Graduate Record Examination Scores as Predictors of First Time Success on the National Certification Examination in a Midwest Nurse Anesthesia Program

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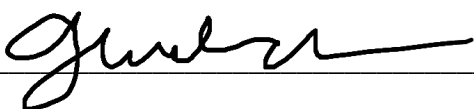Doctor of Nurse Anesthesia Practice Degree

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GRE AS A PREDICTOR OF NCE SUCCESS

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Abstract

Purpose: The purpose of this scholarly project was to determine if GRE scores (verbal reasoning, quantitative reasoning, and analytical writing) predict first-time pass rate on the NCE. This project also investigated the correlation between first-time pass rate on the NCE and the individual covariates of age at program matriculation, sex, race, number of years as an RN, number of years as an ICU RN, entry-to-practice nursing GPA, and nurse anesthesia program GPA.

Methods: A retrospective compilation of secondary data was assembled for 114 master's degree students. Using SPSS® software, bivariate data analysis was performed using 10 independent variables and the dependent variable NCE result (pass/fail). Due to the high first attempt pass rate among the study population (87.7%), a second dependent variable, NCE total score, was also utilized. Multivariate analysis using nine of the 10 independent variables was completed for both NCE result (pass/fail) and NCE total score.

Results: No statistically significant relationship between GRE scores and first attempt NCE pass rate was found. A positive but weak correlation existed between GRE scores and NCE total score, and a slight significance was noted with both GRE quantitative score (positive correlation) and GRE analytical score (negative correlation) in the multivariate linear regression model. Age at program matriculation, number of years as an ICU RN, and nurse anesthesia program GPA were statistically significant using both first attempt NCE result and NCE total score. Younger students with less ICU experience were more likely to pass the NCE on first attempt and scored higher on the NCE. Nurse anesthesia program GPA was positively correlated with both NCE result and NCE total score.

Conclusion: This scholarly project supports removal of the GRE as an admission requirement in the investigator's nurse anesthesia program, thus removing possible financial and motivational admission barriers which may allow for a more diverse, holistic admission process. Removal will likely expand the applicant pool since many other nurse anesthesia programs no longer require the GRE. Future studies may consider use of cumulative science GPA and the type of ICU in which the student has worked prior to matriculation as predictor variables.

Data Sources: CINAHL Complete, Ovid, Google Scholar, and PubMed databases.

Keywords: Nurse anesthesia, advanced practice nursing, CRNA, anesthesia, cognitive intelligence, GRE, admission requirements, admission criteria, nurse anesthesia educational programs, predictors of success, and graduate school success.

Introduction

The practice of nurse anesthesia is rigorous and demanding. Prospective students compete for a limited number of seats, and program administrators and faculty of nurse anesthesia educational programs (NAEPs) are invested in selecting students who are most likely to succeed in the challenging curriculum and extensive clinical education.[1] Determination and selection of high-caliber students who will eventually successfully certify as nurse anesthetists remains an imperfect science.[2]

The Council on Accreditation of Nurse Anesthesia Educational Programs (COA) establishes standards for national accreditation.[2] The only admission requirements set forth by the COA are baccalaureate-prepared registered nurses and at least one year of acute or critical care experience.[3] Outside of these, traditional cognitive criteria used by most NAEPs in the United States include undergraduate grade point average (GPA), core science GPA, and Graduate Record Examination (GRE) scores.[1,4] The University of Michigan-Flint Nurse Anesthesia Program utilizes these criteria, as well as other cognitive and non-cognitive requirements such as letters of recommendation, a knowledge test, and a pre-admission interview.

Goals within the Flint program include minimizing student attrition and maximizing student success on the National Certification Examination (NCE). It is important to examine admission requirements as they relate to student success on the NCE, as there are financial, emotional, and personal repercussions of not being successful.[5] Failure directly affects the student, the NAEP, and the university. NCE first-time pass rates are monitored by the COA and are publicly available; deviation from the established pass rate requirement can negatively affect program accreditation and the future pool of applicants.[2,6] Passing the NCE is the endpoint of an

accredited NAEP, and certification is necessary to begin employment.[7] If a student is not successful on first attempt, employment is delayed, which can negatively impact the employer. The student must also retake the examination at a cost of $995 plus applicable fees.[8]

Avoidance of the above unfavorable consequences has led to an assessment of the current cognitive admission criteria used within the nurse anesthesia program at the University of Michigan-Flint. More specifically, the use, appropriateness, and necessity of the GRE® General Test as a factor in student success is in question. This is important to the admissions committee because it remains a requirement of the program while it has been removed in other nurse anesthesia programs. The association of the GRE as it relates to student success will determine whether there is a need to remove it as a requirement. Removal may streamline the admission process, decrease the financial and emotional burden placed on students, and increase the applicant pool.[9]

It is hypothesized that GRE scores do not correlate with student success as measured by first-time pass rate on the NCE. This project is intended to answer the question: Are GRE scores of Student Registered Nurse Anesthetists (SRNAs) at the University of Michigan-Flint predictive of success in passing the NCE on the first attempt?

