The Correlation Between Self Evaluation Exam Scores and National Certification Exam First Attempt Scores

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Abstract

The Self Evaluation Exam (SEE) is taken by Student Registered Nurse Anesthetists (SRNAs) in most nurse anesthesia programs. The SEE's purpose is to prepare SRNAs for the National Certification Exam (NCE) and provide information about the students' progress. In 2016, the NBCRNA reformatted the SEE to better align with the NCE (NBCRNA, 2017a). Considering the shortage of anesthesia providers, the negative implications to anesthesia programs with declining scores on the NCE, and the complex burden that SRNAs undertake to complete anesthesia school, it is important to evaluate potential relationship of the SEE performance on success on the NCE. The literature was reviewed regarding the correlation of the SEE scores with NCE scores and graduate-level programs that administered interim exams prior to completion of the program. An analysis of scores by AdventHealth University (AHU) Master of Science in Nurse Anesthesia (MSNA) graduates in 2017-2019 determined a significant correlation between SEE and NCE performance. SPSS software version 21.0 was used to perform a Pearson r statistical analysis of de-identified randomized exam scores that were gathered securely from the AHU Nurse Anesthesia Department Chair. The project's aim was achieved, which determined AHU MSNA program graduates in 2017-2019 demonstrated a significant correlation between second year SEE scores and NCE first attempt scores. Due to a strong correlation, a multiple regression analysis was performed to determine the correlation of first attempt SEE and NCE score content domains. A correlation existed in content domains, which provides valuable data for improvement of test-taking strategies for AHU SRNAs.

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The Correlation between SEE and NCE First Attempt Scores

In 1945, the American Association of Nurse Anesthetists (AANA) implemented the National Certification Examination (NCE) to validate that Graduate Registered Nurse Anesthetists (GRNAs) have the baseline knowledge to provide anesthesia safely in the clinical setting (National Board of Certification and Recertification for Nurse Anesthetists [NBCRNA], 2019a). Certification is one of the essential legal markers to validate the competency of nurse anesthesia providers for entry level performance. Since 1991, the SEE has been administered to nurse anesthesia students in preparation for the NCE in order to provide quantitative data on areas of weakness (Muckle, Moriber, & Randmall, 2012b). In 2016, the SEE was modified so that the two exams had equivalent content domains, and the new SEE was first implemented September 1, 2016 (Fagerlund & Mcshane, 2007).

Significance & Background of Clinical Problem

CRNAs deliver anesthesia to approximately 49 million patients annually and are also the primary anesthesia providers to rural and underserved populations (American Association of Nurse Anesthetists [AANA], 2019). In 2007, researchers reported a shortage of 1,282 CRNAs nationwide, which was predicted to persist until 2020 (Daugherty, Benito, Kumar, & Michaud, 2010). This shortage of anesthesia providers may be aggravated by developing trends in the U.S. population such as the aging baby boomer generation, the 300% increase of ambulatory surgeries over the last 10-year period, and 8 million previously uninsured patients gaining access to healthcare services (Boyd & Poghosyan, 2017; Bureau of Labor Statistics, 2019; Landau, 2017). The most recent published data is from 2007 that was referenced in a 2017 publication which stated that Florida had one of the highest CRNA position vacancy rates in the country (Wunder,

Glymph, Schirie, & Valdes, 2017). This vacancy could also be worsened by a decreasing number of first time NCE pass rates.

While the vacancy rates are one large issue, another is accreditation. According to the Council on Accreditation of Nurse Anesthesia Educational Programs (COA), a program's accreditation status will be affected if there is a demonstration of poor quality or serious deficiency in students' education (COA, 2019). COA is currently recognized by the U.S. Department of Education (USDE) and Council for Higher Education Accreditation (CHEA) to grant public recognition to nurse anesthesia programs by providing quality assessment and educational quality enhancement (COA, 2019). Their stated mission is to provide quality assurance through self-study and review. At a local level, AdventHealth University's first attempt rate for the NCE declined from 84.6% in 2018 to 75% in 2019 (AdventHealth University, n.d.). On a national level, the first attempt NCE rate declined from 89.9% in 2008 to 82.6% in 2017 (NBCRNA, n.d.). If this declining trend in first attempt NCE pass rates were to continue, there is potential risk for negative accreditation actions and loss of potential students' interest in not only AHU's Nurse Anesthesia Program but anesthesia programs throughout the United States.

There are other significant issues for SRNAs, including financial constraints and possibly a limited potential to practice in the future. A student's financial burden to complete anesthesia school is approximately $161,809 (Macintyre, Stevens, Collins & Hewer, 2014). This number does not include additional program fees, living expenses, or exam fees, which are $250 for the SEE and $995 for the NCE (NBCRNA, 2019a; NBCRNA, 2019b). Furthermore, even successful completion of a nurse anesthesia program does not guarantee that graduates will become CRNAs; graduates must pass the NCE in order to receive certification to practice as anesthesia providers. This psychological burden can be stressful for students who have been unemployed

for two to three years and have also accrued over $100,000 in debt (MacIntyre, Stevens, Collins, & Hewer, 2014). One study by Chipas and colleagues (2012) found that 41% of SRNAs expressed feelings of depression and 21% expressed suicidal ideation.

Due to these issues and following the revision of the SEE, many anesthesia programs have published minimum requirements for SEE scores which are required for program progression and completion (AdventHealth University, 2021; University of New England, 2018; University of Pennsylvania, 2016). This is a relatively new development, as prior to 2016, the NBCRNA stance was that the SEE was not a good indicator of students' success on the NCE, as they did not have a significant correlation (Muckle et al., 2012b). In 2016, the NBCRNA restructured the SEE to align with the NCE's content outline. After this 2016 change, the NBCRNA published a study that demonstrated a positive correlation between the SEE for second-year students and the NCE after graduation. Although the national SEE scores correlated with first attempt NCE scores, it is unknown if the significant correlation between national performance on the SEE and performance on the NCE applies specifically to AHU nurse anesthesia program cohorts that graduated in 2017-2019.

PICOT Evidence Review Questions

The following are two questions, posed in Problem Intervention Comparison and Outcome (PICO) format, which have assisted in the review of literature and guided the innovation. The first question guided the review of the literature and second question guided the innovation.

1.) For Student Registered Nurse Anesthetists (P), do Self-Evaluation Examination (SEE) scores (I) correlate with first-attempt National Certification Examination (NCE) scores (O)?

2.) For Student Registered Nurse Anesthetists attending AdventHealth University Nurse Anesthesia Program during the 2017-2019 graduating cohorts (P), do Self-Evaluation Examination (SEE) scores (I) correlate with National Certification Examination (C) first-attempt scores (O)?

Search Strategy Results

A literature review was performed for all English language studies on the SEE exam and NCE. The search included Medline, CINAHL, PubMED, Google Scholar, accrediting bodies, and government agencies using the following keywords: “Certified registered nurse anesthetists, certification exam, self-evaluation exam, self-assessment and interim assessment.” Date limitations were 1990 to present in order to include seminal studies on the topic. The search yielded 18 studies. After applying additional inclusion criteria, five studies remained. Additional inclusion criteria were that these were original research studies or systematic reviews in peer-reviewed journals that examined interim exams in graduate nurse anesthesia programs. Due to the limited number of studies, the search was widened to include interim exams in other healthcare graduate level programs, which resulted in a total of 12 studies.

GRADE Criteria

The literature was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) criteria. For the supporting body of evidence, the overall GRADE level initially was a moderate three due to the types of studies (retrospective correlational studies and no randomized control trials). It was then graded down due to limitations, such as imprecision due to small sample size, methodological flaws in the lower quality studies, inconsistency with the variation of the subjects taking the exams, and

indirectness with the research and publications of the exams. Therefore, the GRADE was decreased to low two.

In addition, the body of the literature was graded down for publications' biases to very low one. The universities in which the research was conducted provided funding and grants to the authors who published the articles. Potential conflicts of interest existed in that NBCRNA was the governing organization that created the NCE and the SEE, and they self-published evaluation reports in 2016 and 2018. The articles consisted of multivariate correlational studies and retrospective quantitative data. Many of the articles were based upon a dose-response gradient in the evaluation of the national board scores. Consequently, the GRADE increased to moderate two.

Based on the quality of evidence available, a recommendation can be made on the use of SEE scores as a predictor of NCE first attempt test scores.

Literature Review and Synthesis of Evidence

Overview

This literature review includes a description of the operational definitions, theoretical framework, and a review of the literature. Topics discussed in the literature review include:

a) Importance of identifying success factors for the NCE

b) Importance of passing the NCE on first attempt for the SRNA

c) Importance of passing the NCE on first attempt for the nurse anesthesia program

d) Correlation of interim standardized exam scores with success on board certification exams in graduate level healthcare programs.

Operational Definitions and Objectives

Self Evaluation Exam

Definition For the purposes of this project, the SEE was defined as follows: a voluntary examination offered by NBCRNA to students enrolled in COA accredited nurse anesthesia educational programs.

