THE RELATIONSHIP BETWEEN SUCCESS OR FAILURE IN FIRST SEMESTER NURSE ANESTHESIA COURSES AND SUCCESS OR FAILURE ON THE CERTIFICATION EXAMINATION AND ATTRITION

By

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Abstract

CRNA certification examination success is of critical importance to nurse anesthesia students, educators, and programs. While rigorous entry criteria exist in nurse anesthesia programs, a small percentage of students enter a program and either do not complete the program or do not pass the certification examination on the first attempt. This retrospective study examines the de-identified grades of 266 students from a ten year period at the Case Western Reserve University Nurse Anesthesia Program. The purpose of the study was to determine if anesthesia student grades in any first semester course is related to student attrition and/or success on the certification examination. Chi-square analysis was used to establish the association between grades in first semester nurse anesthesia courses (Chemistry and Physics of Anesthesia, Anesthesia Basics I, and Pharmacological Strategies in Anesthesia Practice) and success/failure on the certification examination and attrition from the program. Passing a course in the nurse anesthesia program was a grade of ‘B’ or better, while passing the certification examination was an overall score of 450 or better. The results of the comparison of the two dichotomous variables is statistically significant ($X^2=39.902$, $p<.001$). Twenty students left the program (5.7%) after admittance during the ten year period, and 94.3% of the remaining students passed the certification examination on the first attempt. The failure rate of those students was 5.7%. Students who passed all first semester courses (91.9%) were almost two times more likely to be successful in completing the program than those that did not (52%). Student failure varied between each of the three courses with a corresponding rise in failure as courses progressed in the first semester.
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Chapter 1

Introduction

Retirement will affect the availability of Certified Registered Nurse Anesthetists (CRNAs). The average age of a working CRNA is 48.5 years, and as CRNAs enter retirement age, only 10% of those eligible to retire continue working (Beattie, 2007). Nurse anesthesia programs must meet the manpower needs of the CRNA profession. CRNAs provide anesthesia services throughout the United States, and they are the sole provider of anesthesia in many rural settings (Fallacaro & Ruiz-Law, 2004). As CRNAs move through their careers, many life events can directly affect their career. Consequently, retirement of CRNAs drains the manpower pool of available CRNAs to practice, and these CRNAs must be replaced. Nurse anesthesia graduate nursing programs aim to meet this need.

Nurse anesthesia graduate nursing programs are aware of the need to produce quality CRNA graduates. Students want to complete a training program and pass the certification examination to be successful in joining the nurse anesthesia profession, and faculty teaching in these programs share this goal. Frequently, programs advertise to potential students their certification passage rate, and frequent comparison is made with the national board pass rate of 88.4% (Anesthetists, 2013). It is essential that factors related to passing the certification examination would be of interest to students as well as programs who have a vested interest in their students being successful in passing the board examination.

Problem Statement

Rigorous admission criteria exist for entry into CRNA programs. These criteria were developed to identify students with the best potential for success. At the
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Francis Payne Bolton School of Nursing Masters of Science in Nurse Anesthesia program, these criteria include graduation from an accredited bachelor’s degree in nursing program, minimum of one year of experience in critical care nursing, completion of the Graduate Record Examination or the Miller’s Analogy Test, overall grade point average greater than 3.0, overall science grade point average greater than 3.0, three references (one from a direct supervisor), and an essay regarding the applicant’s interest in becoming a Certified Registered Nurse Anesthetist (CRNA) (Francis Payne Bolton School of Nursing, 2013). However, completing the aforementioned criteria and gaining admittance into a CRNA program does not guarantee completion of a program, nor does it guarantee certification examination success. Nationwide reports of student attrition rates averaged 8.2%, with a large majority of nurse anesthesia program directors (78%) finding the rate to be very acceptable (Mathis, 1993). As recently as 2005, the nurse anesthesia program nationwide attrition rate averaged 9% (Dosch, Jarvis, & Schlosser, 2008).

Even though attrition is a problem, some students complete their program and do not successfully pass the certification examination on the first attempt. In 2013, the National Board of Certification and Recertification of Nurse Anesthetists reported a first time failure rate of 11.6% (Anesthetists, 2013). It is not known if there is a common academic factor in nurse anesthesia programs that is related to attrition and examination failure. Factors include students that perform poorly in some of their course work prior to the certification examination, including not attaining a 3.0 in their first semester nurse anesthesia courses (ensuring academic progression), yet are attaining an overall 3.0 necessary for graduation when this coursework is combined with their other non-anesthesia graduate nursing courses. An overall GPA of 3.0 is
required for graduation and eligibility to sit for the certification exam. However, it is possible that poor performance in nurse anesthesia courses in the first semester, despite overall GPA, may be associated with attrition or failure of certification examinations.

Identifying students at risk for attrition or certification exam failure early in a program may benefit both the student and the program. Money, effort, and time are wasted by both the individual and the institution when a student continues to perform poorly throughout the length of the program.

Research regarding the predictive ability of first semester nurse anesthesia course grades can assist faculty focusing on identification of the potentially unsuccessful student early in the program. At Francis Payne Bolton School of Nursing master’s degree program in nurse anesthesia, Pharmacological Strategies in Anesthesia Practice, Chemical and Physical Principles of Anesthesia, and Anesthesia Nursing 1 (Basics) are the first semester nurse anesthesia courses. The critical items listed by nurse anesthesia faculty for success in a nurse anesthesia program are pharmacology and physiology grades (Clayton, Lypek, & Connelly, 2000). While pharmacology and physiology grades have been deemed important, it has not been shown that success or failure in either subject has predictive value for passage of the certification examination. The purpose of this proposed study is to determine if anesthesia student success/failure in any first semester course is related to student attrition and/or success on the certification exam.

**Background and Significance**

Much research has been conducted to identify predictors of success on the nursing board examination (NCLEX-RN) for graduates of pre-licensure programs.
Positive predictors have been identified as overall GPA, as well as grades in pathophysiology, anatomy, and medical/surgical nursing (Daley, Kirkpatrick, Frazier, Chung, & Moser, 2003; Mills, Sampel, Pohlman, & Becker, 1992). Demographics and program variables of an undergraduate nursing program have been examined with higher grades in certain classes predicting success (Daley et al., 2003). A study examining success in graduate nursing programs has identified undergraduate cumulative and nursing GPA as predictive of success (Suhayda, Hicks, & Fogg, 2008).

