thus, could not be factored into the logistic regression. The only independent variables that category was left in were anesthesia subsidy, opt-out status, awareness of bylaw limitations, and final determination of choice of anesthesia practice model. The unsure category was left in to specifically attempt to provide information for this hypothesis. Only 6% of respondents reported they were unsure of the anesthesia subsidy, and only 17% reported uncertainty in regards to state opt-out status and anesthesia provider bylaw limitations. The last variable in this set was the hospital administrator making the final decision on type of practice model. One could assume that an individual hospital administrator or group of hospital administrators had the most knowledge to make this decision. The survey results showed that 43% of CEOs made the final decision on type of anesthesia practice model while the decision was made 26% of the time by a group of hospital administrators. The rest of the respondents answered a variety of other singular administrators, such as CFO (9%), COO (9%), CMO (6%), CNO (9%), and the Hospital Board of Trustees (14%), with several respondents including multiple answer choices. Not one respondent answered if they were unsure of the hospital administrator who made this final decision. Overall, the descriptive statistics seem to signify that

hospital administrators do have knowledge of anesthesia services at their facility, which provides support for this hypothesis.

Hypothesis four.

The fourth hypothesis postulated that there was a relationship between perceptions of hospital administrators' regarding anesthesia services offered and the type of practice model at their facility

- H4: There is a relationship between hospital administrators' perceptions of the value of anesthesia services provided at their facility and the anesthesia practice model utilized.

This hypothesis was tested by analyzing the respondent's viewpoint (perceptions) on several topical areas of potential importance to them related to anesthesia services offered or issues related to their facility. This is essentially qualitative data expressed quantitatively. Hospital administrator's perceptions were not researched in relation to the dependent variable so the influence of these responses can not be used as predictors in choice of anesthesia practice model per se but they are still of interest in answering the objectives of this study.

This hypothesis was operationalized by querying the hospital administrators with three separate survey questions utilizing the following Likert degree descriptor scale: 1 = least importance, 2 = minimal importance, 3 = moderate importance, 4 = significant importance, and 5 = highest importance. The first question was soliciting the importance and value placed on a select group of business management services that an anesthesia group could offer that could be of value to hospital administrators in consideration of their choice of anesthesia practice model. Figure 10 displays the results from this question. Instituting operating room (OR) efficiency improvements showed 35% of the respondents considering this of the highest importance followed by tracking reimbursement measures at almost 30%. Overall, it appears that oversight

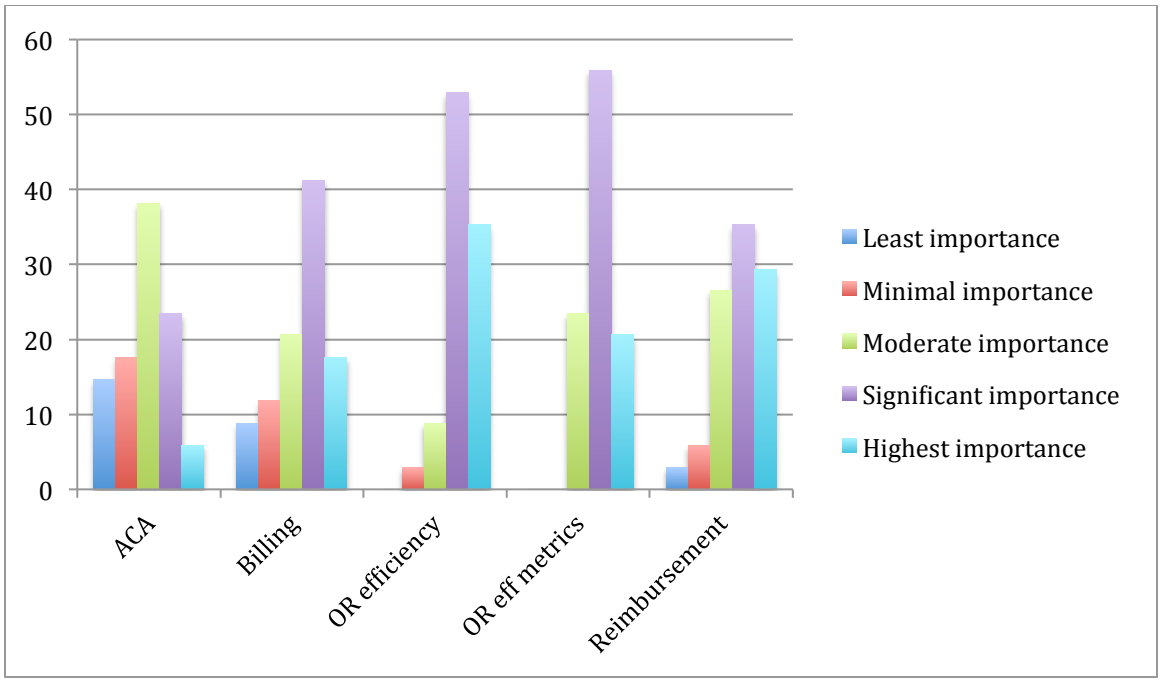

Figure 10. Survey Results from Anesthesia Business Management Services Question. Note. ACA = Awareness of healthcare reform mandates with the Affordable Care Act; Billing = billing oversight; OR efficiency = instituting operating room efficiency improvements; OR eff metrics = measurement of operating room efficiency metrics; Reimbursement = tracking reimbursement measures such as quality-related data. Developed from Massie survey question: Which of these services are of importance for your anesthesia employment group and/or anesthesia providers to offer at your facility?

measures including OR efficiency improvements and tracking of efficiency metrics and reimbursement measures are of significant to highest importance to the hospital administrators in this survey. Awareness of ACA mandates and billing oversight are of least importance.

The next question utilizing this format was soliciting the importance and value placed on a select group of clinical coverage services that an anesthesia group could offer that could be of value to hospital administrators in consideration of their choice of anesthesia practice model. Figure 11 displays the results from this question. Respondents to this question clearly valued 24-hour call and obstetric coverage with 65% ranking this as the highest importance followed by trauma and emergency room coverage, which could be associated with the call coverage choice also. The remainder of anesthesia services were closely associated with each other in terms of ranking importance.

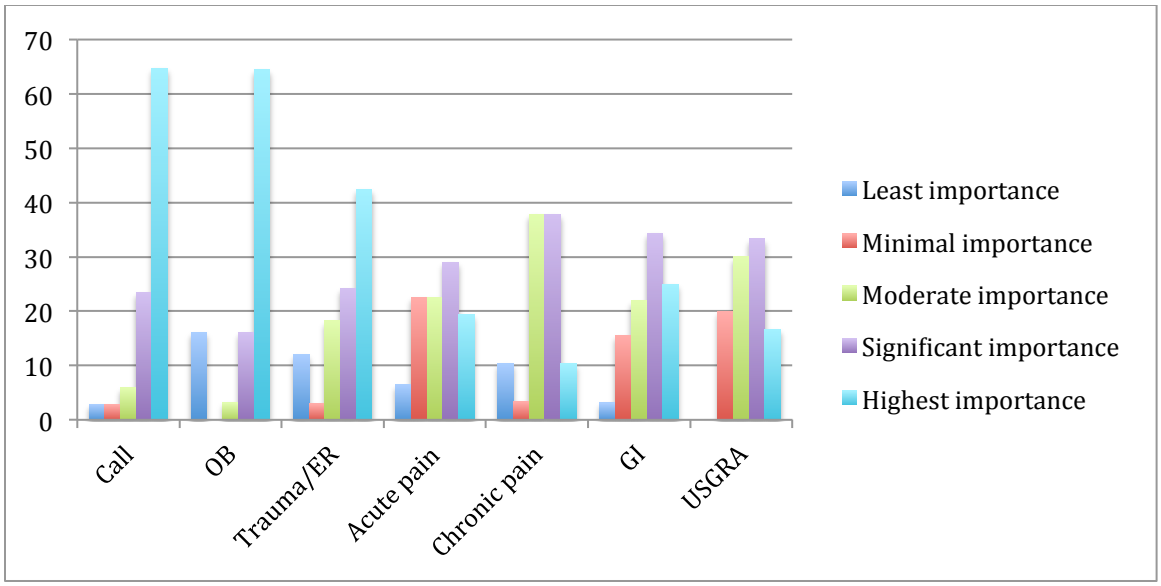

Figure 11. Survey Results from Anesthesia Clinical Coverage Services Question.
Note. Call = 24-hour call coverage; OB = 24-hour obstetric coverage; Trauma/ER = 24-hour trauma/emergency room coverage; Acute pain = acute pain management; Chronic pain = chronic pain management; GI = gastrointestinal services coverage; USGRA = ultrasound guided regional anesthesia services. Developed from Massie survey question: Which of these anesthesia services are of most importance to your hospital?

The last question utilizing this format was soliciting the importance and value of the effect of barriers a hospital could potentially incur if affiliated and affected by certain choices of anesthesia practice models. Figure 12 displays the results from this question. Respondents to this question clearly placed the highest importance on the quality of the anesthesia provider with over 93% ranking it of significant or highest importance. 87% of respondents ranked availability of anesthesia providers as second most important followed by the cost of anesthesia providers at an 81.3% response rate for significant to highest importance.