Literature Review

A literature review was conducted to obtain scholarly articles related to nurse anesthesia programs, admission criteria, predictors of success, national certification examination, and advanced practice nursing. The search utilized Cumulative Index of Nursing and Allied Health (CINAHL) Complete, Ovid, Google Scholar, and PubMed databases. Keywords used in the database searches included nurse anesthesia, advanced practice nursing, CRNA, anesthesia, cognitive intelligence, GRE, admission requirements, admission criteria, nurse anesthesia

educational programs, predictors of success, and graduate school success in various combinations.

Inclusion criteria consisted of articles written in English that were published in the last 30 years, including four unpublished dissertations: three within the last ten years and one in 1995. The extended time period was selected due to the scarcity of articles concerning nurse anesthesia and GRE predictability on the outcome measure of NCE success.

Due to the paucity of research concerning the investigator's research question, the majority of the studies found in this review involved other advanced practice nursing disciplines and a variety of outcome measures of student success.[9-18] Of those specific to nurse anesthesia, most studies did not use success on the NCE but instead used nurse anesthesia program GPA or graduation as a measure of success.[1,19,20] Other common cognitive admission criteria were often investigated in addition to GRE, most notably undergraduate GPA and core science GPA. Only two published studies were found which explored factors that predicted NCE performance; however, both are dated, and the version of the NCE has been changed since these studies were performed.[7,21] One of these studies did not include GRE as a factor.[7] No recent data correlated performance on the GRE with that on the NCE.

The GRE General Test is a standardized test administered by Educational Testing Service (ETS, Princeton, New Jersey) commonly required for admission into graduate nursing education.[9,22] The test aims to supplement a graduate student's application while also giving schools a common measure with which to compare candidates.[9,22] The test has three skill subsections which measure verbal reasoning, quantitative reasoning, and analytical writing skills.[22] The verbal reasoning and quantitative reasoning sections are transformed from raw scores into scaled scores (ranging from 130-170) and reported out as percentiles to indicate

performance by comparison to other test takers.[9] The intent of the GRE is to measure abilities and skills that are developed over time; therefore, reasonably high scores are expected.[9] Research regarding reliability and validity estimates in predicting success is nonexistent for graduate nursing education, and there have been very few validity studies performed in any of the health science disciplines since the major test revision in 2011.[9,23]

The literature demonstrates that graduate programs in nursing do not routinely perform self-validations in reference to GRE use.[9] "This threatens test interpretation and psychometrics, and programs could potentially admit unsuitable candidates."[9] Chicca[9] further states that analysis of GRE validity could help admissions committees determine appropriate utilization and establish more accurate admission criteria, either by discontinuing or modifying the requirement.

Studies involving the GRE in advanced practice nursing has revealed similar results. Megginson[17] used descriptive statistics in nursing PhD programs within the United States and found that 82% of BSN (bachelor of science in nursing) to PhD and MSN (master of science in nursing) to PhD programs required the GRE for admission. The GRE was the second most common required cognitive factor, after undergraduate nursing GPA. This study also revealed that most programs incorrectly use GRE, reporting scores rather than percentiles; only 3.6% of programs reported using percentiles when making admission decisions, which is recommended by ETS evidence-based guidelines.[17] Megginson[17], like Chicca, discussed that schools should conduct self-validation studies, as only 22% of PhD programs reported performing them.