Objectives Its objectives are to provide information to students about their progress in the nurse anesthesia educational program, to program administrators on how well their programs are preparing students with the knowledge they need for anesthesia practice, and to prepare students for the NCE experience (NBCRNA, 2019b). The exam consists of 240 questions within the following SEE content domains: Basic Sciences (25%); Equipment, Instrumentation, and Technology (25%); Basic Principles of Anesthesia (25%); and Advanced Principles of Anesthesia (25%). It is a computerized test with 240 questions; 200 of the questions are scored and 40 are unscored trial questions. Exam takers have a time limit of four hours (NBCRNA, 2019b).

National Certification Exam

Definition NCE is defined as a variable-length computerized adaptive test required for entry into nurse anesthesia practice.

Objectives Its purpose, according to NBCRNA (2019a), is to "measure the knowledge, skills, and abilities necessary for entry-level nurse anesthesia practitioners". The exam consists of a minimum of 100 questions, 30 of which are random, non-graded pretest questions. The exam covers the following domains: Basic Sciences (25%); Equipment, Instrumentation, and Technology (15%), General Principles of Anesthesia (30%) and Anesthesia for Surgical

Procedures and Special Populations (30%). The maximum number of questions is 170, and a maximum time of three hours is allowed for the exam (NBCRNA, 2019a).

Success on the NCE is defined as a score of 450 or greater (NBCRNA, 2019a).

Literature Review

It is possible that challenges related to the SEE and NCE exams may be contributing to a lack of CRNAs. There is a shortage of 1,282 CRNAs nationwide which was predicted to persist until 2020 (Daugherty et al., 2010). The shortage of anesthesia providers has placed a significant burden on the ability to provide anesthesia related quality care to patients throughout the United States (Daugherty et al., 2010)**.** This shortage is also exacerbated by developing trends in the U.S. population, such as the aging baby boomer generation, the 300% increase of ambulatory surgeries over the last 10-year period, and eight million previously uninsured patients gaining access to healthcare services (Boyd & Poghosyan, 2017; Bureau of Labor Statistics, 2019; Landau, 2017). Specifically, Florida was reported to have one of the highest CRNA position vacancy rates in the country in 2007 when compared to 2002; more recent studies were unavailable (Wunder, Glymph, Schirie, & Valdes, 2017).

Passing the NCE on first attempt

In 2012, the SEE was not considered a reliable indicator of scores on the NCE and was considered inadvisable to be used by program directors to assess students (Muckle, et al., 2012b). In 2016, the SEE was restructured to better correlate with the NCE. In the 2018 annual report by the NBCRNA, the reliability of exam scores was positively correlated between SEE and NCE (NBCRNA, 2020c). In a document published by NBCRNA, a strong positive correlation between SEE scores and performance on the first NCE attempt, especially for second year and third year students who take the SEE at least three months prior to their first NCE was identified

(NBCRNA, 2020c). Additionally, reliability of scores on the SEE in FY 2019 was comparable to reliabilities in FY 2018 and FY 2017 and demonstrated substantially improved reliability in comparison to the previous SEE format (NBCRNA, 2020c).

Current design of the SEE

The three objectives of the SEE are as follows: 1) to provide information to students about their progress in the nurse anesthesia program, 2) to provide information to program directors on how well their programs are preparing students with the knowledge they need for anesthesia practice, and 3) to prepare students for the NCE experience (NBCRNA, 2019b). Both the SEE and NCE have similar domains with the four categories of Basic Sciences; Equipment, Instrumentation, and Technology; Basic Principles of Anesthesia, and Advanced Principles of Anesthesia (NBCRNA, 2019a). In a study conducted by the NBCRNA, a group of 2,310 SEE scores were plotted against NCE first attempt pass rates, which demonstrated a reliable predictability with Pearson correlation r=0.58 (NBCRNA, 2017a). The reliability of the new SEE improved from 0.83 to 0.93 for the overall score and all subscores demonstrated a reliability index of greater than 0.75 (NBCRNA, 2020c). Limitations to the studies included the existence of multiple confounding variables such as the length of time students utilized for the exams and how much each student studied in preparation for the exam; many students self-reported that they did not prepare for the SEE at all (NBCRNA, 2017a). Due to the limited number of studies evaluating the correlation of the SEE with the NCE, it would be beneficial for students, faculty, and program directors to see if programmatic results are similar to national results and analyze the correlation between the two exams.

Importance of passing the NCE on first attempt for the nurse anesthesia program

There are a variety of reasons for a nurse anesthesia program to stress the importance of passing the NCE. When graduates do not pass the NCE, they are not eligible to practice as CRNAs, regardless of the education they have completed (NBCRNA, 2019a). If an anesthesia program shows deficiency in their NCE pass rates, negative accreditation actions can result (COA, 2019). In addition, the general perception about a school can be influenced based upon the public record of a cohorts' first attempt scores from that specific university (Guiot & Franqui-Rivera, 2018). When graduates do not pass the NCE, it is problematic for those who have accumulated hundreds of thousands of dollars in debt for the educational program (Macintyre et al., 2014). At a local level, AHU's first attempt NCE pass rate in 2019 was 75%, which is below the national average of 84%, which supported the need for this project's investigation (AdventHealth University, n.d.)

Correlation of interim exam scores with success on board certification exams in graduate level programs

Standardized interim exams are used in healthcare undergraduate and graduate level programs to assess knowledge retention throughout students' education (Barton, Willson, Langford, & Schreiner, 2014; Guiot & Franqui-Rivera, 2018; Naughton & Friesner, 2014; NBCRNA, 2017). Students who did not achieve minimum required scores on the standardized interim exams such as Comprehensive Basic Science Examination (CBSE), Health Education Systems Incorporated (HESI), SEE, and Pharmacy Curriculum Outcomes Assessment (PCOA) potentially experienced delays in their program, regardless of their overall grade in the program (AdventHealth University, 2021; Barton et al., 2014; University of New England, 2018; University of Pennsylvania, 2016). Previous investigators have found that such standardized

interim examinations were predictors of success on first attempt exam scores (Naughton & Friesner, 2014). Graduates who have taken certification exams which allow entry to practice, such as the North American Pharmacist Licensure Examination (NAPLEX), National Council Licensure Examination (NCLEX), NCE, and United States Medical Licensing Examination (USMLE), without passing the first time can impact the schools' accreditation processes (Barton et al., 2014; COA, 2019; Guiot & Franqui-Rivera, 2018; Naughton & Friesner, 2014).

Caldwell (2015) found a positive correlation in first semester grades in nurse anesthesia courses with success on the NCE. Lebeck (2003) evaluated independent variables such as undergraduate GPA, science GPA, GRE scores, age, gender, and SEE scores in year one and two with performance on the NCE for 377 participants and found that SEEs taken in the second year had a significant correlation at the p=.01 level with NCE scores. Preadmission GPA and GRE analytical scores were positively correlated with NCE scores. However, the studies by Lebeck (2003), Caldwell (2015), and Zaglaniczny (1992) were conducted prior to the 2016 change in SEE format.

While there are several articles that support the evaluation of the relationship between various preadmission factors and NCE performance, a limited number of studies specifically analyze the correlation of SEE scores during the program with NCE scores after graduation from the program. This scholarly project evaluated the SEE scores with NCE scores by AHU graduates from 2017-2019.

Theoretical Framework

The ability to predict success on the NCE utilizing scores from the SEE would be beneficial for both SRNAs and nurse anesthesia program directors, as it may aid in quality and process improvement. Although preadmission factors such as admission grade point average

(GPA), science GPA, GRE, age, and gender have been studied for influence on NCE pass rates, the correlations were shown to be weak (Zaglanicny, 1992; Lebeck, 2003). Factors that occur during SRNA education, such as the SEE, have been studied minimally. However, the SEE provides an opportunity for program directors and students to obtain direct feedback on areas of weakness, to focus on specific areas in need of improvement prior to taking the NCE.

Because of the decline in first time NCE pass rates nationally and at AHU, a quality improvement effort is warranted. The purpose of quality improvement is to identify problems, improve process, and implement and monitor corrective actions for effectiveness (ACT, n.d.). Quality improvement projects require a systematic methodology to be effective in their interventions, which is why this scholarly project followed Edward Deming's model of quality improvement: Plan-Do-Study-Act (PDSA) (ACT, n.d.).

In PDSA, "Plan" symbolizes the change that will be tested or implemented throughout the study. "Do" represents the actual implementation of the test or change. "Study" is the process of analyzing the outcome and data obtained from the study. Finally, "Act" represents future changes or the full implementation of the study (ACT, n.d.).

Applicability to Practice/Contribution to Professional Growth

NBCRNA has ensured that the initial certification obtained as a certified registered nurse anesthetist verifies baseline competency in evolving knowledge within the anesthesia field. Professional knowledge and skills require vigorous evidence-based education and continued self-evaluation throughout and after the program. Since 2017, NBCRNA has released annual reports regarding SEE and NCE correlation. In addition, surveys are available for Graduate Registered Nurse Anesthetists (GRNAs) to express their perception of the SEE as it correlates to the NCE delivery.

This scholarly project sought to provide evidence-based recommendations to SRNAs and faculty at AHU. If the results revealed a positive correlation between the SEE scores and the NCE scores at AHU, the University would have an indication that the SEE is a reliable tool to gauge a student's ability and preparation to pass the NCE on the first attempt. It also allows program directors to identify areas of weakness in their student body as a whole and possibly make modifications to the curriculum to emphasize specific content areas.