Overall, a robust amount of information was obtained from these series of questions collecting data on perceptions of hospital administrators regarding anesthesia services in their facilities. These descriptive statistics can be used to summarize the sample of hospital administrators that participated in this survey. Though a statistical conclusion cannot be deduced

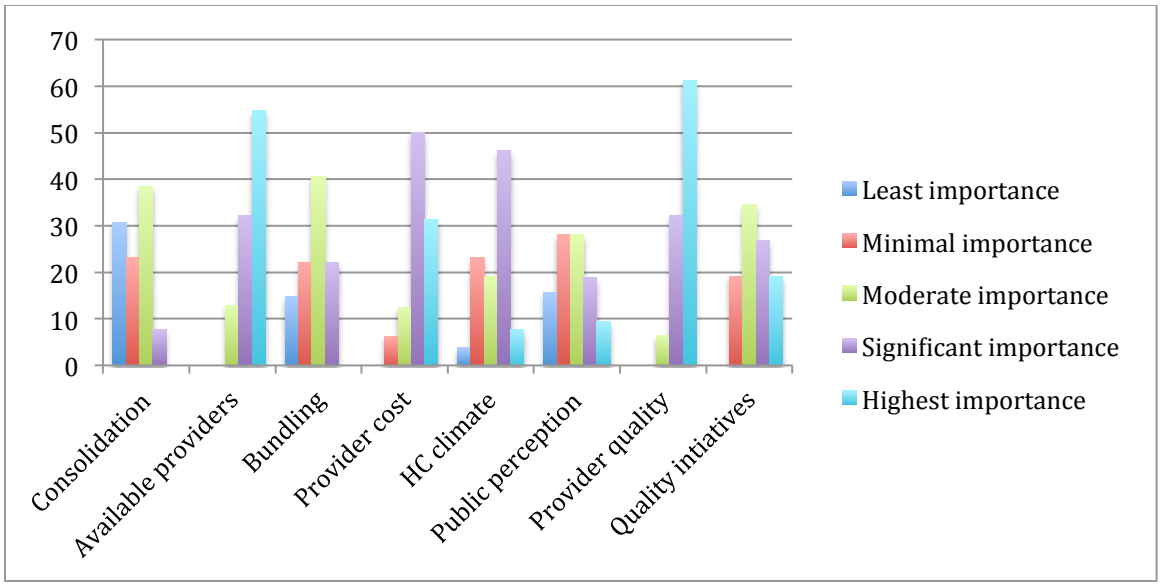

Figure 12. Survey Results from Barriers Affecting Choice of Anesthesia Practice Model Question. Note. Consolidation = anesthesia employment group consolidation; Available providers = availability of anesthesia providers; Bundling = bundling of payment for operating room services; Provider cost = cost of anesthesia provider; HC climate = current healthcare climate; Public perception = public perception of anesthesia provider; Provider quality = quality of anesthesia provider services; Quality initiatives = quality payment initiatives. Developed from Massie survey question: Please rate the importance of the following factors in choosing the type of anesthesia practice model utilized at your facility.

for this hypothesis, the information gathered can provide rich descriptive information to support future exploration of the impact of various anesthesia delivery models.

Chapter Summary

This chapter presented the data collection, preparation, cleaning, and statistical analysis for the two objectives proposed to explore relationships between type of anesthesia practice model and factors hospital administrators use to choose that model. Hypothesis testing was completed using descriptive statistics and logistic regression. The findings revealed support for CRNA-only anesthesia practice models to be more prevalent in medically underserved areas. The next chapter will discuss the implications of the results of this analysis, limitations of this study, and recommendations for future research.

Chapter Five: Discussion

Chapter Five presents an overview of the study and analysis of the results explained in Chapter Four. Data for each objective and related hypothesis will be examined in association with available evidence-based literature and theory. The implications of the study findings, limitations, and recommendations for future research will then be discussed.

Summary and Overview of Problem

Published projections estimate health care expenditures to exceed 40% of the GDP by 2050 (National Coalition on Health Care, 2015). Yet, according to the Institute of Medicine (IOM), approximately one-third of these expenditures are spent on the inefficient delivery and overuse of services with estimates on these items alone at approximately $315 billion per year (IOM, 2010). Hospital administrators are confronted with these ever-increasing resource costs. Capital-related costs, such as hospital upkeep, account on average for less than 10% of overall costs. Patient medical supplies, instruments, drugs, and other patient care supplies account on average for 25% of overall costs. The remainder of costs is attributed to labor as the largest component of hospital costs, accounting for up to two-thirds of total hospital expenses (MHA, 2010).

Lowering healthcare costs, especially labor costs, while providing high-quality care is instrumental to the viability of healthcare systems. In addition to calculating and reporting labor and resource costs, hospital administrators calculate and report their profitability measures to the public and stakeholders on an annual basis. Hospital administrators analyze and participate in the

decision-making of these healthcare cost trends and drivers. They have a responsibility to choose appropriate resources for the most cost-effective delivery of care that is of high quality and assures access for patients to the system. It is essential in the current healthcare environment to analyze the informational factors utilized to base their decisions. Factors related to the costs of delivery of care include provider salaries, supply and demand of providers, provider delivery models, and reimbursement (AHA, 2016).

Hospital administrators are being held accountable by patients, insurers, and other stakeholders in evaluating the factors related to the costs of healthcare delivery and their overall hospital performance is dependent on reducing costs and improving efficiency. With the likely move to alternative payment models and value-based purchasing, hospital administrators must understand the economic viability and value that their specialty services bring to their facility. Decisions made by hospital administrators can affect the hospital's survival in the current competitive environment (Jiang et al., 2006).

This study researched the factors that hospital administrators utilized to determine their choice of anesthesia practice model and explored which anesthesia services were of most importance. French et al. (2016) demonstrated that personnel costs were 79% of the overall costs incurred from providing anesthesia services in a hospital. They stated that a 'basic concept of care redesign is that each provider work to the highest level of their degree and training' (p.2). This supports the 2010 IOM Future of Nursing report statement that all nurses should practice to the full extent of their license and training. French et al. (2016) suggest mapping clinical processes across all specialties to ascertain cost savings across a hospital, evaluating the premise that less costly care does not diminish the quality of care provided to patients. The 2010 study by Hogan et al. supports this premise by concluding that increasing the number of CRNAs in an

anesthesia practice model, allowing full scope of practice, is instrumental in containing costs while offering high quality anesthesia care to patients. Keeping anesthesia personnel costs in mind, reevaluating CRNA and AN practice models with all providers practicing to their full scope may contribute to balancing a hospital's overall budget (French et al., 2016).

The topic of studying hospital administrators' knowledge and perceptions of anesthesia services is a novel idea that has not been found in the scientific literature (Stiefel, 2016). Studies evaluating quality, access, and cost-effectiveness of anesthesia practice models are found in the literature but there is a lack of published information regarding the key determinants of how and why hospital administrators choose certain anesthesia practice models in their facilities. This study was timely and important because hospitals need to identify departments that can decrease expenditures for a cost savings to the facility to regain (or maintain) profitability while providing value-added benefits to the system. The supposition was that more cost- and personnel-efficient anesthesia models could strengthen a hospital's budget by reducing overall anesthesia department expenditures. Areas of possible cost savings for hospital administrators to consider include more efficient use of anesthesia providers and removal of certain supervision and billing requirements (Hogan et al., 2010). The results of this study will be used to inform hospital administrators regarding the factors that determine choice of anesthesia practice model and the benefits that can be derived from finding the best fit for hospital facilities.

Purpose of the Study

The purpose of this study was to identify the determinants New England acute care hospital administrators' utilize in making the choice of anesthesia practice model for their facility. A better understanding of hospital administrators' knowledge and understanding of anesthesia practice models and the advantages and disadvantages of each model allows for a

more substantive discussion of the issues of anesthesia practice in a given hospital among hospital decision-makers (CEOs, CFOs, CIOs, CMOs, CNOs, COOs). Because there is limited evidence-based information about hospital administrators' knowledge and understanding of anesthesia practice model arrangements, this study was designed to gather information that factors into choice of anesthesia services.

Review of Theory and Research Questions

By utilizing a theoretical approach, hospital administrators can make decisions about the selection, assessment, and viability of various anesthesia practice models in a hospital. Resource dependence theory (RDT) provides a foundation when trying to understand determinants that influence a hospital administrator's choice of an anesthesia practice model. RDT proposes that the environment an organization operates within is instrumental in the behavior and success of that organization (Vibert, 2004). To better understand the relationship between the effect of the external environment on a hospital and its internal strategies, structure, and/or performance, researchers have examined both uncertainty and resources (Yeager et al., 2014). Scarcity of resources or uncertainty in the current environment may influence hospital administrators to redesign their anesthesia practice models.

Based on RDT, the constructs of munificence, dynamism, and complexity of a hospital system were used to analyze the factors influential to hospital administrators regarding anesthesia providers and services. Munificence is defined as the behavioral strategy a hospital utilizes to determine availability and accessibility of resources. In this study, the variables of anesthesia provider demographics were explored. Dynamism is defined as the environmental structure that is established by hospital administrators in their facility. A certain geographic location (rural vs. urban) may have an effect on what type of anesthesia provider is available and

what type of employment group model is utilized. Along with associated costs of the provider and group models, hospital bylaw limitations can be dependent on the constantly changing hospital and healthcare environment. Lastly, the construct of complexity is related to and indicative of the performance and success of the hospital (Yeager et al., 2014). Hospital administrators' perceptions of how to build their anesthesia departments based on their background and knowledge of the capabilities and values all providers add to the facility may affect the ultimate success of the organization. Therefore, the results of this study may be helpful in examining how anesthesia practice models are constructed at individual hospital facilities.