Katz et al.[15] also discussed performance of a self-validation study regarding use of the GRE as an absolute admission requirement. This study conducted a retrospective review of 217 MSN and PhD nursing students over one year to determine whether GRE scores predicted graduate school success, measured by cumulative graduate GPA.[15] The authors reported that GRE scores

only explained approximately 5 to 8% of the variance in graduate GPA.[15] Due to these results, the GRE was considered a barrier to application and therefore eliminated as arequirement.[15]

Mancuso and Udlis[13] also performed descriptive research using 137 DNP (doctor of nursing practice) and PhD nursing program in the United States. They found that 43.3% of BSN to DNP programs required the GRE for admission, whereas it was required in only 22.1% of MSN to DNP programs.[13] Furthermore, within the BSN to DNP programs, an additional 13.3% required the GRE if a predetermined GPA was not met.[13] This suggests a GRE waiver as another avenue to explore within graduate and doctoral programs.

Advanced practice nursing literature cites other cognitive admission factors as being more predictive than GRE scores when compared to a specific outcome measure other than a certification examination. Suhayda et al.[10] examined academic records of 738 master's-level nursing students. They concluded that undergraduate cumulative GPA and undergraduate nursing GPA predicted success in the majority of students; the addition of GRE scores added no predictive value to dismissal status, which was the dependent variable.[10] As a result of their study, the authors waived the GRE requirement for applicants to their program who met specific undergraduate and nursing GPA criteria and developed a decision-making algorithm for those who did not.[10] Since implementing these new guidelines, their program has noted a decrease in rate of dismissal and an increase in the number of applicants.[10]

The GRE was found to be predictive in some advanced nursing studies. Rhodes et al.[11] concluded that GRE did correlate with first-year and overall GPA, but it was a weaker predictor of performance than undergraduate GPA. Newton and Moore[14] discovered similar results; they examined data from 120 graduate nursing students within the same program and noted that those with high undergraduate GPAs had higher verbal and quantitative GRE scores and were more

successful within their program. It was thus decided that, given this correlation, it was not necessary to require both GRE and undergraduate GPA for admission.[14] Similar to Sudhaya et al., Newton and Moore waived the absolute requirement and revised their admission policies to only require submission of GRE results if undergraduate GPA was less than 3.5.[14]

Two advanced practice nursing studies showed predictive validity of the GRE. In the first study, a sample size of 59 graduates revealed that both aggregate GRE and GRE verbal scores, when compared with undergraduate GPA, were near equal predictors of graduate GPA.[12] Findings by Richard-Eaglin[18] suggest support for the use of GRE scores as an admission criterion and a predictor of success in a nurse practitioner program. Results of this more recent study showed a statistically significant relationship between verbal, quantitative, and total GRE scores and successful academic progression.[18]

Although there are commonalities between advanced practice nursing curriculum and that of nurse anesthesia, there are also distinct differences. These differences include increased coursework in core science classes and increased clinical cases and hours for nurse anesthesia students.[2] It is the result of these differences and their implications that make it inappropriate to rely heavily on analysis deduced from non-anesthesia student study populations.

Data derived from nurse anesthesia studies is sparse. Results favor the majority of the above research. Haritos et al.[24] surveyed 38 accredited military and master's degree NAEPs. No dependent predictor variable was measured, but it was noted that 11 programs (29%) indicated that they did not use GRE scores as a basis for selecting students for admission.[24] Program directors ranked overall GPA as the most considered factor in the selection process, followed by interview performance, science GPA, and years of critical care experience.[24]

Burns[1] and Hulse et al.[19] conducted studies to consider whether admission criteria predict student success in CRNA programs. Results revealed that admission GPA and science GPA were associated with academic progression in programs.[1,19] Burns[1] noted that GRE was less predictive but a correlation existed between total GRE and current GPA. Hulse et al.[19] concluded that within the United States Army Graduate Program in Anesthesia Nursing, the GRE was not predictive of success, as defined by program graduation (success) and withdrawal or relief (nonsuccess). The latter authors suggest noncognitive factors to be most predictive in this military program.[19] Another military study by Wilson et al.[20] used the same outcome criteria of success as in the Hulse et al. study. Interestingly, results showed that the GRE total and the GRE analytical scores, as well as nursing GPA and age while in the program, were statistically significant predictors.[20]

Ortega et al.[25] conducted an evidence-based review of the literature to examine which admission criteria were best predictors of success in CRNA programs. Findings revealed that the GRE score is supported by some researchers, but most found it to be less predictive than undergraduate science or nursing GPA.[25]

Two published studies investigated GRE as a predictor of NCE success. Dial et al.[21] looked at two outcome measures, graduate GPA and passing the NCE. The authors found that data from two separate anesthesia programs revealed conflicting information. In one program, GRE was predictive of graduate GPA; in the other, undergraduate GPA was predictive of graduate GPA.[21] When both independent variables were considered, it was found that GRE showed the strongest correlation.[21] Due to a very high pass rate in both programs, there was not enough variability to analyze undergraduate GPA and GRE as they relate to passing the NCE.[21] Zaglaniczny[7] also investigated which factors were best predictive of performance on the NCE.

