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The impact of geography, training, and experience on scope of practice among Certified Registered Nurse Anesthetists

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THE IMPACT OF GEOGRAPHY, TRAINING, AND EXPERIENCE

ON SCOPE OF PRACTICE AMONG CERTIFIED REGISTERED NURSE ANESTHETISTS

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

IMPACT OF GEOGRAPHY, TRAINING, AND EXPERIENCE ON SCOPE OF PRACTICE AMONG CERTIFIED REGISTERED NURSE ANESTHETISTS

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

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The role of Certified Registered Nurse Anesthetists (CRNAs) in the delivery of anesthesia care is evolving given the recent recommendations for Institute of Medicine and provisions in the Affordable Care Act. Despite rigorous clinical training and consistent outcomes studies to support quality care given by CRNAs, the scope of practice of nurse anesthetists is frequently limited, and they do not practice to the full extent of their education and training. As health care spending becomes more constrained and demand for anesthesia services rises, the role of nurse anesthetists as more autonomous providers of anesthesia may be required to maintain access to quality care in a cost-conscious environment. Understanding the factors that influence one's decision to engage in a broad scope of practice may guide training and recruiting practices.

Using Bandura's Self-Efficacy Theory as a framework to conceptualize scope of practice, an internet based survey of a cross-section of practicing CRNAs was conducted. Subjects responded to questions to describe the geography of their practice, experience as a civilian or

military CRNA, and detailed clinical training variables. A composite score was created to gauge overall quality of clinical training. Each CRNA then rated their global scope of practice using a novel SOP-VAS, from 0-100.

1409 subjects participated in this study, yielding 1202 usable data sets. CRNAs practicing in rural locations exhibited higher mean SOP scores than those practicing in urban and suburban locations ($p<0.001$). CRNAs practicing in states that had opted-out of physician supervision had higher mean SOP scores ($p<0.001$). Years in Practice was positively correlated with SOP ($p<0.01$), however months on active duty in the military as a CRNA did not show a statistically significant correlation with SOP. Gender and the composite quality score also demonstrated a statistically significant affect on SOP. Regression modeling using significant predictors from prior analyses resulted in predictive model to describe SOP ($p<0.001$).

Use of the novel SOP-VAS was found to be a reliable and valid tool to measure SOP among nurse anesthetists. Further study is warranted to identify additional factors that may contribute to scope of practice among nurse anesthetists.

Chapter One: Introduction

Anesthesia in the United States is predominantly delivered by two types of providers, physician anesthesiologists and Certified Registered Nurse Anesthetists (CRNAs). Currently there are approximately 41,000 practicing anesthesiologists (US Dept of HHS, 2010) and 42,500 practicing CRNAs in the United States (AANA, 2012). Anesthesiologist Assistants comprise a third type of anesthesia provider, with approximately 700 currently found in practice (AAAA, 2011). The education of nurse anesthetists has grown from diploma programs contained completely within a hospital to rigorous programs of study at major universities with extensive clinical training time. Preparation of CRNAs involves having completed a bachelors degree, obtaining licensure as a nurse, spending at least one year of full-time employment in the Intensive Care Unit (ICU) setting, before completing an accelerated program in anesthesia training lasting 27 to 36 months, for a total of at least five years of post-baccalaureate training (Hogan, Seifert, Moore, & Simonson, 2010). Preparation of physician anesthesiologists includes completion of medical school and a residency program in anesthesia, resulting in approximately seven post-baccalaureate years in training. Anesthesiologists and CRNAs have similar roles in the delivery of anesthesia in the US, both having extensive experience with complex cases including open heart procedures, organ transplant, and complex regional anesthesia.

Over the years, collaboration between CRNAs and anesthesiologists has resulted in improved patient satisfaction and an increase in the overall safety in the administration of anesthesia (Bechtold, 1981; Li, Warner, Lang, Huang, & Sun, 2009). Ongoing collaboration has also given rise to the implementation of three distinct anesthesia delivery models. While anesthesia may be administered by a sole-provider, 80% of CRNAs and 79% of anesthesiologists report working in an anesthesia care team (ACT) model (Taylor, 2009), which is described in Medicare Parts A and B as "medical direction". An ACT is comprised of an anesthesiologist providing medical direction for up to four CRNAs in the delivery of concurrent anesthesia cases. The second model for anesthesia delivery is characterized by CRNAs practicing under the "supervision" of the operating physician, podiatrist, or dentist. This supervisory model does not require the presence of an anesthesiologist and is permitted in all states, though only a small percentage CRNAs practice under this model. The third type of anesthesia model is characterized by CRNAs practicing “independently,” without medical direction or supervision, in states who have opted-out of the federal supervision requirement. Anesthesiologists may also practice independently in any state. According to Hogan et al. (2010), these terms "supervision" and “medical direction" are used in the context of anesthesia staffing models and billing, not necessarily in terms of clinical decision making.

Although the majority of anesthesia providers work in ACT environments, a substantial number of cases are performed by anesthesiologists or CRNAs working independently. Several recent studies have attempted to determine if there is a quality difference between the two types of providers working independently as measured by anesthesia-related morbidity and mortality using a retrospective design. To date, no prospective, randomized controlled trials have been undertaken to determine the effect of anesthesia provider on mortality. Because death related to anesthesia has become such a rare event, an adequately powered study would require a very large sample size, making it financially undesirable to study anesthesia-related mortality prospectively

(Li, Warner, Lang, Huang, & Sun, 2009). Throughout the available literature, studies have consistently supported the central thesis that anesthesia-related mortality is rare, occurring less than nine times out of one million surgical discharges, and that *no difference* can be detected between mortality rates based on the type of provider administering the anesthesia (Bechtold, 1981; Beecher & Todd, 1954; Dulisse & Cromwell, 2010; Needleman & Minnick, 2009; Pine, Holt, & Lou, 2003; Simonson, Ahern, & Hendryx, 2007). Using a retrospective analysis of anesthesia related mortality, the quality of anesthesia care does not appear to be affected by the type of provider.

Varying types of anesthesia delivery models, training variability, and locations of practice have resulted in a wide range of scope of practice (SOP) among CRNAs. SOP is defined as "the activities that an individual health care provider performs in the delivery of patient care" (Texas Board of Nursing, 2011). SOP is dynamic and multidimensional. For example, it refers to the supervision or collaborative requirements for nurse anesthetists to practice, the ability of CRNAs to seek reimbursement for services provided, as well as the individual's knowledge, skills and competency related to patient care. The legal authorization to practice as a CRNA is almost universally found in the individual states' regulations set forth by their respective Board of Nursing or Nurse Practice Acts (AANA, 2011).

Although SOP and prescriptive authority are often specifically defined within these legislative documents, other regulations such as insurance mandates, Center for Medicare and Medicaid Services (CMS) policies, and hospital bylaws significantly affect reimbursement and actual anesthesia practice. Individual hospitals determine credentialing limitations within their facility through the bylaws and approval of the medical staff boards. Despite the education and training of CRNAs and state laws regarding SOP, individual physician groups and hospital administrators often decide how to implement anesthesia practice at their facilities, which may limit the SOP of CRNAs.

Scope of practice is a multidimensional phenomenon that is difficult to measure directly. It refers to the regulatory and statutory limitations on practice, the supervision or collaborative environment in which nurse anesthetists practice, as well as the individual's knowledge, skills and competency related to patient care. The concept of SOP also goes beyond measuring what a provider is clinically allowed to do from a licensing perspective. A subjective component related to professional respect, autonomy, authority, and accountability must also be considered. The concept of a Scope of Practice Visual Analog Scale (SOP-VAS) is a novel approach to determine an individual's scope of practice within the regulatory confines of their state while considering the unique practice environment. In this study, a visual analog scale (VAS) was developed, tested and used to quantify a global measure of SOP, which incorporates multiple aspects of the phenomenon of interest simultaneously. According to a comprehensive review of the literature, there are no examples of a VAS being used to measure scope of practice as proposed in this study.

Problem and Significance

As the need for health care and the demand for anesthesia services continues to grow, the role of CRNAs practicing to the full extent of their education and training will become even more important. Driven by economic factors for cost-effective care delivery, the expectation to maintain quality of care, and the projected shortage of anesthesia providers necessitates the development of CRNAs engaging in full scope of practice (Cromwell, Pope, Butrica, & Pitcher, 1991).

In 2008, The Robert Wood Johnson Foundation (RWJF) in partnership with the Institute of Medicine (IOM) launched a two-year initiative to explore the future of nursing and the impact of the Patient Protection and Affordable Care Act (PPACA). They found that as licensing laws vary across states and credentialing rules differ between facilities within the same state, the regulations regarding scope of practice (SOP)—which defines the activities that a qualified nurse may perform—have variable effects on how advanced practice nurses function in different clinical settings. Consequently, the tasks nurse anesthetists are allowed to perform are often determined by hospital bylaws, credentialing committees, and unique state laws rather than by their education and training (IOM, 2011). In the case of nurse anesthetists, state laws unanimously allow for CRNAs to practice without the medical direction of an anesthesiologist (AANA, 2010); however, only an aggregate 20% of them engage in this type of practice. Not enough is known about the influence of mutable variables such as geography, experience as a military or civilian CRNA, and clinical training conditions in determining the resulting scope of practice among CRNAs who exhibit broad scope of practice. In line with the recommendations of the IOM report that nurses should practice to the fullest extent of their education and training, this research will address a significant gap in the literature describing SOP of CRNAs and factors that influence it.

The Patient Protection and Affordable Care Act, passed by Congress in 2010, was a bold initiative aimed at controlling costs, improving access to care, and increasing the number of insured individuals. In order to pay for these initiatives, health care providers are likely to see a reduction in reimbursement rates from government sponsored programs, such as Medicare and Medicaid, and limits on covered services. Anesthesia providers have the potential to influence cost containment as well. Areas for improvement in reducing expenditures related to anesthesia include more efficient use of providers, removal of unnecessary oversight and billing complexities, and a decrease in the cost of educating anesthesia providers (Hogan, et al. 2010). In line with these goals, the Department of Health and Human Services (DHHS) proposed a plan to evaluate burdensome regulatory requirements. Also under scrutiny was physician supervision requirements for anesthesia care imposed under CMS conditions of participation. DHHS estimated that removal of unnecessary and outdated oversight and supervision could save CMS $3 billion over five years (DHHS, 2011).

When investigating the economic impact of removing physician supervision, Hogan et al. (2010) found that the model in which CRNAs worked independently was the most economic use of anesthesia resources. Additionally, in low volume environments such a rural areas or small community hospitals, CRNAs working independently was the only model likely to maintain positive revenue for the department. In those areas, medically directed anesthesia care teams or physician only anesthesia models required government subsidies or hospital support to remain economically viable. Dulisse & Cromwell (2010) also found that anesthesia models in which CRNAs practice independently or under the supervision of the surgeon are growing in their appeal due to the flexibility they provide anesthesia departments, the redundancy of the medical direction model, and the efficiency of their implementation compared to reimbursement rates.

In addition to economic drivers influencing anesthesia delivery models, the RAND study which analyzed labor markets for anesthesiology in 2007, predicted a continued shortage of anesthesia providers across the country (Daugherty, Fonesca, Kumar, & Michaud, 2007). Their report indicated that all regions of the country were experiencing some degree of shortage, ranging from a 5.2% vacancy rate in the South to 10% in the Northeast. Given the current graduation rate of trainees from both nurse anesthesia and physician anesthesia residency tracks coupled with population growth estimates, this shortage is expected to persist until 2020. As concerning as this finding is, this provider shortage prediction does not take into account the recent mandates of PPACA, which will provide insurance to an additional 30 million Americans. It is likely that the provider shortages published in the RAND study have been significantly underestimated in light of the increasing demand for anesthesia services and providers.

The anesthesia manpower shortages are not uniform across the United States. Despite approximately equal numbers of practicing CRNAs and anesthesiologists, their geographic distribution is skewed (Cooper, Henderson, & Dietrich, 1998). Rural areas continue to experience difficulties with access to anesthesia care. Seibert, Alexander, & Lupien (2004) reported that greater than 70% of all anesthetics given in rural hospitals are administered by CRNAs. This finding is supported by the RAND study (2007) when the authors found that only 5% of practicing anesthesiologists are found in rural communities, and greater than 45% of all rural hospitals have no anesthesiologists on their medical staff. The ability of CRNAs to deliver anesthesia independently in rural communities across the country is vital to the continued operation of surgical and obstetric services and access to emergency services for the almost 20% of Americans who live outside of urban areas (US Census Bureau, 2000).

Having established both the economic necessity for the efficient use of anesthesia providers and the consistent safety record of CRNAs working independently or without medical direction of an anesthesiologist, the scope of practice of CRNAs must be explored to determine the influence of certain mutable factors. There is tremendous range in SOP among CRNAs, but there is no available literature to describe what influences a practitioner to choose a certain level of practice. As the market for anesthesia services moves toward more efficient use of available providers, the community of nurse anesthesia educators must ensure that new graduates are prepared for a broader scope of practice and higher levels of autonomy.

Exploring the strength of the relationship between geographic, clinical training, and experiential factors on SOP for CRNAs will be an important first step in addressing the disparity between practice environments for CRNAs throughout the country. This research endeavors to highlight variables that are correlated with broad scope of practice to ensure adequate training and recruitment of new CRNAs in order to maintain the high quality of care that CRNAs have always provided.

Theoretical Framework

Bandura's (1994) Self-Efficacy Theory (SET) will be used as a theoretical framework for this study. In his theory, Bandura describes four processes that affect a person's self-efficacy: mastery experiences, social modeling, social persuasion, and psychological responses (Bandura, 1994). Individuals will be more likely to attempt, persevere, and to be successful at tasks - such as the confidence and competence required for broad scope of practice in anesthesia - when they have a high sense of self-efficacy. Survey items related in this study have been constructed to reflect these four facets of self-efficacy. The influence of geography, experience, and clinical training are closely aligned with the basic tenets of this theory as we will see throughout the development of the methods.

The use of the SET as a framework for this study on scope of practice is an appropriate extension of the attributes of efficacy as they pertain to the dynamics that influence scope of practice among nurse anesthetists. Professional self-efficacy of nurse anesthetists is conceptualized as the degree or breadth of scope of practice to which the practitioner engages. It is reasonable that individuals with higher levels of self-efficacy would engage in the more demanding and challenging practice environments that increased levels of scope of practice require. The basic tenets of SET will be used to frame the variables of interest as they are examined in the context of their influence on scope of practice of CRNAs.

Measuring self-efficacy among CRNAs directly is not an objective of the study. Rather SET will serve as a framework for development of the measured variables to establish construct validity. Utilization and application of this theory will be further developed in Chapter two.

Purpose of the Study

The rapidly changing health care environment has produced conditions that necessitate a critical evaluation of the effect that scope of practice among CRNAs has on economic factors and the shortage of anesthesia providers. In order to meet the growing demand for services, CRNAs must be adequately prepared to practice to the full extent of their education and training and exhibit full scope of practice. However, identifying factors that contribute to the development of that kind of practitioner has not yet been evaluated. Given the movement towards increasing use of CRNAs as independent providers and exercising the full breadth of scope of practice allowed by law in each state, this study will evaluate a variety of variables to determine if they exhibit a relationship with scope of practice.

Despite meeting the minimum educational and clinical training requirements set forth by the Council on Accreditation of Nurse Anesthesia Educational Programs (COA), there are some inconsistencies in training among the 110 schools of nurse anesthesia. Some programs offer enrichment sites where students experience non-medically directed CRNA practice, and other programs offer extensive clinical training with highly invasive surgical cases and complex regional anesthesia that far exceed minimum standards. Access to these types of experiences during the training phase may significantly impact an individual's practice at an early stage.

Experience as a CRNA in the military may also influence SOP secondary to the autonomous environment in which these practitioners are frequently required to practice. Years of experience as a CRNA may influence the type of practice one seeks as he or she gains confidence, builds self-efficacy, and establishes proficiency over time. Additionally, geographic location of practice may influence the type of anesthesia delivery model that the CRNA engages in. Finally gender and age may also contribute to the scope of practice a CRNA seeks. Further support for these variables is provided in a comprehensive literature review. Based on the findings of this study, there may be implications for recruiting of student nurse anesthetists or recommendations regarding training of nurse anesthetists to ensure that CRNAs are trained to engage in full SOP and meet the needs of the new health care environment.

Nurse anesthesia practice has been studied in terms of quality of care attributed to various anesthesia delivery models, but not from a scope of practice perspective. Health care policy changes at the state and national level may necessitate a single provider model where reimbursement will not support the additional cost of a supervisory model. Investigating factors that contribute to higher levels of SOP among CRNAs will serve to inform nurse anesthesia educators regarding clinical training factors that influence practice, and determine the impact of experience and geographic location on scope of practice. In order to elucidate the impact of these variables, the following research question is proposed:

Research question. What is the impact of geographic location, years of civilian and military experience, and clinical training of CRNAs on their scope of practice as measured with a novel Scope Of Practice – Visual Analog Scale?

Objectives. The research question is further divided into the following objectives:

- Identify group differences in scope of practice among CRNAs based on geographic location using a novel Scope of Practice Visual Analog Scale (SOP-VAS) 0-100.
- Examine the correlation between years of experience as a civilian or military CRNA and their reported scope of practice using the SOP-VAS.
- Explore the relationship between several facets of clinical anesthesia training and SOP-VAS scores among CRNAs while controlling for geographic location and experience of the provider.

Hypotheses. Based on the three objectives outlined above, the following hypotheses are proposed:

- H_1: CRNAs working in a rural location will report higher mean SOP-VAS scores than CRNAs working in non-rural locations.
- H_2: Years of experience will be positively correlated with SOP-VAS scores.
- H_3: Years of military experience as a CRNA will be positively correlated with SOP-VAS scores.
- H_4: A combination of experience, geographic location, and clinical training variables will produce a more descriptive model of scope of practice among nurse anesthetists than experience, geography, or clinical training variables examined alone.

Definition of Key Terms

Throughout the text, discussion of anesthesia delivery models may become confusing to an unfamiliar reader. The following definitions are provided for clarity in addition to the discussion of anesthesia models in the background section. Unless otherwise noted, the definitions have been taken from Anesthesia Billing Guide, published by CMS in 2009.

Medical Direction. Occurs if the physician medically directs qualified individuals [CRNAs] in two, three, or four concurrent cases and the physician performs the following activities:

- Performs a pre-anesthesia examination and evaluation;
- Prescribes the anesthesia plan;
- Personally participates in the most demanding procedures of the anesthesia plan, including induction and emergence, if applicable;
- Ensures that any procedures in the anesthesia plan that he/she does not perform are performed by a qualified anesthetist;
- Monitors the course of anesthesia administration at frequent intervals;
- Remains physically present and available for immediate diagnosis and treatment of emergencies; and
- Provides indicated post-anesthesia care.

For medical direction services, the physician must document in the medical record that he or she performed the pre anesthetic exam and evaluation. Physicians must also document that they provided indicated post-anesthesia care, were present during some portion of the anesthesia monitoring, and were present during the most demanding procedures, including induction and emergence, if applicable.

Anesthesia Care Team (ACT). Synonymous with Medical Direction

Supervision of CRNA practice. Collaborative working arrangement by which a CRNA may practice without the presence of an anesthesiologist, under the supervision of the operating physician, dentist, or podiatrist. Hospitals and ambulatory surgery centers may be exempted from the physician supervision of CRNAs if the state in which the facility is located submits a letter to CMS signed by the Governor requesting an exemption or opt-out from physician supervision of CRNAs.

Opt-Out Provision. Final rule published in the Federal Register in 2001 allowing states to determine for themselves if removing the physician supervision of nurse anesthetists was in the best interest of their citizens and consistent with their state law. Governors are required to consult with their respective boards of medicine and boards of nursing, then issue a letter to CMS requesting that their state opt-out of the physician supervision of CRNAs. At such time CRNAs in that state would be permitted to practice without medical direction of an anesthesiologist or supervision of the operating physician (CMS_b, 2001). To date, 17 states have opted-out of this requirement.

Independent practice. CRNA practicing anesthesia without a directing anesthesiologist or physician acting as supervisor. This model is only permitted in states who have opted-out of the supervision requirement.

Non-medically directed practice. Pertaining to a CRNA either being supervised by the operating physician or practicing independently.

Chapter Summary

CRNAs fill an important role in the delivery of anesthesia care in the United States. A brief historical account of education, training, and experiences of CRNAs has been provided to set the stage for the significance of identifying factors that positively influence scope of practice. A preliminary introduction to the economic and legislative perspective on anesthesia is also presented, which will be further developed in the following literature review.

This dissertation is divided into four remaining chapters. Chapter Two contains an extensive literature review which discusses the impetus for this research in light of the recommendations by the Institute of Medicine, previous work on scope of practice for nurse anesthetists and similar specialties, support for the use of the measured variables, and the theoretical foundation for the use of Self-Efficacy Theory as it is applied to scope of practice of nurse anesthetists. Chapter Three describes the study design, explains how the variables were operationalized, details the plan for statistical analysis of the data by objectives, and examines the potential limitations of the proposed study. Chapter Four provides an objective presentation of the data analysis. Finally, Chapter Five offers an overall summary of the study, interpretation of the results, implications of additional findings, discussion of the limitations, as well as recommendations for further study.

Chapter Two: Literature Review

With over 42,000 CRNAs participating in the delivery of more than 32 million anesthetics per year, nurse anesthetists provide a vital service to patients requiring surgical and obstetric services as well as trauma stabilization in all areas of the United States (AANA, 2009). Additionally, as the principal providers of anesthesia care in the military, CRNAs have cared for soldiers on the battlefield in every conflict the United States has been involved in since the Civil War (Wicks, 2010). Nurse anesthetists practice in a variety of capacities, effectively meeting the needs of the members in their communities in collaboration with anesthesiologists and surgical colleagues, but their scope of practice is often determined by political decisions in the state in which they work rather than by their competence, education and training, or safety record. In 2011, the Institute of Medicine in collaboration with the Robert Wood Johnson Foundation published the findings of a two-year multi-disciplinary study examining the future of nursing, specifically the role of nurses in framing health care in the next decade. Advanced practice nurses (APNs), of which CRNAs are a subset, have grown increasingly important to the timely delivery of medical care in this country. Facing the challenges of a reformed health care system under the Patient Protection and Affordable Care Act (PPACA) will require a coordinated effort with the nursing profession while enhancing the role of advanced practice nurses (IOM, 2011).

The recommendation from the Institute of Medicine report that pertains specifically to CRNAs is highlighted as the first Key Message in the report: “Nurses should practice to the full extent of their education and training” (IOM, 2011, p. 29). To ensure continued access to high quality care, it is necessary that barriers to practice and restrictions on scope of practice are removed for APNs. The IOM recommends that states update and standardize their scope of practice regulations to take advantage of the full capacity and education that advanced practice nurses, such as nurse anesthetists, offer. The findings of this committee were the culmination of an exhaustive review of the literature regarding patient care from APNs, which found that high quality of care was maintained across disciplines. The panel supported implementation of broader scope of practice to increase patient access, which is not expected to adversely affect quality.

Echoing the findings of the IOM report, the New England Journal of Medicine published an article by a group of nurse executives, including the former Secretary of the Department of Health and Human Services, advocating for broadening the scope of practice of advanced practice nurses (Fairman, Rowe, Hassmiller, & Shalala, 2011). They argue that the degree of variation in scope of practice regulations does not appear to be correlated with any measure of quality or safety. For example, there is no data to suggest that APNs in states that impose highly restrictive SOP regulations give better or safer care than those APNs in liberal SOP states. The authors point out that using nurse practitioners in primary care clinics has dramatically eased the burden for chronic disease management while potentially saving states such as Massachusetts $4.2 to $8.4 billion over the next 10 years.

Similarly, Ridge (2011) discussed the mechanics of implementing the recommendations of the IOM report to utilize nurses to the fullest extent of their education and training by reducing professional resistance from physician groups, addressing fragmented care, updating antiquated insurance reimbursement practices, and using the evidence in the literature to support a change in practice. In terms of the role of nurse anesthetists to meet the increase in demand for services and maintain quality in a cost-conscious environment, several studies have been conducted to assess quality of anesthesia care and the cost of various anesthesia models.

According to Dulisse & Cromwell (2010), the non-medically directed and independent models of anesthesia delivery are growing in their appeal due to the flexibility they provide anesthesia departments, the redundancy of the medical direction model, and the efficiency of their implementation compared to reimbursement rates. These authors also found that anesthesia practice models at hospitals and outpatient settings across the country are changing to reflect their individual needs, as well as state and federal requirements regarding the scope of nursing practice, rather than maintain an inefficient and costly anesthesia care team model. Anesthesia care is frequently studied in terms of the model used for delivery; however, anesthesia is rarely described in terms of the scope of practice of the provider. Even among a medically directed model with a ratio of 1:4 (anesthesiologist:CRNA), there may be wide variations in the scope of practice among the members of the team. Understanding scope of practice for nurse anesthetists will be critical for evaluating factors that are correlated with high and low levels of practice regardless of the anesthesia delivery model.

Scope of Practice

The legal authorization to practice as a CRNA is almost universally found in the individual states' regulations set forth by their respective Board of Nursing and / or Nurse Practice Acts (AANA, 2011). Although scope of practice and prescriptive authority are often specifically defined within these legislative documents, other regulations such as insurance mandates, CMS policies, and hospital bylaws greatly affect reimbursement and actual anesthesia practice. Individual hospitals are charged with determining credentialing limitations within their facility through the bylaws and approval of the medical staff boards. Despite federal and state laws regarding scope of practice, individual group practices and hospitals often decide how to interpret those laws to best serve their patient population. Because of the many influences affecting practice at the individual level, scope of practice is a dynamic and evolving phenomenon.

To further add to the regulatory complexity of anesthesia practice, the Centers for Medicare and Medicaid Services (CMS), published their final rule in the Federal Register in 2001 maintaining the supervision requirement of nurse anesthetists "*unless* the governor of a State, in consultation with the State's Boards of Medicine & Nursing, exercises the option of exemption from this requirement" (CMS, 2001, p. 56769) through a written request signed by the governor [emphasis added]. To date, 17 states have exercised the opt-out clause, and allow CRNAs to practice without medical direction by an anesthesiologist and without supervision from the operating physician. Removal of the burdensome supervision rule has allowed continued access to anesthesia services in underserved areas and critical access hospitals throughout the United States by enabling hospitals who struggle to recruit adequate numbers of anesthesia providers the flexibility to use CRNAs to their full scope of practice. The impact of removal of physician supervision is not limited to rural areas. Hospitals and ASCs in these states now have the flexibility to determine for themselves what type of anesthesia model best serves the needs of their patients while meeting cost restraints.

Determining the scope of practice among nurse anesthetists is not solely explained by the type of anesthesia delivery model or the supervisory climate. Scope of practice (SOP) is a multidimensional phenomenon that is difficult to measure directly or assign to a given anesthesia delivery model. For example, it refers to the regulatory and statutory limitations on practice, the supervision or collaborative requirements for nurse anesthetists to practice, as well as the individual’s knowledge, skills and competency related to patient care. The concept of SOP also goes beyond measuring what a provider is clinically allowed to do from a licensing perspective. A subjective component related to professional respect, autonomy, authority, and accountability must also be considered. The concept of a Scope of Practice Visual Analog Scale (SOP-VAS) is ideally suited to determine an individual’s scope of practice within the regulatory confines of their unique practice environment, and according to their personal perceptions of the supervisory interactions with the collaborating physicians if applicable. A visual analog scale (VAS) can be used to quantify a global measure of SOP, which incorporates multiple aspects of practice simultaneously. The SOP-VAS, a novel tool to measure SOP, has been validated for use in conjunction with survey data measuring geographic, clinical training, and civilian or military experience factors to detect a possible correlation with SOP. The development and validation of this tool is further described in Chapter Three.

Most frequently recognized as a pain rating scale, the visual analog scale has also been adapted for use in the social sciences to gauge subjects' quality of life and overall health status (Rowan, et al. 2011; & Tran, et al. 2011) which are also multi-faceted constructs. These types of tools are found to be easy to administer, well understood by the subjects, and highly correlated with their target constructs (McCormack, Horne, & Sheather, 1988). When measuring a complex construct like SOP, words may fail to accurately describe the subjective experiences outlined above. Similarly, discrete rating systems may impose artificial categories on a continuous phenomenon. Although various modifications of the VAS can be found in practice, the predominant length of the tool is 100 millimeters. When constructing the SOP-VAS, the same 100 millimeter convention was retained. According to a comprehensive review of the literature, there are no examples of a VAS being used to measure scope of practice as proposed in this study.

