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An Evaluation of Critical Resources in Nurse Anesthesia Educational Programs

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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December 2017

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## Acknowledgements

I would like to take this opportunity to look back in gratitude and acknowledge the bevy of generous and astute people who made this dissertation journey not only possible, but also remarkable. The gifts of wisdom, patience, expertise and counsel given to me along this course have made all the difference. I know that without these gifts I would still be adrift, occasionally steering towards true North but veering inefficiently off on tangents as well.

To the members of my dissertation committee, I profess intense gratefulness and admiration. Dr. Corey Davis navigated the path with me steadfastly, providing constructive insight and key advice at innumerable points. These many portions of advisement were both specific to the research topic, as well as comprehensive regarding project scope and implementation. Dr. Diane Dodd-McCue provided cheerful, invaluable (and patiently repetitive) insight into survey methodology and resource dependence theory integration, a sure foundation upon which I eagerly built. Dr. Michael Fallacaro was a resolute source of encouragement, support and practical operational advice, and his instruction ensured steady progress toward my goal. I also thank him for supporting a departmental scholarship that provided key financial support during my didactic study phase of the program. Dr. Anita Siccardi shared her experience and acumen in research and scholarly publication. She was a touchstone of leadership after my relocation to Indianapolis, and this was key in focusing my energies appropriately. I simply could not have completed this project without each one of you, your benevolence and your instruction. I can never repay you, but I will always be grateful.

There are so many other friends, colleagues and family members who gave to me unwavering consideration and grace. Immediate and extended family members have all offered support, advice and confidence. My treasured colleagues and friends, Maggie Gilbert and Gary Hahn, were instrumental in my pursuit of doctoral education. Dr. Jackie Rowles, my current director at Marian University, has been an irreplaceable champion for my progress in doctoral study and a source of inspiration. I am grateful for the excellent program of doctoral study offered by the School of Allied Health at Virginia Commonwealth University. I would also like to thank Mr. Gerald Clarke and Dr. Paula Kupstas for key contributions to my studies. Mrs. Monica White is always an incredible resource in a myriad of ways, and I am so thankful to her for this support.

A very special mention should be made here of Mrs. Beverly George-Gay and Dr. Georges Mantovani Gay, and the entire Gay household... my Richmond dissertation family, a precious home away from home... without whom I most emphatically would not have made it through. I am so humbled by the joyous love, sage advice and advocacy the Gay family has freely given, and I will be forever in their debt. Family and friends are precious, but family by choice is doubly so. I love you all very much.

Finally, I assuredly could not have completed this odyssey without the guidance, love, support and immeasurable devotion I have from my husband, Greg. He is my truest partner and friend, an incredibly wise and loving man of profound convictions who I so deeply admire. He has generously carried more than his share in our lives always, and certainly this was even more the case during my dissertation. I am ready to be a bona fide life partner to you again, and see where our course lies in the future. Always together, in heart and mind, no matter what may come... our first, best destiny.

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## **Abstract**

### **AN EVALUATION OF CRITICAL RESOURCES IN NURSE ANESTHESIA EDUCATION PROGRAMS**

By Lois Elaine Stewart, PhD

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

Virginia Commonwealth University, 2017

Major Director: Thomas Corey Davis, PhD  
Assistant Professor and Vice Chair of Clinical Affairs, Department of Nurse Anesthesia

Advanced practice registered nurses (APRNs) fill an integral need in the U.S. as a key resource in increasing access to health care. Certified registered nurse anesthetists (CRNAs) are APRNs that comprise a vital portion of the U.S. anesthesia workforce, accounting for over half of the active anesthesia practitioners in the country. Demographic, geographic and epidemiologic factors have combined to produce a forecasted increase in demand for perioperative anesthesia care among a complex, aging and increasing patient population, often located in medically underserved areas. Nurse anesthetists have a long history of valued service in rural and military settings. CRNAs are flexible in all anesthesia patient care models and nurse anesthesia care is economically viable under all patient flow conditions.

Nurse anesthesia education programs (NAEPs) are the single source of new graduate nurse anesthetists for the anesthesia workforce. The ability of NAEPs to adapt to changes in the U.S. anesthesia workforce is one of the best options to serve diverse patient care needs. An analysis

of critical resources in nurse anesthesia education will allow for proactive planning and efficient resource utilization in order to maintain or expand the graduate production in U.S. NAEPs. The purpose of this study was to produce a comprehensive analysis of resource constraints as perceived by U.S. NAEP personnel. The ability of U.S. NAEPs to expand graduate production at current resource levels was also assessed. Resource Dependence Theory grounded the variables and construct linkages utilized in this research, and guided the construction of a novel survey tool for data collection.

The four main domains of critical resources consisted of clinical site resources, prospective student/applicant resources, faculty resources and financial resources. NAEP descriptive characteristics were collected to assess external validity and to serve as covariates in the statistical analysis. The survey was deployed according to a plan developed in collaboration with the Virginia Commonwealth University IRB. This exploratory study utilized a prospective, nonexperimental and cross-sectional design. Purposive sampling was employed among faculty and staff of all 120 accredited U.S. NAEPs, with the goal of one response per program. Standard logistic regressions and correlational analyses were utilized to assess perceptions of resource constraints among U.S. NAEP faculty and staff.

Survey responses received were 84, representing 69 individual NAEPs. This yielded a survey response rate of 57.5%, a number that exceeded the minimum required to adequately power the study. Statistically significant constraints were found in individual predictor items within all four of the domains of critical resources. A free text white space question assessing resource constraints not addressed in the main survey body was used as the last survey item. The main predominant themes in the free text responses were the potential and realized scarcity of clinical learning opportunities, political difficulties in the health care environment and the educational

institution, and the challenge of transitioning to the doctoral entry-to-practice for nurse anesthesia by a mandatory deadline of 2025. Future research directions include refinement of the original survey tool, and the assessment of strategies NAEPs have employed to deal with scarce resources.

## Chapter One: Introduction

Advanced practice registered nurses fulfill a vital and growing need in the U.S. by increasing access to quality healthcare. Nurse anesthetists are one type of advanced practice registered nurses serving in this capacity. Overall demographic trends anticipate the need for anesthesia services is expanding in the face of a likely shortfall in the total anesthesia workforce. This shortage of anesthetic care is more keenly felt in medically underserved areas. Historically, certified registered nurse anesthetists often provide a large portion of anesthetic care in medically underserved areas (Waugaman & Foster, 1995). The spectrum of anesthesia care is a critical service for hospitals and clinics to function safely and efficiently. The ability of nurse anesthesia educational programs (NAEPs) to adapt to changes in healthcare workforce requirements is important in serving to fulfill diverse patient needs. An examination of critical resource constraints to NAEP maintenance and expansion will allow proactive planning and efficient utilization of these important and potentially constraining program resources.

This introduction will briefly cover relevant factors within the general healthcare environment in America, as well as, the anesthesia sector of that environment. These factors include demographic, epidemiological and geographical trends and distinctness driving the healthcare environment. The structure and sufficiency of the anesthesia workforce as an entire entity in the United States will be delineated. The unique attributes and value of nurse anesthesia care to the healthcare environment in the United States will be examined. Certified registered nurse anesthetists (CRNAs) now comprise over one half of the actively practicing anesthesia

workforce in America, providing over 60% of all administered anesthetics (U.S. Bureau of Labor Statistics, 2015a; American Association of Nurse Anesthetists [AANA], 2016a). Nurse anesthesia is critically important for the availability of a full spectrum of anesthetic services in all regions of the nation, especially in medically underserved populations in both rural and urban locations. The purpose of this study is to examine critical resources that are potential constraints upon NAEP graduate output. The conceptual framework appropriate for the research is resource dependence theory. This framework grounds the literature review and guides the novel survey tool construction. A final summary of the challenges in U.S. demographics, safe anesthesia care and a brief overview of the research questions and the analytical scheme used to answer those questions will conclude this introduction.

### **Healthcare Environment (General)**

The evolving healthcare environment in the United States (U.S.) is rife with both challenges and opportunities. The patient population will grow, and increase in medical complexity as the proportion of aged patients expands (AANA, 2012). According to the U.S. Census Bureau (USCB, 2017) the overall population in the U.S. is projected to be over 350 million by the year 2025. The current population of the U.S. in the year 2017 is 324,568,384 persons, with a net gain of one person every 15 seconds (USCB, 2017). In a numerical comparison, the population of Americans aged 65 years or older (elderly) is projected to increase from 43.1 million to 83.7 million, in the period of time between 2012 and 2050 (Ortman, Velkoff & Hogan, 2014). This is almost double the elderly population at the beginning of the measured time period (2012). By contrast, in the preceding score of years, the total membership of this group increased by six million persons (USCB, 2010). Figure 1 illustrates these demographic shifts in the U.S population (USCB, 2017).

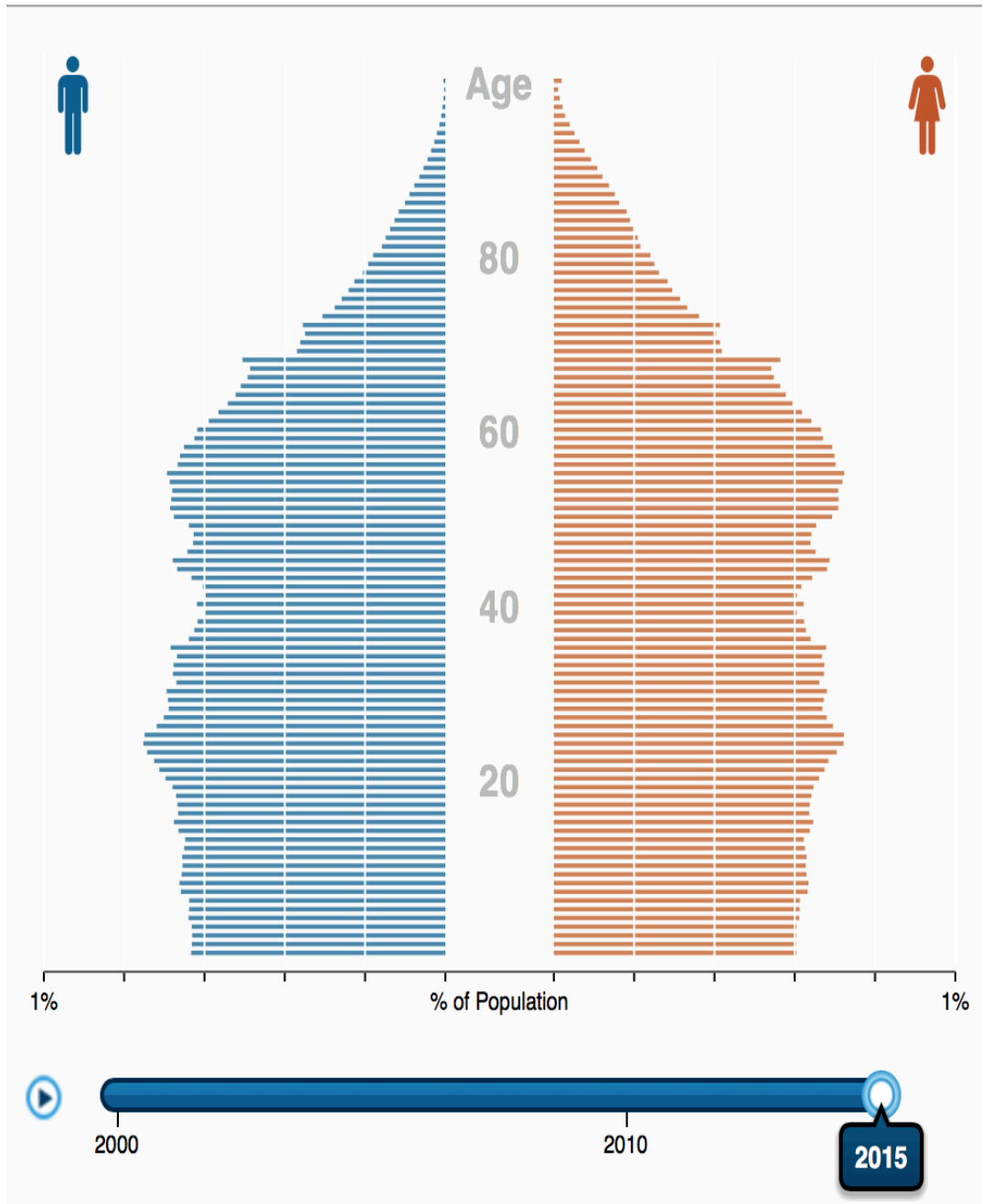


Figure 1: United States Population by Age and Sex

Source: The U.S. Census Bureau. (2017). *U.S. and world population clock*. Retrieved from <https://www.census.gov/popclock/>

The effects of the changing demographics of the U.S. are being felt in many segments of the country. This impact and challenge must be managed in family units, and in the economy within

the business sector as well as the healthcare system (Ortman, et al., 2014). The ubiquity of governmental insurance coverage, via Medicare, for Americans of age 65 and older sharpens this financial impact in the U.S. Between the ages of 70 – 90 years of age, medical spending consumes more than twice as much money as previous age ranges (De Nardi, French, Jones & McCauley, 2015). These same authors note that 65% of the U.S. elderly’s medical expenditures come from governmental sources, and this outlay accounts for at least one third of all total dollars in U.S. medical spending (De Nardi, et al., 2015). In earlier data, the National Center for Health Statistics (NCHS) has shown that members of the elderly age group needed more than 3 times the number of medical procedures compared to other age cohorts (2005). Figure 2 illustrates the increase in the population of Americans aged 65 years or older.

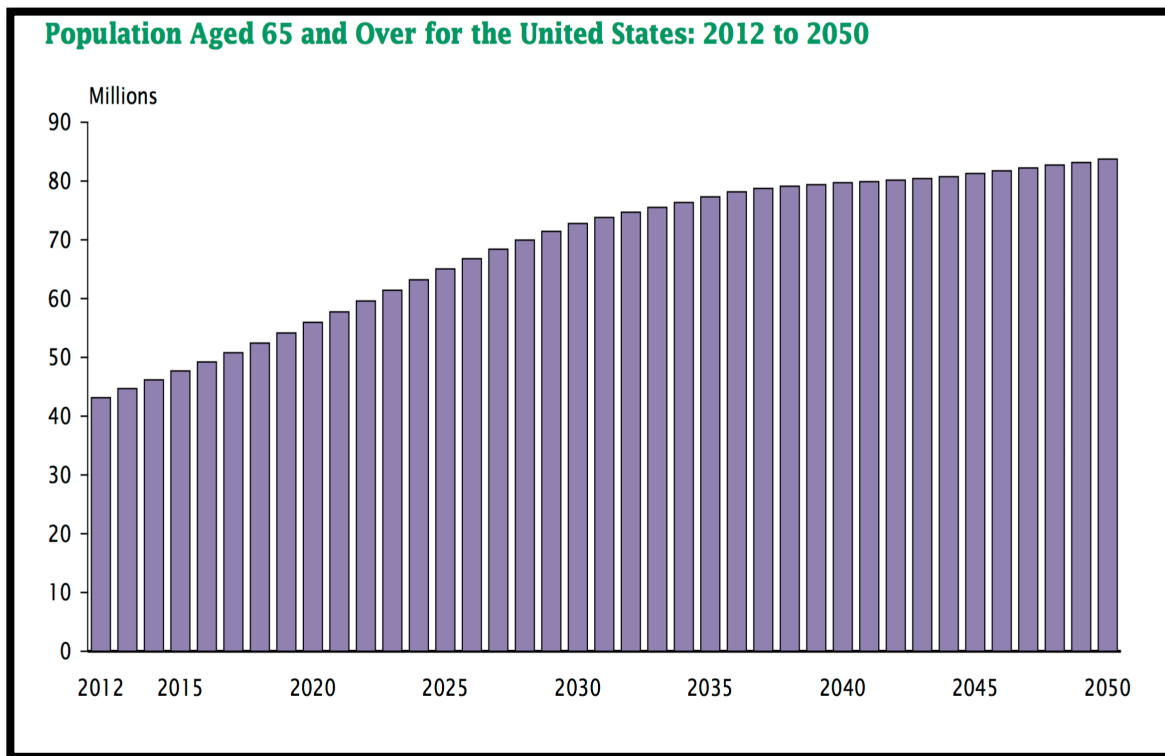


Figure 2: United States Elderly Population 2012 – 2050

Source: The U.S. Census Bureau (2014). *An aging nation: the older population in the United States*. Retrieved from <https://www.census.gov/prod/2014pubs/p25-1140.pdf>



There is a distinct demographic prominence in the U.S. population, due in large part to the ‘Baby Boomer’ phenomenon (USCB, 2017). In addition, more Americans live longer lives and debilitating illness management is improved (Moeller, 2016). Medically, improvements in anesthetic techniques, practice guidelines, sophisticated monitoring, and systematic error reduction have contributed to a substantial decline in anesthetic mortality in all age ranges since the 1980s (Lagasse, 2002; Li, Warner, Lang, Huang & Sun, 2009; Bainbridge, Martin, Arango & Cheng, 2012). Evolving concurrently since the 1970s, an accompanying medical trend of note is an increased perception of anesthetic safety and diminished procedural risk among physicians and surgeons. This perception extends to patients in the elderly age range, patients with complex comorbidities and to procedures with historically high physiological risk (Neuman & Bosk, 2013). These trends summarized together yield the narrative that the population of elderly Americans is increasing disproportionately, this elderly population is living longer, anesthesia has become more safe, and procedural physicians are more inclined to offer diagnostic and interventional services to a larger range of patients than in earlier years. Beyond required medical and surgical procedures for the insured patient population, the age swing in U.S. demographics has led to higher numbers of purely elective procedures as well, such as plastic surgery (DiCanio, 2014).

An additional epidemiologic consideration is the prevalence of obesity in the U.S. and its implicit effects on medical and surgical workloads requiring anesthetic care. Two of the main variables influencing mortality in Americans are smoking and obesity, especially in the elderly population (Ortman, et al., 2014). Given its impact across the U.S. patient population, obesity is an important factor in population disease burden to consider when analyzing future anesthetic

needs. Geographical data across the U.S. varies, and is defined within the USCB major regional definitions of the Northeast, the South, the Midwest, and the West. These are seen in Figure 3.

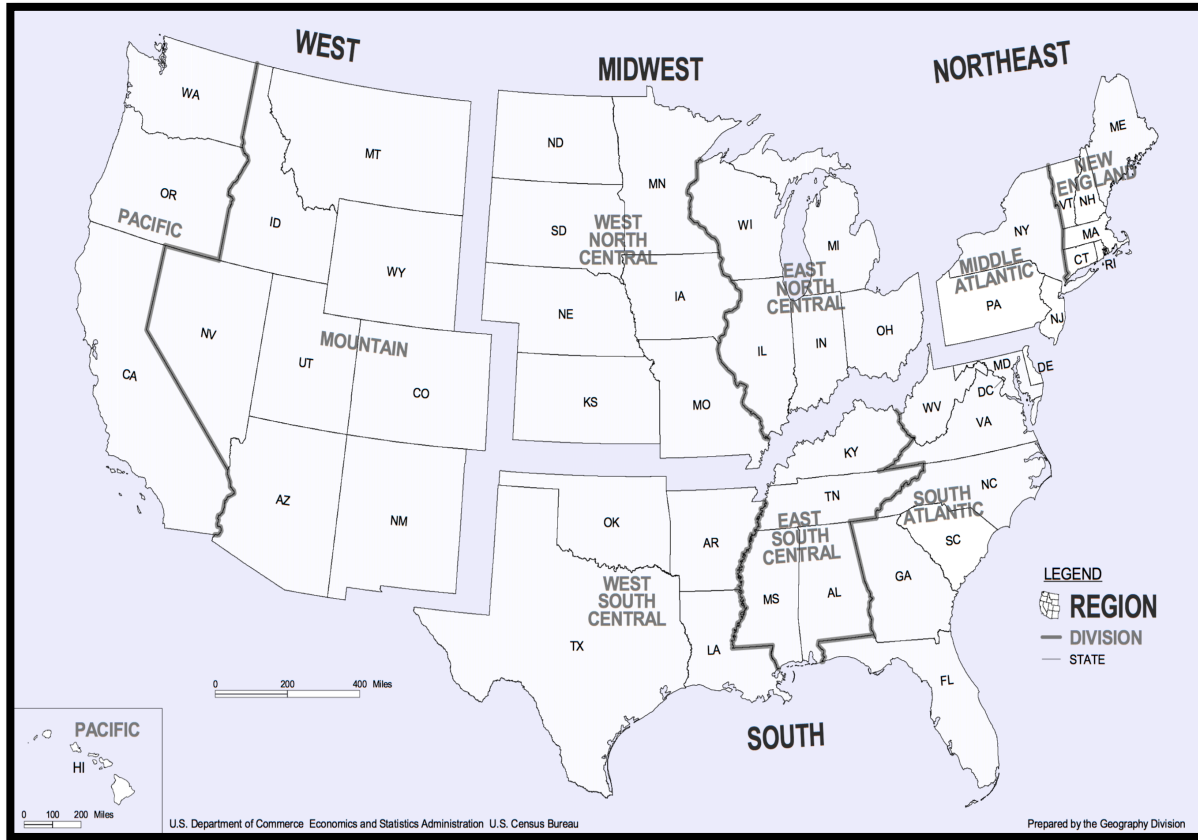


Figure 3: United States Census Bureau Geographic Regions

Source: The U.S. Census Bureau. (2015). *Census regions and divisions of the United States*. Retrieved from: [https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us\\_regdiv.pdf](https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf)

According to the Centers for Disease Control and Prevention (CDC) obesity is strictly defined in adults as having a body mass index of 30 or higher (CDC, 2016). Obesity increases the health risks of many conditions, including hypertension, dyslipidemia and type 2 diabetes (Ortman, et al., 2014). Options for decreasing obesity include exercise and diet modification, vitamin supplementation, medication regimens, and bariatric surgery. Bariatric surgery is primarily meant to physiologically limit the amount of food a person can take in at any one time.

Anesthetic care is required for these bariatric surgical approaches many patients choose as a

method for therapeutic weight loss. Also, as previously mentioned, the presence of obesity confers a higher risk of multiple comorbidities, and further diagnostic, procedural and surgical needs naturally accrue. These include corrective or palliative surgeries for arthritic joint disease, spinal degenerative joint disease, and a constellation of chronic pain, vascular, cardiac, and renal diseases often accompanying obesity and concomitant diabetes (Shubert, Eckhout, Ngo, Tremper & Peterson, 2012). Figure 4 shows the U.S. adult population obesity prevalence map, divided by state boundaries.

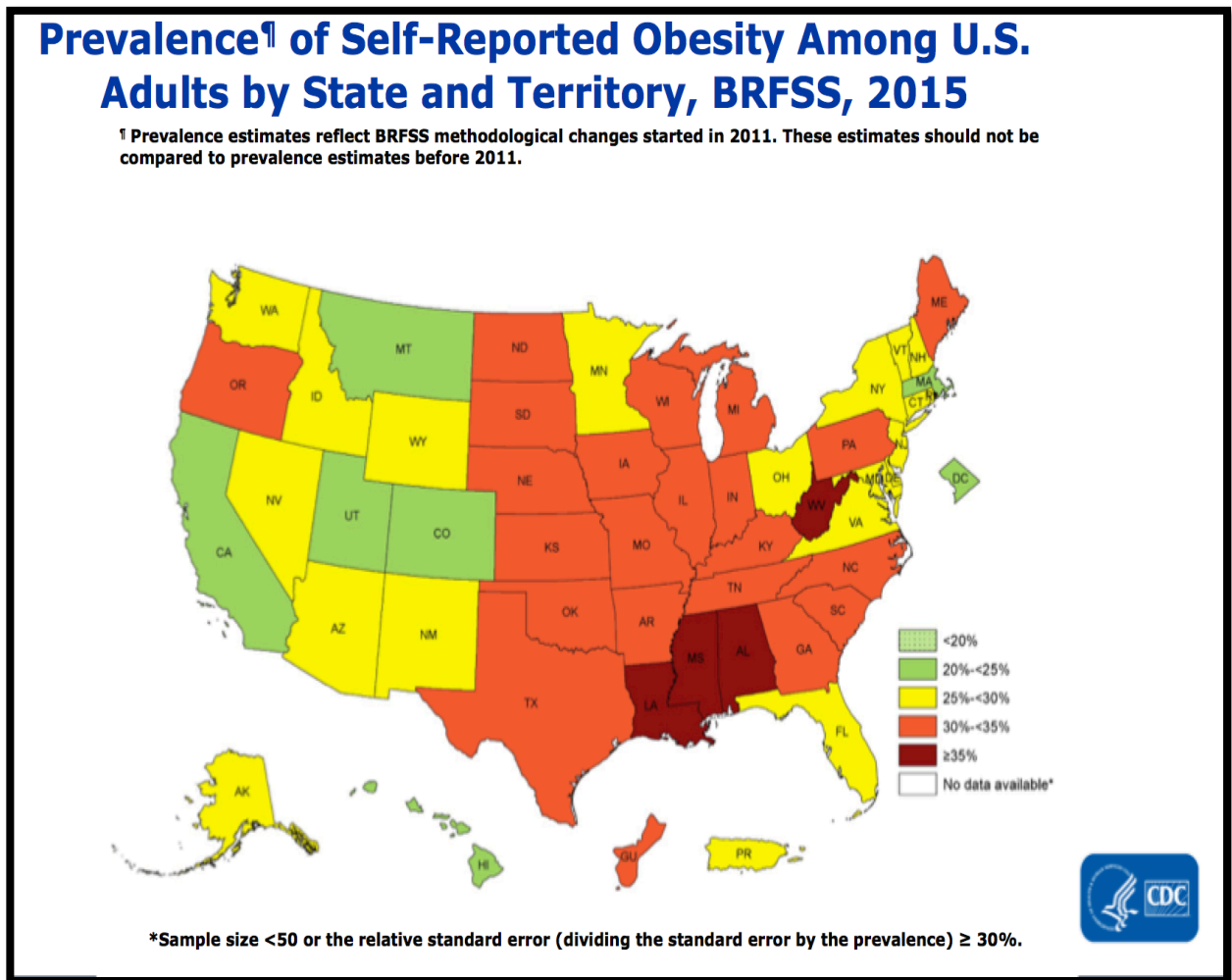


Figure 4: CDC U.S. Obesity Prevalence Map

Source: Centers for Disease Control and Prevention. (2016). *Overweight and obesity*. Retrieved from <https://www.cdc.gov/obesity/data/prevalence-maps.html>

No state in the U.S. has an adult obesity prevalence of less than 20%, and overall the prevalence of adult obesity in the U.S. is 36.5%, equating to more than 81 million people age 18 or over (CDC, 2016). Geographically, the South has the highest overall adult obesity prevalence rate of 31.2 %, followed by the Midwest at 30.7%, the Northeast at 26.4% and the West at 25.2% (CDC, 2016). The four states with the highest overall adult obesity prevalence rates are Alabama, Louisiana, Mississippi, and West Virginia (CDC, 2016). The prevalence of childhood obesity should be considered as well, for patterns set in youth can be long standing. The obesity rate for children aged 2-19 years is approximately 17%, affecting nearly 13 million children and adolescents (CDC, 2016). A further notation from the CDC in this report is that the prevalence of obesity in preschoolers is higher in those children from lower socioeconomic status, a population of children with difficulty in access to medical and surgical care.

Age distribution is another demographic trend to consider as related to geographic prevalence. According to data from 2016, some of the states with the highest percentage of elderly in the U.S. include Hawaii, New Mexico, Arizona, Florida, South Carolina, Montana, West Virginia, Pennsylvania, Michigan, Vermont and Maine (Kaiser Family Foundation, 2017). As noted, the overall elderly population in the U.S. is growing, but the geographic trends in the distribution of the elderly population within the U.S. are notable. The concentration of elderly is historically increased in regions that are traditional retirement communities, but is also increased in regions where young residents must move away for economic or educational opportunity (Kaiser Family Foundation, 2017). This trend towards the migration of youth from economically depressed or stagnant areas contributes to the higher percentage of elderly in rural America, and also to the complexity of needs in medically underserved population areas (Rural Health Information Hub,

2016; Kaiser Family Foundation, 2017). Figure 5 shows the distribution of the elderly (population members aged 65 years and older) within the U.S. by percentage ranges.

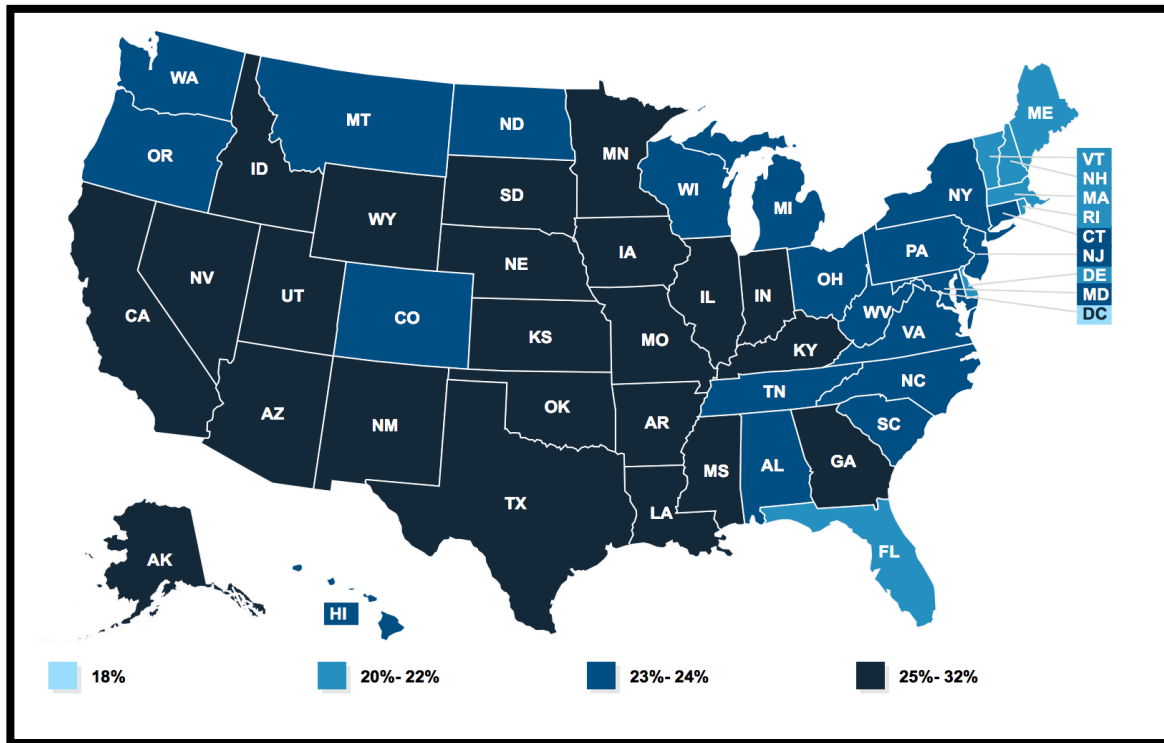


Figure 5: Population Distribution by Age, Adults 65 Years or Older

Source: The Kaiser Family Foundation. (2017). *Population distribution by age*. Retrieved from [http://www.kff.org/population/age-distribution U.S.](http://www.kff.org/population/age-distribution-U.S.)

### Availability of Insurance: Affordable Care Act Impact

In the year 2010, the comprehensive healthcare legislation package entitled the Patient Protection and Affordable Care Act (public law 111–148) and the Health Care and Education Reconciliation Act (public law 111–152) was passed and signed into law. This will be collectively referred to as the Affordable Care Act (ACA). The implementation of the ACA was initially expected to cause an increase in the number of insured patients by approximately 25 million persons at initial full enactment (The White House, 2014; Congressional Budget Office, 2013) and a concomitant increase in anesthesia service demand in a variety of settings (Wilson,

2012 and Schubert, et al, 2012). Revised estimates place the number of previously uninsured patients in the U.S. who have thus far received healthcare coverage since the enactment of the ACA to total 23 million people in the U.S. (Rand Corporation, 2015). Figure 6 shows the most current data for U.S. insured and uninsured rates.

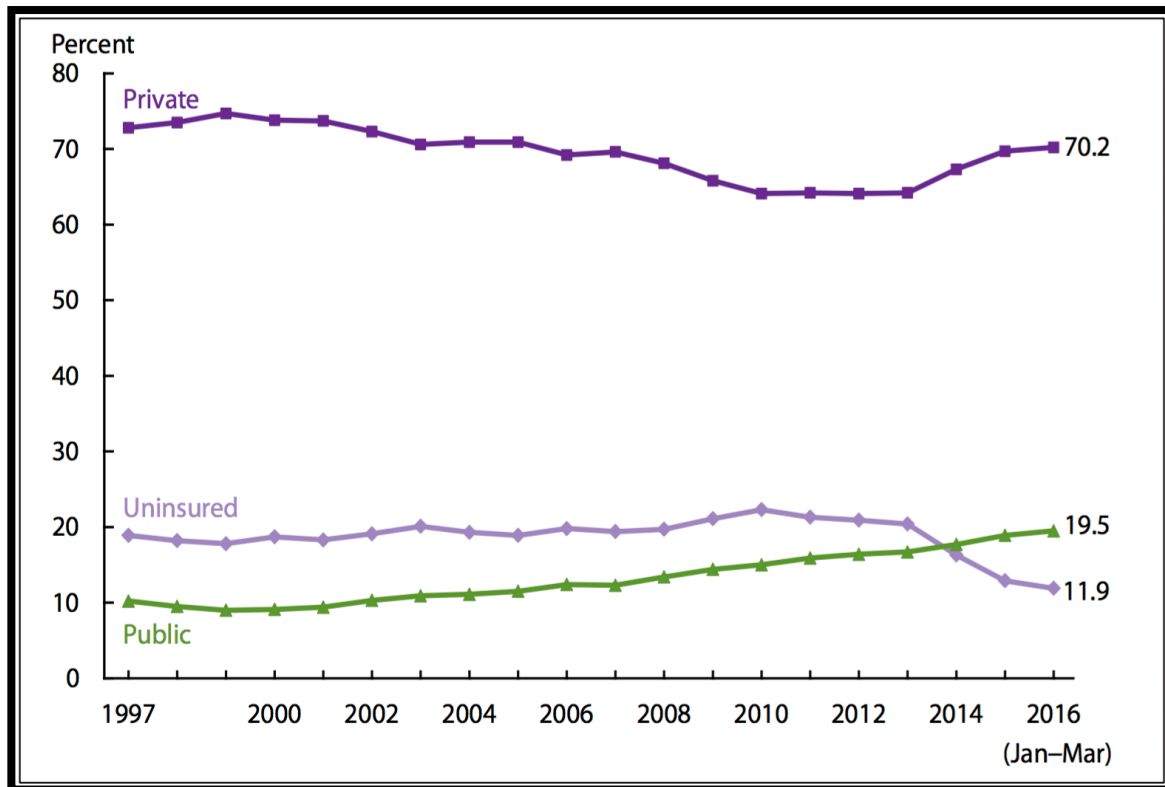


Figure 6: Insured and Uninsured Rates in the U.S.

Source: National Center for Health Statistics. (2016). *Health insurance coverage: early release of estimates from the national health interview survey, January–March 2016*. Retrieved from <https://www.cdc.gov/nchs/data/nhis/earlyrelease/insur201609.pdf>

According to the U.S. Census Bureau, in 2009 there were 50.7 million persons (16.7%) in the country that did not have health insurance; this was prior to the passage and implementation of the ACA health insurance reform. Data gathered by the CDC for the first quarter of 2015 revealed the uninsured rate was equal to 10.5%, or 28.4 million persons (CDC, 2017). This was the lowest figure recorded that numbered the uninsured population in this country (under the age

of 65) for a period of greater than 50 years (ObamaCare Facts, 2015). In the most updated data yet available, 2016, there are now 21.3 million fewer people without insurance than in the year 2010 (National Center for Health Statistics, 2016).

The presence of health insurance is a known driver of demand for healthcare and healthcare spending, and is often seen as a stimulus for innovation and technological advances in healthcare (Smith, Newhouse & Freeland, 2009). Although the 2016 presidential and congressional elections reinvigorated a movement to repeal and replace the ACA, the logistical intricacy of accomplishing a repeal *and* replacement is daunting (Berman, 2016). There are political, policy, contractual and public opinion hurdles to overcome in both the processes. These hurdles have already proven difficult to clear, as the first effort in early 2017 to introduce legislation for repeal and replacement of the ACA was discarded prior to a vote (Hensch, 2017). Efforts at legislation that will modify, repeal or replace the ACA in some manner are continuing. The actions of private insurance companies and the overall insurance market after any affirmative repeal vote are difficult to predict, but the public pressure to preserve coverage for the millions of newly insured Americans has been, and will continue to be substantial (Bade & Everett, 2016; Berman, 2016). The most recent report released by the non-partisan Congressional Budget Office (2017) revealed estimates that the current legislation proposing ACA replacement would increase the number of uninsured persons in the U.S. by 24 million persons by the year 2026 (Congressional Budget Office, 2017). The American public has not been receptive to this prospect. Many experts feel there must be some plan to preserve insurance coverage, both in the short term ‘repeal period’ and in the longer term ‘replacement period’ (Bade & Everett, 2016). These inexact plans are the most concrete evidence currently available within which healthcare professionals may plan for future needs.

The two main federal governmental divisions of healthcare insurance are Medicare and Medicaid. The demographic trends discussed earlier will continue to increase the number of insured individuals in the U.S. over the age of 65, via Medicare. Medicaid coverage is a health insurance program supplied by a federal and state governmental partnership. This program provides coverage to U.S. citizens with low income; its provisions encompass adults, children, the elderly and the disabled (National Conference of State Legislatures [NCSL], 2017). The most current information available shows that 32 states in the U.S. have expanded, or are implementing expansion of the minimum coverage mandated by Medicaid via provisions in the ACA (NCSL, 2017). Specific reforms and their effects are again, largely impossible to predict with accuracy. However, in general within both of these governmental healthcare insurance programs, an increase in the number of insured individuals in the U.S. will continue to be a trend, and a factor driving the demand for healthcare spending. Therefore, the effects of the ACA upon the number of newly insured is likely to be indirectly preserved to some degree and will continue to be broadly accounted for in this research.

Lack of access to healthcare, most often due to lack of insurance coverage or available healthcare providers, is a very important detriment to health, longevity and productivity in U.S. citizens. The risk of early and unanticipated mortality is substantially higher, at least 25% greater, in uninsured adults versus adults who have healthcare insurance (Bailey, 2012). This is believed to be a conservative estimate by many sources, as it does not account for the increased potential of modern healthcare to preserve vitality and prevent costly interventional healthcare (Wilper, Woolhandler, Lasser, McCormick, Bor & Himmelstein, 2009). By means of illustration, colorectal cancer screening rates are markedly lower, as much as five times lower, in individuals who are both low-income and without insurance (Bailey, 2012). The potential for a



screening colonoscopy performed in an appropriate timeframe, to save a life and exponential medical/surgical costs, is difficult to exactly quantify but is acknowledged as extremely significant (The Lewin Group, for the National Colorectal Cancer Roundtable, 2008; Pan, Xin, Ma, Hu & Li, 2016). Between the years of 2003 and 2009, colonoscopy screenings utilizing anesthesia providers grew from 14% to greater than 30% of procedures (Liu, Waxman, Main & Mattke, 2012). By a provision of the ACA, such screening procedures must be covered by new insurance plans as of September 2010, without a co-pay or deductible (U.S. DHHS, 2013b).

This is but one example of increased need for anesthesia services with an increase in the insured population. Although colorectal cancer screening is provided frequently with the services of an anesthesia provider, some facilities alternatively utilize conscious sedation nurses. In this case, an anesthesia service is often the mandated immediate backup or referral service for conscious sedation teams in the case of complex or emergent situations (Higgins, Hearn & Maurer, 1996).

