PREDICTING NCLEX-RN® FAILURE IN A PRE-LICENSURE BACCALUAREATE NURSING PROGRAM

by

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Abstract

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Graduates of pre-licensure baccalaureate nursing programs must pass the National Council Licensure Examination for Registered Nurses, or NCLEX-RN®. First-time pass rates are the primary quality indicator for nursing programs. National pass rates are approximately 90% and schools falling below 85% face funding and accreditation risks. Schools of nursing have adopted stringent admission and progression policies based on predictors of licensure success. However, there is a gap in the current body of evidence associated with predictors of NCLEX-RN® failure. Nursing programs using predictors of success for admission and progression decisions are shutting the door of opportunity on students who could be successful if given the opportunity. The purpose of this dissertation is to develop a model that predicts NCLEX-RN® failure to guide nursing program policy and intervention for at-risk nursing students.

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Chapter 1

Background

The changing state of health and healthcare delivery in the United States has led to a heightened focus on an expected shortage of nurses to meet workforce demands in the coming years. The nursing profession has a projected job growth of 16% from 2014 to 2024 (Bureau of Labor Statistics, US Department of Labor, 2015). Job market projections are complicated by an aging population of baby-boomers. According to the US Census Bureau (2014), the population of individuals 65 and older is expected to double between 2015 and 2060. Furthermore, 50% of nurses in the United States are over 50 years old and many are nearing retirement (National Council of State Boards of Nursing, 2016a). The aging population places an increased demand on the healthcare delivery system and highlights the need to prepare more nurses for the workforce.

Licensure Examination

Graduates of baccalaureate nursing programs must pass the National Council Licensure Examination for Registered Nurses, or NCLEX-RN®. The NCLEX-RN® is a computer adaptive exam that includes a variety of question formats written at an application level or higher, meaning candidates are expected to apply their knowledge beyond basic comprehension and rote memorization. To meet passing standard, examinees are administered between 75 and 250 questions over the course of up to 6 hours (National Council of State Boards of Nursing, 2016b). Along with the obvious financial and professional implications for aspiring nurses, the high-stakes NCLEX-RN® exam also has implications around accreditation and funding for nurse preparation programs. State nursing boards oversee licensure among nurses and

nursing programs. Undergraduate nursing education program approval in Texas is contingent upon an 80% or higher first-time NCLEX-RN® pass rate (Texas Administrative Code, n.d.). In addition to state board program approval, nursing program accreditation agencies have established performance expectations based on NCLEX-RN® pass rates and progression to graduation rates (Accreditation Commission for Education in Nursing, 2017; Commission on Collegiate Nursing Education, 2017). With an increased demand to produce more nurses, nursing programs are challenged to admit and retain students with a high-likelihood of first-time NCLEX-RN® success.

Admission and Exit Exams

In response to increasing workforce demands, university-level program persistence scrutiny, and continued State Board of Nursing regulation, schools of nursing have adopted stringent admission criteria and utilize commercially-produced standardized exams meant to predict a students' likelihood for NCLEX-RN® success. Health Education Systems Incorporated (HESI) and Assessment Technologies, Incorporated (ATI) each offer commonly used testing packages. Students enrolled in nursing programs purchase the testing software prior to program enrollment and schools often bare a portion of the cost associated with proctored testing and reporting. Both HESI and ATI include an admission exam, course-specific exams, and a comprehensive exit exam administered at the end of a program. ATI and HESI admission and exit exams have been extensively validated to predict NCLEX-RN® success with 90% or greater accuracy (Adamson & Britt, 2009; Grossbach & Kuncel, 2011, 2011; Harding, 2010; Hinderer, DiBartolo, & Walsh, 2014a; Knauss & Willson, 2013; Langford & Young, 2013; Liu & Mills, 2017; McCarthy, Harris, & Tracz, 2014;

Shoemaker, Chavez, Keane, Butz, & Yowler, 2017; Wambuguh, Eckfield, & Van Hofwegen, 2016; Young & Willson, 2011; Zweighaft, 2013).

Progression Policies

In recent years, higher education administrators have experienced increasing pressure to objectively quantify program effectiveness (Taylor, Loftin, & Reyes, 2014). Because first time NCLEX-RN® pass rates are often viewed as the primary indicator of nursing program effectiveness, admission and progression policies are designed to identify and prepare graduates with a high likelihood of licensure success. Accordingly, many schools of nursing have implemented admission and progression policies associated with HESI and ATI exam scores to prevent students believed to be at risk for NCLEX-RN® failure from entering and completing the program. Up to 65% of nursing programs have progression policies that are tied to designated benchmark scores on standardized exit exams (such as HESI and ATI), thus preventing at-risk students from taking the NCLEX-RN® exam (Harding, 2010; Hinderer, DiBartolo, & Walsh, 2014; National League for Nursing Board of Governors, 2012).

Statement of the Problem

Admission and progression decisions in nursing programs are largely designed around the likelihood of students passing NCLEX-RN®. Psychometric properties of the NCLEX-RN® exam and challenges in predicting NCLEX-RN® failure have led to an over-reliance on known predictors of success. Focusing solely on NCLEX-RN® success to guide program policy is problematic because it prevents students who could be successful from completing the program and does little to guide timely intervention for at-risk students.

Predicting Failure

There is a gap in the current literature regarding factors associated with NCLEX-RN® failure. Several factors associated with the NCLEX-RN® exam itself make predicting failure a challenge. The computer-adaptive NCLEX-RN® Exam is pass/fail and nursing programs do not receive information about specific knowledge deficits or performance variances among graduates. In 2013, major NCLEX-RN® exam changes related to content distribution, alternate question formats, and an increased passing standard resulted in nationwide declines in pass rates (Mager, Beauvais, & Kazer, 2017; Murray et al., 2016). Despite exam changes, nationwide NCLEX-RN® pass rates remain relatively high, with a national average of 91.07% among baccalaureate graduates (National Council of State Boards of Nursing, 2017). Small samples of NCLEX-RN® failures in nursing programs and NCLEX-RN® exam changes make the empirical evaluation of at-risk students a challenge for nursing program administrators. Admission and progression decisions based on predictors of success are problematic because they are often founded on the assumption that students who are not highly likely to pass NCLEX-RN® are at imminent risk for failure. This notion leads to a false dichotomy of student outcomes as “will pass” or “total failure”. Since many students in the “total failure” category may actually pass, the danger lies in foreclosing educational and career opportunities of those in the academic middle and preventing program implementation of intervention efforts.

Program Policy and Intervention

Both HESI and ATI Comprehensive Predictor Exams have been extensively validated and are marketed to predict NCLEX-RN® success among samples of the highest-performing students (Grossbach & Kuncel, 2011; Hinderer et al., 2014; Knauss

& Willson, 2013; Langford & Young, 2013; Nibert & Morrison, 2013; Sosa & Sethares, 2015). Progression policies requiring students to repeat exit exams until benchmark scores are achieved are problematic because they delay graduation, leave little time for programs to intervene, and are based on an inaccurate categorization of students at risk of NCLEX-RN® failure (Carrick, 2011; Harding, 2010; Langford & Young, 2013; D. Spurlock, 2006). Scoring categories developed by HESI and ATI are based on the likelihood for NCLEX-RN® success among the highest-performing students. However, both exit exams become less accurate in predicting success as scores decrease and neither HESI nor ATI claim their exams are useful in predicting failure. While it is true that more students in lower-scoring HESI and ATI categories fail NCLEX-RN®, these scores are not predictive of failure. For example, a HESI benchmark score of 850 is commonly used for progression policies and students in this category have a 96-99% NCLEX-RN® success rate (Nibert & Morrison, 2013). In a multi-site study of 5,903 students who took the exit HESI exam, Nibert, Young, and Adamson (2002) reported a predictive accuracy of the exit HESI exam of 98.3% among students in the highest scoring category. However, only 684 students of the 2,830 students predicted to fail based on a cut-off score of 850 actually failed, meaning that 76% of students who were predicted to fail and placed in the “do not progress” category actually passed NCLEX-RN® (D. Spurlock & Hunt, 2008). When benchmark scores on exit exams are used for progression decisions, a substantial number of students who might otherwise pass are barred from taking NCLEX-RN®.

Purpose

The purpose of this dissertation is to develop a model that predicts NCLEX-RN® failure. An understanding of factors associated with NCLEX-RN® failure will

guide nursing program policy and aid in the identification of, and intervention for, at-risk students. An empirical evaluation of NCLEX-RN® failure paints a more accurate and complete picture of students who can be successful in nursing programs. Understanding NCLEX-RN® failure and associated factors is a critical first step to ensure nursing programs can effectively meet workforce demands by supplying a robust pipeline of nurses into the profession. The purpose of this research is to identify which (if any) factors can be used to predict NCLEX-RN© failure so as to guide early interventions within nursing programs.