A single reference to measuring SOP among CRNAs was reported by Alves (2005) when he studied perceived scope of practice in anesthesia care team (ACT) settings. Using practice statements from the AANA position paper on scope of practice for CRNAs, the author constructed a Likert-type rating scale for subjects to gauge their SOP. The 41 items were summed for a total SOP score ranging from 41 to 205. According to the results of the study, there was wide variation among the SOP of CRNAs practicing in the same type of ACT model. This finding supports the notion that the anesthesia delivery model itself cannot be used as a surrogate measure for scope of practice. The use of a sensitive indicator, such as a SOP-VAS, will directly measure the SOP of each practitioner, independent of their anesthesia delivery model.

Just as SOP reflects several facets of the anesthesia milieu, it can also be influenced by the perceived level of collaboration between CRNAs and anesthesiologist in a given environment. This finding was supported by Alves (2005), who found that SOP was directly related to collaboration, indicating that CRNAs who were permitted to practice at their full potential perceived higher levels of collaboration. In a subsequent study focusing exclusively on attitudes toward collaboration between CRNAs and anesthesiologists, Taylor (2009) described successful collaboration interactions as those that are nonhierarchical and where the power is shared among participants who are considered collegial equals. The results of this study revealed that CRNAs tended to report more positive attitudes toward collaboration than anesthesiologists. However, the attitude of CRNAs toward collaboration decreased as the percentage of practice with anesthesiologists increased and as the number of years of experience increased. This finding indicates that CRNAs with more experience and increasing amount of practice involving physicians tended to disfavor collaborative interactions, possibly as they felt their SOP was being limited.

Despite the findings that there may be negative attitudes toward collaboration, the use of effective collaboration between CRNAs and anesthesiologists has resulted in improved patient satisfaction and an increase in the overall safety in the administration of anesthesia (Bechtold, 1981; Li, et al., 2009). Ongoing collaboration has also given rise to the implementation of a variety of anesthesia delivery models. While anesthesia may be administered by a sole-provider, 80% of CRNAs and 79% of MDAs report working in an anesthesia care team (ACT) model (Taylor, 2009). Effective collaboration requires that members of the team have a basic understanding, respect, and acceptance of the other's expertise and role. To the extent that dysfunctional collaborative relationships limit scope of practice for CRNAs, there may be poor conflict resolution, job stress, dissatisfaction, and the potential to negatively affect patient care (Jones & Fitzpatrick, 2009). The role of SOP has been alluded to in the studies on collaboration, but it was not a measured variable and is yet to be adequately described among CRNAs in a variety of anesthesia delivery models.

Quality of Care in Anesthesia

Although the majority of anesthesia providers practice using an anesthesia care team approach, a substantial number of cases are performed by anesthesiologists or CRNAs working independently. Several studies have attempted to determine if there is a quality difference between the two types of providers working independently using a retrospective design and anesthesia related mortality as the outcome measure. Throughout the literature, the consistent finding in these types of studies is that anesthesia-related mortality is extremely rare, and it is largely determined by the overall health of the patient and the type of surgical insult the patient is facing (Kennedy, Lee, & Frizelle, 2010). According to a recent review of over 8000 cases in New Zealand, mortality and morbidity rates were affected more by the underlying physical condition and co-existing disease state of the patient rather than the invasiveness of the surgery itself (Kennedy, et al., 2010). The authors did not investigate the influence of the type of anesthesia delivery model or provider on morbidity and mortality in this study.

In a comprehensive analysis of anesthesia complications coded for all surgical cases between 1999 and 2005, Li et al. (2009) used ICD-9 codes to review 105.7 million surgical discharges. They found that the overall anesthesia-related death rate was 1.1 per million per year. The rate was higher among males and varied with age, with the lowest rate found in children aged 5-14 and the highest rate found in patients over 85. Because anesthesia-related mortality is so rare, there has never been a prospective study aimed at identifying mortality differences due to types of anesthesia providers. Consequently, the data to assess quality of care in anesthesia is limited to retrospective analysis as presented here.

In stark contrast to the study by Li et al., a landmark study from 1954 involving 10 academic medical centers and almost 600,000 surgical patients, found anesthesia related mortality to be as high as 1:1560 (Beecher &Todd). This constituted a public health concern. The authors attributed the relatively high mortality rate to a variety of causes such as a lack of adequate monitoring, circulatory collapse after administration of curare, and limited experience with local anesthetics. When examining the influence of the type of provider administering the anesthetic (physician specialist, surgeon, nurse anesthetist, or resident) the authors concluded that, “neither the experience of the individual nor the experience of the institution appears to protect the patient [from mortality associated with anesthesia]" (Beecher & Todd, 1954, p. 20). The safety of anesthesia has dramatically improved since that time due to a variety of factors.

In 1981, Bechtold reviewed over 2 million anesthetics administered in North Carolina to determine precipitating factors in anesthesia-related deaths. This study used a voluntary reporting system in which providers were surveyed after a death was identified. Only 70% of the requests for information were returned. Among the returned data, cases were grouped according to the type of anesthesia provider who administered the anesthetic as CRNA only, anesthesiologist only, or a combination of the two providers. He found the incidence of anesthesia-related mortality among the three groups to be "rather similar." However, no test of statistical significance was provided.

Anesthesia-related complications have also been studied in the obstetric population. In 2007, Simonson, Ahern, and Hendryx reviewed discharge data from 134,806 cases between 1993 and 2004 in Washington State to determine if there was a difference in rates of anesthetic complications in hospitals where the anesthesia was provided solely by CRNAs or anesthesiologists. The authors found that hospitals that exclusively used CRNAs to provide anesthesia had a lower rate of anesthetic complications that those staffed with anesthesiologists (0.58% vs 0.76%, p=.0006). However, when a risk adjusted regression model was used, the difference in complication rates was not statistically significant. Based on these findings, the authors recommended that economic indicators and provider availability be used as determinants of anesthesia staffing models rather than concerns about quality of care as a result of type of anesthesia provider.

More recently, Needleman & Minnick (2009) also examined the obstetrical records from over 1 million (N=1,141,641) patients in six states to determine if there was a difference in mortality and anesthesia complication rates related to the anesthesia delivery model. The authors used logistic regression and propensity analysis to control for variability in patient characteristics and adjust for risk. The analysis revealed that the risk of death was highest in hospitals where only an anesthesiologist was attending obstetric patients, but this difference was not statistically significant. Overall, there was no statistically significant difference among the six anesthesia models tested with regard to anesthesia-related complications.

In 2003, Pine, Holt, & Lou studied risk-adjusted mortality rates for over 404,000 Medicare patients undergoing one of eight inclusionary surgical procedures in 22 states. They found similar risk adjusted mortality rates among anesthesiologists working alone and CRNAs working alone. The study also revealed that hospitals without an anesthesiologist on staff had comparable mortality rates to hospitals with anesthesiologists on staff. The risk-adjusted mortality rates for the ACT delivery model were slightly lower than either an anesthesiologist or CRNA working alone, but this difference did not reach statistical significance.

Finally, with several years of data from states that have exercised the opt-out clause to allow CRNAs to practice without the medical direction of an anesthesiologist or supervision of the surgeon, Dulisse & Cromwell (2010) compared inpatient mortality and complication rates among Medicare patients in opt-out and non-opt-out states over a six-year period. Despite the trend toward more anesthetics being administered by CRNAs independently in both categories of states, there was no increase in adverse outcomes in either opt-out or non-opt-out states. The findings of the study were consistent with previous work, which indicated that broader scope of practice and removal of physician supervision of nurse anesthetists does not result in an increased risk to patients. Although retrospective designs have limitations in terms of their predictive capabilities, these studies provide compelling support to for broad scope of practice for CRNAs.

A single detractor among studies supporting broad scope of practice among CRNAs is a study commissioned by the American Society of Anesthesiologists, published in 1992 by Silber, Williams, Krakauer & Schwartz. This study is often cited as evidence against the independent practice of CRNAs when the authors reported higher "failure to rescue" rates among non-board certified anesthesiologists compared to board-certified anesthesiologists. The impact of CRNA practice was not evaluated in this study, only inferred. These findings have been refuted by Pine, et al. (2003) as well as Biddle (2000), and dismissed by CMS when reviewing information relevant to the issue of supervision of CRNAs (CMS_a, 2001, p. 4677).

Cost Effectiveness of Nurse Anesthesia

Cost effectiveness studies provide an analysis of the costs associated with alternative ways of achieving a given outcome (Hogan et al., 2010). Having established that quality is maintained across the variety of anesthesia delivery models, costs and revenues of those models can be compared to determine their relative cost effectiveness. Health care researchers have recognized the role of CRNAs in meeting the demand for anesthesia services for many years. In 1991, Cromwell et al. published a study highlighting the impact of dwindling numbers of CRNAs and the significant cost impact on the health care system that resulted. The authors recommended increasing production of CRNAs in training programs and using existing providers in a more cost-efficient manner. This was one of the first studies to show that unnecessary supervision of CRNAs was costly to the US health care system.

Faced with eminent changes to reimbursement as a result of PPACA, Hogan et al. (2010) examined the cost of anesthesia services among several models including independent practice by an anesthesiologist, ACT in a variety of ratios, and independent practice by a CRNA. The authors found that CRNAs working independently was the most economic use of anesthesia resources. They also concluded that in high volume areas, a medical direction model of 1:4 (anesthesiologist:CRNA) was profitable as well. However, in low volume areas, such a rural environments or small community hospitals, CRNAs working independently was the only model likely to maintain positive revenue for the department. Other models required government subsidies or hospital support to the anesthesia department for them to remain economically viable.

As health care resources are projected to be strained by the influx of newly insured patients under PPACA, a critical examination of cost, quality, and access to anesthesia care by federal agencies may have practice implications for CRNAs (Hogan, et al. 2010). Evaluating the factors that influence CRNAs to practice to broadest extent of their SOP will be necessary to evaluate training and recruiting of CRNAs to ensure this need is met with qualified and competent providers. Table 1 provides a summary of support in the existing literature regarding scope of practice, cost effectiveness, and quality of care for nurse anesthetists.

Table 1

Summary of Literature Review

Study	Subjects / Number of Cases	Methodology	Findings
Scope of Practice			
Alves, 2005	347	Survey ranking of 41 Practice-related items	Broader SOP was correlated with higher levels of collaboration. Wide range of SOP despite uniform anesthesia delivery model.

Table 1 continued

Study	Subjects / Number of Cases	Methodology	Findings
Taylor, 2009	238 (CRNA) 66 (Anesthesiologist)	Survey using an adapted Jefferson Scale for Attitudes Toward Nurse-Physician Collaboration	CRNAs reported more positive attitudes toward collaboration. CRNAs attitude toward collaboration decreased as years of experience increased and with higher percentages of practice with anesthesiologist.
Jones & Fitzpatrick, 2009	208 (CRNA) 62 (Anesthesiologists)	Survey using an adapted Jefferson Scale for Attitudes Toward Nurse-Physician Collaboration	CRNAs reported more positive attitudes toward collaboration. Participants working in ACT models reported lower collaboration scores.
Cost Effectiveness			
Cromwell, et al., 1991		Workforce forecast supply and demand models.	Increased training of CRNAs to meet demand. Opportunity cost of inefficient manpower mix ranges from $750 million to $1.21 billion annually.
Hogan, Seifert, Moore, & Simonson, 2010		Simulation models of cost to provide anesthesia versus reimbursement using multiple anesthesia delivery models and insurers. Cost to educate and train CRNAs and anesthesiologists	CRNAs practicing alone was the most cost-efficient use of anesthesia resources. Supervision ration of 1:4 efficient only in high volume areas.
Quality of Care			
Beecher & Todd, 1954	600,000	Self report data from 10 university hospitals over 5 years	Mortality reported 1:1560. Type of anesthesia provider (anesthesiologist, surgeon, CRNA, or resident) did not affect mortality.

Table 1 continued

Study	Subjects / Number of Cases	Methodology	Findings
Bechtold, 1981	>2,000,000	Self-report data from questionnaires sent to practitioners involved in a death reported to the medical examiner	Incidence of anesthesia-related mortality among the three anesthesia models (CRNA, anesthesiologist, ACT) was "rather similar."
Pine, Holt, & Lou, 2003	404,194	Medicare Part A and B claims over three years in 22 states for eight inclusionary surgeries.	Similar risk-adjusted mortality rates for CRNA-only, anesthesiologist-only, and ACT models.
Simonson, Ahern, & Hendryx, 2007	134,806	ICD-9 codes from Washington State hospital discharge data for obstetric patients over 12 years	CRNA-only anesthesia model had the lower rate of complications versus the anesthesiologist-only model. After risk adjustment regression modeling, no significant difference shown.
Needleman & Minnick, 2009	1,141,641	ICD-9 codes from discharge data of obstetric patients from six states over three years	Anesthesiologist-only model had the highest rate of complications, although not statistically significant. Using logistic regression modeling, no model had significantly lower rates.
Dulisse & Cromwell, 2010	741,518	Medicare Part A and Part B 5% limited data set for all surgical DRGs over seven years	Increasing percentage of anesthetics were performed by CRNAs-only without increase in mortality rates.
Silber, 1992	5,972	Random selection from HCFA MEDPAR files for two types of surgery over one year.	Higher "failure to rescue" rates in hospitals with low percentages of board-certified anesthesiologists.

Support for Study Variables

Effect of experience. The Annual Practice Profile conducted by the AANA in 2009 found that after 5 years of experience, 28-35% of CRNAs spend 100% of their time in non-medically directed practice (AANA, 2009). However, only 16% of new CRNAs work exclusively in non-medically directed practice. This data garnered from a survey of practicing nurse anesthetists illustrates that as CRNAs gain experience over time, they become more likely to practice without the attendance of an anesthesiologist. Although not a direct measure of scope of practice, this trend toward a more independent model would indicate broader scope of practice among the CRNAs who do not work under the medical direction model.

Similarly, military CRNAs frequently do not practice under the medical direction of an anesthesiologist, especially during times of deployment. A study of military CRNAs in 2009 found that over 91% of respondents rated their perceived level of professional autonomy as "high" (Pearson, Fallacaro, & Pellegrini). In January, 2012, the Department of Defense instituted a new service-wide policy redefining anesthesia care teams to remove supervisory language. The policy states that the new definition of ACT "refers to any combination of anesthesiologist or CRNA working as a team" to promote collaboration in the delivery of anesthesia and its related services (Regulation: AFI44-102, 2012). The military is embracing the efficiency and flexibility of allowing CRNAs to practice independently in light of recently published studies highlighting the safety of anesthesia care provided by CRNAs and the recommendations of the IOM report on the future of nursing. Although actual levels of scope of practice have not been measured in the population of military CRNAs, their propensity to work without the supervision of a surgeon or medical direction of an anesthesiologist indicates a trend toward broad scope of practice.

These studies provide a glimpse into the trends related to anesthesia practice models and the corresponding perception of autonomy and levels of collaboration. Anesthesia delivery models are not necessarily an accurate proxy for scope of practice though. As demonstrated in the study by Alves (2005), a wide range in SOP may exist in one ACT model. However, as a basis to justify analyzing different anesthesia delivery models as a possible factor that influences scope of practice, it is reasonable to assume that CRNAs working independently or without the medical direction of an anesthesiologist would exhibit a broader scope of practice than those practicing in other models.

Effect of geography. A study was undertaken by the RAND Corporation in 2010 to analyze the labor markets for anesthesia to determine if there was an impending surplus or shortage of providers. In collaboration with the professional societies representing both CRNAs and anesthesiologists, a nationwide survey was conducted via email with a response rate of 24% and 22% respectively. Additionally, 1,313 directors of departments of anesthesia were surveyed with a response rate of over 51%. The study revealed some interesting statistics about how anesthesia providers are distributed across the country. The findings from the RAND study indicated that there is a mal-distribution of anesthesia providers across the country, with only 5% of anesthesiologists practicing in rural areas. Access to anesthesia care outside of urban areas is heavily dependent on the services of nurse anesthetists, where they must use their full scope of practice to meet the needs of the patients in those areas. This geographical disparity is represented in Figure 1.

With only 5% of practicing anesthesiologists working in rural areas, the RAND survey also found that many facilities do not have a single anesthesiologist on staff. In rural areas, 45% of hospitals reported to exclusively use the services of CRNAs for anesthesia delivery. The

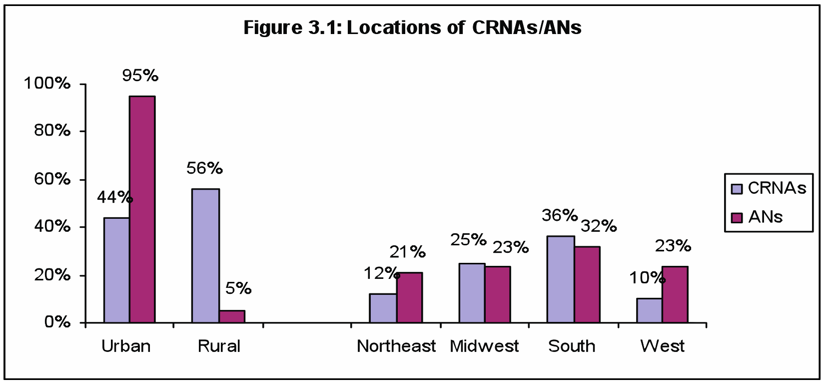

Figure 1. Practice location of CRNAs and Anesthesiologists (AN). Adapted from An analysis of the labor markets for anesthesiology. http://rand.org/pubs/technical_reports/TR688. Copyright 2007.

scope of practice required of CRNAs who work in rural areas is expected to be high to reflect the autonomous nature of their practice. Table 2 provides the percentage of facilities utilizing the services of only physician anesthesiologists or only CRNAs to provide anesthesia services.

Table 2

Percentage of Facilities Using Exclusively Anesthesiologists or CRNAs

Location	% Anesthesiologists only	% With CRNAs only
Northeast	20	5
Midwest	11	28
South	9	18
West	55	18
Rural	9	45*
Urban	26	5

Note. Adapted from An analysis of the labor markets for anesthesiology. http://rand.org/pubs/technical_reports/TR688. Copyright 2007.

The annual practice profile conducted by the AANA (2010) also illustrates the dichotomy in practice trends between rural and urban areas. According to their member survey with 4,366 responses, 68% of CRNAs who work in urban areas report working in a medical directed model.

However, only 30% of CRNAs who work in rural areas report using the medical direction model. The remainder of the rural CRNAs practice independently or under the supervision of the operating surgeon in states who have opted-out of the supervision requirement.

In addition to rural CRNAs tending to practice in a more independent role, a study of ICU nurses practicing in rural areas found that increased autonomy and broader scope of practice was actually used as a recruiting tool by directors of nursing (Stratton et al., 1993). This study supports the role of geography in shaping scope of practice among nurses, and also the desirable nature of broad scope of practice. Although not measured in this study, higher levels of autonomy may be reflected as boosting self-efficacy to the point that it could be used as a recruiting mechanism.

A descriptive study by Seibert, Alexander, and Lupien (2004), described rural anesthesia practice using a survey of CRNAs living in rural areas across the country. Although only a small sample of CRNAs responded (N=28), the findings were consistent with trends highlighted above. Of the responding CRNAs working in towns with less than 10,000 citizens, 100% of them practiced without medical direction of an anesthesiologist, 50% of the respondents from towns with 10,000 to 50,000 residents practiced without medical direction, and all of the respondents (N=3) from towns with greater than 50,000 residents practiced under the medical direction model. Additionally, they found that anesthesiologists were more likely to work in larger rural areas (greater than 50,000 residents). Although scope of practice was not measured directly in this study, the authors found that the majority of respondents provided advanced pain management techniques such as epidural steroid injections and intrathecal narcotics, as well as providing emergency services outside of the operating room. Geography has been shown to be an important determinant in the type of practice in which CRNAs engage.

Based on the definition provided by the Federal Office of Management and Budget, the designation of metropolitan versus nonmetropolitan status will be used to discern the geographic location of respondents as dichotomous categorical variables (OMB, 2009). To standardize data collection and statistical analysis, the OMB defines metropolitan and micropolitan statistical areas. Their convention is that metropolitan areas contain a core urban area of 50,000 people or more, and micropolitan areas contain an urban core of at least 10,000 but less than 50,000 people (OMB, 2009). Areas with population less than 10,000 will be designated as rural areas for this study. These population definitions were used to separate urban, suburban and rural areas for the study participants on the survey.

Effect of clinical training. There is no reference in the literature comparing SOP among CRNAs that can be attributed to the use of different types of supervisory models or a variety of training experiences. Although the Council on Accreditation of Nurse Anesthetists (COA) routinely evaluates programs to ensure they adhere to published educational and clinical standards, there is a vast range of clinical experiences that students encounter from one school to another. For example, there is a wide range in the average total cases reported by programs, average number of neuraxial techniques, and differing lengths of clinical training portions to name a few. Many schools use simulated experiences for students because they struggle to meet the minimum requirements for central line placement or fiberoptic intubations on patients, while others far exceed the minimum standards in those areas. Schools of anesthesia also vary in the types of clinical rotations that their students experience with some offering community and rural anesthesia rotations, and others providing anesthesia training exclusively in academic medical centers. Degrees conferred on the graduates may include a master's degree in science (MS), master's degree in nursing (MSN), doctor of nursing practice (DNP), or doctor of nurse anesthesia practice (DNAP). This research will endeavor to elucidate the effect of these variables on scope of practice when considered in the context of geography and experience of the CRNA.

Taken individually, even with a large sample size it would be difficult to attribute a change in SOP to any one of the many clinical training variables proposed in this study. The concept of a composite variable is proposed as a measure of the global clinical training experience that an individual CRNA reports. Composite variables are useful for summarizing a large number of indicators into a simple summary score or value (O'Brien, 2007). Research on the use of composite variables has shown that they can be more comprehensive than any single measure, and have more precision. According to the Duke Clinical Research Institute, composite variables are widely used throughout clinical outcomes research; with studies involving asthmatic control, Alzheimer's functionality, activity levels with juvenile idiopathic arthritis, severity of hemophilia, and multiple sclerosis function all using this type of variable (O'Brien, 2007).

The Physician Consortium for Performance Improvement (AMA, 2010) recently laid out guidelines for the development and implementation for composite variables. When developing composite variables, the goal is to indirectly measure a latent variable, here the latent variable is the quality of clinical training experience, through more tangible indicators that are closely related to the latent variable. All variables must measure some aspect of the same thing, providing unidimensionality, and they should all be highly correlated to ensure internal consistency. Finally, directionality of the measures must be consistent to sum the indicators into a composite score.

Based on the Self-Efficacy framework, which will be fully developed in the following section, ten aspects of clinical training have been identified as possible indicators of the overall quality of the training experience. These ten clinical training attributes will be used to calculate a composite variable for use in the statistical analysis.

Support has been provided to demonstrate the connection between experience, geography, and clinical training variables and SOP given the available literature. To determine the extent to which these three categories of variables affect SOP among nurse anesthetists, the variables are also considered in the context of Bandura's Self-Efficacy Theory. The investigators propose that the factors that influence self-efficacy are similar to those that shape scope of practice among nurse anesthetists. The theory will be explored in detail to demonstrate the alignment of the proposed study variables with the four basic tenets of self-efficacy.

Bandura's Self-Efficacy Theory

Bandura's Theory of Self-Efficacy is a component of his original work on Social Cognitive Theory (Bandura 1994, 1997, 2001). Bandura defined perceived self-efficacy as belief in one's personal capabilities. Individuals' beliefs in their efficacy influences the choices they make, their aspirations, how much effort they mobilize in a given endeavor, how long they persevere in the face of difficulties and setbacks, and the amount of stress they experience in coping with taxing environmental demands (Bandura, 1994). The basic principle of the theory is that people are likely to engage in activities to the extent that they perceive themselves to be competent at those activities. Through testing of the theory, Bandura found that individuals with a strong sense of efficacy have very different responses to situations. For example, those with strong self-efficacy have a high assurance in their capabilities, and they approach difficult tasks as challenges to be mastered instead of shying away from them as threats. They set challenging goals and tend to sustain their efforts in the face of difficulty. If they fail at a task or suffer a setback, those with high self-efficacy attribute the failure to insufficient knowledge or effort, which can be acquired (Bandura, 1994).

In contrast, individuals with low levels of self-efficacy tend to doubt their capabilities and not engage in tasks that they feel are difficult or threatening. They have low levels of commitment to goals, and will dwell on their personal deficiencies or the likelihood of an adverse outcome when they are faced with challenges. They view failures as the result of their own innate inability, and tend to give up very easily. To avoid falling into a depressive state, people with low self-efficacy may prefer situations where they are comfortable (Bandura, 1994).

Previous work using SET in the context of scope of practice was performed by Le Blanc, et al. (2010) when they examined the correlation between professional efficacy and the goal of collaborative practice between physicians and nurses by surveying nurses working in intensive care units. Based on the motivational potential of efficacy beliefs described by Bandura (1997), the authors postulated that higher professional efficacy would result in more effort (persistence) and improved collaborative relationships. As predicted, they found a high degree of positive correlation between professional efficacy of the nurses and collaborative practice.

The study of ICU nurses used a domain specific measure of self-efficacy that was unique to their practice environment (LeBlanc, et al. 2010). Previous studies have shown that using a domain-specific measure of efficacy beliefs provides a more accurate measure of efficacy than a global scale (Salanova, et al. 2002). Bandura explains that efficacy is not a global trait, but a differentiated set of self-beliefs linked to distinct realms or domains of function. An individual's self-efficacy belief is likely to vary depending on the activity to which it is being related. Therefore there is no all-purpose measure, rather a scale for self-efficacy must be tailored to the particular domain of interest (Bandura, 2006). Several studies using SET in health care related research have employed a domain-specific measure rather than a general measure of efficacy to address perceived professional efficacy as recommended (Maslach & Jackson, 1981; Le Blanc, et al. 2010). The use of the SET as a framework for this study on scope of practice is an appropriate extension of the attributes of efficacy as they pertain to the dynamics that influence scope of practice among nurse anesthetists.

Professional self-efficacy of nurse anesthetists is conceptualized as the breadth of scope of practice in which the practitioner engages. Since self-efficacy is concerned with perceived capability, it will measure what a CRNA *can do* rather than what he or she *will do*. It is reasonable that individuals with higher levels of self-efficacy engage in the more demanding and challenging practice environments that increased levels of scope of practice require. The basic tenets of SET will be used to frame the variables of interest as they are examined in the context of their influence on scope of practice of CRNAs.

In his theory, Bandura described four main sources of influence over self-efficacy: mastery experiences, social modeling, social persuasion, and affective modification. These four sources of self-efficacy are shaped and modified by various modes of induction (Bandura, 1994). Figure 2 illustrates the influence of these four sources self-efficacy and their associated modes of induction as described by Bandura.

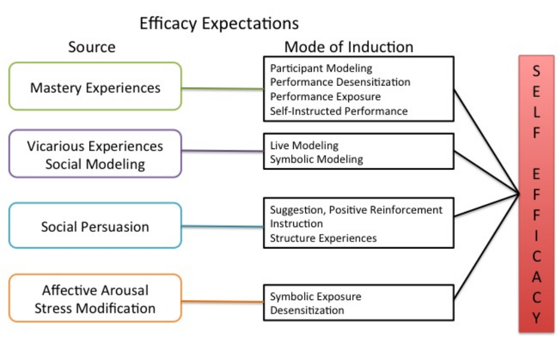

Figure 2. Sources of self-efficacy and mode of induction. Adapted from "Self-efficacy" by A. Bandura, 1994, Encyclopedia of human behaviour, 4, p. 71-81. Copyright 2008 by the Academic Press.

According to Bandura (1994), the most powerful influence over self-efficacy comes from Mastery Experiences. Success builds a strong belief in one's abilities, but failures can undermine it, especially if efficacy is not yet well established. Building resilient self-efficacy does not mean that an individual should experience continuous easy successes, but rather that the he or she must succeed at overcoming obstacles through perseverance. Setbacks offer an opportunity for teaching that can lead people to emerge stronger from adversity.

Mastery experiences are manifested in nurse anesthesia practice through three of the measured variables. First, adequate length of clinical training to provide the necessary experiences is needed to master advanced anesthesia skills. Second, acquiring mastery of anesthetic techniques and critical situations is expected to further develop over years of practice. Finally, experience in the military as a CRNA will allow the practitioner to have repeated exposure to extensive trauma training and allow for mastery of advanced techniques required to enhance self-efficacy and influence scope of practice.