However, GRE was not included as a factor in this study. Undergraduate science GPA was noted

to be most predictive of NCE performance, as was younger age.[7] Results also included gender-

related differences; males achieved higher mean NCE scores than females.[7]

Four non-published nurse anesthesia dissertations were found in the literature. A study by

Fuller[26] was conducted to determine the feasibility of identifying admission criteria that could

predict success in a graduate nurse anesthesia program and on the NCE. Positive correlations

were discovered between quantitative GRE scores, undergraduate GPA, graduate GPA, and NCE

scores.[26] Similarly, Della Rocca[27] conducted a research study which involved 177 participants.

Archived data was used from one nurse anesthesia program to determine if GRE scores and

undergraduate GPA, along with other cognitive factors, were predictive of successful completion

of the NCE.[27] A direct relationship between quantitative GRE score and NCE scores existed, but

undergraduate GPA was not a predictive variable.[27] Hoversten[6] studied a large population of

2010 graduates who were first-time test takers of the NCE. The author did not include cognitive

admission factors as predictors of success, but statistical significance was shown in NCE scores

based on age and years of critical care experience.[6] A more recent dissertation by Stewart[2]

sampled 17 program and assistant program directors to determine their attitudes about those

attributes ranked highest in relation to program success. The highest mean score was for science

GPA, while the lowest was for GRE score and applicant age.[2] Other factors placed high in

importance were undergraduate GPA, as well as emotional intelligence, critical care experience

acuity, and personal interview.[2]

The information found in this literature review demonstrates the existing knowledge gap

regarding the predictive validity of the GRE General Test on first-time pass rates on the NCE.

Methodology

Study design was descriptive and retrospective. After obtaining University of Michigan-Flint IRB approval *(Appendix A)*, secondary data housed electronically within the University of Michigan-Flint nurse anesthesia program was collected and entered into a data spreadsheet. Demographic information regarding student sex and age was collected from the University and added to the spreadsheet.

Study participants included nurse anesthesia students who were accepted and enrolled in the 24-month master's degree nurse anesthesia program at the University of Michigan-Flint/Hurley Medical Center between the years of 2012 and 2017, with respective graduation years of 2014 through 2019. The sample population consisted of 114 students in these six cohorts.

All graduating students were eligible for inclusion. Informed consent was not necessary, as the Office of the Registrar deemed data collection followed the Family Educational Rights and Privacy Act (FERPA) *(Appendix B).*

Data in this study was de-identified and operationalized quantitatively. Data was placed into a central database by the program's graduate research assistant, the primary researcher, and other program faculty. All data was securely located within the nurse anesthesia program, with access only by the graduate student research assistant and the primary investigator. The Statistical Product and Service Solutions (SPSS®) software platform was used for statistical analysis.

Independent variables

A total of eleven independent variables were collected, and ten were analyzed. GRE scores (the main independent variables) were coded as continuous variables using percentiles

reflecting the national average in the three subsections (Verbal Reasoning, Quantitative Reasoning, and Analytical Writing). Continuous variables were utilized for entry-to-practice nursing GPA, and nurse anesthesia program GPA (labeled as program GPA in the tables). It was discovered during data collection that undergraduate cumulative GPA was not calculated consistently within the study population. Therefore, this independent variable was not analyzed. Covariates of student age, as well as number of years as a registered nurse (RN) and number of years as an intensive care unit (ICU) RN, were also coded using continuous variables. Student sex and race were coded categorically. Males were coded as "1", and females were coded as "2". White students were coded as "1", and non-white students were coded as "2."