Initial studies indicate the removal of cost considerations by the ACA for preventive healthcare services resulted in more utilization of these services by patients, especially those in lower socioeconomic strata (Lau, Adams, Park, Boscardin & Irwin, 2014; Han, Yabroff, Guy, Zheng & Jemal, 2015). The recent and continuing expansion of Medicaid is the force that has driven this trend for those patients who would otherwise be without insurance (NCSL, 2017). A recent study in *Diabetes Care* reveals that in the 26 states (plus the District of Columbia) where Medicaid was expanded per the ACA, the total of Medicaid enrollees who were newly diagnosed with diabetes increased by 23%. In those 24 states that did not choose to expand Medicaid, the total of Medicaid enrollees newly diagnosed with diabetes increases by only 0.4% (Kaufman, Chen, Fonseca & McPhaul, 2015). Diabetes is only one of the constellation of comorbidities tied to both obesity and population age cohorts, important for consideration of its impact upon the

healthcare system and procedural demands. Many primary care services and screenings include some that necessitate anesthesia care, such as colorectal cancer screening, surgical treatment of obesity, and the treatment of chronic or acute pain, among other possibilities (Schubert, et al, 2012; Fedewa, Goodman, Flanders, Han, Smith, Ward, Doubeni, Sauer & Jemal, 2015).

The ACA has survived logistical and website challenges since its inception, decreasing insurance company participation, and currently is under scrutiny for an average 22% rise in premium prices for 2017 (Kodjak, 2016). The federal government has emphasized that many subscribers will be able to substantially offset this premium increase with planned federal subsidy increases (Duffy, 2016). The ACA has, and will, face future challenges. Debate regarding the ACA was prominently used in the 2016 U.S. presidential election, encompassing healthcare tax reform, increased availability of health savings accounts, and emphasizing free market concepts of choice, portability, price transparency and competition (Trump-Pence: Make America Great Again, 2016). The institution of any proposed reforms and its effects upon insurance availability and coverage are not predictable. Reforms can conceivably alter or remove insurance coverage from the nearly 23 million newly insured Americans related to the inception of ACA (Rand Corporation, 2015) and alter effects upon healthcare demand. However, the demographic, medical, technologic and epidemiologic trends driving the increasing demands upon the U.S. healthcare system are not dependent upon the existence of the ACA.

### **The Nursing Workforce**

According to the National Council of State Boards of Nursing (NCSBN), as of January 2016, licensed nurses numbered over three million in the U.S. This is the largest single group of healthcare providers in the nation (American Association of Colleges of Nurses [AACN],

2015a). The integral nature of nursing in the healthcare delivery is seen not only in the number of providers, but also in the presence of nursing in all manner of healthcare facilities (AACN, 2015a). Nurses are found in myriad settings and capacities within our nation's healthcare system, with different roles and educational preparation. Entry-level nurses may continue the pursuit of further education and receive masters or doctoral degrees (practice doctorates and/or research doctorates). This advanced education leads to roles as expert bedside clinical nurses, advanced practice registered nurses (APRNs), nurse educators, nurse researchers and nurse administrators.

The presence of, and contributions to the U.S. healthcare delivery system from APRNs is substantial, and can be linked to important health outcomes. These include access to care (availability of care), cost efficiency and quality of care (AACN, 2016). The nursing workforce, however, is aging in a similar demographic pattern as compared to the general population of the U.S. Approximately one-third of the U.S. nursing workforce is between 50-64 years of age, and likely to retire by the year 2025 (Buerhaus, Auerbach, Staiger & Ulrike, 2013). Concurrently, there will be an increasing demand for healthcare services to an increasingly complex and aging patient population. These demands will exist in primary and specialty care, and can be met in part by APRN practice. The U.S. Bureau of Labor Statistics (2014) estimates that the employment of APRNs is expected to grow by at least 30% between the years of 2012 to 2022.

These facts taken together lead to the assertion that the supply of nurses in general, and specifically the supply of APRNs, is a crucial factor in the equitable provision of quality healthcare services in the U.S. The nursing workforce is supplied through nursing education program output, for entry-level providers as well as practitioners educated at the graduate level. Since at least 1964, a funding priority in the U.S. has existed to support the production of well-

educated nurses. The year 1964 marks the inception of the federally funded Title VIII Nursing Workforce Authorization Act (Title VIII of the Public Health Service Act [42 U.S.C. 296 et seq.]). The Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (DHHS) administers this act. Title VIII focuses on all dimensions of the nursing workforce, and provides funding initiatives to support nursing education, practice, recruitment and retention (AACN, 2015a).

The most recent iteration of this funding is H.R. 2713, the Title VIII Nursing Workforce Reauthorization Act. In September 2016, news sources confirmed the passage of H.R. 2713 by the U.S. House of Representatives Energy and Commerce committee (“Capps Applauds Committee,” 2016). A bipartisan group introduced the funding bill for Title VIII into the U.S. House of Representatives on February 7, 2017 (American Nurses Association, 2017). Other institutions involved in the study of healthcare delivery share this support and vision for nurses, and nursing education. One example is the Institute of Medicine, now known as the National Academy of Medicine (NAM). The National Academy of Medicine is a non-profit non-governmental society and is part of the larger National Academies of Sciences, Engineering, and Medicine. This body functions as an independent and unbiased adviser to the U.S. on matters of science, medicine, health and technology. The NAM utilizes evidence-based approaches to information generation, evaluation and policy recommendation (The National Academies of Sciences, Engineering, and Medicine, n.d.).

As with the ACA, continued funding of governmental legislation is unpredictable. Support from reputable healthcare policy agencies, and the long history of Title VIII funding, lends credence to the continuation of this historical and current support for nursing (AACN, 2015a). Figure 7 shows a summary of Title VIII funding since its inception (AACN, 2015a).

## Historical Funding for Title VIII

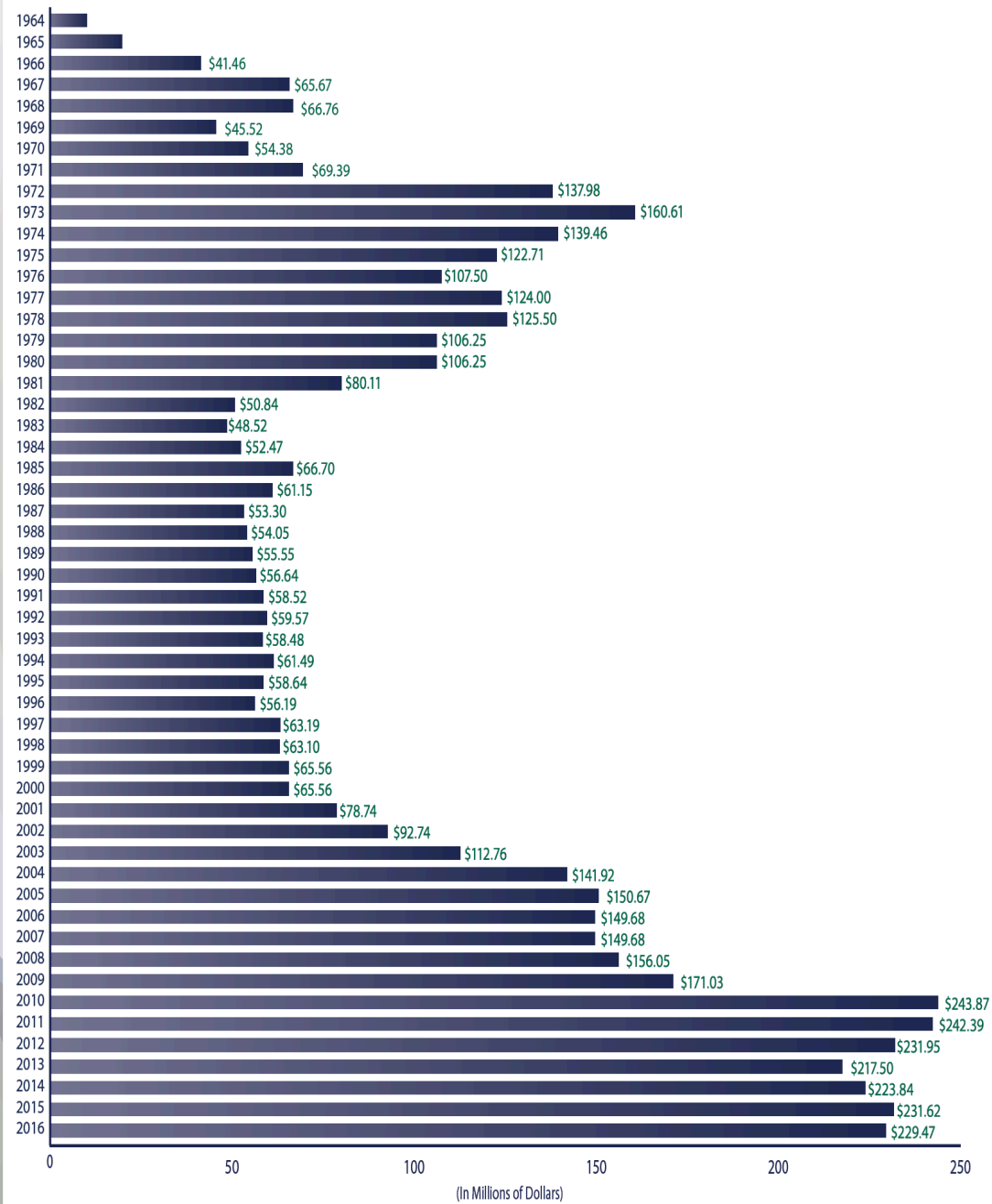


Figure 7: Title VIII Funding History

Source: U.S. Department of Health and Human Services. (2016). Health Resources and Services Administration, Fiscal Year 2016 Justification of Estimates for Appropriations Committees.

The impact of this funding is noteworthy. HRSA found that Title VIII funding provided support to more than 450,000 nurses and nursing students between the years of 2006 – 2012 (American Nurses Association [ANA], 2016). The ANA (2016) reports that the Title VIII grant programs include:

- Advanced Education Nursing Grants: intended to supply grant funds to support the education of APRNs, nurse educators, nurse administrators and public health nurses
- Workforce Diversity Grants: intended to increase opportunities in the field of nursing for individuals from socio-economically disadvantaged backgrounds
- Nurse Education, Practice and Retention Grants: intended to support nurses and schools at the entry-level of practice (associate and baccalaureate degree levels)
- National Nurses Services Corps: intended to help repay nursing loans for graduates in exchange for a work agreement in a designated nursing shortage area for a specified period of time
- Nurse Faculty Loan Program: intended to establish loan programs to within schools of nursing to assist in graduate level education in exchange for a work agreement to teach in an accredited school of nursing for a specified period of time
- Comprehensive Geriatric Education Grants: intended to supplement funds for specific geriatric training for nurses, or to assist financially in further education for nurses who give direct care to geriatric patients.

These programs have been a great value to the profession of nursing in many ways. and within all specialties of nursing and nursing education.

### **Institute of Medicine: The Future of Nursing Report**

Beginning in the year 2009, the Health and Medicine Division of the National Academies of

Sciences-Engineering-Medicine organized a consensus study entitled the Initiative on the Future of Nursing: (<http://www.nationalacademies.org/hmd/Activities/Workforce/Nursing.aspx>). The Institute of Medicine and the Robert Wood Johnson Foundation collaboratively pursued this project with an expert interprofessional panel. The overarching goal of the study was to return a metamorphic report on the future of nursing in the healthcare delivery system of the U.S. This consensus study yielded four major reports over the span of more than 2 years meant to assess and transform the capability of the U.S. nursing profession to meet the evolving needs of the healthcare delivery system. The reports that were generated are as follows:

1. Forum on the Future of Nursing: Acute Care (final in 2009)
2. Forum on the Future of Nursing: Care in the Community (final in 2009)
3. Forum on the Future of Nursing: Education (final in 2010)
4. The Future of Nursing: Leading Change, Advancing Health (final in 2011)

In the last report listed above, entitled *The Future of Nursing: Leading Change, Advancing Health*, emphasis was placed upon fulfillment of the intended scope of practice for all advanced practice nurses as critically important to the U.S. healthcare delivery system (Institute of Medicine [IOM], 2011). APRN roles include the Nurse Practitioner (NP), the Certified Nurse Midwife (CNM), the Clinical Nurse Specialist (CNS) and the CRNA.

This emphasis is important in the delivery of quality outcomes at an efficient cost, especially in medically underserved areas. The role of advanced practice nurses in decreasing disparate access to quality healthcare is vital and includes the realm of nurse anesthesia (Wilson, 2012). Demand is a key component and driver of the distribution and provision of healthcare, but quality of care is also an issue of great import (IOM, 2010a). Disparate access to care is not effectively decreased if outcomes are different between physician-led care and APRN-led care.

However, multiple sources do not come to such a conclusion. On page 5 of a statement by the Alliance for Health Reform, the following quote appears: “Evidence cited by many experts suggests that quality and safety are not compromised and access is improved when nurses are able to exercise the practice of their skills to their full potential.” (Okrent, 2011). A systematic review of 18 years of APRN outcomes from multiple authors, published in *NURSING ECONOMIC\$* found that quality outcomes and satisfaction levels of patients receiving care from APRNs were equivalent to, or in some cases, exceeded those in physician-only care (Newhouse, Stanik-Hutt, White, Johantgen, Bass, Zangaro, Wilson, Fountain, Steinwachs, Heindel & Weiner, 2011). A final direct quote addressing the issue of equivalency in APRN and physician care comes from the IOM paper *The Future of Nursing: Focus on Scope of Practice*: “No studies suggest that APRNs [Advanced Practice Registered Nurse] are less able than physicians to deliver care that is safe, effective, and efficient or that care is better in states with more restrictive scope of practice regulations for APRNs.” (IOM, 2010b).

An additional development occurring in the summer of 2016 is the question of APRN full practice authority within the staff of the U.S. Department of Veterans Affairs (VA). The Veterans Health Administration (VHA) is the component of the VA that provides healthcare services for U.S. veterans with a history of active service in the military, naval or air service. The VHA has an enrollment of 8.97 million subscribers in a system that provides the full spectrum of healthcare, from outpatient centers and offices to full service hospitals, including tertiary referral centers with advanced care and procedures (National Center for Veterans Analysis and Statistics [NCVAS], 2016). This is an immense health system with more employees in the health division than all the other VA components tallied together (NCVAS, 2016). Stories began to circulate in 2014 in various sources, alleging that for years the services



veterans requested in the VHA were not promptly delivered; this has continued to be a complaint recently (Bronstein, Black & Griffin, 2014; Lawrence, Whitney & Tomsic, 2016). In fact, access to needed medical services and procedures proved so problematic, reportedly some veterans died without receiving needed care (Cohen, 2014).

The VHA has been working on initiatives to improve medical service availability to its customers, our nation's military veterans. One solution proposed by the study team at the VHA is a rule change allowing all VHA APRNs to practice to the full scope of their education, training and certification, without the presence or officially designated collaboration of a supervising physician (Department of Veterans Affairs, 2016). This proposed rule is termed "VHA Full Practice Authority" in many resources. The types of APRNs intended to have full practice authority were originally to encompass NPs, CNMs, CRNAs and clinical nurse specialists. The rule notes that this role expansion for APRNs inside the VHA is congruous with the evolving healthcare delivery system outside of the VHA (Department of Veterans Affairs, 2016). Full practice authority is also commensurate with APRN scope as active duty personnel for the Department of Defense, including in forward surgical teams (AANA, 2016). Officials at the VHA assert their personnel cited available research regarding patient outcomes, safety and quality of care delivered by APRNs, making this full practice authority initiative a valid option (Department of Veterans Affairs, 2016b).

Research specifically concerning CRNA care includes a study accepted for publication in the journal, *Medical Care*, a peer-reviewed publication (Negrusa, Hogan, Warner, Schroeder & Pang, 2016). The authors analyzed incidence and covariates on anesthetic complications within a database of over 5.7 million anesthesia cases (AANA, 2016a). They found that the incidence of anesthetic complications significantly varied with patient and procedure-specific factors, but

did not vary dependent upon scope of practice or medical supervision of the anesthesia provider (Negrusa, et al., 2016). An early and foundational outcome study specifically involving nurse anesthesia asserts a similar theme. This is often referred to as the Pine Study, published in 2003 (Pine, Holt & Lou). The Pine Study examined the anesthetic outcomes for over 404,000 Medicare patients in 22 states, whose anesthesia provider(s) of record was clearly delineated. The authors of the Pine Study made the following conclusions (as summarized in the AANA publication *Quality of Care in Anesthesia, 2009*):

- There was no statistically significant difference in the mortality rate for CRNAs and anesthesiologists working together versus CRNAs or anesthesiologists working individually
- Mortality rates were similar for CRNAs and anesthesiologists working individually
- There was no statistically significant difference in the mortality rate for hospitals without anesthesiologists versus hospitals where anesthesiologists provided or directed anesthesia care

Within their sample, the authors assert surgical mortality was not affected by anesthesia provider credentials (Pine, Holt & Lou, 2003).

Over many years, the majority of other studies examining whether a difference in outcomes existed between CRNAs and anesthesiologists have not yielded statistically significant differences (Forrest, 1980; Bechtoldt, 1981; Ahern & Hendryx, 2007; Minnick, 2008; Needleman & Minnick, 2008; AANA, 2009-[Minnesota Department of Health, 1994 study]; Lewis, Nicholson, Smith & Alderson, 2014). There have been other studies that claim CRNA outcomes are not equivalent to anesthesiologist outcomes, notably one by the authors Silber, Williams, Krakauer & Schwartz in 1992. Methodological questions have followed the

publication of this study, concerning the markers of mortality used, the time period used for noting the outcome of mortality, the use of patients having multiple procedures with different anesthesia providers, the equivalence of patient risk factors used across the anesthesia provider categories, and the vagueness of anesthesia provider identification in a large number of medical records (AANA, 2009). A systematic review of all relevant literature comparing outcomes between physician and nurse anesthesia providers yielded no studies showing significant differences in patient outcomes (Smith, Kane & Milne, 2004). This finding was essentially replicated in a 2014 meta-analysis conducted for the independent Cochrane Collaboration (Lewis, et al., 2014).

In summary, the general U.S. healthcare environment presents challenges in demographics, epidemiology, insurance status and geographical population distribution. This produces an aging and medically heterogeneous patient population who will require a greater number of complex procedural and diagnostic interventions, concentrated in both urban and rural medically underserved areas. In the present and future U.S. healthcare delivery system, disparate access to quality and cost-effective healthcare is a challenge. This dilemma has, and can continue to be answered by the steady supply of APRNs to U.S. medically underserved areas. The APRN workforce has safely contributed to the decrease of disparate access to medical and surgical care in the U.S. These beneficial effects are seen in the specialty of nurse anesthesia, by the supply of one of the four types of APRNs: certified registered nurse anesthetists (CRNAs). Anesthetic demand has been increasing through both demographic and general healthcare trends. These trends have been seen previously, and were addressed in prior literature aimed at assessing the barriers to nurse anesthesia educational programs (Oullette, Bruton-Maree & Kohlenberg, 2002). Table 1 summarizes factors that can influence anesthetic demand, from those same authors.

Table 1

*Factors influencing anesthetic demand, from: Ouellette, S.M., Bruton-Maree, N. & Kohlenberg, E. (2002). Expansion of nurse anesthesia educational programs: Where are the barriers? AANA Journal, 70(6), 435-438.*

### **Factors Influencing Anesthetic Demand**

Growth in U.S. population
Growth in the elderly population
Increased number of surgical procedures r/t progression of disease processes
Increased complexity of surgical procedures
Decentralization of anesthesia services
Increased demand for treatment of chronic pain

Accredited nurse anesthesia education programs (NAEPs) are the sole source in the U.S. of graduate CRNAs newly entering the specialty of nurse anesthesia. Although anesthesia providers in the U.S. include CRNAs, anesthesiologists, and anesthesiologist assistants, CRNAs are the majority of the licensed anesthesia providers currently (U.S. Bureau of Labor Statistics, 2015a). The removal of resource constraints to the production of new CNRAs is key to economic efficiency in the provision of anesthesia services, especially in rural and/or medically underserved communities where CRNA anesthetic care is a proven and valuable service. There are sources of governmental, non-governmental organizational and private funding to assist in the clinical education of all APRNs (IOM, 2010a). These sources vary from year to year, and proactive planning is key to leveraging all forms of funding and assistance for NAEPs. Information on potential resource constraints is crucial to accurately prioritize national, regional and institutional needs within NAEPs across the nation. Therefore, a method for the accurate assessment of potential resource constraints is a proactive strategy to ensure the adequate supply of graduate nurse anesthetists to the U.S. anesthesia workforce.

## **Healthcare Environment (Anesthesia)**

The projected increase in demand for surgical services, trauma stabilization, obstetrical services, dental services, procedural and diagnostic analgesia/sedation, critical care intensivist services, and pain management therapy directly leads to an increase in demand for anesthesia services (Schubert, et al, 2012; Wilson, 2012). The Certified Registered Nurse Anesthetist (CRNA) workforce has an established history of safely providing a full spectrum of anesthesia care, including in medically underserved populations (Gunn, 2000; Wilson, 2012). Funding in support of graduate nursing education was built into the ACA to assist in the clinical education of advanced practice nurses (IOM, 2010b). There are public and private grants and traineeships independent of ACA funding available to NAEPs that emphasize interprofessional education initiatives and rural healthcare. Finally, there is advanced practice nursing education assistance available with the continued life of the federally funded Title VIII Nursing Workforce Authorization Act (AACN, 2015a).

Analysis and identification of key resource constraints to the maintenance of CRNA program graduate output is required to guide resource placement wisely. Critical resource evaluation and planning is also instrumental and essential in CRNA program accreditation. Yet, there is a dearth of literature found evaluating critical resource constraints to the sustained or increased production of graduate nurse anesthetists. The purpose of this proposal is to establish the ability of current U.S. CRNA programs to maintain or expand graduate capacity, and to assess and examine potential resource constraints to CRNA programs.

### **Anesthesia Workforce: Provider Types**

Concurrently, there is a shortfall of anesthesia providers, recently cited in a 2011 RAND study by Daugherty, Fonseca, Kumar and Michaud; these authors estimate this shortage

will exist until at least 2020. Other sources feel that RAND's estimate of the anesthesia workforce shortage is quite conservative due to many changing forces, including regulatory, demographic and statistical. One such source, Jordan, wrote in a 2011 article that the RAND estimate did not account for the anticipated increase of anesthetic needs related to the newly insured from the ACA implementation. This applies as well to any replacement legislation.

An update to the original 2011 RAND study was published in 2014, which focuses on the supply of anesthesiologists alone. The authors conclude that the supply of anesthesiologists will peak in the year 2017 and then recede (Baird, Daugherty, Kumar & Arifkhanova, 2014). This prediction seems to correlate well with other statistics from the U.S. Bureau of Labor Statistics, regarding actively practicing anesthesia providers (2015a, 2015b, 2016a, 2016b).

A recent commentary publication in an anesthesiology news forum (Musumeci, 2017) emphasized there is an upcoming challenge, based upon overall population demographics and retirement trends in both anesthesiologist and CRNA workforces leading to significant shortfalls. The 2014 RAND update also listed factors that will exacerbate any anesthesiologist shortage predicted. These factors include: an older and sicker patient population, increasing insurance coverage rates, increasing proportion of women anesthesiologists who work fewer hours, a predicted increase in anesthesiologist retirement trends, and a recent trend in decreasing matching for anesthesia residency spots (Baird, et al., 2014). Where anesthesiologists cannot meet the market demand, CRNAs will be a viable alternative for any practice model. Geographic regions of the U.S. more prone to past and future anesthesia provider shortages include the South, the Midwest and the Pacific West (Baird, et al., 2014). These areas of the country, especially the South and the Midwest, are heavily involved in the demographic and

epidemiologic trends that lead to an increased elderly patient population, a higher prevalence of obesity, and disparate access to healthcare providers.

CRNAs and anesthesiologists (MDAs) provide the great preponderance of the anesthesia workforce in the U.S. with a smaller number of cases staffed by anesthesiologist assistants (AAs). There was an estimate of 30,060 actively practicing MDAs and 36,590 actively practicing CRNAs in this country in 2014 (U.S. Bureau of Labor Statistics, 2015a, 2015b). These numbers have been most recently updated for the year ending on May 2015, and show a trend down in the number of actively practicing anesthesiologists, while the number of CRNAs practicing has trended up (U.S. Bureau of Labor Statistics, 2016a, 2016b). Table 2 summarizes the components of the U.S. Anesthesia workforce.

Table 2

*U.S. Anesthesia Workforce, Estimate of Actively Practicing Anesthesia Providers, from U.S. Bureau of Labor Statistics Data, years 2015 and 2016*

PRACTITIONER	NUMBER (2014)	PERCENT OF WORKFORCE (2014)	NUMBER (2015)	PERCENT OF WORKFORCE (2015)
<b>CRNAs</b>	36,590	53.70%	39,410	55.80%
<b>MDAs</b>	30,060	44.12%	29,220	41.37%
<b>AAs</b>	1487 (*)	2.18% (*)	2000 (*)	2.83%
<b>Totals</b>	68,137	100.00%	70,630	100.00%
* (estimate)				

The number of practicing AAs is most difficult to ascertain precisely. Schubert, et al., finds the most recent data and states figures from the period of 2009-2011 indicate there were 1023 practicing AAs in the US (2012). These authors further indicate AAs enter the workforce at a

rate of 116 graduate providers per year, leading to an estimate of 1487 AAs by the end of calendar year 2015. A more recent estimate from the AANA places the number of AAs in the U.S. at slightly greater than 2000 practitioners (AANA, 2016d).

### **Anesthesia Practice Models**

CRNAs deliver care as independent practitioners or in a team setting called the anesthesia care team (ACT). The ACT arrangement is favored in many urban institutions with multiple anesthetizing locations operating in a decentralized fashion. The ACT practice model will be explored further in the subsequent paragraph. Team care is not mandated, however, in state nursing practice acts codifying nurse anesthesia scope of practice. CRNAs are licensed in each state to function in scope of practice as independent anesthesia providers. However, if functioning as independent practitioners, CRNAs deliver care subject to federal reimbursement rules delineated by the Centers for Medicare & Medicaid Service (CMS). For Medicare and Medicaid anesthesia cases to be reimbursed at the facility level, independent CRNAs are to be medically supervised either by an operating practitioner (e.g. surgeon, gastroenterologist) or an anesthesiologist. This holds true unless a hospital facility is located in a state that has executed a State Exemption, or Opt-out rule. In an exempted state, the governor has submitted a letter to CMS stating that in the state's best interests, CRNAs are exempted from the physician supervision requirement. Governors of such states have pursued this action due to disparate access to anesthesia care without the utilization of CRNAs, and in recognition that quality of care or anesthetic outcomes are not deficient with independent CRNA care (Needleman & Minnick, 2008; Hogan, Seifert, Moore & Simonson, 2010; Lewis, Nicholson, Smith & Alderson, 2014). Currently, there are 18 opt-out states, with the most recent state to pursue and obtain the



exemption being Colorado (AANA Statement Release, Shaffer, 2012). Figure 8 shows the Opt-out States from AANA Resources (2016c).

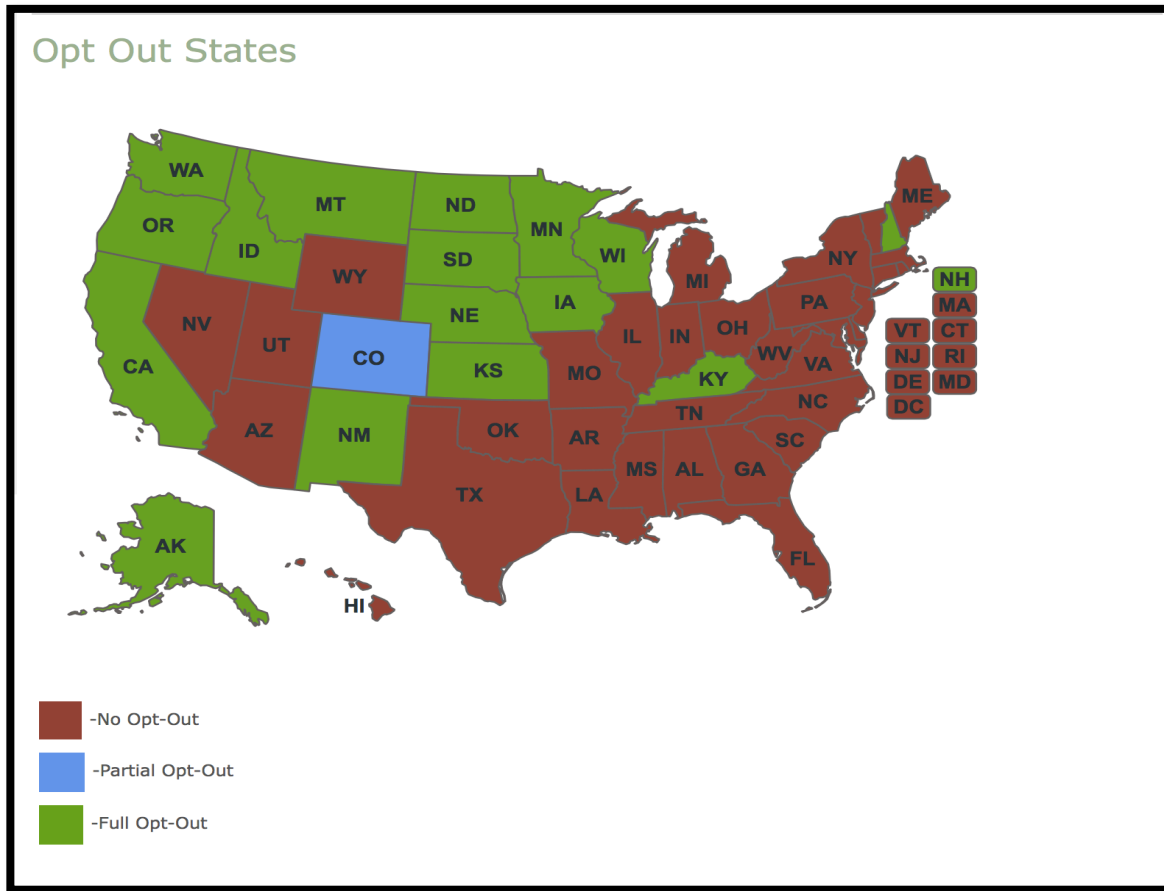


Figure 8: CMS Medical Supervision Reimbursement Regulation Opt-Out States

Source: American Association of Nurse Anesthetists. (2016c). *Study shows practice restrictions and physician supervision have no impact on anesthesia patient safety*. Retrieved from <http://www.aana.com/newsandjournal>

Another working arrangement in which CRNAs deliver care is an anesthesia care team, or ACT. In such an arrangement, a team of CRNAs work together with a MDA who is "medically directing" the anesthetic cases. The CRNAs personally administer each anesthetic and the MDA floats between cases. For federal CMS billing compliance, MDA presence is mandated at high-risk times such as induction of and emergence from general anesthesia, and the maximum

number of CRNAs a single MDA can direct is four. The MDA that bills as the medical director in an ACT must document that he/she has met seven essential requirements, specified by the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA). This enables the ACT CRNA to bill for 50% of the anesthetic he/she personally administers and the medically directing ACT MDA to bill for the other 50%. The MDA can bill 50% per case in up to four separate CRNAs' cases during any single time period. CRNAs can also function in a "medical supervision" model, which typically means an ACT with ratios beyond 1:4, or in a "non-medically directed" model; this implies MDA involvement but without the ability to meet all TEFRA requirements (AANA, 2016a). These last two models are mostly distinguished by billing practice differences and levels of reimbursement. Licensure and regulation through state nursing practice acts, a national credentialing and re-credentialing body that confers board certification, plus reimbursement and institutional privileging rules govern CRNA practice (Waugaman & Foster, 1995).

MDAs deliver care as independent practitioners, or as supervisors in an ACT with CRNAs and/or AAs. Licensure through state medical practice acts, a national credentialing and re-credentialing process, plus reimbursement and institutional privileging rules govern MDA practice. Specialty board certification is not required to practice as a MDA. In 2011, Fields found that 73% of anesthesiologists were board-certified, while the remainder were not. Hybrid models exist in some arenas of anesthetic practice, where CRNAs and MDAs intermix between independent and ACT practice within the same facility, depending on staffing and case mixes. The scope of practice for CRNAs and MDAs include the same techniques, procedures and modalities, as long as institutional privileging allows the same. Independent practice for CRNAs is a critical factor in the provision of anesthesia care to medically underserved communities.

Table 3 provides a comparison of the provider types and the ability to practice within the different models listed.

Table 3

*Anesthesia Provider Practice Model Matrix*

	<b>Independent Practice</b>	<b>ACT: Medically Directed 1:4</b>	<b>ACT: Medically Directed 1:2</b>	<b>Medically Supervised</b>	<b>Non-medically Directed</b>
<b>MDAs</b>	Yes	Yes	Yes	Yes	Yes
<b>CRNAs</b>	Yes	Yes	Yes	Yes	Yes
<b>AAs</b>	<b>No</b>	<b>Sometimes</b>	Yes	<b>No</b>	<b>No</b>

AAs can only deliver care in an ACT under the medical direction specifically of a MDA; their practice is governed by state licensure through medical practice acts or specific state statutes, a national credentialing and re-credentialing body that confers board certification, and reimbursement/institutional privileging. They are unlicensed providers prior to AA school and while they are in anesthetic training. After graduation and licensure or endorsement, there are some anesthetic procedures and techniques that an AA cannot initiate or provide without the immediate presence of a MDA; these differ by state practice act regulations. Additionally, in some states a MDA can medically direct only two AAs at any one time. The ratio varies from 1:2 to 1:4 depending upon state regulations.

**Scarce Resource Provision: Geographic Maldistribution of Anesthesia Providers**

The provision of anesthesia services is multi-faceted and complex, requiring rigorous

preparation for the demands of the specialty and the varied challenges of the patient population. The demand for such anesthetic services is more concentrated in areas of the country with higher population densities, often characterized as metropolitan or urban. However, rural and underserved areas also have a need for well-prepared anesthesia specialists, to serve a broad variety of needs with significantly fewer resources at hand (Gunn, 2000). References generally cite that rural populations in the U.S. have a greater proportion of elderly, as well as difficulty with access to healthcare compared to more urban areas (IOM, 2005; Rural Health Information Hub, 2016). The elderly population, as detailed earlier, presents with complex health concerns and a high incidence of chronic medical conditions. Even considering the younger population of rural communities, there is less likelihood of healthcare insurance through employment, less preventive care, lower socioeconomic status and poorer baseline health (IOM, 2005; Rural Health Information Hub, 2016). These are trends that healthcare insurance expansion was designed to remedy.

Nurse anesthetists have historically provided the majority of anesthetic needs in the rural areas of the U.S. (Fallacaro, 1997; Gunn, 2000; Seibert, Alexander & Lupien, 2004; Fallacaro & Ruiz-Law, 2004). CRNAs in rural communities are frequently utilized to manage airways and stabilize trauma patients, respond to complex or difficult intravenous line needs, serve on pain management teams, and manage mechanical ventilation for critical care unit patients (Gunn, 2000; Penn & Ruthman, 2005). Often, CRNAs in rural communities are the lone anesthesia provider, or provider-type, for a given facility (Penn & Ruthman, 2005). The services provided by these nurse anesthetists extend beyond those of the operative suite and touch the day-to-day function of many departments in the hospital (Penn & Ruthman, 2005; Morgan, 2014).

Additionally, CRNAs are the anesthesia provider most often deployed in forward military

surgical units, and provide the majority of anesthetic care for both active duty and retired military personnel and their family members (AANA, 2012a; AANA, 2012c).

More recent research has confirmed there is a geographic and demographic maldistribution of anesthesia provider types. The RAND anesthesia workforce study found that rural facilities were more likely to employ CRNAs than anesthesiologists (Daugherty, et al., 2011). Other authors shared data showing that 91.6% of actively practicing anesthesiologists resided in metropolitan areas, versus 81.4% of actively practicing CRNAs (Fallacaro & Ruiz-Law, 2004). These same authors found there were 843 counties in the U.S. with no practicing anesthesia provider of any type; the large majority of these underserved counties were not closely contingent upon a metropolitan area for sharing of anesthesia resources (Fallacaro & Ruiz-Law, 2004).

More current research regarding the distribution of physician and nurse anesthesia providers in the U.S. found that CRNA presence correlated in a statistically significant manner with lower-income populations, as well as vulnerable populations (Liao, Quraishi & Jordan, 2015). The authors delineate “vulnerable” populations as those people who are either Medicaid-eligible, unemployed, or uninsured. Other literature reveals similar findings, such as a 2013 study that indicates advanced practice registered nurses (APRNs) and physician assistants are more readily accessible to patients on Medicaid or in low socioeconomic strata (Dill, Pankow, Erikson & Shipman, 2013). Logically, and as the IOM has advocated, allowing APRNs to function according to their full scope of practice will continue to improve access to healthcare especially among disadvantaged populations. Anesthesiologists are difficult to recruit into rural, underserved and/or military areas, and the traditional anesthesiologists subsidy arrangement can financially restrict hospitals and health facilities from their recruitment and retention (Morgan, 2014; Kurtz & Tomcanin, 2009). Where anesthesiologists are difficult to recruit, AA practice

cannot function. Further, AA practice is restricted currently to 17 states, the District of Columbia, and within the VHA. Figure 9 summarizes the U.S. states allowing AAs to practice in care teams (AAAA, 2015).

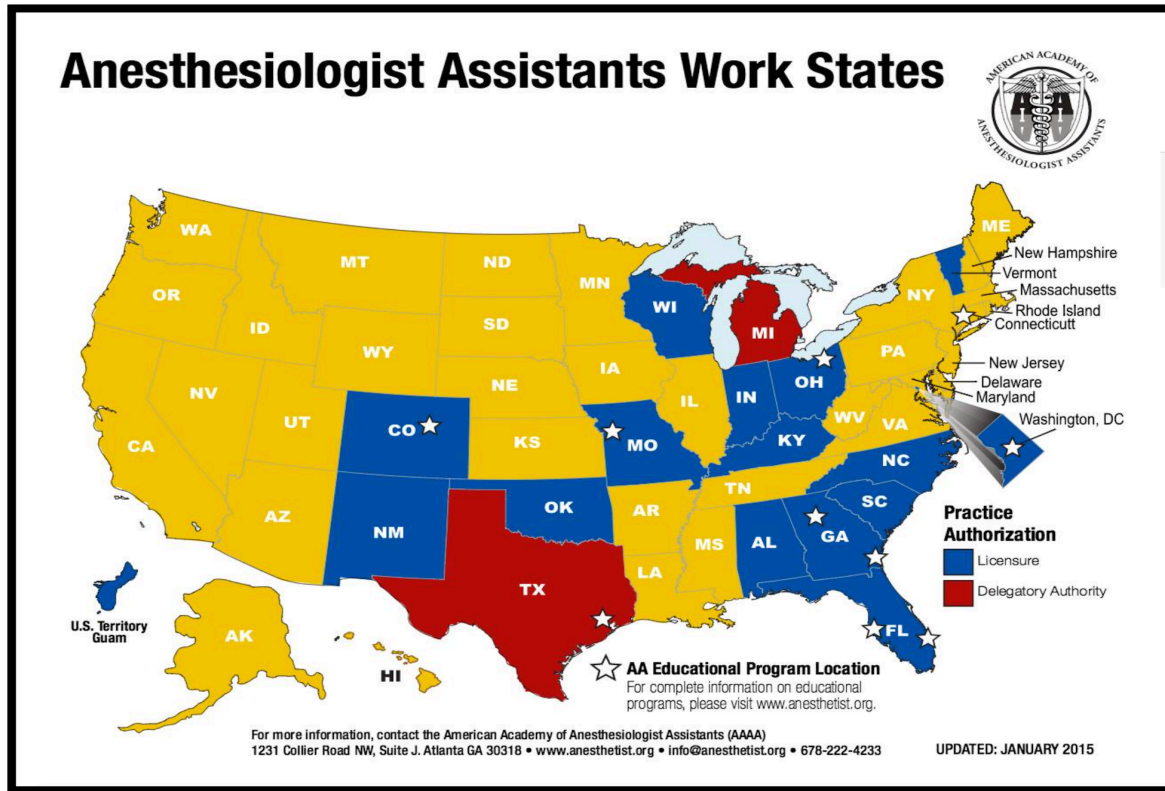


Figure 9: Anesthesiology Assistant Work States, as of January 2015

Source: American Academy of Anesthesiologist Assistants (2015). *Anesthesiologist assistant work states*. Retrieved from <https://aaaa.memberclicks.net/assets/aaaa%20work%20states%20.pdf%20map%20april%202014%20hi%20rez.pdf>

Although anesthesiology assistants (AAs) can function in team care with anesthesiologist supervision, this is by regulation the only way an AA can practice. Independent administration of anesthesia is not within the scope of their practice (AAAA, 2015). Therefore, the anesthetic needs of rural, vulnerable and underserved patient populations are most comprehensively, economically and safely served by the provision of CRNA practice. In many of the states with low population density, it has been shown that nurse anesthetists are often more densely

concentrated than other anesthesia providers (Fallacaro, 1997). In order to maintain the pipeline of anesthesia providers to these underserved areas, constraints upon the supply of CRNAs must be considered. There can be diverse forces that restrict or discourage nurse anesthesia practice into areas of need. These can include, but are not limited to, legal challenges, legislative stipulations, institutional privileging and tradition, nursing practice act restrictions, regional reimbursement issues, and importantly, challenges in the nurse anesthesia educational arena (Malina & Izlar, 2014).