The second way of strengthening self-efficacy is through Social Modeling or vicarious experiences. By observing individuals similar to one's self succeed by sustained effort will raise the observer's beliefs that they also can accomplish similar activities. The impact of social modeling is dependent on the degree of similarity to the model. The more similar the model and the learner are, the greater the impact social modeling will have. Efficacious people seek out proficient models, which have attributes or competencies that the learner desires (Bandura, 1994). Additionally, effective models convey knowledge and teach observers the necessary skills for managing the environmental demands.

In the realm of nurse anesthesia training, non-medically directed CRNAs who precept students model independent practice and broad scope of practice. Additionally, the anesthesia providers in training environments such as large academic centers, rural hospitals, and urban community hospitals will model varying levels of domain-specific self-efficacy manifested as a range of scope of practice. Training in these different environments is expected to influence the resulting scope of practice of the CRNA in his or her career based on the effects of social modeling.

The next dimension of enhancing self-efficacy is Social Persuasion, in which individuals are persuaded verbally that they have the capabilities to master a given task. When provided with positive verbal reinforcement, the learner is likely to mobilize the necessary effort for task completion and sustain it than if they are focus on deficiencies. It is more difficult to enhance self-efficacy through social persuasion than to undermine it. Structuring activities in a way that erodes motivation and creates doubt one's capabilities may lead to its own negative validation. Actions that build self-efficacy go beyond just positive appraisals of performance. Facilitators also use social persuasion to structure experiences and situations in a way that will foster success and growing independence through continuous improvement (Bandura, 1994).

When considering the training environment for nurse anesthetists, social persuasion is an important factor of self-efficacy. The mentorship of preceptors is important for fostering a trusting and structured environment in which students are introduced to appropriate experiences when they have the tools to handle them. Exposure to complex cases at an early phase of training may undermine self-efficacy, whereas those same experiences would strengthen self-efficacy if introduced at a later phase. Variables tested in this study related to social persuasion include the identification of a mentor during training, and the effect of a co-located physician anesthesia training program at a large percentage of nurse anesthesia training sites.

Finally, the fourth factor that influences self-efficacy is managing the stress response to difficult situations by reducing or modifying those stress reactions. Bandura labels this as source Affective Arousal (1994). People may interpret their stress reaction as a sign of inadequate performance or vulnerability. When people view their affective arousal, or natural stress response, as energizing it will facilitate their performance and mitigate self-doubt.

During anesthesia training, students may experience high levels of stress when exposed to invasive and challenging surgical cases. This affective arousal can be harnessed to enhance performance through the quality of the training and support that the learner receives throughout the case. This effect is analyzed through the survey by quantifying the quality of experience that CRNAs report when learning highly invasive anesthesia techniques. Additionally, years of experience in anesthesia practice is expected to lead to a reduction in the stress response as CRNAs adapt and modify their stress response to demanding situations.

Figure 3 provides a graphic conceptualization of the attributes of the theory with the study variables incorporated into the model. Each of the four tenets of self-efficacy have been described above from a theoretical framework perspective as well as a scope of practice perspective, which demonstrates a fitting application of SET for this study on scope of practice.

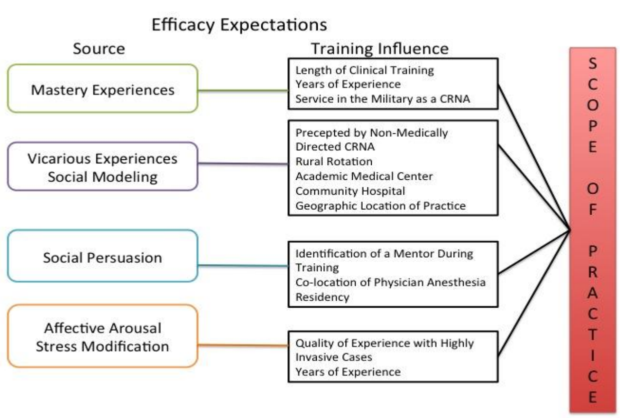

Figure 3. Sources of self-efficacy, adapted for use with scope of practice attributes.

Chapter Summary

A thorough review of the literature suggests that scope of practice of CRNAs is a relatively untapped area for study. Previous work describing practice models exists, but no correlations have been made to the broader construct of scope of practice. There is strong and consistent evidence in support of the safety and efficacy of nurse anesthetists practicing without the medical direction of an anesthesiologist or supervision of the operating physician. Additionally, studies have shown that quality of care is maintained when CRNAs practice independently and cost-efficiency is maximized. Movement away from a restrictive, medical direction model is also supported by the Institute of Medicine's Report on the Future of Nursing when the multi-disciplinary panel recommended that all advanced practice nurses practice to the fullest extent of their education and training. This study endeavors to measure actual scope of practice among CRNAs working in a variety of different models to determine the impact of the variables of interest through a correlational approach and survey methodology described in Chapter Three.

Chapter Three: Methodology

With greater than 42,000 nurse anesthetists delivering over 32 million anesthetics each year either as a member of an anesthesia care team, under the supervision of the operating physician, or as an independent provider (AANA, 2012), the role of nurse anesthetists in the delivery of quality and cost-efficient anesthesia has been well established. Using a variety of anesthesia delivery models, a broad range of scope of practice exists among CRNAs. Recommendations from the Institute of Medicine call for all nurses to practice to the fullest extent of their education and training. Further support for broad scope of practice is found based on several outcomes-based studies demonstrating that quality of care is maintained when nurse anesthetists practice without the medical direction of anesthesiologists or the supervision of the operating physician. Despite documented quality and efficiency of practice models that incorporate broad scope of practice for CRNAs, barriers remain to full scope of practice among nurse anesthetists. Determining the impact of factors such as experience, geography, and clinical training on scope of practice among CRNAs will serve to modify the training and recruiting of CRNAs to promote broader scope of practice.

Problem and Purpose Overview

Given the recent proposed changes to health care delivery through the implementation of the Patient Protection and Affordable Care Act, a surge of newly covered individuals are expected to further stress the system's ability to meet the demand for services. For anesthesia, this increase in demand and corresponding need for reduction in overall cost necessitates a increase in the use of efficient delivery models, and utilizing the full breadth of scope of practice of nurse anesthetists. Research to identify factors that contribute to individual CRNAs' readiness for a broad scope of practice is needed to ensure that quality of care is maintained.

Guided by Bandura's Self-Efficacy Theory (SET) as a theoretical framework for this study, professional self-efficacy of nurse anesthetists is a domain specific "representative" for the breadth of scope of practice in which the CRNA engages. Underlying the development of variables that are aligned with self-efficacy as a conduit for scope of practice is the underlying assumption that individuals with higher levels of self-efficacy would engage in the more demanding and challenging practice environments that increased levels of scope of practice require. The four theoretically-based processes described by Bandura and illustrated in Chapter Two were used to develop variables of interest related to practice that are thought to influence scope of practice.

Research Question. This chapter describes the research methods and statistical analysis that were used answer the research question: "What is the impact of geographic location, years of civilian and military experience, and clinical training of CRNAs on individual scope of practice?"

Objectives. The objectives of this research study are three-fold: The first is to identify group differences in scope of practice among CRNAs based on geographic location. The second objective is to examine the correlation between years of experience as a civilian or military CRNA and reported scope of practice. The final objective is to explore the relationship between several facets of clinical anesthesia training and SOP among CRNAs while controlling for geographic location and experience of the provider. All correlations use the subjects' reported scope of practice as the dependent variable, which was measured by the novel Scope of Practice Visual Analog Scale (SOP-VAS).

Hypotheses. The following study hypotheses guided the evaluation of the relationship between the three variables of interest and scope of practice as conceptualized by the self-efficacy theory. Geography, experience, and clinical training serve as the independent variables and scope of practice is the dependent variable.

- H_1: CRNAs working in a rural location will report higher mean SOP scores than CRNAs working in non-rural locations.
- H_2: Years of experience will be positively correlated with SOP scores.
- H_3: Years of military experience as a CRNA will be positively correlated with SOP scores.
- H_4: A combination of experience, geographic location, and clinical training variables will produce a more descriptive model of scope of practice among nurse anesthetists than experience, geography, or clinical training variables examined alone.

Table 3 illustrates the relationship between the proposed objectives, variables, and hypotheses. An additional list of secondary testable hypotheses is provided in Appendix D.

Research Design

Given the descriptive nature of the research question, this study used a non-experimental, correlational approach that focused on understanding the clinical, experiential, and geographic conditions that exist among CRNAs, and their relationship with scope of practice. Using a nationwide cross section of practicing CRNAs, these factors were investigated using survey methodology. Polit and Beck (2009) describe descriptive research as an appropriate initial step toward understanding factors that influence a relatively underdeveloped phenomenon such as

Table 3

Summary of Study Objectives, Variables, and Research Hypotheses

Objective	**Independent Variables**	**Dependent Variables**	**Hypotheses**
(1) Geography	◆Primary practice location ◆Residence prior to anesthesia training ◆Current residence ◆Opt-out state	Scope of Practice	◆CRNAs working in rural areas will report higher mean SOP-VAS scores than CRNAs working in non-rural locations.
(2) Experience	◆# of years as a CRNA ◆# of months in military service as a CRNA ◆Gender ◆Age	Scope of Practice	◆Years of experience will be positively correlated with SOP-VAS scores ◆Duration of military experience will be positively correlated with SOP-VAS scores
(3) Clinical Anesthesia Training	◆Length of clinical training ◆Precepted by non-medically directed CRNA ◆Identification of a mentor ◆Length of rural rotation ◆Length of training at academic medical center ◆Length of training at community hospital setting ◆Length of training with co-located physician anesthesia residency program ◆Quality of experience with highly invasive anesthesia cases Open heart Major vascular Complex regional Neuraxial blocks Obstetrics Pediatrics Craniotomies Central line placement Trauma Difficult airway management	Scope of Practice	◆A combination of experience, geographic location, and clinical training variables will produce a predictive model of scope of practice among CRNAs

scope of practice for CRNAs. These authors highlight that descriptive, correlational design is ideal for efficiently collecting a large amount of data through realistic and non-artificial means, thus offsetting criticisms of non-experimental designs. Enhancing the rigor of descriptive studies relies on a design that will allow the researcher to rule out competing explanations for given outcomes. As a preliminary study aimed at understanding factors that influence scope of practice, this study was constrained to the effects of only three potential influences, which are not exhaustive. The effect of factors such as personality are valid, but will serve as an opportunity for further study on this topic. The quality of descriptive research is heavily dependent on minimizing threats in internal and external validity while drawing data from a highly representative sample. Methods to design a rigorous descriptive correlational study are provided in the coming sections.

This study was reviewed and approved by the Institutional Review Board (IRB) at Virginia Commonwealth University, and processed for exempt status. The letter of IRB approval was included in the application to the Research Foundation at the American Association of Nurse Anesthetists (AANA), who disseminated the survey link anonymously to 10,000 of its active members for a fee. Representing over 95% of CRNAs in the United States, use of the AANA membership database for subject recruitment was critical to obtaining a representative sample of the practicing CRNA population for evaluation of factors affecting scope of practice.

Using an email solicitation, subjects were invited to participate in an online survey regarding scope of practice using a novel Scope of Practice Visual Analog Scale (SOP-VAS). The invitation included the aims of the study, description of the SOP-VAS tool, and consent to participate in research. This survey collected self-report data collected on a cross-section of practicing CRNAs related to the variables listed in Table 3.

Population, recruitment, and sampling methods. The target population is the 42,500 practicing CRNAs in the United States. According to the 2011 AANA Demographic Survey, the mean age of the population is 49, with a range of 26 to 80. Their education level ranges from 31% with a either a diploma or baccalaureate degree in nurse anesthesia to 67% with a masters degree, and the remaining 2% of practicing CRNAs with a doctorate degree. The percentage of practicing males and females is 45% and 55 % respectively. Data is not available on the race and ethnicity of the population, but this is not considered to be a vulnerable population. The sample consisted of CRNAs registered as members of the AANA who are actively practicing anesthesia full or part time. Participation in the study was voluntary, no personally identifying information was requested, and returns of the survey were de-identified automatically through the data collection software. A random selection of 10,000 CRNAs was made from the membership database at the AANA. Members who have opted out of research participation were not included in the random selection. Since only 3% of members have opted out of participation in survey solicitation, this was expected to have a minimal effect on sampling bias.

By drawing data from a large sampling frame, the population was oversampled to provide the most flexibility for post-stratification sampling. It is important for the analysis that adequate and proportional numbers of CRNAs are represented based on age, gender, regions of the country (urban and rural), anesthesia practice model, and years of experience. The completed surveys were first analyzed as a group to ensure that the composition of the respondent pool was not significantly different that the population of CRNAs relative to the listed demographic items. An over-representation of a subset of CRNAs may have influenced the generalizability of the results. However, after careful review of the composition of the respondent pool and appropriate statistical testing, no post-stratification sampling was necessary.

Sample size and power. A power analysis was performed using the method described by Tabachnick, & Fidell (2007) for multiple regression. Using a medium effect size, an Alpha level of 0.05 and Power (1-B) of 0.8, the following equation is recommended for testing the multiple correlation:

N = 50 + 20 x (#IVs)

N = 50 + 20 x (15) for the full model

N = 350

When testing all variables simultaneously, the sample size required is 350.

The regression analysis will also be run separately to test the variables related to geography, experience, and clinical training individually. When testing fewer IVs, a large sample is not required.

Because of the large number of variables tested in the full model (see Table 3, page 44), a conservative estimate of N=500 is the goal for subject recruitment. Using email solicitation of 10,000 practicing CRNAs and reminders at intervals over the data collection period, 1409 subjects used the embedded link to take the survey. After removing data sets that were missing a value for the dependent variable, 1202 usable data sets remained, which was well above the number of subjects indicated by the power analysis.

Instrumentation

Scope of Practice Visual Analog Scale (SOP-VAS) survey. Because of the multi-faceted nature of scope of practice, a novel measurement tool was devised to represent a range of constructs simultaneously. The use of a visual analog scale has been validated for many different facets of health care and patient care. Most frequently used in the quantification of acute and chronic pain, visual analog scales have also been used to assess nausea and patient satisfaction with care. These types of tools are easy to administer, well understood by the subject, and highly correlated with their target constructs (DeLoach, et al. 1998; McCormack, Horne & Sheather, 1988; Meek, Kelly & Feng, 2009). Although various modifications of the tool can be found in practice, the most prevalently used length of the tool is 100 millimeters. When constructing the novel SOP-VAS, the same 100 millimeter convention was retained for use with the electronic survey.

The practice statements used as correlates for scope of practice were taken from the AANA Position Statement on nurse anesthetists and anesthesiologists practicing together (AANA, 1996). These practice statements are aimed at examining the spectrum of nurse anesthesia practice with extreme anchoring points incorporated to quantify the level of professional autonomy a given CRNA experiences in his or her practice environment. The SOP-VAS was validated using feedback from experts in the field of nurse anesthesia education to ensure content, criterion, and construct validity, as well as item clarity. Individual items on the pilot survey were evaluated for internal consistency using Pearson product moment correlations. The reliability of the tool was then pilot tested using secure online data collection software through the university's REDCap program (Research Electronic Data Capture).

Using a convenience sample of 36 CRNAs whose practices ranged from independent to highly restrictive, responses to detailed practice questions and overall SOP-VAS scores were tested for correlations. Cronbach's alpha for the Likert-type items related to SOP was 0.893, which indicates a very high degree of internal consistency of responses. For the final analysis, the SOP questions were coded for one-way analysis, scored, and tested against the SOP-VAS score using correlation and regression modeling.

Correlation and regression coefficients are reported as r and R-squared respectively. Determining what constitutes and appropriate or significant value of r or R-squared depends heavily on what is being measured. Correlations among practice statements were tested for their significance with a p-value of <0.05, and an r value > 0.5 was required. The higher the r value, the more closely correlated the statements could be considered. R-squared is a term that represents the fraction of the variance explained by the model (Tabachnik & Fidell, 2007). This value is also highly dependent on what variables are being measured and with what precision. In determining the variance in SOP-VAS scores that could be predicted from the pattern of responses on practice statements, the R-squared was considered to be significant to be if it exceeded 0.5 as a basis for validating the scale.

Statistical analysis of the pilot data demonstrated that the anchoring statements, such as "I prefer to work in an autonomous environment," and "I prefer to work in a minimally medical directed environment," showed a high degree of correlation (r= 0.552; p<0.001). Internal consistency was also demonstrated with statement such as, "My education and training are respected by my anesthesia colleagues," and "My opinion regarding patient management is valued" with high correlation values (r= 0.624; p<0.001). Responses to the SOP questions were scored and summed to give each participant a total score on the questionnaire items. The overall score for each respondent was correlated with their SOP score using a VAS. The Pearson correlation for overall item scores against the SOP-VAS was r=0.734, P<0.001, also indicating a high degree of correlation between the two measures of SOP. This final score was then tested against the reported SOP-VAS score using multiple regression modeling which revealed an overall R-squared =0.539, F=33.973, p<0.001.

As illustrated here through a variety of techniques, statistical testing supports the reliability of the SOP-VAS as a single measure of scope of practice. It reflects the multiple practical and professional constructs of scope of practice as an independent global SOP score. This validated tool was then integrated into the full survey for dissemination to the study population. An example of the pilot survey to determine validity and reliability of the SOP-VAS is provided in Appendix A. Additionally, statistical output to support the validation of this tool is also found in Appendix G.

Factors that Influence Scope of Practice survey. To discern the impact of geography, civilian and military experience, and clinical training on scope of practice of CRNAs, the survey for data collection was constructed and presented in four distinct sections. The first section laid out a basic explanation of the study aims, provided instruction for accurate completion of the survey, and obtained basic demographic information from the participant. The next section contained four items related to experience as a CRNA, followed by four items related to geographic location of residence and practice. The third section was comprised of nine items related to clinical training and the completion of a various types of clinical rotations. Finally, respondents answered three items related to the legislative rules governing SOP as a CRNA in their state prior to completing the SOP-VAS. A sample of the complete survey is included in Appendix B.

The demographic items were used to determine homogeneity of the study sample to the population of practicing CRNAs. The geographic categories of urban, suburban and rural are operationalized as categorical variables according to the definitions of the Federal Office of

Management and Budget. The OMB defines metropolitan and micropolitan statistical areas for the purpose of consistent statistical analysis. Using their convention, metropolitan areas contain a core urban area of 50,000 people or more, micropolitan areas contain an urban core of at least 10,000 but less than 50,000 people, and areas with population less than 10,000 are designated as rural areas (OMB, 2009).

Recollection of clinical training details may be difficult to accurately recall for CRNAs who have been in practice for many years. Rather than ask subjects to recall the actual number of cases they performed during training, respondents were asked to quantify their experience using a five point Likert-type rating to reflect the quality of experience with highly complex or invasive anesthesia cases they performed during their anesthesia training. It is expected that subjects will recall their perception of the quality of their training and feeling of preparedness after training with more precision than quantitative numbers of cases. Using the construct of self-efficacy as an indicator of scope of practice, the subject's general perception of the quality of the training and the adaptation or stress modification that results from adequate preparation is a more fitting measure than an actual number of cases. Similarly, subjects were asked to ordinally rank the amount of time that they spent training in a location that also housed a physician anesthesiology residency program, rather than recall the actual number of months.

The final section of the survey contained basic questions about the subject's familiarity with scope of practice laws in their individual state, and whether they practice in an opt-out state. The survey concluded by asking the participant to rate their scope of practice by using a slider on a line measuring 100 millimeters (mm) in length. The survey was constructed in a succinct manner that logically followed from the objectives, allowing the subjects should move efficiently through the questionnaire items. When possible, drop down menus were used to minimize data entry by the participants.

The survey was constructed as an adaptive questionnaire with branching logic that expanded or contracted based on the subjects' responses. This feature allowed detailed information to be gathered on certain topics while minimizing the number of questions that each respondent completed overall. Scope of practice was measured using a "slider" that the respondent physically moved from left to right with the mouse on a line measuring 100mm. The line was anchored with descriptors at 0 and 100. The slider function was tested during the SOP-VAS validation and was found to be user-friendly. The subject also received a numeric indicator as they moved the slider from left to right, giving them a spatial appreciation for the response as well as a quantitative value.

Prior to email solicitation for participation, this survey was pilot tested and reviewed by an expert panel to ensure construct validity and item clarity. The panel used the online data capture tool to evaluate the survey content as well as the user experience with the internet based tool. Their critiques and recommendations were incorporated into the final version of the data collection survey. A summary of the feedback from the expert panel has been provided in Appendix E.

Data Collection

Subjects were invited to participate in this study via an email solicitation sent directly from the AANA Research Division. It is the policy of the AANA not to disclose member emails to outside sources, so the professional association initiated the study invitation email directly. Each email invitation included a brief overview of the study, notice of IRB approval, and consent to participate in research. A sample of the invitation email and consent is provided in Appendix

C. Subjects who consented to participate were instructed to click on a link contained in the invitation email, which connected them to the secure server at Virginia Commonwealth University. Because the survey link was not unique to each participant, it was possible for subjects to access the survey more than once. The directions clearly indicated that each participant should complete only one survey. The presence of duplicate surveys was evaluated during data cleaning procedures. Additionally, as part of the informed consent subjects were informed about the average time required to take the survey based on feedback from the pilot study respondents.

The survey was housed on the REDCap system licensed to Virginia Commonwealth University. REDCap is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources (Harris et al., 2009). This system is easily accessible remotely by all investigators. Although the AANA Research Division disseminated the invitation emails directly, they had no interest in maintaining a copy of the raw data. The returned surveys are the sole property of the investigators and the university. The data will be held on this server until the investigators request that it be destroyed.

The data collection period continued for four weeks, commencing June 10, 2013. After two weeks, and again after three weeks, a reminder email was sent to all subjects to further encourage participation. De-identified data was downloaded weekly from the secure server to the investigator's home computer. The survey was constructed to require responses to each item before the subject was permitted to move on to the next one (forced-choice), which resulted in few incomplete data sets. Subjects were also allowed to save the survey and return to it at a later time, which resulted in a limited number of incomplete data sets due to subjects not returning to complete the survey once started. At the end of four weeks, the survey link was deactivated.

Respondents were asked to reply to the direct solicitation for participation at their convenience, and at the location of their choice. The time and place that the survey was completed was not controlled, however the variability in setting is not expected to influence the generalizability of the results. It was important that the subjects completed the survey in a comfortable and private location to enhance the veracity of the responses since subjects were asked to respond to somewhat sensitive information in regard to their practice.

Data Analysis

The first step in analysis of the data was to clean the data to look for outliers and incomplete data sets. Data was also evaluated for any pattern of missing values. Univariate outliers for the dependent variable were eliminated if they met the criteria of a z-score >3 or <-3. Additionally, incomplete data sets were dropped from the analysis if they were missing the dependent variable, SOP-VAS score. All hypotheses were predicated on the SOP score, so any data that did no have that value would not contribute to the analysis. Data from the remaining subjects was further analyzed terms of descriptive statistics to determine if the sample exhibited appropriate representativeness of the population of CRNAs with respect to age, gender, practice model, and geography. Sample demographics were compared to the population using Chi-squared analysis for categorical variables and analysis of variance t-test for the continuous variable, age. The Chi-squared analysis and t-test indicated that the sample was not significantly different from the population of practicing CRNAs for the variables tested.

Prior to starting any analysis, the dependent variable was tested for normality and homogeneity of variance. The Shapiro-Wilks test of normality was used with this data. The Scope of Practice VAS scores displayed a non-normal distribution. According to Tabachnik and Fidell (2007), when using large samples, a variable with statistically significant skewness often does not deviate enough from normality to make a substantive difference in the analysis. With samples over 200, the impact of skewness and negative kurtosis on the estimate of variance is minimized. In addition to inspecting the frequency distribution to assess normality, the expected normal probability plots and detrended normal probability plots were also inspected. These P-P plots are a more sensitive tool for inspecting normality (Tabachnik and Fedell, 2007).

Despite the non-normal distribution of the data, one-way ANOVA tolerates violations of normality well, with only a small effect on the Type I error rate (Lund Research Ltd., 2013). Additionally, a Kruskall-Wallis test can be used on non-normal data to compare independent groups. When appropriate, the results of both the ANOVA and Kurskall-Wallis tests were provided. However, since ANOVA tolerates violations of normality of the dependent variable, it is the preferred test due to the interval and ratio level of data being analyzed.

When analyzing the survey data, several statistical procedures were used based on the types of variables being considered and the objective of the analysis.

Objective one. Identify group differences in SOP-VAS scores based on geographic location.

When analyzing the geographical influence on SOP, the respondents were separated into two categories: rural and non-rural. The mean SOP scores for each of these groups was then compared for statistical significance using one-way analysis of variance, or ANOVA. Assumptions for ANOVA that must be met include a normal distribution of SOP scores, and a constant variance in SOP scores across geographical categories to ensure homogeneity of variance. The alpha for significance will be set at $p < 0.05$. Results of the ANOVA and tests for assumptions are presented in Chapter Four.

Objective two. Examine the correlation between years of experience as a civilian or military CRNA and reported SOP-VAS score.

When analyzing the effect of experience on SOP, the variables under investigation included interval data for experience as a civilian or military CRNA and age. Multiple regression was used to determine the degree of the relationship between years of civilian and military experience, age, gender, and SOP. Gender, a dichotomous variable, was dummy coded for this analysis to determine if it exerts an additional effect of SOP. Two variables, age and years of experience, were found to be highly correlated with a Pearson correlation of $r=0.881$. For the regression model, age was dropped from the analysis to avoid violations of multicollinearity.

According to Tabachnik & Fidell (2007), regression analysis is widely used to assess the relationship between multiple independent predictors and one continuous outcome variable, which is aligned with this objective. In addition to the overall relationship between variables, regression analysis allows the investigator to determine the relative importance of each predictor variable to the SOP-VAS relationship individually.

In preparation for the regression analysis, the data was screened to assess normality, linearity, and homoscedasticity. Tabachnik & Fidell (2007) recommend close examination of the scatterplots of residuals to test that those assumptions are met. SPSS provides predicted scores and errors of prediction as standardized values. The overall shape of the scatterplot should be nearly rectangular and distributed with a concentration of scores along the center.

The scatterplot of residuals will also be helpful in identifying outliers. With a large sample the authors recommend that each standardized residual in excess of +/- 3.3 be removed as an outlier. Box plots were also used to identify outliers.

Objective three. Explore the relationship between several facets of clinical anesthesia training and SOP among CRNAs while controlling for geographic location and experience of the provider.

Prior to any analysis of this portion of the data, the ten items related to the quality of an individual's training were scored and summed to create a composite variable. These ten items were unidirectionally worded in the survey so that in all cases a high numbered response were indicative of a high quality experience, and conversely a low numbered response would indicate a poor quality experience. Using a 5-point Likert scale, each item in this section received a score from 1 to 5. Each item was assigned equal weight since there was no literature to support the influence of any one factor over another on scope of practice (AMA, 2010). Summing the scores produced a potential range of 10 to 50 if all items had been answered. To account for subjects who do not recall the quality of their experience with any one of these items, or if a given factor was not applicable during their training, the subjects had the option of either "I do not recall," or "Not applicable," which produced a 0 score for that item. Each subject's total score for this section was then divided by the total number of affirmative responses to produce a final quality score in the range of 1 to 5. By excluding the items with a zero score due to inadequate memory or changing training requirements, the overall quality score was negatively affected. The new composite variable was interval level data used in the regression model.

When analyzing the effect of clinical training factors on SOP, the variables pertaining to length of various rotations were reported as interval data. The relative amount of time each subject spent in an environment that was co-located with a physician anesthesiology residency programs was reported as ordinal data, which was scored for analysis in the multiple regression model. Finally, the variables regarding mentorship and preceptorship by a non-medically directed CRNA are dichotomous, and were entered into the regression as dummy variables.

As previously described, regression analysis is ideally suited to assess the strength of a relationship that may exist between multiple predictor variables and one outcome variable. Here regression was used to determine the strength of the relationship between clinical training characteristics and SOP, while controlling for the influence of other influential factors by entering them as covariates. Based on the results of the first two analyses, four variables demonstrated a significant influence on SOP. Geography of practice, gender, practice in an opt-out state, and military service were then entered as covariates to separate their influence on scope of practice for the full model regression and allow the influence of clinical training to be isolated. Prior to analysis of the individual independent variables related to clinical training in the regression, they were tested against each other to ensure that the assumption of multicollinearity was not violated. Combining several of the aspects of training into a composite variable further reduced the likelihood of training variables being highly correlated with each other.