Research Questions

1. What pre-admission factors are associated with NCLEX-RN® outcome?
2. What program factors are associated with NCLEX-RN® outcome?
3. What student characteristics are associated with NCLEX-RN® outcome?
4. Can a combination of pre-admission, program, and student characteristic factors be used to predict NCLEX-RN® outcome?

The research questions are designed to identify factors associated with NCLEX-RN© outcome to guide program policy and intervention for students at risk of NCLEX-RN© failure. Research question #1 looks at student characteristics known prior to admission decisions. These include factors such as overall grade point average, science-specific GPA, and HESI A2 Admission Assessment scores. Understanding this information can be useful in refining admission criteria and developing early interventions for student success. Research question #2 includes program performance data specifically aimed at targeted interventions and the development of formal student success programs. Variables included for research question #2 include: program type, program completion length, number of course repeats, course-specific

HESI scores, HESI E2 score, and number of HESI E2 attempts. Research question #3 seeks to identify relationships between NCLEX-RN© outcome and student characteristics such as gender, ethnicity, previous baccalaureate degree, time between graduation and initial NCLEX-RN® attempt and total number of attempts. Finally, research question four is aimed at gathering findings from the previous three questions to develop a model that accurately predicts NCLEX-RN© failure via a combination of pre-admission, program, and student characteristicvariables. These research questions guide empirical evaluation of NCLEX-RN© outcomes developed to guide program policy and student success.

Methodology

The purpose of this research is to categorize NCLEX-RN® failure in a way that informs intervention for students at risk of failure. This retrospective, longitudinal, quantitative research is designed to explore the relationship between student characteristics, program characteristics and time from graduation to licensure and NCLEX-RN® failure. A quantitative approach is necessary to conduct a statistically valid analysis of empirical data (Creswell, 2014). Specific techniques to be utilized include correlation (research questions 1-3) and binary logistic regression (research question 4).

The target population for this study includes graduates from The University of Texas at Arlington, a large baccalaureate nursing program in Texas with a first-time licensure success rate at or above the national average. The program has maintained full approval from the Texas Board of Nursing, accreditation from the Commission on Collegiate Nursing Education, and has been deemed a Center of Excellence by the National League for Nursing. The urban university has a Tier One Carnegie

classification (R1 – Highest Research Activity) and receives federal funding as a Hispanic-Serving Institution. The program is the largest non-for-profit college of nursing in the nation and the largest producer of baccalaureate-prepared nurses in the state of Texas.

Researcher Positionality

It is imperative for all researchers to consider positionality, or where they come from in relation to the research process (Foote & Bartell, 2011). In my first few days as a newly- graduated, registered nurse in a pediatric emergency department, I realized that passing NCLEX was only a small part of learning to be a safe practitioner. After transitioning to a clinical educator role, I became deeply aware of how nurses' clinical competence in the pediatric emergency department varied from caring for a child with an ear infection to managing a trauma resuscitation. In hiring decisions, GPA became less and less important and I began to wonder if the best nursing students really go on to make the best nurses. These questions did not stop once I transitioned to the academic setting. I have witnessed potential overreliance on NCLEX, as well as increased focus on content-laden and passive lectures while discounting sound pedagogy and decades of educational research and policy in fields other than nursing. In my current administrative role focusing on curriculum, competency-based learning, and preparation for practice initiatives, I continue to question if nursing education's preoccupation with NCLEX pass rates adequately serves the students, patients, and society we serve. Lastly, a transformational learning experience in a doctoral course related to race and culture in education left me with more questions than answers about the fundamental purpose of higher education and provided a lens that cannot easily be removed. Through this lens, I acknowledge the need for reform to eliminate

pervasive disparities that exist in our current education system. I believe we can do more and better and it is my sincerest hope this research informs our practice as educators.

Significance

Understanding factors associated with NCLEX-RN© outcomes is critically important for the production of a qualified nursing workforce. While much is known about NCLEX-RN© success, there is a gap in the literature related to NCLEX-RN© failure, particularly as it relates to intervention efforts. This study contributes to a body of evidence necessary to support the development of sound educational policy and practice based on a comprehensive picture of NCLEX-RN© outcomes.

Research Gaps

This dissertation fills a gap in the literature related to predictors of NCLEX-RN® failure among undergraduate nursing students. Most criteria commonly used in nursing program admission and progression policies has been validated to predict NCLEX-RN© success, resulting in a narrow view of NCLEX-RN© success with a limited understanding of failure. The sample includes 192 NCLEX-RN© failures, which is much larger than the maximum failure sample size of 36 included in previous research (Chen & Bennett, 2016; L. Seldomridge & DiBartolo, 2004; Yeom, 2013). In addition to a larger sample of NCLEX-RN© failures, this study also includes more variables than previous studies, many of which focus primarily on simple demographics, GPA, and standardized predictor exams. This is also the first study aimed at predicting failure since major NCLEX-RN© exam changes in 2013. A broader understanding of factors associated with failure creates a more accurate picture of students who could be successful if given the opportunity. The use of predictor exams aimed at identifying

students with a high likelihood of NCLEX-RN© success prevents admission and graduation among students who may be successful. The current available literature regarding NCLEX-RN© outcomes signifies an incomplete knowledge base with major practice and policy implications for nursing programs.

Policy

Understanding predictors of failure (or risk) can help nursing programs develop admission criteria and success strategies for students who may otherwise be turned away on the basis of academic achievement and standardized exam scores known only to be highly predictive of success. Focusing on identification of and intervention for at-risk students can guide program policy and student success interventions to mitigate the risk of NCLEX-RN® failure. If certain pre-admission factors are not associated with NCLEX outcomes it may be possible to revise criteria to increase educational opportunity for students and increase enrollment. Educators have an ethical imperative to ensure assessments are a valid measure of students' cognitive ability and should ensure high-stakes exams are one of many criteria for admission and progression (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). This research contributes to a sound body of evidence from which nursing program administrators can shape policy and practice.

Practice

Understanding attrition and barriers to success in nursing programs is essential to meet the changing needs of our society. Changing the focus from "most likely to succeed" to "most likely to fail" is the first step in moving beyond standardized exams and academic achievement factors such as GPA that may identify good students but

not necessarily good nurses. Nursing programs have been reluctant to re-evaluate admission and progression criteria that shut students off from NCLEX-RN® testing rather than ensure every student who has the potential to succeed has access to the support they need.

Nursing programs are challenged to increase overall admissions and produce a more ethnically diverse workforce to meet the demands of a changing healthcare delivery system and a diverse population. In recent years, programs have struggled to rise to the call to increase the number of graduates from under-represented groups such as students of color, students with a previous degree, and students from low socioeconomic status and first-generation college families (Carrick, 2011; Colville, Cottom, Robinette, Wald, & Waters, 2015; Giddens, 2009; Harris, Rosenberg, & Grace O'Rourke, 2014; Murray, Pole, Ciarlo, & Holmes, 2016; Taylor et al., 2014). Nurses from underrepresented and disadvantaged backgrounds improve the quality of healthcare through enhanced cultural competence and improved access to care for patients of the same ethnicity and background (Murray et al., 2016). The hyper-focus on NCLEX-RN® success in nursing programs does little to create a more diverse workforce and deters programs from admitting students from underrepresented racial and ethnic groups. Decades of educational research highlights the ways in which standardized exams used as measures of academic achievement disadvantage students of color and students from low socioeconomic status families (Amankwaa, Agyemang-Dankwah, & Boateng, 2015a; Brunn-Bevel & Byrd, 2015; Green & Griffore, 1980; Mendoza-Denton, 2014; National Center for Education Statistics, 2012; Sackett, Borneman, & Connelly, 2008).

Creating an accurate picture of what programs are able to do to help students become successful nurses is paramount in adopting innovative pedagogies and embracing an outcomes and competency-focused approach to nursing education. A broader understanding of risk guides the development of learning analytics technology aimed at identifying and supporting at-risk students through targeted formative and summative assessments and personalized learning plans. Basing admission and progression decisions on the highest likelihood for success instead of truly understanding risk for failure leads to an inaccurate picture of the program's contribution to student achievement.

Definitions

National Council Licensure Examination- Registered Nurse (NCLEX-RN®): The NCLEX-RN® is a computer adaptive exam designed by the National Council of State Boards of Nursing.

National Council of State Boards of Nursing (NCBSN): The National Council of State Boards of Nursing is comprised of membership from each state and oversees the development and ongoing evaluation of the NCLEX-RN®.

State Board of Nursing: boards of nursing in each state oversee nursing licensure and nursing program approval.

Accreditation: In addition to State Board of Nursing program approval, nursing programs are accredited by the American Association of Colleges of Nursing and/or the National League for Nursing.

Baccalaureate Nursing Program: registered nurses in the United States graduate with a Bachelor of Science in Nursing (BSN) or an Associate Degree of

Nursing (ADN). Graduates from both programs are licensed as registered nurses upon successful completion of NCLEX-RN® ®.

First Time Licensure Rate: this measure of nursing program quality reflects the percentage of graduates who successfully complete NCLEX-RN® on their first attempt. State Board of Nursing program approval is contingent upon an 80% first-time licensure rate.