Research specific to CRNA programs that have examined admission criteria found science GPA as significant in predicting performance on the National Certification Examination (Zaglaniczny, 1992). Military nurse anesthesia programs have been studied to identify characteristics associated with clinical success; pharmacology and physiology grades, critical care experience of 1 to 2 years, and undergraduate science GPA were identified by faculty as important to success (Clayton, Lypek, & Connelly, 2000). Characteristics of nurse anesthesia programs such as program structure, program length, use of computerized testing, and number of students per class have been examined in order to identify predictors of certification examination passage. Nurse anesthesia program characteristics have not consistently proven to be significant in predicting board examination passage (Carroll-Perez, 1996; Satariano-Hayden, 2013). Burns (2011) reviewed admission criteria to nurse anesthesia programs seeking to identify which criteria correlated with academic progression. Admission GPA and science GPA were statistically significant predictors of academic progression.
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Nurse anesthesia attrition rates have been studied to determine the average attrition rate nationally and what directors of nurse anesthesia programs find as an acceptable rate of attrition (Dosch, Jarvis, & Schlosser, 2008; Mathis, 1993). Attrition risk has been examined by looking at cognitive and non-cognitive factors. In a study of military student nurse anesthetists, external locus-of-control and a lower trait anxiety were predictive of program success (Hulse et al., 2007). Nurse anesthesia professional socialization has been investigated in relation to attrition, with students experiencing attrition more frequently at the 12-18 month point in their program (p=.001) (Waugaman & Aron, 2003).

Other healthcare professions including anesthesiology, orthopedic surgery and ophthalmology have examined yearly residency examination’s predictive ability for success on their respective board examinations. In anesthesiology and ophthalmology, the first-year examinations were predictive of first attempt success on their qualifying examinations (Johnson, Bloom, Szczotka-Flynn, Zauner, & Tomsak, 2010; McClintock & Gravlee, 2010). In orthopedic surgery, residency examination in years 2-4 were predictive in board examination passage (Herndon, 2009). First semester nurse anesthesia courses have not been examined to determine if there is a relationship with first semester anesthesia course grades and subsequent success on the certification examination. Consequently, a study is needed to investigate whether success in first semester nurse anesthesia course work predicts attrition and/or board examination success. The following research question will be addressed in the proposed research.
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Research Question

What is the relationship between grades in first semester nurse anesthesia classes and the results of the certification examination and student attrition?

Theoretical Framework

Transitions Theory was selected to guide the proposed study. Although Transitions Theory (Meleis, 2010) has been used primarily in relation to health outcomes, it also has applicability to success of students in educational programs (Myton, Allen, & Baldwin, 1992). The goal of a healthy transition is defined as “…consisting of the mastery of behaviors, sentiments, cues, and symbols associated with new roles and identities and non-problematic processes” (Im, 2011, pg 282). Transitions are defined in Transitions Theory in relation to role insufficiency. Role insufficiency is any difficulty in performance or perception of a role or of the sentiments and goals associated with the role behavior as recognized by the self or by significant others (Im, 2010). Role insufficiency is not experienced by those having a successful transition.

The student nurse anesthetist experiences multiple stressful transitions: from the role of a highly functioning critical care nurse to the role of student, by moving from one area of the country to another to attend school, from successfully mastering an undergraduate curriculum to attempting to master a graduate level curriculum, and from successful wage earner to a student with no income. Two major components of transition in CRNA programs are maintaining the required GPA and passing the certification examination. A faulty transition by a student leads to role insufficiency;
thus, attaining the goal of graduate nurse anesthesia program success will be difficult if the student is insufficient in their role.

Dr. Afaf Meleis began developing Transitions Theory in 1975 (Meleis, 1975). Major concepts of Transitions Theory include the types of transitions (developmental, situational and health/illness), properties of transitions, transition conditions (facilitators and inhibitors), process indicators, outcome indicators, and nursing therapeutics. Transition conditions are defined as “…circumstances that influence the way a person moves through a transition, and that facilitate or hinder progress toward achieving a healthy transition” (Im, 2010; Schumacher, 1994). Transition conditions include facilitators and inhibitors that impact the success of the transition.

Transitions for CRNA students are situational. The universal properties in transitions for students include changes in roles and abilities. For the student, transitional conditions could reflect supports such as study groups that are available in the environment. Process indicators in an educational setting are the grades that reflect successful progression through the academic program, and outcome indicators are successful completion of the certification examination and attrition. The concepts of Transitions Theory and their relationship to the proposed study are found in Figure 1.
Significance to Nursing and Nursing Education

A demonstrated relationship between first semester course success and success or failure on the certification examination could provide a base for program evaluation and improvement. For instance, the findings could show the emphasis students and nurse anesthesia education program faculty need to place on mastery of early program nurse anesthesia knowledge. A nurse anesthesia education program can select admission criteria for students to better master these early courses based on evidence from this study. Attrition is a problem for many programs. Showing a link between first semester nurse anesthesia course success to certification exam success can help motivate students from the beginning of the program to make coursework a priority; thus, preventing attrition due to poor grades from occurring. Nurse anesthesia programs could develop plans either for remediation or student removal from a
program based on the evidence from this study. Based on this study, early program tutoring plans for “borderline” students would have justification.

If this study demonstrates a relationship between first semester grade performance and success or failure on the certification examination, nursing schools could benefit. Many schools possess remediation plans for failing students to help the student attain a passing grade of 3.0 on a 4.0 scale. If certain first semester nurse anesthesia courses are found to be more predictive than other courses in attrition or certification examination performance, then schools have demonstrated evidence of the need for students passing these courses before further academic progress. Conversely, additional research could determine if students that have a failing grade the first time a course is taken and subsequently attain a passing score for the class actually pass the certification examination at the same rate as other students who initially pass the first semester class. This research would provide either support or discouragement for remediation efforts for initial poorly performing students in nurse anesthesia programs.

Findings from this study could apply to other advanced practice nursing disciplines. The importance of a first semester course on ultimate certification examination success within a particular advanced nursing discipline would reinforce the need for the course in the curriculum. Ultimately, the validity of certain classes can be enhanced when the justification for the content of the class relates to the profession and to certification examination passage.
Definitions

Success

*Theoretical Definition*. The Merriam-Webster Dictionary defines success as a degree or measure of succeeding, as a favorable or desired outcome, and as the attainment of wealth, favor, or eminence. An outmoded definition for “success” is outcome or result (2012: Merriam-Webster Dictionary).

*Operational definition*. Success on the national certification examination for nurse anesthetists is defined as attaining a scaled score of 450 (Muckle, 2012). This would be determined by reports of certification examination results of the Case Western Reserve University Francis Payne Bolton School of Nursing Nurse Anesthesia Program.

For the purposes of this study, the definition of success in a first semester nurse anesthesia class would be attaining a grade point average of 3.0 in the class. This would be defined from grade reports from the clinical coordinator of the first semester nurse anesthesia class.

Attrition

*Theoretical definition*. Attrition can be defined as the reduction in numbers usually as a result of resignation, retirement, or death (Dictionary, 2013). For the purposes of the proposed study attrition will be defined as the student withdrawing from the CRNA program before completion of course work.