Recent studies on sustaining and improving hospital performance have focused on organizational and market forces that guide hospital administrator's decision-making (Brand et al., 2012; French et al., 2016; Guo et al., 2015; Jiang et al., 2006). Yeager et al. (2014) summarized empirical studies under the resource dependence framework that looked at the constructs of munificence, dynamism, and complexity in an attempt to find variables to operationalize these constructs for healthcare organizations. Hill & Evers (2012) studied performance pressures on hospitals and anesthesiology departments. But no scientific study in the current literature has assessed all of the factors together and applied it to hospital administrator's decision-making related to choosing specific anesthesia practice models for their facility. This study utilized these common constructs of munificence (strategy), dynamism (structure), and complexity (performance) identified throughout previous studies and identified what factors influenced hospital administrators choice of their anesthesia practice model. This study also explored any relationship between the administrators' knowledge and perceptions about anesthesia services and type of practice model employed. Based on these evidence-based

constructs, the following research questions were presented: "What factors are considered by hospital administrator's when making the choice of anesthesia practice model?", "Is there is a relationship between hospital administrators' knowledge of services each type of anesthesia practice model offers and type of anesthesia practice model employed?", and "Is there is a relationship between hospital administrators' perceptions of services each type of anesthesia practice model offers and type of anesthesia practice model employed?"

Methodology

A quantitative, exploratory study of factors hospital administrators use when choosing an anesthesia practice model utilizing a non-experimental, correlational research design was completed. The research was descriptive in nature to determine the factors that influenced a hospital administrator when making decisions about the type of anesthesia practice model that would be the best for their hospital. After VCU IRB exempt approval was received, a survey invitation was emailed to a total of 774 hospital administrators at acute care facilities in the New England states. The actual number of possible participants was 510 after emails were returned as being undeliverable or with out of office replies. A final total of 35 administrators responded for a survey response rate of 6.9%.

A Pearson chi-square (χ^2) analysis or Fisher's exact test was completed to test associations between the dependent and independent variables and assess variances in proportions between variables. After the chi-squared and Fisher's exact test statistics were run, a model for logistic regression was chosen based on the independent variables demonstrating statistical significance.

Study Findings and Application to the Literature

The study findings are reviewed in relation to each objective and related hypotheses applying evidence-based literature for context. Potential implications of the findings, both theoretical and practical, will be discussed. Limitations of the study and findings will be addressed in light of future application to research.

Objective one.

The first objective of this study was to: (1) identify the factors considered by hospital administrators in choosing anesthesia practice models. Three hypotheses were developed to explain this objective.

- H1: There is a higher number of CRNAs working as anesthesia providers in medically underserved areas compared to ANs and AAs combined.

This hypothesis was evaluated using Pearson chi-square (χ^2) analysis or Fisher's exact test. The independent variables used to attempt to support this hypothesis were number of FTE anesthesia providers by type (AN, AA, CRNA), facility geographic location, presence in MUA, and opt-out status of state. This hypothesis could not be fully tested after the data from the survey results was analyzed. The initial categorization and then subsequent collapsing of categories for the final data entry did not allow the actual numbers of anesthesia providers to be calculated. In order for this hypothesis to be fully operationalized, the variable should be continuous instead of categorical.

The final logistic regression model did show statistical significance ($p = .042$) that the presence of an independent CRNA-only anesthesia practice model is almost eight times more likely to be present in hospital facilities located in medically underserved areas compared with practice models with AN involvement. The adjusted odds ratio is within the 95% confidence

intervals of 1.079 – 59.152. The final logistic regression model results support the probability of a CRNA-only practice model being present in medically underserved areas more frequently than models with AN involvement, which supports one part of this hypothesis but not the entire hypothesis.

The supposition was that the number of providers would show a significant difference between CRNAs versus ANs and AAs combined in MUAs. Due to the survey question data collection method employed, the specific data was unable to be obtained in this study. This analysis could potentially be achieved if Beale zip codes were utilized for each provider but that could still skew the results if the provider's residence was different from their work address.

Despite the fact that the survey question design did not allow the ability to gather data to support this hypothesis fully, it is well documented that CRNAs provide the majority of anesthesia care to rural and underserved populations (AANA, 2015). Liao, Quraishi, and Jordan (2015) performed correlation analyses demonstrating that county median income is a key factor in determining anesthesia provider distribution. Their findings demonstrated that CRNAs provided anesthesia care to lower income populations as well as more vulnerable populations such as Medicaid-eligible, uninsured, and unemployed populations compared to ANs who correlated to higher income populations. This literature supports the findings from this study that a CRNA-only anesthesia practice model is almost eight times more likely in MUAs as compared to one with AN involvement.

- H2: Hospital facilities with operating margins (2014 data) greater than 2.2% utilize more CRNAs compared to ANs and AAs combined.

This hypothesis was evaluated using Fisher's exact test. The independent variable used to attempt to support this hypothesis was the hospital's operating margin and was categorized as

above or below 2.2% after collapsing of the categories. 68.6% (n = 24) of the hospitals were below 2.2% and 31.4% (n = 11) were above the 2.2% operating margin. This hypothesis was not supported as it had a p-value of 1.00. However, four out of the seven hospital facilities that utilized a CRNA-only anesthesia practice model were above the 2.2% operating margin with three out of four of them with an operating margin of 4% or greater. It would be interesting to collect an increased sample size and assess if this trend continued throughout other facilities.

Hospital profitability is often measured by operating margin as an overall proxy for hospital operating performance. Operating margin is representative of a hospital's service to patient care and is recognized as successful if costs and quality are maintained. Therefore, operating margin is one of the performance trends that are analyzed by hospital administrators when assessing moves to lower healthcare costs (Jiang et al., 2006). There are issues with reporting operating margins though because there are generally three different measurements used. Thought to be the most accurate measure of a hospital's performance is the patient care and other operations (PCO) operating margin (Flex Monitoring Team, 2008). The limitation that arose in this study is that no explanation of measurement was noted on the survey instrument so future survey instruments will need to explain the operating margin definition.

Research reports from Brino (2014) show that the operating margin for non-profit hospitals dropped to a new median low of 2.2%. The rationale for this was likely due to cost-containment strategies by hospital administrators as well as minimal rate increases from commercial payers and rate cuts from CMS. An operating margin below 2.2% was assumed to be a hospital that could be experiencing some financial burden with a need to improve their debt to income ratio.

- H3: There is a relationship between hospital administrators' knowledge of anesthesia services provided at their facility and anesthesia practice model utilized.

The aim of this hypothesis was to ascertain if hospital administrators were aware of the internal demographics of their facility as well as anesthesia demographics. This hypothesis was tested with the logistic regression model but it was found to be insignificant overall. The five variables that were proposed to be tested in this model were: facility type, number of licensed beds, number of anesthetizing locations, type of employment model, and amount of anesthesia subsidy. Of these variables, facility type ($p = .043$) and number of licensed beds ($p = .036$) were entered into one of the final iterations of the logistic regression model but were found to be statistically insignificant in adding to the final model and were removed. Of the other variables that were considered in this hypothesis, three had insignificant p-values from the Pearson chi-square tests: number of anesthetizing locations ($p = .207$), type of employment model for CRNAs ($p = .385$), and anesthesia subsidy ($p = .339$).

In an attempt to test the knowledge of hospital administrator's about their facilities, the original data sample had the choice of 'unsure' in most survey questions to capture data for this hypothesis. With the need to collapse the categories due to the sample size, the choice of 'unsure' was removed from most and thus, could not be factored into the logistic regression. The only independent variables that category was left in were anesthesia subsidy, opt-out status, awareness of bylaw limitations, and final determination of choice of anesthesia practice model. The unsure category was left in to specifically attempt to provide information for this hypothesis. Only 6% of respondents reported they were unsure of the anesthesia subsidy, and only 17% reported uncertainty in regards to state opt-out status and anesthesia provider bylaw limitations.

The last variable in this set was the hospital administrator making the final decision on type of practice model. One could assume that an individual hospital administrator or group of hospital administrators had the most knowledge to make this decision. The survey results showed that 43% of CEOs made the final decision on type of anesthesia practice model while the decision was made 26% of the time by a group of hospital administrators. The rest of the respondents answered a variety of other singular administrators, such as CFO (9%), COO (9%), CMO (6%), CNO (9%), and the Hospital Board of Trustees (14%), with several respondents including multiple answer choices. Not one respondent answered if they were unsure of the hospital administrator who made this final decision. Overall, the descriptive statistics seem to signify that hospital administrators do have knowledge of anesthesia services at their facility, which provides support for this hypothesis.

Assessing the knowledge of a hospital administrator in regards to anesthesia services appears to be a novel research endeavor, with only anesthesia corporation reports found in the literature (Gooch, 2016). That is one reason why this study is timely and important. Corporate publications such as Becker's Hospital Review come somewhat close to providing peer-referenced data about skills hospital administrators need to possess to navigate the current healthcare environment. Freel (2012) states that there are five challenges hospital administrators must face to be successful in the healthcare industry. These include (a) know how to address shortages and compete for the most qualified healthcare professionals, (b) specialize for growth, (c) prepare for the future, (d) improve patient care through technology, and (e) manage Medicare and Medicaid cases. The most compelling argument throughout all of these challenges is for hospital administrators to strive for fiscal responsibility and to be innovative and outside of the traditional norms in doing so. If these principles were applied to choosing the best anesthesia

practice model for a hospital, incorporating support from all the previous literature on cost-effectiveness, access, and quality, hospital administrators would have a much better understanding of what anesthesia providers and services are needed for their facility.

Objective two.

The second objective of this study was to examine the perceptions of hospital administrators' regarding the delivery of anesthesia services.

- H4: There is a relationship between hospital administrators' perceptions of the value of anesthesia services provided at their facility and the anesthesia practice model utilized.