As seen through these workforce statistics and previous references, the CRNA workforce has an established history of providing for medically underserved and vulnerable populations (Wilson, 2012; U.S. Bureau of Labor Statistics, 2014; Malina & Izlar, 2014). Funding in support of graduate nursing education is continuing under Title VIII, and other grant or stipend mechanisms, to assist in the clinical education of advanced practice nurses (IOM, 2010c; AACN, 2015c). The AANA has lobbied for increases in the specific program within Title VIII funding that directly assists NAEPs and other APRN education initiatives; this is called the Advanced Education Nursing Program and it has received over \$100 million in funding since at least fiscal year 2012 (AANA, 2012d). Analysis and identification of resource constraints to NAEPs is required to guide resource placement and legislative priorities wisely. Resource evaluation and planning is also instrumental in the initial and ongoing accreditation or expansion of NAEPs (Council on Accreditation of Nurse Anesthesia Educational Programs [COA], 2014).

### **Cost Efficiency**

Nurse anesthesia has a long tradition of vigilant, individualized care (Wilson, 2012). The profession has built traditional legitimacy within the U.S. healthcare system based upon mutual goals and exceptional utility. Provision of nurse anesthesia services meets the increasing demand

of the healthcare environment for cost-efficient delivery of safe care. CRNAs perform 43 million anesthetics cases per year in the U.S alone (AANA, 2016a). Anesthesiologist-only care is fiscally complicated by the traditional provision of anesthesia subsidies from hosting or partner hospitals/healthcare systems (Morgan, 2014). This practice became widely entrenched around the year 2000; at that time, 70% of hospitals in the U.S. were paying anesthesiology group subsidies of up to \$3 million (Kurtz & Tomcanin, 2009). Subsidies began as a way of retaining anesthesiology physicians at a time when declining reimbursement and increased workloads in hospital systems complicated such retention (Morgan, 2014). In 2009, a consulting firm called Healthcare Performance Strategies (HPS), published a research survey that attempted to quantify the total anesthesia subsidy in the U.S. The survey included all hospitals with more than 25 inpatient beds. HPS estimated the total anesthesia subsidy paid out in the U.S. in the year 2009 was \$4.2 billion, an average stipend of \$141,428 per anesthetizing location (Healthcare Performance Strategies, 2010).

By contrast, nurse anesthesia groups and individual CRNAs do not traditionally receive extra subsidy compensation. In a review of existent literature, the authors Hogan, Seifert, Moore & Simonson (2010) found that there were no studies revealing significant differences between CRNA, anesthesiologist, or team care in anesthetic morbidity and mortality. These authors conducted stochastic economic simulation analyses of the cost efficiency of various CRNA, anesthesiologist and team care delivery models. Hogan et al. summarized that CRNA practice models are the most cost-effective and versatile anesthesia delivery models, economically viable under a wide range of patient flow conditions. They further indicated that anesthesiologist care is often not seen as financially sustainable without subsidization from hospitals or health systems, as discussed previously in the 2010 study from HPS. Finally, it is noted that inclusive of



graduate and undergraduate costs, total costs to educate and train CRNAs is approximately 15% of costs to train anesthesiologists (Hogan, et al., 2010). They conclude that economically it will cost society and individuals less to maintain or increase anesthesia services by the expansion of CRNA education programs rather than by expansion of anesthesiologist programs (Hogan et al., 2010).

### **Value-Based Reimbursement**

The safe and efficient delivery of quality anesthesia services is a significant factor in the solvency of hospitals and outpatient settings. In the U.S. anesthesia is an industry generating at least an estimated \$19 billion annually (DiCanio, 2014). The provision of anesthesia services makes many patient services possible, including surgical services. Surgical caseload is acknowledged to be a consistent driver of needed profit and market expansion for facilities (DiCanio, 2014). Diagnostic endoscopy has become a source of fiscal stability as well, and anesthesia providers are being used much more frequently for such screenings (Liu et al., 2012).

There has been a marked shift in insurance payer attitude towards value-based healthcare delivery and payment, and this trend is anticipated to continue (Population Health Management [PHM-McKesson], 2014). Traditional reimbursement, in the U.S. and other countries, has been defined as fee-for-service, volume-based, and supply-driven (Somnia, 2016). Fee-for-service healthcare can be viewed as not only antiquated, but as a significant detriment to the improvement of the U.S. healthcare delivery system (Porter & Kaplan, 2016). The implicit incentive in fee-for-service healthcare provision is in quantity and complexity of care delivered, and not necessarily in quality. By contrast, value-based healthcare focuses on interprofessional teamwork in the delivery of the best and most individualized healthcare, at the most efficient cost (PHM-McKesson, 2014). Even with the emphasis on tailoring healthcare to individual needs,

value-based care also possesses an emphasis on health informatics, information sharing and the improvement of population health. This focus will improve comprehensive healthcare outcomes for populations with chronic health conditions, and in the long run provide notable cost efficiencies to individual patients and providers alike (Porter & Kaplan, 2016).

There have been steps towards value-based healthcare put into place by public and private payers. These have been known collectively as “pay for performance” initiatives. These function as incentives or penalties when specific quality indicators are recorded and reported to insurance payers (Health Affairs, Health Policy Brief, 2016). These quality indicators are grouped into four main areas, adapted directly from the 2016 Health Affairs policy brief:

- *Process Measures*: data regarding the performance of care processes that are proven to be of benefit in restoring or optimizing patient health in certain conditions (e.g. aspirin administration for heart attack victims)
- *Outcome Measures*: data regarding the outcome of the care administered to the patient (e.g. temperature measurement in the recovery unit for post-operative patients)
- *Patient Experience*: otherwise known as patient satisfaction surveys encompassing elements unique to the facility utilized
- *Structure Measures*: data regarding the resources used in patient treatment (facilities, staff, technology, health records and equipment)

This emphasis moves the U.S. healthcare delivery system towards two overarching categories of value-base care reimbursement from insurance payers: capitation or bundled payments (Porter & Kaplan, 2016). Capitation reimburses a healthcare provider or organization a fixed single payment for each patient subscriber. This has been used before and has been susceptible to the pitfalls of compromised quality, reduced provider competition and constrained innovation

(Health Affairs, 2016). Bundled payments involve setting a single fee paid by insurance for a certain medical condition or a health incident, to meet all needs encountered in that care (Porter & Kaplan, 2016). According to these authors, this can be inclusive of episodic care as in a surgical need, or continual care as in chronic disease management.

In either of these overarching value-based reimbursement models, nurse anesthetists can bring great efficiency to the delivery of healthcare. CRNA utilization is flexible across anesthesia care models, and in facilities with high or low volume (Hogan et al., 2010). The economic efficiency of high quality care delivered by nurse anesthetists (Wilson, 2012) makes CRNAs well suited to joining interprofessional teams within the value-based paradigm. Nurses learn early in their careers the value of multidisciplinary collaboration, and how to effectively facilitate the same. The deadline of 2025 for the institution of doctoral education for entry into practice in nurse anesthesia (Sanders, 2014) will further enhance CRNA contributions to interprofessional teams. Doctoral education will enable CRNAs to contribute to value-based care teams with informatics, data production and mining, research, policy formation, process standards and the outcome vigilance necessary for value-based care efficiencies.

### **The Anesthesia Workforce Revisited – Demographics**

The increased need for anesthesia services is superimposed upon an overall deficit of anesthesia manpower (Daugherty et al., 2011; Baird, et al., 2014). Currently the ACA is still the healthcare law of the nation. If the ACA continues, it is estimated that Medicaid expansion will add 13 million enrollees by 2023, and the ACA exchange plans will add another 24 million insured individuals to the healthcare market (Congressional Budget Office, 2013). Although the long-term survival of the ACA is unknown, it is unlikely that all of those newly insured through

the ACA will be without insurance coverage after repeal and/or replacement (Berman, 2016; Bade & Everett, 2016).

The anesthesia workforce is aging in similar trends to the general U.S. population. The average age of both anesthesiologists and CRNAs is 49 years (Daugherty et al., 2011), and 49% of CRNAs in the U.S. are age 50 and above (AANA Member Survey, 2016e). In the year 2011, it was reported in a workforce analysis that almost 20% of anesthesiologists in the U.S. were between the ages of 55 – 64 (Fields, 2011). At this writing, that would make nearly one-fifth of the anesthesiologist workforce between the ages of 60 – 69 years, if all of these providers were still in clinical practice. Figure 10 shows data from the AANA member survey for the fiscal year 2015, which reveals that approximately 25% of responding CRNAs intend to retire between the years of 2016 – 2021 (AANA Member Survey, 2016e).

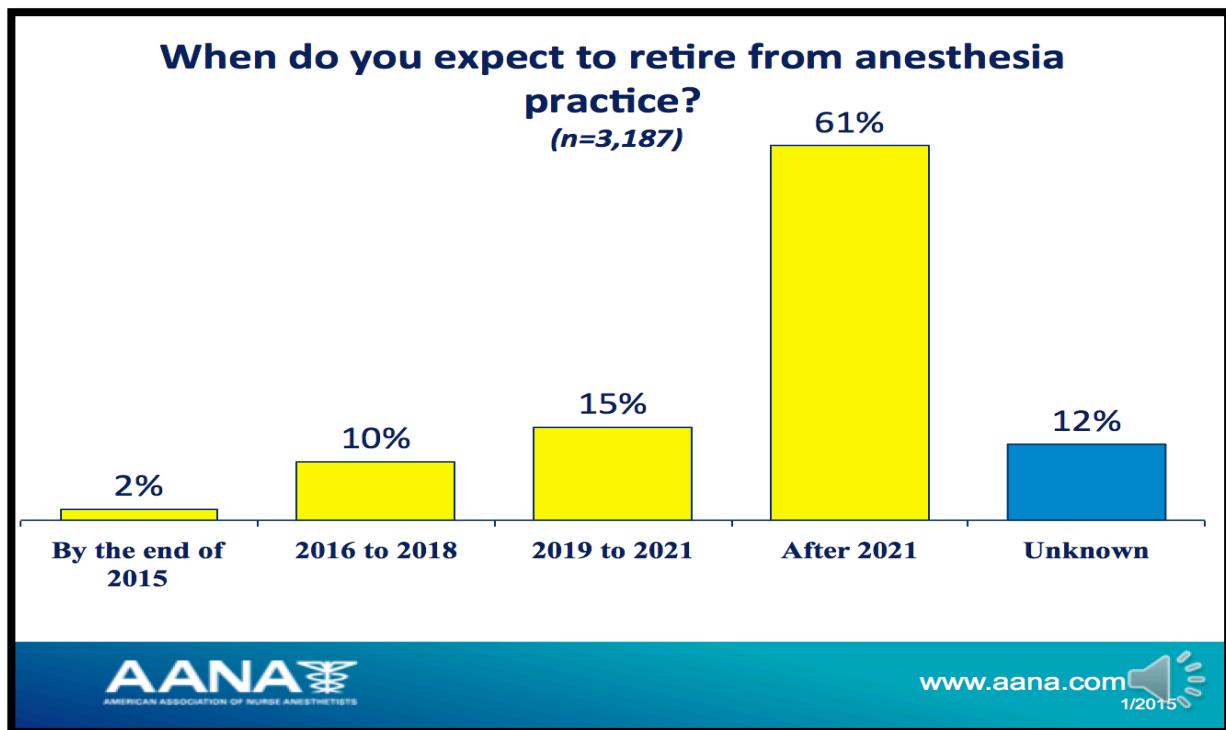


Figure 10: AANA Practice Survey, 2015 – CRNA Retirement Losses

Source: American Association of Nurse Anesthetists. (2016e). *AANA member survey data*. Retrieved from [http://www.aana.com/myaana/Documents/WOW\\_ED\\_update\\_2015](http://www.aana.com/myaana/Documents/WOW_ED_update_2015)

This is the loss of approximately 10,200 experienced CRNAs within the next 4 years. In the year 2014, projections have nearly 2,500 students graduating from all accredited CRNA programs in the U.S. (AANA, 2012d; AANA, 2016a). Assuming steady graduate output, the loss of CRNAs to retirement will consume most of the next 4 years of graduate nurse anesthetists produced, merely to maintain the current supply level of providers. This calculation is also based on the premise that nothing will occur to accelerate or slow the anticipated retirement rate of CRNAs. The supply of graduate nurse anesthetists must be maintained, at least. Proactive planning through the analysis of NAEP critical resources is wise and necessary.

### **Research Questions**

There exists no current literature regarding critical resources acting as potential constraints upon the ability of NAEPs to maintain or expand production of graduate nurse anesthetists. The most recent examination of resource constraints to NAEPs was in 2002 by Oullette, Bruton-Maree & Kohlenberg, utilizing a survey tool sent out to all NAEP directors at that time. The response rate to the survey was 61%, with the results focused mainly on specific clinical procedural requirements as significant limits to NAEP maintenance and expansion. At that time, the authors found only a small minority of respondents selected other factors such as available applicant pools and financial resources as important constraining factors.

Critical resources necessary to the maintenance or expansion of graduates from a program for APRNs, including NAEPs, are most often categorized into four main resource domains (Auerbach, Martsolf, Pearson, Taylor, Zaydman, Muchow, Spetz & Lee, 2015; Lupien & Rosenkoetter, 2006; Newland & Truglio-Londrigan, 2003):

1. Clinical Site Resources = CLIN
2. Student Recruitment/Applicant pool = STU

3. Faculty Resources = FAC
4. Financial Resources = FIN

These are the most frequently mentioned critical resources found in literature regarding all graduate nursing educational programs in general, as well as in APRN programs (Council of Graduate Schools and Educational Testing Service, 2010; Stuart, Erkel & Shull, 2010; Minnick, Norman & Donaghey, 2013; AACN, 2015b; Ketefian, Shaké, & Redman, 2015). If these critical resources are in scarce or uncertain supply, the production of graduates from these programs is constrained. This study's objectives will be accomplished by the deployment of a novel survey tool, distributed to all accredited NAEPs in the U.S. The resource domains will be examined via the theoretical framework of Resource Dependency Theory (RDT) in Chapter Two.

Characteristics and geographical location of the NAEP may alter the importance of resource constraints. Therefore, program characteristics will be analyzed in correlation to the ranked importance of resource constraints. The specific program characteristics considered are listed in research question 3, and will be linked to RDT constructs of munificence, uncertainty, and complexity, within each critical resource domain.

In accordance with the four established resource domains, linked to the theoretical framework of RDT, the research questions to be addressed in this study are as follows:

- *RQ 1:* Can currently accredited NAEPs expand the production of graduate CRNAs with no change in potentially constraining resource levels?
- *RQ 2:* What is the relative importance of barriers to NAEP capacity, in four critical areas of constraining resource levels? (student recruitment = STU; financial = FIN; clinical requirements = CLIN; faculty = FAC)
- *RQ 3:* Are there differences in the relative importance of barriers to NAEP capacity

related to geographical location of the NAEP?

- *RQ 4:* Are there differences in the relative importance of barriers to NAEP capacity related to program characteristics of the NAEP? (public vs. private; shared vs. non-shared clinical sites; urban vs. rural; entry-to-practice degree offered – master’s vs. doctoral)
- *RQ 5:* What are potential barriers to NAEP capacity not explicitly addressed in this survey? (This will be a qualitative open-ended question with white space for answers).

### **Scope and Significance of Study**

Nurse anesthesia has a long tradition of safe and individualized care (Wilson, 2012). The profession has built traditional legitimacy within the U.S. healthcare system based upon mutual goals and exceptional utility. The American Association of Nurse Anesthetists (AANA) projected that in 2013, an estimated 44,000 CRNAs and student registered nurse anesthetists across the U.S. would administer approximately 34 million anesthetics, out of a total of 40 million anesthetics. The actively practicing CRNA workforce is estimated at roughly 39,410 as compared to 29,220 anesthesiologists (U.S. Bureau of Labor Statistics, 2016a, 2016b). CRNAs are used extensively in military and Veterans Health Administration facilities; they are the most common anesthesia provider utilized for U.S. service personnel, either stateside or abroad (AANA, 2012a; AANA, 2012d). A distinction for nurse anesthesia is its history of providing anesthesia services for consumers in rural communities. CRNAs are much more likely to be located in rural area facilities than are anesthesiologists (Daugherty et al., 2011). In some states, CRNAs are the sole anesthesia providers in nearly 100% of rural hospitals (Wilson, 2012).

Healthcare providers are charged with the provision of quality, safe, efficient and economical care for a growing population of patients (IOM, 2010c). Although the future of the ACA or its subsequent replacement is uncertain, the demographic and epidemiologic demands upon

anesthesia services will continue. The U.S. patient population is expected to continue to grow and to increase in complexity as the proportion of aged patients increases (AANA, 2009, AANA, 2012b). Advances in anesthetic and surgical techniques have also expanded the patient population for whom it is reasonable to undergo procedures (Morgan, 2014). The entrance of newly insured patients into the healthcare consumer population of the U.S. will expand the baseline demand for medical and surgical services. This will also expand the demand for diagnostic and preventive procedures that utilize anesthesia services. Concurrently, the demographic trends within the total anesthesia provider workforce studies predict provider shortages (Baird, et al., 2014; AANA Member Survey, 2016e).

NAEPs are the pipeline for maintaining the supply of CRNAs to the anesthesia workforce. Critical resources acting as potential constraints to NAEP maintenance or expansion is foundational in NAEP accreditation procedures. The specialty accrediting body for NAEPs emphasizes the possession of adequate critical resources for U.S. nurse anesthesia education. The Council on Accreditation of Nurse Anesthesia Educational Programs (COA) is the specialty accrediting body for NAEPs in America and its territories. The COA mandates that a NAEP must demonstrate adequate critical resources before initial establishment of a new program, or the expansion of an existing program is allowed (COA, 2014). Key among the required enumerated program resources are financial, clinical and faculty resources. The COA also establishes minimum credentials and prerequisites for applicants to NAEPs. COA accreditation is an essential, mandatory component all NAEPs must maintain to operate. This study's proposed evaluation of potential resource constraints to NAEP graduate production is not only vital to the healthcare delivery system and the service of anesthesia provision, but to academic institutions that have NAEPs. Therefore, the environment of concern in this study is the



healthcare education environment. The organization examined in this study is nurse anesthesia education, or all accredited NAEPs within the U.S. The scope of the study is limited to NAEPs' assessment and perception of the healthcare education environment, and resource constraints within that environment. The study will not address potential actions or strategies that NAEPs may utilize in maximizing control while reducing resource constraints.

### **Summary**

The U.S. healthcare delivery system faces stress from altered demographics, geographical maldistribution of resources, and epidemiological trends. APRNs play a key role in safely and effectively addressing the needs of the entire healthcare system in the face of these trends. Anesthesia needs are on the rise with a growing shortage in the anesthesia workforce forecast to continue. CRNAs provide valuable and safe anesthetic care, often in medically underserved areas at an economically efficient cost. In answer to healthcare market needs, the profession of nurse anesthesia must proactively assess the ability of existent CRNA education programs to maintain or expand graduate production capacity. The most recent assessment of potential resource constraints to NAEPs was cited in the literature (Oullette, et al., 2002). An assessment of critical resources potentially limiting the supply of CRNAs is overdue and would occur under different market conditions as compared to the 2002 study.

The overall objective of the study is to examine potential resource constraints to NAEP graduate production and rank their effects. This will be accomplished by the means of a focused prospective and correlational study employing a novel survey tool, among a sample of NAEP directors and faculty. The variables examined and the survey tool construction will be grounded within the theoretical framework of Resource Dependence Theory. All accredited NAEPs will be given the opportunity to reply. Logistic regression and correlational analyses will be

performed to answer the research questions. Chapter Two will detail the history of NAEPs in the U.S., elaborate upon the relevant literature and detail the theoretical framework supporting the study variables, construct linkages, and the study survey tool construction. Chapter Three will thoroughly explore the study methodology.

## Chapter Two: Literature Review

### Introduction

The purpose of this study is to examine critical resources that may act as constraining factors upon the production of graduates from nurse anesthesia education programs (NAEPs). The study's design will identify resources most likely to restrict graduate production and what possible inter-relationships might exist between these potential constraints and program characteristics. In order to more logically pursue this goal, a review of literature has been conducted. Chapter One introduced a summation of the general healthcare delivery environment in the U.S. An overview was presented of the anesthesia healthcare environment in the U.S. and nurse anesthesia's unique place and value within that environment. NAEPs are the key in maintaining the contributions of CRNAs to the anesthesia workforce. This speaks to the significance of this study examining potential constraining resources for NAEPs.

Chapter Two will summarize the literature review and the theoretical framework grounding the study. First there will be a brief synopsis of the history of nurse anesthesia and nurse anesthesia education in the U.S. The move to doctoral education for all NAEPs as the entry to practice credential will be examined, along with the extra demands commensurate with that change. A brief restatement will be made regarding U.S. healthcare's expanded need for Advanced Practice Registered Nurses. The conceptual framework that grounds the study will be presented in an overview fashion. Finally, the evaluation of constraints to graduate output from NAEPs will be connected to the theoretical framework, and existent literature will be

summarized. Table 4 summarizes key details in the history of anesthesia delivery as a specialty of the profession of nursing.

Table 4

*Historical Timeline for Nurse Anesthesia: adapted from Matsusaki & Sakai, 2011*

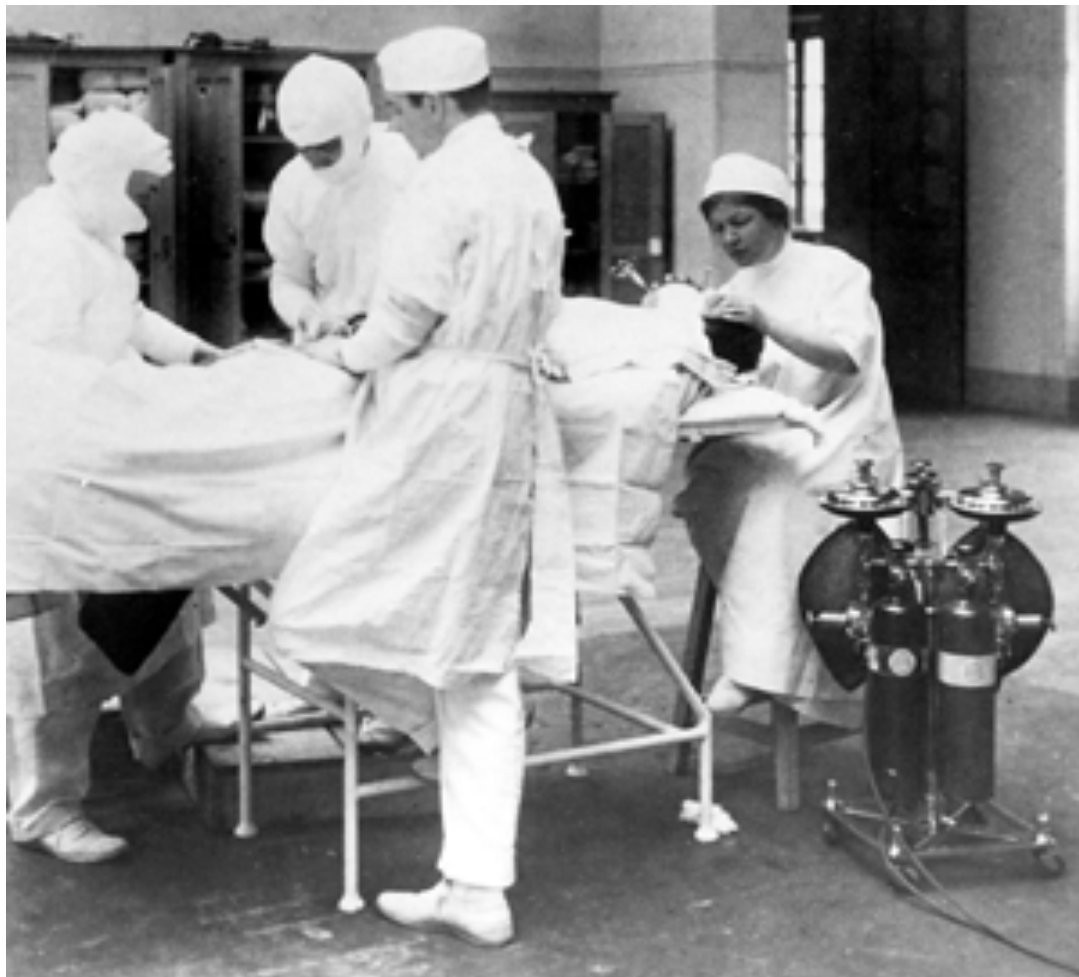
<b>1700</b>	<b>High anesthetic mortality during surgical procedures with no dedicated provider and poor anesthetic agents</b>
<b>1842</b>	Dr. Crawford Long successfully uses ether for anesthesia
<b>1846</b>	William Morton (a dentist) demonstrates ether anesthesia
<b>1877</b>	Sister Mary Bernard at St. Vincent's Hospital in Erie, Pennsylvania works as the first 'nurse anesthetist'
<b>1861 – 65</b>	U.S. Civil War ~ Nurses provide anesthesia: first documented nurse to do so is Catherine S. Lawrence
<b>1880 – 90</b>	Catholic church nurses (nuns) performed anesthesia
<b>1889</b>	Dr. Charles H. Mayo taught anesthesia to nurses at St. Mary's Hospital
<b>1905</b>	First physician anesthetist
<b>1906</b>	Alice Magaw published "A Review of over 14,000 Surgical Anesthetics"
<b>1908</b>	Dr. George Crile (surgeon) in Cleveland Clinic selected Agatha Hodgins as his dedicated anesthetist
<b>1912 – 1920</b>	World War I saw the common use of nurse anesthetists in treating the wounded
<b>1916</b>	Lakeside Challenge: a legal challenge by the IAA to the Lakeside Hospital School of Anesthesia (Cleveland Clinic) regarding anesthesia provided by nurses
<b>1939</b>	NANA renamed the American Association of Nurse Anesthetists (AANA)
<b>1952</b>	AANA established educational institution for nurse anesthetists
<b>1957</b>	Certified Registered Nurse Anesthetists (CRNA) certification was established
<b>1977</b>	AANA established continuing education for CRNAs
<b>1986</b>	U.S. government permitted direct reimbursement for solo CRNA care
<b>1989</b>	Establishment of International Federation of Nurse Anesthetists
<b>1990</b>	Transition to required Master's degree for entry into CRNA practice
<b>1998</b>	Mandatory Master's degree minimum for entry into CRNA practice
<b>2007</b>	AANA announces support for doctoral level entry to practice requirement for CRNAs by <b>2025</b>
<b>2015</b>	No new nurse anesthesia programs may be accredited at a Master's level, but instead must confer a practice doctoral degree

## **The History of Nurse Anesthesia**

The first recorded instance of anesthesia delivered by nurses in the United States was during the American Civil War (1861-65). First named among the nurses who served in this capacity was Catherine S. Lawrence (American Association of Nurse Anesthetists [AANA], 2009). In surgical procedures utilizing anesthetic techniques of the mid- to late nineteenth century, there was not one consistent healthcare provider who regularly served, or was willing to serve, as the anesthetist. The job was seen as less desirable and glamorous than that of the surgeon and was frequently given to residents or medical students. These residents and students were often more invested in surgical techniques than in anesthetic vigilance (Matsusaki & Sakai, 2011) and anesthesia care was commonly cited as a cause for the high surgical mortality of that era (Goode, 2015; Waugaman & Foster, 1995; Wilson, 2012). Surgeons turned to nurses for a provider who could supply the requisite intelligence and dedication but exhibit the era's necessary subordination, lack of surgical ambition, and a minimal desire for financial compensation that their ideal anesthetist would display. Due to surgeon recruitment, nurses with specialty education and training became the first group of healthcare practitioners regularly utilized to provide anesthesia in the U.S. (Waugaman & Foster, 1995).

This arrangement was found to be more reliable than other existing practitioners, and the most reputable surgeons of that generation supported the earliest nurse anesthetists in their work. This included Dr. William Worrall Mayo and his son, Dr. Charles Mayo of St. Mary's Hospital, which would go on to become the Mayo Clinic (Matsusaki & Sakai, 2011); they trained and worked extensively with Alice Magaw, who used and refined techniques in anesthesia care, especially the use of open-drop ether in combination with chloroform (Wilson, 2012). This early nurse anesthetist would be referred to as the "Mother of Anesthesia" by her surgeon colleagues

and visiting practitioners (Harris, 2006). She was known for keeping meticulous logs with outcome data for her patients, individualized care, and for her emphasis on the psychological preparation of patients to ease anxiety (Waugaman & Foster, 1995). The Mayo brothers and Alice Magaw concurrently documented over 14,000 anesthetics she administered without a death related to anesthesia (Goode, 2015). The clinical excellence of Alice Magaw was continued in the practice of nurse anesthesia by Agatha Hodgins. Figure 11 is a photograph of Agatha Hodgins administering an anesthetic.



*Figure 11: Nurse anesthetist Agatha Hodgins*

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Source: College of Health Professions & McAuley School of Nursing: History. (n.d.). In *University of Detroit Mercy*. Retrieved July 1, 2017, from <https://healthprofessions.udmercy.edu/academics/na/about/history.php>

The vanguard of surgeon support for nurse anesthetists in the early 1900s notably included Dr. George Washington Crile, practicing at Lakeside Hospital, which would become the Cleveland Clinic in later years. Among the nurses with whom Dr. Crile collaborated was indeed Agatha Hodgins, who improved upon the anesthetic techniques of the time by perfecting nitrous oxide-oxygen anesthesia (Wilson, 2012). A report on the anesthetic outcomes of over 10,000 patient cases was published by Dr. Crile in the Journal of the American Surgical Association, in which he attested to Ms. Hodgins' critical role in serving as the anesthesia provider for these cases. Most noteworthy, there were no recorded deaths in this large volume of cases (Bankert, 1989). Nurses were sent from other American institutions to learn techniques from these early pioneers of nurse anesthesia. In this manner, the practice of utilizing nurse anesthetists spread across America.

The First World War saw nurse anesthetists reliably and expertly serving in the care of the wounded, which sparked new increased interest in the supply of nurse anesthetists in the United States (U.S) and elsewhere. American nurse anesthetists were increasingly providing anesthetic training for both nurses and physicians, in Europe and in the U.S. (Goode, 2015; Waugaman & Foster, 1995). Nurse anesthesia education began its transformation from hospital/institutional and on-the-job training to formalized curricula in hospitals and educational institutions (Wilson, 2012). The first offering of a master's degree (consistent with that era's requisite credits) for nurse anesthesia education was granted in 1909 at St. Vincent's Hospital in Portland, Oregon (Gunn, 1990; Matsusaki & Sakai, 2011).

Concurrently, legal and practice challenges to the right of nurses to administer anesthesia began to be heard in state courts and medical societies. Medical societies and individual physicians pursued these cases and sought to strictly delineate anesthetic care as the practice of

medicine (Waugaman & Foster, 1995). In all cases the court's opinions ruled in favor of nurse anesthesia practice as legitimate in the eyes of the law. The rulings essentially stated that when a nurse administers anesthesia, it is the practice of nursing, and that the procedural physician or surgeon is the person practicing medicine during these patient cases. The Board of Nursing governs nurse anesthesia practice at the state level. Conversely, when a physician administers anesthesia, it is the practice of medicine, and the state Boards of Medicine govern such practice. This legal sentiment has prevailed since those early challenges (Bankert, 1989). In order to help combat such practice issues, and to unify the profession in training and credentialing, nurse anesthesia societies were instituted on the state and national levels. Notable in this enterprise was the effort of Agatha Hodgins in establishing the fledgling national association. After two previous iterations, the national organization became known as the American Association of Nurse Anesthetists (AANA), which continues as the national level organization today. Slightly over 90% of CRNAs in the U.S. presently belong to this professional organization (AANA, 2016a).

### **The History of Nurse Anesthesia Education Programs**

Although a master's degree program existed for nurse anesthesia since the year 1909, the most common award conferred at the successful completion of NAEPs was a bachelor's degree, or a diploma/certificate. This continued to be the pattern in the majority of NAEPs until the 1970s and 1980s. During those years, NAEPs began to move into institutions of higher learning (Sanders, 2014) and some programs took the initiative to upgrade to master's level preparation for entry into practice as a nurse anesthetist. Post graduation, a certification testing process was initiated, and successful practitioners were recognized as Certified Registered Nurse Anesthetists (CRNA). The certification process was formalized by the AANA in 1957, and the institution of



continuing education for re-certification was codified in 1977 (Matsusaki & Sakai, 2011). In 1990, the AANA began the transition for all accredited NAEPs to confer a master's degree as the mandatory minimum education requirement for entry into practice as a nurse anesthetist, with full transition required by the year 1998 (AANA, 2007).

The existent program nationally for accreditation of NAEPs is the Council on Accreditation of NAEPs (COA), which is the sole program recognized by the U.S. Department of Education for the accreditation of NAEPs. By 1952, the AANA had formal requirements for NAEPs to be accredited, but the singular independent accrediting body known as the COA has only been in existence since 1975. However, this vision of nurse anesthesia having three independent but cooperative bodies for professional association, certification and educational accreditation goes back as far as Agatha Hodgins (Sanders, 2014). The mission of the COA is accrediting NAEPs by setting minimum standards for clinical and didactic education to which all programs must adhere. Figure 12 displays the COA logo.



Figure 12: COA Logo

Source: Council on Accreditation of Nurse Anesthesia Educational Programs. (2011). Retrieved from: <http://home.coa.us.com/Pages/default.aspx>

In 2004, the COA instituted the adoption of optional research and practice/clinical doctorate requirements (Sanders, 2014). In the year 2007, the AANA announced that it would support the transition to a practice/clinical doctorate degree as the mandatory minimum preparation for entry into practice as a CRNA. The target date for complete transition is January 1, 2025. This is in support of a collaborative effort led by the American Association of Colleges of Nursing (AACN) for all advanced practice registered nurses (APRNs) to have doctoral preparation as the mandatory minimum for entry into practice as an APRN (American Association of Colleges of Nursing [AACN], 2004). There are multiple instances of existent NAEPs voluntarily completing the transition to the clinical doctorate level, or having that path as an optional degree with additional coursework (e.g. Virginia Commonwealth University) prior to the deadline. The COA has mandated that by January 1, 2022, all NAEPs must be at the clinical doctoral level in order to complete the target date of 2025 for minimum doctoral preparation for entry into nurse anesthesia practice (Sanders, 2014).

Over the years, important regulatory and insurance/reimbursement changes significant to the practice of nurse anesthesia have developed as well. Nurse anesthetists as a specialty provider were allowed direct reimbursement from Medicare under a law signed by then President Ronald Reagan in 1986 (Wilson, 2012). This was a landmark regulatory change and a first for a nursing specialty. In 2001, further regulatory change occurred at the federal level, within the program called CMS (Centers for Medicare and Medicaid Services). This legislation removed a federal requirement for physician supervision in order to allow for federal reimbursement of anesthesia services provided by a CRNA. Such discretion was transferred to each independent state, yielding fully reimbursed solo CRNA practice where it was needed for the provision of critical healthcare services to medically underserved areas. Since 2001, eighteen states have opted out of

the federal requirement for medical supervision of CRNAs. (Matsusaki & Sakai, 2011; AANA, 2016c).

### **Summary Restatement: The Expanded Need for Advanced Practice Nurses**

The evolving healthcare environment in the United States (U.S.) is rife with both challenges and opportunities. The patient population will grow, increasing in complexity as the proportion of aged patients expands (AANA, 2012; Ortman, et al., 2014). Total anesthesia demand will increase merely as a result of these demographic trends (DiCanio, 2014; NCHS, 2005). The implementation of the ACA, or subsequent replacement legislation, is expected to cause or maintain an increase in the number of insured patients by approximately 25 million persons at initial full enactment (The White House, 2014; Congressional Budget Office, 2013) and a concomitant increase in anesthesia service demand in a variety of settings (Jordan, 2011; Wilson, 2012). Concurrently, there is a shortfall of anesthesia providers, recently cited in a 2011 RAND study (Daugherty, et al.) and updated in 2014 (Baird, et al.).

The profession of Nurse Anesthesia should respond to this need in the U.S. healthcare environment with careful assessment and proactive planning for contingencies. Approximately 20% of the total U.S. population lives in a *Health Professional Shortage Area*, as federally defined by the Health Resources and Services Administration (Kirch, Henderson & Dill, 2012). Access to basic primary care, as well as specialty care such as anesthetic management, is challenging to provide in underserved areas. The Institute of Medicine highlighted the importance of advanced practice nurses (APRNs) in meeting the challenges of disparate access to the healthcare market (IOM, 2005). Nurse anesthesia has been an essential APRN for these challenged areas. Further, the IOM emphasizes the increased production of APRN graduates leading to improved collaboration among healthcare team members to optimize population

health (IOM, 2010c). NAEPs are a vital and solitary link in the supply of CRNAs to the U.S. healthcare system.

### **Brief Introduction to Theoretical Framework**

A nurse anesthesia program must operate by securing critical resources within its environment that are vital to its operation, and the production of graduate nurse anesthetists. Resource Dependence Theory (RDT) focuses on how environmental constraints can exert external control over organizations, and how those organizations assess, plan, and act in adapting to those environmental constraints. NAEPs are organizations that must gain critical resources from the external environment in order to function. Understanding what critical resources have restricted the production of graduates from NAEPs will help in resource planning and allocation. Therefore, RDT is the theoretical framework that will ground the selection of variables, constructs, and survey tool construction in this study.

A related organizational theory, Institutional Theory, is often used in concert with RDT to help explain an organization's actions regarding critical resource allocation (Nienhüser, 2008). Institutional theorists propose that organizations respond to environmental challenges, or uncertainty, with both isomorphism and innovation (Weech-Maldonado, Elliott, Pradhan, Schiller, Dreachsin & Hays, 2012). Isomorphism is essentially adhering to normative rules and performance standards that contribute to societal good (Christensen, 2016; Moulton, 2009). Innovation involves the provision of a resource in creative manner, or the provision of a valuable or scarce resource with great efficiency (Weech-Maldonado, et al., 2012). Critical resources and relationships necessary to an organization's survival must be constantly cultivated, sustained and expanded at need (Moulton, 2009; Christensen, 2016). The value of an organization (the NAEP) to its environment (the healthcare education environment) through isomorphism and/or

innovation gives the organization bargaining power for the external resources it needs in order to operate without constraints (Christensen, 2016).

### **Theoretical Framework: Overview of Resource Dependence Theory**

Resource Dependence Theory is one of the most foundational and oft-cited theories in organizational sociology and human resource literature and strategy (Nienhüser, 2008). Generally speaking, RDT is essentially concerned with the perceived actual needs (resources) that an organization *must* have for continued survival or expansion (Yeager, Zhang & Diana, 2015). Such resources are critical to the organization's survival. Most often it obtains at least some of these resources externally from its environment, which contains other organizations (Pfeffer & Salancik, 1978). These critical resources can act as environmental constraints, and create interdependencies between an organization and its environment (McCue, Thompson & Dodd-McCue, 2000).

Organizations seek to manage these interdependent relationships in a manner that limits external dependency, decreases uncertainty, and expands constraints (Payne & Leiter, 2013; Yeager, et al., 2015). Therefore, control of the supply of critical resources equates to power in a direct relationship (McCue, et al., 2000). Critical resources are categorized as material, human and financial resources (Pfeffer & Salancik, 1978; Pfeffer & Salancik, 2003; Payne & Leiter, 2013). These categories of critical resources within a NAEP can be extrapolated to encompass clinical site resources, student/applicant resources, faculty resources and financial resources. All of these resources can be a source of constraint to a NAEP if they are in scarce or uncertain supply in the healthcare education environment.

