

A Comparison of the Quality of Care and Cost Efficiency Between Anesthesia Providers

2018

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A COMPARISON OF THE QUALITY OF CARE AND COST EFFICIENCY BETWEEN
ANESTHESIA PROVIDERS

by

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A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Nursing
in the College of Nursing
and in The Burnett Honors College
at the University of Central Florida
Orlando, Florida

Summer Term, 2018

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Abstract

The development of anesthesia has greatly contributed to the safety of surgeries, reduced the level of invasiveness of many procedures, and provided increased comfort for patients. The delivery of anesthetics has been primarily provided by one of two unique health care providers: a trained physician who has specialized in anesthesia, or an advanced practice nurse—the certified registered nurse anesthetist (CRNA). Both providers have a similar scope of practice, are nationally certified, and often work side-by-side. However, in recent years there has been some controversy between the two providers regarding autonomy, safety, and quality of services. The purpose of this study was to utilize current research comparing the two professions to determine if there is a difference in the quality of care and cost effectiveness between these two providers. This research was focused on studies performed in the United States after 1985. Results indicated no significant differences in quality of care between providers; however, a cost difference does exist. CRNA's provide a high quality of care equivalent to their physician counterparts, but at a reduced price. They additionally offer access to care in rural areas that lack anesthesiologists.

Limitations include an inability to assess the impact of doctoral level programs for nurse anesthetists (required for entry into practice beginning in 2025) and how this may affect the main components of patient care assessed in this study (quality of care and cost). Future studies should look at ways to improve the relationship between the two providers and to remove barriers to nurse anesthetists' scope of practice in order to increase overall access to care.

Dedications

Foremost, to my parents, Gregg and Judy, whom have supported me and allowed me to chase all my dreams. No words can express my feelings towards them, they have greatly exceeded the definition of great parents, and I certainly would not be the man I am today without their love and support.

Secondly, to my great friend Bronte whom inspired me and gave me the courage to enter nursing school and eventually become a nurse. You have helped pave my way to a professional career.

Acknowledgments

I would like to thank Dr. Christopher Blackwell for being patient and believing that I had ability to take on and complete this research. You have helped direct me in the right direction and allowed me to work at my own pace which has helped to make this a less stressful undertaking. I would also like to thank Dr. Jonathan Decker who never hesitated to help and answer questions after class concerning my thesis. He has assisted me in organizing this study and has always been very supportive.

Lastly, Dr. Andrew Todd deserves many thanks for his time and effort in assisting me in the research portion of this study.

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INTRODUCTION

The two primary providers of anesthesia are CRNAs and physician anesthesiologists, both of whom have very similar roles but very different paths to practice entry. The purpose of this study was to review the existing literature comparing quality of anesthesia care provided, cost efficiency between anesthesiologists and CRNAs, and access to care to determine which could be more beneficial to meet the rapidly increasing demand of anesthesia services in the future.

History

The medical practice of anesthesia began in the mid-1800s and was deemed to be an arbitrary, aimless specialty (Kane & Smith, 2004). Most physicians were more interested in performing surgery rather than anesthesia because of the lack of knowledge regarding the mechanism of action of what limited anesthetic agents were available at the time (Kane & Smith, 2004). It was often medical interns who would administer anesthesia under the supervision of more well-trained interns (Kane & Smith, 2004). There are accounts of many nurses gravitating towards the practice of anesthesia when there were no trained interns or medical students available (Kane & Smith, 2004). During this time, CRNAs became very popular among surgical patients as well as the surgeons they worked with; they allowed the surgeon to dictate the course of the operation (Kane & Smith, 2004). From this point onward, the role of anesthesia became predominately a nursing specialty until the American Medical Association (AMA) recognized anesthesia as a medical specialty in 1937 (Kane & Smith, 2004).

With the AMA recognizing anesthesia as a specialty in combination with World War II, there was a newly created need for anesthesia care. Therefore, a major trend in medical students

choosing anesthesiology as a specialty emerged. In 1966, Medicare's health reform arrangement with anesthesiologists allowed them to bill individually for each procedure (up to four) they supervised. Therefore, if an anesthesiologist worked as part of an anesthesia care team that included CRNAs, the anesthesiologist could supervise up to four cases at one time. This allowed for a greater compensation among anesthesiologists, and therefore, led to a triple in the number of physician anesthesiologist between 1970 and 1996 (Kane, & Smith, 2004). The anesthesiologist had enough compensation to pay the CRNA working as part of the anesthesia care team, with enough income generated to also pay themselves higher salaries (Kane & Smith, 2004).