*Operational definition*. Student attrition records will be obtained from the Nurse Anesthesia Program at Case Western Reserve University Francis Payne Bolton School of Nursing. Student attrition was defined as a student leaving the program without completion of their 27 month program.
Chapter 2

Literature Review

Prediction of success on the National Certification Examination would be fortuitous for nurse anesthesia students working to graduate from their educational programs. Program directors could utilize such information to better design their educational programs for student success. Success on the nursing board examination for graduates of pre-licensure nursing programs (NCLEX-RN), found that overall GPA and successful grades in pathophysiology grade, medical/surgical nursing class, and anatomy were positive predictors and a negative predictor was poor grades in pertinent classwork (Beeson & Rissling, 2001; Daley, Kirkpatrick, Frazier, Chung, & Moser, 2003; Landry et al, 1990; Mills, 1992). However, there is little research concerning factors predicting success during a nurse anesthesia student’s educational experience. The purpose of this literature review is to describe the current literature on the topics of success on NCLEX, success in Graduate School, success in Other healthcare professions, and attrition.

Success on NCLEX

In a descriptive study of an accelerated baccalaureate program, Mills (1992) examined the probability of success of candidates on their first NCLEX-RN attempt. Using a statistical model where 328 students took the NCLEX and 35 failed, 94% of nurse candidates who did not pass the NCLEX-RN could be predicted at the end of their first semester based on cumulative grade point average, gender, and foreign-education. This study found a first semester grade increase by a full letter grade higher would result in a fifteen times better chance of NCLEX-RN success. The second semester grades from a pathophysiology course were an independent variable
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significant for program withdrawal (p<.0001) in that higher grades in a pathophysiology course were associated with an increased likelihood of success in passing the NCLEX-RN (Mills, Becker, Sampel, & Pohlman, 1992).

A large sample (N=505), retrospective, descriptive study was conducted by Beeson and colleagues in 2001. A predictor for failure of their baccalaureate nursing graduates on the NCLEX-RN was the number of C, D, or F grades in a nursing course. Each additional poor letter grade increased the odds of failing the NCLEX-RN by 56%. This study also identified a relationship between a low grade in a sophomore year and the increased likelihood of more C’s in the same student’s junior and senior years (p<.0001). The most significant predictor of board failure was the number of C, D, or F grades (p<.0001) (Beeson & Kissling, 2001).

Daley, Kirkpatrick, Frazier, Chung and Moser (2003) also examined demographics and nursing program variables to review the differences between successful and unsuccessful students on the NCLEX-RN. Specific class grades were found to predict NCLEX-RN success: higher anatomy grade (p=.009), higher pathophysiology grade (p<.001), and didactic and clinical performance in a senior level medical/surgical nursing class (p<.001) (Daley et al., 2003).

Pathophysiology grades were also identified as predictive of student withdrawal in two studies (Mills et al, 1992; Uyehara, Magnussen, Itano, & Zhang, 2007). Uyehara et al wanted to identify the predictors of program success/withdrawal and NCLEX-RN passage from 3 data points during matriculation: admission, within the program, and exit. Utilizing a large sample size (N=280) to identify a specific course predictor variable within their program, Nursing Fundamentals grades had a significant correlation but did not predict success on the NCLEX-RN (r=.195,
p=0038). The study also found that nursing GPA was positively correlated with success (N=217, r=.186, p=.0059) Lower grades from their pathophysiology course were significantly linked to program withdrawal (N=271, p<.0001). The odds of student withdrawal declined at least 48% for each 1-point increase in letter grade of the pathophysiology course. Thus, an increase in pathophysiology grade decreased the likelihood of withdrawal from their nursing program (Uyehara, Magnussen, Itano, & Zhang, 2007).

Finally, the study by Landry et al (2010) provided further support that specific classes including pathophysiology predict NCLEX-RN success. The study included students from three different nursing programs: university based, satellite BSN, and graduate entry BSN. All three groups had large sample sizes: Master’s group, N=143, University based group, N=318, and Satellite BSN group, N=126. There were significant between-group differences of predictor variables: age, all college GPA, nursing program GPA, having a prior bachelor’s degree, race/ethnicity, and first time NCLEX-RN success. Course grades in specific courses: pathophysiology, medical/surgical nursing, and nursing theory were predictive of NCLEX success. An identified problem in this study is the variance between groups in the type of courses that were predictive of NCLEX-RN success: the satellite BSN program had no predictive course, university-based BSN students had pathophysiology as a predictive course, and graduate entry nursing students had medical/surgical nursing and foundations of nursing theory courses which were predictive. Also, there was variability in grading within and across the programs (Landry, Davis, Alameida, Prive, & Renwanz-Boyle, 2010).
Success in Graduate School

Suhayda, Hicks, and Fogg (2008) studied different predictor variables and their impact on student completion and graduation from an advanced practice program in nursing. Their goal was to create a better, validated decision-making algorithm for admitting graduate students to an advanced practice program in nursing. Multiple individual variables were considered with the dependent variable being categorized as dismissal for academic reasons or non-dismissal. Academic records of 738 masters level nursing students were reviewed. A combination of two independent variables: undergraduate cumulative GPA $\geq 3.25$ and nursing GPA $\geq 3.00$ predicted success in 99% of cases (Suhayda et al., 2008).

Admission criteria for graduate nursing education at a private eastern university program were also studied including nursing, non-nursing, and cumulative undergraduate grade point averages in 193 graduates. Other predictor variables examined were Graduate Record Examination scores, age at entrance, number of years intervening between attainment of the bachelors and completion of the master’s degree, and number of years intervening between the basic nursing education and the completion of the master’s degree. Undergraduate nursing GPA ($r = .20$), non-nursing GPA ($r = .21$), and cumulative undergraduate GPA ($r = .22$) were found to be weakly associated with master’s GPA. Number of years between basic nursing education and master’s degree was also weakly associated with master’s GPA ($r = .26$) (Ainsile, 1976).
Success in CRNA Programs

Utilizing multiple regression analysis, Zaglaniczny (1992) studied 13 academic, demographic, and preadmissions factors to determine which could predict the performance of student registered nurse anesthetists on the National Certification Examination. One thousand six hundred and ninety first-time NCE candidates were studied retrospectively. While seven variables were determined to be predictors of overall certification examination score, program science GPA accounted for 24% of the variance which is understandable given that eighty-five percent of the questions on the NCE incorporate scientific principles related to nurse anesthesia practice. Science GPA is composed of grades from classroom instruction in anatomy, physiology, pathophysiology, chemistry, physics, and pharmacology (Zaglaniczny, 1992).