This hypothesis was tested by analyzing the respondent's viewpoint (perceptions) on several topical areas of potential importance to them related to anesthesia services offered or issues related to their facility. This is essentially qualitative data expressed quantitatively. Hospital administrator's perceptions were not researched in relation to the dependent variable so the influence of these responses can not be used as predictors in choice of anesthesia practice model per se but they are still of interest in answering the objectives of this study.

The first question was soliciting the importance and value placed on a select group of business management services that an anesthesia group could offer that could be of value to hospital administrators in consideration of their choice of anesthesia practice model. Instituting operating room (OR) efficiency improvements showed 35% of the respondents considering this of the highest importance followed by tracking reimbursement measures at almost 30%. Overall, it appears that oversight measures including OR efficiency improvements and tracking of efficiency metrics and reimbursement measures are of significant to highest importance to the hospital administrators in this survey. Awareness of ACA mandates and billing oversight are of least importance.

Another question was soliciting the importance and value placed on a select group of clinical coverage services that an anesthesia group could offer that could be of value to hospital administrators in consideration of their choice of anesthesia practice model. Respondents to this question clearly valued 24-hour call and obstetric coverage with 65% ranking this as the highest importance followed by trauma and emergency room coverage, which could be associated with the call coverage choice also. The remainder of anesthesia services (APM, CPM, GI, USGRA) were closely associated with each other in terms of ranking importance.

The third question was soliciting the importance and value of the effect of barriers or considerations a hospital could potentially incur if affiliated and affected by certain choices of anesthesia practice models. Respondents to this question clearly placed the highest importance on the quality of the anesthesia provider with over 93% ranking it of significant or highest importance. 87% of respondents ranked availability of anesthesia providers as second most important followed by the cost of anesthesia providers at an 81.3% response rate for significant to highest importance.

Overall, a robust amount of information was obtained from these series of questions collecting data on perceptions of hospital administrators regarding anesthesia services in their facilities. These descriptive statistics can be used to summarize the sample of hospital administrators that participated in this survey. Though a statistical conclusion cannot be deduced for this hypothesis, the information gathered can provide rich descriptive information to support future exploration of the impact of various anesthesia delivery models.

Hyder et al. (2015) identified that there are few performance measures currently attributed directly to anesthesia practice. Only clinical applications are being measured to prove the value of anesthesia providers (i.e.: normothermia, antibiotic timing). The authors stated that

ANs are under increasing pressure to demonstrate the value of care they provide patients. This can be extrapolated to the value they provide the hospital also. Though they did not include CRNAs or AAs in this article, one can assume the same applies to all anesthesia providers. Incorporation of areas hospital administrators perceive as of significant to high importance could be evaluated with anesthesia providers.

As found from this study, operating room (OR) efficiency is a key metric to be studied. There are an increasing number of studies evaluating a variety of OR efficiency metrics. Epstein & Dexter (2012) evaluated the influence of AN supervision ratios on first case starts. They found that even with a medical direction ratio of 1:2, delays occurred on 35% of days. Their recommendation to mitigate this issue was to either incorporate staggered surgical starts or increase the number of ANs. This solution has inherent issues because surgeons will most likely not be satisfied with changes in their schedules. Increasing the number of ANs present on a daily basis to maintain the medical direction ratios comes with increased costs. This study was using both anesthesia residents and CRNAs in the medical direction mix so they did not attempt to decrease the medical direction ratio. The American College of Graduate Medical Education (ACGME) rules mandate anesthesia residents be supervised in a maximum 1:2 ratio (Epstein & Dexter, 2012). A simpler solution to maintain on time starts in the OR is to pull the CRNAs out of the mix and bill non-medically directed. Especially in teaching hospitals with residents, the ANs could focus on getting their cases started on a timely basis and they could also act in a consultant role if needed by the CRNAs. This would aid in improving the efficiency of the OR and have little change in the overall dynamic of who is actually performing the cases.

These perceptions of efficiency are on the forefront of hospital administrators across the nation. Cleveland Clinic CEO Toby Cosgrove, MD, has stated that hospitals have to find a way

to increase their efficiency metrics and possibly become innovative with some form of consolidation to prevent hospital closures (Rosin, 2016). This study supports these needs for change and provides data on what areas hospital administrators would like to focus on.

Implications for practice.

Identifying the factors that hospital administrators use to determine type of anesthesia practice model utilized at their facility has not been previously explained in the literature. After a thorough literature search, the researcher was only able to find anesthesia corporate surveys that discussed this topic (Gooch, 2016). This study was not able to support every independent variable put forth to have an effect on choice of anesthesia practice model but there are, however, several important implications for practice that can be elucidated on and recommended to be studied in the future.

Theoretical implications.

By utilizing a theoretical approach, hospital administrators can make decisions about the selection, assessment, and viability of various anesthesia practice models in a hospital. Resource dependence theory (RDT) provides a foundation when trying to understand determinants that influence a hospital administrator's choice of an anesthesia practice model. To better understand the relationship between the effect of the external environment on a hospital and its internal strategies, structure, and/or performance, researchers have examined both uncertainty and resources (Yeager et al., 2014). Scarcity of resources or uncertainty in the current environment may influence hospital administrators to redesign their anesthesia practice models. This study attempted to determine the factors that would prompt hospital administrators to make decisions in the current healthcare climate.

Based on RDT, the constructs of munificence, dynamism, and complexity of a hospital were used in this study to analyze the factors that hospital administrators utilized in determining type of anesthesia practice model. Munificence is defined as the behavioral strategy a hospital administrator utilizes to determine availability and accessibility of resources (Yeager et al., 2014). Dynamism is defined as the environmental structure that is established by hospital administrators in their facility. Dynamism means a situation is constantly changing, leading to uncertainty for stakeholders. The current state of the ACA is causing uncertainty for many hospital systems. Because resources are dynamic and can become abundant or in short supply over time, the RDT perspective predicts that in order for an organization to be successful, they must develop strategies that capitalize on munificence in their setting. The construct of complexity reflects the range and quantity of components that need to be considered by an organization when making strategic decisions regarding its performance. In the anesthesia environment, effects of the ACA, the multifaceted payer system, CMS regulations, hospital bylaws, and the perceptions of the enforcement of them adds to the complexity of anesthesia practice.

The survey data reveal that the measures related to the construct dynamism, associated with change and uncertainty in healthcare, carried the lowest importance of the business management measures important to the hospital administrators. Anesthesia providers' awareness of ACA mandates ranked lowest overall at 29.4% (n = 10) of significant to highest importance to administrators followed by billing oversight with a 58.8% (n = 20) ranking as significant to highest importance. On the other hand, performance measures representative of the complexity construct ranked highest: tracking reimbursement measures such as quality-related data (64.7%,

n = 22), measurement of operating room efficiency metrics (76.5%, n = 26), and instituting operating room efficiency improvements (88.2%, n = 30).

Another survey question elicited the importance and value of the effect of barriers or considerations a hospital could potentially incur if affiliated and affected by certain choices of anesthesia practice models. The measures of highest importance to the hospital administrators were related to the construct of munificence: anesthesia provider quality (93.6%, n = 29), availability of anesthesia provider (87.1 %, n = 27), and anesthesia provider cost (81.3%, n = 26). Ranking least important to hospital administrators were measures related to the construct dynamism, again: public perception of anesthesia provider (28.2%, n = 9) and consolidation by anesthesia employment group (7.7%, n = 2).

To better understand the relationship between the effect of the external environment on a hospital and its internal strategies, structure, and/or performance, researchers have examined both uncertainty and resources (Yeager et al., 2014). An assumption of this study is that a hospital administrator would want to capitalize on the best available mix of anesthesia providers and value-based services offered by those providers. The constructs of munificence and complexity were ranked most significant to hospital administrators when considering their choice of anesthesia practice model and this supports the theoretical underpinnings of RDT. The ranking of anesthesia provider quality, availability and cost as highest importance can be associated with the assumption that CRNAs and ANs provide the same high quality care to patients independent of anesthesia practice model utilized.

After analyzing the survey data results and assessing them in their relationship to each construct (munificence, dynamism, and complexity), the results from this study support the premises of resource dependence theory. RDT theorizes that the environment an organization

operates within is instrumental in the behavior and success of that organization (Vibert, 2004). In addition, Pfeffer and Salancik, two of the most influential theorists of RDT, argued that organizations actually depend on resources within their environment to operate and survive and that external resources are a secondary concern (1978). This study demonstrates support of their viewpoint in that internal resources, such as those represented by the construct of munificence are the most influential in the operational processes in the perceptions of the hospital administrators. Resources reflective of internal strategies utilized by hospital administrators were most important, including assuring high quality, available, and cost-effective anesthesia providers to provide anesthesia services in a given hospital.

RDT as a theory that deals with power relationships within organizations can provide useful insights into why hospital stakeholders decide to utilize various anesthesia delivery models. This can be further analyzed by the cost-effectiveness of anesthesia practice and concomitant economic implications of hospital stakeholder perceptions of anesthesia services. The theoretical structure for analyzing these constructs with RDT is driven by the potential financial gains, or reduction in losses, a healthcare facility can realize (Yeager et al., 2014). The results from this study again support Pfeffer and Salancik's theory of RDT utilizing the construct of complexity. The study found that performance measures were of highest importance to hospital administrators when assessing the value they place on anesthesia providers and services offered. Operating room efficiency metrics and improvements as well as tracking reimbursement measures are all reflective of the internal health of a hospital and of highest value to hospital administrators.