Conflict

A turning point in the close collaboration and team work between the two occupations came about in the late 1970s when the education of CRNAs no longer incorporated physicians. Programs changed from a medically trained model into one primarily based upon a nursing one. Up to this point, many CRNAs were in class and side-by-side with medical students. Nurse anesthesia programs were no longer organized by anesthesiologists; and the loss of medical training served as a major point in the criticism of the role today (Kane & Smith, 2004). Years later, by 1989, CRNAs were now allowed to bill for their individual services pushing the collaboration between the CRNA and anesthesiologist even further apart (Kane & Smith, 2004).

An additional drive between the two occupations occurred when anesthesiologists sought after a new type of anesthesia care provider known as an anesthesiologist assistant, or AA. This came as a response to a shortage of anesthesia providers that occurred in the 1960s. The AA would aid the anesthesia care team and relieve some of their demands. Fear of straining the

number of nurses available to provide bedside care to patients was a major reason anesthesiologists provided for not simply increasing the usage of CRNAs during this time (Amburgey, Fordham, Payne, and Trebelhorn, 2007). AAs were first brought into the health care field in the early 1970s. In 1969, programs at Emory and Case Western University accepted their first students. There are now eleven accredited programs in the country and approximately 1,000 anesthesiologist assistants practicing today (MacIntyre, Stevens, Collins, & Hewer, 2014). They are employed in sixteen states and District of Columbia either through licensure and certification or by physician delegation (Amburgey, Fordham, Payne, and Trebelhorn, 2007). State laws and/or boards of medicine dictate anesthesiologist assistants are not allowed to practice in any jurisdiction without being under the direct supervision of a licensed anesthesiologist. This is one major regulation that limits anesthesiologist assistants' scope of practice and autonomy as compared to CRNAs. This barrier also affects patients' access to health care because an anesthesiologist still needs to be present during the administration of anesthetics and required follow-up care. State laws require close regulation and control by the anesthesiologist.

In 1993, Congress demanded that if anesthesiologists and CRNAs worked together as part of an anesthesia care team, their pay would have to be equal (Kane & Smith, 2004). This dissolved the primary purpose of working with CRNAs and/or allowing them to do most of the anesthesia work while the anesthesiologist supervised. Anesthesiologists would get equal pay to CRNAs while taking responsibility for organizing the anesthesia care team, payroll, supervising all ongoing procedures, and feeling the brunt of malpractice litigation (Kane & Smith, 2004). Consequently, anesthesiologists began attempts at convincing hospital managers that nurse anesthetists should no longer be used (Kane & Smith, 2004). Even though the review of material

is old, journals, medical news reports and organizational publications have reported that conflict between the two professionals was evident (Kane & Smith, 2004; Lundine, 2003). These reports and journals argued anesthesiologists, with their superior training, would provide the most economical and safest administration of anesthesia. In addition, it was asserted patients would be more satisfied with their experience, thus improving hospitals' quality of care perception (Kane & Smith, 2004; Kalist, Molinari, & Spurr, 2011).

Distribution

According to Liao and Quraishi, (2015), there were 1.16 times more anesthesiologists than CRNAs employed in the United States (41,236, compared to 35,570) in 2010. The results of their study, which sought to discover discrepancies in geographical location of anesthesia providers, found that CRNAs tend to be more employed in counties where the population earns below median income, has higher unemployment, is largely uninsured, or reliant on Medicaid. Matsusaki and Sakai also reported that anesthesia services provided by CRNAs only is more common in rural areas (2011). Thus, CRNAs have increased access to services that would otherwise not be available in rural hospitals (Rutsohn, 2005). CRNAs make cervical, obstetrics, interventional, and pain management procedures in these areas more possible (Fallacaro, Ruiz-Law, 2004; Gunn, 2000). These rural hospitals often have great difficulty recruiting anesthesiologists, as those specialists gravitate more towards larger cities (Liao & Quraishi, 2015).

Even though evidence is strong and widely available suggesting that anesthesia services provided by CRNA does not result in significant differences in outcomes compared to that provided by anesthesiologists (Simonson, et al., 2007), many studies do not directly compare

adverse events between the two specialties in rural areas. In addition, there aren't many studies comparing their impacts on economics. And while the studies cited above reported increased access to care in rural areas by CRNAs, data are lacking.

The Affordable Care Act has led to an increasing number of insured Americans, which places a great deal of strain on the health care industry, especially in the field of anesthesia. Roughly 22.3 million uninsured American will be eligible for Medicaid posing an imbalance in the supply and demand of health care providers (Liao, Quraishi, & Jordan, 2015). Of health care providers, the service of anesthesia will be greatly impacted because it allows for direct access to surgical procedures and pain management services, which are reliant on anesthesia care. It has been argued anesthesiologists provide better quality of care; however, there is a lack of research to support this claim (Kane & Smith, 2004). Also, the cost and time taken to train new anesthesiologists is far greater than CRNAs. Therefore, CRNAs could be a more efficient alternative and might provide similar clinical outcomes more economically. According to Hogan, Seifert, Moore, & Simonson, cost effectiveness is providing services at the lowest cost without sacrificing quality (2011). Because health care costs related to anesthesia amount for three to five percent of total health care expenditures, there is a large effort to search for ways to decrease this amount for hospitals, third party payers and government insurance (Glance, 2000).