RDT infers that organizations respond to these potential resource constraints with environmental scanning, and plan action via several strategies. Commonly, the strategies may

involve pursuing innovation, cultivating linkages or partnerships, the creation of organizational slack, fortifying boundaries, and increasing resource control by horizontal or vertical integration (Johnson, 1995; Pfeffer, 2003). Specifically, fostering innovation and the cultivation of resource-rich relationships are common tactics (Pfeffer & Salancik, 1978). As noted, innovation often concerns the provision of scarce services or commodities, or the provision of services and commodities with significant efficiency (Payne & Leiter, 2013). The interaction of an organization (NAEPs) and its environment (healthcare education environment) defines the bargaining power each has in resource allocation and relationship dependency. RDT is a valuable perspective for both the NAEP and the healthcare education environment to use in resource scanning, in policy formation and adherence, and in the promotion of the societal good (Christensen, 2016). Utilization of the constructs and variables within the conceptual framework of RDT can guide the ongoing management, and predict the resources needed to maintain or expand the capacity of NAEPs (Christensen, 2016). The organization exhibiting isomorphism, innovation, normative social/regulatory responsibility, public value and important resources for exchange with its environment ensures its own survival. It does so by securing a supply of critical resources it needs from its environment, often in competition with other similar organizations, and by offering valuable outputs (graduate CRNAs) to the healthcare delivery system. These closely related concepts are summarized below:

- NAEPs are organizations interacting within the healthcare education environment
- The critical resources for an NAEP are often in uncertain or scarce supply
- Nurse anesthesia exhibits isomorphism and societal good by provision of safe, economical and efficient care within a highly specialized and critical healthcare service (anesthesia)

- Nurse anesthesia exhibits innovation in the provision of scarce resources via working in a high proportion of the medically underserved areas of the U.S.
- NAEPs provide a critical resource to the healthcare environment, as CRNAs comprise greater than 50% of the anesthesia workforce in the U.S. (critical resource provision = legitimacy and power)
- NAEPs are the only source of new graduates to become CRNAs in the U.S
- NAEPs conform to the economic efficiency expectations by producing graduate CRNAs at significantly less cost of time and expense to society and the individual
- Critical resources are controlled or modified by interactions with organizations outside the NAEP, within the healthcare education environment

The entire spectrum of RDT addresses an organization's assessment/perception of the environment plus how the organization plans and acts to master control the environment. It is important to note that the scope of this study is limited to the assessment and perception of the healthcare education environment by the NAEPs in the U.S. Taking this approach will serve as a foundation for understanding the environmental challenges and resource constraints NAEPs encounter, and how they differ according to program characteristics. This study will not assess how NAEPs in the U.S. act to address the perceptions of potential resource constraints within the healthcare education environment.

An organization (NAEPs), its relevant environment (healthcare education environment), and constraining resource availability is integral to understanding the basis of the interactions and the balance of power between the organization and its environment. This is referred to by Pfeffer (page 1, 2003) as the "ecology" of the organization, and constitutes an environment's characteristics and properties, seen in Figure 13 (Abdulghany, 2015). Organizational ecologies

have fundamental building blocks, and this is true in graduate healthcare education also. The overall interaction of many fundamental RDT constructs come together to form the structure of an organizational ecology. However, the dimensional RDT constructs of focus within this study will be munificence, uncertainty (also called dynamism) and complexity. Figure13 is a diagram of a business environment built within the theoretical framework of RDT.

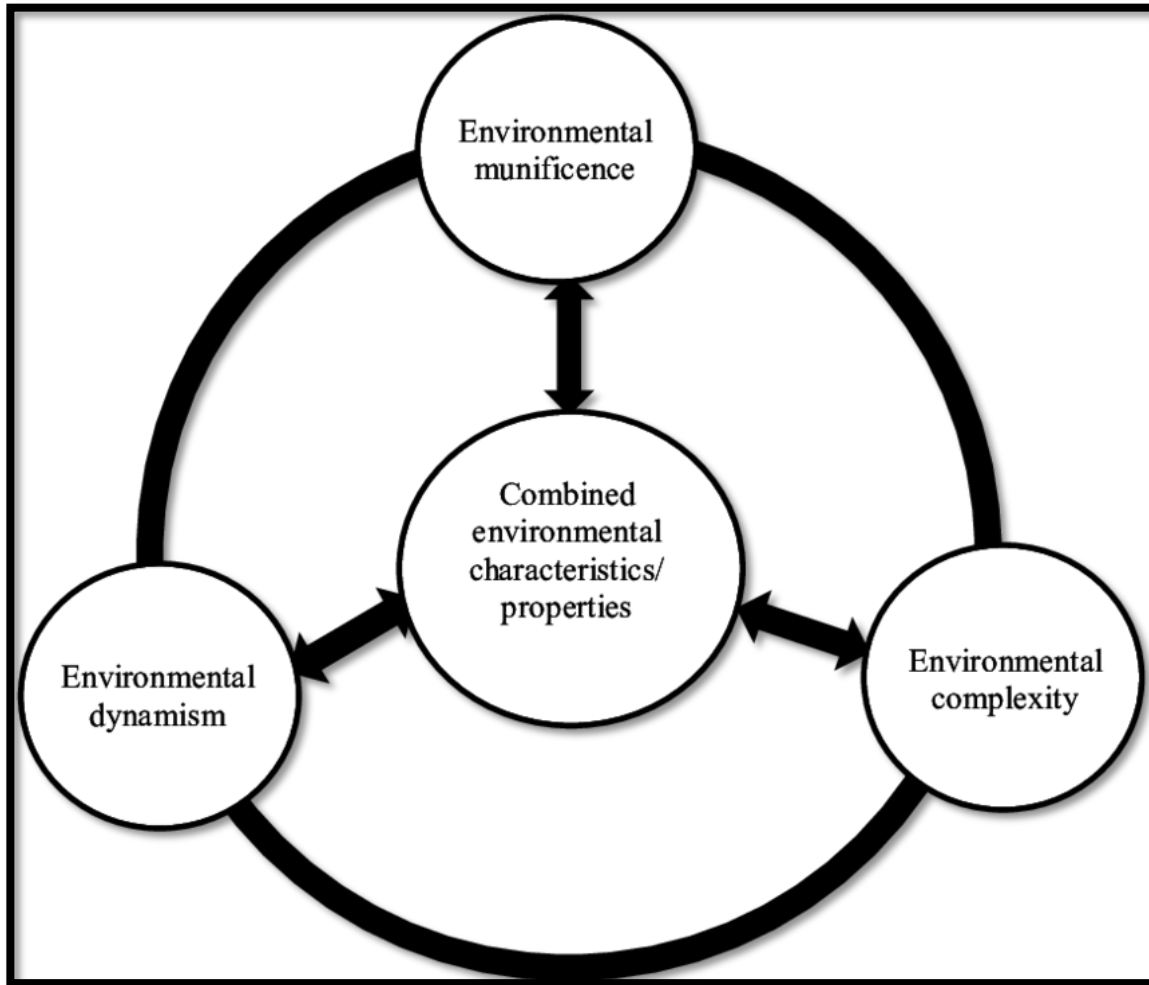


Figure 13: Diagram of a Business Environment

Source: Abdulghany, M. (2015). The International Business Environment: A Proposed Analytical Framework. *International Journal of Business Environment*, 7(2), 168-199.

The four NAEP resource domains comprising the healthcare education environmental characteristics to be explored in this study are:



1. Clinical Site Resources
2. Student/Applicant Resources
3. Faculty Resources
4. Financial Resources

Each of these four resource domains will be examined in the light of munificence, uncertainty and complexity to ground the research design and the construction of the survey tool within the RDT theoretical framework. Each of these constructs from RDT will be explored and linkages to the independent variable domains explained in the remainder of the chapter.

### **RDT Construct: Munificence**

Critical resources are those external resources an organization must have for continued survival and growth (Yeager, Zhang & Diana, 2015). If these resources are in short supply or are expensive to obtain in the environment, they can constrain the survival or growth of the organization. An environment rich in accessible critical resources for an organization is said to exhibit high munificence (Chen, Zeng, Lin & Ma, 2015). Lack of competition for relatively scarce resources will often result in acceptable environmental munificence for an organization. Conversely, an organization can be deemed munificent if its outputs into the environment are scarce, innovative, valuable, and allow access to special knowledge or skills (Chen et al., 2015). An organization in a less munificent environment must find a way to decrease its reliance upon scarce or inaccessible resources, decrease its outputs or locate alternative resources to serve a similar purpose (Yeager et al., 2015).

### **RDT Construct: Uncertainty (aka Dynamism)**

Uncertainty in RDT refers to the lack of predictability or increased volatility within the environment an organization must operate to gain critical resources or access to knowledge

(Pfeffer, 2003). There is little guarantee of an enduring supply of critical resources in an uncertain environment (Yeager et al., 2015). When uncertainty is perceived to be high, the operations of the organization are constrained (Johnson, 1995) and action is often planned to reduce uncertainty and dependence (Pfeffer & Salancik, 2003). Some of the strategies employed by organizations in an uncertain environment are specifically aimed at creating more predictability, possibly at the cost of growth, innovation and instilling an increased resistance to change (Yeager et al, 2015). Strategies may include “buffering” or “bridging”, as termed by Johnson, (p. 14, 1995). Buffering translates into protective actions like stockpiling resources, “amplifying and protecting boundaries”, and reducing the scope of its operations and outputs (Johnson, p. 14, 1995). Bridging leads to the recruitment of strategic partners so that access to critical resources is increased (Johnson, 1995; McCue et al, 2000). A high level of competition within an organization’s environment can increase the perception of uncertainty held by an organization, and affect the rate of newly achieved linkages (Yeager et al., 2015).

### **RDT Construct: Complexity**

The overall interaction of an organization’s perceptions of environmental munificence and uncertainty can be seen as the complexity of an organizational ecology (Nienhüser, 2008). Factors that affect munificence and uncertainty also contribute to complexity and can include criticality, scarcity, competition and interdependence (linkages and integrations). High complexity almost always implies an intense level of competition (Yeager et al, 2015). The intricacy of these aspects can be multiplied significantly depending upon how many organizations must operate within the same environment with common resources of interest; inter-organizational goals or strategies may be convergent or divergent (Yeager, Menachemi, Savage, Ginter, Sen & Beitsch, 2014). These differences between organizations in an

environment can intensify the complexity significantly, and this can lead to increased organizational scanning vigilance and more caution in strategic action (Yeager et al, 2015). Organizational slack in critical resource levels can moderate the effect of environmental complexity upon an organization (George, 2005; Pfeffer & Salancik, 2003) and embolden both planning and strategic action to achieve organizational stability and goals (George, 2005). Bridging may also be used to cope with the level of complexity in an organization's environment, increasing dependence in exchange for the benefit of creating slack critical resources (Chen et al., 2015). Multiple viewpoints are available for idea creation, process improvement, production efficiencies and innovation through the bridging relationships formed; benefits may be available to the organization, the environment, or both (Chen et al., 2015).

### **RDT Summary**

All organizations will ultimately act to decrease the uncertainty and the complexity within the environments they inhabit in some manner (Pfeffer & Salancik, 1978) Prior to these actions, the organization will engage in environmental scanning. This is done to assess critical resources and the environment's characteristics in regard to potentially constraining resources (Pfeffer & Salancik, 2003; Yeager et al, 2015). This is the RDT focus this study will maintain, to evaluate the perceptions of U.S. NAEPs regarding the constraints present due to critical resource levels and how these perceptions may differ according to program characteristics. This is important in properly planning and acting to secure critical resources, so U.S. NAEPs can maintain or increase graduate output.

Power and dependence are the opposing counterpoints of a composite truth in RDT (Christensen, 2016). The environment has power over an organization as long as it holds critical resources or markets for the organization. Conversely, an organization holds power over the

environment if it has outputs or assets that are valuable, especially if those assets have some special advantage, or quality (Christensen, 2016). Environmental actors, organizations and even the outputs of an organization exhibit a great degree of interdependence, which increases the complexity of the relationship (Pfeffer, 2003). This is the case in many organizational ecologies, including the ecology consisting of the healthcare education environment, U.S. NAEPs, NAEP critical resource needs, NAEP graduate outputs and capacity, and the healthcare delivery market.

### **Table of Study Variables and Measurements**

In this study, each independent variable will be one of four resource domains: clinical resources, student/applicant resources, faculty resources and financial resources. The RDT constructs of munificence, uncertainty and complexity will inform selection of the individual survey items under each independent variable. This will link the RDT dimensions of the U.S. healthcare education environment that NAEPs must inhabit. The respondent will evaluate each survey item as to whether it imposes a resource constraint upon the NAEP. If the respondent chooses the affirmative answer, a follow-up question will rank the importance, or severity, of the resource constraint on a Likert-type scale of 1-5. Table 5 summarizes the overall study variables and measurements, which will be elaborated upon in Chapter Three.

### **Literature Search: Previous Use/Critique of RDT**

The framework for this study proposal is the conceptual paradigm of Resource Dependence Theory (RDT), with some limited interaction in concepts from Institutional Theory. This area in organizational theories is rich with history in academic literature from administrative, economic and social sciences (Pfeffer & Salancik, 1978; Fennell & Alexander, 1993; McCue et al, 2000; Proenca, Rosko & Zinn, 2000; Pfeffer, 2003; Pfeffer & Salancik, 2003; Payne & Leiter, 2013). It has been utilized in healthcare delivery literature as well (Alexander & D'Aunno, 2003;

Table 5

*Table of Variables and Measurement: Critical Resources in NAEPs*

INDEPENDENT VARIABLES (RESOURCE DOMAINS)	DEPENDENT VARIABLE (RESOURCE CONSTRAINT) Dichotomous	SEVERITY OF THE RESOURCE CONSTRAINT (If DV = Yes)	MEASUREMENTS
<b>Clinical Resources (CLIN)</b>	Is the item a resource constraint? (Y/N)	Constraint severity Likert scale 1-5	Survey items, Logistic Regression, Ranking, Correlation
<b>Student/Applicant Resources (STU)</b>	Is the item a resource constraint? (Y/N)	Constraint severity Likert scale 1-5	Survey items, Logistic Regression, Ranking, Correlation
<b>Faculty Resources (FAC)</b>	Is the item a resource constraint? (Y/N)	Constraint severity Likert scale 1-5	Survey items, Logistic Regression, Ranking, Correlation
<b>Financial Resources (FIN)</b>	Is the item a resource constraint? (Y/N)	Constraint severity Likert scale 1-5	Survey items, Logistic Regression, Ranking, Correlation

Macfarlane, Barton-Sweeney, Woodard & Greenhalgh, 2013; van Raak, Paulus & Mur-Veeman, 2005), but is a relatively novel conceptual approach in the fields of nurse anesthesia and nurse anesthesia education. As nurse anesthesia is a specialty within the profession of nursing, a literature search was conducted for the previous use or critique of RDT in the analysis of graduate nursing education programs, followed by a literature search specifically concerning nurse anesthesia.

Critical resources most often mentioned in graduate nursing education programs consist of clinical site/preceptor resources, student recruitment resources, faculty resources and financial resources (Council of Graduate Schools and Educational Testing Service, 2010; Stuart, Erkel & Shull, 2010; Minnick, Norman & Donaghey, 2013; AACN, 2015b; Ketefian, Shaké, & Redman, 2015). Recent and continuing demand to increase the number of APRNs available to the

healthcare delivery system, plus the pervasive U.S. population demographics trends, have increased the need for graduate nursing programs to secure qualified faculty and administrative personnel (Minnick, Norman & Donaghey, 2013; AACN, 2015b).

This need for faculty is exacerbated by the planned change in the required degree for entry into practice for all APRNs, from the master's level to a practice doctorate; this change has a deadline of 2025 for all NAEPs (COA, 2015b). The other APRN educational programs are working to develop definitive timelines, but many doctoral APRN programs have already been instituted in a voluntary transition. The American Association of Colleges of Nursing (AACN, 2017) maintains a member program directory page on its website, and currently lists 244 programs in which one can earn a Doctor of Nursing Practice (DNP). This number includes entry to practice programs and post-masters completion programs. Additions to this total number of doctoral programs would be those NAEPs not housed in a school or college of nursing but still offering practice doctorates. The COA accredits all U.S. NAEPs. On the COA website, a search reveals that there are 25 current programs granting the Doctor of Nurse Anesthesia Practice degree, one program granting the Doctor of Anesthesia Practice degree, and one granting the Doctor of Management Practice in Nurse Anesthesia (COA, 2016). This is a total of 271 programs granting practice doctorates for APRN roles.

Resources necessary to a NAEP may be logically inferred, and confirmed through a literature review. The literature is not replete with studies of constraining resources in a NAEP, but there are examples in other clinically oriented graduate programs. A recent study by RAND Health Quarterly evaluated barriers to schools in the U.S. adopting the Doctor of Nursing Practice as the entry level for APRNs; the authors documented constraints related to cost concerns, faculty resources and clinical resources (Auerbach, Martsolf, Pearson, Taylor, Zaydman, Muchow, Spetz

& Lee, 2015). All the articles are congruent in listing resource constraints as being student recruitment, clinical opportunities, faculty resources and financial resources (Lupien & Rosenkoetter, 2006; Newland & Truglio-Londrigan, 2003; Meyers & Martin-Sheridan, 2002; Rosenbach, Cromwell, Pope, Butrica & Pitcher, 1991). NAEPs must interact with the healthcare education environment for the acquisition of these critical resources. Refractory constraints to such resources could threaten the existence of a NAEP. Efficient scanning of the healthcare education environment for NAEPs in the U.S. will direct the distribution of scarce and critical resources most effectively. Table 6 lists the most consistently scored factors inhibiting NAEP expansion in this study, as previously published (Oullette, et al., 2002).

Table 6

*NAEP Expansion Barriers, Ouellette, et al., 2002*

<b>Inhibiting Factor</b>	<b>No. of Programs</b>
Inability to meet proposed requirement of 5 fiberoptic intubations per student	21
Inability to place pulmonary artery catheters	18
Not enough experience placing epidurals (15 required after 2003)	16
Inability to place central venous pressure catheters	15
Insufficient opportunity to participate in cardiopulmonary resuscitation outside of the operating room	14
Not enough intracranial procedures	13
Not enough experience placing spinals (15 required after 2003)	13

Other remaining areas of critical resource constraint have not been explicitly addressed in nurse anesthesia literature. The AANA Foundation sent a survey to NAEP directors in 2016, and a limited presentation of this data was given at the February 2017 Assembly of School Faculty meeting (Jordan, 2017). Some relevant survey findings to the current study are:

- Average acceptance rates in NAEPs were 25.8% of all total applicants
- Average acceptance rates in NAEPs were 40.9% of all qualified applicants
- Threats to clinical opportunities was again a constraint of significant concern
- Opportunities for specialty clinical rotations was the constraint listed most often
- Competition with other anesthesia learners was deemed a significant constraint

Concerns limiting admission capacity are seen in Figure 14, a slide shared from the presentation by Jordan.

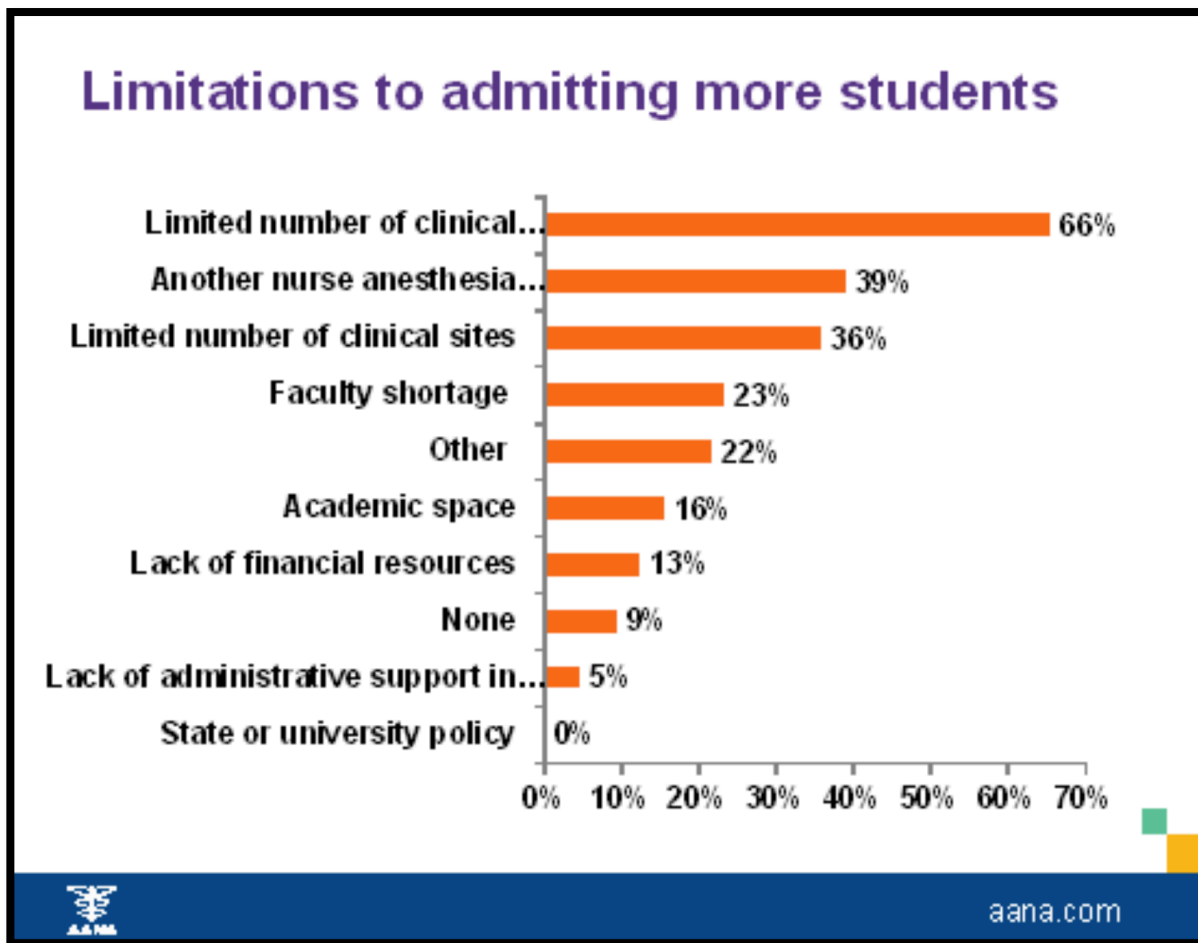


Figure 14: AANA Foundation Survey, 2017

Source: Jordan, L.M. (2017). Presentation of AANA Foundation Program Directors Survey: AANA Assembly of School Faculty Meeting, February 25, 2017.



This most recent assessment of selected resource constraints again focuses on clinical education threats. The healthcare education environment has undergone several large shifts since Oullette et al. did the most complete environmental resource scanning for NAEPs in 2002. It seems logical to resist the assumption that resource constraints to NAEP graduate output have not changed in the intervening years. The survey tool designed for this study is a novel instrument, tailored for the analysis of four areas of critical resource domains in nurse anesthesia education. This study proposes to more completely scan the healthcare education environment for potential constraints to NAEP graduate output. The study analysis will provide refined guidance in the area of overall NAEP resource constraints, instead of specific constraining clinical or administrative factors (Ouellette et al., 2002; Jordan, 2016).

Accreditation is a critical and necessary resource for NAEPs to possess. A regional accreditor of higher education grants the right for the university or college to offer the accredited degree for nurse anesthesia entry-to-practice. NAEPs must also receive initial and ongoing accreditation from the specialty body for nurse anesthesia education. The Council on Accreditation of Nurse Anesthesia Educational Programs (COA) is the single accrediting body for NAEPs in America and its territories. The COA echoes a strong emphasis on critical resources for nurse anesthesia education in the U.S. (COA, 2015a). In a policy adopted in January 2014, entitled “Program Resources and Student Capacity”, the COA specifically mandates that before an existent NAEP increases the total number of accepted students per class year, it must demonstrate adequate resources to support the newly proposed total number of students (COA, 2014). Key among the required enumerated program resources from the COA are clinical, faculty and financial resources. COA accreditation is an essential and mandatory regulative component of the healthcare education environment of NAEPs. This study of potential constraining resources for

NAEPs is not only vital to the healthcare delivery system and the service of anesthesia practice, but to academic institutions that have NAEPs.

The imperative of COA accreditation or re-accreditation for NAEPs provides a further innovative feature of this study. A survey tool developed specifically for this study will provide the constraining resource analysis. This may then be used to guide a critical resource analysis compatible with that required by the COA in its NAEP reviews, or in feasibility studies for new programs. While maintaining confidentiality concerns, completed study data will be offered to participating NAEPs. The RDT perspective can be an important resource in itself for contingency planning for each institution and its NAEP, its resources, and relationships (Christensen, 2016).

### **New Evaluation of Resource Constraints to NAEP Output**

Viewed through the RDT constructs of munificence, uncertainty and complexity, variable domains to be examined via the survey instrument have been constructed to include: Clinical Resources, Student/Applicant Resources, Faculty Resources, and Financial Resources. The survey is intended to examine factors within each critical resource domain as potential barriers to increasing NAEP capacity within the U.S.

**Clinical resources.** It seems intuitive that clinical resources are absolutely critical for a NAEP to produce graduates. As found by the most recent studies of resources that can restrain NAEP capacity, clinical site facilities and specific anesthesia procedural experiences are of utmost concern in NAEPs (Jordan, 2017; Oullette et al., 2002). The COA sets minimum case standards within a matrix of anesthesia case types, patient complexity, patient ages, and specific procedural skills which the graduate nurse anesthetist must meet to sit for the national certification exam after program graduation (COA, 2015a). The COA recently increased the

total number of cases required per student nurse anesthetist (SRNA), as well as case numbers with specialized anesthetic techniques and procedures (COA, 2015a). Even for practicing CRNAs and anesthesiologists, specialty cases and advanced anesthetic techniques/procedures can often be challenging to perform in great number. Availability is highly dependent upon facility caseloads and available anesthesia drugs and technology. The AANA offers specialized clinical training, with didactic content and hands-on workshops to address these advanced clinical training needs for practicing CRNAs (AANA -AANA*Learn*®, 2010). Acquiring these cases for SRNAs is even more of an exercise in battling resource constraints.

The graduate healthcare education environment in clinical professions often exhibits competition for clinical sites and procedures (AACN, 2015c); this competition can be seen as a constraint on program capacity. In graduate nursing education, advanced practice specialties not only face competition for clinical resources from other similar programs, but from medical programs as well (AACN, 2015c). Competition for clinical sites in the nurse anesthesia environment is complex, and can potentially come from three sources: other regional NAEPs, anesthesiology residency programs and anesthesiologist assistant clinical programs. Healthcare facility tradition or politics can complicate the division of specialty anesthetic cases and procedures, as preference in case assignment often favors anesthesiology residents (AACN, 2015a). These challenges can be met with diversification of clinical resources in seeking more affiliated training facilities, or by creating organizational slack through agreements within existing affiliations to flex the number of student clinical rotation spots. At times, meeting these goals will cause a NAEP to pursue clinical affiliations at distant sites. Healthcare facilities or systems are willing to accommodate clinical training needs for the benefit of strategic resource

scanning and competition for anesthesia staffing needs, displaying the complexity and interdependency of the NAEP and its environment.

The RDT concept of access to knowledge relates the importance of the needed clinical preceptors for APRN clinical education, and it is a resource area of concern for all four of the APRN roles (AACN, 2015a). NAEPs differ from other advanced nursing practice education programs because students are not matched with a single preceptor clinician, but instead often rotate to different clinical institutions for the broad-based experience needed to satisfy the minimum COA clinical case requirements (COA, 2015a). This requires a substantial commitment from the anesthesia staff members at participating clinical facilities, because students may need to change preceptors to guarantee the necessary case mix as the daily surgery schedule permits. Another consideration for the recruitment of clinical preceptors in NAEPs is that financial incentives are not often used, due to the fact that the sheer number of preceptors requiring compensation would be financially infeasible (AACN, 2015a).

The criticality and complexity of the graduate healthcare education environment that NAEPs must negotiate is considerable. The interplay of munificence for both the NAEP and its environment speaks to the level of interdependence between the organization and its environmental actors. Other forces that restrict the expansion of nurse anesthesia practice into areas can include, but are not limited to, legal challenges, legislative stipulations, institutional privileging and tradition, nursing practice act restrictions, regional reimbursement issues, and importantly, challenges in the nurse anesthesia educational arena (Malina & Izlar, 2014). For this reason, traditional and legal scope of practice may be viewed as a measure of munificence as well. This is difficult to operationally define but for simplicity this will be captured in state opt-out status. Which factors are most critical within this interplay may likely vary in relation to

NAEP characteristics to be assessed in the survey tool. Characteristics assessed will include geographic location, public versus private educational institution, clinical site learner competition, urban versus rural, CRNA scope of practice, and degree offered (master’s versus doctoral degree). According to this RDT evaluation, the survey items within the variable of “Clinical Resources” will address the six listed areas of potential resource constraints to NAEP capacity in Table 7.

Table 7

*RDT Table for Clinical Resources Domain*

VARIABLE	CONSTRUCTS	CONSTRAINING RESOURCES
Clinical Resources	Munificence	1. Total clinical sites available 2. Number of clinical preceptors available at each site
	Uncertainty	3. Availability of clinical specialty cases
	Complexity	4. Availability of specific anesthetic techniques 5. Availability of specific anesthetic clinical procedures 6. Competition for anesthetic caseload

**Student recruitment/applicant pool resources.** Within the RDT conceptual framework table, student/applicant resources may be viewed as absolutely necessary factors in the complex graduate healthcare education environment. These resources are again relevant under the constructs of criticality, munificence and complexity. It is evident that any graduate healthcare education is critically dependent upon an adequate supply of qualified prospective students, who possess the required attributes for program completion and professional success. The ability of applicants to meet minimum accreditation and program requirements is non-negotiable. Table 8 holds a summary of the RDT constructs and constraining resources within this variable domain.

Table 8

*RDT Table for Student Resources Domain*

VARIABLE	CONSTRUCTS	CONSTRAINING RESOURCES
<b>Student Recruitment/Applicant Pool Resources</b>	Munificence	1. High acuity critical care experience available 2. Competition from other regional NAEPs for students
	Uncertainty	3. Student pool meets COA minimum requirements for eligibility 4. Student pool meets NAEP-specific requirements for eligibility
	Complexity	5. Can meet financial burden of full-time NAEP attendance 6. Lack of student debt relief mechanisms available

According to the COA, students applying for admission to a NAEP must uniformly hold certain minimum pre-requisites for eligibility to apply to NAEPs, seen in the following list (COA, 2015a):

- Must be a bachelor’s prepared registered nurse
- Must hold an unrestricted license as a registered nurse (RN) in the U.S.
- Must have at least one year of critical care nursing experience, or part-time equivalent

The type of healthcare facility within which he/she has practiced may affect the intensity of the critical care experience gained by a RN. These qualifications can be connected to the RDT concepts of access to knowledge and environmental interdependency. Rural facilities are often used mainly for stabilization of critically ill patients until they can be transferred for more definitive care. A critical care nurse who has spent his/her career in a rural facility, with more limits on the critical care technology and pharmacology that nurses are exposed to, or regularly utilize, will be a less competitive candidate for NAEP admission. In this manner, environmental

munificence for potential nurse anesthesia students can be evidenced by the distribution of high-level trauma centers and tertiary-care referral centers. This distribution may be postulated to affect the pool of prospective nurse anesthesia students (AANA, 2016a; AANA, 2017).

Additional pre-requisites or requirements may be necessary per each NAEP's standard admission processes. These may include, but are not limited to, admission testing requirements, pre-requisite course completion, advanced RN certifications, a minimum acceptable undergraduate grade point average, anesthesia shadowing experiences, professional and/or personal references, background checks, evidence of professional development as a registered nurse, completion of a personal statement or essay, and a personal interview (AANA, 2017). Many programs look for and prefer to accept critical care nurses with greater than the minimum required clinical experience (AANA, 2017). These requirements will necessarily limit the pool of acceptable applicants for any particular NAEP. Competition from other NAEPs nearby may also be a factor decreasing the pool of desirable prospective students.

Critical resources in this domain also encompass those that are necessary for the student to complete the NAEP. Often of primary concern are financial expenses and family social support. Prospective students may be excellent applicants but may feel unable to pursue the education program due to financial concerns, or time constraints. NAEPs are full-time graduate educational programs. Due to the demands the program puts on students' time and mental resources, many NAEPs either advise against or completely prohibit continuing work as a RN. The availability of private/public sector education stipends or student loan repayment programs is a characteristic of munificent environment for student nurse anesthetists in considering financial constraints (Christensen, 2016). Financial planning resources, governmental/private aid, and NAEP grants or traineeships are critical resources for students to access for financial challenges. According to

this RDT evaluation, the survey items within the variable of “Student Resources” will address six areas of possible resource constraints to NAEP capacity.

**Faculty resources.** Within the RDT conceptual framework, faculty resources are relevant under the three constructs used in this study. Table 9 contains a summary of RDT constructs and relevant critical resources within the variable domain of “Faculty Resources”.

Table 9

*RDT Table for Faculty Resources Domain*

VARIABLE	CONSTRUCTS	CONSTRAINING RESOURCES
Faculty Resources	Munificence	1. Adequate pool of doctorally prepared didactic faculty available 2. Required academic teaching & advising load plus doctoral project direction
	Uncertainty	3. Salary differences b/w academic and clinical practitioners is a constraint upon hiring qualified faculty
	Complexity	4. Sufficiency of recruitment incentives for faculty and administrators 5. Sufficiency of retention incentives for faculty and administrators

Access to knowledge is the fundamental reason for educational programs. The need for adequate numbers of qualified faculty members is as basic and critical to a NAEP, as is the need for an adequate pool of qualified prospective students. It is well accepted that nursing faculty shortages are present and forecast to continue in the country. The demand for increased production of nurses is ongoing at both the undergraduate and graduate levels (AACN, 2015b; Smeltzer, Sharts-Hopko, Cantrell, Heverly, Wise, Jenkinson & Nthenge, 2014; Sharts-Hopko, 2016). In October 2014, an AACN survey revealed greater than 1200 faculty vacancies in nursing programs across the country (AACN, 2015b). The same schools responding to this



AACN survey also listed over 120 additional faculty positions deemed necessary, over and above the existing vacancies, to function at needed program capacity. A majority of healthcare chief executive officers included in the survey felt this nursing faculty shortage is compromising healthcare delivery in the facilities or systems under their guidance (AACN, 2015b).

Faculty resources have been noted as the fundamental limitation on the production of nursing graduates (Minnick et al., 2013; Smeltzer et al., 2014; Sharts-Hopko, 2016). This demonstrates the interdependence of NAEPs, the academic institutions where they are housed and the environment that serves as both a resource for clinical education and a market for the output of NAEPs. Graduate nursing education for the roles of APRNs (nurse practitioner, clinical nurse specialist, nurse midwife, and nurse anesthetist) is in a transition regarding the mandated degree for entry to practice, from the master's level to the practice doctorate. This transition was first formally called for by the AACN in 2004 (AACN, 2016). The only APRN educational programs to finalize a timeline for the implementation of mandatory doctoral education are NAEPs, the supply program for nurse anesthetists. All NAEPs must complete the transition to doctoral education by 2025 (COA, 2015b). NAEPs must actually complete the transition to doctoral programs by 2022, since practice doctorate programs are three years in length (COA, 2015b). The transition in the entry-to-practice degree for the other three APRN provider roles is occurring voluntarily in the absence of an absolute deadline. In the time period between 2009 and 2014, there was an increase of 17% in the overall number of programs offered to train APRNs (Fang, Li & Bednash, 2014; AACN, 2015c). Programs specifically granting the practice doctorate are also experiencing a sizable and continuing trend in the demand for these APRN doctoral programs, ahead of the growth trend in research doctoral programs. The increased need for primary care and specialty APRNs in the healthcare delivery system is the fundamental

driving force behind these trends (IOM, 2010c). Figure 15 summarizes the data on these growth trends in doctoral education divided by practice and research doctorate degrees (AACN, 2016).

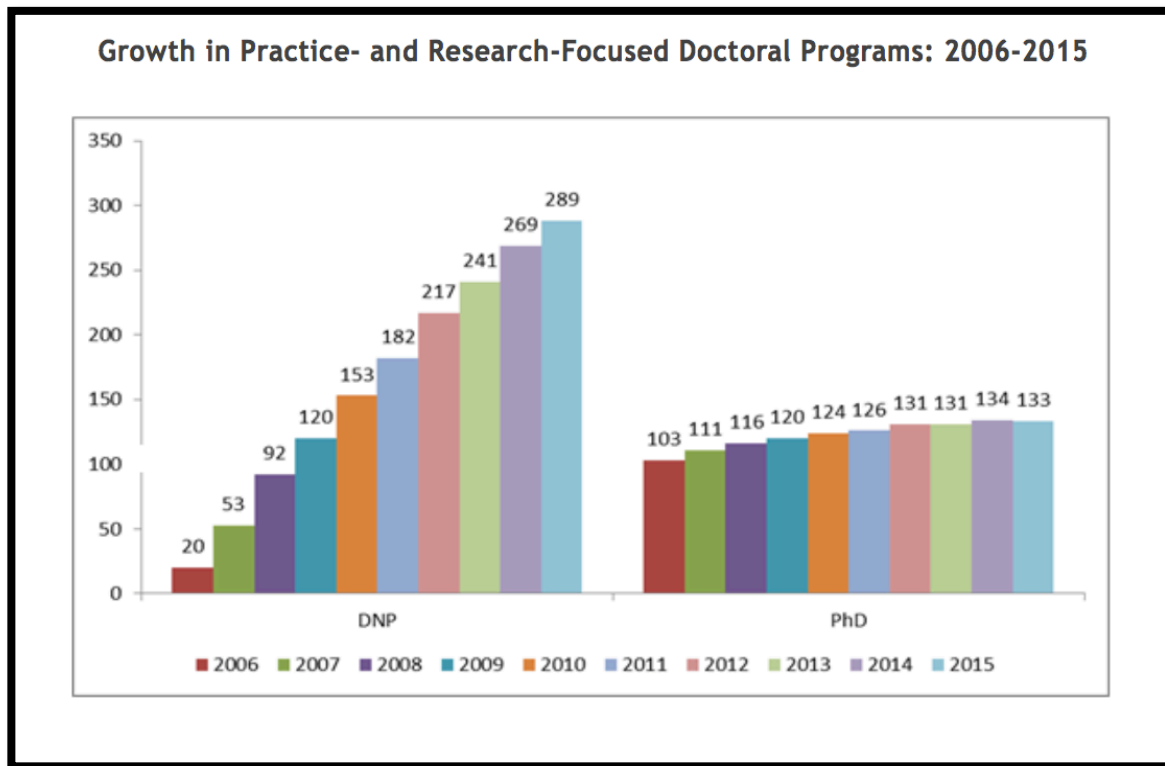


Figure 15: Growth Trends in Doctoral Education

Source American Association of Colleges of Nurses. (2016). *DNP fact sheet*. Retrieved from <http://www.aacn.nche.edu/media-relations/fact-sheets/dnp>

In NAEPs, faculty must juggle a number of responsibilities. This becomes more complex in programs conferring the DNP. These include, but are not limited to: didactic teaching load, clinical practice requirements, simulation/lab instruction load, clinical instruction, service commitments, professional organization duties, committee membership for the educational institution, research and grant work, and supervision or mentoring doctoral students with scholarly project completion (Minnick, Norman & Donaghey, 2013). Many times in calculating faculty workloads, scholarly project supervision is considered, producing an overload and faculty dissatisfaction (Minnick, Norman & Donaghey, 2013; Smeltzer et al., 2014).

In a NAEP, organizational slack may be partially viewed as the possession of resources that enable capacity flexing of the program, maintaining or increasing graduate production at need (Alexander & D'Aunno, 2003). Faculty is seen as a key factor in inhibiting program capacity (Minnick, Norman & Donaghey, 2013; Sharts-Hopko, 2016). Improvement of faculty recruitment and retention is the overt solution to faculty vacancies, but also presents challenges (Ketefian & Redman, 2015). In the clinical world of nurse anesthesia, CRNAs who possess doctoral degrees are often clinical practitioners when first considering a full-time faculty position. The discrepancy between clinical salary and academic salary is often a strong disincentive to choose an academic post. Decreased compensation for academic nursing positions has often come into play as a recruitment barrier in many different specialties of clinical nursing over the years. NAEP allowance for compensated clinical practice can thus be a source of satisfaction both professionally and financially.