Admission criteria to nurse anesthesia programs have been studied to identify which admission criteria correlate with academic progression for the student registered nurse anesthetist (Burns, 2011). De-identified data were utilized to determine which variables (admission GPA, science GPA, GRE scores, critical care experience) correlated with the outcome variable of academic progression (determined by current student GPA and academic status). Admission GPA which was statistically significant ($r=.313$, $p<.01$). Science GPA also was statistically significant with a positive relationship between science GPA and current GPA ($r=0.28$, $p<.001$). Admission GPA, Science GPA, GRE total scores, and critical care nursing experience accounted for 14.5% of the variance with the outcome variable of progression in a nurse anesthesia education program. There is limited generalizability with this research due to the low response rate of programs (19.4%) to the survey (Burns, 2011).
Nurse anesthesia faculty have identified characteristics needed for clinical success in military nurse anesthesia programs. “Integrity, ability to learn from mistakes, judgment, clinical awareness, hardiness, and commitment were rated essential.” (Clayton, Lypek, & Connelly, 2000, p. 517) Essential was defined as required for success in the study. Items labeled as important to success by faculty included pharmacology and physiology grades, critical care experience of 1 to 2 years, and undergraduate science GPA (Clayton, Lypek, & Connelly, 2000).

Nurse anesthesia school characteristics have been examined to determine if there is a relationship between individual program variables (number of students per class, number of clinical rotation sites, program length, type of degree or certificate granted, program structure, and date of graduation) and the outcome variable of NCE passing rate of the nurse anesthesia program graduates. This study had a 70% response rate (N=63) of all nurse anesthesia programs. No significant relationships existed between the variables. A limitation is the study only covered one year of data (1991) and could use replication (Carroll-Perez, 1996). Satariano-Hayden (2013) examined characteristics of nurse anesthesia programs to ascertain if certain characteristics were significant in relation to board passage. None of the characteristics were statistically significant.

Overall, an evidence-based review of admission criteria to nurse anesthesia programs has been done to identify criteria to predict success within those programs. The literature search found nineteen sources with nine of them not including student registered nurse anesthetists. Of the multiple admission criteria, overall GPA, undergraduate science GPA, and nursing GPA were supported by the evidence to predict success in nurse anesthesia programs (Ortega, 2013).
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Success in Other Healthcare Professions

Other healthcare professions can provide further studies highlighting the predictive ability of first year courses on their profession’s initial board examination results. First year coursework in anesthesiology has been demonstrated to predict performance on a board examination. Examining first year anesthesiology residents, McClintock and Gravlee (2010) wanted to predict success on the American Board of Anesthesiology Part 1 and 2 examinations using residency first year Anesthesiologists In-Training Examination (ITE) scores. Stepwise logistic regression analysis of 2,458 anesthesiology residents scores found a significant predictive use of ITE score at the end of the first year for successful passage of the ABA part 1 examinations $[r^2=0.46, (F(4,2,453)=517.9, p<.001)]$. Logistic regression analysis showed that the score on the ITE was a significant predictor for completing the board examination process within one year of residency graduation (p<.001). Location of medical school, accreditation cycle length of the school, and gender were all significant variables of success (p<.001). Limitations to the study included factor association not causation and variables that were not identified or not analyzed (unnamed) accounting for some of the variability in outcomes. (McClintock & Gravlee, 2010).

In ophthalmology, first-year resident performance was found to be predictive of board examination success (Johnson et al., 2010). The Ophthalmologic Knowledge Assessment Program (OKAP) examination scores at the end of each year of residency training were predictive of resident success on the first attempt of the American Board of Ophthalmology written qualifying examination (ABO-WQE). The relationship between OKAP score at the end of the first year and the ABO-WQE was significant.
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(p<.0001). The study included 76 residents from one residency program over a course of a 15 year period of data (Johnson et al., 2010).

The predictive ability of early testing on American Board of Orthopedic Surgery (ABOS) examination score has been examined. Herndon et al (2009) examined multiple predictor variables including the Orthopedic In-Training Examination (OITE) years 2-4. Of the studied predictors of performance, the OITE mean percentile in years 2-4 was significant for first attempt passage on the ABOS board examination. This study provided another example of early coursework (specifically year 2) in a healthcare field predicting the profession’s board examination passage. The predictive ability of first-semester coursework for success or failure on the certification examination will also be examined in CRNA programs with this study.

Attrition

Student attrition in nurse anesthesia programs continues to be a source of concern for the profession as it works to meet the demand for nurse anesthesia providers. As previously mentioned, prior grade point average (GPA) and science grade point average (SGPA) at time of admission can predict academic progression (current academic status and GPA) through a nurse anesthesia program (Burns, 2011). To discover the rate of attrition within nurse anesthesia programs, Mathis (1993) conducted a descriptive study using a survey of nurse anesthesia program directors. There was a high rate of return of surveys (86%, N=48) using a mailed survey. Mathis sent an initial survey with an additional mailing of the survey to program directors that had not completed it by the three week point. The average attrition rate of 8% (136 of 1,696 students) was reported with directors rating this on a three point scale
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(unacceptable, moderately acceptable, and very acceptable) as a ‘very acceptable attrition rate’. The mode of the data was 0%. Outlier data for the five year period of this study’s population included one program with an attrition rate of 25%. At the time of this study, non-master’s degree nurse anesthesia programs existed, but they were excluded from the data collection (Mathis, 1993).

Subsequently, in 2008, Dosch, Jarvis & Schlosser performed a descriptive study assessing the attrition rate within master’s level nurse anesthesia programs from the class of 2005. A 9% average nurse anesthesia program attrition rate was reported which was similar to the Mathis (1993) study. Unfortunately, the response rate by program directors for this study was low (67%) compared to the Mathis (1993) study (86%). The authors utilized a different web based survey tool with email reminders. The total number of students within the studied cohort was 1,499 with 9% not graduating. A limitation identified by the author was the inability to establish causation due to the retrospective nature of the study. The attrition rate did not differ by program size ($X^2=3.5, p=ns$). A weak, positive association was identified between program length and attrition rate ($r=.276, R^2=.076, p=.031$); thus, the longer the nurse anesthesia program, the higher the attrition rate (Dosch et al., 2008).

Cognitive and non-cognitive factors were explored to predict success in nurse anesthesia education and to identify factors putting a student at risk for attrition. Using a three year longitudinal, non-experimental, prospective, descriptive study, Hulse et al. (2007) identified non-cognitive factors of external locus of control and lower trait anxiety as predictive variables for success in a nurse anesthesia program ($p=.012$). The State-Trait Anxiety Inventory was used to measure anxiety proneness (α=.90). The Rotter Locus of Control Scale Instrument placed individuals on a
continuum from internal to external locus of control. Test-retest reliability was established with a correlation coefficient of 0.72. Students in this study with high trait anxiety scores were half as likely to be successful compared with students with less trait anxiety. However, a weakness of this study was the small (N=42), homogeneous population of nurse anesthesia students from only the U.S. Army Graduate Program in Anesthesia Nursing. As noted in the study, the external locus of control may reflect the Army students’ cultural necessity to follow orders which are external to their control (Hulse et al., 2007).