Literature Review

The search yielded 115 results, of which only 18 were relevant to this research because they met the inclusion criteria, fell out of the exclusion criteria, and answered the following research questions: 1) Are clinical outcomes (intraoperative/postoperative adverse events, injuries) between CRNAs and anesthesiologists similar? 2) How does cost of educational preparation and cost of service delivery between CRNAs and anesthesiologists differ? and 3) Do CRNAs increase access to anesthesia services in rural settings?

Research question 1

An inquiry by Simonson, et al., (2007) was a retrospective analysis that studied anesthesia complication rates over a 12-year period in the State of Washington. This study directly compared hospitals that relied solely on anesthesiologists to supply obstetrical anesthesia against hospitals that relied solely on CRNAs to provide the same services. Based on a prior study, they hypothesized there would be no measurable difference in complication rates between the two types of providers. After adjusting for variables, Simonson, et al., concluded there were no differences in complication rates between provider, thus proving their hypothesis correct.

Negrusa et al. (2016) appraised anesthesia claims and their related complications from a large commercial database. The purpose of their study was to determine whether the probability of complications related to anesthesia varied by scope of practice and method of delivery (CRNA compared to anesthesiologist). These colleagues discovered there was a difference in complication rates related to patient characteristics, type of procedure administered, and comorbidities. However, it was concluded that there was no difference in complication rates between scope of practice or delivery model.

Research question 2

Rutsohn (2005) investigated the concept of value exchange as it pertains to the anesthesia workforce. He came to the conclusion that the government has not been responsive to the ineffective purchasing of anesthesia services. He argues that government should intervene to promote rational purchasing of healthcare, and that there are more responsible and more cost-effective methods to providing anesthesia nationwide. Here, Rutsohn presents two key components to compare the economics of anesthesia: cost to society for education, and cost to society for reimbursement.

Anesthesiologist must take four years of undergraduate coursework followed by four years of medical school and four more years of residency for a total pathway of twelve years, post-secondary. A CRNA typically undergoes four years of nursing school followed by two years of critical care experience, then two more years of school for a masters degree in nurse anesthesia for a total of eight years of post-secondary training (Rutsohn, 2005). According to his research, the cost for educating a CRNA is about \$68,000 compared to \$356,000 to educate an anesthesiologist.

Rutsohn's second component, the cost to society, took into consideration third party reimbursement for such services. He reported that Medicare will reimburse CRNA's at eighty percent of an anesthesiologist's rate. When the team approach is utilized, Medicare will reimburse at fifty percent the anesthesiologists rate (50 percent of total) and fifty percent the CRNA rate (40% of total) for a total of ninety percent of the flat anesthesiologist rate. He reaches the conclusion that because of the \$1.7 billion dollars spend annually on anesthesia services, using CRNAs can dramatically decrease healthcare spending.

Glance (2000) utilized a decision-analysis model to investigate the cost effectiveness of anesthesia providers. He compared five different anesthesia care teams ranging from anesthesiologists only, a mix of the two providers, and CRNAs only. In addition, Glance also compared the anesthesia team against the risk level of the patients requiring anesthesia (high risk operations/patients versus low risk operations/patient). The results of his research present valuable information because it is the first report that supports utilizing anesthesiologists over CRNAs in certain situations.

The results of Glance's decision-analysis study found that an all anesthesiologist approach is most beneficial with high-risk patients. In the case of intermediate risk patients, a ratio of anesthesiologist to CRNA of 1:2 is most effective, and in cases comprising low-risk patients, an anesthesia care team approach with a ratio of 1:4 is most effective.

Hogan, Seifert, Moore, & Simonson (2010) performed a blind peer reviewed research study that compared the cost effectiveness of both anesthesiologists and CRNAs. In this study, seven different delivery models were compared to cost and safety. This study was unique in that it also incorporated other variables such as demand, type of anesthesia procedure, and payer distribution. The results of this study concluded that CRNAs provide the most cost-effective anesthesia service. However, in areas where demand is high, an anesthesiologist to CRNA ratio of 1:4 outperformed the other models, and in areas where demand was low, this approach was less effective than the CRNA only model. Hogan, Seifert, Moore, & Simonson also reported that an analysis of claims data demonstrated that independent CRNAs offer the lowest cost to direct payers (2010).