Research on the use of composite variables has shown that they can be more comprehensive than any single measure, and have more precision (O'Brien, 2007). The latent variable, quality of the training experience, was measured through more tangible indicators that are closely related to the latent variable. All contributing variables measured some aspect of the same thing, providing unidimensionality. Finally, directionality of the measures was consistent so that the scores could be summed into a meaningful composite score.

Regression is highly sensitive to the entry of multiple variables. Only those variables that exhibited a significant relationship with the DV were entered. To minimize extraneous variable entry, each clinical training IV was tested against the DV individually using correlation for continuous variables and ANOVA for categorical variables. Using the SPSS regression command for STEPWISE entry of independent variables, the relative influence of those variables that explain the variance in scope of practice scores was elucidated. Each predictor variable in the equation generated a regression coefficient. The significance levels for regression coefficients were assessed through *t* statistics with n-1 degrees of freedom. Significant regression coefficients revealed predictor variables that were significant in describing the variance in SOP-VAS scores. A goal for the final R-squared for the model was set at greater than 60% with a significance level of $p < 0.05$. This would indicate a strong degree of correlation among the predictor and outcome variables (Tabachnick & Fidell, 2007).

Limitations

Survey methodology is frequently constructed using a non-experimental design due to the non-randomization of participants and lack of intervention among participants (Polit & Beck, 2009). The benefits of this design are the ability to reach a large number of practicing CRNAs in an efficient and affordable manner, and the ability to gather a large amount of information at one time. Additionally, the convenience of a non-experimental environment may enhance subject compliance and augment the reliability of the findings. Survey distribution and data collection via the internet has been criticized in the literature because the sampling frame is limited to individuals with accurate email addresses, provides historically low response rates, and may result in inaccurate interpretation of the survey items due to the lack of involvement of an interviewer (Fowler, 2009). However, as the use of the internet for data collection has increased, research shows that response rates via web-based surveys are comparable to those achieved by surface mail, and could yield greater response rates while being more cost efficient to administer (Kaplowitz, Hadlock, & Levine, 2004). With the appropriate mechanisms in place - such as participation reminders, secure servers, ensured confidentiality of responses, and concise survey construction - the negatives of using the internet for data collection were overshadowed by the efficiency that the internet provides.

Potential threats to internal validity with this design include selection bias that accompanies the self-selection of subjects who choose to complete the survey. Additionally, the lack of control over unidentified variables may offer competing explanations for the findings. Examining all factors that may influence SOP is beyond the scope of this study; instead this research focused only on the influence of experience, geography, and clinical training. Elucidating additional factors that influence SOP would be the subject of further study on this topic. Additional threats to internal validity such as maturation, mortality, and instrumentation were avoided through the use of a cross-sectional design with one data collection point (Polit & Beck, 2010). However, the Hawthorne effect was a potential threat to construct validity. As subjects were asked to specifically define their practice, they may have been reluctant to be completely honest and may potentially inflate their scope of practice to reflect ideal levels. By ensuring anonymity of the responses, this effect should was minimized.

Statistical limitations are frequently cited with the use of multiple regression. Regression analysis may reveal relationships among variables, but it does not imply that there is a causal relationship. Regression analysis assumes that the predictor variables are measured without error, which was not possible through this type of research design. Additionally, assumptions regarding normality, linearity, homoscedasticity, and multicollinearity must be met. Careful inspection of residuals was used to identify variables that are degrading rather than enhancing the correlation as well as violations of the assumptions (Tabachnick & Fidell, 2007). During data analysis, every attempt was made to ensure the assumptions were met for valid application of the statistical techniques.

Validity and reliability. Table 4 is presented as a summary of the potential threats to internal and external validity and the steps taken through design and methodology to control for them.

Table 4

Validity Concerns and Control Measures

Validity Concern	**Description**	**Methods to Control**
Selection Bias	Although a random selection of participants will be chosen from a large sampling frame, the investigator cannot assume that the characteristics of the group who chooses to participate in the research are the same as the group who did not participate.	Send out multiple invitations for participation to encourage completion of the survey by at least 30% of invitees. Implement a post-stratification sampling procedure to ensure homogeneity between the study sample and the population.
Instrumentation	Ability of the participant to understand and accurately use the survey tool via an online platform.	Clear and concise instrument construction. Pilot testing of survey.
Construct Validity	Degree to which the design of the study, theoretical foundation, and measures represent their intended construct.	Review of design and instruments by expert panel in the field of nurse anesthesia. Theoretical foundational support for predictor variables and outcome measure.
Hawthorne Effect	The effect on the outcome variable (SOP) that results from the subjects' awareness that they are participants in a study.	Encourage participants to complete the survey in a private area. Ensure anonymity of the completed surveys.
Statistical Conclusion Validity	Inferences regarding a correlation between the factors is real.	Ensure high statistical power through a robust sample. Maximize precision in measurement through the development of a clear and comprehensive data collection tool.
External Validity	Degree to which inferences about observed correlations among study participants will persist among the population as a whole. Generalizability of the findings.	Test the respondent pool using Chi-square analysis to determine the level of representativeness to the population under investigation.

Human Subjects

Submission for exempt status was made to the Institutional Review Board at Virginia Commonwealth University under the specifications of Category 2. Requirements for exempt status include that no personal identifying information on the subjects will be retained, no sensitive information regarding sexual orientation, drug use, or abuse is being collected, no psychologically provoking questions are asked, and the survey does not put the subject at any financial risk (Virginia Commonwealth University, 2011). Due to the nature of the survey and absence of any personal identifying information on returned data, the study qualified for exempt status review. Additionally, this study presented only minimal risk to potential subjects.

Chapter Summary

This chapter discusses the methods by which a non-experimental, descriptive correlational design were used to determine the relationship between geography, experience, and clinical training factors and scope of practice among active certified registered nurse anesthetists. Each of these three categories of factors were analyzed independently and then as components of the full model to provide a comprehensive picture of their influence on scope of practice. The foundation for the use of Bandura's Self-Efficacy theory applied to scope of practice has also been further developed. A detailed description of the population, recruitment, sampling methods, variables, data collection and data analysis are included.

Findings from this study have the potential to describe scope of practice of CRNAs independent of the anesthesia delivery models utilized to determine if there is a correlation between clinical training, experience, geography and scope of practice. If a correlation is detected among certain predictors and high SOP, further study may be warranted in those areas to determine if training parameters, admission criteria, and rotation requirements are suited to meet the needs of our emerging practitioners. As the health care market demands more efficient use of available providers, the community of nurse anesthesia educators may be able to modify existing training and recruiting practices to ensure it is producing CRNAs who are equipped to practice to the fullest extent of their defined scope of practice.

Chapter Four: Results

The primary purpose of this research was to examine the factors that influence scope of practice among CRNAs using a novel Scope of Practice Visual Analog measurement tool. As an exploratory study on this topic, the research was descriptive in nature. The study was designed as non-experimental and correlational, using an internet-based survey of a nationwide cross-section of practicing CRNAs. The objectives of this research study were three-fold: The first was to identify group differences in scope of practice among CRNAs based on geographic location. The second objective was to examine the correlation between years of experience as a civilian or military CRNA and reported scope of practice. The final objective was to explore the relationship between several facets of clinical anesthesia training and SOP among CRNAs while controlling for geographic location and experience of the provider. All correlations used the subjects' reported scope of practice as the dependent variable, which was measured by the novel Scope of Practice Visual Analog Scale (SOP-VAS). Analysis of the survey responses were used to guide an understanding the geographic, experiential, and clinical training conditions that exist among CRNAs, and their relationship with scope of practice. The study was undertaken to address the following research question: "What is the impact of geographic location, years of civilian and military experience, and clinical training of CRNAs on individual scope of practice?"

To answer this research question, the following hypotheses were proposed an analyzed:

- H_1: CRNAs working in a rural location will report higher mean SOP scores than CRNAs working in non-rural locations.
- H_2: Years of experience will be positively correlated with SOP scores.
- H_3: Years of military experience as a CRNA will be positively correlated with SOP scores.
- H_4: A combination of experience, geographic location, and clinical training variables will produce a more descriptive model of scope of practice among nurse anesthetists than experience, geography, or clinical training variables examined alone.

This chapter describes the data preparation steps and subsequent statistical analysis techniques used to address the three proposed objectives laid out in the study proposal. The chapter begins by describing the data cleaning process, followed by a statistical comparison of the sample to the population, and finally a detailed analysis of the objectives of the study.

Review of Methodology

Power analysis. Prior to beginning data collection, a power analysis was performed to determine the necessary sample size. Using the method described by Tabachnick, & Fidell (2007) for multiple regression with a medium effect size, an α level of 0.05 and Power (1- β) of 0.8, the following equation is recommended for testing the multiple correlation:

N = 50 + 20 x (#IVs)

N = 50 + 20 x (15) for the full model

N = 350

The multiple regression analysis has the highest sample size burden, so it was used as the basis for the power analysis. Considering the summary of variables given in Table 3 (p. 45) the regression will include 15 variables for analysis. When testing all variables simultaneously, the sample size required is 350. The regression analysis will also be run separately to test the variables related to geography, experience, and clinical training individually. When testing fewer IVs, a large sample is not required. However, because of the large number of variables tested in the full model, a conservative estimate of N=500 was the goal for subject recruitment.

Population and sampling. Drawing from the database of 42,500 practicing CRNAs, 10,000 potential subjects were randomly selected to participate in this research. Selection criteria for the sampling frame was limited to actively certified and recertified CRNAs who indicated they participated in clinical practice. Application of these criteria eliminated students, retirees, and those primarily engaged in education from selection for participation.

Participation in the study was voluntary, no personally identifying information was requested, and returns of the survey were de-identified automatically through the data collection software. Using email solicitation of 10,000 practicing CRNAs and reminders after weeks two and three, 1409 subjects used the embedded link to complete the survey. This resulted in a 14.1% response rate, which is less than the predicted rate of 30%, but more than adequate to meet the sample requirements of the power analysis. After removing data sets that were missing a value for the dependent variable, 1202 usable data sets remained, which was well above the number of subjects required by the power analysis.

Instruments.

Scope of Practice - Visual Analog Scale. Two instruments were developed to study the scope of practice of nurse anesthetists and the potential factors that influence it. The first was the

Scope of Practice Visual Analog Scale (SOP-VAS). This instrument was validated by a group of experts in the field of nurse anesthesia to ensure content, criterion, and construct validity, as well as item clarity. Individual items on the pilot survey were evaluated for internal consistency using Pearson product moment correlations. The measurement tool was then tested for reliability using a sample of practicing CRNAs through the university internet-based data capture tool, REDCap.

Using a convenience sample of 36 CRNAs whose practices ranged from independent to highly restrictive, responses to detailed practice questions and overall SOP-VAS scores were tested for correlations. Cronbach's alpha for the Likert-type items related to SOP was $\alpha=0.893$, which indicates a very high degree of internal consistency of responses. Responses to the SOP questions were scored and summed to give each participant a total score on the questionnaire items. This final score was then tested against the reported SOP-VAS score using multiple regression modeling which revealed an overall R-squared $=0.539$, $F=33.973$, $p<0.001$. Given that the reliability of the SOP-VAS was supported by statistical testing as a single measure of scope of practice, it was then incorporated into the final survey on scope of practice.

Factors that Influence Scope of Practice survey. To examine the impact of geography, civilian and military experience, and clinical training on scope of practice of CRNAs, the survey for data collection was presented in four distinct sections: (a) instructions, study aims, basic demographic information, (b) experience and location of practice, (c) clinical training, and (d) practice governance and SOP-VAS. This survey was pilot tested and reviewed by an expert panel to ensure construct validity and item clarity. The panel used the online data capture tool to evaluate the survey content as well as the user experience with the internet based tool. Their critiques and recommendations were incorporated into the final version of the data collection survey. The survey was constructed in a succinct manner that logically followed from the objectives. Whenever possible, drop down menus were used to minimize data entry by the participants. Each subject was asked to rate their scope of practice using a virtual slider on a line measuring 100mm in length. In some instances subjects reported difficulty moving the slider. Many of those subjects provided a SOP-VAS value in the comments section, which was manually entered by the researcher for analysis.

Review of data collection. After review of the study by the dissertation committee, Institutional Review Board approval was obtained from Virginia Commonwealth University. The IRB granted an exempt review of the project effective April 2013. The survey was constructed using the online REDCap service with VPN access. A written request was then submitted to the American Association of Nurse Anesthetists (AANA) to select a random sample of 10,000 practicing certified registered nurse anesthetists to receive the invitation to participate. The email invitation and weekly reminders were sent directly from the AANA to potential study participants. Each respondent was automatically assigned a number, and no personally identifying information was obtained. De-identified data was downloaded from the secure server on a weekly basis.

The data collection period lasted four weeks, commencing on June 10, 2013. Subjects received an initial invitation to participate followed by a reminder after two weeks and again after three weeks. At the conclusion of the data collection period, the survey link was deactivated. Over the course of the data collection period 1409 subjects used the embedded link to access the survey. After removing data sets that were missing a value for the dependent variable, 1202 (N=1202) usable data sets remained, which was well above the number of subjects indicated by the power analysis.

Data Preparation and Cleaning

Data was downloaded directly from the REDCap server to Excel spreadsheet format. The direct download ensured no data transfer errors or data entry mistakes. The data was then inspected for missing values. The "comments" section revealed that several subjects had manually entered a value for SOP-VAS since they encountered problems with the slider function. Values for those 12 subjects were then entered in the spreadsheet by the researcher according to the value indicated in the comments. For any additional data sets that were missing a dependent variable, the SOP-VAS, were eliminated from the data set. The dependent variable was essential for all of the analyses, including correlations, ANOVA, and multiple regression. Imputed or substituted values were not used due to the robustness of the remaining sample. Data sets that were missing categorical variable responses remained in the analysis if they contained a value for SOP-VAS.

After elimination of survey responses missing a DV, the entire data set was imported into Statistical Package for the Social Sciences (SPSS) 19.0 for analysis. Again, the transfer of data was automatic and required no manual entry of data. Categorical variables were recoded from string variables to numeric values for analysis. For example, Gender was coded as Male = 1, Female = 2. A missing values analysis was conducted for the independent variables. There were very few missing values overall, and no single variable had greater than 1% missing values.

Describing the sample. The next step in data preparation was to determine the homogeneity of the study sample to the population of practicing CRNAs. Demographic information of the respondents was compared to the population based on age, gender, years of experience, geographic location of practice, and anesthesia delivery model. Population demographic information was obtained from the annual member profile survey published by the AANA in 2010 and 2011.

The mean age for respondents was tested against the mean age for the population using a t-test. However, to test Years in Practice for homogeneity, the sample was grouped into age groups using a binning procedure according to the groups reported by the AANA in their 2011 Member Profile Survey. The resulting percent in each group were then compared using Chi-squared (X^2) analysis. Figures 4 and 5 show the distribution of years in practice for both the sample and the population respectively.

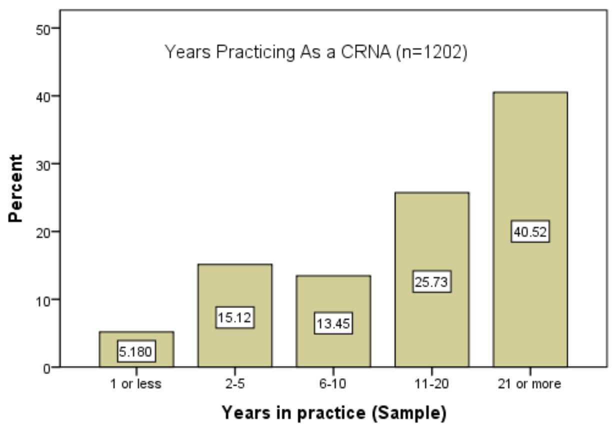

Figure 4. Distribution of Years in Practice, Sample

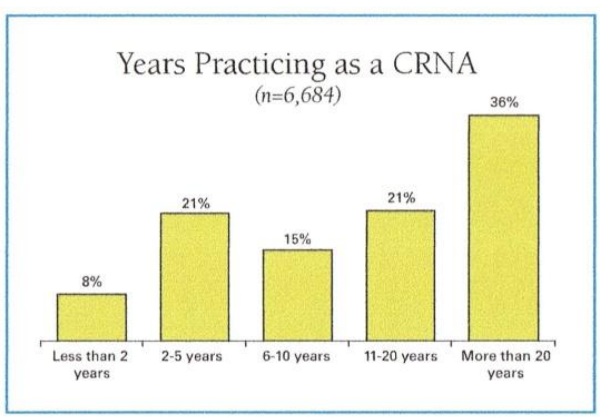

Figure 5. Distribution of Years in Practice, Population

In their survey, the AANA divides their membership into 12 categories for geography of practice based on zip codes of the respondents. The sample was grouped into only three categories according to the definitions of the Federal Office of Management and Budget based on population (Urban: >50,000, Suburban: 10,000 – 50,000, and Rural: <10,000) (OMB, 2009). The sample geographic groups were further condensed into Urban/Suburban and Rural. In order to match the groups from the population to the sample for comparison, the population categories were reduced to two groups as well in accordance with their population definitions. The Urban/Suburban category for the population was comprised of the metropolitan subgroups and the two groups adjacent to large metropolitan areas. This yielded categories similar to the sample categories based on given population densities for accurate comparison.

The anesthesia delivery models were grouped for comparison as well. The Member Profile Survey reported by the AANA (2010) indicated that 70.6% of members practiced under the medical direction or supervision of an anesthesiologist for greater than 1% of their practice, and 29.4% of respondents practiced exclusively without the involvement of an anesthesiologist (N=5097). The respondents in the survey were allowed to choose whether their practice was characterized by 1)medical direction by an anesthesiologist, 2) supervision by an anesthesiologist, 3) supervision by a non-anesthesiologist (operating physician, podiatrist, or dentist), or 4) independent practice. Since only two groups were listed by the AANA survey, the sample for this study was also condensed to two groups for comparison with X^2 analysis. Groups 1 and 2, which both included the involvement of an anesthesiologist, were considered one group (Anesthesia Care Team + Supervision by an anesthesiologist). Groups 3 and 4, which did not include the involvement of an anesthesiologist, were considered the second group

(Supervision by surgeon + Independent practice). The results of the population and sample comparisons are listed below.

The completed surveys were first analyzed as a group to ensure that the composition of the respondent pool was not significantly different that the population of CRNAs relative to the demographic items listed in Table 5. An over-representation of a subset of CRNAs may have

Table 5

Sample Characteristics

Variable	**Frequency**	**Percent**	**Test**	**Result**
Gender				
Sample (F/M)	619 / 583	51.5 / 48.5	Chi-Sq	X^2: 5.958, p=0.015
Population (F/M)[a]		55 / 45		Critical val 6.63
Mean Age				
Sample		50.15 yrs	t-test	p= 0.262
Population[a]		49.8 yrs		
Years in Practice[a]	See figures		Chi-Sq	X^2: 24.359* p<0.001 Critical val 18.467
Geography of Practice				
Sample (U/R)	1027 / 175	85.4 / 14.56	Chi-Sq	X^2: 0.652, p=0.419
Population (U/R)[b]		84.6 / 15.4		Critical val 6.63
Anesthesia Delivery Model[c]				X^2: 5.083, p=0.024
Sample	813 / 389	67.6 / 32.3	Chi-Sq	Critical val 6.63
Population[b]		70.6 / 29.4		

a: From the 2011 AANA Member Profile Survey
b: From the 2010 AANA Member Profile Survey, SPSS Data file
c: Groups collapsed into Anesthesia Care Team + supervision by an anesthesiologist and supervision by surgeon + independent practice.
* indicates a statistically significant difference among the groups.

reduced the generalizability of the results. However, after careful review of the composition of the respondent pool and appropriate statistical testing, the sample was judged not to be significantly different than the population and no post-stratification sampling was necessary. A single parameter, Years in Practice, was found to be statistically different among the population and study sample despite the similar distribution seen in Figures 4 and 5. However, the mean age of the respondents was not. As we will see in a subsequent analysis, the variables Age and Years in Practice are highly correlated variables. No change to the sample was made on the basis of this one variable.

Based on the analysis of the sample according to the parameters of the population obtained from the American Association of Nurse Anesthetists, the sample contains an adequate representation of practicing CRNAs based on age, gender, years of experience, geographic regions, and anesthesia delivery model. By drawing data from a large sampling frame, the population was oversampled to provide the most flexibility for post-stratification sampling. However, because the sample appears to be representative of the population with out further manipulation, no post-stratification sampling techniques were used.

Data Analysis

Analysis of the dependent variable. Prior to beginning any analysis of the data to address the objectives of the study, the dependent variable (DV) was evaluated. As a preparatory step for conducting an ANOVA or regression, certain assumptions must be met in terms of the distribution of the DV and presence of outliers. ANOVA is particular sensitive to the presence of outliers, so they must be identified and dealt with prior to any analysis (Lund Research Ltd., 2013). Univariate outliers were screened using a box plot as seen in Figure 6. The long tail below the box indicates the data is skewed, however no outliers were detected in the complete data set.

ANOVA also assumes that the residuals of the dependent variable should be approximately normally distributed, however ANOVA is considered robust to violations of normality (Lund Research Ltd., 2013). The Shapiro-Wilks test of normality was used with this data which confirmed a non-normal distribution of SOP-VAS ($W=0.879$, $p<0.001$).

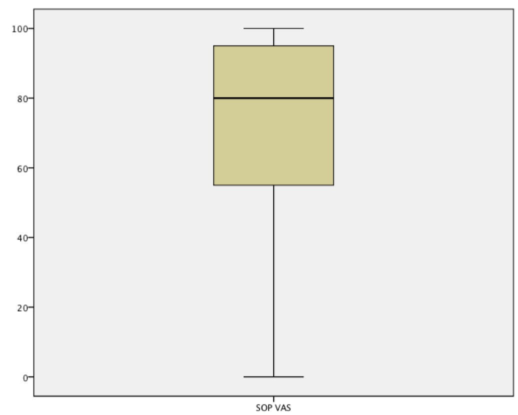

Figure 6. Box plot of dependent variable, SOP-VAS

Pictured in Figure 7 is the histogram showing the distribution of the dependent variable, which illustrates the left skew of the data. The Scope of Practice VAS scores ranged from 0 to 100, mean value 72.59, median value 80, skewness -0.933, and kurtosis -0.180. According to Tabachnik and Fidell (2007), when using large samples, a variable with statistically significant skewness often does not deviate enough from normality to make a substantive difference in the analysis. With samples over 200, the impact of skewness and negative kurtosis on the estimate of variance is minimized.

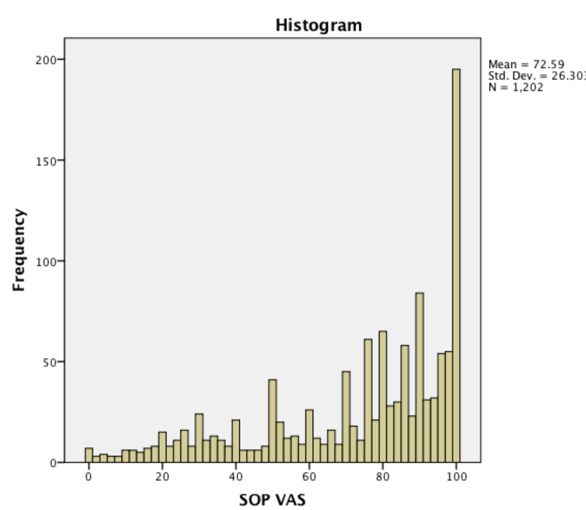

Figure 7. Frequency distribution of SOP-VAS

In addition to inspecting the frequency distribution to assess normality, the expected normal probability plots and detrended normal probability plots should also be inspected. These P-P plots are a more sensitive tool for inspecting normality (Tabachnik and Fedell, 2007). When a variable is normally distributed, the cases distribute themselves on the detrended plot evenly above and below the horizontal line. Figures 8 and 9 confirm a non-normal distribution of the residuals with deviations from the predicted line, possibly due to the left skew of the distribution.

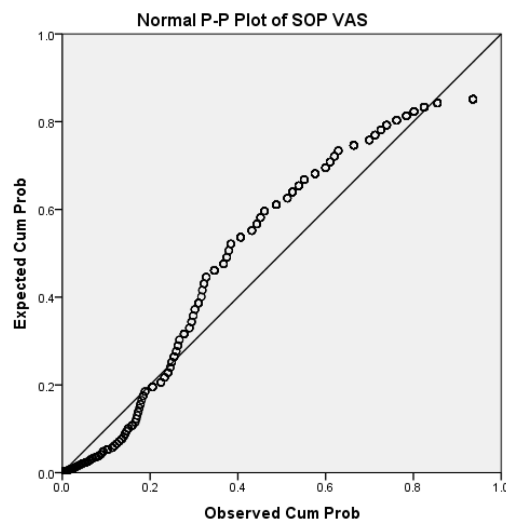

Figure 8. Normal P-P Plot of SOP-VAS

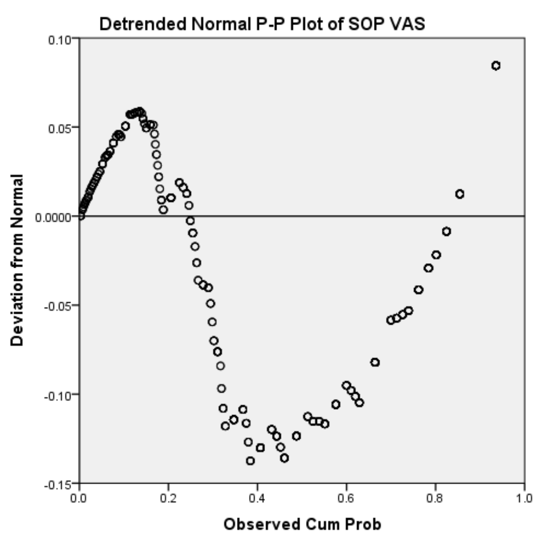

Figure 9. Detrended Normal P-P Plot of SOP-VAS

Despite the non-normal distribution of the data, one-way ANOVA tolerates violations of normality well, with only a small effect on the Type I error rate (Lund Research Ltd., 2013). Additionally, a Kruskall-Wallis test can be used on non-normal data to compare independent groups. This is a non-parametric test that requires the dependent variable be measured at the ordinal or interval level, and the independent variable should consist of two or more categorical and independent groups. When appropriate, the results of both the ANOVA and Kurskall-Wallis tests are provided. However, since ANOVA tolerates violations of normality of the dependent variable, it is the preferred test due to the interval and ratio level of data being analyzed.

The analysis of data will be subdivided into three sections to address each of the three objectives of the study. Any additional assumptions or variable manipulations for statistical testing that were not described in the data cleaning section will be further explained as they pertain to each section.

Objective one. Identify group differences in scope of practice among CRNAs based on geographic location.

When analyzing the geographical influence on SOP, the categorical variables for the subject's residence were correlated with the SOP scores using one-way analysis of variance, or ANOVA. In addition to the assumption of normal distribution, ANOVA also assumes that outliers are not present, the two groups being compared are independent of each other, and there is homogeneity of variance within the groups (Lund Research Ltd., 2013). Results of the ANOVA were used to determine if there were statistically significant differences between two geographical categories (rural and urban / suburban) and reported SOP-VAS scores among CRNAs. The alpha for significance was set at $p < 0.05$.

Prior to analysis of the two groups of CRNAs to evaluate the influence of geography on scope of practice, the sample was divided into two groups: rural and urban/suburban. The rationale for the division of the groups was discussed during sample analysis. When evaluating the two groups independently for SOP-VAS distribution, at least three outliers were discovered in the rural group by inspecting the box plot of scores (Figure 10). The SOP-VAS were then converted to z-scores to evaluate them further. Since the sample size was greater than 80, a z-score of < -3 or >3 was considered an outlier (Tabachnik and Fidell, 2007). Using this guideline for univariate outliers and given that ANOVA is particularly sensitive to the influence of outliers, 5 cases were excluded for the analysis of this objective.