Dependent variables

A categorical variable indicating NCE result was used to decipher whether the student passed or failed the NCE on first attempt. A passing score was coded as "1", while a failing score was coded as "0." Due to the high first attempt pass rate within the study population, overall NCE scores were also collected and analyzed as a continuous dependent variable. The NCE yields an overall scaled score, as well as scaled scores in four domains (basic sciences; equipment, instrumentation, and technology; general principles of anesthesia; and anesthesia for surgical procedures and special populations). These domains are computed independently and are not averaged to produce the overall test score.[28] The overall NCE score range is 0-900; the passing score is 450.[28]

Univariate analysis was used to obtain descriptive statistics for all variables (*Table 1).* Bivariate analysis was performed comparing GRE verbal, GRE quantitative, and GRE analytical percentile scores, as well as the other independent variables with NCE result (Pass/Fail), as well as with overall NCE score. Pearson Chi-Square Crosstabulation was used to show the

relationship between race and NCE result, as well as the relationship between sex and NCE

result. Binary logistic regression predicted the log odds of passing the NCE on first attempt,

using the three GRE scores (verbal, quantitative, and analytical) and the other five continuous

independent variables. An independent samples t-test was used to determine the association

between race and overall NCE score, as well as that between sex and overall NCE score. Pearson

correlation coefficient analysis was performed using all eight continuous independent variables

and overall NCE score.

Table 1. Descriptive Demographic Statistics of Independent
Variables

Independent Variable	No. (%) (N = 114)	Mean (SD)
Sex		
Male	53 (46.5)	
Female	61 (53.5)	
Race		
White	101 (88.6)	
Non-white	13 (11.4)	
Age at matriculation		29.2 (4.572)
<30	73 (64.0)	
30-35	28 (24.6)	
36-39	9 (7.9)	
≥ 40	4 (3.5)	
GRE Scores		
Verbal		62.26 (18.242)
Quantitative		56.30 (16.532)
Analytical		52.84 (22.858)
Years as RN		3.21 (2.096)
Years in ICU		2.40 (1.483)
Nursing GPA[a]		3.69 (.263)
Program GPA[b]		3.83 (.196)

[a] Preadmission nursing degree GPA.

[b] Anesthesia program GPA at graduation.

GRE AS A PREDICTOR OF NCE SUCCESS

A multivariate logistic regression model examined the association between the independent variables and NCE result. A multivariate linear regression model was also done to investigate the association between the independent variables and overall NCE score. All statistical tests with $p < 0.05$ were considered statistically significant.

Results

<u>Demographics</u>

Descriptive statistics were used to summarize demographics among the variables *(Tables 1 and 2).* The majority of students (64%) were under 30 years of age at matriculation into the two-year master's degree program, and 57 students (54%) had between one and two years of intensive care unit experience at the time of interview. NCE first attempt pass rate for the study population was 87.7%. This rate is consistent or slightly higher than the NCE national average; the mean NCE total score for the study population was also consistent with national statistics of first-time test takers in calendar year 2020.[29]

Table 2. Descriptive Demographic Statistics of Dependent Variables

Dependent Variable	No. (%) (N = 114)	Mean (SD)
NCE Results		
Pass	100 (87.7)	
Fail	14 (12.3)	
NCE Score [a]		498 (42.552)

Abbreviation: NCE, National Certification Examination.
[a] NCE scoring range is 0-900.

GRE AS A PREDICTOR OF NCE SUCCESS

NCE Result

Bivariate analysis using first attempt NCE result (pass/fail) as the dependent variable revealed no statistical significance with GRE verbal, GRE quantitative, or GRE analytical scores. Independent variables of significance (p-value < 0.05) included age at matriculation (p-value < 0.01), number of years in the intensive care unit (p-value < 0.01), nursing GPA (p-value 0.02), and nurse anesthesia program GPA (p-value < 0.01). A multivariate logistic regression model *(Table 3)* which included nine of the 10 independent variables showed similar results for age, years in the intensive care unit, and nurse anesthesia program GPA. For each additional year of age, the odds of passing the NCE decreased by 29%. Likewise, each additional year in the intensive care unit reduced the odds of passing by 55%. Every 0.1-point increase in nurse anesthesia program GPA increased the odds of passing the NCE by 66%. The relationships noted in the multivariate model are true while holding all other independent variables constant.

Table 3. Multivariate Logistic Regression Model – 9 of 10 Independent Variables, Dependent Variable of First Attempt NCE Result (P/F)

Independent Variable	Exp(B)	*P*-value	95% Confidence Interval
Age at matriculation*	.714	.002	(0.575 - 0.886)
Years in ICU*	.451	.015	(0.237 - 0.859)
Program GPA*	1.664	.018	(1.092 - 2.535)
GRE Verbal (%)	1.062	.074	(0.994 - 1.134)
GRE Quantitative (%)	1.049	.138	(0.985 - 1.117)
GRE Analytical (%)	.976	.233	(0.938 - 1.016)
Race	.158	.241	(0.007 - 3.449)
Nursing GPA	.983	.803	(0.863 - 1.121)
Sex	1.156	.872	(0.199 - 6.720)

*Statistically significant.