Lastly, the results of this study that correlated with the construct of dynamism were only partially supportive of RDT. Hospital administrator concerns regarding the effect of external

uncertainty on hospital structure were of lowest significance. The effects of the ACA and healthcare climate, public perception of anesthesia providers, and possible anesthesia group consolidation or takeover by an external group were not as troubling as modern RDT theorists would propose. It appears that the study results provide support for Pfeffer and Salancik's underpinnings of RDT. Using RDT as the theoretical framework for this study, hospital administrators biggest concerns were in support of assuring internal stability and external influences were a secondary concern in the overall successful functioning of their hospital facilities.

Practical implications.

The results of this study have practical implications for hospital administrators as well as practicing anesthesia providers. Critical access and community hospitals located in rural and medically underserved areas are almost 100% staffed with CRNAs (AANA, 2015). Some studies have identified that rural hospitals are under siege and vulnerable to either take-over from larger healthcare systems or have the potential to close entirely (Pyrillis, 2015). Some state AN and medical associations have fought to either have the opt-out decisions overturned or not enacted at all. They propose that they would rather have rural hospitals close due to the inability to hire an AN on staff rather than have anesthesia provided by a CRNA only. This is an example of physician-centric thinking over patient-centered care (Rowe, 2012). This study showed that hospital administrators are primarily concerned with the quality, availability, and cost of the provider rather than the professional and educational background and public perception of the anesthesia provider.

Another practical implication of these findings is that hospital administrators appear receptive and open to negotiations centered around value-based services. Not only were

performance measures supported by theory but practically as well. In addition, it does not appear that the data support a propensity towards strictly utilizing ANs for anesthesia services. Hospital administrators value their facilities having 24-hour call coverage (88.2%, n = 30), OB coverage (80.6%, n = 25) and trauma/emergency room coverage (66.6%, n = 22). Having access and availability to quality anesthesia providers is what hospital administrators perceive as most important in supporting their facility.

One finding of significance is the role of public perception regarding CRNAs and ANs. A Robert Wood Johnson Foundation/Gallup poll from 2010 found some interesting results regarding opinion leaders' perceptions from insurance, corporate, health services, government, and industry sectors. They found nurses ranked seventh (14%) behind other stakeholders on their potential to effect healthcare reform with physicians ranking fifth (38%). Many of these opinion leaders recognized that nurses have a unique role in the healthcare system and are well qualified to shape healthcare policy and enact changes in delivery systems for the best possible healthcare outcomes. The poll showed that nurses were not being perceived as important decision makers compared to physicians (69%) and not perceived as revenue generators compared to physicians (68%) (Blizzard et al., 2010). Priorities identified and now funded nationally from this 2010 poll for advancing nursing's role in the future of health care and eliminating barriers to leadership roles for advanced practice nurses are to develop nurse leaders on hospital Board of Directors, instituting evidence-based nurse-led models of care that reduce cost and improve access as well as maintaining or improving quality of care, and supporting the integration of all stakeholders, including nurses, in interdisciplinary healthcare delivery (Barclay, 2010). This study supports the 2010 poll in that CRNAs need to position themselves in hospital administration and demonstrate their worth to the administrators.

Limitations

It is essential in any research study to discuss and recognize the limitations of the study, especially since this acknowledgement may lead to strengthening future study instruments and processes. The limitations in this study are in the areas of research design, survey instrument development, sample population collection method, independent variable measures, and sample size. Threats to internal and external validity are identified and discussed.

Threats to internal validity.

Internal validity denotes the degree of possibility that the independent variable is causing or influencing the dependent variable and that the relationship between both is not an untoward effect of a confounding variable (Polit & Beck, 2008). In this study, the seventeen original independent variables were studied for their effects on the dependent variable, type of anesthesia practice model. The first significant limitation and threat to internal validity in the study was the study instrument itself. Use of a newly piloted survey instrument has inherent validity issues since there has not been significant validity and reliability testing done. Statistical conclusion validity plays a role in affecting the internal validity of this study in relation to the construction and definition of some of the independent variables in the survey instrument. The issue was not with the definitions per se but with the final categorization that was required due to small cell size. After the categories were collapsed with several of the variables, it was difficult to ascertain actual numbers to assess the data, especially with the independent variables of FTEs of anesthesia providers and type of employment model of each anesthesia provider. Maximizing precision was not fully achieved, which is important to increase statistical power, since the survey instrument measures had too much variability in them. This caused a serious limitation in answering the first and second hypotheses, as noted previously.

The same concern can be applied to construct and content validity in this study. These types of validity measured the degree of adequate variable measurement and representativeness of the survey questions. The introduction letter and survey instrument was piloted with a group of eight panel experts that verified the construct and content validity of the survey questions. The expert panel tested content validity of the survey instrument and a content validity index was obtained (CVI) prior to full deployment of the survey to hospital administrators. After data cleaning and statistical analysis, however, it appears that the questions could be more specific to operationalize the constructs of munificence, dynamism and complexity to the participant. Future studies can more specifically focus on these constructs and may elicit more statistically significant data.

The second significant limitation was related to the sample size of the study. The sample size was generated using Agresti's rule of thumb (2007) calculation: for every independent variable, a minimum of ten cases is ideal. In this study, there was more than the minimum of 20 cases (two independent variables went into final model), which fits with our final sample size of 35 respondents. Even though this study fits the rule of thumb, it clearly had a too small sample size evidenced by some cells with less than five cases and a few with zero, skewing the results of the study and making it difficult to analyze several of the independent variables in the final logistic regression model.

Another significant limitation was related to the sampling methods used in the study. The sampling method of emailing participants had its own flaws in contributing to the small final sample. The researcher had a fair amount of difficulty obtaining the correct email addresses for the hospital administrators. The initial assumption was that the addresses would be easily located on the hospital website. This was clearly not the case in most instances. This may have

resulted in a form of selection bias with participants since the survey invitation could only be sent to those with recoverable email addresses. Since these addresses were more easily available, the group of hospital administrators that received the survey invitation and participated may be more concerned with the results of the study and responded accordingly. Utilizing the entire pool of hospital administrators in acute care New England hospital facilities and sending weekly survey reminder emails to all deliverable email addresses mitigated this threat.

The fourth significant limitation that must be acknowledged is the research design. This quantitative, exploratory study of factors hospital administrators use when choosing an anesthesia practice model utilized a non-experimental, correlational research design. Temporal ambiguity may exist in these types of studies unlike randomized clinical trials (RCTs) that create the independent variable and observe the performance on the dependent variable; in RCTs, temporal sequencing is not an issue (Polit & Beck, 2008). In this study, it remains unclear whether any of the independent variables actually preceded the type of anesthesia practice model chosen or vice versa.

Threats to external validity.

External validity is reflective of the degree with which inferences of relationships observed in a study hold constant over variations in people, settings, and conditions, as well as treatments and outcomes (Polit & Beck, 2008). The most inherent threat to external validity in this study is related the generalizability of the results. A final total of 35 (out of 510 potential participants) completed surveys were received at the completion of the survey deployment period. This resulted in a response rate of 6.9%, which was lower than preferred but not unexpected: Fryrear (2015) found that external surveys, those that are not directly affiliated with individuals solicited, can elicit response rates as low as 10 - 15%, on average. The participants

were representative of the pool of hospital administrators throughout New England in terms of executive positions, professional backgrounds and educational degrees so that does aid in increasing generalizability. Despite awareness of these limitations, this is a threat to external validity and weakens the generalizability of the study results.

Nonresponse bias must be acknowledged in this study as a potential threat to external validity. Nonresponse bias is the differences between those who participated in the study and those who declined to participate (Polit & Beck, 2008). Future studies may be able to more effectively deal with this threat by utilizing a mixed methods research design. In addition to a more focused quantitative survey, a qualitative approach utilizing in-person interviews may increase contact with the hospital administrators that either did not have time or were wary about the survey questions when sent via email. A random sampling of administrators could be chosen in hopes to increase the generalizability of the study.

Statistical conclusion validity has a role in affecting the external validity of this study also. Since it is concerned with the validity of the inferences that a relationship truly exists between the dependent and independent variables, any discrepancies in this type of validity can affect the generalizability of the study results. Due to the low sample size, this study lacked adequate statistical power. The possibility exists that there may actually be more statistically significant relationships with the independent variables and dependent variable but this study failed to show that. Increasing the sample size in future studies may lead to a more robust statistical power and ability to detect more relationships.

Recommendations for Future Research

This study collected a moderate amount of rich preliminary data on what hospital administrator's value to be of importance to their facility. With a larger sample size, some of the

independent variables may have shown statistical significance. But due to the low response rate, this survey can be viewed more as a pilot study, one to be improved upon and replicated in the future. In addition, the survey instrument questions could be re-categorized to be able to gather the appropriate data to answer the research questions and support the hypotheses.

Replicating the study to increase generalizability via a mixed methods approach may provide more robust information on individual measures being studied and generate several stand-alone studies. In analyzing the data, there became a natural division in three distinct areas: experience of the hospital administrator, physical demographics of the hospital, and financial factors associated with each hospital. This wealth of information, utilizing too many independent variables in one study, may have contributed to confounding the logistic regression model. If each construct supported by the RDT was studied in the context of these three distinct areas, more statistically significant information might be gleaned from the data.