Potential nurse educators in a NAEP who are doctorally prepared often have had little coursework in didactic instruction and curriculum design; this can present recruitment barriers in clinical practitioners who doubt his/her ability to transition to the professoriate (Minnick, Norman & Donaghey, 2013). Resources provided by the NAEP to remedy and maintain instructional competencies can be a recruitment incentive. Retention issues certainly may stem from the previously mentioned complex matrix of duties as a full-time faculty member, especially the lack of workload credit in directing student doctoral projects (Smeltzer et al., 2014). Credit given for the requisite time for doctoral project advising can be a recruitment and a retention incentive. According to this RDT evaluation, the survey items within the variable of "Faculty Resources" will address five areas of possible resource constraints to NAEP capacity, as previously listed in Table 9.

**Financial resources.** Within the RDT conceptual framework, financial resources available to a NAEP are relevant under the constructs grounding this study. Table 10 contains a summary of the constructs and relevant resource constraints for the financial resources variable domain.

Table 10

*RDT Table for Financial Resources Domain*

VARIABLE	CONSTRUCTS	CONSTRAINING RESOURCES
Financial Resources	Munificence	1. Sufficient budgetary support within the institution housing the NAEP 2. The cost of needed student services
	Uncertainty	3. Availability of federal/state/private funding sources for the NAEP/students 4. Availability of research or grant funding sources for the NAEP/students
	Complexity	5. The move to the DNP degree (and its requisite costs) is a constraint upon the NAEP

The financial health of a NAEP depends upon a web of relationships, both internal and external, displaying interdependence and complexity between the environment and the organization. NAEPs are expensive to operate. They typically encompass higher than usual faculty expenses (AACN, 2015b); also, the cost of simulation resources, accreditation costs, ongoing expenses associated with clinical site procurement/maintenance, and preceptor resource provision all can be considerable (AACN, 2015c). Financial resources to support the NAEP may come from a mix of governmental or private sources, depending on the private or public structure of the higher educational institution. Private colleges and universities are not primarily dependent upon state governments for financial operational resources, but instead rely on typically higher tuition and fee revenues, endowments, research grants and some limited public funding sources (Douglas, 2006). Private institution NAEPs must also deal with the reality of

higher tuition and fees causing a decreased prospective student/applicant pool. Private colleges and universities most often operate as educational/research non-profit organizations, receiving significant tax concessions as well (Douglas, 2006). Therefore, the financial health and level of endowment of a private college or university greatly affects the financial resources a NAEP is allowed. NAEPs residing within private higher education institutions must compete for budgetary funds and grant considerations with other programs and priorities within their respective institutions (Douglas, 2006). These budgetary funds can affect the organizational slack (Chen et al., 2015) a NAEP must have to function well, and alter its capacity for student admission and graduate production.

Public colleges and universities traditionally have been founded, operated and supported by considerable financial allotments from state governments (American Academy of Arts and Sciences [AAAS], 2015). Even though higher education spending is a high priority in most states, the percentage of higher educational funding has been consistently declining (AAAS, 2015; Rizzo, 2006). This is forcing public colleges and universities to seek out private funding sources more often than in the past (Douglas, 2006).

Although it is clear that higher education spending is significant in state budget allowances, fluctuations in funding levels from year to year are often quite common and present uncertainty to institutions and programs residing within them (AAAS, 2015). These fluctuations in critical institutional financial resources can affect program funding, inhibit recruitment and retention of faculty (AAAS, 2015), cause tuition increases, and thus alter the capacity to admit students to the NAEP. Competition for internal budgetary priority with public institutions operates similarly as in private institutions. Figure 16 shows the funding allocations for state general funds across the nation for the year 2014, from the AAAS report on public education funding changes (2015).

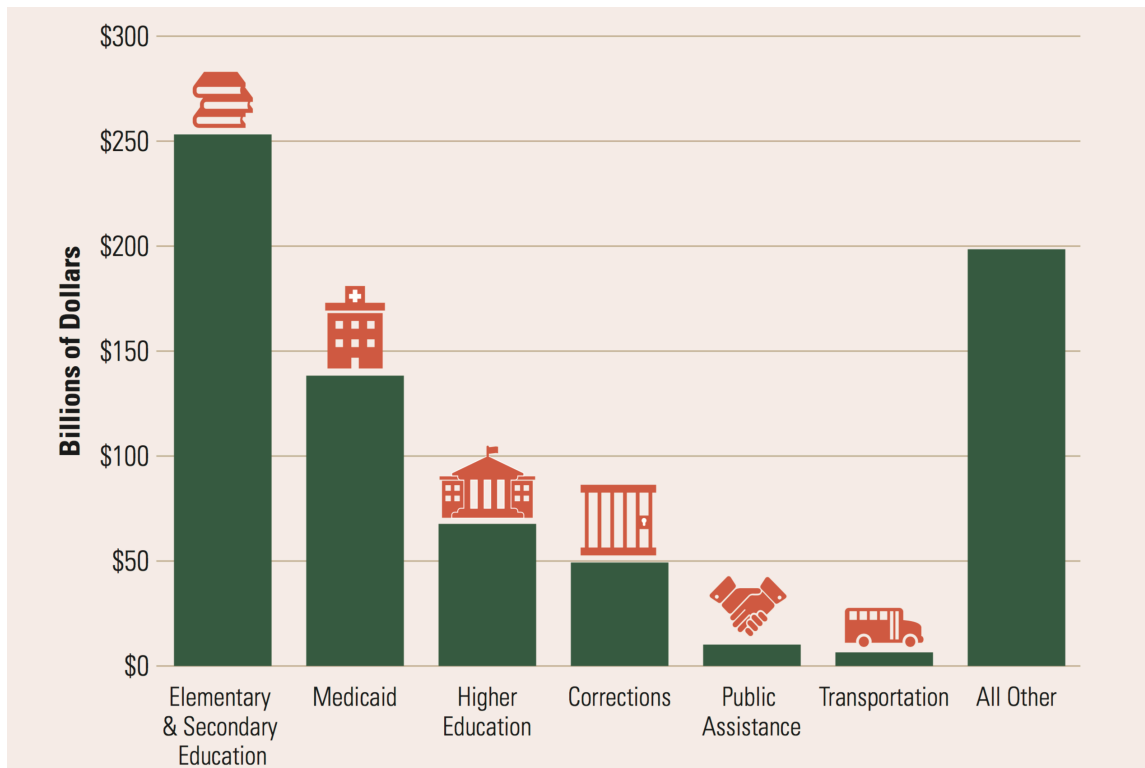


Figure 16: 2014 Data on State General Fund Priorities

Source: American Academy of Arts and Sciences; The Lincoln Project: Excellence and Access in Public Higher Education. (2015). *Public research universities: changes in state funding*. Retrieved from [https://www.amacad.org/multimedia/pdfs/publications/researchpapersmonographs/PublicResearchUniv\\_ChangesInStateFunding.pdf](https://www.amacad.org/multimedia/pdfs/publications/researchpapersmonographs/PublicResearchUniv_ChangesInStateFunding.pdf)

These relationships reveal munificence and interdependence in both the private and public higher education ecologies, as the investments made by private and governmental revenue sources are intended to play out for overall societal gains, through the output of educated graduates to benefit the larger community (AAAS, 2015; Douglas, 2006).

Another consideration in the consumption of critical financial resources in NAEPs is the mandatory transition to the DNP degree as the entry level to practice for all NAEPs by the year 2025 (AACN, 2016). Adding the required curricular content from the AACN's Essentials of Doctoral Education for Advanced Nursing Practice (2006) results in more areas of needed instructional expertise, more hours of didactic instruction, and more hours of scholarly project

supervision (Minnick et al., 2013). These additions translate to a higher number of interprofessional expert faculty members needed, and increased workloads on full-time and adjunct faculty members. These increased curricular obligations can indirectly lead to opportunity costs, via the loss of research opportunities and possible research grant funds, because of the higher consumption of faculty workload for DNP program requirements (Minnick et al., 2013).

Student retention through a NAEP to its concluding graduation is an important indicator of program planning and efficacy (Dosch, Jarvis & Schlosser, 2008), and is a way of evaluating the munificence of the NAEP for its students. Student attrition can therefore be seen as a source of financial resource consumption within a NAEP, with reduced graduate output. Academic factors, individual factors and financial consideration can all come into play with student attrition decisions (Council of Graduate Schools and Educational Testing Service [CFGE], 2010).

Strategically devoting financial resources of the higher education institution and the NAEP to improve student persistence is often deemed a cogent strategy to increase the return on student recruitment/retention expenses (CFGE, 2010). Comprehensive student support services consume fiscal resources. These services include, but are not limited to, student counseling services, academic success services, writing centers, research centers, regularly monitored advising programs, student health centers, information technology support and financial aid departments.

Financial demands placed upon students in NAEPs are considerable, as noted earlier. NAEP attendance is a full-time endeavor, leaving room for only very minimal or no wage production on the student's part. The student will absorb new costs associated with the program's overt and incidental expenses, such as paying for housing at distant clinical sites. The efficiency of the NAEP with obtaining grants and traineeship funds can make a difference in student admission

and retention related to student financial expenses. The NAEP can pursue bridging relationships with healthcare systems that need the nurse anesthesia graduates produced by the program. Examples of this can be found in the existence of scholarships, stipends and loan repayment programs from healthcare systems in return for a defined period of committed employment after the nurse anesthesia student graduates. In one such program, Milton S. Hershey Medical Center will agree to pay \$40,000 in NAEP reimbursement costs to a qualified new graduate in return for continuous employment with them as a CRNA for 36 months (Penn State Health, 2017). These many relationships and opportunities reflect the interaction in access to knowledge, munificence, organizational slack and interdependency present in the complex ecology of the NAEP and its graduate healthcare education environment (Pfeffer, 2003; Christensen, 2016). According to this RDT evaluation, the survey items within the variable of “Financial Resources” will address five inter-related areas of possible resource constraints.

### **Summary**

Resource dependency and institutional theorists posit that organizations and society must agree to mutually acceptable cognitive, cultural and normative concepts in order for an organization to retain its probity (Scott, Ruef, Mendel & Caronna, 2000; Weech- Maldonado, et al., 2012). This relates the past and present value of CRNA practice to its place in the future emphasis of reducing disparate access to healthcare, in the context of an ongoing anesthesia personnel shortage and a burgeoning patient population. Very few studies evaluating barriers to CRNA education program capacity have been found in the literature, and the most recent (Oullette et al., 2002) evaluated only barriers to the clinical education of CRNAs. Studies found evaluating any such obstacle to increasing CRNA graduate production contained none that used the concepts of Resource Dependence Theory (RDT) in framing the variables evaluated. This is



the theoretical framework guiding the literature search in the development of this study's constructs, variables, and survey tool measures, which proposes to evaluate barriers to CRNA education program capacity amongst four critical resource variable domains: student resources, financial resources, clinical opportunities (resources), and faculty resources.

In the face of the rising need for anesthesia providers (Daugherty et al., 2011), demographic trends that both reduce the supply of providers and increase the patient population served, and the fact that CRNAs comprise greater than half of the anesthesia workforce in the U.S. currently, an assessment of the ability to increase NAEP capacity and graduate production is prudent. It has been shown that CRNAs provide valuable and safe anesthetic care, even in medically underserved areas, at an economically efficient cost. In answer to healthcare market needs, the specialty of nurse anesthesia must proactively assess the ability of existent CRNA education programs to expand graduate production as dictated by market need. The most recent assessment of barriers to CRNA education programs was cited in the literature in 2002 (Oullette, et al.). An assessment of critical resources needed to increase the capacity of NAEPs, and therefore of graduate CRNAs, is not found in the current relevant literature.

## Chapter Three: Methods

### Introduction

Nurse anesthetists (CRNAs) fulfill a valuable and specialized role in the U.S. healthcare delivery system. Nurse anesthesia education programs (NAEPs) are the sole source of graduate nurse anesthetists who may become board-certified practicing CRNAs. The demographic and epidemiologic trends of the U.S. population, combined with the overall shortfall in the anesthesia provider workforce, make the continued production of graduates from NAEPs very important. The previous chapter provided an overview of the history and future of nurse anesthesia and NAEPs. There was also an introduction of the theoretical framework of resource dependency theory and its constructs that ground this research investigating critical resources in NAEPs. Chapter Two concluded with a summary of the past literature regarding the evaluation of resource constraints in nurse anesthesia, followed by the formulation of the variable domains used in this new research. This study is an evaluation of critical resources (resource constraints) for NAEPs, their relative importance, and possible correlations with NAEP characteristics. There is scant literature exploring this topic. The last published research focused only on the detailed exploration of barriers to achieving the minimum clinical requirements for student nurse anesthetists (Oullette, et al., 2002). To fill this void in the literature, the current research study has been designed.

The study is a focused prospective research project, exploratory in nature, with a nonexperimental correlational design. The global aim is to assess the perceptions regarding

critical resources that may constrain the operation of NAEPs. In the overarching research scheme, a novel survey tool was developed and validated in order to accomplish the goals of the study. The survey tool examined potential resource constraints for NAEPs, and their relative importance. Demographic data regarding specific NAEP characteristics was collected at survey deployment. The sample consisted of program administrators and/or faculty of all U.S. accredited NAEPs, with the ideal goal of one response per program. This exploration is useful in general to nurse anesthesia education as a guide to more efficiently meet the expectations and needs of the healthcare delivery system. Specifically, the survey data will enable each NAEP to tailor the direction of attention and effort to the most critical resource constraints for that program. Additionally, the survey findings will be directly relevant to accreditation planning for those schools wishing to use the data for such purposes.

Resource dependency theory (RDT) has been used as the grounding theoretical framework for the survey tool development. RDT concentrates upon how an organization's perceptions of the existing environmental resource constraints can shape actions, strategies and tactics (Pfeffer & Salancik, 2003). Organizations continually assess and respond according to these perceptions. Where resource constraints are found to be common for NAEPs, strategies for dealing with these resource constraints can be shared and bolstered, either regionally or nationally. A literature review was conducted for the evaluation of critical resource constraints upon graduate nursing programs in general, and specifically upon NAEPs. This led to the development of four overall independent variables, within the general category of "Resource Domains": 1. Clinical Resources; 2. Student Resources; 3. Faculty Resources, and; 4. Financial Resources.

Each resource domain independent variable (IV) has five to six individual survey items

addressing potential resource constraints to NAEPs. The resource domain IVs have been examined in the light of three foundational RDT constructs in order to formulate pertinent domain survey items. These constructs are:

- Munificence
- Uncertainty (also called Dynamism)
- Complexity

The following chapter describes the research methodology utilized in fulfilling the goals of the study. The research design, population and sampling plan, variables, survey construction and validation, data collection plan, hypothesis testing and ethical considerations are detailed in this chapter.

### **Research Design**

The study is a focused prospective and correlational design, of a cross-sectional and exploratory nature, utilizing the Qualtrics® online survey software for data collection. Surveys can be administered in a number of ways, such as in person, by telephone, written questionnaires, mailed surveys, computer-assisted telephone interviews, and computer-assisted personal interviews (Polit & Beck, 2012). Qualtrics is a research platform utilized frequently in academic and business research, especially survey-based research. It is a privately owned research and experience management company, originally founded in 2002, and focuses on online data collection: it is used in more than 8,800 educational institutions (Qualtrics, 2017a). Qualtrics research software is one type of a “computer-assisted personal interviewing” survey technique (Polit & Beck, 2012, p. 265). This type of survey software enters statistically coded responses into a computer file, without the need for interviewer recording, or delayed data entry.

Through the utilization of computerized survey software, there is less chance for interviewer or data entry error (Polit & Beck, 2012).

Survey data is designed to elicit data regarding specific phenomena within a target population, including frequency, prevalence, distribution and correlational information. As surveys are meant to investigate the breadth of an issue, instead of the depth or detail (Polit & Beck, 2012), this methodology is well suited to a correlational exploratory design. Cross-sectional research is also well suited to exploratory studies, as assembling data from a focused sample at a discrete point in time will help to elaborate priorities and correlations that merit further and more intensive study in the future (St. Germain, n.d.).

A nonexperimental approach was utilized, as the sample was purposive, not randomized or manipulated with an intervention, nor measured at multiple points in time (Trochim, 2006). Although limited in external validity when compared with probability sampling (Polit & Beck, 2012; Field, 2013), the use of purposive sampling is appropriate for this study requiring a sample with the requisite expertise to provide insight into a specialized issue. This is appropriate in the examination of critical resource constraints in nurse anesthesia, a highly specialized area of graduate health professional education.

### **Population and Sampling**

The target population for this study consists of all faculty and administrators in accredited U.S. NAEPs. Purposive sampling was the chosen sampling methodology, due to its ability to focus the research on subjects that can reliably respond to specialized topical areas of inquiry. It is reasonable to postulate that this group of personnel is the most adept in the evaluation of critical resource constraints that could affect NAEP production of graduates. The accessible population was composed of all NAEP faculty and administration of accredited NAEPs in the

U.S., able to be reached by valid email contact information.

The sampling frame is a contact list of all accredited NAEPs in the U.S. via utilization of an accreditation master list. A list of accredited CRNA programs was obtained from the Council on Accreditation of Nurse Anesthesia Educational Programs (COA). There are 120 accredited programs of nurse anesthesia education in the U.S. as of September 2017, according to the COA. Program and director email addresses are provided as public information in the COA document titled “List of Recognized Nurse Anesthesia Programs”. An example of a page from this list and a link to the COA document is provided in the Appendix A. An initial email contact was made with a brief survey invitation document, sent to both the main NAEP and the program director email addresses. The ideal goal again, was one representative from each NAEP’s faculty or administrator staff members. Follow-up calls were made to program administrative assistants or program director as needed, public information that was obtained from specific NAEP webpages.

### **Power Analysis and Sampling Response Rate Goal**

The primary statistical testing method employed was logistic regression. By usual statistical practice, the significance criterion is selected a priori to  $= 0.05$  and the power to  $= 0.80$  (Tabachnik & Fidell, 2007). According to the website entitled *Interactive Statistics*, a binary outcome in a population with a significance confidence level of  $\alpha = 0.05$ : power, or  $(1-\beta) = 0.80$ : and an outcome (the binary dependent variable) proportion of 30% in population 1/population 2 requires a minimum sample size of 56 (<http://statpages.org/proppowr.html>). Adherence to this power analysis will decrease the chance of a Type II error (Polit & Beck, 2012; Tabachnik & Fidell, 2007).

According to Dr. Francis Gerbasi, when he served as the COA Executive Director (personal communication, phone interview; April 17, 2014) his recall and internal review of

NAEP director/administrator literature puts the response rates consistently well above 50%; some survey return rates from NAEP directors, in his experience, have much higher percentages. Reviewing past surveys distributed, the rate of return from the population of NAEP directors and faculty is much higher than the general nurse anesthetist population, such as the survey response return rate from NAEP administrators of 81 % found by Stewart (2016). This is a consistent return rate of above 50% demonstrated in this population.

The risk of non-response in survey research is common and often considerable. To mitigate this risk, several measures will be taken. The invitation to NAEP administrators will encourage the inclusion of any faculty he/she may feel will significantly contribute to this inquiry. At the NAEP's discretion, this inclusion of other faculty/staff members may be in lieu of, or in addition to, the program administrator's participation in the survey. The introductory email detailed confidentiality provisions, and provided the opportunity to ask questions or voice concerns. A few days after the follow-up email, the survey was sent via the Qualtrics software, with a brief summary of the research provided. By utilizing a planning and inquiry period, and allowing respondent flexibility, it was possible to exceed the minimum sample of 56 required to reveal a resource constraint of significance to 30% of the NAEPs in the country. Exact details of the the overall and regional response rates will be covered in the next chapter detailing the results obtained from the study. The NAEPs participating were also offered the chance to have access to the de-identified survey data for proactive planning purposes, and several programs have already expressed interest.

### **Independent Variables**

The independent variables and respective individual survey items linked to the pertinent RDT constructs are seen immediately below in Table 11.

Table 11

*Overview of Independent Variables and RDT Construct Linkage*

<b>RDT Constructs</b>	<b>IV = Clinical Resources</b>	<b>IV = Student Resources</b>	<b>IV = Faculty Resources</b>	<b>IV = Financial Resources</b>
<b>Munificence</b> (resource availability within the environment)	1. Total clinical sites available 2. Number of clinical preceptors available at each site	1. High acuity critical care experience available 2. Competition from other regional NAEPs for students	1. Adequate pool of doctorally prepared didactic faculty available 2. Required academic teaching and advising load is a constraint on faculty resources	1. Sufficient budgetary support within the institution housing the NAEP 2. The cost of needed student services
<b>Uncertainty</b> (AKA dynamism, or the variability within the environment)	3. Availability of clinical specialty cases	3. Student pool meets COA minimum requirements for eligibility 4. Student pool meets NAEP-specific requirements for eligibility	3. Salary differences b/w academic and clinical practitioners is a constraint upon hiring qualified faculty	3. Availability of federal/state/private funding sources for the NAEP/students 4. Availability of research or grant funding sources for the NAEP/students
<b>Complexity</b> (heterogeneity within the environment and organizational range of actions)	4. Availability of specific anesthetic techniques 5. Availability of specific clinical procedures 6. Competition for anesthetic caseload	5. Can meet financial burden of full-time NAEP attendance 6. Lack of student debt relief mechanisms available	4. Sufficiency of recruitment incentives for faculty and administrators 5. Sufficiency of retention incentives for faculty and administrators	5. The move to the DNP degree (and its requisite costs) is a constraint upon the NAEP

As stated in Chapter Two, the chosen independent variables were based upon both focused literature review on NAEP resource constraints and the use of RDT constructs. This yielded four



areas of critical resource constraints that are likely to be of concern to NAEPs and their production of graduates. These four independent variables (IVs) are labeled “Resource Domains” and are: CLIN = Clinical Resources; STU = Student/Applicant Resources; FAC = Faculty Resources, and; FIN = Financial Resources.

Within each IV resource domain, individual survey items, or predictors, will link to RDT constructs of munificence, uncertainty and complexity. The individual predictors within each IV constitute a qualitative scale with that IV critical resource domain. The resultant IV qualitative scale serves to identify aspects of the IV that are more constraining to an NAEP’s perception of critical resources and their relative importance. The linkage to RDT constructs guided the inclusion of each individual survey item, as well as validity measures to be elaborated upon in the survey construction section. In this manner, this global evaluation of critical resource constraints will encompass the RDT dimensions of the U.S. healthcare education environment that NAEPs must inhabit, and how this shapes the perception of resource constraint.

### **Dependent Variable(s) and Scaling**

The dependent variable in this study is both embedded in the IV predictor choices and examined as a distinct and separate variable. The embedded dichotomous choice within the main body of the survey tool is the survey respondent’s answer to the following question, posed repetitively for each predictor item: “The (insert IV item) is a constraint upon the increased production of graduates from your NAEP?” The answer choice is dichotomous, or binary, and was listed as two possible choices: “Yes” or “No”. If the respondent chose “No” then a prompt cycled to the next survey item. If the respondent chose “Yes” the survey tool populated a follow-up scaling question. This requested a score indication on a five-point Likert-type scale,

ranking how important the respondent deemed the resource constraint to be for their NAEP. The Likert-type scale that was used for this scaling evaluation is seen in Figure 17.

*How important is this critical resource constraint to the operation of your NAEP?*

Rarely an important concern = 1	Occasionally an important concern = 2	An important concern = 3	Usually an important concern = 4	Always an important concern = 5
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Figure 17: Likert-type Scale for Resource Constraint Importance

The distinct dependent variable characterized each responding program as not constrained, or constrained. This DV was called “Program Constrained” and the dichotomous choices possible were “Yes” or “No”, coded 1 or 0 respectively. This DV characterization for each responding program was based upon the percent change possible in the volume of graduate production for each NAEP respondent. The cut point was greater than or equal to a 15% production increase = No (not constrained). This numeric data was collected in Section III of the survey tool.

**Survey Construction**

The novel survey tool for this study was developed in three phases. As fully described in Chapter Two, two main things grounded the initial stage of the variable construction. First, a literature review was conducted regarding relevant literature analyzing critical resources for U.S. graduate nursing education programs. This was followed by a more focused review specifically regarding critical resource analysis for U.S. nurse anesthesia education programs. The second main foundation in this initial stage for the variable construction, and the development of linked individual survey items, was the theoretical framework of RDT. This framework has been used extensively in sociology, human resources and healthcare delivery research (Pfeffer & Salancik, 1978; Pfeffer, 2003; Nienhüser, 2008; Christensen, 2016). The linkage to RDT constructs, and the comparison to literature accomplishing the same linkages, was an effort to instill construct validity into the structure of the survey instrument. Construct validity is the consideration of the

degree to which an instrument actually measures the constructs being explored, and is a form of external validity or generalizability (Cook & Campbell, 1979). An evaluation of critical resources is also mandated in initial and ongoing accreditation processes for NAEPs with the specialty nurse anesthesia accreditation agency, the COA (COA, 2015a).

The second phase of the survey construction consisted of survey tool evaluation by expert consultants. A panel of graduate education and NAEP experts was contacted and asked to evaluate the initial survey version for both face and content validity. Face validity measures the extent to which an instrument appears to assess those qualities for which it is designed (Polit & Beck, 2012). Content validity refers to the ability of the instrument to appraise the entire spectrum of content that relates to the concept (or concepts) being measured (Polit & Beck, 2006). The panel consisted of five NAEP administrators, one director of a research doctoral program in allied health, and one family nurse practitioner employed as a full-time faculty member in a DNP program. The educational preparation varied among these individuals, between a practice doctorate and a research doctorate. The U.S. geographic areas represented by the initial panel membership included the east coast, the northeast, the mid- Atlantic, the south, the midwest and the west coast. The array of experts with different geographical locations and differing roles within graduate health services education is intended to increase the representativeness of the final validated survey tool. Revisions based upon expert feedback altered the survey preamble and explanation, eliminated a small number of items, and increased the accuracy and precision of the language in multiple individual survey items.

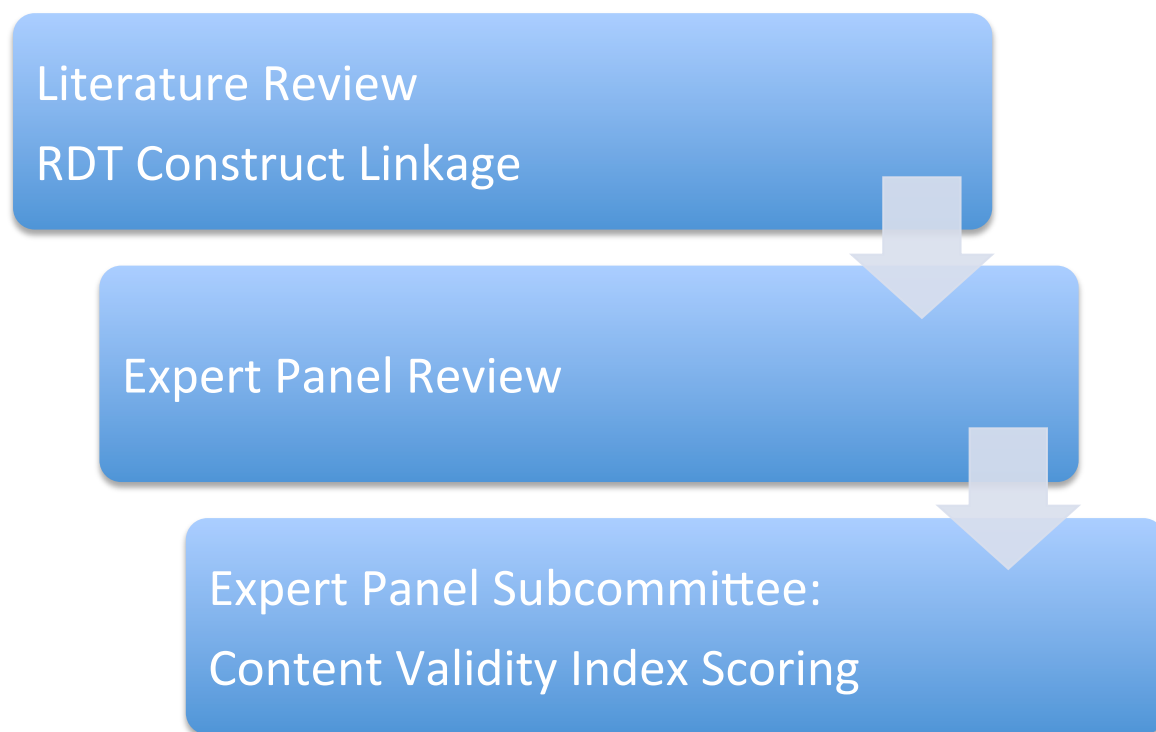
The previous two phases of the survey tool validation were necessary, but qualitative in character. A quantitative means seemed reasonable to more completely evaluate the tool, in order to match the goal of accurately sampling the intended IV resource domains. So, the third

and final phase of survey tool validation took the form of utilizing a ‘subcommittee’ of the original panel of experts to more critically evaluate the revised survey tool. After expert and literature consultation, it was found that an accepted quantitative method of instrument validation is the computation of the instrument’s content validity index (Wynd, Schmidt & Schaefer, 2003). A total of four members from the original seven members of the expert panel were utilized for the indexing of content validity. This subcommittee consisted of three NAEP administrators and the family nurse practitioner/DNP faculty member. These subcommittee members were chosen due to their experience in research or in NAEP resource planning. The entire revised survey tool was provided to these experts, and the subcommittee members were asked to rate the pertinence of the individual survey items to the content frame. A 4-point scale was utilized for this: 1 = not relevant; 2 = somewhat relevant; 3 = quite relevant; and 4 = highly relevant (Grant & Davis, 1997). After obtaining these ratings, a content validity index (CVI) was calculated for all three sections of the survey tool. In section two of the survey tool there are 22 individual items. Sections one and three were considered one question each; though there were multiple parts within those sections the parts all addressed one fundamental question each. This yields a total of 24 items within the survey instrument.

One method of CVI calculation is Lawshe’s formula (1975) that reads as follows:

$CVR = [N_E - N/2] / [N/2]$  where CVR is the content validity ratio,  $N_E$  is equal to the number of raters scoring the item a “3” or a “4”,  $N$  is equal to the number of raters and  $N/2$  is equal to the number of raters divided by 2 (Lawshe, 1975). Individual survey items of sound validity should have a CVI value of at least 0.78 (Polit & Beck, 2006). Using this calculation, all individual survey items, save one, had a CVI = 1.0. That single survey item was judged worthy of retention by the subcommittee, and it’s lowest score by an individual rater was 2 (somewhat

relevant). A final measure of overall instrument content validity is the calculation of the average CVI across all items evaluated. An overall CVI for the instrument of greater than 0.90 is needed to confer excellent instrument content validity (Lawshe, 1975; Polit & Beck, 2006). The revised survey instrument to be used for this research has an overall CIV = 0.979, which merits an excellent rating for content validity (Polit & Beck, 2006). Figure 18 summarizes the phased construction of the survey tool developed for this research. The final revised survey tool is found in Appendix B.



*Figure 18: Phases of Novel Survey Tool Construction*

### **Data Collection**

The research instrument is an electronic survey administered and stored with the use of Qualtrics® online survey software for data collection. The survey consisted of three sections with a combination of forced choice, dichotomous and Likert-type questions. Likert or Likert-type questions are often seen in research to measure perceptions or attitudes (Wuensch, 2015).

There was also a final open-ended question with white space for free text answers. In order to aid analysis, the Likert-type questions had a number assigned to the responses choices (Polit & Beck, 2012).

One of the reasons those in industry and education choose Qualtrics survey software is the company's history of consumer data protection. To ensure server integrity, there are redundancies in the firewall and firewall scanning procedures, complete nightly data backups, early failure notifications, and yearly penetration testing (Qualtrics, 2017b). Confidentiality is also assured in several ways, seen below in a list closely adapted from the company's website description (Qualtrics, 2017b):

- The data storage system is a subcomponent design
  - Only data coded and meant for a certain subcomponent will be allowed into that specific subcomponent
  - System access is restricted, monitored and audited
  - Data is not moved around freely in a "cloud" design
  - Any data center used is certified and independently audited
- Transport layer security, also know as HTTPS is used for all transmitted data
- Surveys are password protected
- Qualtrics security and protection metrics meet or exceed federal guidelines in the U.S.
- Qualtrics is compliant with the Health Information Technology for Economic and Clinical Health Act (HITECH) and the Health Insurance Portability and Accountability Act of 1996 (HIPPA) standards if medical data is needed for research

After the survey data was compiled in Qualtrics, a data file was generated within the Qualtrics platform that populates the relevant programs in the analysis software, IBM SPSS Statistics

(SPSS). This program is widely utilized in statistical analysis in education, healthcare and the social sciences (IBM, 2017) and is utilized at Virginia Commonwealth University. All of the analyses described in the next section was accomplished within the SPSS software the Qualtrics software, or both.

### **Statistical Analysis**

Descriptive statistics regarding the characteristics of the responding NAEPs was compiled from section one which contains forced choices or simple response questions. The greatest majority of the survey items are the binary plus Likert-type scaling questions within section two. They are all structured in the same manner. The IVs (predictors) are within four categorical resource domains, and the categorical response is dichotomous, or binary (“Yes. Additionally, there is a distinct DV labeled “Program Constrained”. This variable arrangement and the research questions point strongly toward the use of logistic regression as the main statistical treatment in this study. Logistic regression is based upon the General Linear Model, but the use of a binary categorical DV violates the assumption of linearity made in standard regression analysis (Field, 2013). In logistic regression, there is a logit transformation of the dichotomous DV, or the likelihood of observing the DV value of interest, given its interaction with IVs (Tabachnik & Fidell, 2007). This analysis will yield the odds probability of the DV occurring within each IV category. Put more specifically, logistic regression will estimate the probability that the survey item under consideration is seen as a resource constraint within each category of the critical resource domains.

The general assumptions that should be met to appropriately use logistic regression include: (1) the categorical DV is dichotomous (2) there are one or more IVs, which may be continuous or categorical (3) the DV categories should be mutually exclusive (Laerd Statistics, 2013). There

are four critical resource domains that serve as the categorical IVs. These will be labeled CLIN, STU, FAC and FIN. The binary DV, called “Program Constrained” is the distinct DV based upon potential production volume increase in graduates and is coded “YES” (1) or “NO” (0). A dichotomous answer to each survey item within the four IV domains was also selected; these answers will be “YES” (1) or “NO” (0) and functioned as an alternate embedded DV for a comparison of regression results.

The program characteristics served as categorical covariates. Logistic regression was carried out with the full model, and individual items within each study IV category (CLIN, STU, FAC, FIN). The individual items found to be statistically significant under each IV regression at the .05 level were examined as covariates on the dichotomous DV (Program Constrained). Model significance for each IV predictor will be examined by the chi-square statistic. Using the chi-square is a means of testing for the ability of the model to detect differences in the value of the DV for two or more groups, in order to assess the degree of association or relationship between categorical variables (Tabachnik & Fidell, 2007; Field, 2013). According to Field (2013), general assumptions that should be met to appropriately utilize the chi-square statistic include: (1) the variables should be categorical (2) there is independence of observations (3) data is from a random sample from a fixed population; importantly, purposive sampling is acceptable (4) sample size is appropriately powered (5) no cell contains a count of less than five cases.

The Likert-type scaling on survey section two items marked as resource constraints was used to produce a rank ordering of identified critical resource constraints. Demographic (rural vs. urban), geographic, and program descriptive characteristics collected in section one will be examined as categorical covariates to the selected critical resource constraints. For the final survey questions, in section three: the figures for ACT and POT will be pooled for the



responding programs and a paired samples *t*-test was used to generalize the ability of the NAEPs in the U.S. to increase the number of graduates in a statistically significant manner, given NO increase in constraining resources. These figures were also used in the calculations for the distinct DV. Finally, the white space question will have answers evaluated for congruent themes.

### **Hypothesis Testing**

The objectives of the study include establishing the ability of NAEPs to increase the number of graduates produced at current resource levels. The second objective is to examine resource constraints to NAEP capacity and/or expansion, and to rank their effects. A final objective is to discover novel barriers not evaluated by the current study. These objectives will be accomplished by the means of a focused prospective and correlational study employing a novel survey tool, among a sample of NAEP directors and faculty. All accredited NAEPs will be given the opportunity to reply. Descriptive statistics, logistic regression and correlational analyses will be performed to answer the following research questions.

- *RQ 1*: Can currently accredited NAEPs expand the production of graduate CRNAs with no change in potentially constraining resource levels?
- *RQ 2*: What is the relative importance of barriers to NAEP capacity, in four critical areas of constraining resource levels? (Student recruitment = STU; Financial = FIN; Clinical requirements = CLIN, and; Faculty = FAC)
- *RQ 3*: Are there differences in the relative importance of barriers to NAEP capacity related to geographical location of the NAEP?
- *RQ 4*: Are there differences in the relative importance of barriers to NAEP capacity related to program characteristics of the NAEP? (public vs. private; shared vs. non-

shared clinical sites; urban vs. rural, and; entry-to-practice degree offered – master’s vs. doctoral)

- *RQ 5*: What are potential barriers to NAEP capacity not explicitly addressed in this survey? (This will be a qualitative open-ended question with white space for answers).

Figure 19 details a schematic overview of the study statistical analysis.

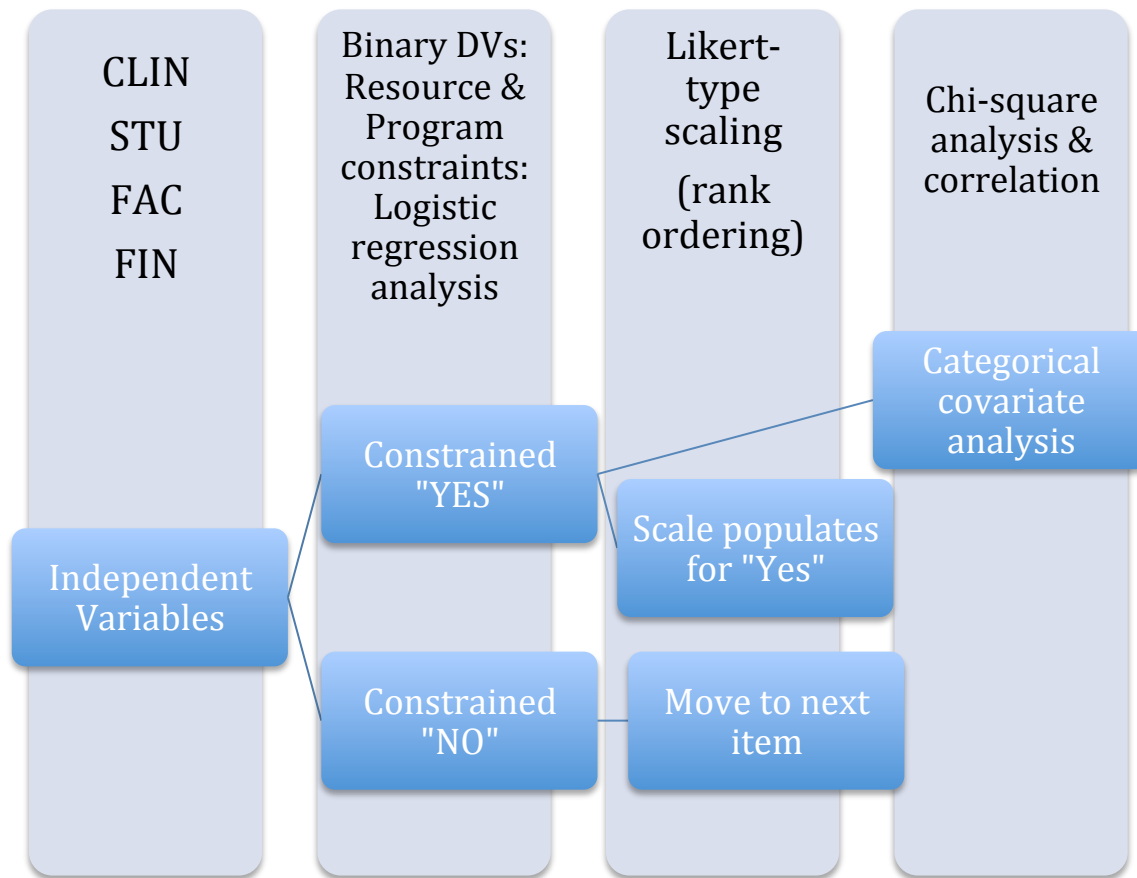


Figure 19: Statistical Analysis Overview

Research question number 1 was answered by comparing the summed figures for ACT and POT collected in survey section three. Research question numbers 2 was answered by the overall logistic regression analysis. Research questions 3 and 4 were addressed by the covariate

correlational analysis. The final research question was explored by the single qualitative question contained in the survey tool and has been analyzed for recurrent and congruent themes..

