A STUDY OF CERTIFIED REGISTERED NURSE ANESTHETIST MANPOWER SUPPLY AND DEMAND IN NEBRASKA: VII

by

Dyanna E. Swanigan BSN

and

Katie L. Twomey BSN

Bryan College of Health Sciences

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Abstract

Background: A shortage of healthcare professionals is a problem many hospitals may face in the era of an expanding aging population. The impact of healthcare provider shortages has proven to be detrimental. A shortage of Certified Registered Nurse Anesthetists (CRNAs) has the potential to impact the healthcare system across the United States. This research study was a continuation of a Nebraska CRNA manpower study originally conducted in 1991 by Sharon K. Loseke. This study represents the seventh Nebraska CRNA manpower study completed.

Methods: A mailed questionnaire was sent to 455 CRNAs with a Nebraska CRNA license who listed Nebraska or Pottawattamie County, Iowa home addresses. The questionnaire addressed demographic information, employment setting, activity rate, and anticipated changes in activity rate (Appendix B). Employers of CRNAs including hospitals, ambulatory surgical centers (ASCs) and private practices were also surveyed. A total of 51 employers were contacted by email and telephone. The hospital, ASC, and private practice questionnaire contained information on demographics, current anesthesia providers, CRNA recruitment, and projected changes in CRNA needs (Appendix C).

Results: The CRNA questionnaire response rate was 69%, with 313 returned questionnaires. The number of CRNAs planning to retire between 2020 and 2025 was 50, or 17% of respondents. There were 22 CRNAs who plan to relocate within five years, or 7.5% of respondents. The employer response rate was 52.9%, with 27 returned questionnaires. A 7.9% vacancy rate was reported, which more than doubled from the reported 3.6% in 2015. Of the 27 respondents, 55.5% of facilities reported CRNAs as the sole anesthesia providers in their facility. An estimated 19 positions were currently vacant among all facilities, with the potential for 33 more positions by 2025.

Conclusion: The current study reversed the declining trend in the proportion of facilities that utilized CRNAs as their sole anesthesia provider, with an increase in the number of these facilities in 2020. The study also found the highest percentage of CRNAs projected to retire since the study was originally conducted in 1991. An estimated need of between 124 to 202 additional CRNAs is projected by the year 2025. This study finds there is still a shortage of CRNAs in Nebraska.

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Introduction

Background

All nurses play an invaluable role in today's health-care system. As advanced practice nurses, Certified Registered Nurse Anesthetists (CRNAs) are valuable assets with the ability to independently practice across the United States. With the state of Nebraska being heavily populated by rural communities, CRNAs are an essential component in order for surgical, obstetric, pain, and emergency care to be offered across the state.

The history of nurses providing anesthesia began in 1877 when Sister Mary Bernard became the first nurse to specialize in anesthesia (AANA, 2020). The profession of nurse anesthesia continued to expand and grow throughout the early 1900s. An exceptionally important event occurred when congress passed legislation that allowed CRNAs to obtain direct reimbursement under Medicare part B in 1986. This enactment labeled CRNAs as the first nursing specialty to be granted direct reimbursement rights under the Medicare program. The CRNA profession continues to develop and grow in working together with surgeons, physician anesthesiologists, and all qualified healthcare professionals to deliver anesthesia care. The supply of CRNAs affects accessibility of healthcare and is vital to the healthcare system not only in the state of Nebraska but also for the entire United States.

Problem Statement

According to the American Association of Nurse Anesthetists (AANA, 2020), CRNAs have been providing care to patients in the United States for more than 150 years and are involved in more than 49 million anesthetics each year. CRNAs practice in a wide variety of settings including but not limited to hospitals, ASCs, offices of physicians, and pain management services. These findings underscore the importance of CRNAs. In a study done by Liao et al.

(2015), they found that anesthesia providers are not evenly dispersed throughout the country leading to an uneven distribution of access to providers across the United States. This is important to consider because in some states, CRNAs are the sole anesthesia providers in rural communities.

Merwin et al. (2009) conducted a descriptive analysis study from data gathered in 2007 in order to predict supply and demand needs of CRNAs across the United States. The state of Nebraska was reported to have CRNA vacancies that were statistically significant (Merwin et al., 2009). National estimated vacancy rates of CRNAs from a prior questionnaire done by Merwin et al. (2006), increased from 2,674 to 5,020 ($p<0.01$). In the United States there is a constant demand for healthcare services, one of these being surgery, which requires anesthesia and thus CRNA's. As the age of the average citizen increases nationally, and as technology allows human beings to live longer, the demand for CRNAs will continue to expand.

Purpose

The purpose of this study was to measure the current unmet need of CRNAs in 2020 and to predict future unmet needs from 2020-2025 of CRNAs in the state of Nebraska. Data gathered included demographic and practice setting information. Regional differences in CRNA demographic and practice data was determined. The purpose of the CRNA questionnaire was to assess how many CRNAs currently practicing in Nebraska expect to retire or relocate out of the state in the next five years, to determine the age distribution of CRNAs in Nebraska, to determine the regional differences within Nebraska related to the prior factors, and to determine where the CRNAs within the state were educated. The data gathered from the CRNA questionnaire was also used to trend information for the time period between 1991-2020.

CRNA employer findings are based on demographics, the number of current anesthesia providers, CRNA recruitment times, and projected changes in CRNA needs (Loseke, 1991). This information was used to predict changes in the number of full-time equivalents for CRNAs required by Nebraska hospitals and ambulatory surgical centers. The demographic data collected from the employers of CRNAs included the number of procedures that required anesthesia services in 2019. The employer questionnaire also included the number of those full-time equivalents that were filled or vacant. Information related to recruitment of CRNAs was included in the questionnaire. The future need for CRNAs was assessed by asking for estimates of either increasing or decreasing the number of CRNA positions within five years.

Operational Definitions

Ambulatory Surgical Center (ASC). A facility that provides surgical procedures to patients with a stay less than 24 hours.

Anesthesia. The art and science of rendering a patient insensible to pain by the administration of anesthetic agents and related drugs and procedures (AANA, 2020).

Anesthesia Services. Services which anesthesia professionals provide upon request, assignment, and referral by the patient's physician or other health care provider authorized by law, most often to facilitate diagnostic, therapeutic and surgical procedures. In other instances, the referral or request for consultation or assistance may be for management of pain associated with obstetrical labor and delivery, management of acute and chronic ventilatory problems, or management of acute and chronic pain through performance of selected diagnostic and therapeutic blocks or other forms of pain management (AANA, 2020).

Anesthetic. The process of providing anesthesia services to an individual. Several different agents and techniques may be utilized to provide one anesthetic.

Physician anesthesiologist. A licensed physician who practices in the specialty of anesthesia.

Certified Registered Nurse Anesthetist (CRNA). A registered nurse who has been educated in the specialty of anesthesia and who has been certified by the National Board on Certification and Recertification of Nurse Anesthetists. Successful completion is necessary for a candidate to be granted certification.

National Certification Examination. The national standardized examination administered by the National Board of Certification and Recertification of Nurse Anesthetists.

Nebraska Hospital Association District Map. The state of Nebraska has been divided into five districts by the Nebraska Hospital Association. (Appendix A)

Full Time Equivalent (FTE). A position that would require one person to work 40 hours a week and 46 weeks per year for a total of 1,840 hours per year.

Nationwide CRNA Supply and Demand

According to Daugherty et al. (2010), it is important to understand the current and future supply and demand for anesthesia services. This is of essence due to an aging population and a growing demand for surgical and interventional procedures. A research study was conducted by RAND health in order to examine anesthesia labor markets in the United States. The researchers first conducted a national survey of physician anesthesiologists and CRNAs regarding work practices, wages, time usage, and procedure volumes. After this data was obtained, they developed an econometric model that drew data from the original surveys and included state level variables in order to estimate the supply and demand for both physician anesthesiologists and CRNAs. The RAND study concluded that there are shortages of both physician anesthesiologists and CRNAs nationwide (Daugherty et al., 2010). The study estimated that 60%

of the U.S. was experiencing a shortage. More specifically they noted that there is a 9.6% shortage of physician anesthesiologists and 3.8% shortage in the CRNA workforce.

These shortages were spread relatively evenly across different regions of the United States, with the northeast part of the country having a more acute shortage of CRNAs specifically. Daugherty et al (2010) found that there were 3.4 CRNA open positions for every 100 positions, while the Midwest only reported 3.06 open positions per 100. There were a total of 1,282 CRNA positions that needed filled and the projected shortage would amount to 4,479 physician anesthesiologists by 2020 with a surplus of 7,970 CRNAs. However, the surplus was predicted with keeping the demands the same and not factoring in the demands for CRNAs and growth of the market increasing in the future. The study also noted that it is important to take a "state-level" approach when addressing the supply and demand of anesthesia providers.

Another large study was conducted by Merwin et al. (2006) to determine the trends in supply, demand and equilibrium in the CRNA workforce across the nation. In order to predict supply into the future, there were three main factors that were evaluated. This included the number of CRNAs educated and newly certified, the age of these newly educated and certified CRNAs at time of entry into the field, and the rate at which CRNAs retire or leave CRNA employment (Merwin et al., 2006). These researchers identified potential factors playing a role in the shortage of CRNAs. According to Merwin et al. (2006), the AANA attributed the lack of CRNA educational programs as a direct cause of a decrease in CRNA graduates. In 1976, there were 194 educational programs for CRNAs (Merwin et al., 2006). This number then declined to 104 by 1986 and to 82 educational programs by 1990 (Merwin et al., 2006). Gunn (1991) recognized that this major series of nurse anesthesia educational program closures was frequently cited as due to an increasing number of medical school graduates seeking to enter residencies,

and clinical resources were needed for these additional residents. Gunn (1991) noted a decline in the number of CRNA graduates from about 1,100 per year to 600; thus producing a very drastic shortage in a very short time period in the 1980s. In 1989, this prompted the AANA to develop a committee known as the National Commission on Nurse Anesthesia Education (NCNAE). This committee was focused on nurse anesthesia educational programs and developed eight goals with corresponding strategies to combat the decline in educational programs. The work of this committee, alongside the council on accreditation (COA) and the AANA education committee, continued to closely monitor the number of nurse anesthesia programs and graduates. As programs continued to close, existing programs increased student enrollment and added more clinical sites (Mastropietro et al., 2001).