For example, the constructs of munificence, dynamism, and complexity could be studied in the context of financial factors associated with a hospital. This future research could analyze the proportion of FTE CRNAs, ANs, and AAs in a hospital and the type of employment model utilized and their effects on the financial status of the facility. In addition, this study would also examine the financial independent variables of MUA, hospital profit status, operating margin, and anesthesia subsidy. One measure that could be added in a future study to analyze the financial factors that hospital administrators utilize in determining their choice of anesthesia practice model is the Hirschman-Herfindahl index (HHI). The HHI is often used to measure market concentration and is useful in turbulent markets of healthcare competition (Nauenberg, Alkhamisi, & Andrijuk, 2004). This would operationalize the constructs of munificence, dynamism and complexity. In the anesthesia realm, market concentration is becoming

increasingly competitive and antitrust authorities are concerned with market share. A recent study by Sun, Dexter, Macario, Miller, & Baker (2015) evaluated Medicare claims data utilizing the HHI and found that there was no association between anesthesia group concentration and private payer payments. They did, however, recommend that this is an area of further research. Of interest for future study is that they used Medicare claims data to study private payer payments and only studied AN involvement in cases. The addition of studying all anesthesia providers and employment models with the other financial variables may yield different results.

Another future study could build on the information gathered in support of the fourth hypothesis and be further explored regarding perceptions of hospital administrators with the underlying construct of dynamism. Dynamism means a situation is constantly changing, leading to uncertainty for stakeholders. Any variations in either resources or external factors create a more dynamic environment. Because of this, the decision-making process is steered mostly by their perceptions about an organization's environment. Again, a mixed methods approach may provide the richest information.

Conclusion

This research examined seventeen independent variables that were hypothesized to determine hospital administrators' choice of anesthesia practice model. The five most statistically significant variables from the chi-square or Fisher's exact tests were then entered into the equation together: professional background ($p = .018$), hospital type ($p = .043$), number of licensed beds ($p = .036$), MUA ($p = .033$), and geographic location ($p = .021$). After the final logistic regression analysis, it was determined that the presence of a hospital being located in a medically underserved area (MUA) alone was a predictor of type of anesthesia practice model utilized. In light of the study limitations and prior literature on the CRNA-only model being

present in almost 100% of rural facilities, more exploration is necessary to come to more robust conclusions on predictors of choice of anesthesia practice model determined by hospital administrators.

The U.S. healthcare system is in a time of uncertainty. As previously noted throughout this study, research has shown that patient safety, quality of care and access, as well as pervasive demands for reducing cost of care is at the forefront of hospital administrators' management needs. In addition, factoring in the need to increase value-based services is positioned to take center stage in the healthcare debate as well. Identifying factors that could strengthen an anesthesia department could alleviate some of the financial and administrative burden from hospital administrators. This study showed that there are definitive areas that hospital administrators identify as high importance to the healthy functioning of their facility. By addressing these needs, an anesthesia department could contribute to the overall stability of the hospital, while at the same time, making themselves a more valuable asset overall.

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Appendix A

List of New England Hospitals per State

Appendix A

List of New England Hospitals per State

State	Hospital Name	Location
Connecticut		
	William W. Backus Hospital	Norwich
	Bridgeport Hospital	Bridgeport
	Bristol Hospital	Bristol
	Hospital of Central CT	New Britain
	CT Children's Medical Center	Hartford
	Danbury Hospital	Danbury
	Day Kimball Hospital	Putnam
	Greenwich Hospital	Greenwich
	Griffin Hospital	Derby
	Hartford Hospital	Hartford
	(Charlotte) Hungerford Hospital	Torrington
	Johnson Memorial Hospital	Stafford Springs
	Lawrence + Memorial Hospital	New London
	Manchester Memorial Hospital	Manchester
	Middlesex Hospital	Middletown
	MidState Medical Center	Meriden
	Milford Hospital	Milford
	New Milford Hospital	New Milford
	Norwalk Hospital	Norwalk
	Rockville General Hospital	Vernon
	St. Francis Hospital	Hartford
	Saint Mary's Hospital	Waterbury
	St. Vincent's Medical Center	Bridgeport
	Stamford Hospital	Stamford
	UCONN Health John Dempsey Hospital	Farmington
	Waterbury Hospital	Waterbury
	Windham Hospital	Willimantic
	Yale-New Haven Hospital	New Haven
Maine		
	Blue Hill Memorial Hospital	Blue Hill
	Bridgton Hospital	Bridgton
	C.A. Dean Memorial Hospital	Greenville
	Calais Regional Hospital	Calais

	Cary Medical Center	Caribou
	Central Maine Medical Center	Lewiston
	Down East Community Hospital	Machias
	Eastern Maine Medical Center	Bangor
	Franklin Memorial Hospital	Farmington
	Houlton Regional Hospital	Houlton
	Inland Hospital	Waterville
	Miles Memorial	Damariscotta
	Maine Coast Memorial Hospital	Ellsworth
	Maine Medical Center	Portland
	Maine General Medical Center	Augusta
	Mayo Regional Hospital	Dover-Foxcroft
	Mercy Hospital	Portland
	Mid Coast Hospital	Brunswick
	Parkview Health	Brunswick
	Millinocket Regional Hospital	Millinocket
	Mt. Desert Island Hospital	Bar Harbor
	Northern Maine Medical Center	Ft. Kent
	Pen Bay Medical Center	Rockport
	Penobscot Valley Hospital	Lincoln
	Redington-Fairview General Hospital	Skowhegan
	Rumford Hospital	Rumford
	Sebasticook Valley Health	Pittsfield
	Southern Maine Healthcare	Biddeford/Sanford
	St. Joseph Hospital	Bangor
	St. Mary's Regional Medical Center	Lewiston
	Stephens Memorial Hospital	Norway
	The Aroostook Medical Center	Presque Isle
	Waldo County General Hospital	Belfast
	York Hospital	York
Massachusetts		
	Anna Jaques Hospital	Newburyport
	Athol Hospital	Athol
	Baystate Health	
	Baystate Franklin	Greenfield
	Baystate Mary Lane	Ware
	Baystate Medical	Springfield
	Baystate Noble	Westfield
	Baystate Wing	Palmer
	Berkshire Medical Center	Pittsfield
	Fairview Hospital	Great Barrington
	Beth Israel Deaconess Medical Center	Boston
	Milton	Milton
	Needham	Needham
	Plymouth	Plymouth

	Beverly Hospital	Beverly
	Boston Children's Hospital	Boston
	Boston Medical Center	Boston
	Brigham & Women's Faulkner Hospital	Boston
	Brigham & Women's Hospital	Boston
	Cambridge Heath Alliance	Cambridge
	Somerville Hospital	Somerville
	Everett Hospital	Everett
	Cape Cod Hospital	Hyannis
	Carney Hospital	Dorchester
	Cooley Dickinson	Northhampton
	Dana-Farber Cancer Institute	Boston
	Emerson Hospital	Concord
	Falmouth Hospital	Falmouth
	Framingham Union	
	Metrowest	Framingham
	Leonard Morse	Framingham
	Good Samaritan Medical Center	Brockton
	Lawrence Memorial	Lawrence
	Melrose-Wakefield	Melrose
	Harrington Hospital	Southbridge
	Heywood Hospital	Gardner
	Hillcrest Hospital	Pittsfield
	Fairview Hospital	North Adams
	Holy Family Hospital	Metheun
	Steward Health System	Haverhill
	Holyoke Medical Center	Holyoke
	Lahey Hospital Medical Center	Burlington
	Lowell General Hospital	Lowell
	Saints Medical Center	Lowell
	Martha's Vineyard Hospital	Oak Bluffs
	Massachusetts Eye and Ear	Boston
	Massachusetts General Hospital	Boston
	Mercy Medical Center	Springfield
	Milford Regional Medical Center	Milford
	Mount Auburn Hospital	Cambridge
	Nantucket Cottage Hospital	Nantucket
	Nashoba Valley Medical Center	Ayer
	New England Baptist Hospital	Boston
	Newton-Wellesley Hospital	Newton
	North Shore Medical Center	Salem
	Norwood Hospital	Norwood
	Saint Anne's Hospital	Fall River
	Saint Elizabeth's Medical Center	Boston
	Saint Vincent's Hospital	Worcester

	Shriners Hospital for Children	Boston/Springfield
	Signature Healthcare Brockton Hospital	Brockton
	Charlton Memorial	Fall River
	St. Luke's Hospital	New Bedford
	South Shore Hospital	S. Weymouth
	Sturdy Hospital	Attleboro
	Tufts Medical Center	Boston
	UMASS	
	Health Alliance	Leominster
	Hahnemann	Worcester
	Memorial Medical Center	Worcester
	University	Worcester
	VA Boston Healthcare System	Brockton/Jamaica Plain/Leeds/West Roxbury
	Winchester Hospital	Winchester
New Hampshire		
	Alice Peck Day Memorial Hospital	Lebanon
	Androscoggin Valley Hospital	Berlin
	Catholic Medical Center	Manchester
	Cheshire Medical Center	Keene
	Concord Hospital	Concord
	Cottage Hospital	Woodsville
	Dartmouth Hitchcock Medical Center	Lebanon
	Elliot Hospital	Nashua
	Exeter Hospital	Exeter
	Frisbie Memorial Hospital	Rochester
	Huggins Hospital	Wolfeboro
	Littleton Regional Healthcare	Littleton
	LRG Franklin Regional Hospital	Franklin
	LRG Lakes Region General Hospital	Laconia
	Memorial Hospital	North Conway
	Monadnock Community Hospital	Peterborough
	New London Hospital	New London
	Parkland Medical Center	Derry
	Portsmouth Regional Hospital	Portsmouth
	Southern New Hampshire Medical Center	Nashua
	Speare Memorial Hospital	Plymouth
	St. Joseph Hospital	Nashua
	Upper CT Valley Hospital	Colebrook
	Valley Regional Hospital	Claremont
	VA Medical Center	Manchester
	Weeks Medical Center Hospital	Lancaster
	Wentworth-Douglass Hospital	Dover
Rhode Island		