External Predictor Exams: Many nursing programs employ testing packages from external vendors such as Health Education Systems Incorporated (HESI) and Assessment Technologies Institute (ATI). These packages include an admissions predictor exam and a comprehensive exit predictor exam. Content-specific exams are included to be administered throughout the program.

Limitations

One major assumption of this research is that a model predictive of NCLEX-RN® failure can be developed with enough data points, a large enough sample size, and the appropriate methodology. Another limitation is the exclusion of non-program variables possibly related to NCLEX-RN® failure such as test environment, perceived self-efficacy, personal stressors, and testing anxiety. Any evaluation of program-controlled factors does not address personal factors which may relate to NCLEX-RN® outcomes. In addition, a more accurate understanding of factors associated with NCLEX-RN® failure does not account for attrition and misses an entire group of students who were prohibited from taking NCLEX-RN® due to restrictive admission and progression policies. This study does not include every student interested in being a nurse, since only those meeting competitive admission criteria and successfully completing degree requirements are included in the sample. Lastly, this research is

conducted using a sample of students in a single nursing program and may not be generalizable to other programs of nursing.

Dissertation Overview

The remaining chapters of this dissertation include a Review of Relevant Literature (Chapter 2), Methodology (Chapter 3), Results (Chapter 4), and Discussion (Chapter 5). Appendices and references follow immediately after Chapter 5. Chapter 2 will explicate NCLEX-RN© as the primary indicator of program quality, what is currently known about NCLEX-RN© outcomes and the importance of comprehending NCLEX-RN© failure. Chapter 3 details methodology used to evaluate NCLEX-RN© outcomes in this study.

Chapter 2: Review of Relevant Literature

The current over-reliance on NCLEX-RN® success inhibits educational and career opportunities for students and precludes program intervention efforts. A broader understanding of NCLEX-RN® outcomes informs program policy for admission and progression and informs the development of student intervention efforts. This chapter includes a synthesis of peer-reviewed literature and highlights the gaps concerning NCLEX-RN® failure. I begin by describing how NCLEX-RN® licensure rates became the primary measure of nursing program quality. Then, I address current challenges associated with repeat testing and lag time between graduation and testing. Following that, I survey the literature on factors associated with NCLEX-RN® outcomes: these include pre-program factors, program factors, student characteristics, and student success interventions. I then address barriers to predicting NCLEX-RN® failure, including progression policies based on cut scores for standardized comprehensive NCLEX-RN® predictor exams. Finally, I discuss Alexander Astin's Theory of Involvement and detail the ways in which it informs the design and execution of the present study.

Nursing Licensure as a Program Outcome

The history of nursing education and licensure provides a foundation for understanding the challenges facing nursing education today. In this section, I review the history of licensure and the National Council Licensure Exam (NCLEX-RN®). I then discuss passing standards and the advent of first-time licensure rates as an indicator of program quality. I end this section by highlighting the gaps in our current understanding of how testing lag time, repeat testing, and second attempt pass rates relate to NCLEX-RN® outcomes and licensure.

History of Mandated Licensure

While the formal training of nurses can be traced back to the 1850s, the profession of nursing is relatively young. In 1903, a series of four laws were enacted to regulate nursing practice and licensure in the United States (Dorsey & Schowalter, 2008). However, it would be another 60 years before all states mandated nursing licensure. A shortage of nurses after World War II prompted the Carnegie Foundation and the Committee on the Function of Nursing to recommend licensed practical nurses receive associate degrees and registered nurses receive baccalaureate level education (Hunt, 2017). By 1950, nursing was the first and only profession to use the same licensing exam throughout the country and The State Board Test Pool Examinations served as the national nurse licensure exam from 1941 to 1982 (Dorsey & Schowalter, 2008).

National Council Licensure Examination

In 1982, the National Council of State Boards of Nursing (NCBSN) changed The State Board Test Pool Examinations to the National Council Licensure Exam for Registered Nurses (NCLEX-RN®) with a passing standard of 67%, which was changed to pass/fail in 1988 (Dorsey & Schowalter, 2008). The paper-pencil exam was administered over two days and was offered twice a year. In 1994, the NCLEX-RN® became the first national licensure exam to be offered in a computer-adaptive format (National Council of State Boards of Nursing, 2017). Computer-adaptive testing alternates between easy and more difficult questions to determine the candidates' level of proficiency. NCLEX-RN® candidates are given a maximum of 250 questions to meet the passing standard.

Passing Standards

The NCLEX-RN® passing standard is determined and re-evaluated every three years using a panel of judges for criterion referencing and an extensive practice evaluation (National Council of State Boards of Nursing, 2016b). Since 1994, the passing standard has increased after every three-year cycle except 2001 and 2016. In 2013, national first-time NCLEX pass rates plummeted from 90.34% to 83.04% when the passing standard was raised (National Council of State Boards of Nursing, 2016b). A historical perspective of NCLEX-RN® pass rates and changes to the passing standard provide an important context for the design of this study. Previous research related to changes in NCLEX-RN® pass rates as the result of program changes do not account for comparative changes in the nationwide pass rate. For this research study, I included NCLEX results within a three-year time frame to prevent variances that could occur as a result of exam changes. This is the first study aimed at creating a model to predict NCLEX failure since major changes were made to the passing standard in 2013.

First-Time NCLEX-RN® Pass Rates

First-time NCLEX-RN® pass rates are the gold standard measure of nursing program quality. Nursing education accreditors and state boards of nursing have established expected levels of performance and enact sanctions on nursing programs who fall below first-time pass rate benchmarks. Despite a growing culture of higher education accountability in recent years, nurse educators have echoed the call to develop program quality metrics other than first-time NCLEX-RN® pass rates. Further, many nursing educators advocate for an increased focus on second-attempt pass rates and program persistence data to depict a more robust dashboard for program

accountability. When the first-time NCLEX-RN® pass rate standard was originally enacted as a measure of entry into the workforce, the NCLEX-RN® exam was administered on paper twice per year. Thus, failure would result in significant delays in employment. Once the exam was offered in electronic format, and thus affording candidates multiple attempts to pass, significant delay in employment was no longer a major concern facing those who initially struggled with the NCLEX-RN®. If first-time licensure rates measure programs' ability to adequately prepare graduates for entry-level nursing practice, researchers should seek to better understand patterns of licensure testing and if other pass rate measures offer a more accurate or comprehensive picture of graduate achievement and career outcomes (Noone, 2017).

Testing Lag Time

In addition to an unclear picture of repeat testing, little is known about how delayed testing relates to NCLEX-RN® outcomes. Not all graduates of nursing programs go on to immediately take the NCLEX-RN®, which raises questions about their ability to retain knowledge and skills gleaned from their respective programs. A 2009 study of all NCLEX candidates testing between July 2006 and June 2008 found an inverse relationship between pass rate and lag time, with number of attempts as a moderating factor (Woo, Wendt, & Liu, 2009). Since candidates who fail NCLEX-RN® must wait 45 days to re-test, there is no clear, causal relationship between delayed testing and NCLEX-RN® failure. This illustrates a clear need for a better understanding of NCLEX-RN® failure among students who delay testing and have multiple unsuccessful attempts prior to licensure.

Factors Associated with NCLEX Outcomes

Most nursing program admission criteria and progression policies are developed around factors associated with academic achievement and NCLEX-RN® success. Much of the literature related to NCLEX-RN® outcomes can be divided into two broad categories: academic metrics used as criteria for admission and progression in nursing programs and student characteristics associated with licensure success or failure. In this section, I highlight the various program factors and student characteristics that have been shown through the literature to associate with NCLEX-RN® outcomes. This collection of factors serves as the basis for the variables selected for my analyses, all of which are discussed in greater detail in chapter three. The following subsections are organized to reflect the scope and sequence of my research questions. I begin with a review of the literature associated with pre-program indicators of success often used for admission criteria, including standardized admission exams and grade point average in science courses. Following that, I address program-related factors associated with NCLEX-RN® outcomes such as content exams and course performance. Lastly, I address student characteristics associated with NCLEX-RN® outcomes, which includes differences among specific groups of students and common program interventions associated with student success. This is the first study to address NCLEX-RN® outcomes using such a large variety of student and program variables.

Pre-Program Predictors

Nursing program admission standards are largely based on factors that are predictive of program or NCLEX-RN® success. A substantial amount of the available research on these predictors is correlational and contradictory. Much of the research related to admission standards occurs before 2012, likely due to a nationwide surge in

qualified applicants that continues today (Glazer et al., 2016; Grossbach & Kuncel, 2011; McVicar, Andrew, & Kemble, 2015). Standardized test scores and grade point averages are commonly used in nursing program admission criteria. In a study of 4,105 nursing students, Wolkowitz and Kelley (2010) found that science content area performance and science course GPA were the strongest early predictors of nursing program success. In contrast, one retrospective study of 200 students placed on probation for one course failure revealed developmental psychology course performance as predictive of program completion with every increase in course letter grade raising the odds of program completion by 60% (Abele, Penprase, & Ternes, 2013). Grade point averages are commonly used in admission criteria based on their ability to predict program completion and graduation, but it is not known if pre-admission grade point average is associated with NCLEX-RN® failure.