To follow up, Merwin et. al conducted a study in 2009 to look at new estimates for vacancies of CRNAs on a state level for hospitals and on a regional level for ASCs. There were 5,400 hospitals and 5,033 ASCs that were surveyed. The study concluded that the states with the highest vacancy rates were in the upper Midwest and many states east of the Mississippi River. Nebraska was found to be among the states with the highest vacancy rates. Rural hospitals had higher vacancy rates and ASCs had fewer vacancies. The number of vacancies grew from 2,674 to 5,020 ($p < 0.01$) compared to Merwin's previous study in 2006 (Merwin et. al, 2009). The study concluded that the increased demand for CRNAs has influenced the supply and training of CRNAs. However, the increase in supply still did not prove to offset the number of CRNAs retiring.

Educational mandates as outlined by the COA were also considered as a potential impact on registered nurses applying for anesthesia school. In 2009, the COA mandated that all CRNA programs after 2022 would be required to receive a practice doctorate upon graduation. This

change increased the number of months required to complete the degree, potentially creating barriers to an interest in CRNA education.

Methodology

Survey methodology was used for both the CRNA questionnaire and the anesthesia employer questionnaire. A mailed questionnaire research design has been the traditional design of the CRNA questionnaire since 1991 when it was originally pioneered. Mailed (postal) questionnaires offer many benefits including access to a large population, convenience, intermediate cost, and no interviewer bias (Story & Tait, 2019). When developing a questionnaire, it is important to develop clear research questions to focus on. The questions that are asked should be clear, short, and kept to a "need to know" format rather than a "nice to know" (Story & Tait, 2019). It is also important to aim for the questionnaire to be completed in under 10 minutes. It is suggested by Story and Tait (2019) that a response rate of greater than or equal to 40% is achieved. There are several disadvantages of postal questionnaires. For example, a lower response rate can occur with this specific design. It is also possible for respondents to have difficulty completing the questionnaire. This can lead to a respondent not returning to the questionnaire. Non-response can be one of the most frustrating aspects of questionnaire research (Story & Trait, 2019). Some non-response is expected in questionnaire research, however, questionnaire research that has a high non-response rate is subject to bias.

CRNA Questionnaire

The Nebraska Certified Registered Nurse Anesthetist (CRNA) manpower study has traditionally been conducted every five years in a similar manner since its origin in 1991. This study represented the seventh time it has been conducted. Prior researchers that completed this study include Loseke in 1991, Knape in 1995, Huls in 2000, Petta in 2005, Webster and Waweru

in 2010, and Aguilos and Sibbett in 2015. In the present research study, data gathering was divided with a researcher focusing on the supply of CRNAs and a separate researcher focusing on the demand of CRNAs. Both questionnaires, the CRNA and employer questionnaire, were originally created by Loseke in 1991. When the original questionnaire was completed in 1991 by Loseke, the CRNA questionnaire consisted of 12 questions. Small adjustments have been made every year, adjusting as needed to help with clarity and to gain more demographic information. Knape added a question to gain relocation information from the CRNA. Petta added two additional questions, one addressing the practice information, and the second question regarding where the CRNA was educated. Aguilos and Sibbett in 2015 removed a question asking how many hours was spent at other facilities. They also included two questions that addressed specific details on retirement information. No changes were made to the CRNA questionnaire for the present research study. The final CRNA questionnaire consisted of 14 questions which aimed to address four general areas: demographics, employment setting, workload and anticipated changes in activity (Appendix B). This CRNA questionnaire aimed to gather information regarding the current and future supply of CRNAs. The questionnaire was designed to measure a variety of variables and to analyze and project future trends in Nebraska CRNAs.

The demographic data that was collected via the questionnaire included age, place of education, location of residence and location of practice. The state of Nebraska is divided into districts I-V by the Nebraska Hospital Association (Appendix A). Prior Nebraska manpower studies have utilized these five districts to group CRNAs and to report the findings as aggregate data. A CRNA that practiced and resided in the same district was categorized into that district. Commonly, a CRNA may practice and reside in different districts, when this occurred, the CRNA was categorized into the district in which they practice. If the CRNA practiced in

multiple districts and resided in a different district, they were categorized into the district of residence.

For the purpose of gaining more data on CRNAs employment setting in Nebraska, a specific question was included and listed five potential options including hospital employee, CRNA group, self-employed, physician anesthesiologist group, and other. Workload of the CRNA was assessed by leaving an open-ended question regarding how many approximate anesthetics were performed in 2019 and the number of hours per week that a CRNA performed direct anesthesia care (including in house call, department management and nurse anesthesia continuing education hours). Another open-ended question to assess the workload asked about the number of facilities a CRNA administers anesthesia during a typical work week. If the open-ended questions were answered with a range of numbers by the respondent, the average of the high and low number was recorded as the response with the exception of the question regarding the number of facilities a CRNA administers anesthesia at during a typical work week. If a range was listed for this question, then the highest number was marked as a response.

Information to help the researchers gain insight on the future supply of CRNAs was included on the questionnaire. The CRNAs were asked if they anticipated changing their work commitment in the next five years and were left with three options, increasing, decreasing, or no change. Also included in the questionnaire was plans to relocate out of the state or retirement within the next five years.

The participants in the study included all CRNAs licensed by the State of Nebraska with home mailing addresses in the state of Nebraska or Pottawattamie County, Iowa. Council Bluffs, Iowa is located in Pottawattamie County and has been included because of the close geographic proximity to Omaha, Nebraska. Omaha is the largest city in Nebraska and a significant number

of CRNAs who practice in Nebraska are likely to live in Council Bluffs, Iowa. Prior studies in 1991, 1995 and 2000 included all CRNAs with a Nebraska license who resided in a state bordering the state of Nebraska including Iowa, Kansas, Colorado, Wyoming, and South Dakota. In 2005 the criteria for inclusion was changed to the present format. A CRNA questionnaire was mailed to CRNAs by one researcher (Appendix B). The CRNA questionnaire was mailed to 455 CRNAs licensed to practice in the state of Nebraska with either a Nebraska or Pottawattamie County, Iowa address. The mailing addresses were obtained via the Nebraska Department of Health and Human Services website which is available to the public for a fee. A cover letter was sent to each participant briefly outlining the details of the enclosed questionnaire with key contact information (Appendix D). A unique number was assigned to each CRNA address. The data was transferred onto mailing labels with the CRNA's name, address, and unique number. Return envelopes that were prepaid and pre-addressed to the Bryan College of Health Sciences were included in the mailing envelope along with a cover letter and the questionnaire. In order to track responses anonymously, the CRNA's unique number was placed on the return envelope. When the questionnaires were returned by the respondent, the college administrative assistant opened and separated the questionnaire from the return envelope, thus blinding the researcher to the identity of the CRNA respondents. The administrative assistant removed the respondents from the CRNA address list. If the original questionnaire was not completed within three weeks, then a follow-up questionnaire was sent. The process was repeated for a third and final time if no response was received after the second mailing.

Each question on the CRNA questionnaire was coded. After the data was collected, each questionnaire was entered as numerical data into a spreadsheet. This data was then analyzed and compared to prior manpower studies completed since 1991.

Anesthesia Employer Questionnaire

A master list of hospitals was created from the DHHS and Nebraska Hospital Association websites. Phone numbers of the facilities were obtained from the websites. A spreadsheet was created to list the name of the facility, contact person, phone number, email address of the administrative party to receive the questionnaire and status updates. A total of 126 facilities were contacted via phone or through previous email addresses on file. Of those facilities, four facilities did not utilize CRNAs, eight facilities did not return the voice message left by the researcher, and three did not provide anesthesia services. A total of 72 facilities used the same CRNA group as another facility or facilities. Only one email address was provided for employers which covered multiple locations, to avoid duplication. There was a place to indicate on the questionnaire if the group had other locations where CRNAs were utilized. Only those facilities that used CRNAs were sent questionnaires. Among the 126 facilities contacted, 51 email addresses were obtained. A cover letter was sent to the email address with information on the upcoming email containing an electronic link to the questionnaire administered through the Typhon questionnaire system (Appendix E)

Once the questionnaire was completed, de-identified results were sent via email to the researcher, maintaining blind results. A spreadsheet was created and responses were coded and entered for each questionnaire. To allow comparison with prior studies, the overall format and questions were kept the same (with the omission of two questions) in hopes of maintaining a high response rate. The only major change was distributing the CRNA employer questionnaires by an email which contained a link. The data was then analyzed and compared to prior manpower questionnaires completed since 1991. The data from previous studies separated the

hospitals from the ASCs. This study will combine the results since many anesthesia groups cover hospitals and ASCs; this will help to not duplicate results or skew the data.

The questionnaire sent to employers consisted of the same format used by Loseke, Knape, Huls, Petta, Webster and Waweru, and Aguilos and Sibbett (Appendix C). The purpose of the anesthesia employer questionnaire was to anticipate changes in the need for CRNAs and the amount of time spent to recruit a CRNA to a Nebraska facility. There were two questions omitted from the most recent questionnaire: *Do you anticipate the Health Care Reform affecting your hiring practices of anesthesia providers? Do you anticipate the Health Care Reform affecting your number of surgical procedures at your hospital/surgery center?* These questions were omitted because the Health Care Reform Act has since been established and should not affect the future five years of hiring CRNAs.

The demographic data collected was the county in which the hospital/ASC resides and the number of procedures that required anesthesia services in 2019. Each facility was assigned one of five districts that were previously established by the Nebraska Hospital Association (Appendix A). If anesthesia services were provided at the facility, they were asked to provide the number of full-time equivalent physician anesthesiologists and CRNAs. The questionnaire also included the number of those full-time equivalents that were vacant.

Information related to recruitment of CRNAs was included in the questionnaire. Administrators were asked about the length of time it took to fill any vacancies and if it was necessary to recruit a physician anesthesiologist due to difficulty recruiting a CRNA.

The future need for CRNAs was assessed by asking for estimates of either increasing or decreasing numbers of CRNA positions within five years.