## **IRB**

Application for Institutional Review Board (IRB) approval will be submitted to Virginia Commonwealth University and Marian University. The U.S. Department of Health and Human Services (DHHS) federal regulation 45 CFR 46, otherwise known as the “Common Rule”, sets rules for IRB processes including criteria for full, expedited and exempt reviews. Exempt status will be sought for this study, as there will be no intervention per se, and survey methodology will be employed with adult subjects of non-vulnerable status. The proposed study fits into one of the commonly used categories for exempt status, found in DHHS 45 CFR 46.101. This is the explanation found at the DHSS site for Category 1 exemption:

*“Research conducted in established or commonly accepted educational settings, involving normal educational practices...”* (U.S. Department of Health and Human Services, 2013).

## **Limitations**

In general, limitations in research can be anticipated within methodologies and sampling frames. Utilization of computerized survey methodology places an obligation on the survey author to be concise and clear in expectations, question structure and wording choices (Polit & Beck, 2012). Reliability in survey items can be measured with markers of internal consistency, such as Cronbach’s alpha (Polit & Beck, 2012). This can be accomplished within the SPSS software. Validity questions were addressed both qualitatively and quantitatively, via the multiple phases of the construction of the survey tool as explained previously in this chapter (Lawshe, 1975; Polit & Beck, 2006).

Missing or incomplete data compels a researcher to discard any data from the respective respondent. According to multiple references, three overarching concerns comprise most of the spectrum of limitations in survey research (Polit & Beck, 2007; Field, 2013).

- There are refusals, or non-responders (missing instruments)
- Missing data by individual items (missing values)
- In longitudinal studies, there can be attrition (loss to follow-up)

Longitudinal attrition will not be a concern in a cross-sectional study design. Given the historical responsiveness of the population of academicians and program administrators to research requests, it is reasonable to suspect that non-responders will not significantly limit the analysis or its statistical conclusion power. Staying within the parameters of the power analysis will answer this concern. The staged deployment of the survey, the choice in respondent per program and the assurance of data confidentiality are anticipated to mitigate the non-responder rate as well. Data will be analyzed for the differentiation between values missing at random, versus values missing in a pattern. If the values are missing at random, and are of small number, consideration will be given to importing the sample mean value for the item in question.

The use of a nonexperimental and correlational design does predispose to limitations in the internal validity of the study, or the ability to draw associations and correlations from the results. However, the design is quite appropriate for exploration of a topic with little recent literature. The inclusion of multiple covariates, drawn from relevant literature review and theoretical linkages is an effort to increase the internal validity of this research. Threats to generalizability of the results from this study could be inferred to exist due to the sampling methodology lacking a true random nature. It was deemed, however, that the benefits from purposive sampling of a

relatively specialized and small group of qualified respondents outweighed this potential concern with external validity.

### **Summary**

This methodology chapter summarized the general nature of the research project analyzing critical resource constraints in U.S. NAEPs. After an introduction, specific details were provided about the overall research design, the intended population and sampling methods, the variables involved, the construction of the novel survey instrument, the logistics of data collection, the means to be used for statistical analysis and hypothesis testing, and finally the perceived limitations of the study as designed. The next chapter will summarize the results obtained from the deployment of the survey instrument and the interpretation of the same.

## Chapter Four: Results

### Introduction

Certified registered nurse anesthetists (CRNAs) are a critical component of the actively practicing anesthesia workforce in this country (U.S. Bureau of Labor Statistics, 2016a, 2016b), composing over 50% of that provider population. Nurse Anesthesia Education Programs (NAEPs) are the sole source of graduate nurse anesthetists who are eligible to sit for board certification as a CRNA. The overall purpose of this research was to provide a critical resource analysis for U.S. NAEPs, with the potential for the analysis to be used both regionally and nationally in proactive efforts in resource acquirement, allocation and accreditation planning. The analysis focused on relative importance of four domains of critical resources, which were grounded in literature review and in the conceptual framework of Resource Dependence Theory (RDT). NAEP characteristics and geographical location were used as covariates to discern any similarities or differences in critical resource constraints related to the corresponding program characteristics.

### Methodology Review

Explained in detail in Chapter Three, this exploratory study was accomplished using a focused prospective and nonexperimental design, via the use of a validated novel survey tool. The study survey was electronically distributed and the data collected using Qualtrics® survey software via the Internet. Purposive sampling was utilized, with email recruitment followed by the deployment of the survey tool to all 120 accredited U.S. NAEPs. This was accomplished by

using college and university websites, and the NAEP accreditation list from the Council on Accreditation of Nurse Anesthesia Educational Programs (COA). This list of all accredited NAEPs is publicly available from the COA website, and includes additional contact information for each program. The goal of the sampling methodology was one response from each accredited U.S. NAEP, but programs were not precluded from sending more than one response.

This chapter will review the study data collection and preparation, the survey response rate and distribution, and detail the descriptive data collected about the responding NAEPs. A data analysis section will follow, reviewing the variables and statistical analysis used in the study to address the resolution of the research questions. The answers to the research questions combined to: (a) establish the ability of U.S. NAEPs to significantly increase graduate anesthetist production with NO increase in constraining critical resources; (b) identify the perceptions of U.S. NAEPs regarding critical resources that can act as a constraint upon the production of graduate nurse anesthetists; (c) establish the relative importance of identified critical resource constraints; (d) explore the possible correlation of critical resource constraint importance with NAEP characteristics; and (e) explore critical resource constraints not addressed by the study.

### **Data Collection/Preparation**

The study protocol was qualified for exemption from full institutional board review, at both Virginia Commonwealth University and Marian University, in accordance with U.S. Department of Health and Human Services (DHHS) federal regulation 45 CFR 46.101(b), category 2 (U.S. Department of Health and Human Services, 2013). The validated survey tool, email invitation and email reminder, permitted recruitment methods and subsequent contact methods were contained within the IRB-approved methodology. This included email scripts (invitation and reminder emails) and telephone scripts, which can be found in appendices C, D and E.

The email invitations were sent out to all 120 accredited U.S. NAEPs using the combined contact information obtained from program websites and the COA accredited program list. The overall respondent list was divided and grouped in major U.S. census regions (U.S. Census Bureau, 2015), herein called the West, Midwest, Northeast and South. These divisions are detailed in Table 12, with state names denoted using the U.S. Postal Service two-letter abbreviations (U.S. Postal Service, 2011). The District of Columbia is included in this table, as well as the commonwealth of Puerto Rico.

Table 12

*Major U.S. Census Regions*

WEST	AK, AZ, CA, CO, ID, HI, MT, NM, NV, OR, UT, WA, WY
MIDWEST	IA, IL, IN, KS, MN, MI, MO, ND, NE, OH, SD, WI
NORTHEAST	CT, MA, ME, NH, NJ, NY, PA, RI, VT
SOUTH	AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, PR, SC, TN, TX, VA, WV

The email invitation was sent out with the following goals: (a) to function as an alert for the upcoming survey; (b) to introduce the study, its purpose and personnel/institutions involved; (c) to inform potential respondents of the Qualtrics® survey technology used, and its data safeguards; (d) to inform how confidentiality of responses would be maintained by collapsing data into U.S. census regions; and (e) to include a statement acknowledging consent and proper personnel inclusion indicated by successful survey completion. Within four days, the survey itself was deployed to the same email addresses used in the original invitation. A brief preamble restated the study purpose, data security provisions and provided a repeated assurance of



confidentiality. A separate statement assured the freedom to opt out at any point before or during the survey. The final survey tool is included in Appendix B.

After a 2-week period of survey distribution, an email reminder about the survey was sent to all the original addressees in the email database. The email reminder script included instructions to be used by a NAEP to prevent any further contact regarding the survey. Only one program utilized this option throughout the entire data collection period. After a 4-week period had passed since survey deployment, a list of non-responding and low-responding states was compiled. Phone contact with program administrators or administrative assistants of these states and NAEPs was pursued with the use of the approved telephone script. A final note of appreciation was sent to the email database addressees once the survey was closed. The total length of survey deployment was 36 days.

Survey data was exported directly from the Qualtrics® platform into IBM SPSS Statistics 24. Most of the survey items were labeled as categorical variables in the database, with the exception of free text items. Variable names were checked and shortened where applicable. The data was inspected for accuracy, missing items or outliers. Seven responses were eliminated due to the percentage of responses recorded being excessively low, which did not reasonably allow the imputation of response means to missing items. All the remaining survey responses were complete, with the exception of numerous deferrals to write in the last free text survey question: this question asked the respondent to identify any areas of critical resource constraint not addressed by the survey tool.

### **Overall Survey Response Rate**

According to the power analysis conducted, responses from 56 out of 120 NAEPs were required to detect a binary outcome difference of 30% in two populations, given a significance

confidence level of  $\alpha = 0.05$ , and a power, or  $(1-\beta) = 0.80$ . Total survey responses received were 84, with the caveat that NAEPs were allowed to respond more than once. Program responses were completed by an anonymous web link embedded in the email invitations via the Qualtrics® software. It was possible, however, to note the GPS location of the IP address connected to the individual responses. Putting the location data together with key descriptive characteristics (private vs. public status, degree conferred, number in recent graduating class) allowed for presumptive identification of programs. When a program was in close proximity to another geographically without a clear delineation via the descriptive characteristics, it was grouped as the same NAEP, rather than as distinct programs. Utilizing this method, responses were received from 69 total NAEPs, conservatively speaking. This is a survey response rate of 57.5%, which is consistent with past response rates from the population of NAEP administrators (Gerbasi, 2014). This response rate and correlated power analysis showed that the study is adequately powered with results that are valid to interpret.

### **Regional Survey Response Rate**

Program responses will be detailed in U.S. census region descriptions and tables within this section. Overall, the distribution of the responding states was well dispersed with only four states not responding, representing a total of four NAEPs. These states were North Dakota, Iowa, Arkansas, and West Virginia. The Commonwealth of Puerto Rico also did not respond, representing a total of three programs. In the case of Puerto Rico, a very significant mitigating factor is the severe blow dealt to the island by Hurricane Maria on September 20, 2017, during the survey study period (Rothman, 2017). Other tropical storms and hurricanes preceding Maria made some impact on Puerto Rico as well. By some estimates the entire power grid of Puerto

Rico was destroyed with Maria’s impact, along with considerable infrastructure and supply destruction (Ferré-Sadurní & Hartocollis, 2017).

**The West.** In the major U.S. census region known as the West, there are a total of 13 states, including Alaska and Hawaii. However, there are eight states in the West that do not have NAEPs. The remaining five states have a total of 10 NAEPs. Western states without programs are Alaska, Colorado, Idaho, Hawaii, Montana, New Mexico, Nevada and Wyoming. Overall, the response rate for the West Region is 8 out of 10 programs, or 80%, as seen in Table 13 detailing the West Region survey response.

Table 13

*Program Survey Response: West Region*

STATE (WEST)	Programs Responding	Number of Programs
Arizona	2	2
California	3	5
Oregon	1	1
Utah	1	1
Washington	1	1
	<i>Total of 10 programs</i>	<i>8 states with no NAEP</i>

**The Midwest.** In the major U.S. census region known as the Midwest, there are a total of 12 states. There are no states in the Midwest that do not have nurse anesthesia education programs. North Dakota and Iowa NAEPs did not respond to the survey, and each of these states has one program. These non-responding programs received the two-week email reminder, as well as the phone call reminders about the survey request. Overall, the program response rate in the Midwest was 19 out of 36 programs, or 52.8%, as seen in Table 14 detailing the region’s survey response rate.

Table 14

*Program Survey Response: Midwest Region*

STATE (MIDWEST)	Programs Responding	Number of Programs
Illinois	2	5
Indiana	2	2
Kansas	1	2
Minnesota	1	4
Michigan	2	5
Missouri	3	4
Nebraska	2	2
Ohio	3	7
South Dakota	1	1
Wisconsin	2	2
	<i>Non-responding states = 2 ND, IA (for a total of 2 programs)</i>	<i>8 states with no NAEP Total of 36 programs</i>

**The Northeast.** In the major U.S. census region known as the Northeast, there are a total of 9 states. There are two states in the Northeast that do not have NAEPs; they are Vermont and New Hampshire. All states with NAEPs in this census region responded to the survey invitation. However, Pennsylvania has a comparatively high volume of NAEPs, with a total of 12 programs. Multiple areas of that state without a survey response did receive phone call reminders in addition to the two-week email reminder, with a modest increase in the total response. Two other states that were non-responders participated after receiving one phone reminder per program. Overall, the program response rate in the Northeast was 16 out of 27 programs, or 59.3%. This data can be seen in Table 15, which details the Northeast Region survey response rate.

Table 15

*Program Survey Response: Northeast Region*

<b>STATE (NORTHEAST)</b>	<b>Programs Responding</b>	<b>Number of Programs</b>
Connecticut	3	4
Massachusetts	1	2
Maine	1	1
New Jersey	2	2
New York	2	4
Pennsylvania	6	12
Rhode Island	1	2
	<i>Total of 27 programs</i>	<i>2 states with no NAEP</i>

**The South.** In the major U.S. census region known as the South, there are a total of 16 states, plus the District of Columbia (D.C.) and the U.S. territory of Puerto Rico. The District of Columbia and Puerto Rico will be called ‘states’ within the table for this section even though that is not the case, for simplicity. There are two states within the South Region that do not currently have NAEPs; Delaware and Oklahoma. The non-responding states of West Virginia and Arkansas received the two-week email reminder, as well as the phone call reminders about the survey request. This did not change their non-responder status. Additionally, the phone call reminders were employed in the low response state of North Carolina, with improved participation after telephone contact (two of six programs responded after the phone call reminder). Overall, the program response rate in the South was 55.3%, even with the inclusion of the Puerto Rican NAEPs. These programs in Puerto Rico were assumed to be physically unable to complete the survey due to the effects of a catastrophic hurricane on communications capability and the power grid of the entire island. Table 16 details the South region’s survey response rate.

Table 16

*Program Survey Response: South Region*

<b>STATE (SOUTH)</b>	<b>Programs Responding</b>	<b>Number of Programs</b>
Alabama	1	2
District of Columbia	1	1
Florida	5	9
Georgia	1	2
Kentucky	1	2
Louisiana	1	2
Maryland	2	2
Mississippi	1	1
North Carolina	2	6
South Carolina	2	2
Tennessee	5	6
Texas	2	5
<b>Virginia</b>	2	2
	<i>Non-responding states = 3 WV, AR, PR (for a total of 5 programs)</i>	<i>2 states with no NAEP Total of 47 programs</i>

This evaluation of the geographic spread of the survey response rates compares very favorably to the overall response rate of the survey. The regional average response rate for NAEPs = 61.1%, as compared to the overall NAEP response rate of 57.5%. This indicates that the overall response rate is well represented in each census region. This is an important aspect of the external validity of the study. One potential concern is the relatively low number of NAEPs overall in the West Region. This is due to the high number of states in the region with no NAEP, and the fact that the majority of the western states have only one program each (three out of

five). This could lead to concerns regarding statistical validity within the geographical covariate analysis of the West Region if cell counts are below five cases.

### **NAEP Respondent Descriptive Data**

Section I of the survey tool collected descriptive data about the responding program's characteristics. These characteristics were used to understand the responding NAEP's demographic profile, but served also to differentiate program identity for calculations, as well as functioning as covariates to be used in later statistical analysis. These characteristics fall into the following categories: (a) geography; (b) public vs. private funding orientation; (c) clinical site competition status; (d) urban vs. rural location; and (e) entry-to-practice degree conferred.

Figure 20 shows Section I of the critical resource survey tool used in this study.

**SECTION I**

*Please respond to the following questions regarding NAEP characteristics. These NAEP characteristics will be correlated with identified critical resources and their relative importance.*

1. Within what state is your NAEP located? \_\_\_\_\_
2. Is your NAEP housed in a public or private institution?
  - a. Public
  - b. Private
3. Is there competition from other anesthesia learners for your clinical sites?  
*(You may select more than one option)*
  - a. Other nurse anesthesia students
  - b. Anesthesia physician residents
  - c. Anesthesiologist assistant students
4. Would you characterize your NAEP location as primarily urban or rural?
  - a. Urban
  - b. Rural
  - c. Combination

*Note: an urban area is defined here as containing at least 50,000 people in a centralized area.*

5. Is your entry-to-practice NAEP conferring a masters or doctoral degree upon program completion?
  - a. Masters
  - b. Doctoral

Figure 20: Survey Section I

This section of the chapter will detail the descriptive data collected about the responding NAEPs within these categories. Geographical distribution has already been detailed in the preceding section, but Table 17 provides a visual summary of the distribution of the states responding to the survey deployment.

Table 17

*Non-Responder States (Blue) and States with No NAEP (Red)*

WEST	AK, AZ, CA, CO, ID, HI, MT, NM, NV, OR, UT, WA, WY
MIDWEST	IA, IL, IN, KS, MN, MI, MO, ND, NE, OH, SD, WI
NORTHEAST	CT, MA, ME, NH, NJ, NY, PA, RI, VT
SOUTH	AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, PR, SC, TN, TX, VA, WV

**Institution type: private vs. public.** The basic funding mechanism of the educational institution that houses a NAEP can impact the financial resources available to the program in multiple ways. This orientation can also have financial implications for the students attending the program, as private institutions regularly charge higher tuition and fee rates. At times this tuition and fee structure can further challenge the financial health of the program by limiting the student applicant pool. The challenges in each setting are diverse in origin, and have been detailed in Chapter Two. Funding challenges must be met in order to have a program of excellence. Methods to address budget and resource shortfalls in privately and publicly funded institutions can employ both similar and unique strategies, but both require planning for contingencies. The majority (57.1%) of the responding NAEPs were housed within privately



funded institutions, and 42.9% resided in publicly funded institutions. Figure 21 shows this covariate distribution.

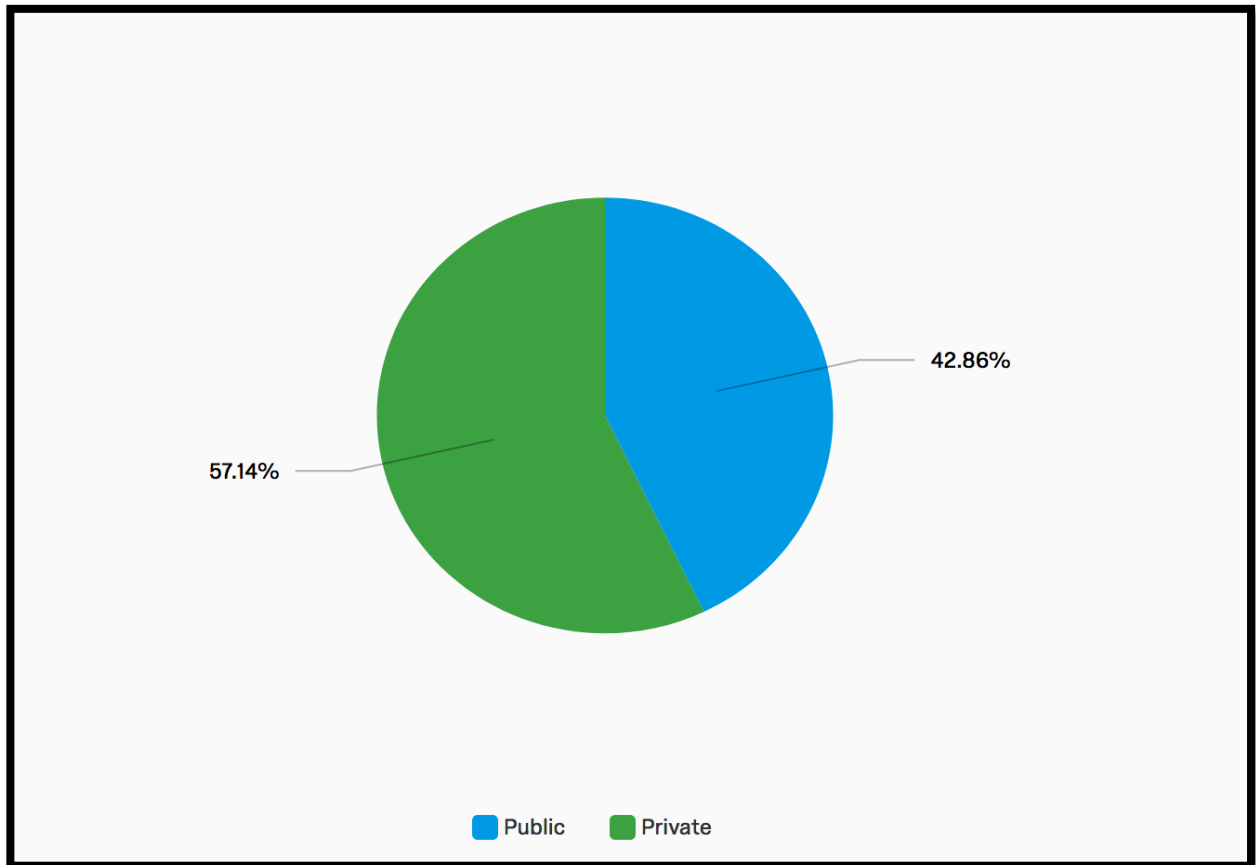


Figure 21: NAEP Institutional Type – Public vs. Private

**Shared clinical sites.** Within a program designed to produce advanced practice registered nurses, clinical sites are a basic critical resource. This resource area can be a major source of constraint upon a NAEP, as found in the past (Jordan, 2017; Oullette et al., 2002). Student nurse anesthetists have a matrix of mandatory case minimums to complete to sit for board certification after graduation. NAEPs must demonstrate to the nurse anesthesia accrediting body (the COA) that clinical rotations will provide this mandatory minimum case mix for the number of students in a requested cohort size. There are two other anesthesia provider types with the need for clinical learners to have anesthesia rotations also: anesthesiologists (MDAs) and anesthesiologist

assistants (AAs). Competition for cases can significantly limit the number of learners a clinical site can reasonably support, especially in specialty cases and procedures. Figure 22 shows the frequency of competition for clinical sites within the responding NAEPs, including a breakdown of learner types competing for clinical cases.

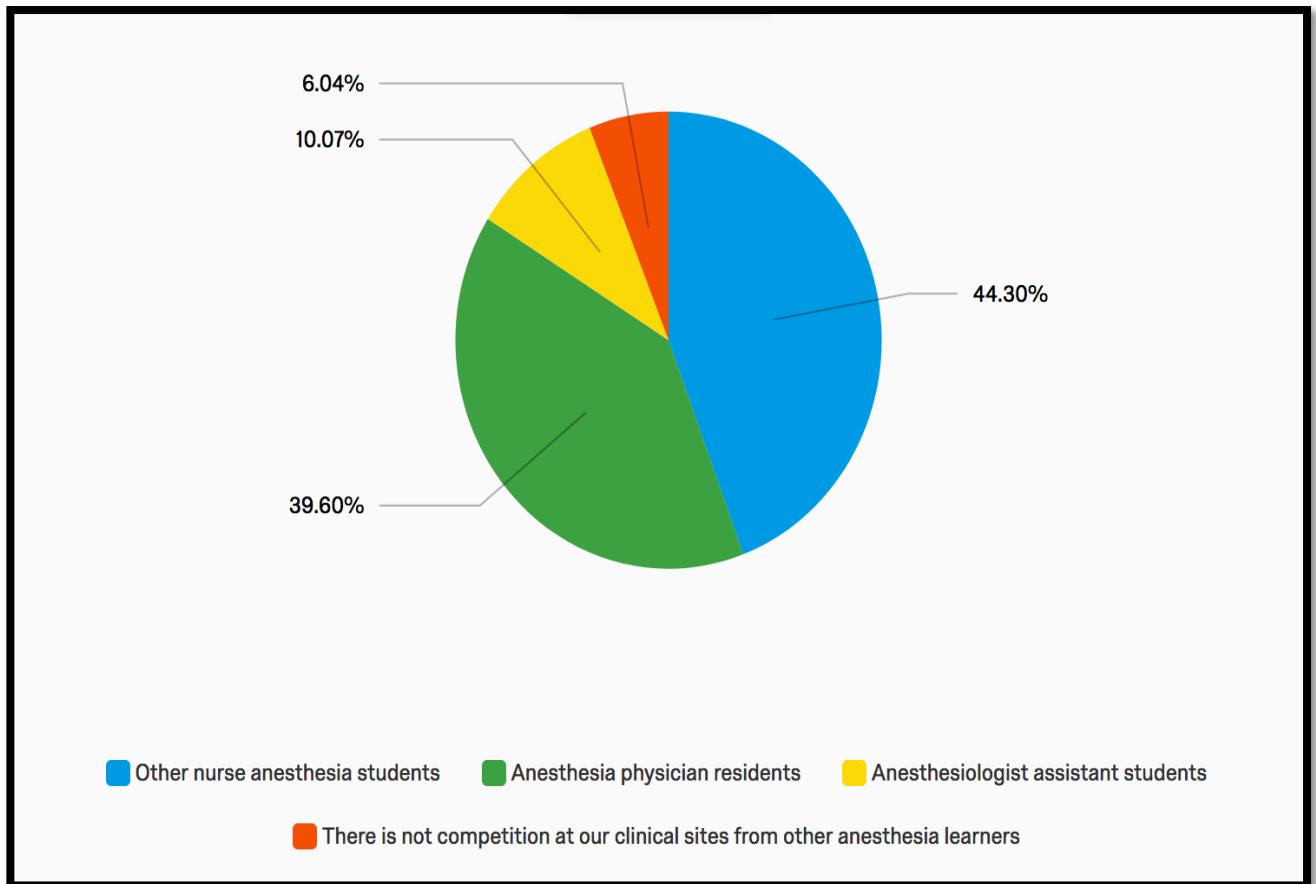


Figure 22: Clinical Site Competition for NAEPs

Respondents could select more than one option within this answer set, as many clinical education sites have diverse sets of learners. Only 6% of responding programs stated there was no competition from other anesthesia learners at clinical sites. Competition from AA students was the next lowest frequency event, affecting 10.1 % of responding programs. It is reasonably expected that sites with more than one type of anesthesia learner is a critical resource constraint

of some significant concern for NAEPs. Table 18 includes other frequencies of note regarding clinical site competition in the responding NAEPs.

Table 18:

*Clinical Site Competition Frequencies*

NAEPs with competition from other nurse anesthesia students	44.3%
NAEPs with competition from anesthesia residents	39.6%
NAEPs with competition from both nurse anesthesia students and anesthesia residents	71.4%
NAEPs with competition from all three anesthesia learners	11.9%

**Urban vs. rural.** There are many definitions of urban and rural classification of geographical areas. The definition of an urbanized area from the U.S. Census Bureau was chosen for this study, described as a centralized area with at least 50,000 inhabitants (2010). Rural areas are thus defined as any other location or territory with a lower population figure than 50,000 in one defined location. This definition was included in the survey item requesting the NAEP to choose an urban or rural designation, in order for the responding program to have a common frame of reference.

There are NAEPs that have more than one campus site, and an even greater number of NAEPs have more than one clinical site. These programs then have the possibilities of being designated as urban, rural or mixed. To allow a choice that fit all possible respondent possibilities, a ‘combination’ answer option was included in this survey item. Urban and rural healthcare systems have unique needs and constraints, and presumably differing access to resources needed for NAEP students. Figure 23 shows the frequency of urban vs. rural classification within the responding NAEPs.

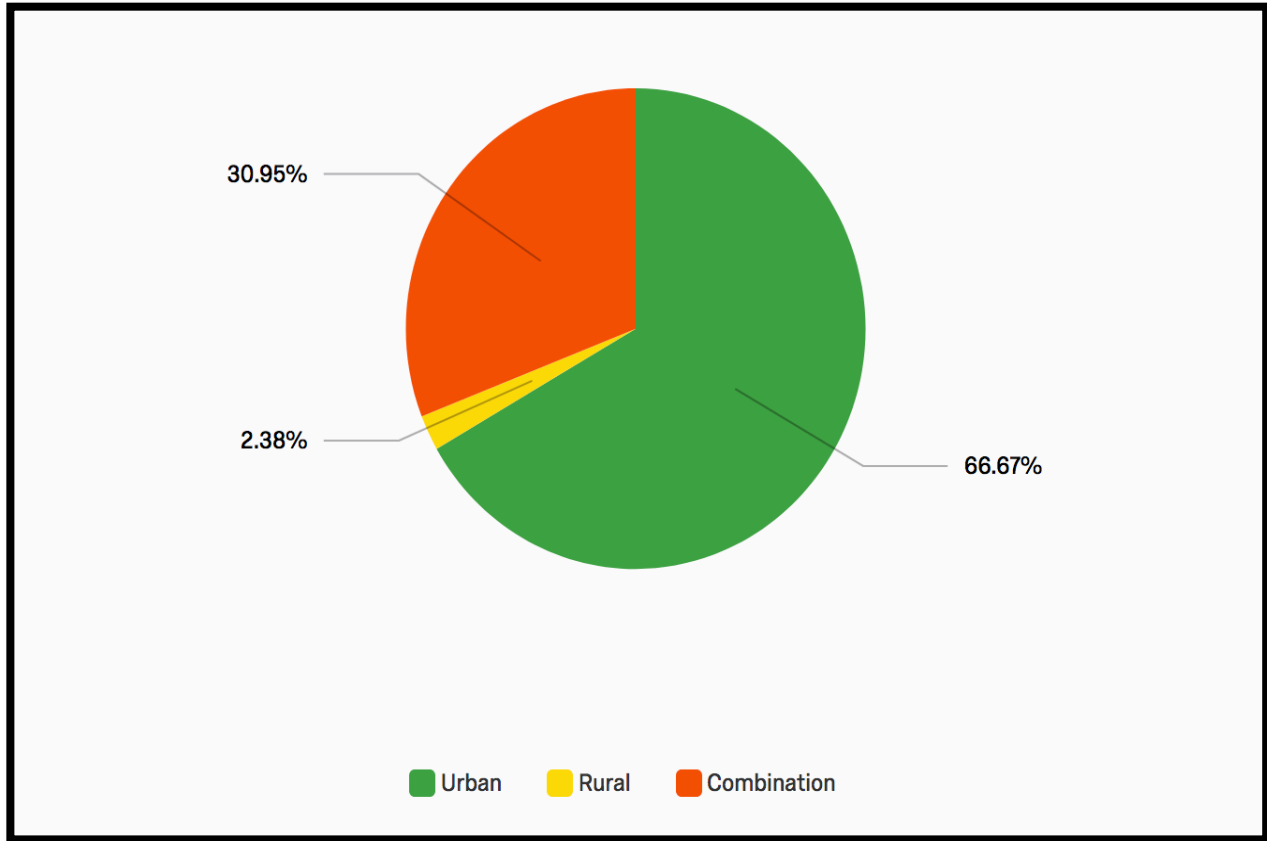


Figure 23: NAEP Institution Setting: Urban vs. Rural Classification

**Entry-to-practice degree.** The specialty of nurse anesthesia has adopted the goal of transitioning the minimum entry-to-practice degree from the current masters level to the clinical or practice doctorate level. This transition has been endorsed by the professional organization for nurse anesthesia (AANA), the certification body for nurse anesthesia (NBCRNA) and the COA, the accrediting body for NAEPs. Doctoral transition is to be complete by the year 2025, with programs of education having a three-year minimum course of study. To accomplish these goals, the COA has mandated that all NAEPs must transition their entry-to-practice degree to the doctoral level by January 1, 2022 (Sanders, 2014). This is an important milestone for NAEPs and it is rapidly approaching. There are multiple steps involved in making this transition, and it often involves regional accreditors of higher education as well as the COA specialty body. The

mandate for doctoral education imposes extra demands on critical resources in multiple areas for a program, including faculty and financial resources. Figure 24 illustrates the frequency of entry-to-practice degree offerings among the responding NAEPs.

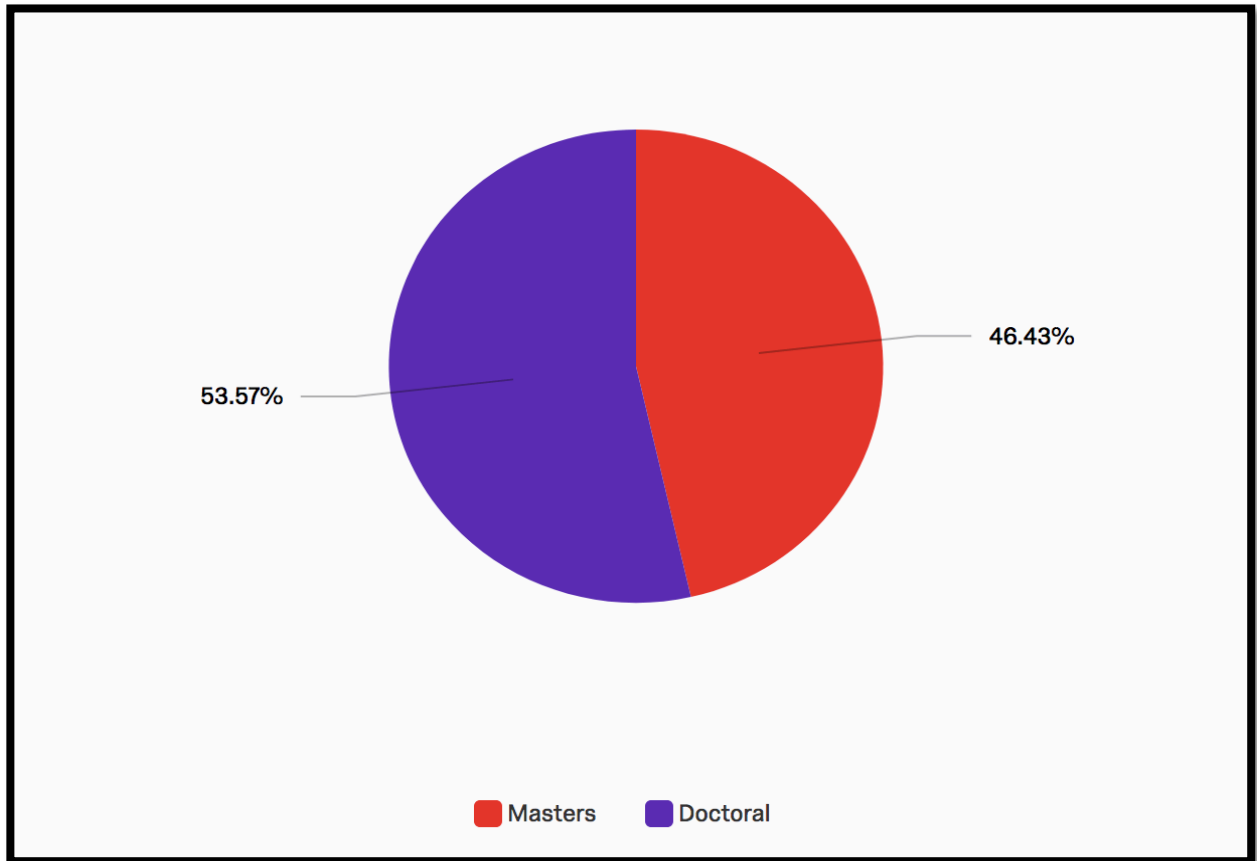


Figure 24: NAEP Respondents Entry-to-Practice Degree

This recorded frequency is in concurrence with the latest statistic from the COA on the percentage of NAEPs in the country that have completed the transition to doctoral entry-to-practice degrees. The most recent update (September 7, 2017) on the COA website has a total of 62 NAEPs in the U.S. that are approved to offer entry-to-practice doctoral degrees (COA, 2017). This represents 51.7% of the U.S. NAEPs, as compared to the figure of 53.6% found for responding programs in this study. This speaks to the representativeness of the sample of programs that responded to this research inquiry.

## Data Analysis

**Numeric variables.** There are only two variables of a continuous nature collected in the survey tool. The first, called ACT, is the number of actual graduates produced by the responding NAEP in the most recent graduating class. The second is called POT, and is the maximum number of graduates the responding NAEP could potentially produce, given *no increase* in the program's critical resources within the four IV domains. The figures for each responding program was used to calculate a mean graduate production per U.S. NAEP within both the ACT and the POT variable categories. The range of ACT responses was from 7 to 105 actual graduates. The range of POT responses was from 10 to 111 potential graduates. The two means will be analyzed for a statistically significant difference.

**Independent variables.** There were four independent variable (IV) domains in the analysis. Each IV domain was composed of five – six separate survey items, incorporating resource dependency theory (RDT) construct linkages among the individual predictor items. These predictors comprised a categorical scale within each IV domain, and were collected from Section II of the survey tool. The respondents were asked to categorize each survey item as a resource constraint, or not a resource constraint, to the increased production of graduates from the NAEP. “No” answers were coded as a 0, and “Yes” answers were coded as a 1 in the data file. Likert-type scale data was used for rank ordering of predictors within IV domains. Tables 19 – 22 will appear sequentially in order to summarize these predictors within the four IV domains: Clinical; Student/Applicant; Faculty; and, Financial. These abbreviations will be used in data tables. First displayed is Table 19, which shows the abbreviated IV predictor items correlated with the shortened survey item text that appeared in the actual Qualtrics ® survey that responding NAEPs utilized.

Table 19

*Clinical Resources IV Domain (CLIN)*

<b>Abbreviation</b>	<b>Shortened Survey Item Text</b>
CLIN-sites	Total number of clinical sites available to your program
CLIN-preceptors	Total number of clinical preceptors available to your program
CLIN-cases	Availability of specialty cases (peds, obstetrics, open heart, etc.)
CLIN-techniques	Availability of specialty techniques (regional, spinal, epidural, etc.)
CLIN-procedures	Availability of specialty procedures (central lines, fiberoptic devices)
CLIN-comp	Competition from other clinical anesthesia learners

Table 20 shows the abbreviated IV predictor items correlated with the shortened survey item text that appeared in the actual Qualtrics ® survey that responding NAEPs utilized.

Table 20

*Student/Applicant Resources IV Domain (STU)*

<b>Abbreviation</b>	<b>Shortened Survey Item Text</b>
STU-icu	Availability of high acuity critical care experience
STU-comp	Competition from other regional NAEPs for students/applicants
STU-coa	Ability of applicants to meet COA minimum requirements
STU-naep	Ability of applicants to meet NAEP-specific requirement
STU-cost	Ability of applicants to manage financial demands of NAEP attendance
STU-repay	Availability of debt relief programs from regional employers

Table 21 shows the abbreviated IV predictor items correlated with the shortened survey item text that appeared in the actual Qualtrics ® survey that responding NAEPs utilized.

Table 21

*Faculty Resources IV Domain (FAC)*

<b>Abbreviation</b>	<b>Shortened Survey Item Text</b>
FAC-doc	Availability of adequate number of doctoral faculty members
FAC-load	Required academic teaching load (disincentive)
FAC-salary	Salary differential b/w clinical and academic practitioners (disincentive)
FAC-recruit	Availability of adequate NAEP faculty recruitment incentives
FAC-retain	Availability of adequate NAEP faculty retention methods

Finally, table 22 shows the abbreviated IV predictor items correlated with the shortened survey item text that appeared in the actual Qualtrics ® survey that responding NAEPs utilized.