In a study looking at the enrollment period where students have an increased risk for attrition, Waugaman and Aron (2003) found a significant drop in enrollment at the one to two year group (p=.001) compared to the students that had been in their programs for at least two years. The twelve to eighteen month group was least oriented to commitment to the profession, and a significant drop in enrollment occurs in this period. However, the response rate of all enrolled nurse anesthesia students was only 35% for this study (Waugaman & Aron, 2003).

Attrition occurs due to events in the academic and clinical environments. Academic data can easily be quantified; however, clinical data tends to be more qualitative. Wong and Li (2011) sought faculty discernment of nurse anesthesia student’s personality characteristics that contribute to safe and unsafe nurse anesthesia practice. A prospective randomized survey of nurse anesthesia academic faculty was used to provide current evidence-based data on relevant safe personality characteristics of student registered nurse anesthetists. An author-based list of 63 intrapersonal and 15 interpersonal characteristics was tested with a pilot study. A relevancy standard of 80% of respondents was set by the authors. Seventeen
intrapersonal and four interpersonal characteristics were beneficial to safe anesthetic practice, while 20 intrapersonal and 3 interpersonal characteristics heralded unsafe nurse anesthesia practice. Anesthetic practice characteristics related to safety were scientific curiosity, patience, sense of humor, baseline knowledge on entry, work experience outside of nursing, ability to analyze data and apply to situations at hand, quick decision making and ability to act on decisions, compassion, organizational skills, self-starter, continuing education, learning new medications and devices, keeping current, neat, organized, situational awareness, ability to anticipate changes in setting, practical thinking, ability to learn amid unfavorable circumstances, a patient provider who puts aside ego, planning ahead, and able to work with others. In the study, characteristics of unsafe nurse anesthesia practice were greedy, lazy, sloppy, timidity, lack of organizational skills, gregarious, welfare mentality or sense of entitlement, addictive personality, hubris, ignorance, impractical thinker, one who is unable to accept failure, a person with a “God syndrome”, not being prepared and constantly blaming CRNAs/anesthesiologists for their shortcomings. (Wong & Li, 2011).

Summary

No studies were located that examined the relationship between first semester success or failure in nurse anesthesia classes and success on the National Certification Examination. Several studies examined the factors related to attrition. Nursing has looked at this topic in relation to the NCLEX-RN. First semester grades, pathophysiology courses, anatomy courses, clinical performance, and specific nursing courses were predictive of student success on the NCLEX-RN. Student cumulative GPA and science GPA were predictive of nursing program success.
The nurse anesthesia literature has examined admission criteria for students and its relation to student success in the nurse anesthesia education program. Preadmission GPA, science GPA, GRE total, and critical care experience were predictive of success. Nurse anesthesia faculty identified pharmacology and physiology grades as important to success. The actual characteristics of nurse anesthesia schools themselves have been studied with no significant relationships found between variables. A review of past research on admission criteria found that overall GPA and undergraduate science or nursing GPA were supported to predict nurse anesthesia program success. Other investigators in different healthcare disciplines: Anesthesiology, Ophthalmology, and Orthopedic Surgery examined early residency success to predict whether it portends success on their board examinations, and they found significant relationships with early academic success and board success.

Attrition continues to occur in most programs in nurse anesthesia, and rarely is the attrition voluntary. Quantitative factors such as grade data can also easily explain a student’s dismissal; however, clinical anesthesia factors are more qualitative in nature. Some nurse anesthesia students will not reach graduation or the certification examination due to attrition from their programs. The prevalence of attrition in nurse anesthesia students related to success/failure in a specific first semester nurse anesthesia course has not been explored.
A review of the literature has revealed a gap in the knowledge concerning the relationship between student success or failure on their first attempt at first semester nurse anesthesia courses and success or failure on the certification examination. Also, there is an identified lack of research concerning whether student attrition is affected by student success or failure on their first attempt at first semester nurse anesthesia coursework. To improve student outcomes, it is important to investigate the effects of student success or failure in their first semester nurse anesthesia coursework on both attrition and board examination success/failure. The proposed study is designed to determine if there is a relationship between student success or failure in their first semester nurse anesthesia coursework on student attrition and success or failure on the certification examination. This study will focus on answering the research question:

What is the relationship between grades in each first semester nurse anesthesia course and the results of the board examination and student attrition?

Research Design

A retrospective, descriptive, correlational design was used in this proposed research. This study design was chosen because it can “… give a picture of what is happening in a population, e.g., the prevalence, incidence, or experience of a group” (Medicine, 2013). This method was also chosen to “…provide knowledge of the variables and the study population that can be used for future research in the area.” (Burns & Grove, 2009, pg 238).
Sample

A convenience sample of nurse anesthesia students in the CWRU Nurse Anesthesia program from the years 2002-2012 was used. The Case Western Reserve University Nurse Anesthesia Program graduates 25-30 students annually for an anticipated sample size of 250. Inclusion criteria are Case Western Reserve University (CWRU) Frances Payne Bolton (FPB) nurse anesthesia students with grades from the first semester nurse anesthesia courses.

Setting

The setting for this study is Case Western Reserve University/Francis Payne Bolton School of Nursing Nurse Anesthesia Program. Historically, the Nurse Anesthesia Program has admitted 25-30 students split between three clinical sites: Cleveland Clinic, Summa Health System, and University Hospitals. Program length has been 27 months with an early clinical exposure in providing anesthesia after eight weeks in the program. Clinical subspecialty rotations to several outside institutions allow for a broad base of anesthetic experiences. Overall, the program has 25-30 sophomores, 25-30 juniors, and 25-30 senior students.

Variables

A SPSS file was developed using the following variables from the database: grades (pass or fail with passage defined as greater than a letter grade of a ‘C’) from Pharmacological Strategies in Anesthesia Practice, Chemical and Physical Principles of Anesthesia, and Anesthesia Nursing 1 (Basics), attrition (yes/no), and score on certification examination (pass or fail). Gender was listed as a demographic variable from the pre-existing data set. These data were obtained from the records of the previous program director and were de-identified. Past student certification
examination results have been reported to the program by the National Board of Certification and Recertification of Nurse Anesthetists. The student score attained on the first attempt within six months of graduation was used. Student success/failure on the board examination was determined by the National Board of Certification and Recertification for Nurse Anesthetists with a scaled score of 450 determining passage or failure (Muckle, 2012).

Attrition from the Masters of Science in Nurse Anesthesia at Case Western Reserve University was identified if the student withdrew at any time from the program during or after the first semester. De-identified data were obtained from a retrospective record review of grade data on student nurse anesthetists, and all data were pooled to ensure anonymity.