Institutional Approvals

Each questionnaire was reviewed by the IRB separately. The CRNA questionnaire was approved with expedited review by the Institution Review Board (IRB) at Bryan College of Health Sciences on April 15, 2020 (Appendix F). The anesthesia employer questionnaire was granted exempt status by the IRB on May 29, 2020 (Appendix G).

Limitations

Non-response is an important consideration to take into account with questionnaire research. Non-response bias is a limitation of this study, however, with a response rate of 69% and 52.9% this is minimal. Recall that bias is another potential limitation to the CRNA questionnaire. This is specifically related to being able to remember certain aspects of the questions asked, such as *"how many anesthetics did you administer in 2019?"*.

The impact of the COVID-19 pandemic on the research of this study was a limitation. The employer questionnaire was put on hold while hospitals were not conducting elective surgeries during the summer of 2020. CRNAs were being utilized in other areas of the hospital during the COVID-19 pandemic. With all the changes due to the pandemic, hospitals and ASCs were not contacted until August 2020 in order to give the facilities time to start up with regular caseloads again. This may have had an impact on timing for hiring new CRNAs and potential increased or decreased number of CRNA positions available.

Assumptions

It was assumed that all respondents were willing to provide truthful and accurate information. It was also assumed that the respondents would be able to interpret each question accurately in order to provide a factual response.

Results

Response rate

In 2020 there were 455 CRNAs with a Nebraska license that had either a Nebraska address or Pottawattamie County, IA address. Overall, the response rate for CRNAs was 69% with 313 respondents (Table 1), a slight increase from the 67% rate achieved in 2015. The studies conducted between 1991-2005 all had response rates between 72% and 84%. The present study had 21 respondents, or 7% of respondents, who did not provide anesthesia in Nebraska in 2019. These 21 respondents were only used to calculate response rate and not for any further data analysis. The responses by district were as follows (Table 2): District I, 125 respondents or 43% of respondents. District II had 39 respondents or 13% of the total respondents. District III had 23 respondents or 8% of respondents. District IV had 49 respondents or 17% of respondents. District V had 56 respondents or 19% of respondents. Analyzing, over the past 20 years, it has been a consistent finding that District I represents the highest percentage of CRNA respondents to the questionnaire (Table 3).

Of the 51 email contacts for the employer questionnaire, there were 27 total responses to the questionnaires; this equals a response rate of 52.9%. The return rate for 2015 was 61.9%, 2010 was 71.1%, 2005 was 75.6%, 2000 was 82%, 1995 was 74% and 1991 was 89% (Table 4). The response rate can be broken down by district (Table 5). District II had the largest number of responses with 8, or 30% of the responses. Districts IV and V each had 26% of the responses (n=7). District I had 11% (n=3), and District III had 7% (n=2) of the total responses.

CRNA Questionnaire Findings

The seventh Nebraska CRNA manpower questionnaire was designed to gather data in order to gain more information on the current and future supply and demand of CRNAs in the state of Nebraska. The CRNA questionnaire was designed to gather data for five research questions. The data collected reflected the year 2019.

Research Question 1: How many CRNAs currently practicing in Nebraska expect to retire or relocate out of the state in the next five years? A total of 50 respondents or 17.1% indicated that they would be retiring within the next five years (Table 6). The 1991, 1995, 2000, 2005, 2010, and 2015 studies had retirement estimates of 24 (15%), 21 (13%), 25 (13%), 20 (10.6%), 20 (9.2%), and 36 (15.3%) respectively. The present study has the highest percentage of projected CRNAs to retire since the study was originally conducted in 1991. The percentage of potential retirees within the next five years varied by region with a high of 39% (n=9) in District III to a low of 9.6% (n=12) in District I. To determine the percentage of retirees per district the total number of respondents was broken down into district location. For example, District I had 125 total respondents. Twelve of these respondents indicated that they would be retiring within the next five years. This creates a 9.6% retirement rate.

In regard to, CRNAs planning to relocate out of state by the end of 2025 there were 22 respondents (7.5%) that indicated they would be relocating out of state (Table 7). The 1995, 2000, 2005, 2010, and 2015 studies found 8%, 7%, 10.6%, 7.8%, and 8.9% respectively. In 1991 when the original study was completed, this question was not present in the CRNA questionnaire. The district with the highest percentage of respondents indicating relocation out of the state was District III at 6 respondents or 26.1%. District I, II, and III all recorded 6 respondents that indicated relocation out of Nebraska by the end of 2025. The District with the lowest percentage was District IV, with only 1 respondent or 2% of the CRNAs in the district indicating relocation out of the state in the next five years.

Research question #2: What is the age distribution of CRNAs in Nebraska? Approximately 36.3% (n=106) of the CRNA respondents are under the age of 40. Another large representation of age distribution of the respondents was 30.1% (n=88) in the 40-49 years of age

(Table 8). In the prior study completed in 2015, 34.4% (n=77) of respondents were under the age of 40 and 22.3% (n=50) were between the ages of 40-49 (Figure 1). The district with the greatest percentage of CRNAs over the age of 49 was District III, with 11 respondents, representing 47.8% of the CRNA respondents in the district (Table 9). In 2015, District III also represented the highest percentage of CRNAs over the age of 49 with 70.6% (n=12) of respondents representing this age category.

Research question #3: What are the regional differences within Nebraska related to the above factors? District III represented the highest percentage (39%, n=9) of CRNA respondents in the district who plan to retire within the next five years. District III also represented the highest percentage (26.1%, n=6) of CRNA respondents in the district with plans to relocate by the end of 2025. District I had the lowest percentage (9.6%, n=12) of CRNA respondents in the district planning on retiring by the end of 2025. Comparing the regional differences in CRNA age distribution District I had a fairly even percentage of CRNAs less than 40 (35.3%, n=44), 40-49 (34.4%, n=43), and greater than 49 (30.4%, n=38). Interestingly, District II had the highest percentage (48.7%, n=19) of CRNAs to report an age less than 40. District III had the highest percentage (47.8%, n=11) of CRNA respondents to report an age greater than 49. As mentioned earlier, the prior study showed District III represented the highest percentage of CRNAs reporting an age over 49. District IV and District V had similar findings to District I.

Research question #4: Where were the CRNAs within the state of Nebraska educated? There were 37 different CRNA education programs from across the United States that were listed by the 292 respondents (Table 10). Many of the programs listed are no longer in existence. Currently there are 124 accredited Nurse Anesthesia programs across the United States. If more than one degree was listed by the respondent, the original degree obtained was recorded as an

answer. For instance, if both the masters and the bachelor nurse anesthesia education programs were listed, the place of the Bachelor degree in nurse anesthesia education was recorded.

The Bryan College of Health Sciences Nurse Anesthesia program represented the highest number of respondents at 118 or 40.4% of CRNA respondents. Mount Marty School of Nurse Anesthesia was reported as the place of education by 69 CRNAs, representing 23.6% of the respondents. Clarkson School of Nurse Anesthesia represented 24 respondents, or 8.2%. This number saw a significant increase in comparison to the 2015 questionnaire with only 4 respondents reporting Clarkson as the place of education. The Clarkson College of Nurse Anesthesia has been open since 2010. The University of Kansas had 11 respondents or 3.8% of CRNAs. Creighton represented the fifth largest number of CRNAs reporting their place of education at 10, representing 3%. A total of 79.5% of respondents were educated at one of these five programs. Programs that were listed in the state of Nebraska represented 52.4% of the respondents' place of education. However, Creighton and the University of Nebraska programs are no longer in existence.

Research question #5: What are the trends for these factors for the time period from 1991 to 2020? It is important to note the differences in the number of CRNAs that the questionnaire was mailed to when looking at the past twenty years. In the year 2005, the inclusion criteria was changed from being a CRNA licensed to practice in the state of Nebraska with a mailing address that bordered the state of Nebraska to being a CRNA licensed to practice in the state of Nebraska with a mailing address in Nebraska or Pottawattamie County, Iowa. From 2005 to 2015 when the survey was completed every five years, the number of CRNAs who received a questionnaire went up by about 50 participants. Importantly, the present study completed in 2020 saw a total mailing of 455 CRNAs. This is an increase of 104 licensed CRNAs between 2015-2020.

The 2020 Nebraska CRNA Manpower study represented the highest percentage (17.1%, n=50) of CRNA respondents planning to retire by the end of 2025. The 2015 study found that 15.3% or 36 CRNA respondents were planning to retire by the end of 2020. This percentage has been increasing every five years since the study was completed in 2010. In regard to the question about CRNAs planning to relocate by the end of 2025, this year's study found a slight decrease in percentage (7.5%, n=22) of CRNA respondents. This percentage has been consistently within 1% of this level every year since 2010. The highest percentage (10.6%, n=20) of CRNA respondents reporting relocation plans in five years was reported in 2005. The average age distribution of CRNAs seems to be fairly consistent when comparing the present study's results versus the 2015 results. There was a slightly higher percentage (43.2%, n=97) of respondents reporting an age greater than 49 in 2015 compared to 2020 (33.6%, n=98). There was a higher percentage (30.1%, n=88) of CRNA respondents reporting an age between 40-49 in 2020 compared to 2015 (22.3%, n=50).

CRNAs were also asked about the practice setting in which they are employed. There were five practice setting options including hospital employed, physician anesthesiologists group, self-employed, CRNA group, and other. The majority of respondents reported being hospital employees (45.2%, n=132) (Table 11). There were 23.6% (n=69) of the respondents that reported being employed by a physician anesthesiologist group. CRNA only group was reported by 6.5% (n=19) of respondents, 12% (n=35) were Self-employed, and Other was the response in 5.1% (n=15) of respondents.

The hospital employee practice setting was the most common in 2015 and 2020. However, this finding was different in 2010, 2005, and 2000. In those years, the highest percentage of respondents were employed by a physician anesthesiologist group. The district

reporting the highest proportion of hospital employees was District III at 73.9% (n=17). District I had 48.8% (n=61), District II 48.7% (n=19), District IV 36.7% (n=18) and District V 30.3% (n=17) (Table 11). Hospital employee was the most prevalent practice setting for District I-IV. District V respondents reported a physician anesthesiologist group as the most prevalent practice setting representing 46.4% (n=26) or respondents.