This scholarly project has provided objectively relevant data to SRNAs and faculty at AHU, which may help to motivate SRNAs to adequately prepare for the SEE.

Project Aims

The purpose of this scholarly project was to determine whether the AdventHealth MSNA program cohorts that graduated in 2017-2019 demonstrated a correlation between second year SEE and first attempt NCE scores. A secondary aim was to make evidence-based recommendations appropriate for those findings. This project aimed to examine predictive validity and examination reliability in SEE scores with first attempt NCE test takers at AHU. The project also provided relevant data to program administrators to help improve future NCE pass results among GRNAs at AHU.

The objectives were delineated as follows:

1. Determine if there is a correlation between first attempt NCE scores and SEE scores within the 2017-2019 MSNA graduating cohorts by Spring 2020.
2. Determine if first attempt SEE scores are predictive of first attempt NCE scores within the 2017-2019 MSNA graduating cohorts by Spring 2020.

3. Make evidence-based recommendations for the appropriate use of SEE scores as an influencing factor on AHU NAP decision-making, program recommendations, as well as AHU student recommendations for preparedness by Spring 2021.

Methods

This scholarly project design was quantitative, retrospective, and correlational. The following variables were studied: SEE scores as the independent variable and NCE scores as the dependent variable. Inclusion criteria were each student's SEE score from their first attempt in year two of the MSNA program and their corresponding first NCE attempt after graduation from AHU MSNA cohorts that graduated in 2017-2019. SEE and NCE scores prior to September 2016 were excluded due to the restructuring of the SEE, with the new SEE implemented in September 2016. Additional exclusion criteria were second attempt NCE scores, first year SEE scores, and repeat second year SEE scores. The program administrator collected the original exam data in the AHU nurse anesthesia department's secure drive. The program administrator compiled only the specific data needed for this study in an Excel spreadsheet, and the data was de-identified and randomized before it was uploaded to a password protected file on Microsoft SharePoint. Upon receipt of this data via the SharePoint file, it was stored in a password-protected file on Microsoft SharePoint which granted access only to the program director (Dr. Alescia DeVasher Bethea), scholarly project chair (Dr. Sarah Snell), statistician (Dr. Roy Lukman), Soyeon Kim, and Molinda Estima. The Microsoft SharePoint file will auto-delete after five years, which was confirmed by the Information Technology department at AHU.

Using SPSS software version 21.0, Dr. Roy Lukman performed a Pearson r analysis. A Pearson's product-moment correlation coefficient was computed to assess for a relationship between first attempt SEE scores and first attempt NCE scores using the traditional alpha value

of < 0.05. Because significance was obtained, a correlation between total SEE scores and the four NCE content domains scores was examined, utilizing the traditional p value of <0.05. At the conclusion of the statistical analysis, evidence-based recommendations were formulated based upon the results.

The setting and study site were AdventHealth University, a small, private Christian university in the southeast. The convenience sample included scores by students from the AHU Master of Science in Nurse Anesthesia (MSNA) program graduating in 2017-2019. Inclusion criteria were that subjects had first attempt scores on the NCE and second year SEE scores. Exclusion criteria were students who exited the program or repeat NCE attempt scores. The sample size was small (n=72). The AHU Information Technology (IT) department relayed communication related to methods that were used to keep data secure.

The Plan-Do-Study-Act model was applied to this scholarly project in a strategic manner.

Plan

A literature review was completed on articles relative to SEE and NCE scores and exam data. Interim standardized exams in other healthcare professions were also included in the literature review. A presentation including the purpose and aim of the project was made to key stakeholders. Second year SEE first attempt scores and corresponding NCE first attempt scores were requested from the department chair regarding the 2017-2019 MSNA graduates.

Do

This phase consisted of the AHU nurse anesthesia program administrator entering the de-identified data in a Microsoft Excel spreadsheet and SharePoint.

Study

In this phase, SPSS software version 21.0 was utilized to perform a Pearson r analysis on the correlation of SEE and NCE first attempt scores. As the NCE and SEE scores demonstrated a significant correlation, a multiple regression analysis was performed for the four SEE content domains and NCE first attempt scores to determine if correlation existed.

Act

Stakeholders such as faculty, students, educators, and program administrators were presented with evidence-based recommendations based on the study results.

Planning and Procedures

Planning Timeline

Key stakeholders for this scholarly project were selected based on their roles at AHU. They were selected as follows: Dana Williams, program admission coordinator of the Nurse Anesthesia Department; Dr. Alescia DeVasher Bethea, Chair of the Nurse Anesthesia Department; and Dr. Sarah Snell, faculty member of the Nurse Anesthesia program.

In order to fulfill course requirements for this scholarly project, a presentation was made regarding the importance of passing the NCE on first attempt and potential implications of correlation of SEE scores and NCE first attempt scores, PICOT, and aims of the scholarly project. Research was presented on the importance of passing the NCE on the first attempt and assessment of interim healthcare standardized exams.

Implementation Timeline

In May 2019, a proposal for a topic was submitted to the AHU faculty. A problem was identified, and PICOT questions were developed. Relevant studies and scholarly articles were obtained in June 2019. Once the topic was reviewed and tentatively approved by AHU faculty, interviews were conducted among key players: Dana Williams (program admission coordinator),

Dr. Alescia DeVasher Bethea (Nurse Anesthesia Department Chair), and Dr. Sarah Snell (AHU faculty) in June 2019. A proposed method PowerPoint was presented to Dr. Snell and Dr. Roy Lukman in June 2019.

A Proposal was submitted to the International Review Board (IRB) in December 2019. Upon approval, de-identified exam scores were obtained in a Microsoft Excel spreadsheet from Dr. DeVasher Bethea in March 2020. Following receipt of the data, multivariate analyses of the scores were completed utilizing SPSS software with the assistance of Dr. Lukman.

Barriers and Facilitators

A barrier that was encountered in this project was the extended timeframe that is required to gather the de-identified data. Upon interviews with the three facilitators, each key player emphasized that obtaining the data required at least three to four months, as each faculty member expressed that they had significant pre-existing commitments that must be balanced with this project. It was essential that once the de-identified data were obtained, students' identities remained anonymous. Dr. DeVasher Bethea copied the specific data fields that were requested into a master data file and created a separate Excel spreadsheet with no identifying information and with corresponding SEE and NCE scores for individuals on the same rows. The data charts were merged from all three cohorts into one spreadsheet. The rows were randomized by the computer with corresponding data remaining paired.

Facilitators to this project included the key stakeholders: department chair, program admission coordinator, AHU faculty member, statistician, and information technology (IT) department. These key players helped navigate the project in the right direction and ensured that only de-identified data was provided for this project.

Results

Data was examined to determine whether a relationship existed between the independent variable (SEE) and dependent variable (NCE). A convenience sample of n=72 was obtained from the department chair. Only first SEE scores in second year and first attempt NCE scores were included. First year SEE scores, repeat SEE scores in the second year, and repeat NCE scores were excluded. Analysis of the data was performed using the Statistical Package for Social Sciences (SPSS) software (version 21.0, SPSS Inc, Chicago, Illinois). Correlation statistics were used to test the hypothesis set at the level of significance < .05. First, a Pearson R correlational analysis was performed to determine if there was a correlation between second year SEE scores and first attempt NCE scores. Second, a linear regression analysis was performed to determine if second year first attempt SEE scores were predictive of first attempt NCE scores. Third, a multivariate regression analysis was performed to determine if category scores in SEE were predictive of category scores in the NCE.

Analysis Assumptions

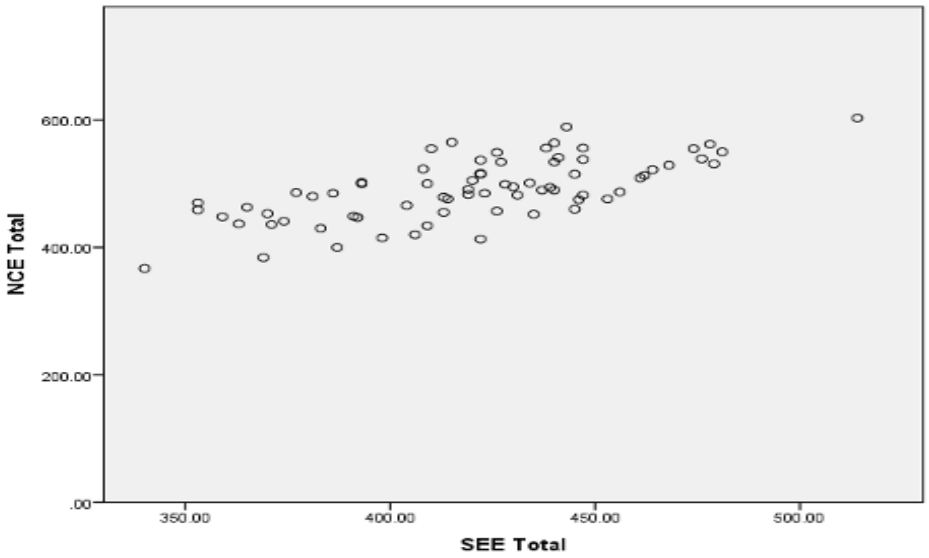
For this analysis, the total NCE score was the dependent variable, and the total SEE score was the independent variable. Several assumptions were made. First, it was assumed that both variables were continuous. Second, it was assumed that both variables were paired. Third, it was assumed that there was a linear relationship between the two variables. These three assumptions were upheld as evidenced by the scatter plot indicating a linear relationship existed between the two variables (See figure B1). The fourth assumption was that there were no outliers in the data for both variables. SPSS graphs showed no outliers in the data, so this assumption was upheld. The fifth assumption was that the data was normally distributed. This was upheld as shown by the obtained Shapiro-Wilk statistic for both variables are associated with p values greater than

.05 (See table B1). Assumption six was that the data showed homoscedasticity, which was upheld (Figure B2). Assumption seven was upheld, which stated that the residuals of the regression line are approximately normally distributed. This was evidenced by a normally distributed histogram and confirmed by a normal P-P plot (Figure B3 and B4).