Research question 3

Gunn (2000) wrote a review article that represents the role CRNAs play in rural America. He makes the distinction between geographical locations of CRNAs and anesthesiologists, demonstrating that CRNAs provide a service to lower income citizens that reside in rural locations. According to his study, populations that reside in rural America generally include: the elderly, children under the age of 18, higher incidence of chronic disease, less likely to have health insurance, and a forty percent higher rate of mortality resulting from accidents. This population has relied heavily on anesthesia services provided by CRNAs and according to reports that Gunn (2000) presents, the respective communities are pleased with the level of care provided by CRNAs (Gunn, 2000). This source contributes useful information for formulating the conclusion of this article that CRNA's greatly contribute to access to care.

Fallacaro & Ruiz-Law, (2004) conducted a review article that analyzed five distinct databases that contained about 1.5 million records to distinguish the locations of CRNA's and anesthesiologists. These authors analyzed the six states that opted out of the Medicare part A requirement for physician supervision of CRNAs (which allows CRNAs to practice at their full licensure). In these states, CRNAs outnumbered anesthesiologists 1.36 to 1, 33.6 percent of the total CRNAs are employed in rural counties compared to 16.7 percent of anesthesiologists (Fallacaro & Ruiz-Law, 2004). Their data showed more CRNA's are employed in rural counties; however, there are still 843 counties in the US without any anesthesia provider. Of these 843 counties, 97 percent (816) are considered rural counties (Fallacaro & Ruiz-Law, 2004). The findings of their study suggest CRNAs may further increase access to care by decreasing the number of counties without anesthesia services.

Liao & Quraishi, (2015) conducted a blind peer reviewed article that highlighted the distribution of anesthesia providers in the United States. They incorporated the implementation of the Affordable Care Act, focused on the evaluation of the geographical location of providers based on population income and connected these variables to the location of employment for anesthesiologists and CRNAs. Liao & Quraishi reaffirmed that anesthesiologists are more prominent in urban counties and list three factors that determine distribution as: 1) number of operating rooms, 2) county median income, and 3) population density (Liao & Quraishi, 2015). Their study further emphasized the impact CRNAs have on vulnerable populations in rural America.

Kuo, Loresto, Rounds & Goodwin, 2013 used the increase in use of nurse practitioners to estimate the lack of primary care physicians. They utilized five percent of the Medicare beneficiaries and found that between 1998 and 2010, there was a fifteen-fold increase in the use of nurse practitioners; states with the least restriction on nurse practitioner scope of practice experienced the largest increase in nurse practitioner use. This further emphasizes how non-physician providers can increase access to care.

METHODS

A review of the existing literature regarding the differences in the two anesthesia providers was performed using the Cumulative Index to Nursing and Allied Health Literature with Full Text Cochrane Central Register of Controlled Trials, MEDLINE and PsycINFO via electronic access through the EBSCOhost research interface. Terms used to query the databases, derived from input from a professional research nurse librarian, were: ("nurse* anesthetist*" or CRNA*) AND (Economic* or manpower or Reimbursement) AND ("Cost Benefit Analysis" or "Cost Analysis" or "Economic Competition" or utilization or "geographic factors" or "supply & distribution" OR supply W2 demand OR "Statistics and Numerical Data"). The inclusion criteria were limited to studies published after 1988, published in English, conducted in the United States, and focused on two main providers of anesthesia, and assessed scope of practice, education, and cost effectiveness. The exclusion criteria were studies conducted outside the United States consisting of research performed prior to 1988. The search yielded 112 results, of which 14 qualified as relevant to this research because they met the inclusion criteria.

Findings

Quality of Care

Numerous studies have investigated adverse events related to anesthesia care. These studies compared the adverse events within each of the three-primary providers who provide anesthesia, which includes anesthesiologists only, anesthesia teams comprised of anesthesiologists and CRNAs, and finally, CRNAs only. Results from these studies all indicate there are no statistically significant data demonstrating one type of provider, or combination of providers, equates to safer outcomes. Matsusaki and Sakai reported that patient outcomes between anesthesiologists and CRNAs demonstrated no statistically significant data showing any superiority of provider type (2011). Negrusa, Hogan, Warner, Schroeder, & Pang, also found no evidence correlating scope of practice or the delivery model of anesthesia to increased incidence of morbidity or mortality (2016). They did, however, find that patient characteristics, comorbidities, and type of surgical procedure did influence complications related to anesthesia; but between provider types, there was no significant difference. Although his data were collected outside of the inclusion criteria, Blumenreich (1986), concluded it was not the level of education by anesthesia provider that led to adverse patient outcomes; instead, lack of attention, focus, and overall monitoring were statistically significant. The adverse outcomes attributed to lack of attention and focus included hypoxia and premature intubation. Blumenreich reached the conclusion that beyond a certain point of anesthesia training and education, patient safety and outcomes no longer improve (1986). Anesthesia therefore is a field of medical science that is impacted more by the ability of one's concentration, focus, and attention rather than years of training and education.