The highest number of respondents reported working at one facility when providing anesthesia (39.4%, n=115) (Table 12). However, it was reported by 34.6% (n=101) of respondents that they administered anesthesia in two facilities. Thirteen percent (n=39) of respondents reported working in three or more facilities during a typical work week. The greatest increase in percentages when compared to the 2015 questionnaire was the number of respondents reporting working in two facilities. In 2015 researchers found that 42% (n=99) worked at 1 facility, 21% (n=49) at 2 facilities, and 37% (n=87) at three or more facilities. Interestingly, from 1991-2015 there was always a steady increase in the percentage of respondents reporting working in three or more facilities. In 1991, it was found that fewer than 3% worked at three or more facilities. There was a slight decrease in the percentage of respondent reporting working at three or more facilities. When comparing the data across districts, District III had a significant percentage (82.6%, n=19) of respondents who reported working at one facility (Figure 2). District V also had a higher percentage of respondents (57.1%, n=32) compared to the other four districts who reported working at three or more facilities.

The average number of anesthetics administered in 2019 was 839. When comparing the average anesthetics across the five regions in the state of Nebraska, District I, III, and V all had similar averages (Figure 3). The district with the lowest average of anesthetics reported was District II at 700 anesthetics per year. The overall number of average anesthetics reported has

increased from the prior manpower questionnaire in 2015, which had 735.1 as an average number of anesthetics administered by the CRNA. In 2010, the average number reported by respondents was 688. Comparing this number to prior studies, the trend has always been an increase in the average number of anesthetics reported every five years, with the exception of the time period between 2005 and 2009 where there was a decrease in the average cases reported.

The average hours worked by a CRNA in Nebraska in 2019 was 38 hours per week. Hours worked included direct anesthesia care, in house call, department management, and nurse anesthesia education hours. This finding was slightly lower when compared to the 2015 manpower questionnaire. Findings from 2015 revealed that respondents reported an average of 43.6 hours worked per week. When comparing the hours worked per week across the state, the number of hours worked was fairly consistent (Figure 4). District I and II averaged about 37 hours per week, District III 36.4 hours per week, District IV was the highest at 40.3 hours per week and District V was 37.1 hours per week.

In order to gather information about the potential future changes of CRNA supply across the state of Nebraska, the respondents were asked a question in regard to plans to increase, decrease or maintain the same work activity within the next five years. It was reported by 35 respondents (12%) that within the next five years they would be increasing their work (Table 13). This number was similar to the 2015 questionnaire findings with 34 respondents (15%) reporting an increase in work within the next five years. District III had the highest percentage (21.7%, n=5) of respondents reporting an increase in work within the next five years. In 2010 there were 10% (n=20) of respondents reporting a future plan of increasing work in the next five years, 16% (n=30) in 2005, 20% (n=40) in 2000, 14% (n=22) in 1995 and 1991.

There were 56 respondents or 19.2%, that indicated they would be decreasing work by the end of 2025 (Table 14). The District with the highest percentage of respondents indicating decreasing work in the next five years was District II at 23.1% (n=9). Comparing these numbers to prior manpower questionnaires, 2015 reported a similar finding at 18% (n=40). The 2010 finding was 17% (n=34), 2005 was 24% (n=46), 2000 was 28% (n=54), 1995 and 1991 were both 21% (n=33).

Respondents were asked if they had planned on retiring and have yet to do so, why they have continued to practice. Seven options were given to the respondents to select: health, benefits, job satisfaction, salary, economy, other, and not applicable. There were 26 respondents who indicated they had planned to retire, but have not yet retired. Twenty one respondents did not respond to the question and 245 respondents selected not applicable. Health was marked twice, benefits were marked 7 times, job satisfaction 14 times, salary 12 times, economy 7 times, other two times. (Table 15).

Anesthesia Employer questionnaire Findings

The CRNA employer questionnaire was designed to gather data for four research questions. Use of the CRNA questionnaire-driven research questions related to retirement and relocation were also used to assess the future need for CRNAs in Nebraska for the year 2025. The following data collected reflected the year 2019 and 2020.

Research Question 1: What is the unmet need for CRNAs in Nebraska at the present time? There were a total of 19 full time equivalent CRNA vacancies among facilities. The total FTEs that were in the 2020 budget are 240.89. This equals a 7.9% vacancy rate among the state. District I had the most vacancies, with 14 open FTEs, an 11.8% vacancy rate. District V reported the second most vacancies with 4 open FTEs, showing a 6% vacancy rate. District II only had 1

vacancy, reporting a 4.3% vacancy rate. The other districts reported there were no current vacant FTEs for CNRAs, however, one of those districts reported there is not a current vacancy, but there will be within the next few months (Table 16). District I had the highest vacancy rate, but they also reported the highest number of CRNA FTEs.

Research Question 2: How is this need projected to change within the years 2020 through 2025 as perceived by hospital, ASC anesthesia department or private practice administrators? Considering the data from the CRNA questionnaire and the CRNA employer questionnaire, demand for CRNAs in Nebraska was projected for the five years 2020 through 2025. When asked how many potential positions would be available in the next five years, there were a total of 33 additional FTEs expected. District I reported the most, with 18 new positions to be available by 2025. District IV was the next highest with 6 new positions. District II reported 5 new positions, and Districts III and V each reported 2 new positions each (Figure 5). Not a single respondent reported a plan to decrease CRNA positions in the next five years.

By combining the number of CRNAs who indicated that they would be retiring or relocating, the number of current CRNA vacancies, and the projected new CRNA positions, the number of additional CRNAs that would be needed to meet the state's demand was estimated. As stated previously, there are 50 CRNAs planning to retire in the next five years, 22 relocating out of state, 19 current vacancies among all facilities, and 33 potential new positions available by 2025. An estimated 124 CRNAs are projected to be needed by 2025 (Table 17). The projected number does not account for CRNAs that desire to increase workload or decrease workload over the next five years as reported in the CRNA questionnaire. Adjusted for 100% response rate yields an additional 78 positions predicted to be available. It is projected that the state of Nebraska will need between 124 to 202 additional CRNAs by the year 2025. In 2015, it was

projected 134 to 212 additional CRNAs would be needed by 2020. This data shows a continued unmet need for CRNAs in Nebraska.

Research Question 3: What is the average length of time required to recruit a CRNA to a practice setting in Nebraska?

Of the 27 respondents, approximately half (n=13) reported that they recruited CRNAs to their practice within the past two years. On average, it took those facilities 6.65 months to recruit a CRNA; this time doubled from 2015 and is the longest time to be reported in the last ten years (Table 18). Three of the respondents replied with either no response or not applicable when asked about length of recruitment. All districts reported that they use recruitment for the hiring of CRNAs. CRNA employers were asked if a physician anesthesiologist had been recruited because of difficulty in recruiting a CRNA. Of the 27 respondents, no facility reported the need to recruit a physician anesthesiologist due to difficulty in recruiting a CRNA.

Research Question 4: What are the regional differences within Nebraska related to the above factors? Of the 27 responses, 10 reported less than 1000 procedures requiring anesthesia services at their facility in 2019. This represents 37% of the respondents. There were 9 respondents that reported 1,000-5,000 procedures requiring anesthesia services. In total, 70% of the respondent hospitals reported between 0-5,000 procedures requiring anesthesia services at their facility. District I had 2 respondents report more than 20,000 procedures requiring anesthesia services at their facilities. There were 5 respondents reporting 5,001-10,000 procedures requiring anesthesia services, with 3 out of the 5 located within District IV (Figure 6).

Anesthesia employers were asked to report the number of their current anesthesia providers. Of the 27 respondents, 55.5% of facilities reported CRNAs as the sole anesthesia providers in their facility (Table 19). The 1991, 1995, 2000, 2005, 2010 and 2015 studies showed

CRNAs as the only anesthesia providers in 72%, 63%, 60%, 72.7%, 62.5% and 47% of facilities in Nebraska. The current study reversed the declining trend by having an increased percent in the number of facilities that utilized CRNAs as their sole anesthesia provider in 2020. District I reported no hospitals with CRNAs as the only anesthesia providers. District II reported the greatest percentage with 75% (n=6) of its respondents being sole CRNA facilities. District III reported half of its facilities as CRNA only, but there were only 2 responses. District IV and V tied with 57.1% (n=4) of their facilities being CRNA only (Table 19).

Full time equivalents (FTEs) for CRNAs were calculated based on the questionnaires returned. Of the 27 respondents, there were a total of 240.89 CNRA FTEs (Table 20). Data obtained from previous years was 149 in 1991, 177 in 1995, 203.5 in 2000, 173 in 2005, 223 in 2010 and 340 in 2015, this was trending upward every year until this year's study. District I had the greatest number of reported FTEs at 119. District III reported the fewest, with only 2. The other respondent from District III reported that they were a contracted group, so no FTEs were reported for them. District II and IV were close with 23 and 30.64 FTEs. District V had a larger number of FTEs at 66.25.

The number of vacancies increased over the last ten years that this study has been conducted. The 2020 reported vacancy rate (7.9%) and the rate reported in 2000 (8%) are the highest vacancy rates identified in the 19 years this study has been conducted. With the FTE totals trending upwards, it would be expected that vacancy rates increase in direct proportion to the FTEs. However, the number of FTEs increased by 100 from 2010 to 2015, and the vacancy rate remained the same at 3.6% (Table 16). With the response rate being lower for this study compared to the previous studies, it would be fair to expect that the vacancy rate and FTEs would be lower as well. In contrast, the vacancy rate more than doubled from 3.6% in 2015 to

7.9% in 2020. District I noticeably has the highest vacancy rate due to the highest number of FTEs reported. It is also a metropolitan area, with multiple hospitals, ASCs and private practice groups. District V had the next highest reported FTEs, so it makes sense that the data shows it to be the next highest in demand with a 6% vacancy. District IV stands out because they have the next highest FTEs (n=30.64), but they are not in need of any CRNAs, even with their plan to increase CRNA FTEs by 11 within the next five years.