NCE Total Score

Given the high first-time NCE pass rate among the six cohorts, a second dependent variable was used in statistical analysis. The relationship between all independent variables and NCE total score was investigated. Similar to the results above, bivariate analysis demonstrated statistical significance with age (p-value < 0.01), number of years in the intensive care unit (p-value < 0.01), and nurse anesthesia program GPA (p-value < 0.01). A negative yet weak correlation was noted with age and number of years in the intensive care unit, while a positive moderate correlation was noted with nurse anesthesia program GPA.

Interestingly, all three GRE scores revealed a positive yet weak correlation with NCE total score. However, only GRE verbal and GRE quantitative scores were statistically significant (p-values 0.03 and 0.01, respectively). A multivariate linear regression model *(Table 4)* demonstrated consistent results with reference to age, number of years in the intensive care unit, and nurse anesthesia program GPA. For every one-year increase in age, there is an associated decrease in NCE total score of 2.6 points. For each additional year of intensive care unit experience, NCE total score decreases by 5.6 points. Also, for each 0.1-point increase in program GPA, NCE total score increases by 9.1 points. In this model, GRE quantitative score, as well as GRE analytical score, showed statistical significance. Interpretation revealed that each additional percentile point increase in the GRE quantitative score is associated with an *increase* of 0.48 in NCE total score. Additionally, each additional percentile point increase in the GRE analytical score is associated with a *decrease* of 0.32 in NCE total score. Based on these results, collinearity between the three GRE scores was assumed, but tests revealed that collinearity was not a concern, with 0.154 of the variances in the GRE analytical score explained by the other two GRE scores. As was mentioned in the multivariate logistic regression model, the relationships

noted in the multivariate linear regression model are true while holding all other independent

variables constant.

Table 4. Multivariate Linear Regression Model – 9 of 10 Independent
Variables, Dependent Variable of Overall NCE Score

Independent Variable	Exp(B)	*P*-value	95% Confidence Interval
Program GPA*	9.118	.000	(5.383 - 12.852)
Age at matriculation*	-2.597	.001	(-4.166 - -1.027)
Years in ICU*	-5.556	.023	(-10.334 - -0.779)
GRE Quantitative (%)*	.479	.041	(0.019 - 0.938)
GRE Analytical (%)*	-.320	.047	(-0.636 - -0.005)
GRE Verbal (%)	.308	.184	(-0.149 - 0.766)
Nursing GPA	-1.084	.209	(-2.783 - 0.616)
Sex	-4.546	.516	(-18.374 - 9.281)
Race	-6.004	.596	(-28.431 - 16.423)

*Statistically significant.

Discussion

This study demonstrated that there is no significant relationship between the GRE scores

(verbal, quantitative, and analytical) and first attempt NCE result. Bivariate analysis of the GRE

scores with NCE total score revealed a positive but weak correlation; however, slightly different

results were found with multivariate analysis. Since collinearity was determined not to be a

concern, a possible explanation of the negative association between the GRE analytical score and

the NCE total score in this model is that perhaps the logical inference skills measured in the

analytical section of the GRE are not as important as the quantitative reasoning skills measured

by the quantitative GRE score in reference to NCE performance.

The variables of age at program matriculation, number of years in the intensive care unit

prior to admission, and nurse anesthesia program GPA showed a consistent relationship with

both first attempt NCE result and total NCE score. The younger the student, the better the odds of passing on first attempt, and the higher the score on the NCE. Specifically, of those candidates who are under 30 years of age, pass rate was 96%, whereas those aged 40 and older only passed 50% of the time. This data is consistent with NCE national averages from calendar year 2020, which revealed a 92.5% pass rate in those NCE candidates under 30, and a progressively lower pass rate in older candidates (pass rate of 72.1% in those aged 40 or older).[29] This data is also consistent with the literature.[6,7,20]

This inverse relationship was duplicated with the number of years a student spent in the intensive care unit prior to admission into the nurse anesthesia program. The data can best be explained as a correlation with age, since more intensive care unit experience is a function of age. These results contradict data found in the literature regarding years of intensive care experience and NCE success.[6,7,24]

Nurse anesthesia program GPA is positively correlated with both NCE first time pass rates and NCE total score in this study. This is consistent among the paucity of advanced practice nursing and nurse anesthesia literature as it pertains to program or graduate GPA.[12,26]

It is important to mention that these correlative results are academically interesting, but they are in no way discriminatory.