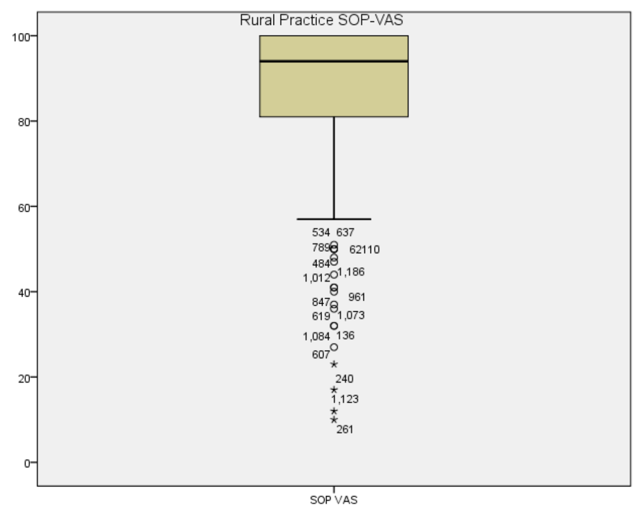

Figure 10. Box plot of SOP-VAS distribution for rural practice respondents

Hypothesis testing.

H_1: CRNAs working in a rural location will report higher mean SOP scores than CRNAs working in non-rural locations.

The average SOP-VAS for the Rural and Urban/Suburban groups was 88.19 and 70.27 respectively. The results of the ANOVA are given in Table 6.

Table 6

ANOVA Results, Impact of Geography on SOP-VAS

ANOVA	Sum of Squares	df	F statistic	Significance
Between Groups	46861.315	1	72.841	<0.001
Within Groups	768782.882	1195		
Total	815644.197	1196		

The large value of the F statistic indicates a statistically significant difference in SOP-VAS between the two groups of practicing CRNAs ($F(1, 1195) = 72.841$, $p<0.001$). However, the groups were very different in size (1027 vs. 170), so the Levene's test was used to determine homogeneity of variance within groups. The data did not satisfy Levene's test ($t=68.422$, $p<0.001$).

If homogeneity of variance is violated, one can report the alternative statistic from Brown-Forsythe using degrees of freedom for the effect of the model and degrees of freedom for the residuals of the model. The Brown-Forsythe test is a statistical test for the equality of group variances when performing an ANOVA. It produces an F statistic resulting from an ordinary one-way analysis of variance on the absolute deviations from the median. Alternatively, the Levene's test produces an F statistic analysis of the variance on the absolute deviations from the mean. The Brown-Forsythe test may be preferred test when data exhibits a heavily skewed distribution, as is seen with the distribution of SOP-VAS (Brown & Forsythe, 1974). According to the Brown-Forsythe F-ratio, there was a significant effect of the geography of practice on the SOP-VAS reported by CRNAs. $F(1, 330) = 138.550$, $p<0.001$. The data support the hypothesis that CRNAs in rural areas of practice report higher SOP than those in urban and suburban areas.

Geographical trends were also analyzed to investigate the correlation between residence prior to anesthesia training, current geographic location of residence, and geographic location of practice. Bivariate correlation revealed that Geography of Residence and Geography of Practice were highly correlated with each other (r = 0.661, p<0.001). Additionally, a weak but statistically significant correlation existed between Geography Prior to Training and Geography of Residence (r = 0.359, p<0.001) and Geography of Practice (r=0.242, p<0.001). These correlations demonstrate that, to some extent, CRNAs returned to the type of geographic location from which they came in order to practice.

Finally, the influence of residence in an opt-out state was evaluated using ANOVA to compare SOP group means of respondents who reported working in a state which has opted-out of physician supervision and those who did not work in such a state. In response to this question, 114 subjects were not sure if they lived in an opt-out state when given the choice Yes, No, or I don't know. The number of years in practice for those who were not sure ranged from 1 to 47. Excluding respondents who were unsure about the opt-out status in their state, ANOVA detected group differences in mean SOP scores between the two remaining groups as shown in Table 7. Respondents from opt-out state reported a mean SOP score of 79.8 while respondents from non opt-out states reported a mean SOP score of 69.58 (p<0.001).

Table 7

ANOVA Results, Impact of Opt-Out of Physician Supervision on SOP scores

ANOVA	**Sum of Squares**	**df**	**F statistic**	**Significance**
Between Groups	24475.019	1	36.477	<0.001
Within Groups	725317.415	1081		
Total	749792.434	1082		

Objective two. Examine the correlation between years of experience as a civilian or military CRNA and reported scope of practice.

When analyzing the effect of experience on SOP, the variables under investigation include interval data for age and experience as a civilian or military CRNA. In addition to correlations between predictor variables and SOP, multiple regression was also used to determine the degree of the relationship between years of experience, age, gender, and SOP-VAS. Gender, a dichotomous variable, was dummy coded for this analysis to determine if it exerted an additional effect of SOP. According to Tabachnik & Fidell (2007), regression analysis is widely used to assess the relationship between multiple independent predictors and one outcome variable, which is aligned with this objective. In addition to the overall relationship between variables, regression will also allow the investigator to determine the relative importance of each predictor variable to the SOP-VAS relationship individually.

Prior to the analysis, correlations were run on the predictor variables to determine if they exhibited a high Pearson product moment correlation coefficient among themselves. Two variables, Age and Years in Practice were found to be highly correlated with each other ($r = 0.881$, $p < 0.01$, $N=1197$). Below, Figure 11 shows the scatterplot of Age and Years in Practice. Since these two variables were highly correlated with each other, only one of them was needed in the regression analysis to avoid violations of the assumption of multicollinearity.

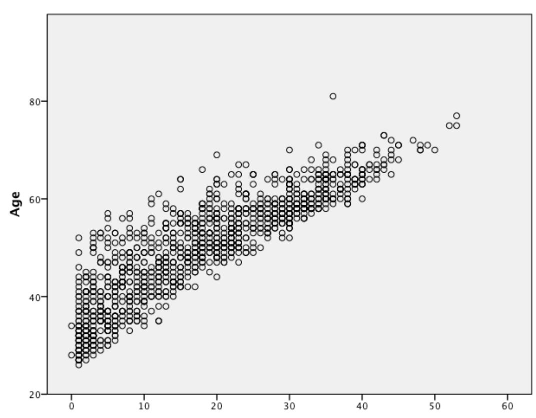

Figure 11. Scatterplot for Age and Years in Practice

To determine which variable to eliminate from the regression analysis, a bivariate correlation between Age, Years in Practice, and SOP-VAS was performed. The correlations with SOP-VAS were $r = 0.141$, $p < 0.01$ and $r = 0.163$, $p < 0.01$ for Age and Years in Practice respectively. Since Years in Practice showed a slightly stronger correlation with SOP-VAS, it was retained for the multiple regression analysis and Age was dropped as a predictor variable.

To assess the influence of gender on SOP-VAS for possible inclusion in the multiple regression as a predictor variable, an ANOVA was performed using two groups. The average SOP-VAS for the female (n=619) and male (n=583) groups was 67.53 and 77.95 respectively. The results of the ANOVA are given below in Table 8.

Table 8

ANOVA Results, Influence of Gender on SOP-VAS

ANOVA	Sum of Squares	df	F statistic	Significance
Between Groups	32569.941	1	48.956	<0.001
Within Groups	798351.561	1200		
Total	830921.502	1201		

The large value of the F statistic indicates a statistically significant difference in SOP-VAS between the two groups of practicing CRNAs ($F(1, 1200) = 48.956$, $p<0.001$). Despite the groups having a similar cell size, the data did not satisfy Levene's test ($t=14.542$, $p < 0.001$). The Brown-Forsythe test, a robust test of the equality of means within cells, was also performed. According to the Brown-Forsythe F-ratio, gender had a statistically significant effect on the SOP VAS reported by CRNAs. $F(1, 1199) = 49.188$, $p<0.001$.

Hypothesis testing.

H_2: Years of experience will be positively correlated with SOP scores.

Using Pearson product moment correlation, Years in Practice was found to be correlated with SOP-VAS. Pearson correlations are used to measure the strength of a linear relationship between variables. In order to perform a Pearson correlation, data must be measured at the interval or ratio level but they do not need to be measured on the same scale (Lund Ltd., 2013). Both variables Years in Practice and SOP-VAS are interval level data.

An examination of Figure 12 reveals a weak positive correlation (r = 0.163, P <0.01) between the variables Years in Practice and SOP-VAS. This finding indicates that to only a small extent, years in practice is correlated with higher levels of scope of practice.

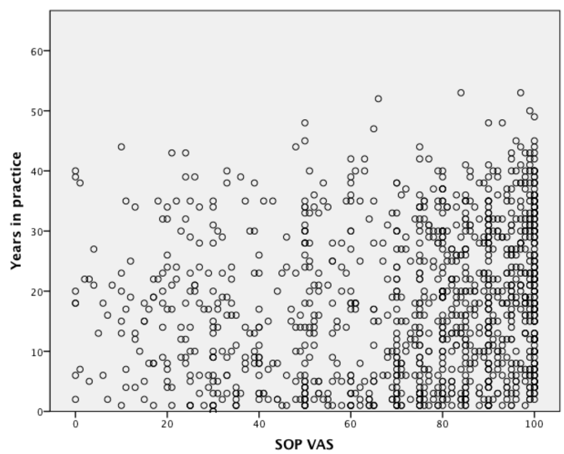

Figure 12. Scatterplot of Years in Practice and SOP-VAS

The data supports the stated hypothesis that years of experience (variable: Years in Practice) exhibits a positive correlation with SOP scores.

The second hypothesis under this objective dealt with the influence of military service as a CRNA on SOP. The influence of military service on SOP-VAS was evaluated first by using an ANOVA to compare groups of CRNAs who had reported working as a CRNA in the military (either on active duty or as a reservist) and those who had not. Prior to the analysis of the two groups, the sample was divided and examined for outliers in the distribution of SOP-VAS scores. The box plot in Figure 13 graphically shows at least one value that appears to be an outlier. The

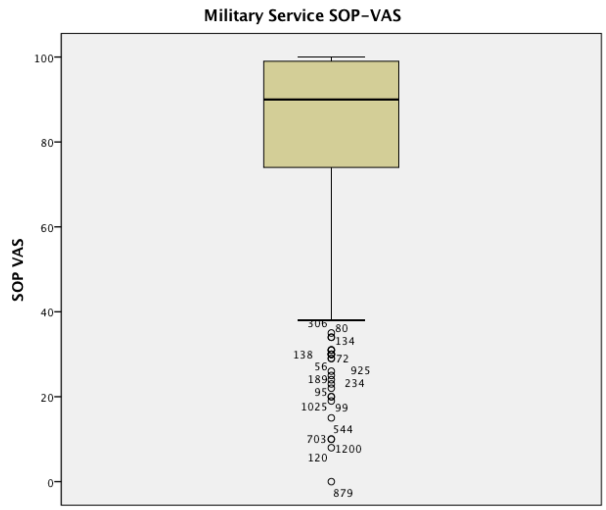

Figure 13. Box plot of SOP-VAS distribution for military service respondents

SOP-VAS scores were then converted to z-scores. Any z-score with a value greater than 3 or less than -3 was be considered a univariate outlier (Tabachnik & Fidell, 2007). Using this guideline and given than ANOVA is particularly sensitive to the presence of outliers, one case (#879) was excluded from the analysis of this objective. This case is seen in Figure 13, which shows the distribution of SOP scores for CRNAs who reported military service as an anesthesia provider.

Collectively, the military group of CRNAs exhibited a higher mean SOP score than the group of civilian CRNAs, with scores of 79.52 and 71.04 respectively. This was a statistically significant mean difference. The F statistic was sufficiently large to indicate a statistically significant difference in SOP-VAS between the two groups of practicing CRNAs ($F(1, 1189) = 19.106$ $p<0.001$). The groups were tested for homogeneity of variance, and the data did not satisfy Levene's test ($t=8.048$, $p = 0.005$). The Brown-Forsythe test, a robust test of the equality of means within cells, was also performed. Results of the Brown-Forsythe F-ratio given in Table

9 indicated that military service as CRNA had a statistically significant effect on the SOP-VAS. $F(1, 351) = 21.264$, $p<0.001$.

Table 9

ANOVA Results, Influence of Military Service as a CRNA on SOP-VAS

ANOVA	Sum of Squares	df	F statistic	Significance
Between Groups	13008.052	1	19.106	<0.001
Within Groups	809505.123	1899		
Total	822513.175	1190		

After detecting a difference among mean SOP scores between CRNAs who had practiced in the military and those who had not, a Pearson correlation between the two variables was attempted. Subjects were prompted to enter the type of service in the military and then the number of months spent on active duty. Respondents were not permitted to enter a value for length of service for both reserve and full-time service. Months of Service was then correlated with SOP-VAS. Even though the ANOVA demonstrated a difference between group means for military service, the Pearson correlation showed no evidence of a linear relationship between time spent on active duty either as a reservist ($r = -0.002$, $p =0.987$) or as a full-time member of the military ($r = 0.119$, $p =0.183$) and SOP scores.

Finally, a multiple regression model was run to determine the influence of experience-related variables on SOP. Regression is highly sensitive to the order in which variables are entered into the analysis. Only those variables that had shown a significant relationship with the DV were entered. Since Years in Practice, Gender, and Military Service had demonstrated a statistically significant influence on SOP through analysis with ANOVA, they were used as variables in the regression. Using the SPSS regression command for STEPWISE entry of independent variables, the relative influence of those variables that explain the variance in scope of practice scores was elucidated. Each predictor variable generated a regression coefficient to establish the relative influence of that variable on the overall regression equation. The significance levels for regression coefficients were assessed through *t* statistics with n-1 degrees of freedom (Tabachnick & Fidell, 2007). Significant regression coefficients reveal predictor variables that are prominent in describing the variance in SOP-VAS scores. The final R-squared for the model was set *a priori* at 60% with a significance level of $p < 0.05$, which would indicate a strong degree of correlation among the predictor and outcome variables.

R-square for the regression to determine the degree of the relationship between military service as a CRNA and scope of practice was maximized by entering Gender, then Years in Practice. These two variables yielded an R-square value of 0.06. The overall R-Square was only marginally enhanced by adding months of Military Service to the analysis. The significance level of the change from Model 2 to Model 3 was not statistically significant. With three variables in the equation, the resulting R-square = 0.064. Overall, this is a low very value for R-square indicating that only 6.4% of the variance in SOP can be explained by these Years in Practice, Gender, and Military Service. The results of the regression model are summarized in Table 10.

Table 10

Multiple Regression Results, Experience Variables and SOP

Multiple Regression	**Predictors**	**R-square**	**R-square change**	**F Change**	**Sig F Change**
Model 1	Gender	0.038	0.038	47.45	<0.001
Model 2	Gender + Years in Practice	0.060	0.021	26.99	<0.001
Model 3	Gender + Years in Practice + Military Service	0.064	0.004	4.8	0.029

Hypothesis testing.

H_3: Years of military experience as a CRNA will be positively correlated with SOP scores.

Military service demonstrated an effect on SOP through analysis with ANOVA when subjects were grouped according to whether they had served in the military or not. The data did not support the hypothesis that a linear relationship can be shown between length of military service as a CRNA and SOP using Pearson correlation. Finally, regression modeling did not adequately predict a relationship between military service as a CRNA and SOP.

Objective Three. Explore the relationship between several facets of clinical anesthesia training and SOP among CRNAs while controlling for geographic location and experience of the provider.

Using Bandura's Theory of Self-Efficacy as a framework to support the selection of study variables, multiple aspects of clinical training were identified which align with the four broad influences on self-efficacy outlined in the theory. These aspects of clinical training may have an influence on the scope of practice that a CRNA seeks upon completion of training. Taken one at a time, these variables were unlikely to exert a strong enough influence on SOP to be detected in this study. However, taken together as a group, the overall "quality of the training experience" may exert enough influence on SOP to be detected through statistical modeling. To that end, a composite variable was created from ten items that related to the quality of an individual's nurse anesthesia training.

Recollection of clinical training details may be difficult to accurately recall for CRNAs who have been in practice for many years. Rather than ask subjects to recall the actual number of cases they performed during training, respondents were asked to quantify their experience using a five point Likert-type rating to reflect the quality of experience with highly complex or invasive anesthesia cases they performed during their anesthesia training. During the clinical training portion of the survey, respondents completed 10 items that were unidirectionally worded so that in all cases a high numbered response corresponded with a high quality experience, and conversely a low numbered response corresponded with a poor quality experience. Using a 5-point Likert scale, each item received a score from 1 to 5, giving each respondent a potential quality score range of 10 to 50 if all items had been answered. The total score for this section was divided by number of affirmative responses to produce a final quality score in the range of 1 to 5. Items that were not answered or were not applicable did not adversely affect the overall quality score. The new composite variable was used as interval level data in the regression model.

As previously described, regression analysis is ideally suited to assess the strength of a relationship that may exist between multiple predictor variables and one outcome variable. Here it will be used to determine the strength of the relationship between clinical training characteristics and SOP, while controlling for geographic location and experience as covariates. Based on the results of the first two analyses, we have seen that Geography of Practice, Gender, Years of Experience, Practice in an Opt-Out State and Military Service have shown a statistically significant relationship with SOP. These variables were used as covariates in the full regression model to obtain a regression solution which describes the strength of the relationship between clinical training variables and SOP.

Hypothesis testing.

H_4: A combination of experience, geographic location, and clinical training variables will produce a more descriptive model of scope of practice among nurse anesthetists than experience, geography, or clinical training variables examined alone.

Prior to performing the regression analysis, a simple bivariate correlation was run on the clinical training variables not captured in the composite variable. Length of training (in months), Length of rural rotation (in months), Preceptorship by non-medically directed CRNA (length in months), Training at a community hospital (length in months), and Training at an academic medical center (length in months) were not correlated with SOP-VAS. Additionally, the reported percentage of time spent during training at a facility that had a co-located physician anesthesia residency program (interval level data) did not exhibit a correlation with SOP. Finally, identification of a mentor during clinical training did not influence SOP-VAS through analysis with ANOVA. However, the calculated composite variable did show a weak but statistically significant correlation with SOP ($r = 0.089$, $p = 0.002$).

For the final regression model to address the third objective of the study, the only variable related to clinical training that showed any statistically significant correlation with SOP was the Quality of Training Composite Score. The regression was run by entering variables that demonstrated a significant relationship with SOP scores from objectives one and two as covariates. These variables included Geography of Practice, Gender, Years in Practice, Practice in an Opt-Out State, and Service in the Military. The results of the full regression model and resulting R-square are shown in Table 11.

The composite score alone did not produce a highly descriptive regression equation. The R-squared for composite score explained <1% of the variance in SOP scores. However, taken together with statistically significant variables from previous objectives entered as covariates, the full model had an R-squared of 0.129 which indicates that 12.9% of the variance in SOP can be explained by these six variables. Examination of the beta-weights shows that Years in Practice contributed very little to the regression equation with a value of 0.267. This variable also

Table 11

Multiple Regression Results, Full Model of Variables Predicting SOP

Multiple Regression	Predictors	R-square	R-square change	F Change	Sig F Change
Model 1	Composite Score	0.008	0.008	9.915	.002
Model 2	Composite Score + Geo Practice	0.068	0.060	75.864	<0.001
Model 3	Composite Score + Geo Practice + Gender	0.098	0.30	39.883	<0.001
Model 4	Composite Score + Geo Practice + Gender + Years in Practice	0.114	0.015	20.372	<0.001
Model 5	Composite Score + Geo Practice + Gender + Years in Practice + Service in Military	0.118	.004	5.855	0.016
Model 6	Composite Score + Geo Practice + Gender + Years in Practice + Service in Military + Practice in Opt-Out State	0.129	0.011	14.952	<0.001

demonstrated very small R-square change of 0.015. Additionally, Military Service had a modest beta weight (4.621), but demonstrated the smallest R-square change at 0.004 to the equation. The overall R-squared value of 0.129 is below the predicted level set *a priori* of 0.60, so the model is not considered a highly predictive model for SOP.

Chapter Summary

This chapter has presented the statistical analysis of the three objectives proposed to investigate factors that influence scope of practice among CRNAs. Using the proposed hypotheses, a combination of statistical methods were employed to address the research question according to the stated hypotheses. The relationship between SOP and geographical influences was confirmed using correlation and one-way ANOVA. The effect of experience as a civilian and military CRNA on SOP was evaluated using correlations, ANOVA, and multiple regression. Finally, clinical training variables were correlated with SOP through the creation of a composite variable and through the use of bivariate correlations and multiple regression. The following chapter will further discuss the research findings in the context of the study objectives, including the limitations of the study and implications for further research.

Chapter Five: Discussion

Summary Review and Description of the Problem

In 2010 the Institute of Medicine published the results of a multi-disciplinary panel regarding the future of nursing. One of the primary findings of the report was that nurses should practice to the fullest extent of their education and training. When reviewing practice patterns, the panel found that the tasks nurse anesthetists (and all advanced practice nursing specialties) are allowed to perform are often determined by hospital bylaws, credentialing committees, and unique state laws rather than by their education and training (IOM, 2011). Several retrospective outcomes-based studies have demonstrated that quality of care is maintained when nurse anesthetists practice without the medical direction of anesthesiologists or the supervision of the operating physician. However, despite the documented quality and efficiency of practice models that incorporate broad scope of practice for CRNAs, barriers remain to full scope of practice among nurse anesthetists. Greater than 42,000 nurse anesthetists participate in the delivery of over 32 million anesthetics each year either as a member of an anesthesia care team, under the supervision of the operating physician, or as an independent provider (AANA, 2012). The variety in anesthesia delivery models has resulted in a broad range of scope of practice among CRNAs.

Given the recent changes to health care delivery through the implementation of the Patient Protection and Affordable Care Act, a surge of newly covered individuals is adding further stress the system's ability to meet the demand for services. Additionally, geographic disparities exist as the delivery of anesthesia in rural areas continues to be a challenge. A nationwide increase in demand and corresponding need for reduction in overall cost may necessitate an increase in the use of more efficient anesthesia delivery models by utilizing the full breadth of scope of practice of nurse anesthetists.

Despite meeting the minimum educational and clinical training requirements set forth by the Council on Accreditation of Nurse Anesthesia Educational Programs, there are inconsistencies in training among the 110 schools of nurse anesthesia. Training attributes such as repeated exposure to highly invasive cases, preceptorship by an autonomous CRNA cadre, competition with physician residents for case selection, and development of a mentor relationship are examples of factors that may result in vastly different SOP for the graduate. Geography of practice, military service as a CRNA, and years of experience are also factors that are supported in the literature as having an effect on the type of practice in which one engages.

Nurse anesthesia practice has historically been studied in terms of quality of care attributed to various anesthesia delivery models, but not from an individual scope of practice perspective. Health care policy changes at the state and national level may necessitate a single provider model where reimbursement will not support the additional cost of a supervisory model. Measuring SOP and investigating factors that contribute to higher levels of SOP among CRNAs is an important first step in addressing the economic and policy changes that are already starting to evolve.

Purpose of the study. The rapidly changing health care environment has produced conditions of imbalanced supply and demand as well as economic pressure to reduce the cost of care delivery while maintaining the same level of quality. Having established both the economic necessity for the efficient use of anesthesia providers and the consistent safety record of CRNAs working independently or without medical direction of an anesthesiologist, the scope of practice of CRNAs must be explored to determine the influence of certain mutable factors. There is tremendous range in SOP among CRNAs, but there is no available literature to describe what influences a practitioner to choose a certain level of practice. It is necessary to investigate the influence of factors related to experience, geography, and clinical training on SOP to identify factors that can enhance SOP among CRNAs.

This research endeavors to highlight variables that are correlated with broad scope of practice to ensure adequate training and recruitment of new CRNAs in order to maintain the high quality of care that CRNAs have consistently provided. The primary purpose of this research was to examine factors that may influence scope of practice among CRNAs using a novel Scope of Practice Visual Analog Scale as the measurement tool. Identification and quantification of these factors may have implications for future recruitment and training of CRNAs so that they are prepared for the full breadth of practice that is required in our evolving health care system.

Review of theoretical framework. Guided by Bandura's Self-Efficacy Theory (SET) as a theoretical framework for this study, scope of practice is conceptualized as a domain specific representation of professional self-efficacy. In his theory, Bandura describes four processes that affect a person's self-efficacy: mastery experiences, social modeling, social persuasion, and psychological responses (Bandura, 1994). Individuals will be more likely to attempt, persevere, and to be successful at tasks - such as the confidence and competence required for broad scope of practice in anesthesia - when they have a high sense of self-efficacy. Identification of variables for study that may influence SOP were aligned with self-efficacy using the underlying assumption that individuals with higher levels of self-efficacy would engage in the more demanding and challenging practice environments that increased levels of scope of practice require. The four theoretically-based processes described by Bandura and illustrated in Chapter Two were used to develop variables of interest related to practice that are thought to influence scope of practice.

Research question. Using Bandura's Self-Efficacy Theory as a framework for identifying variables that may influence SOP, the following research question was proposed: "What is the impact of geographic location, years of civilian and military experience, and clinical training of CRNAs on individual scope of practice?"

Review of Methodology

A descriptive, non-experimental, correlational design using an internet based survey of a nationwide cross-section of practicing CRNAs was employed. After obtaining exempt status from the IRB at Virginia Commonwealth University, an email invitation for study participation was distributed to a random selection of 10,000 practicing CRNAs. The sampling frame was determined by research division at the American Association of Nurse Anesthetists (AANA), which blinded the researchers to the names and email addresses of the potential participants. Data collection continued for four weeks. A total of 1409 surveys were returned, yielding 1202 usable and complete data sets. Descriptive statistics of demographic categories demonstrated that the sample composition was statistically similar to the population of practicing CRNAs. Relationships between years in practice, age, length of military service, and clinical training variables were analyzed using Pearson product-moment correlations. Group means for SOP scores were compared using ANOVA. Creating a model to describe the influence of multiple variables on SOP was done using multiple regression techniques. In all analyses, the subjects' reported scope of practice was the dependent variable, which was measured by the novel Scope of Practice Visual Analog Scale (SOP-VAS). Analysis of the survey responses were used to guide an understanding the geographic, experiential, and clinical training conditions that exist among CRNAs, and their relationship with scope of practice.

Review of Study Findings

The findings of the study are reviewed here in the context of the three study objectives and corresponding hypotheses. Additionally, potential implications of the findings are presented in light of existing literature and practice trends.

Objective one. Identify group differences in scope of practice among CRNAs based on geographic location.

H_1: CRNAs working in a rural location will report higher mean SOP scores than CRNAs working in non-rural locations.

Respondents were categorized into two groups according to the population in their location of practice. Three groups, urban, suburban and rural (U/S/R), were reduced to two groups, urban + suburban and rural (U+S/R) to reflect the convention reported in previous demographic studies by the AANA. Assumptions of the ANOVA were met except for homogeneity of variance. This violation was revealed with Levene's Test. In light of this violation, the Brown-Forsythe F statistic was used, which does not assume equality between groups. The average SOP-VAS for the Urban/Suburban and Rural groups was 70.27 and 88.19 respectively. The Brown-Forsythe F statistic demonstrated a statistically significant effect of the geography of practice on the SOP-VAS reported by CRNAs ($F(1, 330) = 138.550$, $p<0.001$).

Geographical trends before, during, and after anesthesia training were also analyzed. Geography of Residence and Geography of Practice were highly correlated with each other ($r=0.661$, $p<0.001$), which indicates that CRNAs tend to live and practice in the same geographic area. Geography Prior to Training and Geography of Residence exhibited a modest correlation ($r=0.359$, $p< 0.001$), which indicates CRNAs who came from rural areas tended to return and reside in rural areas (and conversely, CRNAs from urban or suburban areas tended to return to those same areas). Finally, Geography Prior to Training and Geography of Practice showed a weak but statistically significant correlation ($r = 0.242$, $p<0.001$). This finding indicates that to a small extent, CRNAs tended to practice in the same geographic area they lived prior to anesthesia training.

Another factor to consider when looking at the influence of geography on SOP is whether or not the CRNA resides in a state that has opted-out of physician supervision of CRNAs. Respondents in opt-out states did show a statistically significant difference in their SOP scores with a mean of 79.8, compared to 69.58 for respondents in states that had not opted-out ($p<0.001$, $N=1088$).