Total NCE Score and total SEE score

Using SPSS, a Pearson r correlation analysis demonstrated a positive correlation between first attempt NCE and SEE total scores (r= .683, p < .005, 2 tailed). The total SEE score accounted for 46% of the variation in the total NCE scores as evidenced by an adjusted R^2 value of 0.46 and Durbin Watson value of 2.164. Regression analysis indicated that the predictive model is statistically significant F (1,70) = 61.360, p<.005; therefore, it can be concluded that the total SEE scores from the first SEE attempt in year two of the program significantly predict NCE total scores (Table B2). The higher the SEE total score, the higher the NCE total score, and conversely, the lower the SEE total score, the lower the NCE total score. The predictive model can be expressed by the equation (Y' = a + b(X)): NCE Total = 101.97 +101.937 SEE Total.

Figure B 1



Note: Visual inspection demonstrates linear relationship

Figure B 3

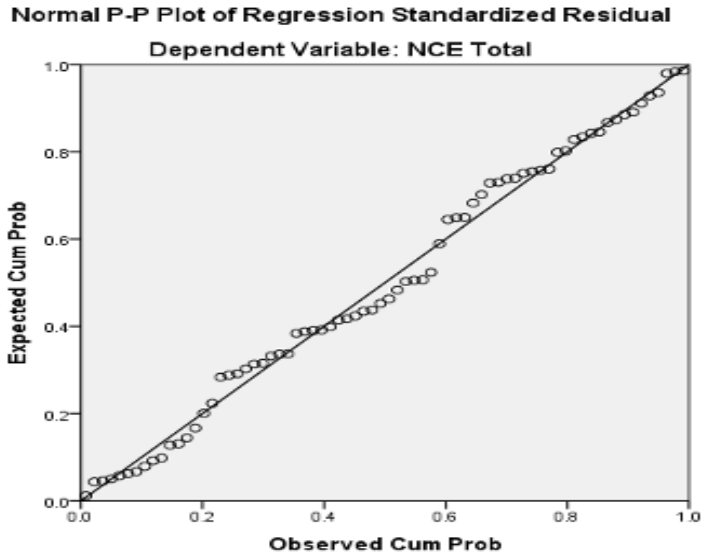
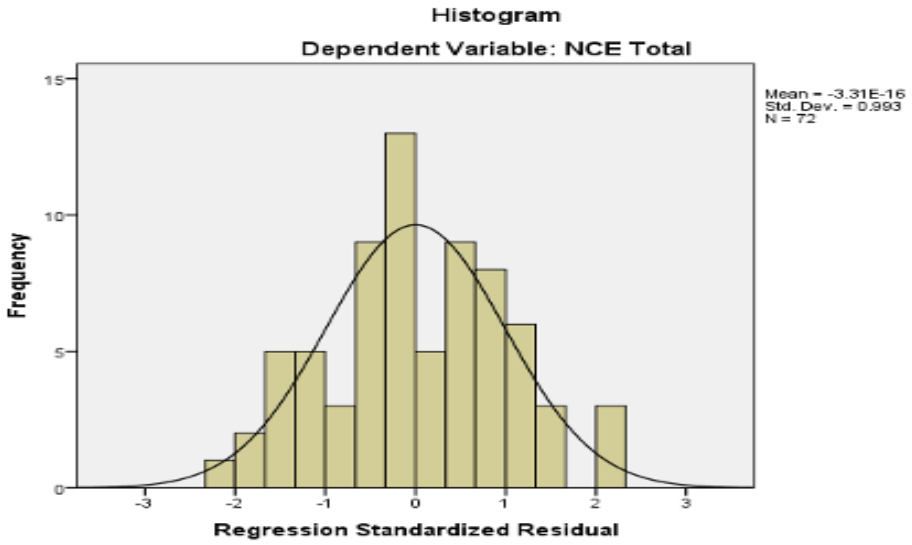


Figure B 4



Subcategories of SEE and NCE

Since correlation was achieved between the NCE and SEE total scores, the four subcategories were evaluated for correlation utilizing Pearson r correlation analysis according to the second aim of the project. A correlation matrix evidenced that every possible pair of variables

is significantly correlated (See table B3). In investigating correlations between specific selected variables, the Bonferroni method was applied. The level of confidence to determine statistical significance was .05 /4 = .0125. All assumptions were satisfied prior to analyses.

All sub-categories indicated a positive correlation significant at the 0.01 level (2-tailed) (Table B4). SEE Basic Sciences accounts for 30.36% of the variance in NCE Basic Sciences. For predictive ability derived from a regression model, the adjusted R^2 (29.4%) is used to minimize Type 1 error (see Table B5). SEE Technology accounted for 21.25% of the variance in NCE Technology. SEE Basic Principles accounts for 18.66% of the variance in NCE Basic Principles. SEE Basic Principles accounts for 20.88% of the variance in NCE Advanced Principles.

Total SEE and NCE scores

Table B6

Descriptive statistics for Second year SEE first attempt and NCE First attempt (Mean)

	AHU 2017-2019 Mean	AHU 2017-2019 Mean failed score	National Score 2019 Mean
SEE Total (2nd year)	420	383.1	409.7
Basic Sciences	411.4	374.5	407.2
Equipment, Instrument, & Technology	424.0	394.2	413.4
Basic Principles	425.8	390.6	410.0
Advanced Principles of NA	423.1	376.2	411.5
NCE Total	491.7	422.9	493.7
Basic Sciences	497.5	431.5	499.3
Equipment, Instrument, & Technology	502.4	428.6	504.1
Basic Principles of NA or General Principles of NA	496.9	420.1	496.0
Advanced Principles of NA or Anesthesia for surgical procedures and special population	491.7	425	495.5

Note: National Scores were retrieved from NBCRNA (2020a).

Table B7

Minimum, Maximum, and Mean Scores on SEE Second year correlated with passing on NCE first attempt (score 450 or greater) AHU Cohorts graduating 2017-2019, n=58

	Min	Max	Mean	SD
SEE total (2nd year)	353	514	429.3	32.4
SEE Basic Sciences	326	546	420.2	42.3
Equipment, Technology	348	497	431.2	33.6
SEE Basic Principles	327	517	434.2	38.3
SEE Advanced Principles	323	529	434.3	41.4

Discussion, Applicability to Practice, and Contribution to Professional Growth

Subsequent to the NBCRNA reformat of the SEE in 2016 to align with the NCE content domains, NBCRNA's statistics revealed that first attempt scores on the SEE and NCE correlated on a national level. However, studies were limited regarding whether this applies to individual nurse anesthesia programs, including at AHU. The aim of this project was to determine the correlation of second year SEE and first attempt NCE scores by AHU MSNA graduates in 2017-2019. The objectives were to determine the correlation between the SEE and NCE scores by 2017-2019 graduates, determine if the SEE predicts first attempt NCE scores, and provide evidence-based recommendations.

The data collected from the AHU Nurse Anesthesia department revealed that a statistically significant relationship existed between the first attempt SEE scores in the second year of the program and first attempt NCE scores. Data suggested the total scaled score of 429 or above on the SEE correlated with passing the NCE with the minimum score of 450 on the first

attempt. Since the SEE revision occurred, the SEE score that correlated to passing the NCE on the first attempt has increased every year, from 423.7 in 2017, to 428.5 in 2018, to 437.5 in 2019 (NBCRNA, 2020c).

The categories of the SEE (Basic Sciences, Equipment, Instrumentation and Technology, Basic Principles of Anesthesia, and Advanced Principles of Anesthesia) were also compared with the categories of the NCE (Basic Sciences, Equipment, Instrumentation and Technology, General Principles of Anesthesia, and Anesthesia for Surgical Procedures and Special Populations). SEE category scores that were correlated with passing on the NCE were as documented in Table B7.

When compared with the national average scores in 2019, the data about AHU MSNA graduates in 2017-2019 demonstrated higher mean scores on the SEE and all of its categories yet lower scores on the NCE and all of its categories, although only by a few points for each category (See Table B6). For NCE scores greater than 450 (n=58), the mean SEE score was 429, with a minimum of 353 and a maximum of 514, standard deviation of 32.3.