Table 22

*Financial Resources IV Domain (FIN)*

<b>Abbreviation</b>	<b>Shortened Survey Item Text</b>
FIN-budget	Adequate institutional budgetary support
FIN-services	Cost of student services
FIN-funding	Competition for federal/state/private funding
FIN-grants	Competition for research or grant funding
FIN-costDNP	Cost of moving to the doctoral entry-to-practice degree



**Dependent variable(s).** The dependent variable in this study was both embedded in the IV predictor choices and examined as a distinct and separate variable. The embedded dichotomous choice (Resource Constraint) within Section II of the survey tool was the respondent's classification of 22 predictor items as a resources constraint ("Yes" = 1), or not a resource constraint ("No" = 0). The distinct dependent variable was called "Program Constrained" and was also dichotomous as required by the planned statistical analysis. If NAEP production is constrained by the supply of critical resources at its disposal, the DV was listed as "Yes" and coded in the data set as a 1. If NAEP production is not constrained by the supply of critical resources at its disposal, the DV was listed as "No" and coded in the data set as a 0. This binary classification was based on the calculation of potential change in the percentage of graduate production for each NAEP respondent. The calculation was accomplished for each program with the figures for the numeric variables of ACT (actual number of NAEP graduates) and POT (maximum number of potential NAEP graduates possible), leading to a production volume percent change figure for each program. All NAEP respondents able to increase graduate production by 15% or greater were classified as "No", or not constrained. All NAEP respondents not able to increase graduate production by at least 15% were classified as "Yes", or constrained.

This cut point is chosen based upon the projected losses in the main providers of the U.S. anesthesia workforce, CRNAs and anesthesiologists (MDAs), detailed in Chapter One. Both these provider workforces are projected to lose approximately 20% of the current workforce in the coming decade (AANA, 2016e; Daugherty, et al., 2011; Fields, 2011). This demographic decrease in the workforce has been consistently forecast, while the projected increases in the demand for anesthesia healthcare delivery has varied to a greater degree. Using only the CRNA

workforce loss projections, the U.S. needs an increase in the production of anesthesia providers by 20% over the coming years to meet only the static needs of anesthesia provider supply. This is the basis for the conservative selection of 15% as a cut point in graduate production increase in determining whether a NAEP is classified as constrained.

The descriptive data detailed earlier regarding the characteristics of the responding NAEPs will also be used in the analysis as covariates. These covariates will be: U.S. geographical region, institution type (public vs. private), clinical site competition, institution setting (urban vs. rural location), and entry-to-practice degree (masters vs. doctoral).

### Research Questions

**Research question 1.** Can currently accredited NAEPs expand the production of graduate CRNAs with no change in potentially constraining resource levels? The answers to the first two items in survey Section III were tabulated in the SPSS data file under the numeric variable names previously described as ACT and POT. A paired-samples *t*-test was used to calculate the mean number of U.S. NAEPs for ACT and POT, and these means were compared. This analysis shows a statistically significant difference between the means of the ACT (mean= 23.69, SD=15.18) and POT (mean=28.54, SD=16.78) variables, with  $t(83)$  and a  $p < 0.001$ . This result suggests that overall, the responding U.S. NAEPs *can* significantly increase the production of graduates, given no concurrent increase in the level of critical and potentially constraining resources. The SPSS descriptive and test output for this analysis is seen in Table 23 and 24.

Table 23

#### *Paired Samples Descriptive Statistics*

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	ACT	23.69	84	15.181	1.656
	POT	28.54	84	16.777	1.830

Table 24

*Paired Samples Test: Paired Differences*

							t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	ACT - POT	-4.845	5.861	.639	-6.117	-3.573	-7.577	83	.000

**Research question 2.** What is the relative importance of resource constraints to NAEP capacity, in four areas of critical resource levels (IV domains)? This research question was answered by survey response data within Section II. An analysis was conducted utilizing logistical regression, and was conducted with both the distinct DV (Program Constrained) and the embedded DV (Resource Constraint). Assumptions testing, necessary variable transformation and tests for multicollinearity were conducted prior to the logistic regression analysis. A standard regression was the procedure selected, in keeping with the function of an exploratory study. No suppositions were in place regarding the relative importance of the IV items and so all IV items were entered into the procedure at the same step. All IV predictors that were found to be significant were placed in rank order by utilizing the Likert-type scale scoring chosen by NAEP respondents in follow-up survey questions.

**Full model logistic regression.** A standard logistic regression was conducted using the full set of 22 IV domain predictors against the *distinct DV*, “Program Constrained”. This regression was not statistically significant as compared to a constant only model ( $\chi^2 = 32.057$ ,  $df = 22$ ,  $p = 0.076$ ). Classification prediction was improved from the constant only model (55.4%) to the full model (74.7%). Nagelkerke’s  $R^2$  showed that the full model explained 52.9% of the variance in

the distinct DV (Program Constrained). There were no items with statistical significance at the 0.05 level for Wald statistic calculation. Beta weights indicated the following indicators had the most influential associations with the DV Resource Constraint, in descending order:

- Clinical Resources: CLIN-techniques, CLIN-comp, CLIN-procedures
- Student Resources: STU-coa, STU-comp, STU-icu
- Faculty Resources: FAC-doc, FAC-retention
- Financial Resources: FIN-budget, FIN-costDNP, FIN-services

In order to assess the *embedded DV* of Resource Constraint, standard logistic regressions were conducted using each IV predictor as a DV, against all other 21 IV predictor items. Using this procedure, the relationship among the IV predictors was assessed, and the most influential resource constraints on NAEP production were determined. The regressions were statistically significant as compared to a constant only model in each case. A representative case has the following details: using CLIN-comp as the DV against the full model of the remaining 21 IV predictors, the model was statistically significant ( $\chi^2 = 94.159$ ,  $df = 22$ ,  $p < 0.001$ ). The model explained 91.5% (Nagelkerke's  $R^2$ ) of the variance in Resource Constraint, and correctly classified 96.4% of the cases. Beta weights indicated the following indicators had the most influential associations with the DV Resource Constraint, in descending order:

- Clinical Resources: *CLIN-comp*, *CLIN-techniques*, *CLIN-procedures*, CLIN-cases
- Student Resources: *STU-comp*, STU-repay
- Faculty Resources: FAC-salary, *FAC-retention*
- Financial Resources: *FIN-budget*, *FIN-costDNP*

These predictors emerge repeatedly as the most influential as classified by beta weight value across the 22 iterations of this logistic regression for Resource Constraint (predictors listed in

italics are those in common with the first full model logistic regression). Wald statistic calculations were not consistently significant at the significance level of 0.05 for most of these listed influential predictors. The exceptions were CLIN-cases (0.04) and STU-repay (0.05).

***IV domain regressions.*** All IV domains were examined independently, to assess the relationship of the individual predictor items within each domain, and establish their relative importance. The DV employed in these analyses is the embedded Resource Constraint, since the survey answers directly affected the predictor item tabulations of “Yes” and “No” in the dataset.

The clinical resources IV domain was assessed with standard logistic regressions using each IV predictor within the domain of Clinical Resources as a DV, against all other 5 IV predictor items. Each logistic regression in the Clinical Resource IV domain was statistically significant as compared to a constant only model. In a representative case, the DV CLIN-comp was used against the full model of clinical resource predictors. This regression was statistically significant ( $c^2 = 74.136$ ,  $df = 6$ ,  $p < 0.001$ ). The model explained 79.6% (Nagelkerke’s  $R^2$ ) of the variance in the embedded DV Resource Constraint, and correctly classified 91.6% of the cases. Among all 6 regressions, beta weights indicated the following predictor items had the most influence within this category: CLIN-cases, CLIN-techniques, CLIN-procedure and CLIN-comp. Wald statistic computations were statistically significant for CLIN-cases (0.05), CLIN-techniques (0.04) and CLIN-comp (0.05).

The student resources IV domain was assessed with standard logistic regressions using each IV predictor within the domain of Student Resources as a DV, against all other 5 IV predictor items. Each logistic regression in this IV domain was statistically significant as compared to a constant only model. In a representative case, STU-naep was used against the full model of student resource predictors. The regression was statistically significant ( $c^2 = 57.411$ ,  $df = 6$ ,  $p <$

0.001). The model explained 78.3% (Nagelkerke's  $R^2$ ) of the variance in the embedded DV Resource Constraint, and correctly classified 95.2% of the cases. Among all 6 regressions, beta weights indicated the following predictor items had the most influence within this category: STU-repay, STU-icu and STU-comp. Wald statistic computations were not significant for any predictor in this category.

The faculty resources IV domain was assessed with standard logistic regressions using each IV predictor within the domain of Faculty Resources as a DV, against all other 4 IV predictor items. Each logistic regression in the IV domain was statistically significant as compared to a constant only model. In a representative case, FAC-salary was used against the full model of student resource predictors. The regression was statistically significant ( $c^2 = 93.295$ ,  $df = 5$ ,  $p < 0.001$ ). The model explained 91.2% (Nagelkerke's  $R^2$ ) of the variance in the embedded DV Resource Constraint, and correctly classified 96.4% of the cases. Among all five regressions, beta weights indicated the following predictor items had the most influence within this category: FAC-doc, FAC-salary and FAC-recruit. Wald statistic computation was significant only for FAC-salary (0.04).

The financial resources IV domain was assessed with standard logistic regressions using each IV predictor within the domain of Financial Resources as a DV, against all other 4 IV predictor items. Each logistic regression in this IV domain was statistically significant as compared to a constant only model. In a representative case, FIN-costDNP was used against the full model of financial resource predictors. The regression was statistically significant ( $c^2 = 99.139$ ,  $df = 5$ ,  $p < 0.001$ ). The model explained 93.6% (Nagelkerke's  $R^2$ ) of the variance in the embedded DV Resource Constraint, and correctly classified 95.6% of the cases. Among all 5 regressions, beta weights indicated the following predictor items had the most influence within this category: FIN-

budget, FIN-grant and FIN-costDNP. Wald statistic computations were not significant for any predictor within this category.

**Likert-type scale scoring.** Within the main body of the survey tool (Section II), if a respondent indicated “Yes”, a predictor item was considered a resource constraint, a follow-up question populated which requested a Likert-type scaling response. Figure 27 is the Likert-type scale used for this follow-up question, which then ranked the importance of the resource constraint item under consideration.

<b>Rarely an important concern = 1</b>	<b>Occasionally an important concern = 2</b>	<b>An important concern = 3</b>	<b>Usually an important concern = 4</b>	<b>Always an important concern = 5</b>
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Figure 25: Likert-type Scale for Resource Constraint Importance

The predictor items consistently found as influential in the logistical regression analyses utilizing the embedded DV Resource Constraint were compared regarding the total number of “Yes” responses in survey Section II. The total number of Likert-type scale responses of 3, 4 and 5 class were then tabulated as the primary determinant of the rank order. These three Likert-type scale responses encompassed both the middle of the importance scale as well as the highest ranking portion of the scale.

Secondary importance was given to the total number of “Yes” responses in the case of equivalent Likert-type scale rankings. This produced a rank order of predictors in relation to their relative importance on the Likert-type scale information. There were 4 clinical predictor items, 4 faculty predictor items, 3 student predictor items and 3 financial predictor items. If a tie was present in the ranking between two items, concerning total “Yes” responses and high Likert-type scale responses, the item with the highest number of 3/4/5 Likert-type scale responses predominated. Observing these rules, Table 25 summarizes the rank order of these 14 items.

Table 25

*Likert-type Scale Scoring of IV Domain Predictors*

RANK	NUMBER OF “YES”	IV PREDICTOR	LIKERT	LIKERT
	RESPONSES		1/2	3/4/5
1	52	FAC-salary	4	48
2	58	CLIN-cases	13	45
3	41	FIN-costDNP	1	40
4	45	CLIN-procedures	8	37
5	43	FAC-recruit	9	34
6	37	FAC-doc	9	28
7	33	FAC-retain	5	28
8	30	CLIN-techniques	2	28
9	35	FIN-budget	8	27
10	34	CLIN-comp	8	26
11	31	STU-comp	9	22
12	25	STU-repay	10	15
13	14	FIN-grant	2	12
14	12	STU-icu	2	10

**Research question 3.** Are there differences in the relative importance of barriers to NAEP capacity related to geographical location of the NAEP? This program characteristic was collected with other descriptive data in the first section of the survey. The responses were divided into major U.S. census regions named the West, the Midwest, the Northeast and the



South. This was for simplicity, and also because trends in healthcare delivery and patient populations are often regionally driven coincident with changing demographics and market factors. The U.S. census regions used are seen in Figure 26.

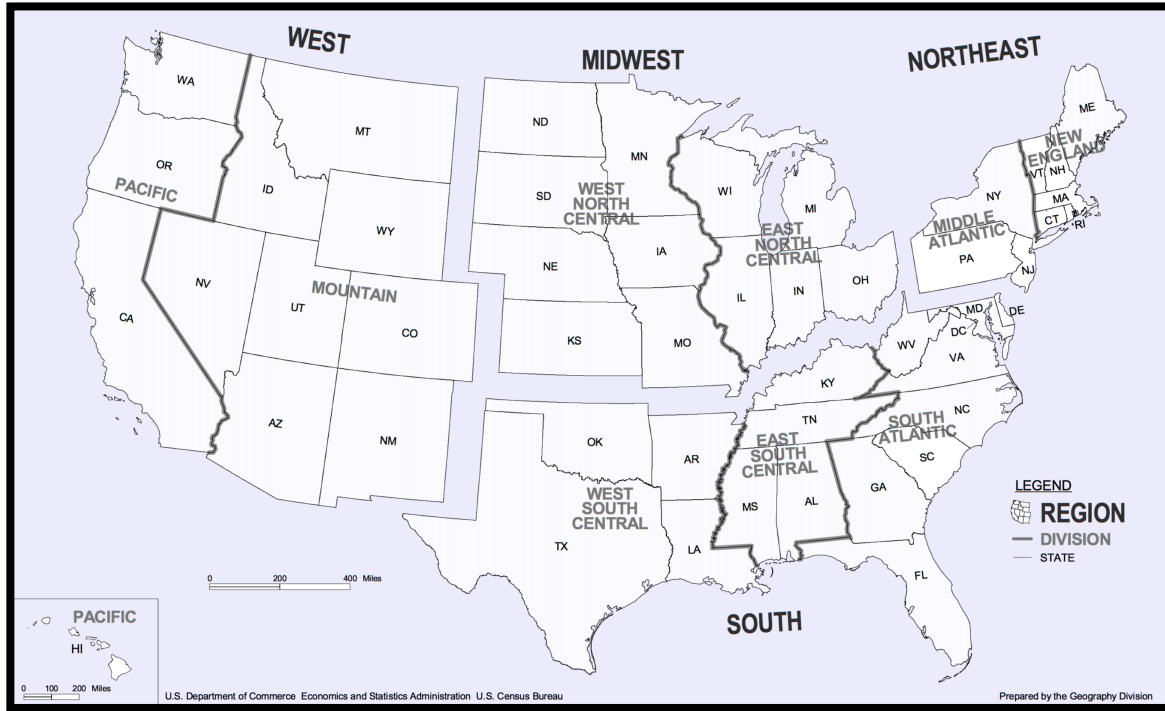


Figure 26: United States Census Bureau Geographic Regions

Source: The U.S. Census Bureau. (2015). *Census regions and divisions of the United States*. Retrieved from: [https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us\\_regdiv.pdf](https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf)

Cross tabulation with the predictor items within each IV domain yielded the following statistically significant relationships:

1. CLIN-techniques: Availability of specialty anesthetic techniques such as regional, spinal, and/or epidural anesthetics ( $\chi^2 = 11.05$ ,  $df = 3$ ,  $p = 0.011$ , 2-sided). This predictor was not seen as a significant resource constraint except in the South (13 No, 17 Yes). In all other census regions the “No” responses were in the majority, showing a regional difference. There are two cells in the contingency table that had counts of less than 5

cases, in the West and the Midwest regions; but only one of these was noted in the SPSS file due to the minimum expected count being exceeded in the Midwest region. SPSS output showing the regional responses and chi-square tests within this predictor are found sequentially below in tables 26 and 27.

Table 26

*Crosstab: Clinical Specialty Technique vs. Geographical Covariate*

		Region				Total
		West	Midwest	South	Northeast	
Availability of specialty anesthetic techniques is a constraint	No	8	21	13	12	54
	Yes	2	4	17	7	30
Total		10	25	30	19	84

Table 27

*Chi-Square Tests: Clinical Specialty Technique vs. Geographical Covariate*

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.054 <sup>a</sup>	3	.011
Likelihood Ratio	11.441	3	.010
Linear-by-Linear Association	3.890	1	.049
N of Valid Cases	84		
<i>a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.57.</i>			

2. FAC-load: This predictor was selected if the required academic instruction load was considered a disincentive, and thus a constraint on securing or retaining faculty. It is significant for this regional covariate chi-square analysis ( $c^2 = 8.903$ ,  $df = 3$ ,  $p = 0.031$ , 2-sided). Two regions perceived this predictor as a resource constraint, the South (12 No, 18 Yes) and the Northeast (8 No, 11 Yes) while the other two U.S. regions did not. There

was one cell with a count of less than 5, in the West region. This result represents a tentative regional difference. SPSS output in the sequential tables 28 and 29 show the regional responses and chi-square tests within this predictor.

Table 28

*Crosstab: Faculty Load vs. Geographical Covariate*

		Region				Total
		West	Midwest	South	Northeast	
The required academic teaching load for your institution is a constraint	No	9	15	12	8	44
	Yes	1	10	18	11	40
Total		10	25	30	19	84

Table 29

*Chi-Square Tests: Faculty Load vs. Geographical Covariate*

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.903 <sup>a</sup>	3	.031
Likelihood Ratio	9.861	3	.020
Linear-by-Linear Association	6.756	1	.009
N of Valid Cases	84		
<i>a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.76.</i>			

- CLIN-comp: Competition from other anesthesia learners. This was not a statistically significant correlation within the predictor ( $c^2 = 5.592$ ,  $df = 3$ ,  $p = 0.133$ , 2-sided). It is mentioned here due to the maintenance of a geographical pattern. As with the other geographical covariate correlations listed above, the South (13 No, 17 Yes) was a region showing a divergence from the other regional perceptions of constraint. No other region's responses showed a majority considered CLIN-comp a significant constraint.

The West region again had a cell count just below 5 cases.

**Research question 4.** Are there differences in the relative importance of barriers to NAEP capacity related to program characteristics of the NAEP? These program characteristics of the responding NAEPs are the descriptive covariates collected in survey Section I, described earlier in this chapter. Correlational analyses were conducted by the use of the cross tabulation function within the Qualtrics® survey platform, to discern any relationship between predictor survey items within the four IV domains and the NAEP covariate characteristics simultaneously. Testing for significant relationships was performed utilizing chi-square analysis.

Cross tabulation with all predictor items within each IV domain yielded the following statistically significant relationships with the covariate of Institutional Type (public vs. private):

1. CLIN-sites: Total number of clinical sites available ( $c^2 = 4.34$ ,  $df = 1$ ,  $p = 0.04$ ).  
Public institution NAEPs were more likely to perceive that total clinical sites available were NOT a resource constraint (24 No, 12 Yes); the private institution NAEPs were more likely to perceive that total clinical sites were *indeed* a resource constraint (21 No, 27 Yes).
2. STU-icu: Availability of high acuity critical care experience ( $c^2 = 3.92$ ,  $df = 1$ ,  $p = 0.05$ ). This predictor in the STU domain was NOT perceived as a resource constraint, by NAEPs in both the public and the private institutional setting; however, the differential was much greater for the public institutional NAEPs (34 No, 2 Yes) than for the private institutional NAEPs (38 No, 10 Yes).
3. STU-comp: Competition from other regional NAEPs for applicants ( $c^2 = 8.25$ ,  $df = 1$ ,  $p < 0.01$ ). This predictor in the STU domain was NOT perceived as a resource constraint by the public institutional NAEPs (29 No, 7 Yes), whereas the perception

was evenly split among the private institutional NAEPs (24 No, 24 Yes).

4. STU-coa: Ability of applicants to meet COA minimum standards ( $c^2 = 4.77$ ,  $df = 1$ ,  $p = 0.03$ ). This predictor in the STU domain was NOT perceived as a resource constraint, by NAEPs in both the public and the private institutional setting; however, the differential was much greater for the public institutional NAEPs (32 No, 4 Yes) than for the private institutional NAEPs (33 No, 15 Yes).

The remainder of the predictor items in the domains of CLIN or STU did not have a relationship with this covariate. No predictor items in the IV domains of FAC or FIN had a statistically significant relationship with the covariate of institutional type.

Cross tabulation with all predictor items within each IV domain yielded no statistically significant relationships within the covariate of Clinical Competition. This finding will be discussed further in Chapter Five. Prefacing that discussion, the lack of significance in this designed covariate analysis by no means conveys a lack of overall significance to the distinct IV predictor item of clinical site competition.

Cross tabulation with all predictor items within each IV domain yielded no statistically significant relationships for the covariate of Institutional Setting (urban vs. rural). It is worthwhile to note that the number of NAEPs classifying their programs in a purely rural setting is in the great minority, and all cells with only rural programs contain less than 5 cases. Only 2.4% of the NAEPs responding selected rural as their institutional setting. The remainder of the programs classified the institutional setting as urban or mixed.

Cross tabulation with all predictor items within each IV domain yielded the following statistically significant relationship within the covariate of Entry-to-Practice Degree (master's vs. doctoral):

1. FAC-recruit: the availability of adequate recruitment incentives ( $c^2 = 6.98$ ,  $df = 1$ ,  $p = 0.01$ ). This predictor in the FAC domain was seen as a resource constraint in NAEPs that offer the masters degree (13 No, 26 Yes). However, it was *not* seen as a resource constraint by NAEPs that offer the entry-to-practice doctoral degree (28 No, 17 Yes).

This was a statistically significant divergence for these two types of programs.

Among the other IV predictors there were no other significant relationships correlated with the covariate of entry-to-practice degree offering.

**Research Question 5.** What are potential barriers to NAEP capacity are not explicitly addressed in this survey? This was a qualitative open-ended question with white space for free text answers at the end of the last section of the survey tool. Table 30 displays the total counts and themes of the responses to this question from survey section III.

Table 30

*Other Areas of Potential Resource Constraint for NAEP Production*

Political difficulties within the clinical realm or with institutional administration	9
Access to clinical specialty cases	4
Lack of housing for students at distant clinical sites and/or travel costs	2
Willingness of clinical faculty to instruct students	1
Willingness of clinical sites to instruct junior students (new to clinical rotations)	1
Clinical sites charging a fee to the NAEP	1
Lack of affordable health care insurance for students	1
Disadvantages of rural student/applicants	1
Transition to doctoral education, in general	3
Lack of faculty for supervision of doctoral scholarly projects	3
Doctoral faculty shortage	2
Constraints related to issues with COA mandates	2
Lack of standardized student-faculty ration for doctoral NAEPs	1
Lack of institutional support for needed faculty development (doctoral studies tuition/stipend)	1

The respondents had an expansive field supplied for multi-faceted answer, if needed. The question text read: “What potential areas of resource constraint have not been addressed in this survey?”. Among the 84 survey responses that were recorded, 44 respondents entered text answers to this final survey item. Within these entered responses, 18 simply stated that he/she had no other areas of potential resource constraint to contribute. The other responses are grouped under main congruent themes, with some responses counted under more than one category.

### **Summary**

Chapter Four presented the findings of this research utilizing a validated survey tool to prospectively explore the relationships between IV predictors and covariates that affect the perception of critical resource constraints in U.S. NAEP administrators and faculty. The global objectives were: (a) to assess the ability of NAEPs to expand graduate production at current critical resource levels; (b) to establish useful associations with IV domain predictors for the DV outcome of resource and program constraint; and (c) to discover novel constraints not analyzed by this research. Survey response rate and descriptive characteristics were collected. A paired samples *t*-test was used to quantitatively assess graduate production capacity and expansion capability in the responding NAEPs. Logistic regression analyses were performed to determine the influence of 22 predictor items upon both an embedded and a distinct DV, “Resource Constraint” and “Program Constrained”, respectively. Likert-type scaling data was used to produce a rank order of predictor items found to be influential in relevant logistic regression analyses. Correlational analyses produced a view of NAEP characteristics acting as covariates upon the selection of critical resource constraints by U.S. NAEPs. Chapter Five will analyze the implications of the study results, discuss the limitations, and provide recommendations for future research in this topic.

## Chapter Five: Discussion

### Introduction

The healthcare delivery system of the U.S. is dynamic, and constantly evolving. Many issues are directly contingent upon this evolution. A few of the basic issues are the level of patient demand for healthcare services, patient access to the healthcare system, and the supply of healthcare providers who deliver the necessary care for the patient population. Demographic trends in the U.S. indicate a growing need for healthcare in an aging patient population. Concurrently, the country's demographics are affecting the supply of healthcare providers, primarily through anticipated retirement losses and geographical disparity in provider distribution (Musumeci, 2017; Liao, et al., 2015) .

Anesthesia care is a highly specialized portion of the healthcare delivery system, with three approved provider types in the workforce. The great preponderance of the workforce is made up of certified registered nurse anesthetists (CRNAs) and anesthesiologists (MDAs), with CRNAs comprising more than 50% of the actively practicing workforce in this country. Patient access to anesthesia care has been, and continues to be, a problematic factor in the U.S. healthcare delivery system (Migoya, 2017). Accredited NAEPs are the only source of new graduate nurse anesthetists eligible for national certification as CRNAs. The production capacity of U.S. NAEPs is critical to the healthcare delivery system to maintain the anesthesia workforce at acceptable levels. An analysis of critical and potentially constraining resources to these NAEPs was performed, with the goal of providing direction in resource planning and allocation.



This study evaluated critical resources (resource constraints) for U.S. NAEPs, their relative importance, and possible correlations with NAEP characteristics. The conceptual framework of Resource Dependence Theory (RDT) grounded the construction of the research tool. There is little literature exploring this topic, and none was found that utilizes RDT constructs in the research design. The most recently published research focused on the detailed exploration of barriers to achieving the minimum clinical requirements for student nurse anesthetists (Oullette, et al., 2002). To fill this void in the literature, the current research study has been conducted.

### **Summary of Findings**

**Respondent demographics.** Responses to the research survey tool deployment totaled 84, representing 69 U.S. NAEPs, for a total response rate of 57.5%. This response exceeded the sample needed (56 U.S. NAEPs) by the power analysis conducted for the planned statistical analyses. Descriptive characteristics collected for purposes of external validity and as covariates included geographical location, institutional type (public vs. private), clinical site competition, institutional setting (urban vs. rural) and entry-to-practice degree offered by the NAEP respondent.

The geographical coverage of the U.S. was nearly complete, with only four states and one U.S. territory not responding (Iowa, North Dakota, West Virginia, Arkansas and Puerto Rico). The descriptive characteristics of institutional type, clinical site competition and entry-to-practice degree offered demonstrated a large degree of heterogeneity in the sample, a favorable finding for the generalizability of the findings (Polit & Beck, 2012). The covariate of institutional setting (urban vs. rural vs. combination of rural and urban) was markedly skewed towards the urban and combination designations (97.6% of responses). Normally this would make statistical validity and generalizability for this covariate difficult. This distribution of respondent programs

however is in accord with the predominant urban location of NAEPs in the United States. Of note in the descriptive characteristics was the fact that only 6% of responding NAEPs did not experience competition for student cases at their clinical rotation sites: 71.4% experienced competition from both other student nurse anesthetists and anesthesia physician residents.

**Research question 1.** *Can currently accredited NAEPs expand the production of graduate CRNAs with no change in potentially constraining resource levels?* This research question was answered in a statistically significant way, via the use of a paired-samples *t*-test to compare the means of two numerical variables. ACT was the number of graduates in each program's most recent graduating cohort. POT was the maximum number of potential graduates each program reported it could produce with no change in critical resources. Calculations were completed within each variable including a comparison of the means. This result strongly suggests the responding U.S. NAEPs *can* significantly increase the production of graduates with no concurrent increase in the level of critical and potentially constraining resources.

The question this result raises is the cause of the disparity between the actual graduates produced and the maximum graduates possible. This question was not explored in the survey and is a notable limitation in the research design. Some of the possibilities for this disparity could include program didactic attrition, program clinical attrition, program attrition due to extraneous student factors (such as an extended illness), clinical restrictions, institutional or political strictures. It could very well represent a voluntary conservation of slack resources for strategic planning purposes. The reasons behind the differences in the means of ACT and POT may have both national and regional implications for the direction of education and professional organization actions and planning. This finding should be replicated and explored in more detail, to further understand its ramifications.

**Research question 2.** *What is the relative importance of barriers to NAEP capacity, in four critical areas of constraining resource levels?* The answer to this exploratory research question was pursued by the use of logistic regression analyses, utilizing both an embedded DV and a distinct DV. Independent variable domains consisted of four critical areas of constraining resource levels. These were Clinical Resources, Student Resources, Faculty Resources and Financial Resources. A total of 22 predictor items were developed within these four IV domains. The embedded DV was “Resource Constraint”. This binary variable was found in the “Yes/No” answers from survey respondents regarding their perceptions of the IV predictor items as resource constraints.

The distinct DV “Program Constrained” was also a binary variable, and was an exploration of a new measure of constraint in this research. The dichotomous classification of NAEPs as “Yes, constrained = 1” or “No, not constrained = 0” were arrived at numerically. The percent change in production possible for each NAEP was calculated from the figures for ACT and POT. Any NAEP not able to increase graduate production by at least 15% was classified as constrained. All other programs were classified as not constrained. This cut point was chosen as a conservative figure, based upon consistent estimates of losses in the anesthesia workforce in the near future. This rationale is expedient for the healthcare market’s need for anesthesia providers and is linked to the RDT constructs of complexity and uncertainty. All logistic regressions conducted using this exploratory distinct DV failed to reach statistical significance. This included the logistic regressions conducted for the full model of 22 IV predictors, and the separate IV domain logistic regressions. The lack of statistical conclusion validity shows that the exploratory DV construct is not without confounders. One likely source is the unexplained variance in the variables underlying its construction, the figures ACT and POT. As indicated

previously, this is a rich area for future research inquiries.

Logistic regressions were conducted using the embedded DV “Resource Constraint” against the full model of 22 IV predictors, as well as, the separate IV domains. These regressions were more statistically valid in the estimates of model significance, the DV variance explained and the correct classification of cases. There was a significant amount of congruence among all the models regarding influential predictors according to the calculated beta weights. This congruence produced 14 IV predictors that potentially possessed influence on the variance in the embedded DV. Computation of the Wald statistic yielded only 4 IV predictors with significance. These were: CLIN-cases, CLIN-techniques, CLIN-comp and FAC-salary.

The CLIN-comp predictor is an indication that competition for learning opportunities at clinical sites is a persistent concern of importance to the responding NAEPs. The major contributors to that competition level are other nurse anesthesia students and physician residents. At sites with AA students as well, competition for cases can be assumed to be quite fierce. This is especially true of specialty cases and specialty anesthetic techniques, the other two statistically significant IV predictors. This can be a major source of limitation to NAEP cohort size, and thus to the maintenance or expansion of the CRNA workforce. Specialty cases and specialty anesthetic techniques occur in less volume than other cases, as the patient population is more limited. Learner exposure to specialty techniques and specialty cases can also be limited by preceptor familiarity, departmental policy and politics, and available anesthesia equipment supplies. Viewed through the perspective of RDT, all of these aspects are dimensions of the munificence of the clinical environment. Additional survey questions under these IV predictors reveal the cases and techniques considered the most important resource constraints. These can be seen in Table 31, listing importance by total number of “Yes” responses.

Table 31

*Rank of Resource Constraints: Specialty Cases and Techniques*

RANK	SPECIALTY CASE OR TECHNIQUE	NUMBER OF “YES” RESPONSES
1	Open Heart	44
2	Thoracic	26
3	Regional/Peripheral Blocks	26
4	Pediatrics	25
5	Neurosurgery	20
6	Obstetrics	18
7	Epidurals	9
8	Vascular	4
9	Spinals	1

Considering the exploratory nature of the study, the 14 IV predictors found to be influential by beta weights were rank ordered for completeness. This utilized the Likert-type scaling that followed each “Yes” answer assessing the embedded DV in Section II of the survey tool. For further ranking analysis, Table 32 reveals the highest ranked IV predictors according to Likert-type scale responses. The Clinical Resources IV domain in this ranking list adds the CLIN-procedures to the list of challenging clinical learning opportunities as a resource constraint. These specialty procedures can be quite a challenge to obtain for all clinical learners at a site. This specific predictor included a list of three specialty clinical procedures respondents ranked as most important. These were: (1) central venous line insertions , totaling 44 “Yes” responses;

Table 32

*Influential IV Predictor Items by Likert-type Scoring*

RANK	NUMBER OF “YES” RESPONSES	IV PREDICTOR	LIKERT 3/4/5
1	52	FAC-salary	48
2	58	CLIN-cases	45
3	41	FIN-costDNP	40
4	45	CLIN-procedures	37
5	43	FAC-recruit	34
6	37	FAC-doc	28
7	33	FAC-retain	28
8	30	CLIN-techniques	28
9	35	FIN-budget	27
10	34	CLIN-comp	26
11	31	STU-comp	22
12	25	STU-repay	15
13	14	FIN-grant	12
14	12	STU-icu	10

(2) pulmonary artery catheter insertions, totaling 36 “Yes” responses, and; (3) endoscopic or videoscopic intubation methods, with 10 “Yes” responses.

None of the student domain predictors were statistically significant in the logistic regression analyses. However, by the beta weight comparison there were three student predictor items of influence noted which were highly ranked by Likert-type scaling. These were: (1) STU-comp –

competition for applicants from other NAEPs; (2) STU-icu – acceptable critical care/intensive care unit experience in the student applicant pool; and (3) STU-repay – availability of student debt relief programs from regional healthcare facilities or companies.

The faculty domain predictor of most significance was the salary differential between clinical CRNAs and academic CRNAs. This predictor was fourth and last IV item found to be statistically significant in the logistic regression analyses, and was at the top of the rank order of the 14 most influential predictors associated with the DV Resource Constraint. This salary gap has been commonly acknowledged for most clinical practitioners in nursing and medicine for quite some time. CRNA compensation is an evolving area in the clinical realm, especially in areas of the country with anesthesia provider shortages already emerging. Perusal of popular clinical anesthesia employment websites reveals the presence of recruitment and even retention bonuses that were not common less than five years ago. Additional faculty domain predictors perceived as causing constraint are insufficient faculty recruitment and retention measures.

None of the financial domain predictors were statistically significant in the logistic regression analyses. Within the rank order list, three financial predictor items were noted. These were: (1) FIN-costDNP – the financial cost of transitioning to the doctoral entry-to-practice degree; (2)FIN-budget – availability of sufficient budgetary support within the educational institution; and (3) FIN-grant – competition with other NAEPs for research or grant funding.

In summary, these regressions reveal that clinical concerns continue to predominate in the perceptions of critical resource constraints on NAEP graduate production, just as Oullette, et al., found in 2002, over 15 years ago. Four out of six items measured within the clinical IV resource domain were of concern as constraints in U.S. NAEPs. The exceptions were the total number of clinical sites and total number of clinical preceptors. These items were not found to be

statistically significant nor highly ranked by the Likert-type scaling. The only remaining statistically significant predictor in the full regression model is the disincentive posed by the salary differential for CRNA clinical practitioners vs. academicians. This is a significant limitation in the recruitment and retention of talented NAEP faculty members.

**Research question 3.** *Are there differences in the relative importance of barriers to NAEP capacity related to geographical location of the NAEP?* This categorical covariate analysis question was answered using cross tabulation procedures that assessed the statistical significance of the chi-square statistic. There were three IV predictors that showed a geographical difference. These were CLIN-techniques, CLIN-comp and FAC-load. The South region showed a statistically significant difference with all other regions in the importance of the predictor items CLIN-techniques and CLIN-comp. The South and the Northeast regions were statistically correlated with perceiving faculty load calculations as a disincentive for maintaining adequate faculty resources. While this is a consistent pattern, the West region had cell counts below 5 in all three of these significant results. This is due to the fact that many of the states in the West do not have NAEPs. In those states that do have programs, the majority have only one NAEP. A possible solution was to collapse the West region into one of the other regions. Another option would be to eliminate the West region from the geographical covariate analysis, and would be the most pragmatic solution. The demographic and healthcare market trends in the West are likely distinct enough to be wary of collapsing the region into another one.

**Research question 4.** *Are there differences in the relative importance of barriers to NAEP capacity related to program characteristics of the NAEP?* These program characteristics served as categorical covariates to assess for relationships between the IV predictors and the chosen



NAEP characteristic. As with the geographical covariate, cross tabulation procedures were used that assessed the significance of the chi-square statistic.

NAEPs housed in privately funded institutions were significantly more likely to see the total number of clinical training sites available as a resource constraint than were publicly housed NAEPs. This could be related to the fact that NAEPs housed in public institutions are more likely to have ties to large healthcare delivery systems. Large healthcare delivery systems are more likely to have an adequate supply of anesthesia learner training options, even if other anesthesia learners are present within the system or facility. Three other predictors were not likely to be viewed as a resource constraint by both types of institutional NAEPs: (1) STU-icu – student applicant critical care experience in high acuity units; (2) STU-comp – overall competition for student applicants; and (3) STU-coa – student applicants ability to meet minimum COA requirements for program attendance. However, with all three of these predictors, publicly housed NAEPs were significantly less likely to see these items as a resource constraint as compared to privately housed NAEPs. A likely explanation is that there is a higher volume of applicants overall to public NAEPs than private NAEPs. One significant factor in this could be that private institutions typically charge more in tuition and fees than public institutions.

There were no statistically significant relationships within the covariate analysis for shared clinical sites, also known as competition for clinical sites and cases. The ubiquity of clinical site competition and its perception as a critically important constraint makes it likely that all programs experiencing competition perceive it quite similarly. The criticality of this resource predictor was also borne out in the full model logistic regression.

There were no statistically significant relationships within the covariate analysis for comparing urban versus rural settings. A contributing factor to this lack of significance was the

finding that only 2.4% of NAEPs classified themselves as rural. There are rural healthcare facilities and systems that have clinical anesthesia rotations from NAEPs housed in an urban educational institution. An example of this is the nurse anesthesia program at Virginia Commonwealth University. Rural and critical access facilities have unique challenges and offer a valued learning opportunity that many urban programs have pursued. This likely accounts for the large number of NAEPs that were classified as “mixed”, versus urban or rural.

NAEPs that grant a masters degree for their entry-to-practice programs were much more likely to see the recruitment of faculty as a significant resource constraint than programs that have already transitioned to the doctoral entry-level degree. With the transition to this entry-level doctoral degree in progress and mandated to occur by 2022, it is logical that masters programs have difficulty in faculty recruitment. The transition to a new degree requires accreditation review with both specialty and regional accreditors, the acquisition of an adequate number of doctoral faculty and a significant tincture of time. Programs that have not completed the transition could be seen as a potentially temporary place of employment by faculty. Programs that are in the beginning phases of transitioning or those that have not instituted a coherent plan, would likely be seen as an overtly bad risk to potential new faculty members.

**Research question 5.** *What are potential areas of resource constraint (barriers) to NAEP capacity not explicitly addressed in this survey?* This was a qualitative open-ended question with white space for free text answers. A total of 44 respondents chose to use this white space option. The answers were grouped together in four main thematic areas. These areas consisted of: (1) political difficulties with the clinical site(s) or with institutional administration; (2) clinical issues (3) student issues; and, (4) issues related to the transition to doctoral education. The last group of issues encompassed predictors in both the faculty and financial resource



Political difficulties with either the clinical realm or the institutional administration is the second most commonly noted resource constraint not explicitly addressed in this survey. Political difficulties with other anesthesia provider types, especially MDAs, are a frequent topic of discussion and these are certainly beyond the scope of this research. The issues can include clinical rotation agreements, clinical teaching assignments, CRNA scope of practice, reimbursement issues, and MDA willingness to teach nurse anesthesia students, among others. Many, if not most, of these are more appropriately addressed via the professional nurse anesthesia associations at the state or national level. To that end, proactive communication must occur to inform the professional organizations of the relevant local or regional phenomenon. Internet blogs and bulletin board communities, such as AANA Connect, are useful forums for private communication and sharing of ideas and potential solutions. Seen through the lens of RDT concepts, these activities represent types of horizontal integration. Horizontal integrations occur among competing organizations vying for the same source of funds or critical resources (Chen, et al., 2015). An efficient horizontal integration of NAEPs and professional organizations will lead to the sharing of both challenges and solutions.