Standardized Nursing Admission Exams

Nursing program admission criteria often includes scores on one of two commonly used standardized nursing admission exams: The Assessment Technology Institute Test of Essential Academic Skills (or ATI TEAS) and the HESI Admission Assessment Exam (or HESI A2). In one study comparing successful program completion among two cohorts of students using the ATI TEAS and HESI A2 for admission criteria as the independent variable, HESI A2 performance explained 15.9% of the variance in program completion outcome, while the ATI TEAS explained 5.9% (Manieri, De Lima, & Ghosal, 2015). Researchers have also uncovered positive correlations between high HESI A2 scores and first-semester nursing GPA (Hinderer et al., 2014; Underwood, Williams, Lee, & Brunnert, 2013). A more robust understanding

of standardized nursing admission exams and NCLEX-RN® outcomes could inform changes in admission criteria to afford more students the opportunity to be successful.

Admission Criteria

In addition to standardized nursing admission exams, other admission criteria are used by nursing programs to select from large pools of applicants. Wambuguh (2016) evaluated the relationship between NCLEX-RN® performance and five commonly used admission considerations: possessing a bachelor's degree, having healthcare work experience, completing pre-requisites at the university, pre-admission science GPA, and ATI TEAS score. The sample included 497 students who passed NCLEX-RN® and 16 students who failed NCLEX-RN®. Wambuguh (2016) concluded that a student with a TEAS score of 82 or higher had a 96% probability of passing NCLEX-RN® and that a pre-admission science GPA of at least 3.8 granted a 98% probability of passing NCLEX-RN®. However, students with a TEAS score less than 82 and pre-admission science GPA of below 3.8 still had an 87% probability of passing NCLEX-RN®. Lower scores on NCLEX-RN® predictor exams such as ATI TEAS does not necessarily equate to a comparable decrease in NCLEX-RN® outcome. It is important to ensure admission criteria developed to ensure NCLEX-RN® success does not prevent students from entering the program when they still have a chance of being successful.

Program Predictors

In addition to the use of admission criteria designed to ensure NCLEX-RN® success, nursing programs often place emphasis on common courses and content areas within nursing programs and employ standardized, third-party content exams associated with NCLEX-RN® success. Most nursing programs have a lock-step or

sequential curriculum with an early emphasis on foundational content before progressing to more complex nursing care in specialty settings. Faculty should invest resources in early remedial interventions for students who struggle to grasp foundational content since they will likely continue to meet academic challenges as content complexity increases. Since nursing program curricula are not nationally standardized, identifying specific courses may not be as useful as identifying content area weaknesses for personalized learning strategies and instructional design enhancements. Understanding how curriculum-related factors are associated with NCLEX-RN® failure is essential to formulating early interventions for struggling students.

Courses

Certain courses and content areas have been associated with NCLEX-RN® success. Many programs include similar foundational courses such as Pharmacology, Anatomy and Physiology, and Medical-Surgical Nursing. Several studies have determined that student performance in the Medical-Surgical Nursing course correlates with NCLEX-RN® success (Penprase & Harris, 2013; Seldomridge & DiBartolo, 2004; Trofino, 2013) . Many programs have de-emphasized Medical-Surgical nursing content in favor of focusing on specialty and high-acuity care. However, program administrators and faculty may be missing an opportunity to ensure students have mastered essential content prior to introducing advanced concepts and the care of patients increasingly complex care environments.

Course Grades

Recent literature related to nursing faculty grading behaviors highlights concerns related to the accuracy of measures of student achievement in nursing

programs. In a study of 235 faculty across multiple universities, Docherty and Dieckmann (2015) report that 43% of respondents awarded higher grades than merited. Since courses are lock-stepped, students who fail out of a program cannot be replaced and significantly impact progression-to-graduation rates. The number of nursing program course grades of C, D, or F has also been associated with NCLEX-RN® outcome. In one study of 53 students who had three or more course grades of C,D, or F, 26 (or 49%) of them failed NCLEX-RN® (Beeson & Kissling, 2001). Similarly, in a study of 77 graduates, Jeffreys (2007) found that 94% of students without withdrawals or course failures passed the NCLEX-RN on their first attempt, while only 50% of students with two or more withdrawals or failures passed on the first attempt. The lack of a standardized nursing curriculum across the US creates a challenge in the generalizability of course performance, GPA, and NCLEX-RN® outcomes. In this regard, the use of standardized, third-party content-mastery exams may curtail the teaching and assessment variability in individual institutions.

Content-Mastery Exams

Many nursing programs use standardized content-mastery exams developed by HESI or ATI. Emory (2013) evaluated standardized ATI content exam performance among a sample of 119 baccalaureate nursing graduates from a single program between 2008 and 2010. The sample included 112 students who passed NCLEX-RN® and seven students who failed NCLEX-RN® and identified the Pharmacology content exam to be predictive of NCLEX-RN® success with 73% accuracy (Emory, 2013). Since pharmacology-related content is often considered foundational, program administrators may be missing an important opportunity to provide early remediation to ensure student success throughout the program. In another study of 151 students,

Yeom (2013) found the ATI standardized content exams in Medical-Surgical Nursing, Pharmacology, and Community Health Nursing accurately classified 93.2% of NCLEX-RN® success. There are no research studies since exam changes in 2013 that detail an empirical association between standardized content exams and NCLEX-RN® outcome.

Student Characteristics

While there is a clear gap in the literature related to predictors of NCLEX-RN® failure, some researchers have examined correlations between student characteristics and NCLEX-RN® failure. In response to calls for a more diverse workforce, program administrators must invest in resources beyond quality instruction to ensure student success. In this study, student characteristics such as prior work experience, age, gender, and ethnicity are used in a way to account for groups of students that are too often under-represented, but greatly needed, in the nursing profession. A greater understanding of nursing student characteristics and NCLEX-RN® outcomes could guide the development of student support systems and provide important insight into improving educational attainment amount various groups of students.

Prior Work Experience

In recent years, accelerated nursing programs have been established to offer nursing degrees in as little as eleven months to students with undergraduates degrees in fields other than nursing, as well as for veterans with healthcare work history. Employers have embraced these graduates who bring unique life experiences and maturity to healthcare (American Association of Colleges of Nursing, 2017). Many employers have partnered with nursing programs to offer tuition assistance and job placement for graduates in exchange for guaranteed clinical placement sites, which

makes accelerated programs a win-win for practice and program administrators. Despite the recent surge in accelerated programs, little is known about how NCLEX-RN® outcomes differ among students enrolled in traditional and second-degree accelerated nursing programs. Some researchers have reported higher NCLEX-RN® pass rates among second-degree accelerated nursing students when compared to traditional program delivery (Seldomridge & DiBartolo, 2005; Shier, DeBasio, & Roberts, 2008). In contrast, other researchers have found lower NCLEX-RN® pass rates among second-degree accelerated nursing programs (Aktan et al., 2009; Bentley, 2006). The present research study includes NCLEX-RN® outcomes for more than 100 accelerated program graduates, which can help address the gap in our understanding of how nursing programs can effectively meet the needs of non-traditional students.

Age

Due to economic instability and an increase in flexible nursing degree offerings, more mature-age students are applying to nursing programs (American Association of Colleges of Nursing, 2017; Hayden, Jeong, & Norton, 2016). However, little is known about NCLEX-RN® outcomes among mature-age students. Trofino (2013) found that students over the age of 22 on admission were 3.026 times more likely than students younger than 22 to pass NCLEX-RN®. In a study of 267 nursing students with an average age of 25 years old, Salamonson and Andrew (2016) found that older students performed better in nursing coursework than younger peers but had higher rates of attrition. Peer support and meaningful relationships with faculty are associated with program completion and NCLEX-RN® success among older students (Bernard, 2015; Moe et al., 2009; O'Brien, Keogh, & Neenan, 2009). As a result of increasing numbers

of mature-age applicants, nursing program administrators should ensure students have the necessary support for successful program completion and licensure.

Gender

The relationship between gender and NCLEX-RN® outcomes is poorly understood. According to Seago and Spetz (2005) nursing programs with a higher percentage of male students had lower than average first-time NCLEX-RN® pass rates. Similarly, males are disproportionately represented among students who fail NCLEX-RN®. Taylor, Loftin, and Reyes (2014) reported that males comprised 21% of their specific study's sample of nursing students. However, in their analysis of licensure outcomes over a three-year period, males represented 50% of NCLEX-RN® failures. A better understanding of the unique challenges facing male nursing students could lead to the development of student success interventions.