Applicability for SRNAs

This study at AHU confirmed that the SEE can serve as a reliable tool to gauge a student's understanding of anesthesia, as well as to help predict future performance on the NCE. Students can view their individual SEE scores immediately upon taking the exam. Once the students identify their weaknesses from the SEE scores, evidence-based remediation can be utilized for areas in which deficiencies are present. If students score below the national average of 410 on the SEE, or below the average passing score of 437.5, then they can dedicate additional time and use additional resources prior to the end of matriculation from their program. Various resources are available to SRNAs provided by the university and NBCRNA's website,

including an exam handbook and bibliography. In addition, AHU SRNAs are provided with a complete online board review system to utilize throughout the program. Currently at AHU, the nurse anesthesia program has transitioned to a three-year doctorate degree program. SRNAs are required to take the SEE at least twice while in the program (second year and third year). They are then granted repeated attempts until the designated score is achieved (AdventHealth University, 2021). This repeated opportunity allows the students to reflect on their progress in the nurse anesthesia program.

Applicability for Educators/Faculty

The SEE results can be used to further help administrators and faculty at AHU to modify the program's curriculum to emphasize specific content areas in which overall weaknesses were identified. This modification will, in turn, improve the preparation methods for future cohorts. In addition, evidence-based remediation can be implemented to help individuals who scored below the most current national average SEE score for second year students or below the most current national average SEE score that correlated with passing the NCE on the first attempt for third year students. SEE data changes annually, thus requirements may be changed annually to reflect national evidence. The results will help guide faculty to determine subsequent changes that can be made to the program. Educators are also able to help improve the overall experience of first attempt NCE test takers by acquiring past cohorts' feedback on board preparation specific to AHU.

Recommendations

Based on the data collected in this project, a significant correlation existed for the MSNA cohorts of 2017-2019 between the first SEE attempt in the second year and the first attempt SEE

scores. Therefore, it is recommended that the AHU nurse anesthesia program continue to require second year and third year students take the SEE prior to graduation. NBCRNA publications demonstrated there was a strong positive correlation between the SEE results and first attempt NCE in second year and third year graduate students if taken at least three months prior to the NCE (NBCRNA, 2020c). Although a high performance on the SEE does not guarantee passing the NCE on first attempt, it is recommended that SRNAs take the SEE at least three months prior to taking the NCE to get the most accurate prediction on their NCE score.

Data also demonstrated that AHU graduates in 2017-2019 who scored a mean of 429 on the SEE passed the NCE on the first attempt. Students who scored below 450 on the NCE achieved a mean SEE score of 383 (See table B6). Although this project found that 429 was the SEE score that correlated with 450 on the NCE by AHU MSNA graduates in 2017-2019, the research recommends faculty and administrators continue to require second year and third year students to repeat SEE attempts until a score of 437.5 or higher is achieved due to its correlation with passing the NCE on first attempt nationally (NBCRNA, 2020c). However, it is important to note that the SEE score correlated with passing has increased from 423.7 in 2017 to 437.5 in 2019, so the recommended score for 2021 and subsequent years may change depending on the most current national data.

The data obtained from this project solely focused on second year first attempt SEE and first attempt NCE scores. Future studies in which repeat SEE scores in second year and third year are assessed may provide more informative data on success rates on the NCE. While this project addressed MSNA graduates at AHU, at AHU, further assessment is recommended in the

future due to the transition from a 28-month MSNA program to a 36-month DNAP program in 2018.

Limitations

This scholarly project had multiple limitations. The project was limited to a small convenience sample of 72 subjects. This may impact the interpretation of the data, specifically the confidence intervals and *p*-value. The lack of a large sample size did not mean that there is no effect on the data, but it indicated a potential risk for a false-positive result (see Figure 2). Additionally, as the data was gathered from one university, the results may not be applicable to all nurse anesthesia programs in the US. Of importance, student confidentiality with accordance to the university's IRB policy restricted information which could provide descriptive data. The compilation of three years of data did not separate by year, so it was impossible to compare each cohorts' results with corresponding national annual data. Instead, data from all three years were merged and then compared to one year of the most current national data. Important variables such as total study time prior to the SEE or NCE and time elapsed between the first attempt SEE and NCE were not considered.

A limitation was solely using the second year SEE first attempt score. According to the 2021 AHU DNAP Student Handbook Supplement, students are allowed to retake the SEE exam as many times as needed by the end of the trimester to obtain the minimum score that is required at AHU (the current minimum score for second year is 410 and minimum score for third year is 440) (AdventHealth University, 2021). Repeat SEE scores were not studied in this project, which may have shown an improvement on SEE scores if the students were to utilize the feedback gained from the initial SEE score.

Another limitation to this project was the change in two individual domain names for the NCE effective January 1, 2018. Before 2018, the categories for the NCE were Basic Sciences (25%), Equipment, Instrumentation and Technology (15%), Basic Principles of Anesthesia (30%), and Advanced Principles of Anesthesia (30%). As of January 1, 2018, the category Basic Principles of Anesthesia was renamed General Principles of Anesthesia, and Advanced Principles of Anesthesia was renamed Anesthesia for Surgical Procedure and Special Populations. According to a statement by NBCRNA, no significant changes were made to these categories, but they were re-labeled to better describe the knowledge areas under those content domains (NBCRNA, 2017b). In addition, several topics were added to General Principles of Anesthesia regarding professional issues, ethical considerations, legal issues, and safety and wellness (NBCRNA, 2017b). An "imaging" section was added to Equipment, Instrumentation and Technology. Categories were broadly worded in Basic Sciences (i.e. drug classifications were listed instead of lists of specific drugs) (NBCRNA, 2017b).

Moreover, this scholarly project did not account for any changes to the NCE preparatory methods used within the AHU Nurse Anesthesia program for cohorts graduating in 2017-2019. Multiple preparatory methods are available to students such as Apex Anesthesia, Valley Anesthesia, Core Concepts, and the SEE. Core Concepts was required for AHU graduation cohorts of 2017-2019 in their final year of enrollment, and Apex Anesthesia was also incorporated for cohorts of 2018 and 2019.

Conclusion

NBCRNA has ensured that the initial certification obtained as a GRNA verifies baseline competency in advanced knowledge within the anesthesia field. CRNA certification is one of the essential requirements that allow a nurse anesthetist to administer anesthesia to patients. In order

to enter the nurse anesthesia workforce, GRNAs must pass the NCE. In an effort to increase preparation of students for the NCE experience, many nurse anesthesia programs have required students to take the SEE prior to the NCE. The SEE has become a growing trend as a reliable tool for students enrolled in nurse anesthesia programs to prepare for NCE.

The findings of this scholarly project identified for the AHU MSNA cohorts that graduated in 2017-2019 who earned a total SEE score of 429 or higher in their second year correlated with passing the NCE with a minimum score of 450 with 95% confidence. For the individual categories in the SEE, the following scores were associated with passing on the NCE: SEE Basic Sciences, a mean score of 420 (SD 42.3); SEE Instrument and Technology, a mean score of 431 (SD 33.6); SEE Basic Principles of NA a mean score of 434.2 (SD 38.3); SEE Advanced Principles of NA, a mean score of 434.3 (SD 41.3) (See Table B7). Of the students who did not pass the NCE on the first attempt, the mean total SEE score in their first attempt SEE in their second year was 383. For the individual categories, the following mean scores were associated with failing on the NCE: SEE Basic Sciences 374.5, SEE Instrument and Technology 394.2, SEE Basic Principles of NA 390.6, SEE Advanced Principles of NA 376.2 (See Table B6). Of importance, the national data from NBCRNA revealed the SEE score that correlated with passing the NCE in 2017 was 423.7 and in subsequent years increased to 437.5 in 2019 (NBCRNA, 2020c).

Although the findings from this project indicated a strong positive correlation between second year first attempt SEE score and the NCE first attempt score among MSNA cohorts 2017-2019, students should acknowledge high performance on the SEE does not guarantee passing the

NCE on first attempt. The impetus to pass the NCE ultimately relies on the GRNA's individual efforts.

Dissemination Plan

A preliminary PowerPoint presentation was created and presented at AHU's campus in November of 2019 to institutional key members and DNAP colleagues. Dissemination will occur in the Spring of 2021 at AdventHealth University in Orlando, Florida. A narrated PowerPoint presentation will be presented through AHU's website in Spring of 2021. A presentation will be made at a DNAP faculty meeting in April 8, 2021. The scholarly project will be placed in AHU library archives and made accessible for students' and faculty viewing.

Budget/ Grant

This scholarly project submitted for a Grant from the AHU Research department which was awarded on December 8, 2020 for professional editing services in the amount of $1,327.30. Due to unforeseen circumstances, publication was not sought prior to graduation in April 2021 and grant money was returned to the research department.