Data Analysis

Two-way chi-square statistical analysis was done to test the relationship between the two variables: pass/fail on a first semester class and pass/fail on the certification examination. The two-way chi-square analysis was done for each student’s first semester class grade and pass/fail on the certification examination. After reviewing statistical analysis information regarding this type of study, two-way chi-square analysis requires a minimum of ten percent of the study population within the ‘failed (name of course) and failed board examination category’ (Graham, 2014). The student that fails a first semester course and also subsequently fails the certification examination occurs approximately once or twice every two years; thus, with this frequency and class size between 25 – 30 students, approximately 250 student records were reviewed (Kless, 2014).

Two-way chi square analysis was done to test the relationship between attrition and pass/fail in each of the first semester nurse anesthesia courses. Since the literature
points to an average attrition rate from 8-9%, the number of subjects needed to obtain the level of data frequency to perform this chi square analysis was also 250 student records.

*Ethical Considerations*

Institutional Review Board approval from Case Western Reserve University was sought. The anticipated risk to participants in this study was minimal since it is a retrospective, descriptive, correlational study utilizing de-identified grade and demographic data. Past student grade data were kept by the independent party in a secure location and locked in a secure cabinet when not in use.

Once data were transferred to a computer file, the data file were kept on an encrypted flash drive and a password protected file.

*Procedures*

Institutional Review Board approval was obtained.

The courses from the first semester nurse anesthesia coursework were Chemical and Physical Properties of Anesthesia, Pharmacological Strategies in Anesthesia Practice, and Anesthesia Nursing I.

Grade data were recoded changing the variable from ordinal level to pass/fail, nominal level. The Francis Payne Bolton School of Nursing definition of a ‘B’ or greater determined whether the student passed or failed. Thus, grades recorded as ‘B’ and above were considered ‘pass’, and grades below the level of a ‘B’ were considered ‘fail’.

*Data Collection*

Data collection was done by an independent party with access to grade and board examination result data. The data collection was done with the nurse anesthesia program records accessed by the former director. Data were recorded with a numerical identifier
COURSE SUCCESS AND CERTIFICATION EXAM/ATTRITION

for each subject, gender of the subject, noted pass or fail for each first semester nurse anesthesia course, whether the subject completed the program, and finally, whether the subject passed or failed the certification examination. A data coding key master list was created by the independent party to serve as a reference for each subject’s numerical identifier and their grade data. The purpose of the coding key was for any identified problems from data collection requiring data cleaning. Each data set recorded was a binary variable. Access to the de-identified data was by the principal investigator (PI). The original data coding key will be destroyed at the conclusion of the DNP thesis by the PI.

Data Coding

A codebook was established for entering data into a file to reflect the following information: subject numerical identifier, gender (1=male, 2=female), first semester nurse anesthesia class (1=Basics, 2=Chemistry, 3=Pharmacology), grade for each class in pass/fail (1=pass, 2=fail, 3=didn’t take), board examination results (1=pass, 2=fail), and attrition (1=completed program, 2=left program).

Data was entered into an Excel sheet data base file and checked for accuracy. A password-protected backup file was created.

Protection of Human Subjects

The grade data used in this study was de-identified prior to the Principal Investigator utilizing the data.
Chapter 4

Results

The purpose of this study was to determine if anesthesia student grades in any first semester nurse anesthesia course are related to student attrition and the results of the certification examination. Failure to successfully complete the nurse anesthesia program of study was defined as those students who failed the certification examination on the first attempt and/or those who did not complete the program. Success was defined as passing the certification examination the first time the examination was taken. De-identified data were obtained from the Case Western Reserve University Nurse Anesthesia Program from the years 2002-2012.

The total number of de-identified records reviewed was 266 from the period 2002-2012. Of those participants, 72.9% (N=194) were female and 27.1% (N=72) were male.

Of the two hundred and sixty-six students, two hundred and forty six subjects did not leave the program and took the certification examination (92.5%). Twenty subjects failed to take the examination due to attrition (7.5%).

Two hundred thirty two subjects of the 246 who took the board examination passed the first time (94.3%). Fourteen students failed the certification exam (5.7%). There were a total of 34 students who were not successful in completing the program through either failing the certification examination on the first attempt or leaving the program through attrition (12.8%).

Three classes are taught in the first semester of the nurse anesthesia curriculum: Anesthesia Basics, Chemistry and Physics of Anesthesia, and Pharmacology. Even though these classes are taught during the first semester, they are
taught in the following sequence: Chemistry and Physics of Anesthesia, Anesthesia Basics, and Pharmacology. Passage of a course is obtained through a grade of ‘B’ or better at the conclusion of the course. Anesthesia Chemistry and Physics is a first semester course providing the student with an introduction to and elaboration of the basic chemical and physical principles in relation to clinical nurse anesthesia practice. Anesthesia Nursing I (Basics) provides an introduction to the student of the art and science of nurse anesthesia including basic principles. Pharmacological Strategies in Anesthesia Practice applies the pharmacokinetic and pharmacodynamics principles of anesthetic and adjunct drugs used in safe anesthesia practice to the clinical practice of the student.

Table 1 presents the passage rates for each of the three courses. Two hundred and fifty-one passed the Anesthesia Basics course (94.4%), 13 students failed the course (4.88%), and 2 student did not take the course (0.08%). A higher proportion of students passed the Chemistry and Physics of Anesthesia course (N=263, 98.9%). One student failed the course (0.04%), and two students did not take the course (0.08%). A lower proportion of students passed the Anesthesia Pharmacology course (N=236, 88.7%). Twenty-five students failed the course (9.4%), and five students did not take the course (1.9%).

<table>
<thead>
<tr>
<th>Course</th>
<th>Pass N (%)</th>
<th>Fail N (%)</th>
<th>Did not take N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesia Basics (n = 266)</td>
<td>251 (94.4)</td>
<td>13 (4.88)</td>
<td>2 (.08)</td>
</tr>
<tr>
<td>Anesthesia Chemistry and Physics (n = 266)</td>
<td>263 (98.9)</td>
<td>1 (.04)</td>
<td>2 (.08)</td>
</tr>
<tr>
<td>Anesthesia Pharmacology (n = 265)</td>
<td>236 (88.7)</td>
<td>25 (9.4)</td>
<td>5 (1.9)</td>
</tr>
</tbody>
</table>
COURSE SUCCESS AND CERTIFICATION EXAM/ATTRITION

The grades in each of the three courses were then compared to the grades in the other two courses. Table 2 and 3 both describe the grades in the Anesthesia Pharmacology and Chemistry and Physics courses for the students who failed Basics of Anesthesia course (n = 13) and the results of passing the certification examination. Table 2 shows those that failed the Basics course and were successful in completing the program (n=5). Table 3 displays those that failed the Basics course and were not successful in completing the program (n=8). Regardless of passing or failing any other course, for those who failed the Basics course, 38% were successful in passing the certification examination.