The findings of this study support the removal of the GRE as an admission requirement in the investigator's nurse anesthesia program, thus removing possible financial and motivational barriers to admission which may allow for a more diverse, holistic admission process. Its removal will likely enhance the applicant pool as well since many other nurse anesthesia programs no longer require it.

Limitations of Study

Limitations of this scholarly project include a small sample size and missing data points within one of the statistically significant independent variables. The number of cohorts of students used in this study was limited by a change in the NCE passing standard on January 1, 2014. This prevented the investigator from including data prior to this date. A larger sample size may allow for a richer study population with more accurate and representative results.

Upon construction of the data set, data from nine students were found to be missing from the independent variable of number of years in the intensive care unit. Since this variable was a significant predictor of NCE first attempt result and total NCE score, these missing data points may have skewed the results.

Suggestions for Further Research

Future research should include the independent variable of cumulative science GPA as it relates to NCE result and NCE total score. This variable is important since the literature cites positive correlation with advanced practice nursing and nurse anesthesia program success (measured with various outcome variables) in multiple studies. This variable has been used in multiple studies as a predictor of success.

Another suggestion would be to include the type of intensive care unit in which the prospective student has worked prior to matriculation, as this data may be predictive of NCE success. In addition, it is a statistic that is measured by the NBCRNA each year; thus, the data could be compared to these national averages and possibly be an important admission factor to consider by the anesthesia program admissions committee.

<u>Dissemination</u>

The results of this study will be disseminated via a poster presentation at the Michigan Association of Nurse Anesthetists (MANA) State Meeting in Fall 2021. In addition, the results of this study will be submitted for publication in the American Association of Nurse Anesthetists (AANA) Journal.

Conclusion

This study demonstrated that GRE scores were not predictive of NCE pass rate on first attempt. A weak correlation was noted between the three GRE scores and NCE total score, with GRE verbal and GRE quantitative scores having statistical significance. In the multivariate linear regression model, GRE quantitative scores displayed a mild positive correlation, while GRE analytical scores showed a mild negative correlation. When analyzing correlations between independent variables and NCE first attempt results (pass/fail) and NCE total scores, it was found that age, number of years in the intensive care unit, and nurse anesthesia program GPA were significant.

These results provide evidence-based guidance that can be used to examine and improve the admissions requirement process within the investigator's nurse anesthesia program in an effort to ensure graduate success on the NCE.

Appendix A: IRB Approval Letter, University of Michigan – Flint

UNIVERSITY OF MICHIGAN
eResearch.umich.edu

Flint Institutional Review Board • 530 French Hall, 303 E. Kearsley St, Flint, MI 48502 • phone (810) 762-3383 • fax (313) 593-0526 • research@umflint.edu

To: Shawn Fryzel

From:

Kazuko   Hiramatsu

Cc:

Amy   Franckowiak
Jane   Motz
Shawn   Fryzel
Lawrence   Stump
Gena   Welch

Subject: Notice of Exemption for [HUM00131674]

SUBMISSION INFORMATION:
Title: Can Health Science Reasoning Test with Numeracy and California Critical Thinking Dispositions Inventory Scores Predict Academic Success in a Nurse Anesthesia Program?
Full Study Title (if applicable): Can Health Science Reasoning Test with Numeracy and California Critical Thinking Dispositions Inventory Scores Predict Academic Success in a Nurse Anesthesia Program?
Study eResearch ID: HUM00131674
Date of this Notification from IRB: 8/14/2017
Date of IRB Exempt Determination: 8/14/2017
UM Federalwide Assurance: FWA00004969 (For the current FWA expiration date, please visit the UM HRPP Webpage)
OHRP IRB Registration Number(s): IRB00000248

IRB EXEMPTION STATUS:
The IRB Flint has reviewed the study referenced above and determined that, as currently described, it is exempt from ongoing IRB review, per the following federal exemption category:

> **EXEMPTION #1 of the 45 CFR 46.101.(b):**
> Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Note that the study is considered exempt as long as any changes to the use of human subjects (including their data) remain within the scope of the exemption category above. Any proposed changes that may exceed the scope of this category, or the approval conditions of any other non-IRB reviewing committees, must be submitted as an amendment through eResearch.