Cost

Cost-effectiveness is an extremely important aspect of any discussion in healthcare; and it will continue to play an essential role in the health care system as more people become insured and have greater access to anesthesia care. Cost-effectiveness comparison between CRNAs and anesthesiologists has immense implications in the discussion on access to care, particularly in rural hospitals and underserved regions. This portion of the study focused specifically on costs related to the length and cost of graduate nursing and medical education, reimbursement opportunities as well as cost to independent payers.

An important contributing factor to the economics and financial impact of anesthesia providers is their education, specifically the length of their education. CRNAs complete eight years of education beyond high school (Rutsohn, 2005). Anesthesiologists complete twelve years of education following high school (Rutsohn, 2005). In 1992, the average educational cost per year for a student CRNA was \$11,741 compared to \$84,837 for an anesthesiology resident (Matsusaki and Sakai, 2011). According to Medicare/Medicaid, the cost of educating a CRNA is \$68,000 compared to \$356,000 for an anesthesiologist (Rutsohn, 2005). Thus, education and training costs for an anesthesiologist far outweigh those of a CRNA. Because of their shorter education, CRNAs can more quickly meet supply and demand by two thirds; and analysis of the data by Rutsohn (2005) indicates their education is 520% cheaper.

When considering the cost difference between providers, it is important to control for several factors such as setting, location, demand (number of surgeries or people seeking anesthesia) and type of anesthesia/operation. Hogan, Seifert, Moore, and Simonson (2010) considered these important variables and compared many different anesthesia provider models to

determine relationships between them. These models included anesthesiologist only, CRNA only, and four different supervisory models in which an anesthesiologist supervised one, two, three, or four CRNAs (referred to as anesthesia teams or care teams). This study compared time, cost, subsidies, and revenues obtained by each model in inpatient, outpatient and ambulatory surgical center settings. The conclusion was that anesthesia provided by CRNAs only, resulted in the least amount of cost and greatest revenue in most cases. This was also the only method that showed any cost benefit in situations where demand fluctuated the greatest or where demand was low. In other words, if there was any time during the day where one of the nurse anesthetists was not involved in a case, this method would become progressively less cost-effective; however, it became more effective when compared to the other provider combinations. The provider method in which one anesthesiologist supervises one CRNA was the least cost-effective in all scenarios, even when demand was high, therefore ranking as the least likely of provider models to be utilized. In cases where the demand was consistently high, the medical direction model in which one anesthesiologist supervised two to four CRNAs could nearly match the revenue of the nurse anesthetists only method if reimbursement policies were not an issue (Hogan, Seifert, Moore, & Simonson, 2010). In addition, according to an analysis of claims data, CRNA only methods provide the most affordable care to private payers (Hogan, Seifert, Moore, & Simonson, 2010).

Access to Care

As an increasing number of people are entering retirement, qualifying for Medicaid and Medicare (resulting in an increasing number of insured Americans), the number of surgeries, and consequent need for anesthesia care, will subsequently increase (Schubert, Eckhout, Ngo, Tremper, & Peterson, 2012). Hospitals are progressively having to find ways to cut costs to

provide quality care. This increase in insured Americans and the projected increase in surgical operations strains the healthcare system because the number of anesthesiologists may be unable to meet the populations' demand for anesthesia services. (Schubert, Eckhout, Ngo, Tremper, & Peterson, 2012).

A study by Liao, & Quraishi, (2015) compared the numbers of anesthesiologists and CRNAs employed throughout the country and their location of employment. It was found that 64 percent of anesthesiologists occupied rural locations where average household income was above the 75th percentile compared to only 42 percent of CRNAs. The study also concluded more CRNAs are employed where median household income was below the 25th percentile. Another geographical imbalance between the two providers is that anesthesiologists tend to reside in coastal locations on both the western and eastern seaboard. Anesthesiologists are also found to be employed by hospitals in denser urban counties where there are greater populations and more operating rooms. This is most likely because anesthesiologists demand higher salaries, and therefore, can only be employed by the larger inner-city hospitals that can offer these higher wages. Liao & Quraishi (2015) found states that contain higher numbers of rural counties and have greater populations of persons who earn below the poverty line employed larger numbers of non-physician providers, such as CRNAs, as compared to higher income states and urban counties.