On the issue of institutional political challenges, the ASF Faculty Forum encouraged patient and consistent advocacy within the educational institution housing the NAEP. It was also mentioned that institutional political traction could be gained via NAEP faculty attendance at institutional meetings, as well as service on committees and volunteer projects. Consistent and diplomatic requests for seats on influential advisory committees and boards were also endorsed. Additionally, an alternative explanation for political challenges within the educational institution could be the logistical and financial demands experienced from the adaptation to the mandated deadline for instituting the doctoral entry-to-practice degree. Proactive communication with

institutional administration, complete with supporting evidence for the benefits as well as the needs incurred with the change to doctoral education can be educational and persuasive. Some benefits include increased legitimacy for the institution, from the improved scholarship and professional development experienced with faculty operating at the doctoral level. Grant opportunities and research initiatives are often more adeptly pursued by doctorally prepared faculty and represent increased financial resources. These activities can be seen in the RDT framework as a type of environmental scanning, complete with outputs of value to the educational institution, with the potential for procurement of slack resources.

Clinical issues included a wide range of topics, many including clinical resource constraints already assessed within this research. Four respondents mentioned clinical specialty cases as a serious resource constraint for their programs. Two respondents mentioned the lack of housing at required but distant clinical sites for their students. There are federal and state rural initiatives that may be leveraged, if critical access or rural facilities are involved. However, competition for grants or traineeships can be arduous, and funding limited. Sometimes a housing solution can be found within the community of the distant clinical rotation, but it requires diplomatic communication and diligent investigation of any options forwarded. One respondent commented that the NAEP had problems finding clinical instruction specifically for beginning clinical students. A single respondent mentioned that clinical facilities had begun charging fees for accepting nurse anesthesia students on rotation, even though the facility had a recurrent history of hiring the program's graduates. This could be quite significant if the practice of clinical site fees grows or continues. The AANA ASF Faculty Forum topics that correlate with this area include the continued or expanded incorporation of high fidelity simulation for partial fulfillment of specialized clinical procedure requirements in short supply, such as central line insertion.

Collaborating with regional healthcare facilities and systems is a crucial activity for U.S. NAEPs. Affiliation agreements represent a type of vertical integration from the RDT perspective, which often occurs in the business world between buyers and sellers (Malatesta & Smith, 2014). The healthcare systems are critical partners possessing the clinical resources needed by NAEPs. With the predicted shortfall in the U.S. anesthesia workforce, NAEPs producing graduate nurse anesthetists will become ever more important partners for regional healthcare systems. Clinical rotations serve a subtle but very important purpose: they function as an extended job interview for the students and for the clinical rotation sites. This is an example of critical resource interdependence, with a balance of power maintained by market supply and demand. The munificence of the clinical environment can be capitalized upon to ease the constraints placed upon the students when the balance is in favor of NAEPs. Facilities contemplating the employment of student learners are motivated to provide the clinical cases, specialty techniques and logistical requirements for successful student rotations.

There were three student issues that were unique to the white space responses. The first addressed the difficulty students experience after acceptance into the NAEP with obtaining affordable health care insurance. As national healthcare law stands currently, young adults can be carried on a parent's health insurance until he/she is 26 years of age. A large majority of students admitted to a NAEP are beyond this age limit. If a student remains in full-time employment there may be health insurance available from the employer. This is not always the case for part-time or flex-time employees dependent upon institutional policy. In some instances, when a student *has not* remained employed after program matriculation, application can be made for public health plans such as Medicaid. However, precise communication regarding their full-time graduate student status and lack of employment is crucial for acceptance

into these programs. Low cost university student health plans may be available at some institutions but is not consistently present.

This issue can be a considerable constraint to the student, and can make study-life balance quite difficult. Additionally, most NAEPs have a “no working” policy that is in force at some point in the program, and so this constraint will be present for most students in U.S. NAEPs during their course of study. A possible solution for some of these concerns can stem from the growing demand for anesthesia providers in the workforce. Student loan repayment incentives upon reaching an employment agreement is an option facilities often utilize for recruitment incentives. Even more attractive for student nurse anesthetists are programs that offer in-school financial support in exchange for a promised period of employment upon graduation and certification. This has the potential of mitigating concerns about affordable student health insurance. Student health insurance could even be a benefit provided by the employing group or healthcare system, at a more reasonable cost for all involved.

The second unique potential student resource constraint was the disadvantage perceived for applicants to NAEPs from rural areas, noted by one respondent. At past ASF assemblies, it has been anecdotally noted that students who have practiced at smaller community or rural facilities can be disadvantaged in didactic preparation and clinical experience acuity. There have been no quantitative studies that define the exact set of necessary clinical proficiencies and cognition to acquire from critical care experience, in predicting student success in NAEPs. Yet high acuity critical care experience is often listed very high in program administrator surveys as key in student selection, and seen as a link to success in both student graduation and first-time certification pass rates (Ortega, Burns, Hussey, Schmidt & Austin, 2013). Conversations at the AANA ASF Faculty Forum continue to reinforce that the length of time and the acuity of the

critical care experience is seen as integral to student success, and that such experiences are less often available at rural or community hospitals. The survey respondent perceived that more NAEPs would be willing to invest the time and resources in potentially disadvantaged rural students, if there were not program accreditation consequences related to the first-try pass rates on the CRNA national certification exam taken by NAEP graduates.

The Council on Accreditation of Nurse Anesthesia Educational Programs (COA) mandates that a minimum percentage of a NAEP's graduates pass the national certification exam on the first try. There are slight differences depending upon the length of time a NAEP has been in existence. For new programs, the COA preferred pass rate is 80% of all graduates taking the certification exam for the first time. Once a NAEP has produced three or more cohorts of graduates the mandated pass rate is 80% of all first-time exam takers, averaged over the most recent three-year period. The COA evaluates program pass rates two times each year. A program below the mandated pass rate for first-time certification exam takers must begin a period of COA monitoring, voluntary curriculum review and/or revision, and annual reporting on program interventions to improve student performance. If the pass rate remains below the COA mandatory minimum, the program faces COA compliance issues and potentially must navigate the adverse accreditation decision process.

The third student issue mentioned both in the survey and at the AANA ASF Faculty Forum was specifically the COA mandate on minimum first-time pass rates for the national certification board exam for new nurse anesthesia program graduates. Discussion ensued regarding the new sensibilities of the "millennial student" in viewing a first run at the certification exam as a "scouting" effort, instead of a high stakes, must-pass endeavor. Consideration was endorsed by a large faction for the establishment of a minimum *timeframe* for a graduate to achieve a passing



score on the exam, rather than the existent mandatory minimum percentage of first-time exam takers. So in this newly proposed measure of program quality, as long as a passing score occurred within the minimum timeframe, the NAEP would be considered in compliance with the COA passing standard for that graduate. A minimum pass rate percentage within a minimum timeframe would be the overall programmatic measure. A suggested minimum timeframe was 30 – 60 days after graduation. An educator present at the ASF stated that for the last five years, every graduate from his respective NAEP who did not pass the certification exam on the first attempt, did successfully pass it on the second attempt. For his program, the second successful attempt most frequently occurred within 14 – 17 days of the first exam attempt. This short time period between attempts does not seem to indicate that a program curriculum deficit caused the initial failure, because such a deficit is unlikely to be remediated in a two-week period.

The challenge of transitioning to doctoral education was the single most common free text response, numbering 12 responses. It was also quite frequently mentioned at the 2017 AANA ASF Faculty Forum. Salary differential between clinical CRNAs and full-time academic CRNAs was prominent in the survey and discussion results, and is a commonly identified problem with other healthcare clinical professions. Often the perception of the salary gap is exacerbated by the need for academic CRNAs to continue work after going home and during non-scheduled work hours. The most recent quantitative study of this issue in nurse anesthesia found that this practitioner-to-educator gap in salary was a significant disincentive to enter full-time academic practice as a CRNA (Merwin, Stern & Jordan, 2008). The authors measured this gap from survey respondents as the “... mean perceived improvement in salary associated with leaving...” full-time academic employment (Merwin, et al., 2008, p. 93). In 2008, they found that this gap was perceived as: (a) \$20,000 for program directors; (b) \$27,500 for assistant

program directors, and; (c) \$37,500 for academic faculty members.

Other academic disciplines mitigate remuneration gaps with supplemental activities. This option for nurse anesthesia administrators and faculty can include speaking engagements and clinical practice. Educational institutions or departments may set restrictions upon compensated outside activities for the NAEP faculty. In the 2008 study mentioned above, 36% of faculty felt “significantly restricted” in outside activity participation (Merwin, et al., p. 93). Given these continued perceptions, and the fact that the gap figures are from 2008, it is likely that the salary differential is larger in current dollars. A possible solution, endorsed by Merwin, et al., and many of those present at the 2017 AANA ASF Faculty Forum, is the granting of regular clinical practice days with retained compensation. This is a solution that costs the educational institution very little and can potentially improve relationships with key clinical facility partners.

Other common topics included the overall shortage of doctorally prepared faculty, time and workload constraints with supervision of doctoral scholarly projects, lack of COA-endorsed student to faculty ratio in doctoral NAEPs, and lack of institutional support or incentives for professional development. This last comment was interesting, and the respondent mentioned that support for the practice doctoral level should be instituted in a similar manner to that being exercised for research doctoral students. This was envisioned to include doctoral studies tuition support, hours released from academic duties and a living stipend related to the lost hours of work. This solution has benefits for both parties, as a faculty member pursuing a doctoral degree in this manner is not entirely lost from the curricular workload, and is more likely to be retained. Many NAEPs depend upon volunteer expert clinicians to cover aspects of the didactic instructional load. This volunteer force is uncertain at the best of times, making the retention of talented academic faculty an important consideration.

## Limitations

This study was limited in internal validity by the selection of a nonexperimental and correlational design, although this was purposeful for the exploratory objectives of the research. Neither survey response rates nor missing data were limitations to this study. Internal validity may be threatened by the construction of a statistically non-viable distinct DV, rather than reliance upon the valid embedded DV. However, the embedded DV “Resource Constraint” served the exploratory purposes well, and lessons were learned in the failure of the distinct DV “Program Constrained’. There was a large amount of congruence in the selection of influential predictors according to beta weights from the distinct DV in relation to the embedded DV. The need for a follow-up inquiry is clear regarding the differential in actual and potential NAEP graduates.

The study was somewhat limited in external validity by two factors: (a) the small number of programs in the U.S. West region; and, (b) the lack of potentially rich and diverse information from the three programs in Puerto Rico, and the four non-responder states of Iowa, North Dakota, West Virginia and Arkansas. However, in all other measured descriptive characteristics, the responding NAEPs were a heterogeneous and representative sample for external validity purposes. It is advisable to eliminate the urban vs. rural and the clinical competition covariate comparisons for the sake of parsimony.

Statistical conclusion validity was offset in return for the rich diversity of exploratory information found in the survey responses. The individual items within the four IV resource domains can now be more tightly drawn with fewer distractors of low influence present. This can be done using the significant results from the logistic regression analyses, the relevant covariate correlation analyses, the rank ordering of predictor items and new directions from

research question 5. This redesign of the IV resource domains will tighten the construct validity as well.

### **Implication of Findings: Theoretical**

Theoretically, RDT is a rich source of constructs linkages for critical resources in this area of graduate healthcare education. Environmental munificence, uncertainty and complexity will yield equally rich variables for exploratory research in diverse aspects of the U.S. healthcare delivery system, and translate well into several areas of allied health professions education. There is ample precedent in health administration literature, complimented by this study in nurse anesthesia education. By using this framework, critical resources may be assessed and planned for proactively. At the very least, it provides a new thought process for highly specialized practitioners and educators... to envision cooperative and more permanent solutions to old or new challenges.

This research thoroughly explored the use of RDT as a framework for assessing an organization's perception of its environment and the attendant critical resource constraints. An organization can produce or procure critical resources necessary to its survival. In this case the organization under study was nurse anesthesia education programs in the U.S., both as a unified entity and divided by specific covariate designations. The environment inhabited by these NAEPs is a complex mix of graduate education and the healthcare delivery system, with regulatory elements (accreditors, scope of practice issues, political issues), institutional elements (academic institutions and departments) and clinical education elements (healthcare facilities, systems and patient populations). Critical resources studied were comprised of four main domains: clinical resources, student/applicant resources, faculty resources and financial resources.

Actions taken by an organization to limit constraints to critical resources and to improve an uncertain supply occur within the inhabited environment, and in coordination or competition with other actors and organizations. Actions taken in coordination with another organization can involve some loss of autonomy and power, or result in decisions with other stakeholders' needs prioritized. Where there is mutual dependence, or a mutual gain in legitimacy, this loss of power can be mitigated (Yeager, et al., 2014). An example of this is when an organization has outputs of value to another organizational actor, creating an interdependence (Pfeffer & Salancik, 2003). Within this conceptual framework, some conventional responses from an organization to cope with resource constraints are: (a) environmental scanning (b) producing and conserving slack resources; (c) horizontal integrations; (d) vertical integrations, and; (e) capitalizing on environmental munificence. The principles and constructs of RDT may be extended into recommendations for actions intended to mitigate critical resource constraints for U.S. NAEPs. There have been examples of all these organizational responses to critical resource constraints for U.S. NAEPs, illustrated in the data analysis results and proposed solutions within this chapter.

NAEPs inhabit a healthcare delivery system where the outputs of graduate nurse anesthetists are highly valued and in demand. CRNAs are a majority of the actively practicing U.S. anesthesia workforce, and have consistently practiced in an adaptive manner that answers both past and current healthcare access disparities. In these characteristics, the specialty of nurse anesthesia has established legitimacy and great utility. The demographics of the U.S. are shifting to decrease the overall supply of anesthesia providers in the country while the patient population increases. The most expedient answer to this challenge is to increase the supply of CRNAs, which can only happen by assuring critical resources are supplied to U.S. NAEPs. The needs of

the healthcare delivery market will impart incentives for other actors in the institutional and clinical environment to seek integrations with sources of future nurse anesthetists. A comprehensive strategy from U.S. NAEPs should be employed with the main actors in the environment that can benefit the programs and their students. This strategy will be detailed in the following section. It will focus on the most significant of the predictor items revealed by the data analysis.

### **Implication of Findings: Practical**

The overarching goal of this study was to examine critical resources in nurse anesthesia education programs. This goal has been advanced. More focused inquiry is warranted in this area, for further exploration and effective problem management. Many of the potential solutions to resource constraints reside in the areas of effective proactive communication and diligent advocacy, leading to productive integrations.

Interprofessional collaboration should be emphasized as a type of both horizontal and vertical integration that can lead to improved patient outcomes. Doctorally prepared faculty are well positioned to interact with other professions to produce didactic and clinical curricular items to foster interprofessional education. These collaborations can lead to improved availability of didactic and clinical faculty, and an increased value placed on productive teamwork in healthcare. This is a mutual interdependence where everyone benefits and slack resources may be produced in myriad ways, because it involves major actors within the environment: other professions in competition for learning experiences, healthcare delivery facilities and systems, patients (both in areas of outcomes and satisfaction), educational institution components, and possibly political entities.

Academic institutions and the NAEPs must prioritize the recruitment and retention of

doctorally prepared faculty. Salary differential between academic and clinical CRNAs is a highly relevant predictor in the faculty resource domain. While salaries for full-time academic CRNAs cannot likely match those of full-time clinicians, other remedies should be pursued. Departmental or institutional restrictions on outside compensated activities should be eased or eliminated. Retained compensation for outside professional and clinical work is strongly suggested. Institutional support for faculty members engaged in doctoral studies should be promoted strongly with the academic institutions that house NAEPs. Support mechanisms can encompass tuition assistance, work hours designated for doctoral studies, or a living stipend related to lost hours of faculty work. Any combination of these would be powerful incentives for both recruitment and retention of faculty.

Clinical competition with other anesthesia learners is a critical matter that is of long standing. A period of increased concern regarding CRNA recruitment is reasonable to anticipate, both in healthcare delivery systems and in large anesthesia management companies. Utilization of CRNAs to the full scope of practice is the most economically feasible solution to anesthesia workforce needs, especially in underserved populations. NAEPs in the U.S. must incorporate some of the fundamental techniques imparted to its students. The vigilant scanning of the institutional and clinical environments for increased munificence and potential slack or innovative resources must be purposeful, ongoing and comprehensive.

Acquisition of new clinical sites and proactive communication with existent sites must remain highly prioritized. Collaboration with administration and staff at clinical facilities in professional development, scholarly work, or in quality initiatives linked to student doctoral projects are suggested methods of productive clinical site engagement. Proposals for innovative student recruitment incentives are a means to start broader conversations and networking related

to improved student support and success at clinical sites. Student debt repayment options linked to facility or system employment have been successful in the past in retaining talented critical care nurses after NAEP attendance and graduation. Effective methods of early outreach to potential students should be considered in collaboration with clinical facility professionals, especially in rural areas. This outreach to prospective students felt to be at a disadvantage in the NAEP applicant pool can be a means of enriching the pool for all regional NAEPs while improving the diversity of the profession.

A focused and concerted outreach from U.S. NAEPs to the COA with advocacy for programmatic concerns should be pursued. A formal NAEP faculty and administrator liaison board could be suggested. The issues that seem to be of high concern are:

- (a) Clinical specialty techniques and procedures that can be in short supply with a competitive pool of anesthesia learners: a dialogue concerning the continuation or expansion of innovative simulation or cadaveric testing for partial fulfillment of requirements is recommended.
- (b) COA emphasis on first-time certification exam pass rate: a dialogue regarding the evidence for utilizing the current standard of minimum first-time exam pass rate should be requested. Is the current standard measure valid and reliable? The NAEP outreach group should produce a literature review for acceptable alternatives, such as the proposed minimum time frame for successful exam completion.
- (c) Cooperative outreach from the nurse anesthesia certification body, the NBCRNA, and the COA in advising NAEPs with subpar examination pass rates. A request from the faculty liaison group for more structured input into suggested programmatic



improvements could be forwarded. The improved utilization of professional resources and academic networks by NAEP personnel should be a specific point of emphasis.

(d) COA assistance or guidance on recommending a workload calculation for supervision of doctoral scholarly projects, or a recommended student-faculty ratio in doctoral programs: NAEPs are struggling to define and justify academic workload accountability related to DNP projects, and it is a frequently mentioned source of dissatisfaction for faculty. Educational institutions must heed suggestions and guidelines issued by accreditation officials. Suggestions on this topic from the COA can be a crucial portion of evidence. Benchmarking with other graduate nursing programs or other accreditor suggestions is another source of comparison data.

In summary, active professional association membership and responsible social media utilization are two major avenues of communication, problem solving and advocacy that are readily available. Professional development as faculty members in the areas of NAEP education refinement, scholarly endeavors, and research and grant funding are also ways to find solutions and gain an agency in institutional and political matters. Networking with healthcare systems and other disciplines effectively is very beneficial for students and the profession of nurse anesthesia. Building these and other avenues of horizontal and vertical integration is part and parcel of a RDT-based solution to critical resource constraints.

### **Future Research Directions**

The first research question revealed the existence of apparently slack resources within U.S. NAEPs. That is the implication of the evident ability of the responding NAEPs to significantly increase the mean graduate production per program. Further investigation is needed in this area to understand what drives the difference between the figures given for actual and maximum

potential graduates. Constraining factors that could cause the discrepancy should be investigated, as well as the possibility that the conservation of resources is strategic. Assurance that the question was understood appropriately should occur in the form of a differently worded question assessing the same items. In narrowing and refining the four IV resource domains, the following predictor items are recommended:

- CLIN: specialty cases, specialty techniques, specialty procedures, the use of simulation resources
- STU: applicant critical care experience, competition factors, repayment options for student debt
- FAC: faculty to student ratio in doctoral programs, recruitment and retention measures (to include salary gap mitigation)
- FIN: institutional budget support, research and grant funding, cost of DNP transition

This narrows down the predictors to 12 main items from the original 22, while also incorporating new items. Covariates can be confined to geography, institutional type, and entry-level degree conferred (eventually evolving as a topic to specific doctoral transition covariates).

Unquestionably, a search for a more refined or appropriate distinct DV for resource or program constraint should be undertaken.

Inquiry into RDT-based strategies and actions employed by U.S. NAEPs should be incorporated into future research. Strategies could include, but are not limited to, environmental scanning, slack resource conservation, horizontal and vertical integration and methods to monitor and capitalize on environmental munificence. Refinement of the new research instrument could proceed as detailed in the methodology section of this study. The use of an expert panel and

content validity indexing is proven in literature and further endorsed by the utility of this survey instrument.

With further refinement of the study tool used in this research, it is feasible to produce a plan for U.S. NAEPs to statistically evaluate the critical resources available to each individual program. A quantitative tool that shows valid and reliable estimates of the most critical resource needs in a NAEP is invaluable for short and long term planning. It could be used for accreditation planning needs. Such a tool would also be an objective measure to use in the pursuit of increased resources within the educational institution or department housing the NAEP. The qualitative portion of the tool would remain, as a way to foster innovation in problem recognition and resolution. Compilation of data would be made available for recognition of local, regional or national trends.

## **Conclusion**

Access to quality healthcare resources within a reasonable distance from home is an essential component of population health. In the past and for the future, nurse anesthesia is one effective answer to the challenges of disparate access to highly specialized healthcare services. Anesthesia is a complex and rapidly evolving body of knowledge, demanding the best out of practitioners, educators and students. Nurse anesthesia education programs are interdependent and valuable to a complex set of interested parties, complete with critical required resources and outputs in demand: graduate nurse anesthetists. In order to maximize resource allocation and planning, this critical resource analysis was conducted.

This exploratory study utilized a novel survey tool examining critical resources constraints on U.S. NAEPs. The research design and survey tool was constructed with reliance on linkages between literature review and the RDT constructs. This conceptual framework has not

previously been utilized for a critical resource analysis in nurse anesthesia education. The study's exploration lays a rich foundation both for more focused inquiries in this area or expansion of the original exploration. This expansion is readily envisioned with the respondent replies to the last research question asking for areas of constraint the study did not encompass. A further extension would be an inquiry into strategic mechanisms that U.S. NAEPs use to cope with critical resource limitation. For the future of nurse anesthesia and equitable anesthesia service delivery, vigilance in the planning for education is as essential as planning for the delivery of each unique anesthetic.

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**Appendix A**  
**COA List of Accredited Programs**

## Sample Page

<http://home.coa.us.com/accredited-programs/Documents/LOAP%20June%202017.pdf>

### Alabama

#### **Birmingham - Department of Nurse Anesthesia Ida V. Moffett School of Nursing Samford University**

Samford University, 800 Lakeshore Drive, 35229;  
(205) 726-2047  
E-mail: amaddox@samford.edu  
Terri Cahoon, DNP, CRNA  
DLR: 05/2015; NRD: 05/2025  
Post-Master's Certificate, L:28; SD:January; DE:Yes  
Doctor of Nursing Practice, Entry Level, L:36;  
SD:May; DE:Yes  
Master of Science in Nursing, Entry Level, L:28;  
SD:January; DE:Yes  
Master of Science in Nursing, Completion, L:20;  
SD:N/A; DE:Yes

#### **Birmingham - The University of Alabama at Birmingham Doctor of Nursing Practice Pathway in Nurse Anesthesia**

Program name change (from "MSN Pathway in Nurse  
Anesthesia" to "Doctor of Nursing Practice Pathway in  
Nurse Anesthesia") effective 4/6/2017.  
1720 2nd Avenue S, NB 502, 35294-1210; (205) 934-  
7412  
E-mail: jlavier@uab.edu  
Susan McMullan, PhD, MSN, CRNA  
DLR: 10/2010; NRD: 10/2020  
Doctor of Nursing Practice, Entry Level, L:36;  
SD:May; DE:No

### Arizona

#### **Glendale - Midwestern University Nurse Anesthesia Program**

19555 North 59th Avenue, 85308-6813; (623) 572-  
3760  
E-mail: fimus@midwestern.edu  
Scott Imus, MSN, CRNA  
DLR: 10/2011; NRD: 10/2021  
Doctor of Nurse Anesthesia Practice, Completion,  
L:0; SD:August; DE:No  
Master of Science in Nurse Anesthesia, Entry Level,  
L:27; SD:June; DE:Yes

#### **Tucson - The University of Arizona College of Nursing Nurse Anesthesia Program**

PO Box 210203, 1305 N. Martin Ave., 85721-0203;  
(520) 626-5889  
E-mail: info@nursing.arizona.edu  
Kathleen A. Piotrowski, DNP, CRNA  
DLR: 01/2015; NRD: 10/2020  
Doctor of Nursing Practice, Entry Level, L:36;  
SD:June; DE:Yes

### Arkansas

#### **State University - Arkansas State University College of Nursing and Health Professions School of Nursing**

P.O. Box 910, 72467-0910; (870) 680-8187  
E-mail: czitzelberger@astate.edu  
DLR: 05/2014; NRD: 05/2024  
Master of Science in Nursing in Nurse Anesthesia,  
Entry Level, L:28; SD:January; DE:No

### California

#### **Fresno - National University Fresno Nurse Anesthesia Program**

20 River Park Place West, 93720-1551; (559) 256-  
4968  
E-mail: btune@nu.edu  
Bryan Tune, DNP, CRNA  
DLR: 05/2017; NRD: 05/2027  
Master of Science, Anesthesia, Entry Level, L:27;  
SD:April; DE:Yes

#### **Loma Linda - Loma Linda University School of Nursing Nurse Anesthesia Concentration**

11262 Campus Street, 92350; (909) 558-4923  
E-mail: graduatenursing@llu.edu  
Kurt Cao, DNAP, CRNA  
DLR: 05/2017; NRD: 05/2027  
Master of Science, Entry Level, L:30; SD:September;  
DE:Yes

#### **Los Angeles - University of Southern California (USC) Program of Nurse Anesthesia Department of Anesthesiology Keck School of Medicine**

1540 Alcazar Street, CHP #205, 90089-9012; (323)  
442-2037  
E-mail: uscnap@usc.edu  
Michele E. Gold, PhD, CRNA; Karen Embrey, EdD,  
CRNA  
DLR: 05/2009; NRD: 05/2019  
Doctor of Nurse Anesthesia Practice, Entry Level,  
L:36; SD:June; DE:Yes  
Master of Science in Nurse Anesthesia, Entry Level,  
L:28; SD:May; DE:No

#### **Oakland - Samuel Merritt University Program of Nurse Anesthesia**

450 30th St, Suite 3702, 94609; (510) 869-1536  
E-mail: mcode@samuelmerritt.edu  
Joseph Janakes, MSN, CRNA  
DLR: 05/2014; NRD: 05/2024  
Master of Science in Nursing, Entry Level, L:27;  
SD:September; DE:Yes

#### **Pasadena - Kaiser Permanente School of Anesthesia California State University Fullerton**

100 South Los Robles, Suite 501, 91188-6305; (626)  
564-3016  
E-mail: sandra.j.hinkson@kp.org  
John J. Nagelhout, PhD, CRNA, FAAN  
DLR: 05/2017; NRD: 05/2027  
Master of Science in Nurse Anesthesiology, Entry  
Level, L:24; SD:August; DE:No

### Connecticut

#### **Bridgeport - Fairfield University and Bridgeport Hospital Nurse Anesthesia Program**

Bridgeport Hospital, 267 Grant Street, Perry 3, 06610  
-2870; (203)-384-3054  
E-mail: sandra.lynch@bpthosp.org  
Nancy A. Moriber, PhD, CRNA, APRN  
DLR: 10/2010; NRD: 10/2020  
Doctor of Nursing Practice, Entry Level, L:36;  
SD:May; DE:No

List of Recognized Educational Programs by Council on Accreditation  
of Nurse Anesthesia Educational Programs

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**Appendix B**  
**Critical Resource Analysis Survey**



## Survey: Critical Resources in NAEPs

This survey is a tool for use in proactive planning for nurse anesthesia educational programs (NAEPs). It will help to identify critical resources, and important differences in these as related to NAEP characteristics.

Information regarding the responding program's characteristics is collected in Section I. Survey questions will follow in Section II. This 22-item portion focuses on perceived resource constraints and their relative importance. There will be three final follow-up questions after in Section III.

The survey will be administered by Qualtrics Research technology, and will be available on multiple devices. The survey platform meets or exceeds industry security procedure standards to maintain confidentiality. If you choose, the items may be completed via a hard copy or a phone call: you need only to utilize the contact information at the end of the survey for this option. Completing the survey should take no longer than 10 - 15 minutes total. You are free to opt out of the survey from the beginning, or at any point during the survey. All published data will be de-identified and collapsed into AANA regions or U.S. Census regions in order to maintain respondent confidentiality.

### SECTION I

*Please respond to the following questions regarding NAEP characteristics. These NAEP characteristics will be correlated with identified critical resources and their relative importance.*

1. Within what state is your NAEP located? \_\_\_\_\_
2. Is your NAEP housed in a public or private institution?
  - a. Public
  - b. Private
3. Is there competition from other anesthesia learners for your clinical sites?  
*(You may select more than one option)*
  - a. Other nurse anesthesia students
  - b. Anesthesia physician residents
  - c. Anesthesiologist assistant students
4. Would you characterize your NAEP location as primarily urban or rural?
  - a. Urban
  - b. Rural
  - c. Combination

*Note: an urban area is defined here as containing at least 50,000 people in a centralized area.*

5. Is your entry-to-practice NAEP conferring a masters or doctoral degree upon program completion?
  - a. Masters
  - b. Doctoral

## SECTION II

All the following questions will ask if the item described is a resource constraint for your program's increased production of graduate nurse anesthetists. If the answer to the item is "Yes" then a Likert scale will populate to allow for respondents to rank the importance of the resource constraint. This will allow for prioritization of the critical resources to your NAEP. Immediately below is the Likert scale to be utilized.

### How important is this critical resource constraint to the operation of your NAEP?

Rarely an important concern	Occasionally an important concern	An important concern	Usually an important concern	Always an important concern
1	2	3	4	5

### CLINICAL SITE RESOURCES

1. Is the total number of clinical sites available to your program a constraint upon an increased production of graduates in your NAEP?
  - a. No
  - b. Yes
    - i. Likert Scale
2. Is the total number of clinical preceptors available to your program a constraint upon an Increased production of graduates in your NAEP?
  - a. No
  - b. Yes
    - i. Likert Scale
3. Is the availability of clinical specialty cases (e.g. open heart cases, thoracic, neuro, vascular, OB, peds) a constraint upon an increased production of graduates in your NAEP?
  - a. No
  - b. Yes
    - i. Likert Scale
    - ii. Which cases are a resource constraint? *(You may select more than one answer)*
      1. Open heart
      2. Thoracic
      3. Neuro
      4. Vascular
      5. OB
      6. Peds
4. Is the availability of specialty anesthetic techniques (e.g. regional, spinal, epidural anesthesia) a constraint upon an increased production of graduates in your NAEP?
  - a. No
  - b. Yes
    - i. Likert Scale
    - ii. Which techniques are a resource constraint? *(You may select more than one answer)*
      1. Spinal
      2. Epidural
      3. Regional/peripheral nerve blocks
5. Is the availability of specialty anesthetic procedures (e.g. CVC insertion, PA catheter insertion, endoscopic/videoscopic intubation methods) a constraint upon an increased production of graduates in your NAEP?
  - a. No

- b. Yes
  - i. Likert Scale
  - ii. Which procedures are a resource constraint? *(You may select more than one answer)*
    - 1. Central venous catheter insertion
    - 2. PA catheter insertion
    - 3. Endoscopic/videoscopic intubation methods
- 6. Is competition from other clinical anesthesia learners a constraint upon an increased production of graduates in your NAEP?
  - a. No
  - b. Yes
    - i. Likert Scale

### **STUDENT RECRUITMENT/APPLICANT POOL RESOURCES**

1. The availability of high acuity critical care experience in the NAEP catchment region is a constraint upon applicants to your NAEP. *(Note: "catchment region" here is defined as the main territory from which your NAEP derives the majority of prospective students)*
  - a. No
  - b. Yes
    - i. Likert Scale
2. Competition from other regional NAEPs is a constraint upon the applicant pool for your NAEP.
  - a. No
  - b. Yes
    - i. Likert Scale
3. Prospective students' ability to meet minimum COA requirements for NAEP eligibility is a constraint upon an increased production of graduates in your NAEP.
  - a. No
  - b. Yes
    - i. Likert Scale
4. Prospective students' ability to meet your program-specific minimum requirements for eligibility is a constraint upon an increased production of graduates in your NAEP.
  - a. No
  - b. Yes
    - i. Likert Scale
5. Prospective students' ability to meet the financial requirements of full-time attendance in your NAEP is a constraint upon the program's ability to increase production of graduates.
  - a. No
  - b. Yes
    - i. Likert Scale
6. Is the availability of student debt relief programs from the regional healthcare delivery facilities (such as stipend agreements or loan repayment options) a constraint upon an increased production of graduates in your NAEP?
  - a. No
  - b. Yes
    - i. Likert Scale

### **FACULTY RESOURCES**

1. Having an adequate number of doctorally prepared faculty members is a constraint upon an increased production of graduates in your NAEP?
  - a. No
  - b. Yes
    - i. Likert Scale
2. The required academic teaching load for your institution is a constraint upon an increased production of graduates in your NAEP?

- a. No
  - b. Yes
    - i. Likert Scale
3. Salary differences between clinical practice and academic practice are a constraint upon the recruitment of faculty at your institution.
- a. No
  - b. Yes
    - i. Likert Scale
4. Faculty recruitment incentives at your institution are a constraint upon an increased production of graduates in your NAEP?
- a. No
  - b. Yes
    - i. Likert Scale
5. Faculty retention incentives at your institution are a constraint upon an increased production of graduates in your NAEP?
- a. No
  - b. Yes
    - i. Likert Scale

### **FINANCIAL RESOURCES**

1. The budgetary support within your institution is a constraint upon an increased production of graduates in your NAEP?
- a. No
  - b. Yes
    - i. Likert Scale
2. The cost of student services for your program is a constraint upon an increased production of graduates in your NAEP?
- a. No
  - b. Yes
    - i. Likert Scale
3. Competition for federal/state/private funding dollars is a constraint upon an increased production of graduates in your NAEP?
- a. No
  - b. Yes
    - i. Likert Scale
4. Competition for research or grant funding is a constraint upon an increased production of graduates in your NAEP?
- a. No
  - b. Yes
    - i. Likert Scale
    - c. If Yes, Likert Scale
5. The cost of hiring additional doctorally prepared faculty members, or utilizing consultants, as required in the move to doctoral entry to practice, is a constraint upon an increased production of graduates in your NAEP?
- a. No
  - b. Yes
    - i. Likert Scale

### **SECTION III**

*The answers to the first two questions in this section will be critical to establish a predictive model of graduate output capabilities from present NAEPs. The final question will be important to guide future research in critical resources for NAEPs.*

1. Please provide the total number of graduates from your NAEP's most recent graduating class.  
\_\_\_\_\_
2. Please state what the maximum total number of graduates from your NAEP **could** be with **NO** change in potentially constraining resources. \_\_\_\_\_
3. What potential areas of resource constraint have not been addressed in this survey?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

*Thank you very much for adding your valued, expert insight into this research. The data collected in this project is confidential and will be de-identified prior to any publication. To reiterate, state data will be collapsed into AANA regions or U.S. Census regions. This research is intended to help guide NAEPs in the U.S. in planning for critical resource needs.*

*For any questions or concerns, please send emails to [Lstewart@marian.edu](mailto:Lstewart@marian.edu)  
If you prefer a phone contact, please call 540-797-6634*

*Thank you, once again.*

**Appendix C**  
**Email Invitation**

Colleagues:

I am Lois Stewart, Assistant Program Director of the Marian University DNP nurse anesthesia program. I am also a doctoral student at Virginia Commonwealth University in the PhD in Health Related Sciences program. In both roles I am interested in relevant evidence to guide current and future nurse anesthesia education.

Please be on the alert for a survey assessing critical resources and constraints upon graduate anesthetist production in U.S. nurse anesthesia educational programs. The results of this research will be used to develop a comprehensive analysis of the critical resource needs of nurse anesthesia educational programs and to identify variations by institutional characteristics. These characteristics include geography, public or private status, and entry to practice degree conferred.

I respectfully request that you consider completing the survey, and ask that you distribute it among your faculty and staff for voluntary completion as well. For the purpose of the research only one response per program is needed, but you are free to complete as many as desired. The survey uses Qualtrics survey technology, which meets or exceeds industry standards for data security and encryption. All responses will be anonymous and all identifying state level data will be collapsed into AANA or U.S. Census Bureau regions prior to any publication. De-identified survey data will be available to nurse anesthesia programs upon completion.

In short, the survey results will provide a baseline profile that may help guide current and future nurse anesthesia education. This baseline profile is currently not available.

Survey completion is implied as acknowledgement that you have read this email introduction, understand the nature of the study, and understand data confidentiality protections. Survey completion also implies acknowledgement that you are above 21 years of age, that English is your primary language, and that you are faculty or staff in a U.S. nurse anesthesia program. Completing the survey should take no more than 10 – 15 minutes.

I appreciate your interest and participation in this research. Please forward any questions to me for clarification.

Thank you *very* sincerely,

Lois E. Stewart, PhD (c), MSNA, CRNA  
Assistant Director, DNP Nurse Anesthesia Program, Marian University  
3200 Cold Spring Road  
Indianapolis, IN 46222-1997  
[lstewart@marian.edu](mailto:lstewart@marian.edu)  
317-955-6180

**Appendix D**  
**Email Reminder**



Colleagues:

I recently distributed a Qualtrics survey link, with the purpose of assessing critical resources and constraints upon graduate anesthetist production in U.S. nurse anesthesia educational programs. The results of this research will be used to develop a comprehensive analysis of the critical resource needs of nurse anesthesia educational programs and to identify variations by institutional characteristics.

This is a reminder that the research is ongoing. I respectfully request your voluntary participation. Only one response per program is needed, but you are free to complete as many as desired. The survey uses Qualtrics survey technology, which meets or exceeds industry standards for data security and encryption. Any disseminated data will be de-identified.

If you wish to opt out of any further correspondence regarding this research survey, simply email that request to me at the address listed below. If you have any questions, please do not hesitate to forward those as well.

Thank you *very* sincerely,

Lois E. Stewart

Lois E. Stewart, PhD (c), MSNA, CRNA  
Assistant Director, DNP Nurse Anesthesia Program  
Assistant Professor, Leighton School of Nursing  
Marian University  
3200 Cold Spring Road  
Indianapolis, IN 46222-1997  
[lstewart@marian.edu](mailto:lstewart@marian.edu)  
(317) 955-6180 - office

**Appendix E**  
**Telephone Script**

Hello, I'm Lois Stewart. I am calling to touch base with your program about a research survey I recently distributed by email to all U.S. nurse anesthesia education programs. The results of this research will be used to develop a comprehensive analysis of the critical resource needs of nurse anesthesia educational programs and to identify variations by institutional characteristics. I have used publicly available contact information to ask for your voluntary participation.

I respectfully request that you consider completing the survey, and ask that you distribute it among your faculty and staff for voluntary completion as well. For the purpose of the research only one response per program is needed, but you are free to complete as many as desired.

The survey uses Qualtrics survey technology, and all responses will be anonymous. All identifying program level data will be collapsed into AANA or U.S. Census Bureau regions prior to any publication. De-identified survey data will be available to nurse anesthesia programs upon completion.

The interview requires about a maximum of 10-15 minutes, and is completely voluntary. You may decline to answer any question. You may opt to complete the survey by this phone call if you so desire.

Survey completion is implied as acknowledgement that you understand the nature of the study, and understand data confidentiality protections. Survey completion also implies acknowledgement that you are above 21 years of age, that English is your primary language, and that you are faculty or staff in a U.S. nurse anesthesia program.

Any questions may be forwarded to me at using the following contact information: Lois E. Stewart, Assistant Director, DNP Nurse Anesthesia Program, Marian University, Indianapolis, IN: [lstewart@marian.edu](mailto:lstewart@marian.edu)  
(317) 955-6180 – office

Thank you very much.

## Vita

Lois Elaine Stewart was born in Bluefield, West Virginia. She graduated from Radford University with a Bachelor's of Science in Nursing in 1987; she subsequently graduated from Virginia Commonwealth University, where she earned a Master's of Science in Nurse Anesthesia in 2004. Lois has practiced as a Registered Nurse since 1987, and as a Certified Registered Nurse Anesthetist since 2005. After a rewarding career in Virginia focused on nurse anesthesia practice and education, she is currently serving as the Assistant Director of the Nurse Anesthesia program at Marian University in Indianapolis, Indiana.