Ethnicity

Nurses from underrepresented and disadvantaged backgrounds improve the quality of healthcare through enhanced cultural competence and improved access to care for patients of the same ethnicity and background (Murray et al., 2016). While children of color represent more than half of the K-12 student population in many states, only 29% of students enrolled in baccalaureate nursing programs represent a racial or ethnic group other than Caucasian (American Association of Colleges of Nursing, 2016). In a statewide study of California nursing students, Seago and Spetz (2005) reported a 77.4% first-time NCLEX-RN® pass rate among programs with a high percentage of African American students compared to an overall state average of 84.4%. Sayles, Shelton, and Powell (2003) compared the academic records of 83 nursing graduates and found that African American and Hispanic nursing students

were less likely than their White counterparts to pass NCLEX-RN® on the first attempt. Ethnically diverse nursing students have unique academic challenges due to lack of faculty support, feelings of isolation, less access to college preparation, and deeply-rooted societal mechanisms of systemic oppression pervading American public education (Alameida et al., 2011; Harris et al., 2014; Love, 2010; Murray et al., 2016).

Barriers to Predicting Failure

Schools of nursing across the country are implementing admission and progression policies to prevent admitting and promoting students whose NCLEX-RN® performance could negatively impact the program's first-time licensure success rates. This section begins with an overview of exit exam administration and progression policies used by nursing programs. Next, I emphasize the inherent problems in the current use of exit exams as predictors of NCLEX-RN® failure. I end this section by detailing the methodological challenges in previous attempts to model NCLEX-RN® failure. Understanding the pitfalls in predicting NCLEX-RN® failure underscores the dire need for research to guide policy and practice in nursing programs.

Progression Policies

Despite caution from nursing organizations at the state and national level, nursing education programs continue to use predictor exams such as HESI and ATI for progression decisions. Programs often employ progression policies to prevent or delay graduation for students who are not likely to pass NCLEX-RN® based on comprehensive predictor exam scores as a mechanism to protect first-time NCLEX-RN® pass rates (Lauer & Yoho, 2013; Sosa & Sethares, 2015). According to the National League for Nursing Board of Governors (2012), 33% of nursing programs have progression policies that require a minimum score on a predictor exam to

progress to graduation. The actual rate of progression policy usage is thought to be much higher than 33% since many schools use predictor exam scores as a portion of the course grade or a pass/fail component of the final course in a program (Noel, 2009; Santo, Frander, & Hawkins, 2013; Taylor et al., 2014). Nibert and Young (2013) reported that 43 of the 66 nursing programs surveyed use cut scores on the Exit HESI for remediation and re-testing. Understanding how comprehensive exams are used to predict NCLEX-RN® success brings to light the legal and ethical responsibility of educators to set fair cut scores when employing high-stakes exams.

Predicting Success

While the practice of using benchmark cut scores on predictor exams is intended to increase NCLEX-RN® pass rates, faculty should ensure exit exams are not inaccurately targeting students as "likely to fail NCLEX-RN®". The Exit HESI exam is proven to be a valid measure of a student's likelihood to pass NCLEX-RN® with a 96-99% rate of accuracy among students who score in the highest-ranking category (Langford & Young, 2013; Nibert & Morrison, 2013; Sosa & Sethares, 2015; Zweighaft, 2013). Multiple researchers point out that as Exit HESI scores decreased, number of failures increase (Langford & Young, 2013; Nibert & Morrison, 2013). However, the fact that it becomes more difficult to correlate Exit HESI scores with NCLEX-RN® success as scores decrease should not warrant the placement of students below the cut score as "likely to fail". Multiple validation study authors warn that the Exit HESI exam was not designed to detect students at risk for failure and encourage faculty to use results to tailor individualized remediation plans instead of delaying graduation until benchmark scores are met (Nibert & Morrison, 2013; Sosa & Sethares, 2015; Spurlock & Hunt, 2008; Young & Willson, 2011).

Actual Risk of Failure

Understanding how scores are used to categorize a student's likelihood for NCLEX-RN® success is essential to discerning the flawed logic behind the use of cut scores to categorize students as at-risk for NCLEX-RN® failure. Many programs use exit HESI scores of 850 or 900 as a benchmark in progression and remediation decisions (Nibert & Morrison, 2013; Sosa & Sethares, 2015; D. Spurlock & Hunt, 2008). However, a closer look at the actual NCLEX-RN® outcomes of students who score below 900 highlights the issue of using cut scores to identify students at risk of failure. In a large study of Exit HESI scores and NCLEX-RN® outcomes among 5,903 students, only 19% of students scoring below 900 actually failed NCLEX-RN® (Nibert et al., 2002). Even when evaluating the NCLEX-RN® outcomes of students scoring less than 700, predicted probability of NCLEX-RN® failure is 0.22 - 0.29, meaning this category of students only have a 30% chance of failing NCLEX-RN® (Spurlock & Hunt, 2008). Pennington and Spurlock (2010) investigated the validity and predictability of HESI scores among students who score below the 850 cut-score and found a 10% failure rate among students who score between 800 and 850 and a 24% rate of failure among students who score between 700 and 800 (Pennington & Spurlock, 2010). This would suggest that progression policies may prohibit students who are not necessarily doomed for NCLEX-RN® failure from graduating. Using a cut score of 850 or 900 for progression decisions will likely overestimate the actual risk for NCLEX-RN® failure and presents a legal and ethical conflict for program administrators aiming to develop policies based on assurance of first-time licensure success.

Low Failure Rates

While a dearth of literature exists regarding factors associated with NCLEX-RN® success, less is known about NCLEX-RN® failure. Understanding factors associated with failure in addition to success is important because the current use of success predictors is not effective in determining true risk of failure and the need for intervention. Only basing failure risk on known predictors of success results in intervention for students who may still have a high likelihood of passing NCLEX-RN®. Furthermore, a predictive model for success is not developed to predict students at risk for failure, leading to an inaccurate categorization of a student whose likelihood for success cannot be accurately predicted by the model as “highly likely to fail”. Previous studies lack a sufficient sample size of failures and statistical power to develop a predictive model for NCLEX-RN® failure. Since national NCLEX-RN® failure rates are around 10-15%, predicting failure with a diagnostic or predictive test can prove challenging without a large sample (Harding, 2010; Spurlock & Hunt, 2008). Previous attempts to model failure are only able to correctly predict 30-50% of failures using sample sizes of 30-50 students (Chen & Bennett, 2016; L. Seldomridge & DiBartolo, 2004; Yeom, 2013). The present research study fills a gap in the literature related to NCLEX-RN® failure and addresses challenges in predicting failure with the use of a sample of more than 200 failures at a site with overall pass rates at or above the national average since major exam changes in 2013.

In conclusion, the current available literature highlights the ways in which the focus on assurance of NCLEX-RN® success leads to an incomplete depiction of risk for failure. A broader understanding of NCLEX-RN® outcomes will inform program intervention efforts and aid in the development of fair and equitable admission and

progression criteria. Rather than admitting and promoting only the students with the highest likelihood for success, nursing program administrators should focus on designing more effective learning environments as a primary strategy for contributing to a more diverse and talented workforce. This research informs policy and practice by creating a more accurate picture of NCLEX-RN® outcomes.

Theoretical Perspective

Alexander Astin's theory of involvement (Astin, 1985) guides the development of this research study and provides important context for the development of student success interventions. Astin (1985) defines involvement as "the amount of physical and psychological energy that the student devotes to the academic experience". Astin (1985) challenges the traditional view of students as a "black box" with policies or programs as an input and educational achievement as an output. Instead, students' own behaviors serve a mediating role in their educational outcomes (Astin, 1999b). After spending twenty years researching student development in higher education, Astin sought to connect the empirical knowledge about environmental influences on student learning with classic learning theories. Astin aspired to assist faculty and administrators in designing more effective learning environments. In the following section, I review the main elements of Astin's theory of involvement and provide a rationale for its use in guiding the design and analysis in this study.

Theory Overview

Astin (1985) questions the focus on prestige among higher education administrators as a mechanism to recruit more qualified applicants. He argues this approach does little to maximize human capital and enhance the educational effectiveness of higher education (Astin, 1985). According to Astin (1985), a talent

development approach redefines institutional quality by maximizing personal and intellectual development, increasing student motivation, and improving the learning environment. The talent development approach is essential to nursing education and this research study because it focuses on program intervention and maximizing student capacity instead of policies designed to prevent admission and progression. Astin (1985) emphasizes designing more effective learning environments over choosing students most likely to succeed, which is the fundamental purpose of this research study.

Tying Theory to Practice

Astin's purpose was to tie program policy and implicit pedagogical theories to student development outcomes. Astin evaluates common pedagogical theories to further illustrate the need to view student learning outcomes within the lens of program factors as well as student characteristics. Three pedagogical theories are addressed: subject-matter theory, resource theory, and individual theory. In subject-matter theory, student learning is dependent on exposure to the right content, which assigns a passive role to the student (Astin, 1999). Resource theory applies to administrator procurement of resources to support student learning such as personnel, facilities, and funding to recruit high achieving students and prestigious faculty (Astin, 1999). While this approach may benefit the institution, it does little to improve the overall education of our country's citizens or to ensure resources are used effectively. Individual theory emphasizes the unique needs of learners as individuals but is costly and difficult to implement (Astin, 1999). Astin bridges all three common theoretical approaches by positing that any resource or intervention must elicit student effort to effectively produce the desired learning outcome (Astin, 1999). For nursing education, simply

refining content and admission criteria is no longer a viable solution to meet the needs of our profession. Astin's theory informs the methodology of this study through the notion that programmatic policy based solely on changing who is admitted or what is taught falls short in improving learner outcomes. Programs must also consider student factors and how to develop the talent of students who can be successful if given the chance.