References

ACT Academy. (n.d.). *Plan, do, study, act (PDSA) cycles and the model for improvement* [PDF]. Retrieved from https://improvement.nhs.uk/documents/2142/plan-do-study-act.pdf

AdventHealth University. (2021). *Nurse anesthesia program student handbook supplement.* [Handbook]. Orlando, FL: AdventHealth University

AdventHealth University. (n.d.). Doctor of nurse anesthesia. Retrieved from https://www.ahu.edu/academics/doctor-of-nurse-anesthesia-practice

American Association of Nurse Anesthetists [AANA]. (2019, August 8). CRNA fact sheet. Retrieved from https://www.aana.com/membership/become-a-crna/crna-fact-sheet

Barton, L., Willson, P., Langford, R., & Schreiner, B. (2014). Standardized predictive testing: Practices, policies, and outcomes. *Administrative Issues Journal Education Practice and Research*, *4*(2), 68-76. doi:10.5929/2014.4.2.2

Boyd, D. & Poghosyan, L. (2017). Certified registered nurse anesthetist working conditions and outcomes: A review of the literature. *AANA Journal*. Retrieved from https://www.aana.com/docs/default-source/aana-journal-web-documents-1/certified-registered-nurse-anesthetist-working-conditions-and-outcomes---a-review-of-the-literature.pdf?sfvrsn=2dae4ab1_4

Bureau of Labor Statistics. (2019, September 4). Nurse anesthetists, nurse Midwives, and nurse practitioners. Retrieved from https://www.bls.gov/ooh/healthcare/nurse-anesthetists-nurse-midwives-and-nurse-practitioners.htm#tab-6

Caldwell, M. A., & Dowling, D. (2015). *The relationship between success or failure in first semester nurse anesthesia courses and success or failure on the certification examination*

and attrition [Unpublished doctoral dissertation]. Case Western Reserve University Frances Payne Bolton School of Nursing.

Carlson, A. G., Wilson, G. W., Normand, K., & Guy, K. (2012). Preparation strategies for the American board of anesthesiology in-training examination and indicators of success: a national survey. *Jacobs Journal of Anesthesiology and Research, 1*(2). Retrieved from https://jacobspublishers.com/

Chipas, A., Cordrey, D., Floyd, D., Grubbs, L., Miller, S., & Tyre, B. (2012). Stress: Perceptions, manifestations, and coping mechanisms of student registered nurse anesthetists. *AANA*, *80*(4), S49-S55. Retrieved from www.aana.com/aanajournalonline

Council on Accreditation [COA]. (2019). Standards for accreditation of nurse anesthesia educational programs. Retrieved from https://www.coacrna.org/wp-content/uploads/2020/01/2004-Standards-for-Accreditation-of-Nurse-Anesthesia-Educational-Programs-revised-October-2019.pdf

Daugherty, L., Benito, R. F., Kumar, K. B., & Michaud, P. C. (2010, July 07). United States faces a shortage of anesthesia providers. Retrieved from https://www.rand.org/pubs/research_briefs/RB9541.html

Dosch, M. P. (2012). Practice in computer-based testing improves scores on the national certification examination for the nurse anesthetists. *AANA Journal,80*(4), S60-S66. Retrieved from https://www.aana.com/publications/aana-journal

Fagerlund, K., & McShane, F. (2005). The self evaluation examination: Past, present, and future. *AANA Journal,73*(1), 21-23. Retrieved from https://www.aana.com/docs/default-source/aana-journal-web-documents-1/p21-23.pdf?sfvrsn=9ef455b1_6

Gauer, J. L., Wolff, J. M., & Jackson, J. B. (2016). Do MCAT scores predict USMLE scores? An analysis on 5 years of medical student data. *Medical Education Online, 21*(1), 31795. doi:10.3402/meo.v21.31795

Guiot, H. M., & Franqui-Rivera, H. (2018). Predicting performance on the United States medical licensing examination step 1 and step 2 clinical knowledge using results from previous examinations. *Advances in Medical Education and Practice*, 943-949. doi:10.2147/amep.s180786

Hiller, K., Franzen, D., Heitz, C., Emery, M., & Poznanski, S. (2015). Correlation of the national board of medical examiners emergency medicine advanced clinical examination given in July to intern American board of emergency medicine in-training examination scores: A predictor of performance? *Western Journal of Emergency Medicine, 16*(6), 957-960. doi:10.5811/westjem.2015.9.27303

Landau, J. (2017, October 03). Health-care dilemma: 10,000 baby boomers are now Retiring each day. Retrieved February 04, 2021, from https://www.cnbc.com/2017/10/03/health-care-dilemma-10000-boomers-retiring-each-day.html

Lebeck, L. (2003). *Correlation of Student Factors with Performance on the National Certification Examination for Nurse Anesthetists* [Doctoral dissertation, Rush University]. Ann Arbor, MI: Proquest Information and Learning Company.

MacIntyre, P., Stevens, B., Collins, S., & Hewer, I. (2014, February). Cost of education and earning potential for non-physician anesthesia providers. Retrieved February 04, 2021, from https://pubmed.ncbi.nlm.nih.gov/24654349/

Mcclintock, J. C., & Gravlee, G. P. (2010). Predicting success on the certification examinations of the American Board of Anesthesiology. *Anesthesiology, 112*(1), 212-219. doi:10.1097/aln.0b013e3181c62e2f

Monty, L., & Osborn, D. (1991). Deming's quality principles: A health care application. *Hospital & Health Services Administration1*, *36*(1).

Muckle, T. J., Plaus, K. A., Henderson, J., & Waters, E. (2012a). Professional practice analysis: Determining job relatedness of the certification examination for nurse anesthetists. *Journal of Nursing Regulation, 3*(3), 55-61. doi:10.1016/s2155-8256(15)30199-x

Muckle, T., Moriber, N., & Randall, G. (2012b). To SEE or not to SEE intended purposes vs. actual uses of the self-evaluation exam. Retrieved from https://www.nbcrna.com/docs/default-source/exams-documents/exam-statistics/20121212-see-article.pdf

National Board of Certification and Recertification for Nurse Anesthetists [NBCRNA]. (2017a). Evaluation of the first year administration of the reconfigured Self Evaluation Exam (SEE). Retrieved from https://www.nbcrna.com/docs/default-source/initial-certification/program-administration/evaluation_new_see_posting_dec2017-final.pdf

National Board of Certification and Recertification for Nurse Anesthetists [NBCRNA]. (2017b). National certification examination professional practice analysis. Retrieved from https://www.nbcrna.com/docs/default-source/exams-documents/nce-see-bibliography/2016_nce_ppa_exec_summ(2).pdf?sfvrsn=93f15a17_2

National Board of Certification and Recertification for Nurse Anesthetists [NBCRNA]. (2019a). NCE Handbook. Retrieved from https://www.nbcrna.com/docs/default-source/publications-documentation/handbooks/nce_hb(1).pdf

National Board of Certification and Recertification for Nurse Anesthetists [NBCRNA]. (2019b). SEE Handbook. Retrieved from https://www.nbcrna.com/docs/default-source/publications-documentation/handbooks/20180105_final_see_handbook.pdf?sfvrsn=47c6363d_4

National Board of Certification and Recertification for Nurse Anesthetists [NBCRNA]. (2020a). Annual NCE and SEE Report. Retrieved from https://www.nbcrna.com/docs/default-source/initial-certification/program-administration/annual-nce-and-see-report_cy-2019_072920.pdf?sfvrsn=42833088_2

National Board of Certification and Recertification for Nurse Anesthetists [NBCRNA]. (2020b). NCE and SEE Interpretive Guide. Retrieved from https://www.nbcrna.com/docs/default-source/initial-certification/program-administration/combined_final_nce-see-interpguide2018v2.pdf?sfvrsn=4e9c4b4a_6

National Board of Certification and Recertification for Nurse Anesthetists. (2020c). SEE evaluation report performance and clinical experience. Retrieved from https://www.nbcrna.com/docs/default-source/initial-certification/program-administration/combined-final-see-evaluation-report-2018v2.pdf?sfvrsn=555ace53_4

National Board of Certification and Recertification for Nurse Anesthetists. (n.d.). Summary of NCE and SEE performance and clinical experience. Retrieved from https://www.nbcrna.com/docs/default-source/initial-certification/program-administration/2017_nce_see_annual-report.pdf?Status=Temp&sfvrsn=362bc33d_4

Naughton, C. A., & Friesner, D. L. (2014). Correlation of P3 PCOA scores with future NAPLEX scores. *Currents in Pharmacy Teaching and Learning*, *6*(6), 877-883. doi:10.1016/j.cptl.2014.07.017

Opara, I. M., Onyekuru, B. U., & Nook, J. U. (2015). Predictive power of school based assessment scores on students' achievement in Junior Secondary Certificate Examination (JSCE) in English and mathematics. *Journal of Education and Practice, 6*(9), 112-116. Retrieved from https://files.eric.ed.gov/fulltext/EJ1082451.pdf

Ortega, K. H., Burns, S. M., Hussey, L. C., Schmidt, J., & Austin, P. N. (2013). Predicting success in nurse anesthesia programs: An evidence-based review of admission criteria. *AANA Journal, 81*(3), 183-189. Retrieved from https://www.aana.com/publications/aana-journal

University of New England. (2019). *Didactic handbook class of 2021* [Handbook]. Portland, ME: University of New England

University of Pennsylvania. (2016). *University of Pennsylvania school of nursing nurse anesthesia program graduate student handbook addendum* [Handbook]. Philadelphia, PA: University of Pennsylvania

Wunder, L. L., Glymph, D. C., Schirle, L., & Valdes, J. A. (2017). Workforce initiative for current predictors of CRNA employment in the state of Florida. *AANA*, *85*(3). Retrieved from https://www.aana.com/docs/default-source/aana-journal-web-documents-1/workplace-initiative-0617-pp217-221.pdf?sfvrsn=1c948b1_6

Yeo, S., & Chang, B. H. (2019). Students' self-assessment of achievement of terminal competency and 4-year trend of student evaluation on outcome-based education. *Korean Journal of Medical Education, 31*(1), 39-50. doi:10.3946/kjme.2019.117

Zaglaniczny, K. L. (1992). Factors which predict performance on the National Certification Examination for Nurse Anesthetists. *Journal of the American Association of Nurse*

Anesthetists, 60(6), 533-540. Retrieved from https://www.aana.com/publications/aana-journal

Appendix A

<table>
<tr><th colspan="6">References</th></tr>
<tr><td colspan="6">Dosch, M. P. (2012). Practice in Computer-Based Testing Improves Scores on the National Certification Examination for the Nurse Anesthetists. AANA Journal,80(4), S60-S66. Retrieved May 28, 2019.
Gauer, J. L., Wolff, J. M., & Jackson, J. B. (2016). Do MCAT scores predict USMLE scores? An analysis on 5 years of medical student data. Medical Education Online,21(1), 31795. doi:10.3402/meo.v21.31795</td></tr>
<tr><th>Purpose</th><th>Variables</th><th>Setting/Subjects</th><th>Measurement and Instruments</th><th>Results</th><th>Evidence Quality</th></tr>
<tr><td><u>Study One:</u>
To evaluate if the utilization in CBT in SRNA improved scores on the NCE.