Data from 2015 suggested that hospitals and ASCs would be increasing their CRNA positions by 2020. District I reported they would have a total of 161 CRNA FTEs by 2020. Data from 2020 found that there were 119 FTEs in the September 2020 budget. This district did not meet their projected increase, but they reported they would again be increasing CRNA FTEs by 18 in the next five years. District II reported in 2015 that they would be at a total of 30.1 FTEs in 2020. The data from 2020 shows a total of 23 FTEs in the budget. District III predicted an increase to 19.5 FTEs by 2020; data shows the actual FTE for 2020 was 2, however there were only two reporting facilities from this study. District IV anticipated a total of 74.5 FTEs by 2020 with the actual data reporting 30.64 FTEs in the budget. District V was the only district that surpassed its 2015 prediction. The previous study reported an increase to 44 FTEs in District V by the year 2020, and actual data from the study shows a total of 66.25 FTEs in the 2020 budget.

Summary

Conclusions

Monitoring the supply and demand of nurse anesthetists is an important component to the healthcare system. With an aging population, there will undoubtedly be a shortage of all medical care providers across the world. CRNAs are a critical piece in the ever-demanding healthcare system. In light of the current COVID-19 pandemic, the importance of an adequate number of

healthcare workers to provide care to patients has never been more evident. The Nebraska CRNA manpower study allows researchers and educators to monitor the local supply and demand of CRNAs every five years. With a very similar approach to the research design every five years, trends and data can be compared and analyzed.

The response rate was 69% with 313 of 455 possible CRNA respondents. A total of 50 respondents or 17.1% indicated that they would be retiring within the next five years (Table 6). The present study represented the highest percentage of projected CRNAs to retire since the origin of the study in 1991. The percentage of potential retirees within the next five years varied by region with a high of 39% in District III and 9.6% in District I. There were 22 respondents (7.5%) that indicated they would be relocating out of state (Table 7). Approximately 36.3% of the CRNAs practicing in Nebraska are under the age of 40 and 30.1% are in the 40-49 year of age. Bryan College of Health Sciences Nurse Anesthesia program represented the highest number of respondents at 118 or 40.4% of CRNAs. Mount Marty School of Nurse Anesthesia was reported as the place of education by 69 CRNAs, representing 23.6% of the respondents. There is a 7.9% vacancy rate among CRNAs in Nebraska. By combining the number of CRNAs who indicated that they would be retiring (50) or relocating (22), the number of current CRNA vacancies (19), and the projected new CRNA positions (33), a calculated 124 CRNAs are projected to be in need by 2025 (Table 15).

Recommendations

The following will be recommendations for the future CRNA supply and demand of Nebraska research study to be performed in five years.

1. The study should be repeated in the year 2025 in order to continue to monitor the supply and demand of CRNAs across the state of Nebraska.

2. Continue to send CRNA questionnaires via mail due to the continued high response rate.
3. Consider resending the anesthesia employers questionnaire more than once for those that did not complete it the first time.
4. Add a question to the employer questionnaire asking if there are certain things that increased their need or decreased their need for CRNAs over the course of the year.

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Appendix A: Nebraska Districts

Appendix B: CRNA MANPOWER STUDY- NURSE ANESTHETIST QUESTIONNAIRE

1. Did you administer anesthesia in Nebraska in 2020? **Yes_____ No_____**

If you answered "No" please return the questionnaire with the remaining questions unanswered.

2. Approximately how many anesthetics did you administer in 2019? _____

3. Approximately how many hours per week do you average for direct anesthesia care, including: in-house call, department management, and nurse anesthesia education?

_____

4. In what type of practice setting do you work?

Hospital employed _____ CRNA group _____ Self employed _____

Physician anesthesiologist group _____ Other _____

5. During your typical work week, at how many facilities do you administer anesthesia?

_____

6. Are any of these facilities freestanding outpatient surgical centers? **Yes_____**

No_____

7. Do you anticipate changing your work commitment in the next five years? (For example, changing from part-time to full-time, or adding another facility to your present area of practice)

Increasing _____ Decreasing _____ No change _____

8. Do you expect to relocate out of state in the next five years? **Yes_____ No_____**

9. If you planned on retiring in the last five years and have not, why have you chosen to continue practicing?

Health _____ Benefits _____ Job satisfaction _____ Salary _____ Economy _____

Other _____ Not applicable _____

10. In which year do you expect to retire from anesthesia practice?

2020 _____ 2021-2022 _____ 2023-2025 _____ 2025-2029_____ After 2030 _____

11. Please state your county of residence _____

12. Please state your county or counties of anesthesia delivery _____

13. What is your age in years?

<30_____ 30-34 _____ 35-39 _____ 40-44_____ 45-49_____ 50-54 _____ 55-59 _____

60-65 _____ >65_____

14. What is the name of the Nurse Anesthesia program where you were educated?

_____

Appendix C: CRNA DEMAND IN NEBRASKA ANESTHESIA EMPLOYER QUESTIONNAIRE

1. Please state the county/counties in which your group/department administers anesthesia.

_____

If your group/department provides anesthesia coverage for multiple locations, combine all locations when completing the questionnaire.

2. How many anesthetizing locations does your group/department staff on average (include OB L&D coverage as 1 anesthetizing location)?

1-4 ____ 5-9 ____ 10-20 ____ 20-30_____ 30-50 ____ > 50 _____

3. How many procedures in 2019 required anesthesia services? _____

< 1000 ____ 1000-5000 ____ 5001-10,000____ 10,001-20,000____ > 20,000____

4. How many full-time equivalent physician anesthesiologists provided anesthesia services in September 2020?____

5. Do CRNAs provide anesthesia services in your group/department? **Yes_____ No_____**

If you answered "Yes":

6. How many full-time equivalents for CRNAs are in your September 2020 budget?
7. How many full time equivalent CRNAs are currently practicing in your group/department? _____
8. How many full time equivalent CRNA positions currently vacant? _____

9. Have CRNA's been actively recruited (with advertisement or an agency for example) in the past two years? **Yes _____ No _____**

10. If "Yes" how many months did it take to fill a CRNA position? _____
11. If you are still looking to fill a CRNA position, how many months have you been recruiting? _____

12. Do you anticipate increasing CRNA positions in the next five years?

Yes _____ No _____

13. If "yes" you plan to increase CRNA positions, by how many? _____

14. Do you anticipate decreasing CRNA positions in the next five years?

Yes _____ No _____

15. If "yes" you plan to decrease CRNA positions, by how many? _____

16. Will you or have you recruited a physician anesthesiologist because of difficulty in recruiting a CRNA?

Yes _____ No _____

Appendix D: Cover Letter for CRNA Questionnaire

May 11, 2020

Dear CRNA:

My name is Dyanna Swanigan, a senior SRNA in the Bryan College of Health Sciences School of Nurse Anesthesia Practice (DNAP) program. For my DNAP project, I am researching nurse anesthesia manpower in the state of Nebraska. The current research will allow me to determine the supply and demand of nurse anesthetists in the state of Nebraska.

Participation in this questionnaire is voluntary. Please complete the enclosed questionnaire within two weeks and return it in the paid postage envelope if you wish to participate. If you did not provide anesthesia in 2020, please answer question #1 and return the questionnaire in the provided envelope.

The findings of this research will be compared to prior manpower studies that have been conducted in 1991, 1995, 2000, 2005, 2010, and 2015. This will allow me to trend manpower needs over the past thirty years. A complete copy of the results can be obtained through Bryan College of Health Sciences, School of Nurse Anesthesia. All information gathered will be kept confidential and compiled results will be shared with the Nebraska Association of Nurse Anesthetists.

Thank you in advance for your participation in completing the questionnaire. Your assistance is greatly appreciated. You may contact my research advisor, Sharon Hadenfeldt, CRNA, Ph.D. at 402-481-8606 or via email Sharon.Hadenfeldt@bryanhealthcollege.edu if you have any questions.

Sincerely,

Dyanna Swanigan RN, BSN

Appendix E: Cover Letter Employer Questionnaire

Dear Anesthesia Director

I am a senior in the Bryan College of Health Sciences Nurse Anesthesia program. I am researching nurse anesthesia manpower in the state of Nebraska. This is my doctoral degree research project.

I am requesting that the head of the anesthesia department or group, or individual responsible for anesthesia coverage complete an online questionnaire via ***Typhon Group Notification System***. This questionnaire will be sent out this week. Participation in the questionnaire is voluntary and will take approximately 10 to 20 minutes. Please complete the questionnaire within one week.

The research will allow me to determine current supply and demand of nurse anesthetists in Nebraska. The research from 1991, 1995, 2000, 2010, and 2015 will be compared to data from this year that so manpower trends over the last twenty-five years can be determined. Compiled results will be shared with the Nebraska Association of Nurse Anesthetists. A copy of the complete results of the questionnaire can be obtained through the Bryan College of Health Sciences School of Nurse Anesthesia. All questionnaire responses will be confidential.

If you have any questions you may contact me at katie.twomey@bryanhealthcollege.edu. You may also contact my faculty advisor, Sharon Hadenfeldt, PhD at Sharon.Hadenfeldt@bryanhealthcollege.edu.

Thank you for completing the questionnaire. Your assistance is greatly appreciated.

Sincerely,

Katie Twomey, RN, BSN, SRNA
Sharon Hadenfeldt PhD, CRNA
Dean of Nurse Anesthesia
Bryan College of Health Sciences
Sharon.Hadenfeldt@bryanhealthcollege.edu

Appendix F: CRNA questionnaire IRB Approval

BRYAN COLLEGE OF HEALTH SCIENCES
INSTITUTIONAL REVIEW BOARD
Notification of Action

Date of Notification: 4/15/2020

This letter pertains to IRB actions regarding:
Title of Study/Project: A STUDY OF CERTIFIED REGISTERED NURSE ANESTHETIST MANPOWER IN NEBRASKA: VII

IRB Number: #2004-004
Submitted by: Dyanna Swanigan

Type of Review Performed:
____Exempt – Performed by_____
__X_Expedited
____Full

Date of Review: 4/15/2020
Document(s) Reviewed: Revised Request for Review and Dr. Hadenfeldt's certificate.

Decision
The Bryan College of Health Sciences' IRB has made the following decision related to your study:

_X__APPROVED: Your study has been found to meet criteria necessary for the protection of human subjects as stated in the Code of Federal Regulations Title 45 Part 46. Data collection may start once all required IRB approvals are obtained.

____PENDING APPROVAL CONTINGENT ON MINOR CHANGES: Your study has been found to meet criteria necessary for the protection of human subjects as stated in the Code of Federal Regulations Title 45 Part 46; however minor changes are necessary to strengthen one or more part(s) of the study. Those minor changes are detailed below. Please resubmit the final amended *Request for Review, Informed Consent,* or any other necessary study documents. After submission of the final documents you will receive an approval letter with the approved, stamped informed consent document if required for the study/project.