Implications for Research

Understanding how pre-program, program, and post-program variables correlate to NCLEX-RN© outcomes is paramount to developing program policy and student success interventions. In addition to understanding how student characteristics and instruction affect learning outcomes, Astin's focus on talent development has profound implications for the development of a study focusing on student success rather than solely on recruitment of the brightest nursing students. The empirical data anchoring Astin's theory highlights involvement as more strongly associated with student outcomes than both student admission and institution characteristics (Astin, 1985). This provides important rationale for the emphasis in this study on refining admission criteria and investing in student support resources for students who may otherwise be excluded from the program. While this study does not specifically address affective factors associated with NCLEX failure, the evaluation of factors outside of the program's control such as time between graduation and testing are examined. The multi-dimensional factors associated with education outcomes highlights the need for a deeper understanding of NCLEX-RN© failure and the need to develop quality indicators beyond first time licensure success.

Practical Implications

Beyond informing the design of this research study, Astin's theory of involvement has practical implications for administrators. Most importantly, the focus shifts from what is being taught to what students can actually do and how they behave. Student support interventions begin with an evaluation of student motivation and involvement to consider the effect of competing priorities and ensure students have study habits and resources to be successful. In addition to considering student motivation as a contributor to academic performance, faculty and student support personal can ensure interventions are tailored to students' individual needs. Otherwise, more content will always be the solution for a struggling student. When involvement is considered, the focus of assessment is shifted from summative to formative as method of individualizing instruction for at-risk students in lieu of progression policies designed to merely delay NCLEX-RN© testing. A primary aim of this study is to change the narrative from only admitting students with the highest likelihood for NCLEX-RN® success to a more comprehensive understanding of students who could be successful if given the opportunity and necessary support to increase involvement.

This study cannot account for all aspects of Astin's theory. While student motivation is not specifically measured, this study is responsive to the notion of involvement as posited by Astin. In lieu of restrictive nursing program admission and progression policies, Astin's talent development approach supports the emphasis on student support resources and developing more effective learning environments. In this study, involvement is reflected in the use of variables other than traditional measures of academic achievement, such as student characteristics, licensure attempt patterns, and student characteristics. Understanding student factors associated with licensure

outcomes is an important first quantitative step to inform future research associated with motivation and student success in nursing programs.

Chapter 3: Methodology

The purpose of this study is to model NCLEX-RN® outcomes in a way that informs program policy and student intervention. This research fills a gap in the literature related to predictors of NCLEX-RN® failure. In this chapter, I describe the methodological approach used to describe the relationship between variables and develop a model to predict NCLEX-RN® outcomes using a combination of variables. This chapter begins with a description of the research setting and participants. I then describe the data and variables used in this study. The chapter concludes with a detailed description of research procedures and techniques.

Setting

The target population for this study includes graduates from a large baccalaureate nursing program in Texas with a first-time licensure success rate at or above the national average. The program has maintained full approval from the Texas Board of Nursing, accreditation from the Commission on Collegiate Nursing Education, and has been deemed a Center of Excellence by the National League for Nursing. The urban university has a Tier 1 Carnegie classification and receives federal funding as a Hispanic-Serving Institution.

Participants

Purposive sampling includes all graduates from the research site with an initial NCLEX-RN® licensure attempt occurring between Spring 2013 and Fall 2017. I have selected this time frame to account for NCLEX-RN® changes in April 2013 which would preclude a valid outcomes comparison. The latest available NCLEX-RN® data includes results from Fall 2017. The final sample will include a total of 2,104 students, 1,912 of whom passed and 192 of whom failed their initial licensure attempt (90.87%

pass rate). The sample size of 192 failures is important because previous studies attempting to predict failure were limited to a maximum of 36 students who failed NCLEX-RN® and lacked the statistical power to model failure (Chen & Bennett, 2016; L. A. Seldomridge & Dibartolo, 2004; D. R. Spurlock & Hunt, 2008; Yeom, 2013). The sample will be homogenous in that all students were subjected to the same curricular interventions and same course sequence. However, two separate program delivery types will be included in the sample: Accelerated Online and On-Campus. The Accelerated Online Program is a 15-month program with didactic courses delivered online and the Campus-Based students attend face-to-face lectures for didactic content. Students in both programs complete the same number of clinical hours with a student to faculty ratio of 10:1.

Data

I will collect data included in this study from archived student records of program graduates between January 2013 and January 2017. I will obtain approval from the university's Institutional Review Board prior to beginning data collection. All identifying student data will be removed by program employees prior to use for data collection and no student names or identifying information will appear on records associated with data collection. I will collect NCLEX-RN® licensure outcomes from archived records of NCLEX-RN® licensure results provided by the National Council of State Boards of Nursing. All other data included in the study will be obtained from the university's student management system. The instrument for data collection will be a table created specifically for the study and will include a variety of categorical and continuous measures. I will perform statistical analysis and associated procedures using IBM SPSS Statistics© for Windows, version 25.

Variables

The dependent variable of primary interest in this study is NCLEX-RN® licensure outcome, which is dichotomous and reported as pass or fail. I have organized the independent variables into four categories which correspond with the factors associated with NCLEX-RN® outcome that I addressed in chapter two: pre-admission variables, program variables, student characteristic variables, and other variables. All variables are either continuous or dichotomous. Continuous variables will be standardized (z-scored) to a mean of zero and a standard deviation of one, which is helpful for consistency in interpreting results (Logan, 2010). Table 1 includes a description of each variable included in the study.

Table 1
Defined Variables

Variable	Category	Definition	Type	Code
nclex	Dependent	Measure of initial licensure attempt outcome	categorical, dichotomous	0 (yes) or 1 (no)
gpa	Pre-Admission	Measure of grade point average on admission	continuous	n/a
a2hesi	Pre-Admission	Measure of standardized admission exam performance	continuous	n/a
mshesi	Program, academic	Measure of Medical-Surgical Content Mastery Exam score	continuous	n/a
e2hesi	Program, academic	measure of initial HESI E2 exit exam score	continuous	n/a
progpa	Program, academic	Measure of grade point average upon program completion	continuous	n/a

grade3632	Program, academic	Measure of course grade in Foundations course	continuous	n/a
grade3561	Program, academic	Measure of course grade in Medical-Surgical course	continuous	n/a
grade4581	Program, academic	Measure of course grade in Critical Care course	continuous	n/a
prodeliv	Program, progression	Measure of program type	categorical, dichotomous	0 (campus-based) or 1 (accelerated-online)
offtrack	Program, progression	Measure of on-time completion	categorical, dichotomous	0 (no) or 1 (yes)
age	Student Characteristic	Measure of student age at admission	continuous	n/a
age2	Student Characteristic	Measure of age-squared term	continuous	n/a
male	Student Characteristic	Measure of student gender	categorical, dichotomous	0 (no) or 1 (yes)
ethnicity	Student Characteristic	Combined measure of race and ethnicity	categorical, nominal	Asian, Black, Latino, White, Other
Asian	Student Characteristic	Descriptor of student race or ethnicity	categorical, nominal	0 (no) or 1 (yes)
Black	Student Characteristic	Descriptor of student race or ethnicity	categorical, nominal	0 (no) or 1 (yes)
Latino	Student Characteristic	Descriptor of student race or ethnicity	categorical, nominal	0 (no) or 1 (yes)
White	Student Characteristic	Descriptor of student race or ethnicity	categorical, nominal	0 (no) or 1 (yes)
Other	Student Characteristic	Descriptor of student race or ethnicity	categorical, nominal	0 (no or 1 (yes)
timetest	Other	Measure of days between graduation and initial licensure attempt	categorical, dichotomous	0 (within 45 days) or 1 (>45 days)
vet	Student Characteristic	Measure of student military veteran status	categorical, dichotomous	0 (no) or 1 (yes)

second degree	Student Characteristic	Measure of student with a second degree	categorical, dichotomous	0 (no) or 1 (yes)
partnered	Student Characteristic	Measure of student employed by partnering healthcare system	categorical, dichotomous	0 (no) or 1 (yes)

Pre-admission Variables

In this study, variables in the pre-admission category are measured prior to students' entry into the nursing program and are included in admission criteria. Science GPA, overall GPA, and HESI A2 composite score are included as variables in this category. The HESI A2 exam is used by many nursing programs as a standardized admission exam. These variables were used in previous research related to predicting NCLEX-RN® licensure outcome (Crow, Handley, Shaw Morrison, & Shelton, 2004; Knauss & Willson, 2013; Manieri et al., 2015; Wambuguh et al., 2016). All three of these variables are continuous, with GPA measurements on a 4-point scale and HESI A2 scores ranging from 0-100%. Science GPA is a cumulative average of the following pre-requisite courses: Anatomy and Physiology 1, Anatomy and Physiology 2, Microbiology, and General Chemistry. The overall GPA is calculated using all courses completed by the end of the term prior to admissions review.