<u>Study Two:</u>
To determine the correlation between MCAT scores and the USMLE.</td><td rowspan="3"><u>Study One:</u>
Primary outcome: improve student's score on the NCE

Secondary outcome: none

<u>Study Two:</u>
primary outcome: improve USMLE scores.

Secondary outcome: none</td><td><u>Study One:</u>
Setting: single university (name is unknown)

Subjects: 205-graduates (1998-2009)

<u>Study Two:</u>
Setting: University of Minnesota

Subjects: All students who matriculated between 2007 and 2011 in pursuit for MD (N=1060) and MD/PHD (N=5)</td><td><u>Study One</u>
Computer-based eZ.exam (Questionmark Corp, Norwalk, Connecticut)

<u>Study Two</u>
SPSS statistics, multiple linear regression, correlation, and chi square</td><td><u>Study One</u>: Mean NCE score was higher in CBT (2.68 ± 0.44) than in the paper (2.36 ± 0.91) (P = .002).

<u>Study Two</u>: <u>Correlations:</u> Step 1 (r=0.39, p<0.001) and Step 2 CK (r=0.31, p<0.001). Positive relationship.
<u>Multiple linear regression:</u> BS (β=0.277, p<0.001), PS (β=0.199, p<0.001), and VR (β=0.062, p=0.031) significant predictors.
<u>chi-square:</u> p-values were <0.001.
Correlation p<0.05</td><td rowspan="3"><u>Study One</u>
Methodological flaws: Students were sampled from different time period. The curriculum may have changed.
Inconsistency: none
Indirectness: none
Imprecision: none
Publication bias: none

<u>Study Two</u>
Methodological flaws: None
Inconsistency: none
Indirectness: none
Imprecision: none
Publication bias: The University of Minnesota Medical school provides funding for the salaries of the authors</td></tr>
<tr><th>Design</th><th colspan="3">Implications</th></tr>
<tr><td><u>Study one:</u>
Retrospective study

<u>Study Two:</u>
Correlational study</td><td colspan="3"><u>Study One:</u> Students with extensive experience in CBT achieved higher scores on the NCE than students with less experience in CBT.

<u>Study Two:</u> MCAT scores are predictive of student performance on the USMLE exam.</td></tr>
</table>

References

Muckle, T., Moriber, N., & Randall, G. (2012, December). To SEE or not to SEE Intended Purposes vs. Actual Uses of the Self Evaluation Exam. Retrieved May 25, 2019, from https://www.nbcrna.com/exams/see-resources

Yeo, S., & Chang, B. H. (2019). Students' self-assessment of achievement of terminal competency and 4-year trend of student evaluation on outcome-based education. *Korean Journal of Medical Education,31*(1), 39-50. doi:10.3946/kjme.2019.117

Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One: To identify appropriateness of SEE exam and to validate evidence for the SEE with NCE scores. **Study Two:** To evaluate how well students achieved competencies over the course of medical school.	**Study One:** **Primary outcome:** SEE **Secondary outcome**: Improve NCE scores **Study Two:** **Primary outcome:** self-assessment how well they achieved competency, analyze differences and trends of the scores by year **secondary outcome:** students evaluate the need for curriculum improvement of the curriculum	**Study One:** Settings: Subjects: SEE test taker (N=4,085) since 2009. **Study Two:** Setting: School of Medicine, Kyungpook National University (KNUSOM) Subjects: 186 fourth-year students of KNUSOM who took medical education classes from 2015-2018	**Study One:** annual analysis of the total SEE scores has exhibited good reliability, with coefficients over 0.85, indicating a high level of reliability. observed Pearson correlation was ρ = +0.57, Observed x-y scatterplot **Study Two:** Questionnaire survey, 5 domains of competency on a 5 point Likert scale, one-way analysis of variance (ANOVA) with Scheffe's post-hoc test was conducted to analyze the differences in competency scores of students who graduated in different years.	**Study One:** Pearson correlation was ρ = +0.57, $p < 0.01$. **Study Two:** students' scores on the graduation competency were 2.03 to 4.06 points	**Study One:** **Methodological flaws:** None **Inconsistency:** Some school mandate SEE to pass the program. Whereas, other school may not. Giving variation in the amount of time students prepare for the exam. **Indirectness:** None **Imprecision:** None **Publication bias:** NBCRNA created the SEE **Study Two:** **Methodological flaws:** The student perceived self-assessment in competency may not correlate with their actual competency **Inconsistency:** None **Indirectness:** No confidence interval was given **Imprecision:** None **Publication bias:** None
Design **Study one:** Correlational study, retrospective study **Study Two:** Correlational study				**Implications** **Study One:** students who studied more than 50-hours a week, there was a strong predictive relationship between SEE and NCE scores, weak/ low correlation with less than 50 hours a week studied **Study Two:** no year to year difference in 30 main competencies but difference in 26 sub competencies	

References

Carlson, A. G., Wilson, G. W., Normand, K., & Guy, K. (2012). Preparation Strategies for the American Board of Anesthesiology In-Training Examination and Indicators of Success: A National Survey. *Jacobs Publishers*. Retrieved May 29, 2019.

NBCRNA. (2017, December 15). Evaluation of the First Year Administration of the Reconfigured Self Evaluation Exam (SEE). Retrieved May 28, 2019, from https://www.nbcrna.com/docs/default-source/initial-certification/program-administration/evaluation_new_see_posting_dec2017-final.pdf

Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One: To evaluate the success rates of the various strategies utilized by anesthesiology residents in preparation for the ITE or ABAWE **Study Two:** To conduct an evaluation of 2017 results to the new SEE's predictive validity	**Study One:** Primary outcome: Improve ITE and ABAWE scores Secondary outcome: various preparation strategies **Study Two:** Primary outcome: SEE Secondary outcome: Improve NCE scores	**Study One:** **Setting:** Nationwide **Subject:** 174-anesthesiology residents **Study Two:** **Setting:** computer data base **Subject:** 3,845 examinees	**Study One:** Descriptive technique was used most results. Inferential statistics were used on Chi-Squared. Electronic surveys to those who scored >75th percentile. **Study Two:** Survey feedback, Statistical psychometric indicator	**Study One:** Residents who scored high on CA-1 year did well in CA-2 and CA-3 year ($p < 0.001$). Female did not perform better than men ($p = 0.13$), marital status did not improve scores ($p = 0.34$). No correlation between books ($p = 0.41$). Cramming increased performance ($p = 0.048$). Respondents from the South performed better ($p = 0.013$). **Study Two:** On a scale from 0-1, the reliability score revealed improvement from 0.83 to 0.93	**Study One:** **Methodological flaws:** None **Inconsistency:** None **Indirectness:** None **Imprecision:** limited sample size **Publication bias:** None **Study One:** **Methodological flaws:** Direct comparison is not possible due to different rubric in content. **Inconsistency:** None **Indirectness:** None **Imprecision:** No confidence interval was given **Publication bias:** NBCRNA created the SEE
Design				**Implications**	
Study One: Correlational study **Study Two:** Correlational study				**Study One:** Reading and question-based preparation strategy throughout residency is the most effective way to guarantee passing the ABAWE **Study Two:** There is a high, positive correlation between New SEE scores and performance on the first NCE attempt.	

Opara, I. M., Onyekuru, B. U., & Nook, J. U. (2015). Predictive Power of School Based Assessment Scores on Students' Achievement in Junior Secondary Certificate Examination (JSCE) in English and Mathematics. *Journal of Education and Practice,6*(9), 112-116. Retrieved May 28, 2019.

Caldwell, M. A., & Dowling, D. (2015). *The relationship between success or failure in first semester nurse anesthesia courses and success or failure on the certification examination and attrition* (Unpublished doctoral dissertation). Case Western Reserve University Frances Payne Bolton School of Nursing.

Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One: To investigate the school-based assessment (SBA) scores on students' achievement in Junior Secondary Certificate Examination (JSCE) in English and Mathematics. **Study Two:** To determine if anesthesia student grades in any first semester course is related to student attrition and/or success on the NCE	**Study One:** Primary outcome: Students' achievements **Study Two:** Primary outcome: success on NCE scores	**Study One:** Setting: Obio-Akpor Local Government Area of Rivers State schools Subject: 50 students from ten (10) schools out of twenty (20) Junior secondary schools. **Study Two:** **Setting:** Western Reserve University Nurse Anesthesia program **Subject:** 266-students registered nurse anesthetist	**Study One:** Instrument: students SBA score for JS1, JS2, JS3 and JSCE scores in English and Mathematics. Measurement: multiple regression. **Study Two:** Chi-score Analysis	**Study One:** multiple regression in mathematics: R= 0.795, R square= 0.632 adjusted = 0.627 and standard error= 10.08567. Analysis of variance for the multiple regression had an F-value of 140.750 which is significant at 0.05 alpha level. **Study Two:** The two variables (X^2=39.902, p<.001). 20-students withdrew from the program. 5.7% failed after admittance during the ten-year period, and 94.3% of the remaining students passed the NCE first attempt.	**Study One:** **Methodological flaws:** None **Inconsistency:** None **Indirectness:** None **Imprecision:** limited sample size **Publication bias:** None **Study Two:** **Methodological flaws:** None **Inconsistency:** Discrepancies in curriculum between institutions limit using multi-institutional data sets. **Indirectness:** None **Imprecision:** Limited sample size **Publication bias:** none
Design				**Implications**	
Study One: Retrospective, Quantitative study **Study Two:** Retrospective study Descriptive study				**Study One:** SBA scores significantly predicted students' achievement in Junior Secondary Certificate Examination in English and Mathematics **Study Two:** There is a statistically significant relationship between the quality of first semester coursework and program's success on passing the NCE first try.	

Ortega K. H., Burns, S. M., Hussey, L. C., Schmidt, J., & Austin, P. N. (2013). Predicting Success in Nurse Anesthesia Programs: An Evidence-Based Review of Admission Criteria. *AANA Journal,81*(3), 183-189. Retrieved May 29, 2019.

Zaglaniczny, K. L. (1992). Factors which predict performance on the National Certification Examination for Nurse Anesthetists. *Journal of the American Association of Nurse Anesthetists,60*(6), 533-540. Retrieved May 29, 2019.

Purpose	Variables	Setting/Subjects	Measurement and Instruments	Results	Evidence Quality
Study One: Examine the evidence of evaluating applicants to Nurse anesthesia programs that may help predict success in program and on the National Certification Examination (NCE) **Study Two:** predicting the performance of registered Nurse Anesthetists (RNA's) on the NCE	**Study One:** Primary outcome: success in nurse anesthesia program Secondary outcome: success on NCE **Study Two:** Primary outcome: Success on the NCE	**Study One:** 8 graduate Nurse anesthesia programs, 9 graduate nursing programs without SRNA's, 2 with SRNA's 1980-2011 **Study Two:** 1690 RNA's who took 5 NCE's administered from December 1987 through December 1989	**Study One:** System proposed by Melnyk & Fineout-Overholt- evidence grade level 1(systematic reviews) to level VII (expert opinion). **Study Two:** One-way analysis of variance (ANOVA), student's t-test was used to determine differences in gender performance in overall CES. Significance level of P< 0.05	**Study One:** Undergrad GPA >3.25 significantly predicted graduate GPA ($p<0.001$), GRE scores less predictive, inverse relationship with age and NCE **Study Two:** Science GPA accounted for 24% of the variance of overall certification R square 0.239, the other 6 variables- age, gender, years' experience, previous degree- cont 3%	**Study One:** **Methodological flaws:** None **Inconsistency:**None **Indirectness:** not all studies involved SRNA's or anesthesia programs, same outcomes measured **Imprecision:** None **Publication bias:** None **Study Two:** **Methodological flaws:** None **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** This study was supported by a grant from the AANA Education and Research Foundation
Design				**Implications**	
Study One: Literature review **Study Two:** Retrospective analysis with multiple regression analyses				**Study One:** overall low quality, ssupported commonly used admissions criteria (UGPA, science & nursing GPA, GRE less, years' experience in critical care, age) in predicting success in NAEP & NCE. Bachelor of Science vs. other bachelor's degree= no correlation. **Study Two:** GPA is highest predictor of success. Inverse relationship w age and NCE pass. Bacc degree higher pass rate than diploma or ASN. Yrs of experience in nursing correlate with higher pass rate	

Appendix B

Figure 2

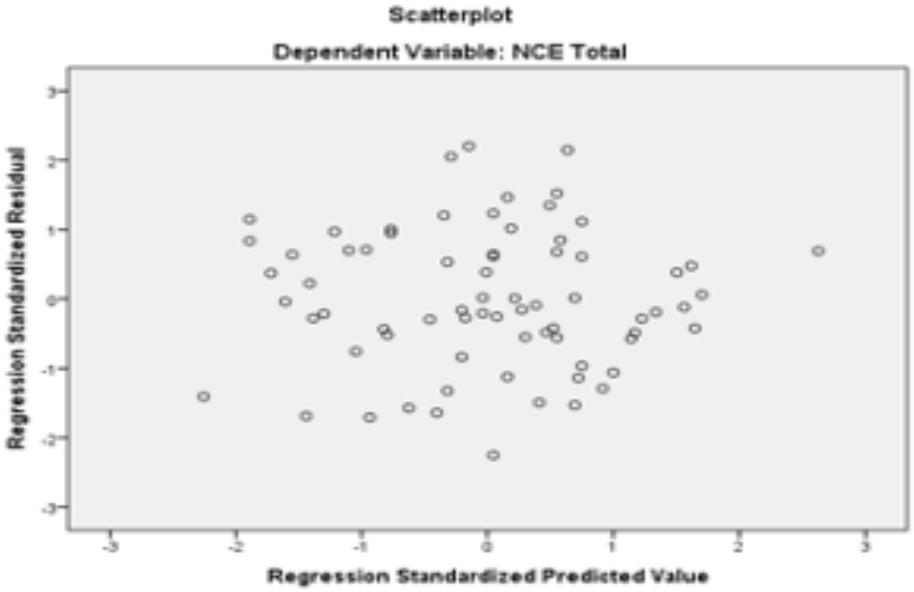


Table B1

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SEE Total	.068	72	.200*	.988	72	.723
NCE Total	.046	72	.200*	.993	72	.970

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table B2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	77583.190	1	77583.190	61.360	.000[b]
	Residual	88507.129	70	1264.388		
	Total	166090.319	71			

a. Dependent Variable: NCE Total

b. Predictors: (Constant), SEE Total

Table B3

Correlations

		SEE Basic Sciences	SEE Technology	SEE Basic Principles	SEE Advanced Principles	NCE Basic Sciences	NCE Technology	NCE Basic Principles	NCE Advanced Principles
SEE Basic Sciences	Pearson Correlation	1	.572**	.704**	.702**	.551**	.421**	.541**	.446**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
	N	72	72	72	72	72	72	72	72
SEE Technology	Pearson Correlation	.572**	1	.584**	.607**	.469**	.461**	.391**	.318**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.001	.007
	N	72	72	72	72	72	72	72	72
SEE Basic Principles	Pearson Correlation	.704**	.584**	1	.637**	.438**	.389**	.432**	.399**
	Sig. (2-tailed)	.000	.000		.000	.000	.001	.000	.001
	N	72	72	72	72	72	72	72	72
SEE Advanced Principles	Pearson Correlation	.702**	.607**	.637**	1	.451**	.453**	.466**	.457**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
	N	72	72	72	72	72	72	72	72
NCE Basic Sciences	Pearson Correlation	.551**	.469**	.438**	.451**	1	.445**	.439**	.359**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.002
	N	72	72	72	72	72	72	72	72
NCE Technology	Pearson Correlation	.421**	.461**	.389**	.453**	.445**	1	.523**	.406**
	Sig. (2-tailed)	.000	.000	.001	.000	.000		.000	.000
	N	72	72	72	72	72	72	72	72
NCE Basic Principles	Pearson Correlation	.541**	.391**	.432**	.466**	.439**	.523**	1	.578**
	Sig. (2-tailed)	.000	.001	.000	.000	.000	.000		.000
	N	72	72	72	72	72	72	72	72
NCE Advanced Principles	Pearson Correlation	.446**	.318**	.399**	.457**	.359**	.406**	.578**	1
	Sig. (2-tailed)	.000	.007	.001	.000	.002	.000	.000	
	N	72	72	72	72	72	72	72	72

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

Table B4

Variables	*Obtained coefficient*	*P value*
SEE and NCE Basic Sciences	.551	.005
SEE and NCE Technology	.461	.005
SEE and NCE Basic Principles	.432	.005
SEE and NCE Advanced Principles	.457	.0125

Table B5

Correlations

		SEE Basic Sciences	NCE Basic Sciences
SEE Basic Sciences	Pearson Correlation	1	.551**
	Sig. (2-tailed)		.000
	N	72	72
NCE Basic Sciences	Pearson Correlation	.551**	1
	Sig. (2-tailed)	.000	
	N	72	72

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