As of 2009, Alaska, California, Colorado, Iowa, Idaho, Kansas, Kentucky, Minnesota, Montana, Nebraska, New Hampshire, New Mexico, North Dakota, South Dakota, Washington, Wisconsin, and Oregon have elected to opt-out of the federal requirement for physician supervision of CRNAs. In these states, CRNAs are often the sole providers of anesthesia

services, thus providing these states with access to many surgical and obstetric services that otherwise may not be possible (Matsusaki & Sakai, 2011). Furthermore, there is a 250% increase in the chance patients in states with less restrictions on scope of practice will receive care from advanced practice nurses than in states with more restrictions (Kuo, Loresto, Rounds & Goodwin, 2013). In addition to increasing accessibility to care, about half of participants in a study conducted by Dill, Pankow, Erikson and Shipman were willing to receive care from a non-physician provider; but this number greatly increased when factoring in the wait time needed to see a physician compared to a non-physician provider (Dill, Pankow, Erikson, & Shipman, 2013) as cited in Liao & Quraishi, 2015.

Fallacaro & Ruiz-Law (2004) reported that CRNAs reside in 825 counties in the United States where no anesthesiologists reside, and 97 percent of the 825 counties (740) are rural. In addition, Fallacaro & Ruiz-Law also reported that 843 counties in the United States have no anesthesia provider, of which 97 percent (816) are rural counties.

DISCUSSION

The evidence found in the existing literature suggests no statistically significant differences in patient mortality related to anesthesia provider (Glance, 2010; Hogan, Seifert, Moore, & Simonson, 2010; Rutsohn, 2005; Simonson, Ahern & Hendryx, 2007). In addition, a conclusion might be drawn that safety outcomes between CRNAs and anesthesiologists are equal since there were no data uncovered during the review to suggest otherwise. This result allows for a more accurate comparison between the two professions as the quality of care variable can be disregarded.

The other question answered in this paper was which provider was the most cost-effective? Cost-effectiveness greatly impacts employment opportunities as well as access to health care for many rural hospitals and underserved regions. There are many things to consider when comparing the cost effectiveness between CRNAs and anesthesiologists, including similarities and differences between the two professions. Both providers have such similar scope of practice that it seems to overlap; their only major difference is in education, reimbursement and geographical distribution.

Salaries of anesthesiologists are, on average, double the salaries of CRNAs. In 2008, the median yearly income of an anesthesiologist was \$321,686 compared to CRNAs, who received a yearly income of \$160,000 (Kalist, Molinari, & Spurr, 2011). From these data, it is reasonable to conclude that the cost to receive care from an anesthesiologist is costlier than that of a CRNA. It would be wise for hospitals and independent payers to utilize the most effective and efficient method of anesthesia, especially in a buyers' market. Hospitals and buyers need to recognize the significant difference in cost with little to no difference in quality of care between provider type.

By utilizing the most cost-efficient anesthesia provider, hospitals and individuals will gain substantial savings. Hogan, Seifert, Moore, & Simonson, (2010) have already demonstrated the scenarios that most effectively utilize CRNAs and anesthesiologists to maximize cost-efficiency.

The third difference seen in provider type is in their location of employment. The imbalance in distribution of anesthesia care providers has revealed some vital information, especially when considering the states that have opted out of the Medicare part A requirement for physician supervision. In the states that have opted out of this requirement, CRNAs outnumber anesthesiologists 1.36:1 (Fallacaro & Ruiz-Law, 2004). The same study arbitrarily selected three states with large urban populations (excluding the states that opted out of the Medicare requirement) and found that anesthesiologists outnumber CRNAs 4.2:1 (Fallacaro & Ruiz-Law, 2004). These findings suggest two things: first, that CRNAs are choosing to work where they have the least number of barriers and their license is least restricted, therefore maximizing their scope of practice. Second, these findings indicate government policy makers in states that opted out of the Medicare part A requirement for physician supervision did so to increase their populations' access to anesthesia services.

The increase in demand and expense of health care in general will continually push hospitals and the government to find ways to cut health care costs while simultaneously providing efficient and high-quality services. Liao and Quraishi found a strong correlation between three variables that influenced the geographical distribution of anesthesiologists (2015). These variables included population density, county median income, and the number of operating rooms (Liao and Quraishi, 2015). This results in rural hospitals having greater difficulty in attracting and supplying anesthesiologists. When the vulnerable populations in rural

America need anesthesia services, they are more likely to receive them from a CRNA (Liao & Quraishi, 2015). This leads states that contain large amounts of rural counties and populations that earn below the poverty line to attract non-physician health care providers such as nurse practitioners, physician assistants, and CRNAs (Liao & Quraishi, 2015). These lower income and rural dominated states attract non-physician providers by allowing greater autonomy and broader scope of practice. This permits non-physician providers to practice to their full potential while concurrently increasing their earning potential. Consequently, CRNAs are employed in greater numbers in states with the least amount of regulations and restrictions regarding scope of practice and prescriptive authority (Fallacaro & Ruiz-Law, 2004).

The results of the study conducted by Hogan, Seifert, Moore, & Simonson (2010) indicated CRNAs are most cost-effective in situations where demand is low or where demand fluctuates greatly. This may further serve as a primary reason why CRNAs make up most of anesthesia care providers in rural locations. These results also have great implications for rural hospital managers and employers who are needing to cut costs while still providing quality access to health care.