	Butler Hospital	Providence
	Kent Hospital	Warwick
	Landmark Medical Center	Woonsocket
	Hasbro Children's Hospital	Providence
	Miriam Hospital	Providence
	Newport Hospital	Newport
	Rhode Island Hospital	Providence
	Memorial Hospital	Pawtucket
	Our Lady of Fatima Hospital	Providence
	Providence VA Hospital	Providence
	Roger Williams Medical Center	Providence
	South County Hospital	Wakefield
	Westerly Hospital	Westerly
	Woman & Infants Hospital	Providence
Vermont		
	Brattleboro Memorial Hospital	Brattleboro
	Central VT Medical Center	Barre
	Copley Hospital	Morrisville
	Gifford Medical Center	Randolph
	Grace Cottage Hospital	Townshend
	Mt. Ascutney Hospital	Windsor
	North Country Hospital	Newport
	Northeastern VT Regional Hospital	St. Johnsbury
	Northwestern Medical Center	St. Albans
	Porter Medical Center	Middlebury
	Rutland Regional Medical Center	Rutland
	Southwestern Vermont Medical Center	Bennington
	Springfield Hospital	Springfield
	University of Vermont Medical Center	Burlington
	VA Medical Center	White River Junction

Appendix B

VCU Institutional Review Board Approval letter

Appendix B

VCU Institutional Review Board Approval letter

TO: Suzanne Wright

CC: Maribeth Massie

FROM: VCU IRB Panel A

RE: Suzanne Wright ; IRB HM20009632 Determinants of Hospital Administrators' Choice of Anesthesia Practice Model

On 3/10/2017 the referenced research study ***qualified for exemption*** according to 45 CFR 46.101(b), **category 2**.

The information found in the electronic version of this study's smart form and uploaded documents now represents the currently approved study, documents, and HIPAA pathway (if applicable). You may access this information by clicking the Study Number above.

If you have any questions, please contact the Office of Research Subjects Protection (ORSP) or the IRB reviewer(s) assigned to this study. The reviewer(s) assigned to your study will be listed in the History tab and on the study workspace. Click on their name to see their contact information.

Attachment – Conditions of Exempt Approval

Conditions of Exempt Approval:

In order to comply with federal regulations, industry standards, and the terms of this approval, the investigator must (as applicable):

1. Conduct the research as described in and required by the Protocol.
2. Provide non-English speaking patients with a translation of the approved Consent Form in the research participant's first language. The Panel must approve the translation.
3. The following changes to the protocol **must be** submitted to the IRB panel for review and approval before the changes are instituted. Changes that do not meet these criteria do not

have to be submitted to the IRB. If there is a question about whether a change must be sent to the IRB please call the ORSP for clarification.

THESE CHANGES MUST BE SUBMITTED:
- Change in principal investigator
- Any change that increases the risk to the participant
- Addition of children, wards of the state, or prisoner participants
- Changes in survey or interview questions (addition or deletion of questions or wording) that change the level of risk or adds questions related to sexual activity, abuse, past or present illicit drug use, illegal activities, questions reasonably expected to provoke psychological anxiety, or would make participants vulnerable, or subject them to financial, psychological or medical risk
- Changes that change the category of exemption or add additional exemption categories
- Changes that add procedures or activities not covered by the exempt category(ies) under which the study was originally determined to be exempt
- Changes requiring additional participant identifiers that could impact the exempt category or determination
- Change in inclusion dates for retrospective record reviews if the new date is after the original approval date for the exempt study. (ex: The approval date for the study is 9/24/10 and the original inclusion dates were 01/01/08-06/30/10. This could be changed to 01/01/06 to 09/24/10 but not to end on 09/25/10 or later.)
- Addition of a new recruitment strategy
- Increase in the planned compensation to participants

4. Monitor all problems (anticipated and unanticipated) associated with risk to research participants or others.
5. Report Unanticipated Problems (UPs), following the VCU IRB requirements and timelines detailed in VCU IRB WPP VII-6).
6. Promptly report and/or respond to all inquiries by the VCU IRB concerning the conduct of the approved research when so requested.
7. The VCU IRBs operate under the regulatory authorities as described within:
   - U.S. Department of Health and Human Services Title 45 CFR 46, Subparts A, B, C, and D (for all research, regardless of source of funding) and related guidance documents.
   - U.S. Food and Drug Administration Chapter I of Title 21 CFR 50 and 56 (for FDA regulated research only) and related guidance documents.
   - Commonwealth of Virginia Code of Virginia 32.1 Chapter 5.1 Human Research (for all research).

Appendix C

Full Survey Instrument, Including Expert Panel Section

Appendix C

Full Survey Instrument, Including Expert Panel Section

Determinants of Hospital Administrators' Choice of Anesthesia Practice Model

Thank you for agreeing to participate in this survey. The purpose of this study is to examine and gain a better understanding of factors that go into hospital administrators' decision-making in choosing an anesthesia practice model. This study also aims to identify anesthesia services that are most important for hospital administrators at their facility.
There are no risks associated with participating in this survey and no identifying information will be collected. All responses will be recorded anonymously.
The survey is composed of three parts: Demographics of Hospital Administrator, Demographics of Hospital Facility, and Hospital Administrator's Knowledge and Perceptions of Anesthesia Services.
Please answer the questions to the best of your ability based on your experience as a hospital administrator. This survey should take no more than 10 minutes to complete.
Thank you.
Maribeth Massie, VCU SAHP PhD Candidate

Part 1: Demographics of Hospital Administrator

1. What is your current position at your hospital facility? Select all that apply.

   Chief Executive Officer (CEO)
   Chief Financial Officer (CFO)
   Chief Information Officer (CIO)
   Chief Medical Officer (CMO)
   Chief Nursing Officer (CNO)
   Chief Operating Officer (COO)
   Other

2. How many years have you been in your current position?

   <1
   1-5

5-10
>10

3. How many years have you been in senior management in a healthcare setting?

   <1
   1-5
   5-10
   >10

4. What is your professional background? Select all that apply.

   Allied Health, other than anesthesia
   Allied Health, Anesthesiologist Assistant (AA)
   Business
   Finance
   Healthcare administration
   Law
   Medicine, other than anesthesia
   Medicine, Physician Anesthesiologist (AN)
   Nursing, other than anesthesia
   Nursing, Certified Registered Nurse Anesthetist (CRNA)
   Other

5. What educational degrees have you earned? Select all that apply.

   Associate (AS)
   Bachelor's (BS)
   Master's in Allied Health (ie: AA, MSOT)
   Master's in Business Administration (MBA)
   Master's in Healthcare/Hospital Administration (MHA)
   Master's in Nursing (MSN)
   Master's in Nurse Anesthesia (MSNA)
   Master's in other field (MS)
   Clinical Doctorate-Doctor of Jurisprudence (JD)
   Clinical Doctorate-Doctor of Medicine (MD)
   Clinical Doctorate-Doctor of Nurse Anesthesia Practice (DNAP)
   Clinical Doctorate-Doctor of Nursing Practice (DNP)
   Clinical Doctorate-Doctor of Osteopathy (DO)
   Clinical Doctorate-Doctor of Pharmacy (PharmD)
   Clinical Doctorate-Doctor of Physical Therapy (DPT)
   Clinical Doctorate-Other
   Research Doctorate-Doctor of Education (EdD)
   Research Doctorate-Doctor of Philosophy (PhD)
   Research Doctorate-Doctor of Science (ScD)
   Research Doctorate-Other

Part 2: Demographics of Hospital Facility

1. What type of facility is your hospital? Select all that apply.

   Community hospital-small (26-99 beds)
   Community hospital-medium (100-249 beds)
   Community hospital-large (>250 beds)
   Critical access hospital (25 or less beds)
   Teaching hospital
   Tertiary care hospital
   Other
   Unsure

2. What is the number of licensed beds in your facility?

   Less than or equal to 25
   26-99
   100-249
   250-399
   > 400
   Unsure

3. What is the profit status of your hospital?

   Government
   Non-profit
   Profit
   Other

4. Is your facility in a medically underserved area (MUA)?

   MUA designation based on ratio of primary medical care physicians per 1,000 population, infant mortality rate, percentage of the population with incomes below poverty level, and percentage of population age 65 and over

   Yes
   No
   Unsure

5. What geographic location is your facility located?

   Rural: Counties with less than 2,500 people

   Urban: Counties with at least 2500 people; this definition includes urban clusters (UCs) that have > 2500 but < 50,000 people and urbanized areas (UAs) that have > 50,000

people

Rural
Urban
Unsure

6. In the past year, what was your facility's operating margin?

-5% -4% -3% -2% -1% 0% 1% 2% 2.2% 3% 4% 5%

Part 3: Hospital Administrator's Knowledge and Perceptions of Anesthesia Services (Abbreviations: AN=Anesthesiologist; AA= Anesthesiologist Assistant; CRNA= Certified Registered Nurse Anesthetist)

1. How many anesthetizing locations are in your facility?

1-5
6-10
11-15
16-20
>20
Unsure

2. How many full-time budgeted providers (budgeted FTE) are employed at your facility?

	0	1-5	6-10	11-20	21-40	41-60	61-80	81-100	>100	Unsure
AN										
AA										
CRNA										

3. What type of EMPLOYMENT model is currently utilized for your anesthesia department?

	Hospital employee: employees receive a salary and benefit package from the facility they are employed	Small external anesthesia group: locally owned by AN/CRNA with < 100 providers and < 10 sites	Regional external anesthesia group: owned by AN/CRNA or nonclinician with 100-500 providers and 10-50 sites; may cross state lines	Large external anesthesia group: owned by AN/ CRNA/nonclinician with 100-1000s of providers and > 50 sites nationally; can be private equity or publicly traded	None	Unsure
AN						
AA						
CRNA						

4. In the last two years have you considered an alternative to your current anesthesia employment model?

   Yes
   No
   Unsure

4a. If your facility did change anesthesia EMPLOYMENT models, what type did you utilize prior to the change?