<table>
<thead>
<tr>
<th>Subject #</th>
<th>Basics</th>
<th>Chem</th>
<th>Pharm</th>
<th>Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>Yes</td>
</tr>
<tr>
<td>28</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>37</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>87</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>Yes</td>
</tr>
<tr>
<td>249</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Five students failed either failed Basics or failed it along with Pharmacology, but they were successful in completing the program. Three of these successful students (60%) failed the Basics course and passed both of the other two courses, while two successful students (40%) failed both the Basics in Anesthesia course and the Anesthesia Pharmacology course (Table 2).

Table 3 highlights that two students failed only the Basics of Anesthesia course, and were not successful in completing the program. All other non-successful students had failed Basics and Anesthesia Pharmacology. Overall, seven students failed both Basics of Anesthesia and one other course. No students failed all three courses (Table 2 and 3).
COURSE SUCCESS AND CERTIFICATION EXAM/ATTRITION

Of those that failed the Basics of Anesthesia course, all subjects passed the Chemistry and Physics course. Five of the non-successful subjects (62.5%) failed both the Basics of Anesthesia course and Anesthesia Pharmacology course (Table 3).

Table 3 Comparison Table of Basics Failure with First Semester Class Grades and Non-success in Program Completion

<table>
<thead>
<tr>
<th>Subject #</th>
<th>Basics</th>
<th>Chem</th>
<th>Pharm</th>
<th>Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>97</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>No</td>
</tr>
<tr>
<td>121</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>No</td>
</tr>
<tr>
<td>251</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>No</td>
</tr>
<tr>
<td>70</td>
<td>Fail</td>
<td>Pass</td>
<td>Did not take</td>
<td>No</td>
</tr>
<tr>
<td>84</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>No</td>
</tr>
<tr>
<td>116</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>No</td>
</tr>
<tr>
<td>246</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 4 compares those students that failed Anesthesia Pharmacology with their grades in the Basics of Anesthesia and the Chemistry and Physics in Anesthesia courses but were successful in passing the certification examination. Of the twenty-five subjects that failed Anesthesia Pharmacology, thirteen subjects (52%) continued with the program and were successful. Two of the 13 successful students (15%) also failed the Basics course.

Table 4 Comparison table of Pharmacology failure to Grades in Basics and Chemistry for Students Who were Successful in Completing the Program

<table>
<thead>
<tr>
<th>Subject #</th>
<th>Pharm</th>
<th>Basics</th>
<th>Chem</th>
<th>Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>68</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>75</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>98</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>106</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>108</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>113</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>114</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>119</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>122</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>123</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Fail</td>
<td>Fail</td>
<td>Pass</td>
<td>Yes</td>
</tr>
<tr>
<td>87</td>
<td>Fail</td>
<td>Fail</td>
<td>Pass</td>
<td>Yes</td>
</tr>
</tbody>
</table>
In Table 5, failing Pharmacology grades are compared to the grades in the Basics and the Chemistry classes for students who were not successful in completing the program. Six students (24%) who failed Pharmacology were not successful despite having passed both the Basics course and the Chemistry and Physics in Anesthesia course. Five subjects (20%) failed both the Basics of Anesthesia and Anesthesia Pharmacology and were not successful.

<table>
<thead>
<tr>
<th>Subject #</th>
<th>Pharm</th>
<th>Basics</th>
<th>Chem</th>
<th>Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>135</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>55</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>76</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>240</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>94</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>233</td>
<td>Fail</td>
<td>Pass</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>97</td>
<td>Fail</td>
<td>Fail</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>121</td>
<td>Fail</td>
<td>Fail</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>251</td>
<td>Fail</td>
<td>Fail</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>84</td>
<td>Fail</td>
<td>Fail</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>116</td>
<td>Fail</td>
<td>Fail</td>
<td>Pass</td>
<td>No</td>
</tr>
<tr>
<td>255</td>
<td>Fail</td>
<td>Pass</td>
<td>Fail</td>
<td>No</td>
</tr>
</tbody>
</table>

Of the students that left the program through attrition (n = 20), half of them did not have passing grades in at least one of their first semester nurse anesthesia courses (n = 10). The remaining ten left the program for other reasons: four students left due to personal problems (Subjects 86, 88, 190, and 194), two students left due to substance abuse (Subjects 245 and 247), and four students left as a result of clinical failure (Subjects 96, 200, 220, and 239).

A comparison of those subjects that failed any nurse anesthesia course in the first semester with their performance in the program (i.e. success or failure) is shown in Table 6. Two hundred and thirty five individuals out of the total population did not
fail any first semester nurse anesthesia coursework (88.3%). Thirty-one subjects did fail at least one first semester nurse anesthesia course (11.7%).

A total of 232 subjects (87.2%) were successful in completing the program. Of those that were successful, two hundred and sixteen did not fail any first semester nurse anesthesia course (93.1%). Sixteen successful participants (6.9%) did fail at least one first semester course.

Thirty-four individuals failed to successfully complete the program (12.8%) either through attrition from the program (n = 20) or failing the certification examination on the first attempt (n = 14). Of those thirty-four individuals who did not complete the program successfully, fifteen individuals did not pass at least one of their first semester nurse anesthesia classes (44.1%), while the remaining nineteen individuals (55.9%) passed all first semester nurse anesthesia classes.

Table 6 Relationship Between Failing Any First Semester Course and Successful Program Completion

<table>
<thead>
<tr>
<th>Success</th>
<th>Failed/Attrition</th>
<th>n</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
<th>χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% within success</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within failany</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Success</td>
<td>Failed/Attrition</td>
<td>19</td>
<td>15</td>
<td></td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within success</td>
<td>55.9%</td>
<td>44.1%</td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within failany</td>
<td>8.1%</td>
<td>48.4%</td>
<td></td>
<td>12.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>7.1%</td>
<td>5.6%</td>
<td></td>
<td>12.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successful</td>
<td>n</td>
<td>216</td>
<td>16</td>
<td></td>
<td>232</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within success</td>
<td>93.1%</td>
<td>6.9%</td>
<td></td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within failany</td>
<td>91.9%</td>
<td>51.6%</td>
<td></td>
<td>87.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>81.2%</td>
<td>6.0%</td>
<td></td>
<td>87.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>235</td>
<td>31</td>
<td></td>
<td>266</td>
<td>39.902</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>% within success</td>
<td>88.3%</td>
<td>11.7%</td>
<td></td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within failany</td>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of Total</td>
<td>88.3%</td>
<td>11.7%</td>
<td></td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The relationship between failure of a first semester nurse anesthesia course and program success (passing the certification examination on the first attempt and
program completion) was tested using chi square analysis (Table 6). Of those who failed at least one of the first semester courses, 51.6% (n=16) were successful, and 48.4% (n=15) were not (left the program or failed the certification examination). Of the students who did not fail any first semester courses, 91.9% (n=216) successfully completed the program, and 8.1% (n=19) did not successfully complete the program. These differences are statistically significant ($X^2 = 39.902, P < .001$).
Chapter 5
Discussion

This study was the first to examine whether success or failure in any first semester nurse anesthesia course is related to successful completion of the program as evidenced by program completion and passing the certification examination the first time it is taken. Students were considered to be unsuccessful if they left the program before completing the coursework or failed the certification examination the first time it was taken. The original intent of the study was to separately examine the relationship between passing first semester nurse anesthesia courses and passing the certification examination on the first attempt and the relationship to program completion (attrition). However, the number of subjects in the available 10 year dataset that failed at least one semester course and failed the certification examination on the first attempt was too small to have a meaningful statistical analysis. Consequently, to have a sufficient sample size of non-successful students it was decided to combine the subjects that left through attrition with those that failed the board examination on the first attempt; those two groups were considered to be unsuccessful while successful students were those who completed the program and passed the board examination the first time.