The data supports the hypothesis that there are differences in mean SOP scores among rural and non-rural categories of CRNAs. Bivariate correlations regarding residence prior to training and current practice location were weak. The data does not necessarily support recruiting potential CRNAs from a given area to fill a need. For example, recruiting nurses from rural areas to become rural CRNAs may not adequately result in graduates returning to those areas to practice. Another geographic finding related to SOP was that residing in an opt-out state also appears to have an effect on mean SOP scores. However, a closer look at the "opt-out" respondents revealed that 114 CRNAs (9.5% of total) were not sure if they lived in an opt-out state or not. Their years in practice ranged from 1-47 years. When completing the survey, this item was a forced-choice response, which means the respondent had to choose Yes, No, or I don't know. It seems worrisome that nearly 10% of all respondents were not sure about a major SOP law in their state.

Objective two. Examine the correlation between years of experience as a civilian or military CRNA and reported scope of practice.

H_2: Years of experience will be positively correlated with SOP scores.

In preparation for to examine the effect of experience using correlations and regression analysis, variables were tested against each other using bivariate correlations to avoid violations of the assumption of multicollinearity. Two variables, Age and Years in Practice, were found to be highly correlated with each other ($r = 0.881$, $p < 0.01$, $N = 1197$). Years in Practice demonstrated the greater correlation with SOP, so it was retained for further analysis.

Using Pearson product-moment correlation, Years in Practice demonstrated a weak but statistically significant correlation with SOP ($r=0.163$, $p<0.01$), which indicates that to only a small extent years in practice is correlated with higher levels of scope of practice. The data support the stated hypothesis that years of experience will be positively correlated with SOP.

H_3: Years of military experience as a CRNA will be positively correlated with SOP scores.

The influence of military service on SOP was first tested using ANOVA by grouping respondents into two groups, those who had served in the military (either on active duty or as a reservist) and those who had not. Due to violations of the assumption of homogeneity of variance, Brown-Forsythe F statistic was used, which does not assume equality between groups. Collectively, the military group of CRNAs exhibited a higher mean SOP score than the group of civilian CRNAs, 79.17 and 71.04 respectively ($F(1, 348) = 18.937$, $p < 0.001$).

After finding a difference between mean SOP scores between CRNAs who had practiced in the military and those who had not, a correlation between Months of Service and SOP was performed. Even though the ANOVA demonstrated a difference between group means for military service, the Pearson correlation showed no evidence of a linear relationship between time spent on active duty either as a reservist ($r = -0.002$, $p = 0.987$) or as a full-time member of the military ($r = 0.119$, $p = 0.183$) and SOP scores.

The influence of gender on SOP was also evaluated for possible inclusion in the multiple regression as a predictor variable using ANOVA. The average SOP-VAS for the female (n=619) and male (n=583) groups was 67.53 and 77.95 respectively. Again homogeneity of variance within cells was violated and the group differences were reported as Brown-Forsythe F statistic. According to the Brown-Forsythe F-ratio, gender had a statistically significant effect on the SOP VAS reported by CRNAs ($F(1, 1199) = 49.188$, $p<0.001$).

To analyze the influence of the all the experience-related variables on SOP, a multiple regression model was used. Since regression is sensitive to the order of entry of variables, only Years in Practice, Gender, and Military Service were used since they had previously demonstrated a statistically significant influence on SOP through analysis with ANOVA.

The regression yielded an equation to explain the relative influence of each of the variables through a beta-weight, which ranged from 1.96 for Military Service to 0.061 for Years in Practice. The overall R-square for the regression describes the percent of variance in SOP that can be attributed to the entered independent variables. In this regression, R-square was maximized by entering Gender, then Years in Practice. These two variables yielded an R-square value of 0.06. The overall R-Square was only marginally enhanced by adding Military Service to the analysis. The significance level of the change from Model 2 to Model 3 was not statistically significant ($p=0.29$). With three variables in the equation, R-square = 0.064. Overall, this is a low very value for R-square indicating that only 6.4% of the variance in SOP can be explained by Years in Practice, Gender, and Military Service. The level of significance for R-square was set *a priori* at 0.60 with a significance level of $p < 0.05$, which would indicate a strong degree of correlation among the predictor and outcome variables (Tabachnick & Fidell, 2007). This regression model did not meet the standard set for significance.

Length of military service did not demonstrate a linear correlation with SOP as hypothesized. However, having served in the military did have an influence on SOP through analysis with ANOVA. Regression analysis failed to demonstrate a reliable model to predict SOP using the variables Gender, Years in Practice, and Military Service.

Objective Three. Explore the relationship between several facets of clinical anesthesia training and SOP among CRNAs while controlling for geographic location and experience of the provider.

H_4: A combination of experience, geographic location, and clinical training variables will produce a more descriptive model of scope of practice among nurse anesthetists than experience, geography, or clinical training variables examined alone.

Bandura's Self-Efficacy Theory was used a framework to identify clinical training attributes that may demonstrate an influence on SOP. Due to the large number of clinical training attributes identified, a composite variable was created which captured the overall quality of the clinical training experience. The composite variable was calculated from the scores respondents gave on a five point Likert-type scale. The total score was divided by the total number of responses, up to ten, which resulted in a Quality Score with a range of one to five.

Prior to performing the regression analysis, variables were tested to identify those that exhibited a statistically significant influence on SOP. Bivariate correlations were used to test variables not captured in the composite score. Length of Training, Length of Rural Rotation, Preceptorship by Non-Medically Directed, Training at a Community Hospital, and Training at an Academic Medical Center (all measured as length in months) were not correlated with SOP. Percentage of time spent during training at a facility that had a co-located physician anesthesia residency program (interval level data) did not exhibit a correlation with SOP. Finally, identification of a mentor during clinical training did not appear to influence SOP through analysis with ANOVA. However, the calculated composite variable did show a weak but statistically significant correlation with SOP ($r = 0.089$, $p = 0.002$).

The third objective was tested using a regression model with the Quality Score as the primary predictor variable and statistically significant predictor variables from previous analyses entered as covariates. Covariates included Geography of Practice, Gender, Years in Practice, Practice in an Opt-Out State, and Service in the Military.

When tested alone, the composite score alone did not produce a highly descriptive regression equation, yielding an R-squared of only 0.08. However, when tested together with the covariates, the full model resulted in an R-squared of 0.129. This value indicates that 12.9% of the variance in SOP can be explained by these six variables. The overall R-squared value of 0.129 is below the predicted level set *a priori* of 0.60, so the model was not considered a highly predictive model for SOP. Regression analysis failed to demonstrate a reliable model to predict SOP using a composite variable with covariates, which does not support the stated hypothesis.

Application to the Literature

Defining scope of practice and identifying factors that influence it is not unique to nurse anesthetists. All advanced practice nurses have a vested interest in understanding the evolution of their practice, maintaining quality, and providing cost-efficient care to ease the access burden that our health care system is facing. A vast array of literature exists outlining the policy implications of increasing the role of advanced practice nurses (Fairman et al., 2011; IOM, 2011; Kugler, Burhans, & George, 2011; Nelson, 2012; Phillips, 2012; Ridge, 2011; Stanley, 2012) as well as the quality and efficiency studies to support those policy recommendations (Dulisse & Cromwell, 2010; Hogan et al., 2010; Needleman & Minnick, 2009; Newhouse et al., 2012; Pine et al., 2003; Simonson et al., 2007). In contrast, a single study was identified which actually quantified scope of practice among nurse anesthetists and their levels of collaboration (Alves, 2005).

This current research was conducted to address the lack of information regarding actual scope of practice among nurse anesthetists in the literature. Due to inconsistent regulations from state to state and at the facility level, it would be difficult for any researcher to measure a practitioners SOP given only responses to certain practice statements. Through the development and validation of a novel tool to allow the practitioner to measure their own SOP through the use of a visual analog scale, multiple aspects of SOP could be considered simultaneously for a more accurate and comprehensive picture. This study represents the first time that a VAS has been used to measure SOP, but it has frequently been used in the past to measure multifactorial phenomena such as patient satisfaction and quality of life (McCormack, et al., 1988; Rowan et al., 2011; & Tran et al., 2011).

In 2013 the Veteran's Health Administration proposed changes to the scope of practice for the 3,600 advanced practice nurses it employs by allowing them to function without physician supervision. The change comes in an effort to meet a growing demand for services (Lowes, 2013). Similarly, in 2012 the United States Air Force updated their policy concerning the delivery of anesthesia. CRNAs were no longer required to work in a medical direction model, citing a collaborative relationship as the key component of safe, quality care. The official publication mandated that the provision of anesthesia and its related services by CRNAs be determined by their licensure, certification, and expertise; and that CRNAs are recognized as independent practitioners. The term "anesthesia care team" is now considered any collaboration among anesthesia providers in the administration of anesthesia (AFI 44-102, 2012).

At a time when there is a call at the national level for advanced practice nurses, a collective group of which CRNAs are a part, to function at level that reflects their education, training, and experience (AFI 44-102, 2012; Fairman et al., 2011; IOM, 2011; Kugler, Burhans, & George, 2011; Lowes, 2013; Nelson, 2012; Newhouse et al., 2012; Phillips, 2012; Ridge, 2011; Stanley, 2012), a critical evaluation of factors that contribute to broad scope of practice was proposed. Geography, experience, and clinical training were studied as three potential factors that may influence SOP. It is incumbent upon individual providers to determine their level of practice based upon their experience and training. For that reason, SOP in this study was measured at the individual level considering the unique practice limitations that may exist for each respondent.

In a recent study addressing the SOP of CRNAs, Neft and colleagues (2013) used an internet-based survey of over 40,000 CRNAs to look at the comprehensiveness of the nurse anesthesia practice document published by the AANA. Their findings revealed that 44.6% of respondents (N=4200) felt that they were not permitted to practice to their full scope of practice. Similarly, in this study on factors that affect the scope of practice of CRNAs, respondents were asked, "Do you believe your scope of practice adequately reflects your education, experience, and training?" Of the respondents who answered "Yes" (64.74%), their mean SOP was 82.86. The respondents in this survey who answered "No" (35.26%) had a mean SOP of 54.56 (See

Figure 14). The difference in SOP between CRNAs who felt they were practicing at a level that reflects their education, experience, and training and those who did not was statistically

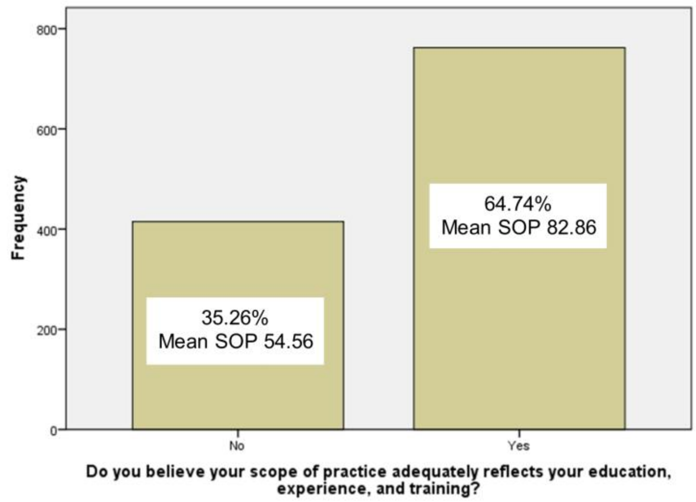

Figure 14. *Frequency and mean SOP scores in response to the item, "My level of scope of practice adequately reflects my education, experience, and training.*

significant (F=432.638, p<0.001). This finding is in direct contravention to the recommendation of the Institute of Medicine, and comparing the SOP scores among these two groups reveals a predictable difference. Those CRNAs who felt their environment allowed them to practice to the level that their training and experience had prepared them for demonstrated a significantly higher mean SOP. Further research is needed to identify specific barriers to broader scope of practice among qualified providers.

These results reflect a consistent theme that a large percentage of practicing CRNAs feel they are being underutilized in the clinical setting. Additionally, by using the SOP-VAS to assess this practice deficiency, we are quantifying the degree to which a disparity exists. There is a large chasm between a SOP score of 82.86 and 54.56. This finding also serves to further validate the use of a VAS to measure the phenomenon of SOP.

Additional Findings

As a preliminary study investigating the factors that contribute to SOP, this research is considered exploratory in nature. To that end, additional analysis of the data was undertaken which yielded compelling findings; some of which may serve as a basis for further study. For example, the literature on the practice of nurse anesthesia is limited to using practice models as a surrogate for describing the SOP of CRNAs. However, the model alone might not be the whole story where SOP is concerned. As expected, CRNAs had increasing mean SOP scores as we move from ACT to Supervision by an Anesthesiologist, to Supervision by a surgeon / dentist / or podiatrist, and finally Independent practice as depicted in Figure 15. When group means were compared using ANOVA, the difference among the four groups was found to be statistically significant ($F=100.279$, $p<0.001$).

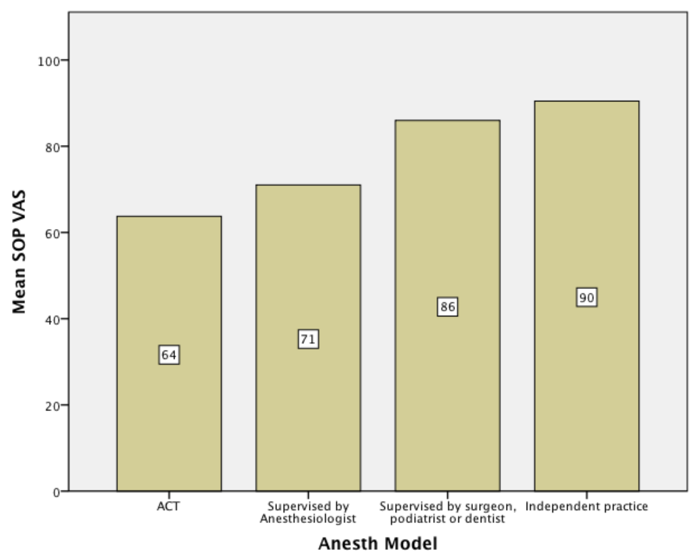

Figure 15. *Mean SOP Scores by Anesthesia Model*

Intuitively this difference is understood from the existing literature on patient outcomes related to anesthesia based on anesthesia delivery models (Needleman & Minnick, 2009; Pine et al., 2003; Simonson et al., 2007), but the mean only shows a snapshot of the overall practice in a given model. A look at the unique distribution of SOP among the different models tells a slightly different story. The distribution of SOP scores for each of the four models is shown in Figures 16-19.

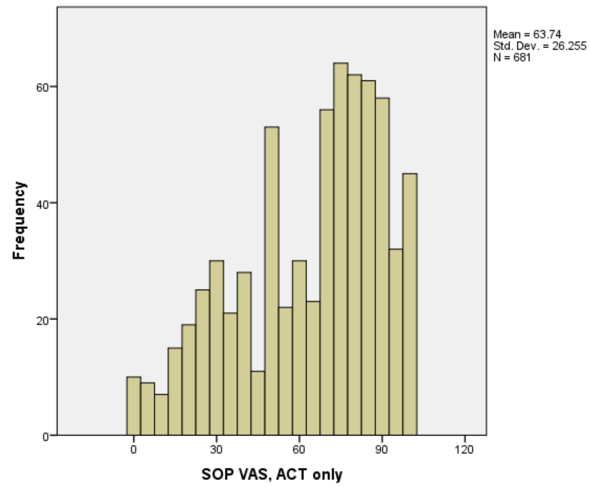

Figure 16. *SOP Distribution for ACT (Anesthesia Care Team) Model*

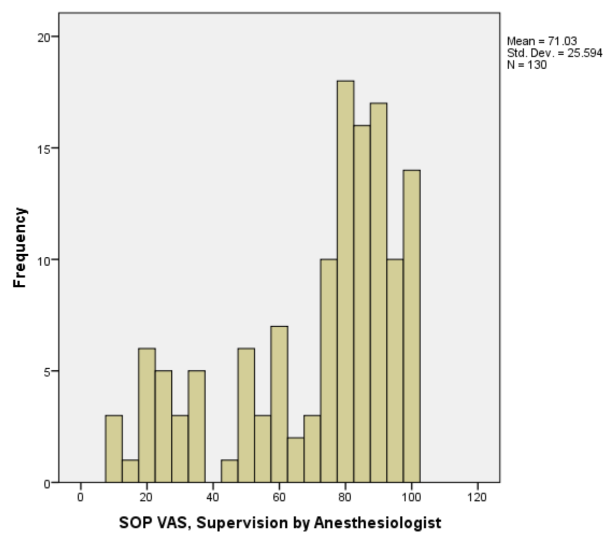

Figure 17. *SOP Distribution for Supervision by Anesthesiologist Model*

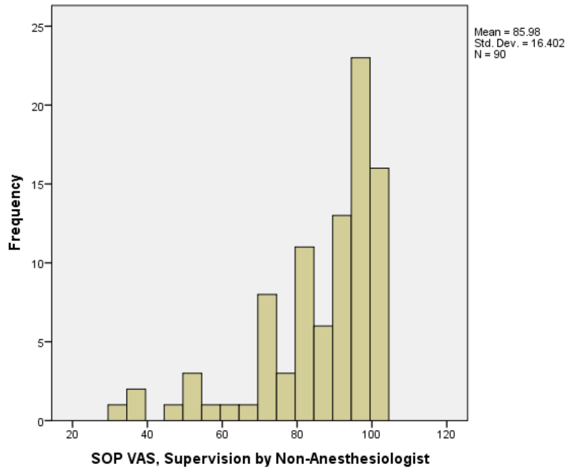

Figure 18. *SOP Distribution for Supervision by non-Anesthesiologist Model*

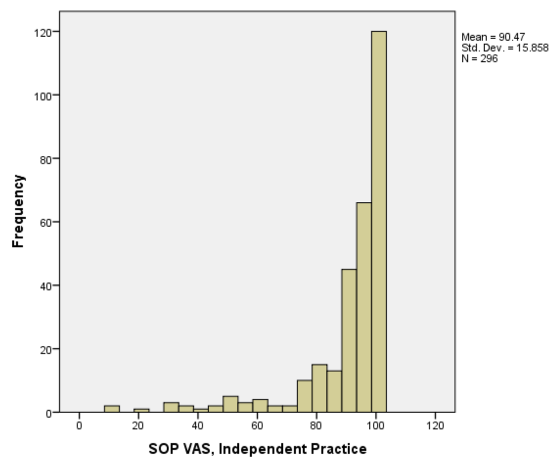

Figure 19. *SOP Distribution for Independent CRNA Practice Model*

From these four figures (Figures 16-19) we see that the SOP within a given model can vary widely. Assigning a certain level of SOP to any of these models based solely on their staffing composition may not be accurate. The range of SOP scores given by the respondents as shown in the preceding histograms illustrate that a CRNA may have a very limited SOP even while practicing independently. Conversely, a CRNA may have a very broad SOP while practicing in an ACT environment. Previous studies have used the anesthesia delivery model as a substitute for scope of practice by assuming that ACT models demonstrate a certain level of practice and independent CRNA models demonstrate a completely different level of practice.

This may be true when looking at averages as seen Figure 15. However, SOP is a highly individualized phenomenon, and should be measured at the individual level.

Table 12 identifies the ranges of SOP scores among members of the same delivery model, demonstrating that even within the same model, SOP is different for every CRNA. If broader levels of SOP are recommended and advised, changing the model is not necessarily the objective. Rather the objective should be to empower and educate the provider through enhancing their self-efficacy to seek broader responsibility within their own practice.

Table 12

Range and Mean of SOP by Anesthesia Delivery Model.

Model	**SOP Range**	**Mean**	**N**
ACT*	0-100	63.74	681
Supervision by Anesthesiologist	10-100	71.03	130
Supervision by non-Anesthesiologist	32-100	85.98	90
Independent Practice	11-100	90.47	296

* Anesthesia Care Team, also called Medical Direction

Within the ACT model, there are also varying degrees of medical direction ratios. For example, Medicare billing rules allow for an anesthesiologist to provide medical direction for up to four concurrent cases (CMS, 2009). Ratios of medical direction range from 1:1 (MD to CRNA), up to a 1:4 ratio. To investigate the effect of medical direction ratios on SOP, subjects were grouped based on the type of medical direction ratio they reported working in the most often. As seen in Table 13, very few respondents utilize the 1:1 ratio. This is a costly and inefficient model, and it is not surprising that this group only constituted 1.7% of the total ACT respondents.

A CRNA sharing the time and attention of an anesthesiologist with three other CRNAs is expected to have a different level of practice than a CRNA that was working with a dedicated

Table 13

Mean SOP Grouped by Medical Direction Ratio.

Medical Direction Ratio	Mean SOP-VAS	N
1:1	60.82	11
1:2	60.31	107
1:3	62.49	209
1:4	64.61	323

anesthesiologist. The CRNAs providing care in a model with higher ratios would possibly have to make more clinical decisions independently, perform patient care activities without assistance, and manage the anesthetic course with much less input from the attending anesthesiologist. The results of this rudimentary comparison illustrate that the medical direction ratio does not appear to impact the SOP of the subjects (F=0.812, p=0.487). Across the four ratios, mean SOP appears to be consistent, indicating the ratio itself does not influence the SOP of the participants.

In addition to practice models and medical direction ratios, SOP was analyzed based on legislative inputs provided by the subjects. Prior to rating their individual SOP, respondents were asked four questions related to the legislative (state law) and local credentialing requirements at their place of work. The findings are presented in Table 14.

The affirmative response to the second question illustrates that there are factors beyond the control of any one provider to practice to the fullest extent of their capabilities when 40.6% of respondents said that the hospital or surgery center imposes even greater restrictions on their practice than the state mandates. Working in a location that imposes such restriction appears to impact the overall SOP of this group because they report a 30% lower average SOP score than those who do not feel they have such restrictions.

Opt-Out states provide an interesting comparison group because their state laws do not require that CRNAs are supervised by physicians, either anesthesiologists or otherwise. Analysis

Table 14

Legislative and Credentialing Influence on SOP.

Questionnaire Item	Frequency	Percentage	Mean SOP-VAS
1. Are you familiar with the scope of practice laws that apply to CRNA practice in your state?	No: 66 Yes: 1097	5.7 94.3	65.85 73.29
2. Do the credentialing parameters at your primary place of clinical practice impose restrictions on your practice that are in addition to the legal limitations dictated by the state?	No: 691 Yes: 472	59.4 40.6	82.78 58.34
3. Do you practice in a state that has "Opted- Out" of physician supervision of CRNAs?	No: 723 Yes: 333	68.5 31.5	69.66 79.75
3a. (IF yes above) Has that change in legislation to become an "Opt-Out" state affected your individual scope of practice?	No: 270 Yes: 62	81.3 18.7	77.14 90.05
4. Do you believe your scope of practice adequately reflects your education, experience, and training?	No: 410 Yes: 753	35.3 64.7	54.56 82.83

of the influence of geography on SOP, Objective One, has shown that CRNAs in opt-out states exhibit a higher average SOP. Responses to this series of questions also show that 18.7% of the 333 respondents who live in an opt-out state report experiencing an impact on their individual SOP. This change appears to have had a positive impact on their collective SOP, with this group exhibiting the highest mean SOP at 90.05. Removal of the supervision barrier appears to have resulted in a broader SOP for this group of CRNAs.

In 2013, Cook et al. reported on preparedness for entry to practice among recent graduates and employers. They found that 97.8% (N=544) of graduates and 96.5% (N=1413) of rated graduates (rated by their employers) were considered prepared for entry to practice. Even though their study showed a very high percentage of CRNAs who have graduated within the previous two years felt that they were fully prepared to enter practice, the SOP scores for this group in the current study tell a slightly different story. The mean SOP for respondents with two years or less in practice was 63.09, and 74.8% reported working in an ACT model (N=111). Mean SOP scores for the groups increased along with years of experience up to the highest mean SOP of 77.23 for the group with over 20 years in practice as seen in Table 15 below. Not only did SOP consistently increase with each group of Years in Practice, the percentage of practitioners in ACT models decreased while the percentage of practitioners in independent practice increased. Even though the variable Years in Practice demonstrated only a weak correlation with SOP during the analysis of Objective Two, there is appears to be a trend among group means when we look at the SOP among these groups. Perhaps the new graduates surveyed in this study were more critical of their overall preparedness for all aspects of practice within the first two years unlike the positive singular response in the study by Cook et al.

Table 15

Mean SOP Grouped by Years in Practice and Anesthesia Model

Years in Practice	**Frequency**	**Percentage ACT**	**Percentage Independent**	**Mean SOP-VAS**
2 or less	N=111	74.8	10.8	63.09
3-5	N=131	62.6	16.0	70.18
6-10	N=161	62.1	19.9	68.07
11-20	N=305	55.4	25.6	72.78
Greater than 20	N=484	50.6	31.4	77.33

The SOP-VAS has provided a unique and reliable way to measure SOP, which allows the individual respondent to consider all the various facets of their practice environment and quantify their practice in a single number. The variation in SOP follows a predictable pattern across anesthesia delivery models, among geographic locations, and in accordance with reported practice limitations. Future study on SOP of nurse anesthetists should endeavor to use this tool and increase its reliability as a global indicator of SOP. There is also application of this tool for similar research among all types of advanced practice nursing to quantify scope of practice.

Limitations

The limitations of this study are related to the design, instrumentation, and statistical analysis methods. To varying degrees the internal and external validity of the results are impacted by these limitations, which are identified and addressed in this section.

Threats to internal validity. A non-experimental design is frequently used with survey methodology due to the lack of intervention among subjects. Although the design introduces potential threats to internal validity, it may also increase subject compliance and enhance reliability of the findings due to the convenient research setting (Polit & Beck, 2009). Potential threats to internal validity with this design include selection bias that accompanies the self-selection of subjects who choose to complete the survey. This threat was mitigated by drawing the sample through a random selection process, providing multiple reminders to increase participation, and through careful respondent pool analysis to ensure adequate demographic composition.

Another threat to internal validity is the lack of control over unidentified variables that may offer competing explanations for the findings. This is a legitimate threat to the study in that not all potential factors were examined. However, as a preliminary exploratory study on factors that affect SOP among CRNAs the scope of the project was limited to testing the influence of experience, geography, and clinical training. Analysis of the data using regression modeling did not produce a model that adequately described the influence of clinical training variables, geography, and experience on shaping scope of practice. There may be other influences that contribute to SOP that were not captured in the study and will serve as a basis for further research in this area.

Use of a novel measurement tool carries inherent validity concerns as well. The SOP-VAS was constructed based upon published practice statements that all CRNAs are encouraged to adhere. These practice statements were also used as a basis for examining SOP of nurse anesthetists in a previous study (Alves, 2005). Instrument validity was confirmed using the Delphi technique by a group of nurse anesthesia education experts. Using a structured convenience sample, the SOP-VAS was found to be a highly reliable indicator of global SOP. The final survey was developed using Bandura's Self-Efficacy Theory as a framework to ensure construct validity of the items. The SOP-VAS was incorporated into the final survey as the response variable. The final survey was again developed through the Delphi technique to confirm validity with an expert panel. The final survey was also pilot tested as an internet-based interactive survey to ensure usability, readability, and item clarity. After launch of the survey, the researcher was contacted via email by three subjects regarding categories of anesthesia delivery. This item was clarified and the survey was updated immediately.

Statistical limitations are frequently cited as a threat to internal validity with the use of multiple regression. Regression analysis may reveal relationships among variables, but it does not imply that there is a causal relationship. Regression analysis assumes that the predictor variables are measured without error, which is not possible through this type of research design (Tabachnick & Fidell, 2007). Only a moderate relationship was found between clinical training factors using experience and geography as covariates. This finding did not meet the criteria for statistical significance, so the influence of statistical modeling has not been overstated. During data analysis with ANOVA, correlations, and multiple regression, every attempt was made to ensure the assumptions were met for valid application of the statistical technique.

Threats to external validity. The external validity refers to the degree to which inferences about observed correlations among study participants will persist among the population as a whole, or the generalizability of the findings (Polit & Beck, 2007). The Hawthorne effect is a potential threat to external validity if subjects simply react to the fact that they are being studied and modify their responses as a result. Subjects were asked to specifically quantify their scope of practice and score it, which may have resulted in inflated SOP scores to reflect ideal levels. This threat was minimized by ensuring anonymity of the responses. Although the distribution of SOP was skewed toward higher scores, many respondents scored themselves in the lower range of SOP. The accuracy of this finding can only be confirmed through further study using this tool.

The generalizability of the results depends primarily on whether the sample is representative of the population of interest. This threat was minimized through rigorous comparison testing of the sample to known parameters of the population. The sample was found to be similar to the population with a high degree of statistical certainty based on average age, gender, years in practice, geographic distribution, and anesthesia delivery model. The threats to external validity of the study were greatly minimized through anonymous responses, random sampling of a large population, and a diverse respondent pool.