____MUST BE RESUBMITTED WITH MAJOR CHANGES: Your study HAS NOT been found to meet all criteria necessary for the protection of human subjects as stated in the Code of Federal Regulations Title 45 Part 46. One or more major change(s) must be made as detailed below. **DATA COLLECTION MAY NOT BE STARTED** until those changes have been made and formal approval has been granted by the IRB.

Obligations to the IRB
The investigators of a study approved by the IRB must fulfill the following obligations in order to retain permission to conduct their study:

CONSENT FORM: If you submitted a consent form for approval, the approved consent will be returned to you marked with a red '**APPROVED**.' **Colored copies** of that **approved** consent must be made and all participants enrolled in the study must sign one of those **colored consent forms**. The original, colored consent forms must be saved with the investigator's study documents. Each participant must be given a copy of the informed consent. The participant's copy may be a black and white copy of the original, colored informed consent.

PLANNED CHANGES TO THE STUDY: Any non-editorial change to an approved study/project must be submitted to the IRB for approval before initiation of the change except when necessary to eliminate immediate hazards to the participant(s). These changes include (but are not limited to):

- Names and roles of study/project personnel;
- The number of enrolled participants;
- Change to the methods used in the study/project;
- Change to the study/project's consent form;
- Additional method(s) used to recruit subjects (beyond those approved with the initial review);
- Proposed communication(s) to potential or enrolled subjects.
- Any change initiated prior to IRB approval (undertaken to eliminate immediate hazards to participants) must be reported as soon as possible to the Chair or Secretary of the IRB.

UNANTICIPATED PROBLEM OR ADVERSE EVENTS: The investigators of an approved study/project are required to submit to the IRB a full report of the following within two (2) business days of the occurrence:

- An unanticipated problem or adverse event occurring to one or more enrolled subjects including, but not limited to:
    - Any breach in confidentiality.
    - Physical or psychological harm.
    - Unresolved complaint of a participant, family member, or other individual.
    - Any other occurrence of an adverse nature related to participation in the study/project.
- Any deviation from the approved study/project protocol with the reason for the deviation and any consequences to the study/project participants or the integrity of the study/project's data.
- The withdrawal of any participant
- If a preliminary review of a study/project's data indicates the probability that continuing with the study/project will result in harm to one or more participants.

ONGOING AND FINAL REPORTS: The investigators of an approved study/project will submit a final report (using the IRB Final Report template) within sixty (60) days of the end of data collection. If an approved study has not completed data collection 12 months after the initial IRB approval date, the investigators must submit an Annual Report (using the IRB *Annual Review* template).

Michelle Johnson, PhD, RN — 4/15/20

Secretary, Bryan College of Health Sciences' IRB — Date

Appendix G: CRNA employer IRB Approval

BRYAN COLLEGE OF HEALTH SCIENCES
INSTITUTIONAL REVIEW BOARD
Notification of Action

May 29, 2020

Katie Twomey, RN
Bryan College of Health Sciences
5035 Everett Street
Lincoln, NE 68506

IRB #2005-001
Title of Protocol: DEMAND FOR CERTIFIED REGISTERED NURSE ANESTHETISTS IN NEBRASKA

RE: Study resubmission

Dear Ms. Twomey,

As Chair of Bryan College of Health Science's IRB I have reviewed your resubmission for the above-titled Request for Review and determined it to be exempt from IRB Committee review.

This letter constitutes official notification of exempt status from Bryan College of Health Science's IRB. Please inform the IRB of any changes to your plan.

Respectfully submitted on behalf of the IRB.

Shannon Pecka, PhD, CRNA
IRB Chair
Bryan College of Health Sciences
Lincoln, NE

Table 1

Statewide CRNA Questionnaire Response Rate

Years	**2020**	**2015**	**2010**	**2005**	**2000**	**1995**	**1991**
CRNAs	455[+]	351[+]	300[+]	236[+]	298[*]	212[*]	233[*]
Respondents	313	235	217	204	251	174	188
Response %	69%	67%	72%	86.4%	84%	82%	81%

[*]Mailed to CRNAs with NE license and a NE, CO, IA, KS, SD or WY mailing address

[+] Mailed to CRNAs with a NE license and a NE or Pottawattamie County, IA mailing address

Table 2

District CRNA Questionnaire Respondents

District	Respondents
I	125
II	39
III	23
IV	49
V	56
Total	292

Table 3

District CRNA Questionnaire Respondents the past 20 years

District	Respondents 2020	Respondents 2015	Respondents 2010	Respondents 2005	Respondents 2000
I	125	85	65	62	52
II	39	29	27	29	24
III	23	17	30	15	19
IV	49	45	29	34	38
V	56	45	49	49	38
Non-response	0	3	5	7	6

Table 4

Statewide Employer Response Rate

Year	**2020**	**2015**	**2010**	**2005**	**2000**	**1995**	**1991**
Surveys Sent	51	97	90	90	82	94	95
Returned	27	60	64	68	67	70	85
Returned Percentage	52.9%	61.9%	71.1%	75.6%	82%	74%	89%

Table 5

Employer Responses by District

District	n	Percentage
District I	3	11.1%
District II	8	29.6%
District III	2	7.4%
District IV	7	25.9%
District V	7	25.9%
Total	27	

Table 6

CRNAs Planning to Retire by the End of 2025

District	n	Responded	%
I	12	125	9.6%
II	11	39	28%
III	9	23	39%
IV	10	49	20.4%
V	8	56	14.3%
2020	50	292	17.1%
2015	36	235	15.3%
2010	20	217	9.2%
2005	20	204	10.6%
2000	25	251	13.0%
1995	21	174	13.0%
1991	24	188	15.0%

Table 7

CRNAs Planning to Relocate by the End of 2025

District	n	% of CRNAs
I	6	4.8%
II	6	15.4%
III	6	26.1%
IV	1	2%
V	3	5.4%
2020	22	7.5%
2015	21	8.9%
2010	17	7.8%
2005	20	10.6%

Table 8

Nebraska CRNA Age Distribution

Age	**n**	**%**
<30	2	0.68%
30-39	104	35.6%
40-49	88	30.1%
50-59	45	15.4%
60-65	30	10.3%
>65	23	7.9%

Table 9

CRNA Age Distribution by Nebraska Hospital Districts

Districts	**I**	**II**	**III**	**IV**	**V**
Age					
<40	44 (35.3%)	19 (48.7%)	5 (21.7%)	16 (32.7%)	22 (39.3%)
40-49	43 (34.4%)	3 (7.7%)	7 (30.4%)	19 (38.8%)	16 (28.6%)
>49	38 (30.4%)	17 (43.6%)	11 (47.8%)	14 (28.6%)	18 (32.1%)

Table 10

CRNA Education Program Representation

CRNA Education Programs	Number of CRNA questionnaire respondents
Bryan	118
Mount Marty	69
Clarkson	24
Creighton	10
University of Kansas	11
McKennan University of South Dakota	6
St. Mary's School of Anesthesia	4
Texas Wesleyan University	4
United States Air Force	3
University of Iowa	3
Mayo	3
Wolford	3
Barry University	2
LSU	2
Minneapolis School of Anesthesia	2

Texas Christian University	2
Truman Medical Center	2
Arkansas State University	1
Case Western Reserve	1
Central North Dakota	1
Charleston Area Medical Center	1
Drake University	1
Hospital of St. Raphael	1
Medical College of Georgia	1
Memorial Hospital of Rhode Island	1
Old Dominion University	1
Oregon Health and Science	1
Southern Illinois University	1
St. John's School of Anesthesia	1
St. Joseph's Hospital	1
Uniformed Services University	1
University of Missouri Kansas City General Hospital	1
University of Southern California	1

University of Texas Health Science Center	1
UNMC	1
United States Army School of Anesthesiology for Ancillary Officers	3
Westminster College	1
Unknown	2

Table 11

CRNA Practice Setting

Practice Setting	**I**	**II**	**III**	**IV**	**V**	**2020**	**2015**	**2010**	**2005**	**2000**	**1995**	**1991**
Hospital	48.8 %	48.7 %	73.9 %	36.7%	30.3%	45.2 %	52%	35%	17%	21%	46%	55%
MDA Group	25.6 %	15.4 %	0%	10.2%	46.4%	23.6 %	27%	38%	42%	42%	29%	23%
CRNA Group	4%	2.6%	0%	26.5%	0%	6.5%	11%	12%	13%	21%	10%	2%
Self	6.4%	20.5 %	17.4 %	16.3%	12.5%	12%	13%	9%	12%	15%	15%	10%
Other	7.2%	2.6%	4.3%	6.1%	1.8%	5.1%	4%	6%	9%	2%		
Hospital and other	5.6%	7.7%	4.3%	4.1%	7.1%	5.8%						
Self-employed and other	2.4%	2.6%	0%	0%	1.8%	1.7%						

MDA=physician anesthesiologist

Table 12

Number of facilities anesthesia administered during a typical work week

Number of facilities anesthesia administered	**n**
1	115
2	101
3	39
4	22
5	13
6	2

Table 13

CRNAs Planning to Increase Work by the End of 2025

District	n	% by Region	Respondents
I	15	12%	125
II	5	12.8%	39
III	5	21.7%	23
IV	5	10.2%	49
V	5	8.9%	56
2020	35	12%	
2015*	34	15%	
2010	20	10%	
2005	30	16%	
2000	40	20%	
1995	22	14%	
1991	23	14%	

*Those planning to increase work by 2020

Table 14

CRNAs Planning to Decrease Work by the End of 2025

District	n	% by Region
I	25	20%
II	9	23.1%
III	4	17.4%
IV	7	14.3%
V	11	19.6%
2020	56	19.2%
2015	40	18%
2010	34	17%
2005	46	24%
2000	54	28%
1995	33	21%
1991	34	21%

Table 15

Reason/s you have not retired

Reason(s) you haven't retired	n=26
Health	2
Benefits	7
Job satisfaction	14
Salary	12
Economy	7
Other	2
Not applicable	245
Unknown	21