After excluding the students who left the program before completing coursework (n=20) the percentage of subjects passing the National Certification Examination the first time from Case Western Reserve University’s nurse anesthesia program was 94.3%. This percentage is higher than the latest national statistics on passing the examination the first time (88.2%)(NBCRNA, 2013). The passage rate also exceeds the Council of Accreditation mandatory threshold requirement for
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certification examination passage of 71% (Gerbasi, 2014). The failure rate for first-time takers from the Case Western Reserve University nurse anesthesia program (5.7%) is half the national average (11%) (NBCRNA, 2013). If the passage rate on board examination was calculated from the number of students entering the program (266) it would be 87%. However, passage rates are only calculated based on the number of students who take the examination.

Fifty-two percent of students who failed one or more first semester courses were successful in completing the program, while 91.9% of students who passed all first semester courses were successful in completing the program ($X^2=39.902, p<.001$). This finding, that students who passed all the first semester courses were almost two times more likely to be successful in completing the program highlights the importance of the need to intervene when a student fails any first semester course.

While 52% of students who failed the pharmacology course were successful in program completion, only 38% of the students failing the Basics course were successful in completing the program. Class sequence in the first semester, student adjustment to the program, or course difficulty may account for this variance. However, due to the combination of attrition and certification exam failure as defining lack of success, it was not possible to test these relationships individually.

Attrition from the program was 7.5% for the 10 year period. This is consistent with the national average of 8% (Dosch et al., 2008). Of those students who left the program through attrition (N=20), ten students (50%) failed at least one nurse anesthesia course. It is unknown from the data why students left the program.
Different numbers of students failed each of the first semester nurse anesthesia courses: Anesthesia Basics (N=13), Anesthesia Chemistry and Physics (N=1), and Pharmacological Strategies in Anesthesia Practice (N=25).

In examining Tables 3, 4, 5 and 6, it is interesting to note that five of the failing Basics of Nurse Anesthesia students failed Anesthesia Pharmacology also and were not successful in completing the program. Additionally, another subject failed both Anesthesia Pharmacology and Chemistry and Physics of Nurse Anesthesia and were unsuccessful in the program.

Coursework difficulty as evidenced by the number of failures in each of the courses may be related to academic difficulty, course sequencing, and/or student adjustment.

Data from Table 7 reveals those subjects that did not fail any first semester nurse anesthesia course were highly likely to be successful (93.1%). Of the subjects that did fail any nurse anesthesia course, nearly half of them (48.4%) did not experience success within the nurse anesthesia program. Some subject did fail a first semester nurse anesthesia course and were able to succeed in the program (N=16, 6.9%). Interestingly, two subject identified in Table 3 failed both Pharmacology and Basics of Anesthesia, and were able to succeed in the program.

For an individual course at the Case Western Reserve University Nurse Anesthesia Program, a grade of ‘C’ or higher will allow a student to pass if their overall GPA for the semester is greater than a 3.0. The definition of failure for this study was an individual nurse anesthesia course grade of less than a ‘B’; thus, students with a grade of ‘C’ were included within the definition of failure. Based on the results of this study, students with a ‘C’ grade in a first semester nurse anesthesia course do
not have a high likelihood of success on the certification examination. Nurse anesthesia program faculty and administration need to continually look at overall academic progress to ensure student success in a program. A ‘C’ grade in a nurse anesthesia course can serve as a red flag identifying students needing early intervention.

**Limitations**

The retrospective nature of the study is a limitation. The convenience sample provides a ten year data set for this exploratory study, but it does not provide, other than gender, other variables for future research. While gender is known in the data set, other variables such as age of the student, marital status, number of years as a critical care nurse, and other demographic data might be helpful in finding a factor contributing to the lower grade in a first semester nurse anesthesia class. Program admission criteria for each student would also provide more data for comparison: GRE scores, CCRN passage, Science GPA, overall GPA, etc. There is limited generalization of the findings since the data set focuses on only one institution’s first semester nurse anesthesia classes and their outcomes. Discrepancies in curriculum between institutions for their first semester nurse anesthesia classes might also limit using multi-institutional data sets.

**Future Research**

Follow-up studies using the data set could look at the impact of gender and passing a first semester nurse anesthesia course predicting success/failure on the certification examination. Physiology grades were also found by faculty to be necessary for success in a nurse anesthesia program (Clayton, Lypek, and Connelly, 2000). The grade results from this undergraduate nursing class could also be used in
future research to see their predictive value for performance on the nurse anesthesia certification examination.

Another study could consider the impact of the specific grade in the first semester nurse anesthesia course as it affects the actual student’s score on the certification examination. While NCE passage is paramount, the degree the first semester grade affects the score would supply even more support for the argument advocating early mastery of nurse anesthesia course content.

Beginning in 2014, the Case Western Reserve University Nurse Anesthesia Program underwent a curriculum change based on the 2008 American Association Colleges of Nursing Consensus Model for APRN Regulation: Licensure, Accreditation, Certification and Education (Nursing, 2014). Due to these new curriculum requirements, three courses were added which the nurse anesthesia students take with other advance practice nursing students: Physical Assessment, Pharmacology, and Physiology/Pathophysiology. Chemistry and Physical Properties of Anesthesia and Pharmacological Strategies in Anesthesia Practice were eliminated from the curriculum. Because of these curriculum changes within the program, the program was extended three months to a total length of 31 months. A future study could compare the new first semester courses within the nurse anesthesia program to success within the program.

Finally, nurse anesthesia programs are generally divided into two types: one year of didactic education followed by clinical experience, and programs which blend the didactic and clinical education throughout the length of the program. Each type of program could be researched to see if the program type influences whether success in
a first semester nurse anesthesia class predicts success/failure on the certification examination.

Conclusion

A study was carried out examining whether success in a first semester nurse anesthesia course was related to success on the nurse anesthesia certification examination on the first attempt and attrition from the program. The de-identified data used in the retrospective, descriptive study were studied using chi-square analysis. Using chi square to test the relationship, a statistically significant relationship \( (X^2=39.902, p<.001) \) was established between the quality of first semester coursework and program success (passing the certification examination on first attempt and program completion).
References


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