To meet the demand, it is possible more medical institutions will be forced to drop physician-only lead anesthesia groups and move towards the more cost-effective method of utilizing CRNAs. This would not only help with hospital costs but also increase the populations' access to healthcare. Results of this study provide viable solutions to access to care. As already demonstrated, government officials have solved this problem in many states by opting out of the Medicare part A requirement for physician supervision. This is a significant method of attracting more CRNAs. This could be because it allows CRNAs to practice to their full potential by

removing limitations to their scope of practice. Existing data reflect that the numbers of CRNAs tend to be higher in states where there are less restrictions to their practice and in vulnerable populations (those living below poverty, higher proportion of elderly residents, and those reliant on Medicaid).

Conclusion

In conclusion, CRNAs provide equal quality of care; and they do so at a cheaper price (Hogan, Seifert, Moore, & Simonson, 2010). The cost of educating an anesthesiologist is far greater than educating a CRNA (Rutsohn, 2005). And this longer and more expensive education/training has not been found to improve quality of care to any significant extent compared to CRNAs. The longer more expensive training that anesthesiologists undergo results in higher wages and costs to hospitals and third-party payers (Kalist, Molinari & Spurr, 2011). As demand increases and more uninsured Americans become insured, CRNAs can greatly contribute to greater access to care and due to their shorter route of education, can reduce the number of needed anesthesia providers by 2/3rds the time compared to anesthesiologists. The implications from the findings in this study suggest hospitals can cut costs and provide high quality health care in a time where many Americans are becoming insured by utilizing the services of CRNAs and by allowing them practice to their full scope.

Limitations

The limitations of this study fail to incorporate the impact and implications that other non-physician anesthesia providers, like the AA, has in regard to quality of care, efficiency, and access to care. This key factor was left out because of the lack of data and studies performed on

AAs. They are a relatively new addition to the anesthesia care provider team; therefore, there is not a substantial amount of evidence published on their profession.

In addition, this study does not take into consideration how the change in educational requirements to become a CRNA will impact these issues. Starting in 2025, all CRNA programs must conclude with the earning of a doctorate degree. Thus, it will take a decade or longer to fully assess the care and cost impacts resulting from requiring a doctoral level of education by CRNAs. This change will also affect the cost and length education, and possibly quality of care. These are three components investigated in this study. Future studies need to take these changes into consideration and evaluate how it will affect costs, quality of care, and supply of CRNAs.

Recommendations

The results of this study demonstrate that non-physician providers are more likely to be employed in rural America serving low-income populations, the elderly, and the uninsured. CRNA programs need to implement these data into their curriculum to better prepare these professionals for the demographics they will most likely serve. Viable solutions could be to have more rotations/clinical sites in rural counties, courses in public health, management, and communication.

An area of conflict includes the relationship between anesthesiologists and CRNAs. These two professionals get along well and even flourish in team settings. However, in states where the requirement for physician supervision has been removed, they have a more competitive relationship. Future studies need to investigate this issue and accomplish ways to improve their relationship especially during a time when CRNAs' scope of practice is broadening and limitations to their scope of practice are being removed.

References

- Amburgey B, Fordham M, Payne B, Trebelhorn M. (2007) A study of anesthesiologist assistants (Report No. 337). Frankfort, Kentucky: Legislative Research Commission. Retrieved from <http://www.lrc.ky.gov/lrcpubs/RR337.pdf>
- Blumenreich, G. A. (1988). Physician-controlled insurance companies. *American Association of Nurse Anesthetists Journal*, 56(3), 198-200. Retrieved from <https://web-a-ebSCOhost-com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?vid=14&sid=aad12b26-6412-47fb-ac40-abcc827d1398%40sessionmgr4008>
- Dill, M.J., Pankow, S., Erikson, C., & Shipman, S. (2013). Survey shows consumers open to a greater role for physician assistants and nurse practitioners. *Health Affairs*, 32(6), 1135-1142. doi:10.1377/hlthaff.2012.1150
- Fallacaro, M., & Ruiz-Law, T. (2004). Distribution of US anesthesia providers and services. *American Association of Nurse Anesthetists Journal*, 72(1), 9-14. Retrieved from <https://web-a-ebSCOhost-com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?vid=32&sid=fe8c94be-759d-4dc9-84bc-7cad79d3d7a5%40sessionmgr4006>
- Glance, L. G. (2000). The cost effectiveness of anesthesia workforce models: a simulation approach using decision-analysis modeling. *Anesthesia And Analgesia*, 90(3), 584-592. doi:10.1097/00000539-200003000-00017
- Gunn, I. P. (2000). Rural health care and the nurse anesthetist. *CRNA: The Clinical Forum For Nurse Anesthetists*, 11(2), 77-86. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/11271044>