Although an exemption determination eliminates the need for ongoing IRB review and approval, you still have an obligation to understand and abide by generally accepted principles of responsible and ethical conduct of research. Examples of these principles can be found in the Belmont Report as well as in guidance from professional societies and scientific organizations.

SUBMITTING AMENDMENTS VIA eRESEARCH:
You can access the online forms for amendments in the eResearch workspace for this exempt study, referenced above.

ACCESSING EXEMPT STUDIES IN eRESEARCH:
Click the "Exempt and Not Regulated" tab in your eResearch home workspace to access this exempt study.

Kazuko Hiramatsu
Chair, IRB Flint

Appendix B: De-Identified Data Use Agreement

De-Identified Data Use Agreement for External Use

This data use agreement (the "Agreement") is by and between The Regents of the University of Michigan ("The Regents"), a Michigan constitutional corporation with its principal place of business in Ann Arbor, Michigan, and _Amy Franckowiak_ ("User") and is effective as of (the "Effective Date").

WHEREAS, The Regents maintains certain information that User wishes to use and/or disclose for research, public health, or other purposes permitted under 45 C.F.R. § 164.514;

NOW, THEREFORE, the parties, in consideration of the mutual promises and obligations set forth herein, the sufficiency of which is hereby acknowledged, and intending to be legally bound, agree as follows:

1. The Regents shall provide User with access to certain data (the "De-identified Data Set") in accordance with the terms and conditions of this Agreement. Under no circumstances shall The Regents be required under this Agreement to provide the User with any information that does not qualify as part of a "De-identified data set" under 45 C.F.R. § 164.514(a).

2. The following individuals (the "Authorized Parties") are authorized to use the De-identified Data Set or any part of it on behalf of User and agree to abide by the terms of this Agreement:

   Name: _Amy Franckowiak_   Signature: _Amy Franckowiak_

   Name: _____ Signature: _____

   Use an attachment to list any additional individuals. The attachment must be signed by authorized representatives of User and The Regents.

3. User, and any Authorized Party on User's behalf, may use the De-identified Data Set only for the purpose identified below: _For purpose of conduction of a research study for my doctoral scholarly project_

   Use an attachment to list any additional permitted uses. The attachment must be signed by authorized representatives of User and The Regents..

4. User and each Authorized Party agrees as follows:

   ✓ Not to use or further disclose the De-identified Data Set or any information contained therein other than as permitted by this Agreement or required by applicable law.

   ✓ To use appropriate safeguards to prevent use or disclosure of the information other than as provided for by this Agreement.

   ✓ To report to The Regents, through the Health System Privacy Officer, any use or disclosure of the De-identified Data Set or any part of it not provided for by this Agreement of which User or any Authorized Party becomes aware.

   ✓ To ensure that any User employees, agents, or subcontractors, to whom User or an Authorized Party provides the De-identified Data Set or any part of it to agree to the same restrictions and conditions that apply to the User and Authorized Parties under this Agreement.

   ✓ Not to use the information contained in the De-identified Data Set to identify the individuals whose information is contained in the De-identified Data Set, nor to contact them under any circumstances.

   ✓ To destroy or return the De-identified Data Set at the completion of the purpose identified above in Section 3.

5. In the event The Regents becomes aware of any use of the De-identified Data Set or any part of it that is not authorized under this Agreement or required by applicable law, The Regents may (i) terminate this Agreement upon notice; (ii) disqualify (in whole or in part) the User and/or any Authorized Parties from receiving protected health information in the future; and/or (iii) report the inappropriate use or disclosure to the Secretary of the Department of Health and Human Services. Further sanctions may apply to the User and/or Authorized Parties under 45 C.F.R. parts 160 and 164.

WHEREFORE, the parties, through their authorized representatives, hereby accept and agree to the terms and conditions of this Agreement.

THE REGENTS	USER
Authorized Signature: _Karen H Arnold_	Authorized Signature: _Amy Franckowiak_
Name (Printed): _KAREN H ARNOLD_	Name (Printed): _AMY AU FRANCKOWIAK_
Title: _UNIVERSITY REGISTRAR_	Title: _Educational Coordinator, UMF/HMC Nurse Anesthes Program_
Date: _9/25/17_	Date: _9/25/17_

THE REGISTRAR IS SIGNING W/ APPROVAL THAT THIS REQUEST IS FERPA COMPLIANT.

De-Identified Data Use Agreement
February 29, 2012

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