Recommendations for Future Study

As one of the preliminary studies on scope of practice of nurse anesthetists, this research was exploratory in nature. After addressing the three objectives through statistical analysis and discussion, additional information was presented that may prompt further study on this topic. There are many ways to use this data or build upon this work to further investigate scope of practice and the factors that contribute to it. For example, the sample could be limited to rural

CRNAs to look at clinical training factors that may be unique and different to that subset of the population. Similarly, by limiting the sample to CRNAs who report working in an independent environment, factors related to clinical training may be analyzed for their influence on SOP. Commonalities may emerge when these two smaller groups are analyzed separately from the larger group of respondents.

The respondent pool was grouped into quartiles for the purpose of designating Highly Restrictive, Moderately Restrictive, Liberal, and Minimally Restricted groups in terms of their SOP as seen in Figure 20. As a different tactic than employed throughout the study, investigating the respondents who fell into the Low SOP quartile may reveal interesting training characteristics and offer insight on potential ways to improve training.

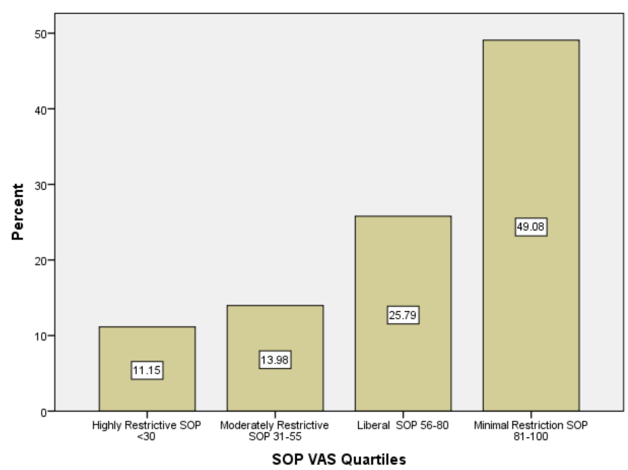

Figure 20. *SOP Range by Quartiles*

In several instances the data has shown that SOP is a unique phenomenon that is very different for each individual who may be working in the same state, same type of facility, same anesthesia delivery model, and the same number of years in practice. This speaks to the dynamic and subjective aspects of SOP that may be heavily influenced by personality traits or work environment characteristics not directly measured in this study. Using Bandura's Theory of Self-

Efficacy, personal influences on SOP would be easily incorporated into further study. As a way to further validate the use of this theory as a domain specific measure of SOP, one would consider measuring self-efficacy using one of Bandura's existing tools adapted for the unique anesthesia practice environment along with the SOP-VAS. Evidence was provided by LeBlanc et al. (2010) that nurses practicing in the ICU who perceived high levels of collaboration also reported their self-efficacy at work to be high. It is hypothesized that self-efficacy would vary together with SOP among nurse anesthetists with a high degree of positive correlation.

Job satisfaction may be another factor that contributes to SOP and is also influential on a person's perceived self-efficacy. Studies by Taylor (2009) and Jones and Fitzpatrick (2009) demonstrated CRNAs reported an increase in satisfaction when there were appropriate levels of collaboration between anesthesia providers. Many respondents in this study provided comments that indicated collaboration and respectful working relationships continue to be a struggle. SOP may be hindered due to these poor working relationships. Further study investigating SOP, Ideal SOP, perceived self-efficacy, and job satisfaction may illuminate the effect that poor working conditions have on scope of practice among nurse anesthetists.

This research was unable to produce a predictive model, which provided a comprehensive explanation of factors that influence SOP when considering only these three categories of variables. Other factors that were not tested are surely part of the equation. Future research should endeavor to elucidate those factors so that the SOP of nurse anesthetists can continue grow in a consistent, structured, and organized fashion so that quality is maintained. The use of a SOP-VAS is a unique and powerful tool to measure SOP on an individual basis. Ongoing validation of this tool is recommended to enhance is reliability and stability when measuring SOP among different groups of advanced practice nurses.

Concluding Remarks

The future landscape of health care is uncertain and changing at a very fast pace. With the implementation of the Affordable Care Act and the unsustainable growth in the cost of care delivery, efficiency and quality have to find a way to coexist. Advance practice nurses, specifically nurse anesthetists, are in a position to be a major contributor to the safe and efficient delivery of care through broadening their scope of practice so that it is consistent with their training and experience. Identifying factors that contribute to broad SOP will be important to ensure that meeting the growing need for access to quality anesthesia care is met with competent providers that are truly ready for that level of practice.

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Appendix A

Scope of Practice Visual Analog Scale (SOP-VAS) Validation Survey

(Administered via REDCap electronic survey software with branching logic and forced choice.)

Thank you for participating the pilot assessment of the Scope of Practice Visual Analog Scale. In order to assess the ability of the VAS to accurately represent an individual's scope of practice, it has to reflect multiple constructs simultaneously. For example, the unique scope of practice and licensing provisions that affect your practice from a legislative perspective, and the actual oversight and physician participation in your practice on a practical level both factor into the resulting scope of practice. Several detailed questions are asked regarding your state, hospital regulations, and actual practice. Please include your comments and feedback at the end of the survey so they can be used to improve the use of this tool. If you work in multiple areas, you may consider your *overall* practice and how those environments shape your total scope of practice.

Please indicate your gender

- M
- F

What is your age? (Could use year of birth, but we want the age to match the experience to match the responses at the time…)

- Fill in ____

How many years have you been practicing as a CRNA?

- Fill in ____

Have you ever served in the US Military as a CRNA?

- Y/N
- If yes, Active Duty or Reserves
  - If Reserves, How many months have you spent on active duty as a CRNA?

In which state do you practice?

- Fill in ______

Do you practice in an opt-out state?

- Y/N/Not sure
- If yes, Has that change in legislation personally affected your scope of practice?
  - Y/N

Are you familiar with the scope of practice laws that apply to CRNAs in your state?

- Y/N

What type of anesthesia model best describes your area of primary employment?

- ACT (Medical Direction)
  - 1:1
  - 1:2
  - 1:3
  - 1:4
- Supervised by physician, dentist, or podiatrist
- No medical direction or supervision

How would you characterize the setting(s) in which you currently practice? (May check more than one).

Urban
Rural
Community
University Hospital
Office-based
Surgery Center / ASC
Other: Specify_________________

To get an idea of the type of environment in which you practice, please respond to the following questions about your practice. Describe the level to which the following scenarios are true (4 point Likert scale):
1) Always, 2) usually, 3) sometimes, 4) never

- The anesthesiologist performs a pre-anesthetic evaluation for my patients prior to the case
- The physician determines the anesthesia plan for the patient
- The anesthesiologist administers the induction drugs for the case
- In consultation with the anesthesiologist or supervising physician, we determine collaboratively the best anesthesia plan for the patient
- The anesthesiologist performs the necessary neuraxial techniques for the case
- The anesthesiologist is present for induction of anesthesia
- The anesthesiologist is present for emergence and / or extubation of the patient
- I respond to airway emergencies throughout the facility
- The anesthesiologist is available for consultation at critical times during the case
- I am primarily responsible for writing the orders in the recovery room for the patient
- The anesthesiologist performs the necessary peripheral regional techniques for the case
- If there is a complication related to anesthesia in the immediate post-operative period, the recovery staff call me for consultation and evaluation of the patient
- I perform the post-anesthesia visit for the inpatients I have cared for the day after surgery
- When invasive lines are required for patient management, I am the one to place them

- I am assigned to the most complex cases that my place of work offers
- I consult with the anesthesiologist prior to giving any type of vasoactive medication

According to the customary practices at your place(s) of employment, describe the level to which you agree or disagree with each of the following statements (5 point Likert scale):
1) Strongly agree, 2) Agree, 3) Neutral, 4) Disagree, 5) Strongly Disagree

- I prefer to work under the medical direction of an anesthesiologist
- The anesthesiologist I work with is available for consultation, but generally leaves decisions up to me
- My education and training are respected by my anesthesia colleagues
- It is important to me to perform regional anesthesia techniques for my patients
- It is important for me to be involved in all the types of cases that my hospital has to offer
- My education and training are respected by my surgical colleagues
- I prefer to work in an autonomous setting
- My opinion regarding patient management is valued
- The anesthesiologists I work with make it clear that they have the "last word" in patient management decisions
- I work in a collegial environment of anesthesia providers
- I prefer to work in a minimally medically directed environment

Rate your scope of practice by clicking on the line below. 0 describes a very restrictive practice and 100 describes a full scope of practice environment within the limits of your state statutes.

0____100

How long did it take you to complete this survey?
_____ (mins)

Thank you for your participation in this pilot study. Your comments and constructive feedback are appreciated. Please take a minute to write any comments below.

Appendix B

Factors Affecting Scope of Practice Survey

(The computer version of the survey included automatic branching logic. The indentations indicate when subsequent questions would follow based on the response of the subject. Not all subjects will see all of the items.)

Thank you for participating in this research study to investigate the impact of experience, geography, and clinical training on scope of practice among CRNAs. Please answer the following questions by filling in data with your keyboard or selecting an answer from a dropdown menu with your mouse. If you have more than one practice arrangement, please respond to the questions based on the type of practice in which you spend the most time. The survey should take approximately 10 minutes to complete; however, you may save the survey and return at a later time if necessary. Complete the survey only once.

Please indicate your gender

- M
- F

What is your age?

- Fill in ____

EXPERIENCE

How many years have you been in practice as a CRNA?

- Fill in ____

Have you ever served in the US Military as a CRNA?

- Y/N
- If yes, Active Duty or Reserves
  - If Reserves, How many months have you spent on active duty as a CRNA?
  - If Active Duty, How many years have you spent as a CRNA in the military?

How would you characterize the clinical setting in which you currently practice? (if more than one, select your primary employment area)

- Community Hospital
- University Medical Center
- Suburban hospital with academic affiliation
- Office-based surgery suite
- Free-standing Surgery Center / ASC
- Other: Specify__________________

What type of anesthesia-delivery model best describes your area of primary employment?

- Anesthesia Care Team (ACT), or Medical Direction
  - Supervision ratio 1:1
  - Supervision ratio 1:2
  - Supervision ratio 1:3
  - Supervision ratio 1:4
- Supervised by physician, dentist, or podiatrist, non-medically directed
- No medical direction or supervision, independent practice

GEOGRAPHY

Prior to entering anesthesia training, how would you characterize the town or city in which you lived?

Urban (greater than 50,000 population)
Suburban (10,000 to 50,000 population)
Rural (less than 10,000 population without an adjacent urban community)

How would you characterize the town or city in which you currently live?

Urban (greater than 50,000 population)
Suburban (10,000 to 50,000 population)
Rural (less than 10,000 population without an adjacent urban community)

How would you characterize the town or city in which you currently practice?

Urban (greater than 50,000 population)
Suburban (10,000 to 50,000 population)
Rural (less than 10,000 population without an adjacent urban community)

In which state do you currently practice?

Drop Down Menu

CLINICAL TRAINING

How long was the clinical training portion of your training? (#of months that you spent 4-5 days per week in the operating room)

Fill in ______

During your anesthesia training, did you identify a mentor that took a personal interest in your education and success?

Y/N

During your anesthesia training, did you have a clinical rotation where you spent at least one month in a rural setting?

Y/N

If yes: how long was the rotation? ____(# of months)

During your anesthesia training, did you have a clinical rotation where you spent at least one month in which you were precepted by a CRNA who practiced without the medical direction of an anesthesiologist?

Y/N

If yes: how long was the rotation? ____
Would you characterize the rotation as a rural setting? Y/N

During your anesthesia training, how many months did you spend in a community or suburban hospital setting?

Fill in ______

During your anesthesia training, how many months did you spend at an academic medical center?

Fill in ______

During your anesthesia training, what percentage of the time were you performing clinical duties at a site which also housed a physician anesthesiology residency program?

Not co-located with a physician residency program at any time
<25%
26-50%
51-75%
76-100%

During your anesthesia training, how would you classify your experience as the sole learner in the following categories? 1) Excellent, 2) Good, 3) Average, 4) Barely Adequate, 5) Poor, Other) I do not recall or This was not a requirement when I was in training

Open heart
Major vascular
Neuraxial anesthesia (spinal and / or epidural)
Complex regional anesthesia (such as femoral nerve blocks, interscalene, axillary)
Pediatric anesthesia
Obstetric anesthesia
Craniotomies
Central line placement
Trauma anesthesia
Difficult airway management (such as fiberoptic scope, lightwand, LMA-Frastrach)

SCOPE OF PRACTICE

As you consider the following items regarding scope of practice, keep in mind that the concept of "Scope of Practice" is a multidimensional phenomenon that includes regulatory and statutory limitations on practice, the supervision or collaborative environment, as well as the individual's knowledge, skills and competency related to patient care. A subjective component related to professional respect, autonomy, authority, and accountability must also be considered

Are you familiar with the scope of practice laws that apply to CRNA practice in your state?

Y/N

Do the credentialing parameters at your primary place of clinical practice impose restrictions on your practice that are in addition to the legal limitations dictated by the state?

Y/N

Do you practice in a state that has "Opted-Out" of physician supervision of CRNAs?

Y/N/Not sure

If yes, Has that change in legislation to become an "opt-out" state has affected your individual scope of practice?

Y/N

Do you believe your level of scope of practice adequately reflects your education, experience, and training?

Y/N

Using the slider below, indicate your scope of practice by clicking on the line. 0 describes a very restrictive practice and 100 describes a full scope of practice environment within the limits of your state statutes.

0____100

Appendix C

Invitation and Consent to Participate

Dear Fellow Nurse Anesthetist,

You are being asked to participate in an important research initiative titled "The Impact of Geography, Training, and Experience on Scope of Practice Among Certified Registered Nurse Anesthetists." You were randomly selected to participate in this research because you are an active nurse anesthetist, certified or recertified by the National Board of Certification and Recertification for Nurse Anesthetists, and have an email address on file with the American Association of Nurse Anesthetists.

The purpose of this study is to investigate the impact of geography, experience, and clinical training variables on scope of practice.

The study will be conducted through the link below to the online survey. Your participation is voluntary, and your responses are completely anonymous. The survey should take you approximately 10 minutes to complete. There are minimal risks or discomforts anticipated from your participation in this survey.

Participation will provide no direct benefits to you, but knowledge gained from this study will be used to determine to what extent these three factors influence scope of practice, and may be used as a basis to enhance training and / or recruitment of nurse anesthesia trainees. You will not be compensated for the time you take to complete this survey. There are no costs to you associated with your participation. There will be no negative consequences if you decide not to participate or change your mind during the survey. By clicking the link below you will give consent to participate in this research.

LINK to REDCap here

If you have any questions or concerns concerning this research you may contact the Principal Investigator Chuck Biddle, PhD, CRNA at cjbiddle@vcu.edu or the co-investigator Jennifer Greenwood, PhD(c), CRNA at greenwoodje@vcu.edu. If you have questions about your rights as a research participant, you may contact the Office of Research Subjects Protection, Virginia Commonwealth University, at 804-828-0868 or ORSP@vcu.edu.

The Virginia Commonwealth University IRB has approved this protocol for one year from April 8,2013.

Appendix D

Secondary Testable Hypotheses

Objective	Independent Variables	Dependent Variable	Hypotheses
Geography Rural Urban	• Primary practice location (c) • Residence prior to anesthesia training (c) • Current residence (c) • Opt-Out State (c)	Scope of Practice VAS score	• CRNAs practicing in rural areas will report high SOP-VAS scores • CRNAs who lived in rural areas prior to training will show a positive correlation with residence in a rural geographic area after training. • CRNAs practicing in opt-out states will report high SOP-VAS scores
Experience	• # of years as a CRNA (i) • # of months in military service as a CRNA (i) • gender (c) • age (i)	Scope of Practice VAS score	• Years of experience as a CRNA will be positively correlated with SOP-VAS scores • Months of experience as a military CRNA will be positively correlated with SOP-VAS scores

Clinical Anesthesia Training	• Length of clinical training (months) (i)
	• Precepted by non-medically directed CRNA (d)
	• Identification of a mentor (d)
	• # of months of rural rotation (i)
	• # of months at an academic medical center (i)
	• # of months in a community hospital setting (i)
	• Co-located physician anesthesiology residency program (o)
	• Quality of experience with highly invasive anesthesia cases (o)
	  • Open heart
	  • Major vascular
	  • Complex regional anesthesia
	  • Neuraxial anesthesia
	  • Obstetrics
	  • Pediatrics
	  • Craniotomies
	  • Central line placement
	  • Trauma
		Scope of Practice VAS score	• Length of clinical training will be positively correlated with SOP-VAS scores
			• Months of rural clinical rotation will be positively correlated with SOP-VAS scores
			• Months at an academic medical center will be negatively correlated with SOP-VAS scores
			• Months in a community hospital setting will be positively correlated with SOP-VAS scores
			• Co-located anesthesiology residency programs will be negatively correlated with SOP-VAS scores
			• Quality of experience with highly invasive anesthesia cases will be positively correlated with SOP-VAS scores
			• A combination of experience, geographic location, and clinical training variables will produce a more descriptive model of scope of practice among nurse anesthetists than experience, geography, or clinical training variables examined alone.

(c): categorical variable (d): dichotomous variable (i): interval (o): ordinal

Appendix E

Summary of Expert Panel Comments on Factors Affecting Scope of Practice Survey

(The expert panel consisted of six CRNAs in field of nurse anesthesia education and practice. One person made several comments on the survey itself through REDCap. One person emailed the researchers directly. Four others had no comment.)

Feedback with rationale and response:

1. 20 minutes to take especially if looking for population demographics.
2. What type anesthesia-delivery model- OK questions. Drop down menu second choice might be clarified adding 'non-anesthesiologist physician supervision'...
3. Follow up question if team approach- good specific question to explore ratio if team approach used.

Items 2 and 3 were incorporated into the survey.

4. Definition of rural vague- you will lack objective criteria for determining rural vs suburban vs urban by not having an established criterion. Consider using the federal governments definition of rural. 'adjacent' to urban area is vague. Adjacent means 5 miles, 10 miles, 50 miles, 100 miles?????? Rural CRNA practice is important to adequately define and data collect. As for collecting this data- that becomes difficult for the respondents. I consider myself 'rural', I live out in the woods 30 miles from the cities big buildings but only 13 miles form the city limits. Population is defined but do respondents know their city population? Do they know their work town's population? Will they Google that during the survey? Maybe ask them to have this information available prior to taking survey to increase response rate and accuracy of responses.

Having people bring research to the table to take the survey will likely discourage people from taking the survey. The three levels of population are given according to the convention used by the Federal Government. (HRSA standards.) It is reasonable that people know the ballpark of the population of their community. If they don't know numbers exactly, they have a feeling about whether they are "considered" suburban or rural. This respondent felt he practiced in a rural area. He or she should answer rural. I could not find a further definition of "adjacent" to describe how far away a rural area had to be from a metro area to be considered rural. Only that it should not be adjacent to one. Population choices are listed in the survey in this manner:
Urban (population greater than 50,000)
Suburban (population 10,000 to 49,999)
Rural (population less than 10,000 without an adjacent urban community)

5. Regarding Mentor. Consider adding 'did you or your program identify a mentor....' I did not identify my mentor-he was assigned by my program director and I am grateful and appreciative. I would not have picked him to formally identify as such but in reflection then and now I call many CRNAs my mentors.

The question was changed to reflect this expert's concern. The question was meant to determine whether a mentor could be identified, not necessarily how he or she was obtained.

6. 'During your anesthesia training, did you have a clinical rotation where you spent at least one month in a rural setting?' Again-what defines rural?

Same rural definition as defined above. This will be clear in the response choices.

7. 'During your anesthesia training, how would you classify your experience as the sole learner in the following categories?' Clarify 'sole learner' . I assume you mean sole learner in that particular anesthetic OR case. ie: If I was learning hearts- I was the only learner in

that room but there were two other rooms that had another SRNA or resident so heart cases had 3 learners but only one per room.

This question was changed and the term "sole learner" was removed. Instead the item asked how the respondent would classify the quality of their learning experience in the following categories..."

8. 'Are you familiar with the scope of practice laws that apply to CRNA practice in your state?' Legislative laws vs Board of nursing or Nurse Association scope of practice (SOP)? You are clear but I, like others may, think professional web site SOP and have seen them but not necessarily the official state's legal jargon.

No change was made to this survey item. There may be conflict between the practice statements put out by the AANA and state laws governing practice. This item is meant to get respondents thinking about actual limits to practice in preparation to rate their practice on the VAS.

9. 'Do the credentialing parameters at your primary place of clinical practice impose restrictions on your practice that are in addition to the legal limitations dictated by the state?' Wow - loaded, all encompassing question. I don't think that could be adequately answered. I live in a non-opt out state but am medical directed. This goes in my opinion beyond requirements but still within SOP. Therefore, the question's answers may not get the true reflection of what you are asking. I, and maybe others, may not know of any particular do and don'ts in legislative law. We often follow SOP as dictated/passed onto us from professional regulatory bodies. Usually professional state organization.

It was important for respondents to think about what they Can Do and Actually Do before they answer the SOP VAS question.

10. 'Do you believe your scope of practice adequately reflects your education, experience, and training?' Hmmm- 'yes' and 'no'. I do all I want in a level I facility. There is no anesthesia procedure I cannot do or are restricted from performing. That being said, I do not feel I need physician supervision.

Same principle as above.

11. The supervision question – I would keep it simple and avoid the word Anesthesia Care Team (ACT) as it may be confusing with all the focus on interprofessional teams currently in the literature. We are all part of an interprofessional team and don't really see ACT too much in the literature any more. I recommend: Supervised by an anesthesiologist, Supervised by a non-anesthesiologist such as a surgeon, podiatrist, obstetrician, dentist, etc., and Not supervised.

ACT is still a term that is used in practice, and CRNAs are familiar with the definition. It is also the billing term used for medical direction, which most CRNAs use. To make the distinction more clear, anesthesiologist was added to Medical Direction and non-anesthesiologist was added to the Supervision option.

12. You may want to ask the state that the CRNA practices in, if you have not done so later in the survey. Some may respond that they are not supervised, but work in a non-opt out state.

State of practice is a survey item.

Appendix F

IRB Approval Notice

V I R G I N I A C O M M O N W E A L T H U N I V E R S I T Y

VCU

Make it real.

Office of Research Subjects Protection
BioTechnology Research Park
BioTech One, 800 E. Leigh Street, #3000
P.O. Box 980568
Richmond, Virginia 23298-0568
(804) 828-0868
(804) 827-1448 (fax)

DATE: April 19, 2013

TO: Clarence Biddle, CRNA, PhD
Nurse Anesthesia
Box 980226

FROM: Lisa M. Abrams, PhD
Chairperson, VCU IRB Panel B
Box 980568

RE: **VCU IRB #: HM15106**
Title: Impact of Geography, Training, and Experience on Scope of Practice of Certified Registered Nurse Anesthetists

On April 12, 2013 the following research study ***qualified for exemption*** according to 45 CFR 46.101(b) Category 2. This determination reflects the revisions received in the Office of Research Subjects Protection on April 8, 2013. This determination includes the following items reviewed by this Panel:

RESEARCH APPLICATION/PROPOSAL: NONE

PROTOCOL: Impact of Geography, Training, and Experience on Scope of Practice of Certified Registered Nurse Anesthetists, version 3/8/13, received 3/11/13

- Factors Affecting Scope of Practice Survey, version 2-4/6/13, received 4/8/13

CONSENT/ASSENT:

- Because the project is exempt from federal regulations, the procedures described in § 46.116 (Consent) and 46.117 (Documentation of Consent) are not applicable to your research study. Nevertheless, the Common Law of the Commonwealth of Virginia, as well as the canons of sound ethics require you to inform potential subjects of foreseeable risks and possible benefits (if any) associated with participation in your research study. Therefore potential subjects should be informed of foreseeable risks and possible benefits of participation in your research study. They should also be informed that they may refuse to participate in your research and they should understand that they might withdraw at any time without penalty. They should then be invited to provide verbal consent.
- This process of informed decision-making should be documented along with other information associated with the study.
- Survey Instructions, version 2-3/29/13, received 4/8/13

ADDITIONAL DOCUMENTS:

- None

The Primary Reviewer assigned to your research study is Stephen Auerbach, PhD. If you have any questions, please contact Dr. Auerbach at and 828-1172; or you may contact Donna Gross, IRB Coordinator, VCU Office of Research Subjects Protection, at irbpanele@vcu.edu or 827-2261.

Attachment – Conditions of Approval (PLEASE NOTE RECENT CHANGES TO #3)

Conditions of 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:
   a) Change in principal investigator
   b) Any change that increases the risk to the participant
   c) Addition of children, wards of the state, or prisoner participants
   d) 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
   e) Changes that change the category of exemption or add additional exemption categories
   f) Changes that add procedures or activities not covered by the exempt category(ies) under which the study was originally determined to be exempt
   g) Changes requiring additional participant identifiers that could impact the exempt category or determination
   h) 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.)
   i) Addition of a new recruitment strategy
   j) 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
).

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:
   a) 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.
   b) U.S. Food and Drug Administration Chapter I of Title 21 CFR 50 and 56 (for FDA regulated research only) and related guidance documents.
   c) Commonwealth of Virginia Code of Virginia 32.1 Chapter 5.1 Human Research (for all research).