Table 16

Full-time Equivalent Vacancy Rate

District	Vacancies	n	Vacancy Percentage
District I	14	119	11.8%
District II	1	23	4.3%
District III	0	2	0%
District IV	0	30.64	0%
District V	4	66.25	6%
Total 2020	19	240.89	7.9%
2015	9.5	267	3.6%
2010	6	167	3.6%
2005	12	173	6.9%
2000	15.5	203.5	8%
1995	4.9	177	3%
1991	11	149	7%

Table 17

Number of CRNA Positions to Be Filled in Nebraska Between 2020 and 2025

Category	**Actual**	**Projected with 100% Response**
Retirees	50	72
Vacancies	19	36
New Positions	33	62
Relocate	22	32
Total 2020	124	202
2015	134	212
2010	89	122
2005	91.5	115
2000	74	90
1995	57	68
1991*	58	68

* Did not include CRNAs relocating out of Nebraska

Table 18

Average CRNA Recruitment Time

District	**Months**
District I	5.5
District II	NR
District III	8
District IV	6
District V	10
2020 Average	6.65
2015	3.6
2010	5.3

Table 19

Percentage of Facilities that Use CRNA as the Sole Provider

District	n	Percentage
District 1	0	0%
District II	6	75%
District III	1	50%
District IV	4	57.10%
District V	4	57.10%
2020	15	55.5%
2015	28	47%
2010	40	63%
2005	48	73%
2000	40	60%
1995	44	63%
1991	58	72%

Table 20

CRNA FTEs Currently Practicing

District	**n**
District I	119
District II	23
District III	2
District IV	30.64
District V	66.25
Total 2020*	240.89
2015*	340
2010*	223
2005*	173
2000	203.5
1995	177
1991	149