Program Variables

Program variables are defined by their occurrence *after* a student enters the nursing program. All program variables have been identified in previous research related to NCLEX-RN® licensure outcome and include two sub-categories: academic metrics and program progression descriptors. Academic metrics in the program variable category are continuous and include: Medical-Surgical HESI Content-Mastery

Exam score, initial HESI E2 Exam score, and program GPA. Both HESI score percentile rankings range from 0-100 and program GPA is measured on a 4-point scale. In addition, grades in the following courses are included as variables: Foundations, Medical-Surgical, and Critical Care. Variables in the program progression descriptor category have been used in previous research studies to reflect program policy and various content delivery methods which could be related to NCLEX-RN® licensure outcome. The first variable, program delivery method, is dichotomous and reflects either accelerated-online or campus-based instruction. The second variable, labeled offtrack, is also dichotomous and reflects continuous enrollment over four semesters (campus-based) or 15 months (Accelerated Online). The on-time completion variable is selected to identify students who did not complete the program in the expected time frame, either due to course failures or other issues resulting in a drop or withdrawal.

Student Characteristic Variables

Age is included as a student characteristic variable. Because age may have a non-linear relationship with NCLEX-RN®, I will also evaluate the inclusion of an age-squared term. Student gender is reflected through “male”, a dichotomous dummy variable reflecting whether or not the student is male. The student race/ethnicity categories currently used in institutional reporting are: Hispanic or Latino or Spanish Origin of any race, American Indian or Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, Black or African American, White, two or more races, unknown, or non-resident alien. Due to cell size and statistical power considerations, these categories will be collapsed into a series of five dummy variables wherein students are coded as either Asian, Black, Latino, White, or Other. Three additional student

characteristic variables identify special populations of students admitted to the program: military veterans, students with a second degree, and students employed by a partnering healthcare facility.

Other Variables

The final variable to be included in this study is time to test, which is continuous and expressed in days. Time to test reflects the time between graduation and initial licensure attempt, which has been addressed in previous research related to testing lag time (Woo et al., 2009). For this study, time to test is dichotomous and reflected as "0" for students whose initial licensure attempt was within 45 days of graduation and "1" for students whose initial licensure attempts was more than 45 days after graduation. Since less than half of students who fail NCLEX-RN® on their first attempt go on to pass on their second attempt, it is important for program administrators to have a clear understanding of how testing patterns relate to NCLEX-RN® outcomes (Taylor, Loftin, & Reyes, 2014).

Technique

Recall that the research questions guiding this study are as follows:

1. What pre-admission factors are associated with NCLEX-RN® outcome?
2. What program factors are associated with NCLEX-RN® outcome?
3. What student characteristics are associated with NCLEX-RN® outcome?
4. Can a combination of pre-admission, program, and student characteristic factors be used to predict NCLEX-RN® outcome?

Correlational Analysis Procedure: Research Questions 1-3

Research questions 1-3 will be addressed using correlational methodology and bivariate analysis will reflect the association between NCLEX-RN® licensure outcome and each individual independent variables. Each independent variable will be correlated with NCLEX-RN® outcome and the resultant strength and significance of the correlation will guide the selection of predictor variables to be included in the logistic regression analysis used to answer research question 4. Understanding the correlational strength and significance of each independent variable with NCLEX-RN® outcome in isolation is an important first step in the quest to identify a combination of variables used to predict NCLEX-RN® outcome. Descriptive statistics identify patterns and distribution data which many inform inferential and multivariate techniques (Vogt, 2014).

To understand the correlation between each independent variable and NCLEX-RN® outcome, direction, form, and consistency of the relationship between each variable and NCLEX-RN® outcome will be evaluated. A universal *p*-value cut-off of .05 will be used to determine statistical significance. The strength of the relationship between variables is measured between -1 and +1, with negative values indicating an inverse relationship, 0 indicating no relation, and positive values indicating a direct relationship between the dependent and independent variable (Gravetter & Wallnau, 2013). For dichotomous or binary independent variables, a Phi-coefficient correlation will be calculated and expressed as ϕ to measure association between variables. For the continuous variables included in the study, a point-biserial coefficient will be calculated and measured as r_{pb}. Point-biserial coefficients are used to measure correlations between dichotomous and continuous variables. Cohen's standard will be

applied to assess the correlation coefficient with .1 indicating a weak association between variables, .3 indicating and medium correlation, and .5 representing a strong correlation (Cohen, 1977).

Procedure: Research Question 4

Logistic regression is used to address Research Question 4. Logistic regression results in the determination of the probability of binary group membership based on a combination of predictor variables expressed in log odds (or logit) (Tabachnick & Fidell, 2013). Previous research studies aimed at determining the probability of NCLEX-RN® success based on academic metrics have used logistic regression (Alameida et al., 2011; Crow et al., 2004; Spurlock & Hunt, 2008).

Assumptions

There are five assumptions that must be met in the use of logistic regression. First, the dependent outcome must be binary, which is assured by the use of an outcome of pass or fail. If there are too few cases in relation to independent variables, logistic regression can produce large parameter estimates and standard errors. Adequacy of expected frequencies and power are measured in goodness-of-fit test with smaller frequencies resulting in smaller power (Tabachnick & Fidell, 2013). The second assumption is independence of observations, which holds that outcomes for each sample are not duplicated and are unique and is satisfied by ensuring there are no repeated measures or matched data (Tabachnick & Fidell, 2013). This study uses a between-subject strategy to maintain independence. The third assumption in logistic regression is there are no outliers, which is examined using residuals in model fit analysis (Tabachnick & Fidell, 2013). The fourth assumption of logistic regression is linearity between independent variables and log odds, which is tested by ensuring each

independent variable has a linear relation to the log odds (Tabachnick & Fidell, 2013). The final assumption in logistic regression holds that there is no multicollinearity among independent variables, which could negatively affect predictor significance. I will test for multicollinearity by calculating variance inflation factors (VIFs) for each variable. VIFs are a measure of interdependence between predictor variables (Thompson, Kim, Aloe, & Becker, 2017).

Formula

Since raw coefficients are not linear in logistic regression, exponentiation of logit coefficients to odds ratios is necessary (Tabachnick & Fidell, 2013). The odds ratios for each independent variable represent the change in the odds of NCLEX-RN® failure that are associated with a 0 to 1 (or "no" to "yes" in the case of dummy variables) change in that independent variable, holding all other variables constant. Odds ratios greater than 1.0 indicate a greater likelihood of NCLEX-RN® failure, while those below 1.0 indicated a lessened likelihood of NCLEX-RN® failure. The logistic regression formula used for this research is as follows:

$$\text{Logit } Y_{NCLEX\ Failure} = b_0 + b_{1-3}X_{pre-admission} + b_{4-6}X_{program} + b_{7-11}X_{student} + b_{12-13}X_{other}$$

In this formula, Logit Y represents the log odds of an individual failing NCLEX-RN®, b_0 is the constant, and b_{1-13} represent the separate coefficients (Tabachnick & Fidell, 2013). The *X*s represent the all of the independent variables, and their subscripts reflect the buckets in which they fall. Only variables with significant correlations will be included in the formula. Variables not associated with NCLEX-RN® outcomes will be excluded from the logistic regression formula.

Reporting Model Results

Reporting of model results will include an overall evaluation of the model, goodness of fit statistics, and an interpretation of the predicted probabilities (Peng, Lee, & Ingersoll, 2002). Unlike ordinary least squares estimation used with linear regression, there is no R^2 statistic to explain the proportion of dependent variable variance accounted for by predictor variables. Three pseudo-R^2 measures will be reported in this study as goodness-of-fit measures: Cox-Snell R^2, McFadden R^2, and Nagelkerke R^2. These pseudo R^2 measures reflect different measures of model fit, therefore details of the interpretation of each is offered in the next chapter. Finally, I evaluate classification rates, which compare the predicted outcome of each observation (based on estimated coefficients) to the actual, known outcomes (Tabachnick & Fidell, 2013).

In this chapter, I have described the methodological approach used to describe the relationship between variables and develop a model to predict NCLEX-RN® outcomes using a combination of variables. This chapter began with a description of the research setting, participants, and data collection methods. Next, I described independent and dependent variables used in the study. The chapter concludes with a detailed description of research procedures and techniques for each research question.

Chapter 4: Results

To better understand student characteristics associated with NCLEX-RN® failure, I performed a sequence of analyses. First, I performed a correlational analysis to determine significant relationships between NCLEX-RN® outcome and independent variables. After the correlation analysis, I conducted a logistic regression analysis to determine the strength of each independent variable as a predictor of NCLEX-RN® outcome.