Appendix G

Output from Validation of SOP-VAS

Correlations

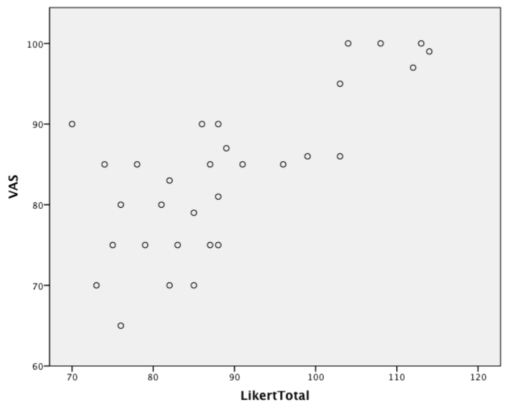
		PreferMedDir	DecisionsUp ToMeRC	Training RespectAnes RC	Perform RegionalRC	InvolvedAll CasesRC	Training RespectSurg RC	Preg AutonomyRC	Opinion ValuedRC	MDLastWord	Collegial EnvironRC	PreferMin MedDirRC
PreferMedDir	Pearson Correlation	1	-.217	.115	.174	.045	.023	.514**	.112	.033	-.095	.633**
	Sig. (1-tailed)		.102	.252	.155	.398	.447	.001	.259	.424	.291	.000
	N	36	36	36	36	36	36	36	36	36	36	36
DecisionsUpToMeRC	Pearson Correlation	-.217	1	.148	.256	.003	.198	-.214	.362*	.241	.385*	-.150
	Sig. (1-tailed)	.102		.194	.066	.493	.124	.105	.015	.079	.010	.191
	N	36	36	36	36	36	36	36	36	36	36	36
TrainingRespectAnesRC	Pearson Correlation	.115	.148	1	.312*	.195	.669**	.113	.624**	.470**	.332*	-.113
	Sig. (1-tailed)	.252	.194		.032	.127	.000	.256	.000	.002	.024	.255
	N	36	36	36	36	36	36	36	36	36	36	36
PerformRegionalRC	Pearson Correlation	.174	.256	.312*	1	.256	.448**	.218	.419**	.080	.138	.408**
	Sig. (1-tailed)	.155	.066	.032		.066	.003	.101	.005	.321	.210	.007
	N	36	36	36	36	36	36	36	36	36	36	36
InvolvedAllCasesRC	Pearson Correlation	.045	.003	.195	.256	1	.220	.357*	.127	.084	-.014	.279*
	Sig. (1-tailed)	.398	.493	.127	.066		.098	.016	.230	.312	.467	.050
	N	36	36	36	36	36	36	36	36	36	36	36
TrainingRespectSurgRC	Pearson Correlation	.023	.198	.669**	.448**	.220	1	.148	.609**	.438**	.139	.000
	Sig. (1-tailed)	.447	.124	.000	.003	.098		.194	.000	.004	.209	.500
	N	36	36	36	36	36	36	36	36	36	36	36
PregAutonomyRC	Pearson Correlation	.514**	-.214	.113	.218	.357*	.148	1	.152	-.006	-.286*	.552**
	Sig. (1-tailed)	.001	.105	.256	.101	.016	.194		.187	.486	.045	.000
	N	36	36	36	36	36	36	36	36	36	36	36
OpinionValuedRC	Pearson Correlation	.112	.362*	.624**	.419**	.127	.609**	.152	1	.567**	.370*	.033
	Sig. (1-tailed)	.259	.015	.000	.005	.230	.000	.187		.000	.013	.424
	N	36	36	36	36	36	36	36	36	36	36	36
MDLastWord	Pearson Correlation	.033	.241	.470**	.080	.084	.438**	-.006	.567**	1	.548**	-.133
	Sig. (1-tailed)	.424	.079	.002	.321	.312	.004	.486	.000		.000	.220
	N	36	36	36	36	36	36	36	36	36	36	36
CollegialEnvironRC	Pearson Correlation	-.095	.385*	.332*	.138	-.014	.139	-.286*	.370*	.548**	1	-.155
	Sig. (1-tailed)	.291	.010	.024	.210	.467	.209	.045	.013	.000		.183
	N	36	36	36	36	36	36	36	36	36	36	36
PreferMinMedDirRC	Pearson Correlation	.633**	-.150	-.113	.408**	.279*	.000	.552**	.033	-.133	-.155	1
	Sig. (1-tailed)	.000	.191	.255	.007	.050	.500	.000	.424	.220	.183	
	N	36	36	36	36	36	36	36	36	36	36	36

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

Correlations

		PreAnesthEval	MDPlan	MDInduction Med	CollabPlanRC	MDNeuraxial	MDPresent Induction	MDPresent Emerg	Airway EmergencyRC	MDConsulation	PACUOrders RC	MDperiphblk	PACUComplic RC	PostopVisitRC	InvasiveLines RC	Complex CasesRC	Vasoactive Meds
PreAnesthEval	Pearson Correlation	1	.569**	.392**	.021	.599**	.697**	.473**	.161	.629**	.550**	.538**	.588**	.362*	.202	.482**	.132
	Sig. (1-tailed)		.000	.009	.451	.000	.000	.002	.174	.000	.000	.000	.000	.015	.118	.001	.222
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
MDPlan	Pearson Correlation	.569**	1	.663**	-.063	.514**	.485**	.549**	-.073	.493**	.234	.573**	.257	.158	.245	.327*	.051
	Sig. (1-tailed)	.000		.000	.357	.001	.001	.000	.335	.001	.085	.000	.065	.179	.075	.026	.384
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
MDInductionMed	Pearson Correlation	.392**	.663**	1	.070	.407**	.497**	.462**	-.043	.510**	.396**	.619**	.473**	.279*	.194	.323*	.159
	Sig. (1-tailed)	.009	.000		.343	.007	.001	.002	.402	.001	.008	.000	.002	.049	.129	.027	.177
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
CollabPlanRC	Pearson Correlation	.021	-.063	.070	1	.098	.011	-.005	.095	-.192	.048	-.013	.176	.277	.281*	.252	.019
	Sig. (1-tailed)	.451	.357	.343		.285	.474	.488	.292	.131	.391	.470	.153	.051	.049	.069	.457
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
MDNeuraxial	Pearson Correlation	.599**	.514**	.407**	.098	1	.623**	.319*	.349*	.587**	.207	.792**	.518**	.327*	.215	.645**	.156
	Sig. (1-tailed)	.000	.001	.007	.285		.000	.029	.018	.000	.113	.000	.001	.026	.104	.000	.181
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
MDPresentInduction	Pearson Correlation	.697**	.485**	.497**	.011	.623**	1	.633**	.275	.675**	.467**	.598**	.606**	.259	-.009	.393**	.051
	Sig. (1-tailed)	.000	.001	.001	.474	.000		.000	.052	.000	.002	.000	.000	.064	.480	.009	.384
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
MDPresentEmerg	Pearson Correlation	.473**	.549**	.462**	-.005	.319*	.633**	1	.102	.525**	.470**	.326*	.409**	.054	-.070	.149	.450**
	Sig. (1-tailed)	.002	.000	.002	.488	.029	.000		.276	.000	.002	.026	.007	.377	.343	.193	.003
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
AirwayEmergencyRC	Pearson Correlation	.161	-.073	-.043	.095	.349*	.275	.102	1	.369*	-.094	.317*	.333*	.022	-.011	.250	.309*
	Sig. (1-tailed)	.174	.335	.402	.292	.018	.052	.276		.013	.292	.030	.023	.450	.475	.070	.034
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
MDConsulation	Pearson Correlation	.629**	.493**	.510**	-.192	.587**	.675**	.525**	.369*	1	.373*	.708**	.712**	.436**	-.076	.445**	.293*
	Sig. (1-tailed)	.000	.001	.001	.131	.000	.000	.000	.013		.013	.000	.000	.004	.329	.003	.042
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
PACUOrdersRC	Pearson Correlation	.550**	.234	.396**	.048	.207	.467**	.470**	-.094	.373*	1	.294*	.519**	.260	.189	.035	.087
	Sig. (1-tailed)	.000	.085	.008	.391	.113	.002	.002	.292	.013		.041	.001	.063	.134	.419	.306
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
MDperiphblk	Pearson Correlation	.538**	.573**	.619**	-.013	.792**	.598**	.326*	.317*	.708**	.294*	1	.615**	.398**	.167	.552**	.226
	Sig. (1-tailed)	.000	.000	.000	.470	.000	.000	.026	.030	.000	.041		.000	.008	.165	.000	.092
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
PACUComplicRC	Pearson Correlation	.588**	.257	.473**	.176	.518**	.606**	.409**	.333*	.712**	.519**	.615**	1	.476**	-.011	.551**	.185
	Sig. (1-tailed)	.000	.065	.002	.153	.001	.000	.007	.023	.000	.001	.000		.002	.475	.000	.140
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
PostopVisitRC	Pearson Correlation	.362*	.158	.279*	.277	.327*	.259	.054	.022	.436**	.260	.398**	.476**	1	.359*	.444**	-.015
	Sig. (1-tailed)	.015	.179	.049	.051	.026	.064	.377	.450	.004	.063	.008	.002		.016	.003	.465
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
InvasiveLinesRC	Pearson Correlation	.202	.245	.194	.281*	.215	-.009	-.070	-.011	-.076	.189	.167	-.011	.359*	1	.252	-.045
	Sig. (1-tailed)	.118	.075	.129	.049	.104	.480	.343	.475	.329	.134	.165	.475	.016		.069	.398
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
ComplexCasesRC	Pearson Correlation	.482**	.327*	.323*	.252	.645**	.393**	.149	.250	.445**	.035	.552**	.551**	.444**	.252	1	.226
	Sig. (1-tailed)	.001	.026	.027	.069	.000	.009	.193	.070	.003	.419	.000	.000	.003	.069		.093
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
VasoactiveMeds	Pearson Correlation	.132	.051	.159	.019	.156	.051	.450**	.309*	.293*	.087	.226	.185	-.015	-.045	.226	1
	Sig. (1-tailed)	.222	.384	.177	.457	.181	.384	.003	.034	.042	.306	.092	.140	.465	.398	.093	
	N	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).



Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.893	.898	27

Correlations

		VAS	LikertTotal
Pearson Correlation	VAS	1.000	.734
	LikertTotal	.734	1.000
Sig. (1-tailed)	VAS	.	.000
	LikertTotal	.000	.
N	VAS	31	31
	LikertTotal	31	31

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.734[a]	.539	.524	6.707

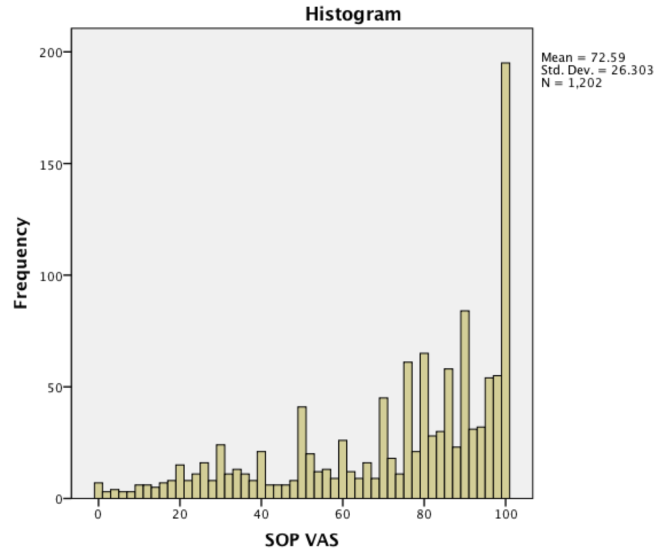
a. Predictors: (Constant), LikertTotal

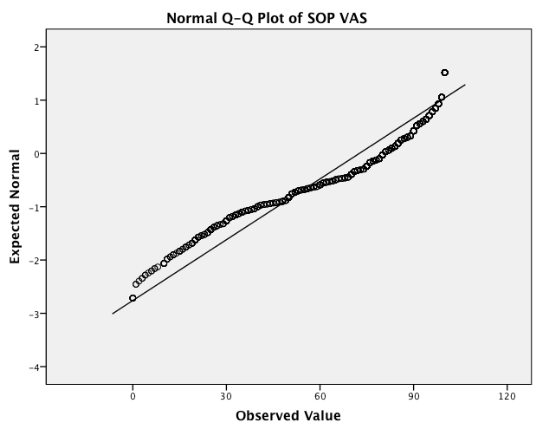
b. Dependent Variable: VAS

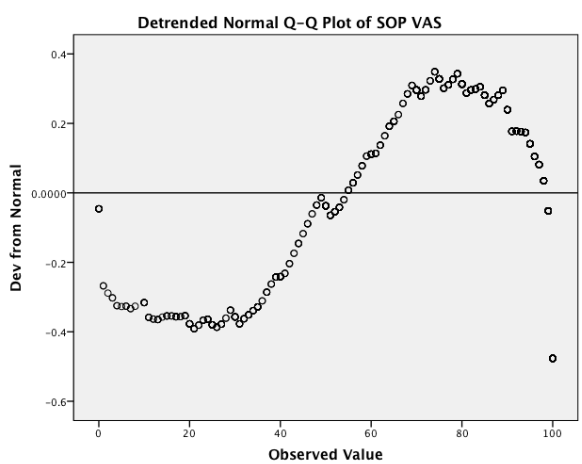
Appendix H

Output from Data Analysis

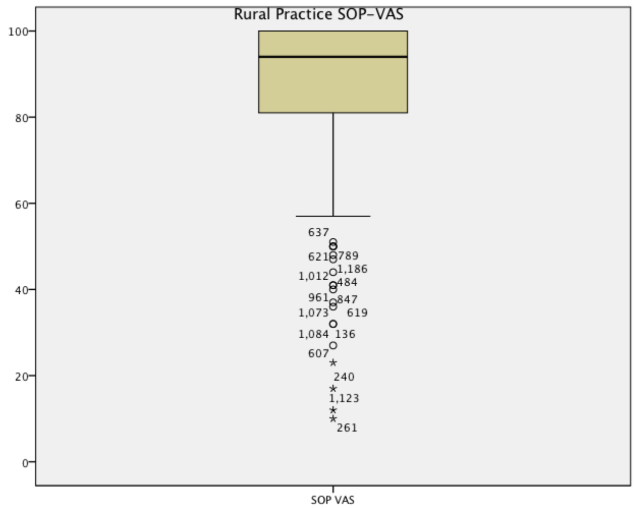
Analysis of the DV, SOP







Objective 1:
Identification of outliers.



Descriptives

SOP VAS

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Urban / Suburban	1027	70.27	26.525	.828	68.65	71.89	0	100
Rural	170	88.19	16.666	1.278	85.67	90.72	32	100
Total	1197	72.82	26.115	.755	71.33	74.30	0	100

Test of Homogeneity of Variances

SOP VAS

Levene Statistic	df1	df2	Sig.
68.422	1	1195	.000

ANOVA

SOP VAS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	46861.315	1	46861.315	72.841	.000
Within Groups	768782.882	1195	643.333		
Total	815644.197	1196			

Robust Tests of Equality of Means

SOP VAS

	Statistic[a]	df1	df2	Sig.
Welch	138.550	1	330.849	.000
Brown-Forsythe	138.550	1	330.849	.000

a. Asymptotically F distributed.

Correlations

		Geo Residence Urban Rural	UrbanRuralPractice
Geo Residence Urban Rural	Pearson Correlation	1	.615**
	Sig. (2-tailed)		.000
	N	1197	1197
UrbanRuralPractice	Pearson Correlation	.615**	1
	Sig. (2-tailed)	.000	
	N	1197	1197

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		GeoPracticeN	Current Geography	Geo Before Training
GeoPracticeN	Pearson Correlation	1	.661**	.242**
	Sig. (2-tailed)		.000	.000
	N	1197	1197	1197
Current Geography	Pearson Correlation	.661**	1	.359**
	Sig. (2-tailed)	.000		.000
	N	1197	1197	1197
Geo Before Training	Pearson Correlation	.242**	.359**	1
	Sig. (2-tailed)	.000	.000	
	N	1197	1197	1197

**. Correlation is significant at the 0.01 level (2-tailed).

Objective 2:

Correlations

		Years in practice	SOP VAS
Years in practice	Pearson Correlation	1	.163**
	Sig. (2-tailed)		.000
	N	1197	1197
SOP VAS	Pearson Correlation	.163**	1
	Sig. (2-tailed)	.000	
	N	1197	1202

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		SOP VAS	Age
SOP VAS	Pearson Correlation	1	.141**
	Sig. (2-tailed)		.000
	N	1202	1199
Age	Pearson Correlation	.141**	1
	Sig. (2-tailed)	.000	
	N	1199	1199

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		Age	Years in practice
Age	Pearson Correlation	1	.881**
	Sig. (2-tailed)		.000
	N	1199	1197
Years in practice	Pearson Correlation	.881**	1
	Sig. (2-tailed)	.000	
	N	1197	1197

**. Correlation is significant at the 0.01 level (2-tailed).

Objective 3:

Report

SOP VAS

Anesth Model	Mean	N	Std. Deviation
1.00	63.59	683	26.372
2.00	71.03	130	25.594
3.00	85.29	91	17.596
4.00	90.01	298	16.772
Total	72.59	1202	26.303

Descriptives

SOP VAS

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
ACT	681	63.74	26.255	1.006	61.77	65.72	0	100
Supervised by Anesthesiologist	130	71.03	25.594	2.245	66.59	75.47	10	100
Supervised by surgeon, podiatrist or dentist	90	85.98	16.402	1.729	82.54	89.41	32	100
Independent practice	296	90.47	15.858	.922	88.65	92.28	11	100
Total	1197	72.82	26.115	.755	71.33	74.30	0	100

Test of Homogeneity of Variances

SOP VAS

Levene Statistic	df1	df2	Sig.
62.961	3	1193	.000

ANOVA

SOP VAS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	164259.161	3	54753.054	100.279	.000
Within Groups	651385.036	1193	546.006		
Total	815644.197	1196			

Descriptives

SOP VAS

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ratio 1:1	11	60.82	28.844	8.697	41.44	80.20	12	100
Ratio 1:2	107	60.31	28.627	2.767	54.82	65.80	0	100
Ratio 1:3	209	62.49	25.022	1.731	59.08	65.90	0	100
Ratio 1:4	323	64.61	26.446	1.472	61.71	67.50	0	100
Total	650	63.16	26.400	1.035	61.12	65.19	0	100

Test of Homogeneity of Variances

SOP VAS

Levene Statistic	df1	df2	Sig.
1.578	3	646	.194

ANOVA

SOP VAS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1699.543	3	566.514	.812	.487
Within Groups	450623.763	646	697.560		
Total	452323.306	649			

Correlations

		SOP VAS	Composite Score
SOP VAS	Pearson Correlation	1	.089**
	Sig. (2-tailed)		.002
	N	1197	1197
Composite Score	Pearson Correlation	.089**	1
	Sig. (2-tailed)	.002	
	N	1197	1197

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation of training variables an SOP:

Correlations

		SOP VAS	Length of clinical training	Months on rural rotation	Months precepted by NonMedically Directed CRNA	Training months community / suburban	Training months academic medical center	Months as AD	Years in practice
SOP VAS	Pearson Correlation	1	-.015	-.048	.134*	-.025	-.009	.095	.162**
	Sig. (2-tailed)		.598	.405	.019	.397	.754	.291	.000
	N	1197	1195	302	303	1162	1168	126	1192
Length of clinical training	Pearson Correlation	-.015	1	.002	.090	.151**	.099**	-.156	.030
	Sig. (2-tailed)	.598		.968	.117	.000	.001	.081	.296
	N	1195	1195	302	303	1161	1167	126	1190
Months on rural rotation	Pearson Correlation	-.048	.002	1	.580**	.054	-.194**	-.028	.018
	Sig. (2-tailed)	.405	.968		.000	.355	.001	.909	.760
	N	302	302	302	172	298	297	19	302
Months precepted by NonMedically Directed CRNA	Pearson Correlation	.134*	.090	.580**	1	.036	.088	.055	.374**
	Sig. (2-tailed)	.019	.117	.000		.537	.128	.735	.000
	N	303	303	172	303	300	302	40	303
Training months community / suburban	Pearson Correlation	-.025	.151**	.054	.036	1	-.300**	-.098	-.041
	Sig. (2-tailed)	.397	.000	.355	.537		.000	.287	.163
	N	1162	1161	298	300	1162	1157	121	1160
Training months academic medical center	Pearson Correlation	-.009	.099**	-.194**	.088	-.300**	1	-.120	.115**
	Sig. (2-tailed)	.754	.001	.001	.128	.000		.184	.000
	N	1168	1167	297	302	1157	1168	124	1166
Months as AD	Pearson Correlation	.095	-.156	-.028	.055	-.098	-.120	1	.100
	Sig. (2-tailed)	.291	.081	.909	.735	.287	.184		.266
	N	126	126	19	40	121	124	126	126
Years in practice	Pearson Correlation	.162**	.030	.018	.374**	-.041	.115**	.100	1
	Sig. (2-tailed)	.000	.296	.760	.000	.163	.000	.266	
	N	1192	1190	302	303	1160	1166	126	1192

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Regression Output:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.092[a]	.008	.008	26.028	.008	10.103	1	1190	.002
2	.260[b]	.068	.066	25.248	.059	75.708	1	1189	.000
3	.314[c]	.098	.096	24.841	.031	40.249	1	1188	.000
4	.338[d]	.114	.111	24.635	.016	20.973	1	1187	.000
5	.354[e]	.125	.121	24.489	.011	15.181	1	1186	.000

a. Predictors: (Constant), Composite Score

b. Predictors: (Constant), Composite Score, UrbanRuralPractice

c. Predictors: (Constant), Composite Score, UrbanRuralPractice, Gender

d. Predictors: (Constant), Composite Score, UrbanRuralPractice, Gender, Years in practice

e. Predictors: (Constant), Composite Score, UrbanRuralPractice, Gender, Years in practice, Do you practice in a state that has 'Opted-Out' of physician supervision of CRNAs?

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6741.625	1	6741.625	9.915	.002[b]
	Residual	805091.212	1184	679.976		
	Total	811832.836	1185			
2	Regression	55259.365	2	27629.683	43.203	.000[c]
	Residual	756573.471	1183	639.538		
	Total	811832.836	1185			
3	Regression	79954.410	3	26651.470	43.043	.000[d]
	Residual	731878.426	1182	619.186		
	Total	811832.836	1185			
4	Regression	92365.093	4	23091.273	37.904	.000[e]
	Residual	719467.743	1181	609.202		
	Total	811832.836	1185			
5	Regression	95917.252	5	19183.450	31.619	.000[f]
	Residual	715915.584	1180	606.708		
	Total	811832.836	1185			
6	Regression	104882.475	6	17480.412	29.153	.000[g]
	Residual	706950.361	1179	599.619		
	Total	811832.836	1185			

a. Dependent Variable: SOP VAS

b. Predictors: (Constant), Composite Score

c. Predictors: (Constant), Composite Score, UrbanRuralPractice

d. Predictors: (Constant), Composite Score, UrbanRuralPractice, Gender

e. Predictors: (Constant), Composite Score, UrbanRuralPractice, Gender, Years in practice

f. Predictors: (Constant), Composite Score, UrbanRuralPractice, Gender, Years in practice, Served in Military

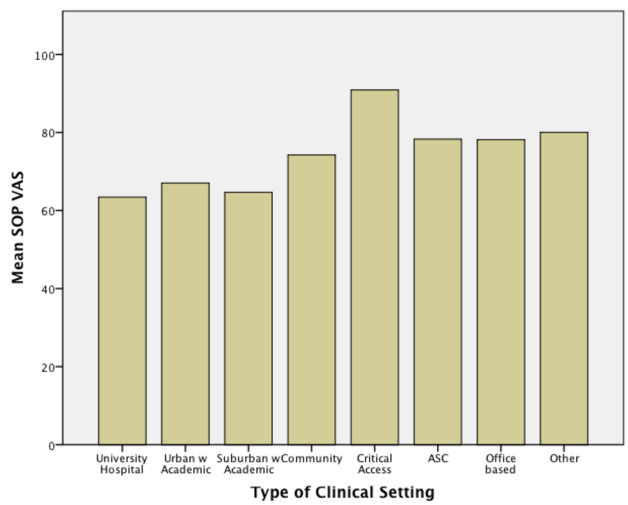
g. Predictors: (Constant), Composite Score, UrbanRuralPractice, Gender, Years in practice, Served in Military, Do you practice in a state that has 'Opted-Out' of physician supervision of CRNAs?

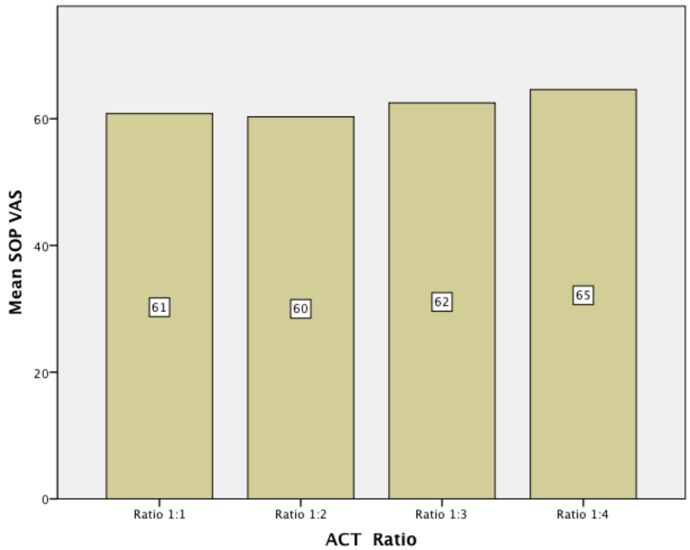
Coefficients[a]

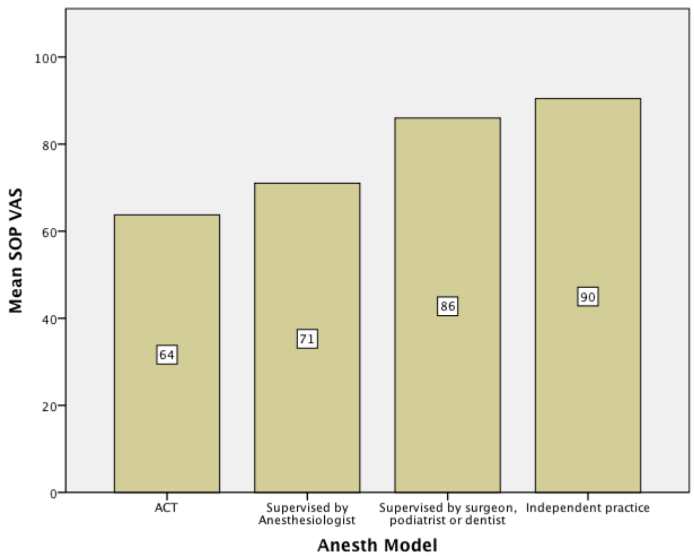
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	61.453	3.672		16.736	.000
	Composite Score	3.193	1.014	.091	3.149	.002
2	(Constant)	38.967	4.398		8.859	.000
	Composite Score	3.632	.985	.104	3.688	.000
	UrbanRuralPractice	18.321	2.103	.245	8.710	.000
3	(Constant)	53.951	4.936		10.931	.000
	Composite Score	3.748	.969	.107	3.868	.000
	UrbanRuralPractice	17.009	2.080	.227	8.177	.000
	Gender	-9.179	1.453	-.175	-6.315	.000
4	(Constant)	50.320	4.961		10.143	.000
	Composite Score	3.366	.965	.096	3.488	.001
	UrbanRuralPractice	16.446	2.067	.220	7.956	.000
	Gender	-8.673	1.446	-.166	-5.998	.000
	Years in practice	.267	.059	.125	4.514	.000
5	(Constant)	49.293	4.969		9.920	.000
	Composite Score	3.128	.968	.089	3.232	.001
	UrbanRuralPractice	16.587	2.064	.222	8.037	.000
	Gender	-7.900	1.478	-.151	-5.345	.000
	Years in practice	.249	.060	.116	4.189	.000
	Served in Military	4.621	1.910	.069	2.420	.016
6	(Constant)	48.516	4.944		9.813	.000
	Composite Score	3.230	.963	.092	3.356	.001
	UrbanRuralPractice	15.985	2.057	.214	7.769	.000
	Gender	-8.293	1.473	-.158	-5.630	.000
	Years in practice	.235	.059	.110	3.968	.000
	Served in Military	4.401	1.900	.065	2.317	.021
	Do you practice in a state that has 'Opted-Out' of physician supervision of CRNAs?	4.183	1.082	.106	3.867	.000

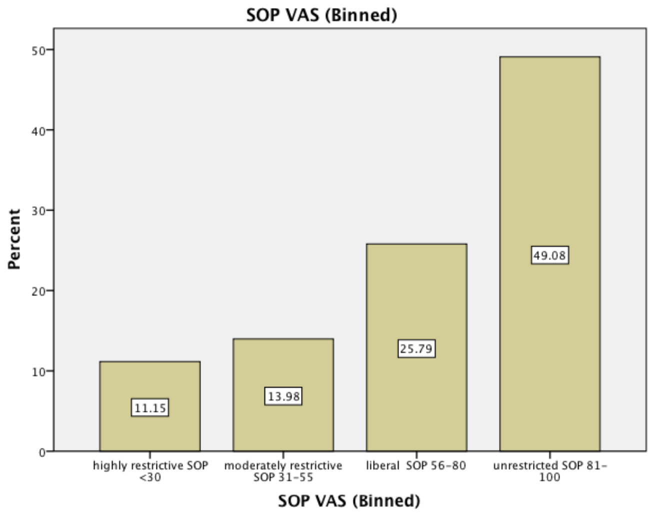
a. Dependent Variable: SOP VAS

Output for proposed additional analyses:




Mean SOP VAS
61
60
62
65
Ratio 1:1
Ratio 1:2
Ratio 1:3
Ratio 1:4
ACT Ratio


Mean SOP VAS
64
71
86
90
ACT
Supervised by Anesthesiologist
Supervised by surgeon, podiatrist or dentist
Independent practice
Anesth Model


SOP VAS (Binned)
Percent
11.15
13.98
25.79
49.08
highly restrictive SOP <30
moderately restrictive SOP 31-55
liberal SOP 56-80
unrestricted SOP 81-100
SOP VAS (Binned)

Practice in an opt-out state (Y/N):

Descriptives

SOP VAS

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
No	740	69.58	26.466	.973	67.67	71.49	0	100
Yes	343	79.80	24.643	1.331	77.18	82.42	0	100
Total	1083	72.82	26.324	.800	71.25	74.39	0	100

ANOVA

SOP VAS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24475.019	1	24475.019	36.477	.000
Within Groups	725317.415	1081	670.969		
Total	749792.434	1082			

Vita

Jennifer Elyse Greenwood was born at Eglin Air Force Base, Florida. She is a 1999 graduate of Saint Mary's College, and a 2004 graduate of DePaul University and the Evanston Northwestern School of Nurse Anesthesia. She has been a practicing Certified Registered Nurse Anesthetist since 2004, including two deployments as a CRNA with the US Army. She has also worked as the clinical coordinator and adjunct faculty for nurse anesthesia students at Rosalind Franklin University of Medicine and Science. She is currently the chief nurse anesthetist at Northwestern Memorial Lake Forest Hospital, and adjunct faculty for DePaul University.