*Includes Hospitals and ASCs

Figure 1

Age Distribution of CRNAs in Districts I-V and comparing 2020 to 2015

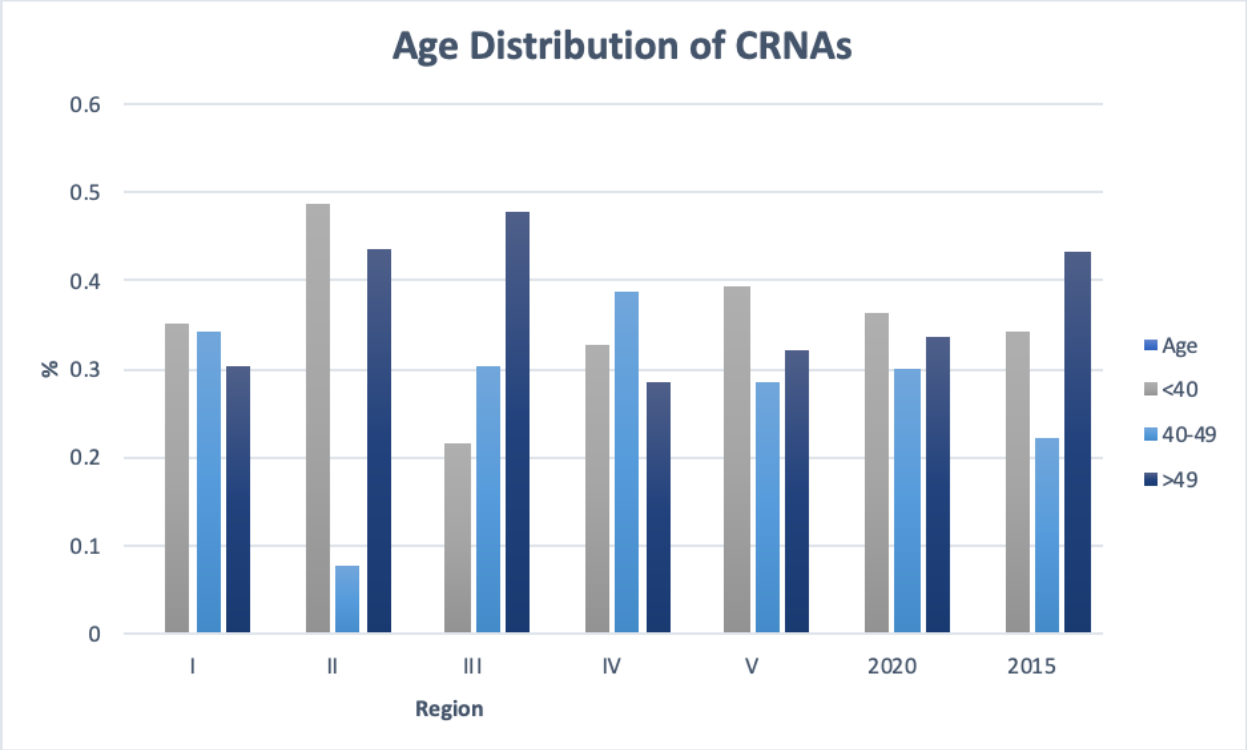


Figure 2

Number of Facilities per Week in Districts I-V

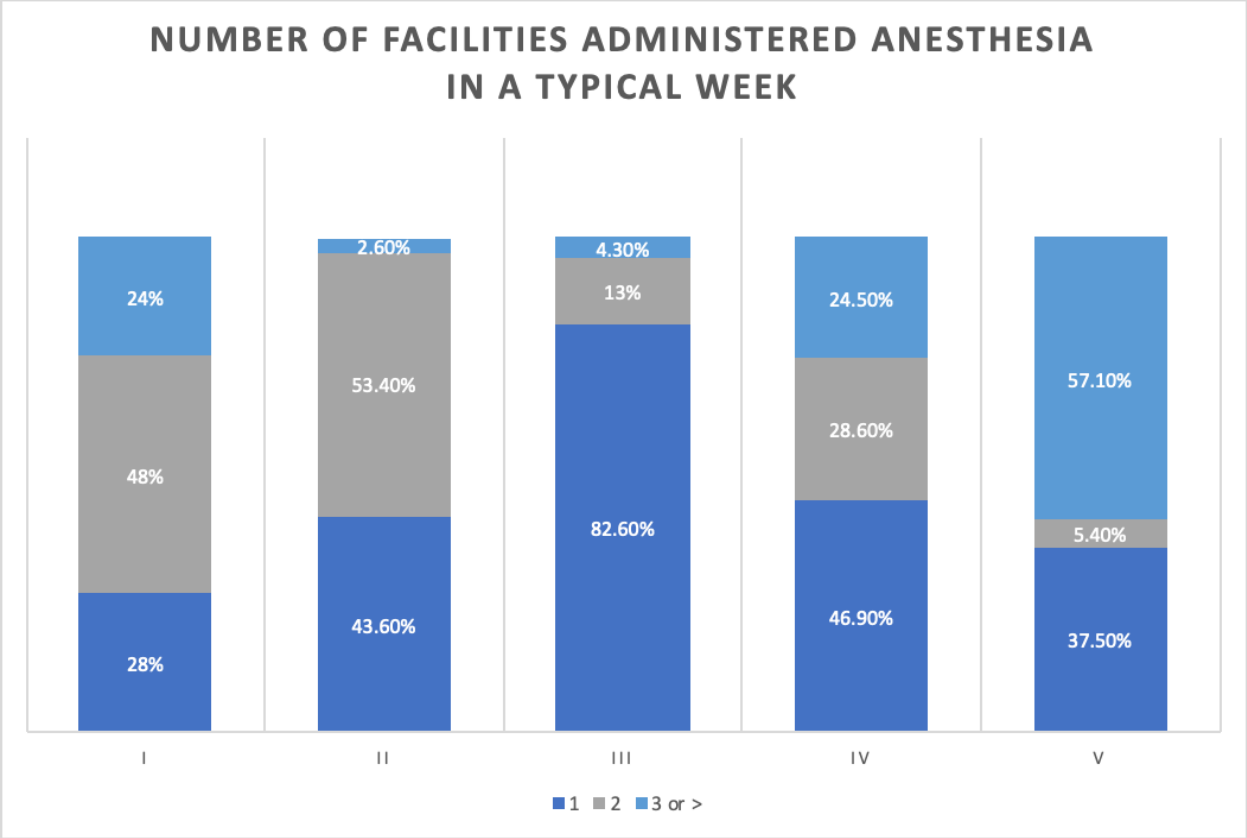


Figure 3

Average Number of Anesthetics per CRNA in Districts I-V

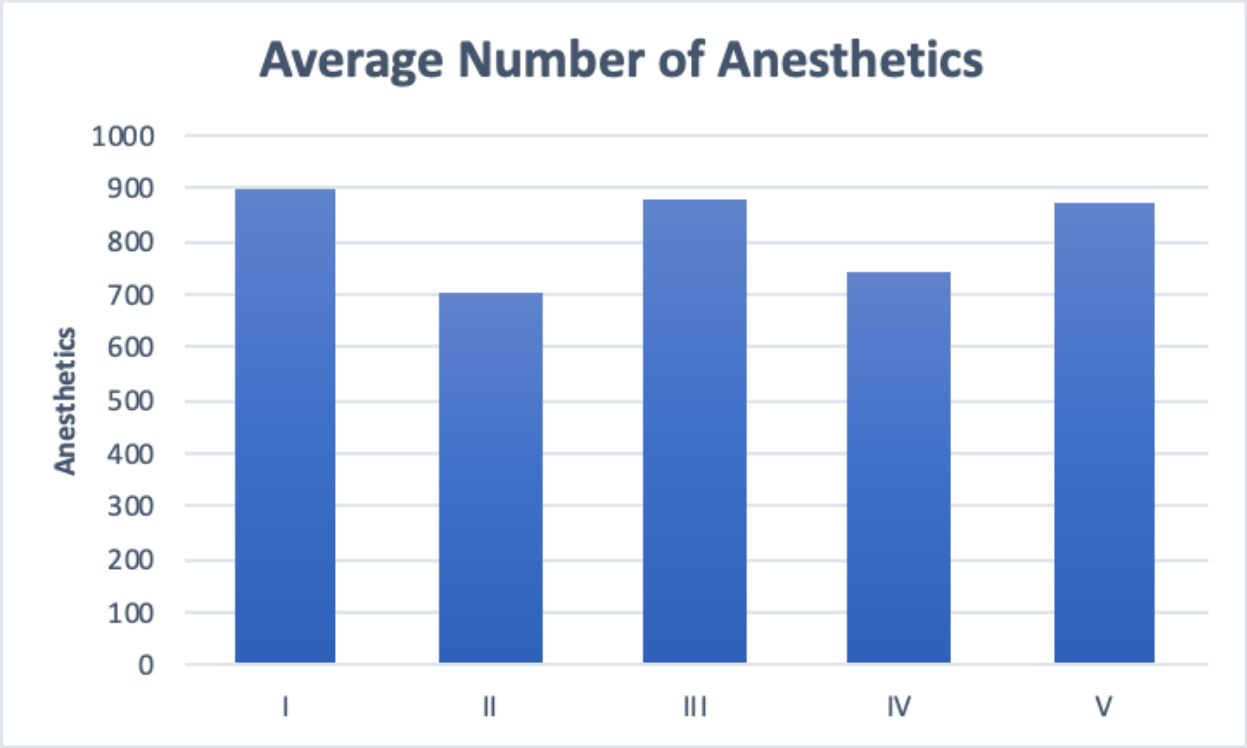


Figure 4

Average Number of Hours Worked per CRNA Work Week in Districts I-V

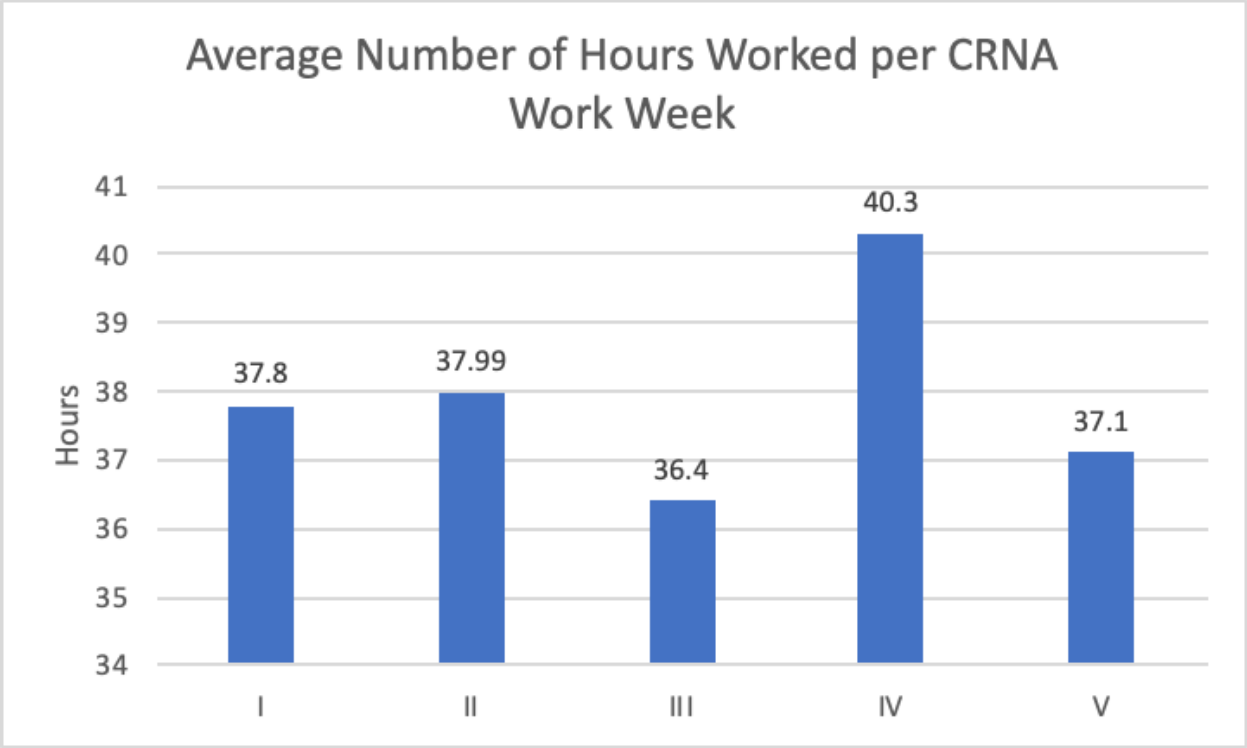


Figure 5

Number of CRNA Positions to be Filled in Nebraska between 2020 and 2025

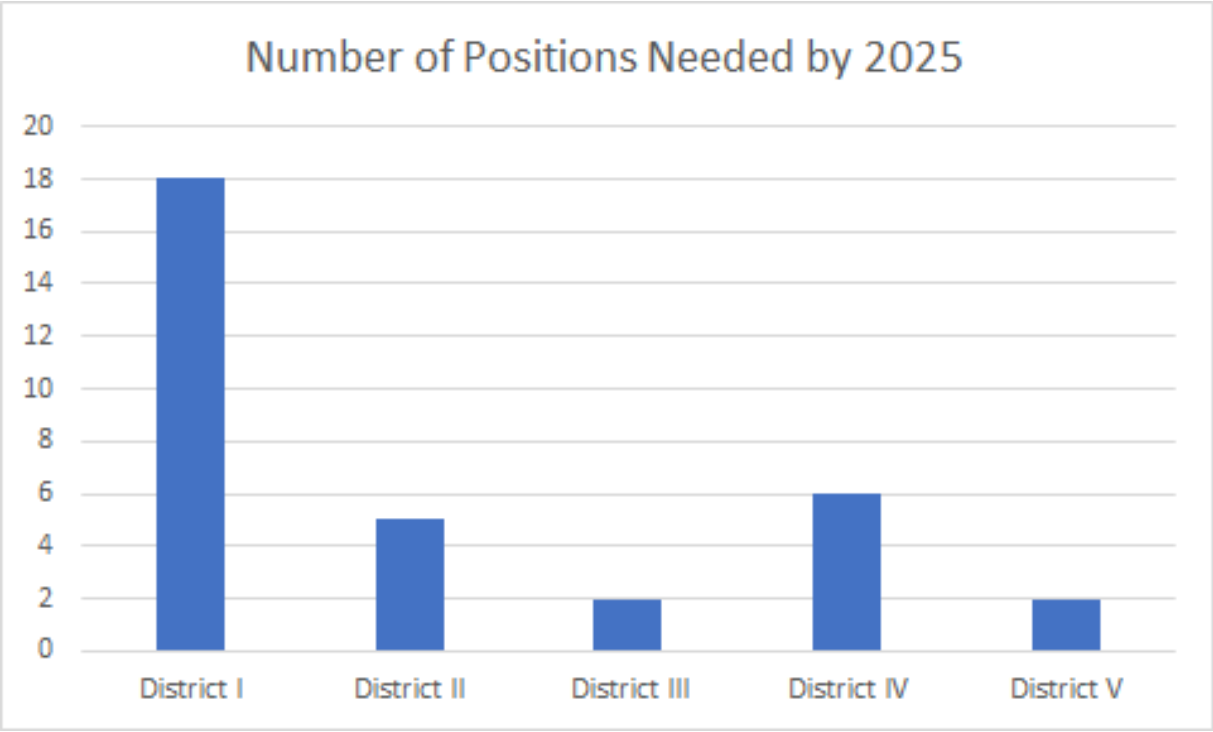
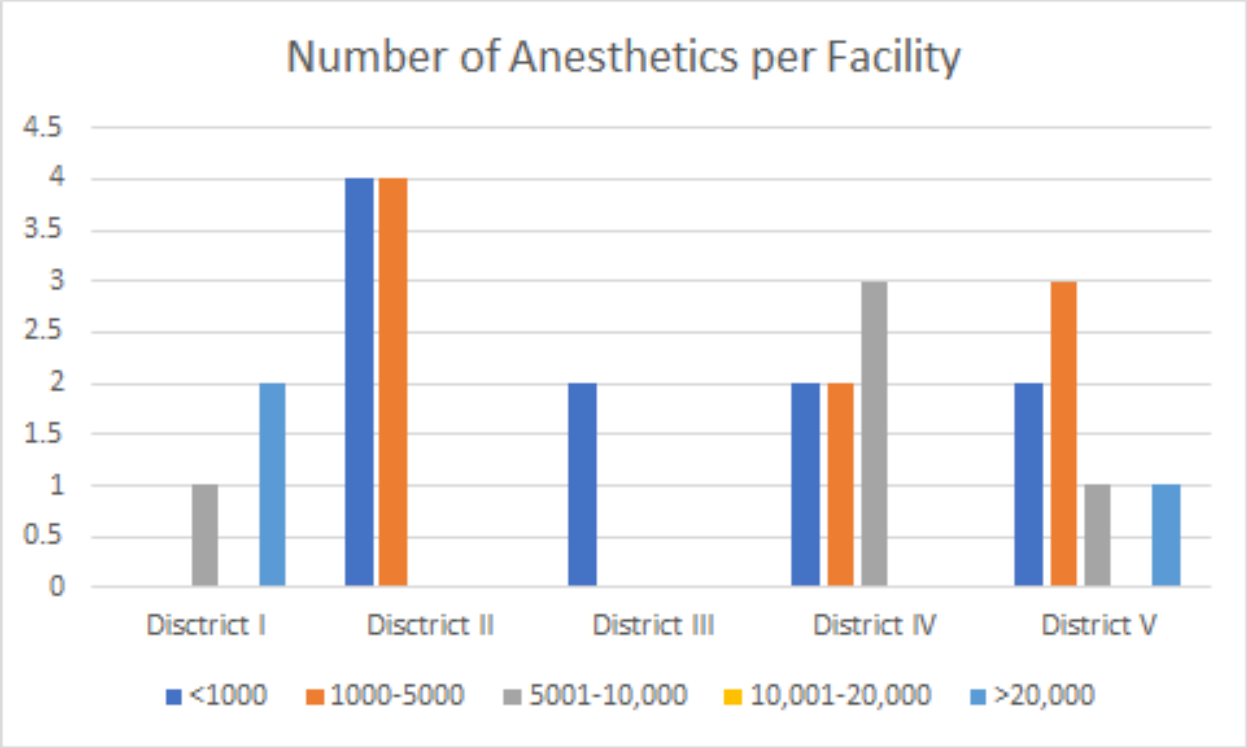


Figure 6

Number of anesthetics per Facility by District