	Hospital employee: employees receive a salary and benefit package from the facility they are employed	Small external anesthesia group: locally owned by AN/CRNA with < 100 providers and < 10 sites	Regional external anesthesia group: owned by AN/CRNA or non-clinician with 100-500 providers and 10-50 sites; may cross state lines	Large external anesthesia group: owned by AN/ CRNA/non-clinician with 100-1000s of providers and > 50 sites nationally; can be private equity or publicly traded	None	Unsure
AN						
AA						
CRNA						

5. What amount of total anesthesia subsidy does your facility currently provide for an anesthesia group annually?

   None
   $1-$50,000
   $50,001-$100,000
   $100,001-$500,000
   $500,0001-$1,000,000
   $1,000,001-$3,000,000
   $3,000,001-$5,000,000
   >$5,000,000
   Unsure

6. Which of these services are of importance for your anesthesia employment group and/or anesthesia providers to offer your facility?

	Least importance	Minimal importance	Moderate importance	Significant importance	Highest importance
Awareness of healthcare reform mandates					
Billing oversight					
Instituting operating room					

efficiency improvements

Measurement of operating room efficiency metrics

Tracking reimbursement measures such as PQRS

Other

7. What is the current anesthesia PRACTICE model utilized at your facility? If you changed your anesthesia PRACTICE models within the past two years, what was your previous model?

	Current Model	Previous model
Independent anesthesiologist only: AN administers anesthesia alone and bills 100 % of the physician fee schedule		
Independent Certified Registered Nurse Anesthetist only (aka Non-medical direction): CRNA administers anesthesia without medical direction or supervision by an AN and bills 100 % of the physician fee schedule		
Medical direction (aka Anesthesia Care Team): AN and CRNA/AA each bill Medicare for 50 % of the available physician fee schedule. One AN can cover up to four concurrent rooms with a CRNA/AA administering anesthesia (1:4 model). The AN must perform and document seven payment steps, according to the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA regulations). If these steps are not done by the AN, medical direction cannot be billed and the facility does not receive payment for that procedure		
Medical supervision: One AN can function in a consultant role and supervise more than four CRNAs concurrently. Under Medicare Part B, the CRNA bills 50 % of the physician fee schedule and the AN bills for three to four base units/case (on average), per the Medicare Resource-Based Relative Value Scale (RBRVS) plus time units		
CRNA and AN working in same facility as independent providers		
Unsure		

8. What administrator determines the choice of anesthesia PRACTICE model utilized at your facility? Please select all that apply.

CEO
CFO
COO
CIO
CMO
CNO
Group of hospital administrators
Hospital Board of Trustees
Other
Unsure

9. Is your facility located in a state that has medicare opt-out status of physician supervision for CRNAs?

   Definition of opt-out status: Allows the governor of a state, after careful input from stakeholders, to allow CRNAs to practice without physician supervision (currently required by Medicare unless state opt-out). For a state to be exempt of the federal supervision requirement, the governor must send an attestation letter to CMS. The letter must state that the state's boards of medicine and nursing have been consulted regarding access to and quality of anesthesia services as well as state law and that in the best interest of the citizen's of the state, the opt out should be enacted.

   Yes
   No
   Unsure

10. Are you aware of any hospital bylaws, rules, or regulations that restrict the scope of practice of an anesthesia provider at your facility?

    Yes
    No
    Unsure

11. Please rate the importance of the following factors in choosing the type of anesthesia PRACTICE model utilized at your facility.

	Least importance	Minimal importance	Moderate importance	Significant importance	Highest importance
Anesthesia employment group consolidation					
Availability of anesthesia provider					
Bundling of payment for operating room services					
Cost of anesthesia provider					
Current healthcare climate					
Public perception of anesthesia provider					
Quality of anesthesia provider services					
Quality payment initiatives					
Reimbursement for anesthesia services					
Surgeon preference of anesthesia provider					
Variety of anesthesia services offered by provider					

12. Which of these services are currently covered at your facility? Select all that apply.

24-hour call coverage
24-hour obstetric coverage
24-hour trauma/emergency room coverage
Acute pain management
Chronic pain management
GI services
Ultrasound guided regional anesthesia
Other
Unsure

13. Which of these anesthesia services are of most importance to your hospital facility?

	Least importance	Minimal importance	Moderate importance	Significant importance	Highest importance
24-hour call coverage					
24-hour obstetric coverage					
24-hour trauma/emergency room coverage					
Acute pain management					
Chronic pain management					
GI services					
Ultrasound guided regional anesthesia					
Other					
Unsure					

Part 4: Expert Panel Survey Evaluation

1. Was the introduction letter short enough to read?

   Yes
   No

2. Did the introduction letter state the study purpose clearly?

   Yes
   No

3. Were the instructions clear at the start of the survey?

   Yes
   No

4. Are any survey questions ambiguous or difficult to answer?

Yes
No

5. Does the survey feel relevant?

   Yes
   No

6. Does the survey feel repetitive or too long?

   Yes
   No

7. Does the survey feel superficial?

   Yes
   No

8. Are there any annoying features of the wording or formatting of the survey?

   Yes
   No

9. Are there any inconsistent responses that might indicate that changes in response endpoints are problematic for respondents who complete the survey quickly?

   Yes
   No

10. How many minutes did it take you to complete Parts 1-3 of this survey? _____

Appendix D

Content Validity Instrument

Appendix D

Content Validity Instrument

Content Validity Instrument for Massie Dissertation titled 'Determinants of Hospital Administrators' Choice of Anesthesia Practice Model'

Questions	1= Not relevant	2= Unable to assess relevance without item revision	3= Relevant but needs minor revisions	4= Very relevant/ succinct	Comments/ Suggestions
Part 1					
#1, 1a					
#2					
#3, 3a					
#4					
#5, 5a					
Part 2					
#1					
#2					
#3					
#4					
#5					
#6					
#7					
#8					
#9					
#10					
Part 3					
#1					
#2					
#3					
#4					
#5					
#7					
#8					

#9, 9a					
#10					
#11					
#12					
#13, 13a					
#14, 14a					
#15					
#16, 16a					
#17, 17a					
Overall validity					

Appendix E

Survey Invitation Letter

Appendix E

Survey Invitation Letter

Subject Header on email: You are invited to participate in a PhD research survey titled "Determinants of Hospital Administrators' Choice of Anesthesia Practice Model"

Dear Hospital Administrator:

You are invited to participate in a research study titled "Determinants of Hospital Administrators' Choice of Anesthesia Practice Model". This study is being conducted by Maribeth Massie, MS, CRNA and her research committee from the PhD program in Health-Related Sciences School of Allied Health Professions (SAHP) at the Virginia Commonwealth University (VCU). The present research available concerning factors that hospital administrators use to decide on their choice of anesthesia practice model is limited. The purpose of this study is to examine and gain a better understanding of factors that go into hospital administrators' decision-making in choosing an anesthesia practice model. This study also aims to identify anesthesia services that are most important for hospital administrators at their facility.

In this study, you will be asked to complete an electronic survey. Your participation in this study is voluntary and you are free to withdraw your participation from this study at any time. The survey should take approximately five to ten minutes to complete.

This survey has been approved by the Institutional Review Board (IRB) of Virginia Commonwealth University. There are no risks associated with participating in this study. This survey collects no identifying information of any respondent. All of the responses in the survey will be recorded anonymously. By completing and submitting this survey, you are indicating your consent to participate in the study. Your participation is greatly appreciated. We would very much appreciate it if you could complete this survey within the next two weeks. You will receive a follow-up reminder email from us at the one and two week marks.

While you will not experience any direct benefits from participation, information collected in this study may benefit you as a hospital administrator in the future. By better understanding factors considered in staffing your anesthesia department, significant information such as anesthesia subsidy amounts and anesthesia services rendered may be important to consider in future staffing decisions.

If you have questions regarding the survey or research project in general, please contact PhD student Maribeth Massie at massieml@mymail.vcu.edu or Principal Investigator Dr. Suzanne Wright, PhD, CRNA at swright@vcu.edu. If you have questions concerning your rights as a

research participant, please contact the IRB of Virginia Commonwealth University at 804-828-0868.

Thank you,

Maribeth Massie, MS, CRNA, PhD Doctoral Candidate, Virginia Commonwealth University
Dr. Suzanne Wright, PhD, CRNA, School of Allied Health Professions, Department of Nurse Anesthesia, Virginia Commonwealth University

Please follow this link to the survey:

Vita

Maribeth Leigh Massie (nee Hrach) was born on August 27, 1962, in Cleveland, Ohio. She graduated from Nordonia High School, Macedonia, Ohio in 1980. She received her Bachelor's of Science in Nursing from The Ohio State University, Columbus, Ohio in 1986. She received her Master of Science in Nursing with a specialty in Nurse Anesthesia from Columbia University, New York, New York in 1998. Maribeth has practiced as a Certified Registered Nurse Anesthetist since 1998. She has been the Program Director and Associate Clinical Professor of the Master of Science in Nurse Anesthesia program at the University of New England, Portland, Maine since 2010.