- Hogan, P., Seifert, R., Moore, C., & Simonson, B. (2010). Cost effectiveness analysis of anesthesia providers. *Nursing Economic\$,* 28(3), 159-169. Retrieved from <https://web-a-ebshost-com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?vid=21&sid=fe8c94be-759d-4dc9-84bc-7cad79d3d7a5%40sessionmgr4006>
- Kalist, D. E., Molinari, N. A., & Spurr, S. J. (2011). Cooperation and conflict between very similar occupations: the case of anesthesia. *Health Economics, Policy, And Law,* 6(2), 237-264. doi:10.1017/S1744133110000162
- Kane, M., & Smith, A. F. (2004b). An American tale – professional conflicts in anaesthesia in the United States: implications for the United Kingdom. *ANAESTHESIA,* 59(8), 793-802. doi:10.1111/j.1365-2044.2004.03801.x
- Kuo, Y., Loresto, F. J., Rounds, L. R., & Goodwin, J. S. (2013). States with the least restrictive regulations experienced the largest increase in patients seen by nurse practitioners. *Health Affairs (Project Hope),* 32(7), 1236-1243. doi:10.1377/hlthaff.2013.0072
- Liao, C. J., & Quraishi, J. A. (2015). Geographical imbalance of anesthesia providers and its impact on the uninsured and vulnerable populations. *Nursing Economic\$,* 33(5), 263-270. Retrieved from <https://web-a-ebshost-com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?vid=23&sid=fe8c94be-759d-4dc9-84bc-7cad79d3d7a5%40sessionmgr4006>
- MacIntyre, P., Stevens, B., Collins, S., & Hwer, I. (2014). Cost of education and earning potential for non-physician anesthesia providers. *American Association of Nurse Anesthetists Journal,* 82(1), 25-31. Retrieved from <https://web-a-ebshost->

com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?vid=23&sid=aad12b26-6412-47fb-ac40-abcc827d1398%40sessionmgr4008

Matsusaki, T., & Sakai, T. (2011). The role of certified registered nurse anesthetists in the United States. *Journal Of Anesthesia*, 25(5), 734-740. doi:10.1007/s00540-011-1193-5

Merwin, E., Stern, S., & Jordan, L. (2006). Supply, demand, and equilibrium in the market for CRNAs. *American Association of Nurse Anesthetists Journal*, 74(4), 287-293. Retrieved from <https://web-a-ebSCOhost-com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?vid=7&sid=c0c7e9e6-3dda-4489-b2ce-7244346d8509%40sessionmgr4008>

Negrusa, B., Hogan, P. F., Warner, J. T., Schroeder, C. H., & Pang, B. (2016). Scope of practice laws and anesthesia complications: no measurable impact of certified registered nurse anesthetist expanded scope of practice on anesthesia-related complications. *Medical Care*, 54(10), 913-920. doi:10.1097/MLR.0000000000000554

Rutsohn, P. (2005). Anesthesiologists and anesthetist: are we paying for outcome or process?. *Journal Of Hospital Marketing & Public Relations*, 15(2), 69-77. doi:10.1300/J375v15n02_05

Schubert, A., Eckhout, G. V., Ngo, A. L., Tremper, K. K., & Peterson, M. D. (2012). Status of the anesthesia workforce in 2011. *Anesthesia & Analgesia*, 115(2), 407-427. doi:10.1213/ane.0b013e3182575b4e

Simonson, D. C., Ahern, M. M., & Hendryx, M. S. (2007). Anesthesia staffing and anesthetic complications during cesarean delivery: a retrospective analysis. *Nursing Research*, 56(1), 9-17. Retrieved from <http://ovidsp.tx.ovid.com.ezproxy.net.ucf.edu/sp->

3.29.1a/ovidweb.cgi?WebLinkFrameset=1&S=CKGBFPDKCMDDEAEPNCFKFHLBC
INCAA00&returnUrl=ovidweb.cgi%3f%26Full%2bText%3dL%257cS.sh.32.33%257c0
%257c00006199-200701000-
00002%26S%3dCKGBFPDKCMDDEAEPNCFKFHLBCINCAA00&directlink=http%3
a%2f%2fovidsp.tx.ovid.com%2fovftpdfs%2fFPDDNCLBFHEPCM00%2ffs046%2fovft
%2flive%2fgv023%2f00006199%2f00006199-200701000-
00002.pdf&filename=Anesthesia+Staffing+and+Anesthetic+Complications+During+Ces
arean+Delivery%3a+A+Retrospective+Analysis.&pdf_key=FPDDNCLBFHEPCM00&p
df_index=/fs046/ovft/live/gv023/00006199/00006199-200701000-00002