Data Characteristics

Students included in the sample for this study completed the nursing program and had their initial licensure attempt between May 2013 and July 2017. It is important to note that students who did not graduate and students who graduated but did not attempt licensure were excluded from the sample, as there would be no measure for the dependent variable in each of their cases. In addition, the NCLEX-RN® pass/fail report provided to colleges of nursing only provides student name. Without an additional identifier, there was no way to match students with name changes since graduation to academic records. The total sample included 2214 students, with 1977 students who passed NCLEX-RN® on their initial attempt and 237 students who failed NCLEX-RN® on their initial attempt. This sample represents 96% of all program graduates between May 2013 and July 2017. Table 2 compares a variety of descriptive measures between students who passed NCLEX-RN® and those who failed.

Table 2

Descriptive Statistics of Students Who Passed NCLEX and Students Who Failed NCLEX-RN®

Category	All Participants n=2214	NCLEX Pass n= 1977 (89.3%)	NCLEX Fail n= 237 (10.7%)
On-Campus	1226 (55.4%)	1106 (90.3%)	120 (9.7%)
Accelerated Online	988 (44.6%)	873 (88.4%)	115 (11.6%)
Time to Test >45 days	679 (30.7%)	557 (82%)	122 (18%)
Time to Test <45 days	1535 (69.3%)	1420 (92.5%)	115 (7.5%)
Off-track	503 (22.7%)	395 (78.5%)	108 (21.5%)
Male	379 (17.1%)	313 (82.6%)	66 (17.4%)
Female	1835 (82.9%)	1664 (90.7%)	171 (9.3%)
Latino	394 (17.8%)	363 (92.1%)	31 (7.9%)
Asian	388 (17.5%)	325 (83.8%)	63 (16.2%)
Black	350 (15.8%)	272 (77.7%)	78 (22.3%)
White	1006 (45.4%)	953 (94.7%)	53 (5.3%)
Veteran	107 (4.8%)	94 (87.8%)	13 (12.1%)
Second Degree	681 (30.8%)	617 (90.6%)	64 (9.4%)
Category	All Participants Mean (SD)	NCLEX Pass Mean (SD)	NCLEX Fail Mean (SD)
Admission GPA	3.32 (.33)	3.35 (.32)	3.04 (.29)
4581	2.69 (.68)	2.75 (.67)	2.19 (.54)
3561	2.83 (.61)	2.89 (.59)	2.31 (.55)
3632	2.97 (.56)	3.01 (.54)	2.59 (.54)
HESI E2	903.9 (122.48)	916.07 (118.31)	802.41 (108.99)
HESI A2	356.75 (17.69)	358.08 (17.09)	345.45 (18.55)
MS HESI	897.66 (161.02)	910.24 (157.54)	792.76 (151.51)

In the total sample, 89.3% of students passed NCLEX-RN® and 10.7% of students failed. The program pass rate of 89.3% is slightly above the average national pass rate of 87.16% between 2013 and 2017 (National Council of State Boards of Nursing, 2017). In the following section, I discuss differences among specific groups of students.

Pre-Admission Variables

The average admission GPA among the total sample was 3.32. Among students who passed NCLEX-RN®, the average admission GPA was 3.35. Students who failed NCLEX-RN® had an average admission GPA of 3.04. The average HESI A2 score of the total sample was 356.75, with an average of 358.08 among students who passed NCLEX-RN® and 345.45 in students who failed NCLEX-RN®. Overall, there was little variability in admission GPA and HESI A2 score based on NCLEX outcome.

Program Variables

There were no major differences in percentages of failures among students enrolled in the on-campus (9.7%) and accelerated online (11.6%) programs. This is an important measure of program quality for program administrators considering the development of an accelerated method of program delivery. Students who waited longer than 45 days after graduation for their initial licensure attempt represented a higher percentage of failures (18%) than students whose initial licensure attempt occurred within 45 days of graduation (7.5%). While this does not illustrate a causal relationship between testing lag time and failure, it supports previous research related to the disproportionate number of failures among students who wait longer to test after graduation (Woo et al., 2009). Students who were considered “off-track”, or took longer

than expected to persist to graduation, had much higher rates of NCLEX-RN® failure (21.5%) than those who graduated on-time. This is not surprising since many of these students took longer than expected to graduate due to a course failure, but this sample also includes students who took time off from the program for personal or non-academic reasons.

Student Characteristics

The percentage of males in this sample who failed their initial licensure attempt was almost double the percentage of females who failed their initial licensure attempt. This finding aligns with previous research related to the disproportionate representation of males among NCLEX-RN® failures (Seago & Spetz, 2005; Taylor et al., 2014). In addition to differences in NCLEX-RN® outcomes based on gender, there are also differences on the basis of ethnicity. Black students were disproportionately represented among NCLEX-RN® failures, with a 22% failure rate. The NCLEX-RN® failure rate among Asian students was 16%. Conversely, the NCLEX failure rate was lower among White students (5.3%) and Latinos (7.9%) than the overall mean (9.7%). There were no major differences in NCLEX-RN® outcomes among Veteran or Second-Degree students. This is an interesting finding since these students are often admitted with lower academic criteria than students without these qualifications. Based on these descriptive findings, a number of variables seem to be related to NCLEX-RN® failure: off-track, time to test >45 days, male, Asian and Black. Next, a correlational analysis determines the strength, direction, and statistical significance of any associations between student characteristics and NCLEX-RN® outcomes, so as to ultimately guide the logistic regression analysis.

Correlation Analysis

Research questions 1-3 address the association between NCLEX-RN® outcome and pre-admission, program, and student characteristics. The purpose of this analysis is to determine the characteristics of students who fail NCLEX-RN®. I used a phi coefficient correlation to determine the relationship between categorical outcomes and NCLEX-RN® outcome. Like the Pearson correlational coefficient, the phi coefficient (denoted by ϕ) is measured from -1 to 1 with direction of relationship indicated by sign, wherein negative measures reflect an inverse relationship while positive measures reflect a direct relationship. Larger absolute values represent stronger correlations (Lewis-Beck, Bryman, & Liao, 2004). For continuous variables, I used the point-biserial correlation (denoted by r_{pb}) to determine the strength of association with NCLEX-RN® outcome. Interpretation of point-biserial correlation values is the same as for phi coefficients. The probability measure, or α, is used in place of the traditional *p* value, and determines strength of association in much the same way as the phi coefficient. I will determine significant only those correlations with probability measures below .05. I draw upon Cohen's (1977) standards for assessing correlations to interpret all correlational analyses of this study. Absolute values up to .1 indicate "weak" or no association between variables, values between .1 and .3 indicate a "medium" correlation, and those .5 and greater represent a "strong" correlation (Cohen, 1977). Table 3 indicates the coefficient and significance for all correlations.

Table 3

Correlation Analysis of Characteristics with NCLEX-RN® Failure

Characteristic	Phi Coefficient	Approx. Significance
Delayed Test Time	0.386	0.018
Male	0.882	0.000
Black	.705	0.000
Off-Track	.304	0.081
Characteristic	**Point-Biserial**	**Approx. Significance**
GPA	-.481	0.179
HESI A2	-.232	0.007
Medical-Surgical HESI	-.074	0.451
HESI E2	-.539	0.000
Foundations Course Grade	-.328	0.041
Med-Surg Course Grade	-.564	0.001
Critical Care Course Grade	-.491	0.001

The following variables had statistically significant, medium to large effect sizes, each indicating a substantial positive relationship with NCLEX-RN® failure: Delayed Test Time (α=0.386), Male (α=0.882), Black (α=.705),and Off-Track (α=.304). In addition, the following variables were negatively associated with NCLEX-RN® failure: GPA (α=-.481), HESI A2 (α=-.232), Foundations Course Grade (α= -.328), Medical-Surgical Course Grade (α= -.564), and Critical Care Course Grade (α=-.491). All of

these significant variables are included in the logistic regression model. With the correlational analysis, I described the relationship between each independent variable and NCLEX-RN® outcome. Next, the logistic regression analysis determines how these variables predict NCLEX-RN® failure.

Logistic Regression Analysis

The logistic regression analysis provides a better understanding of the relative influence of each variable on the likelihood of NCLEX-RN® failure. Recall that research question 4 asks: *Can a combination of pre-admission, program, and student characteristic factors be used to predict NCLEX-RN® outcome?* The logistic regression results I provide here include an overall evaluation of the model, statistical tests of each predictor, goodness-of-fit statistics, and an assessment of predicted probabilities (Peng et al., 2002).

Formula

Only significant variables were included in the final equation for the logistic regression formula. The final equation is as follows:

$$\text{Logit } Y_{NCLEX\ Failure} = b_0 + b_{GPA} + b_{A2HESI}\, X_{pre-admission} + b_{MSHESI} + b_{MSHESI} + b_{E2HESI} + b_{grade3632} + b_{grade3561} + b_{grade4581}\, X_{program} + b_{offtrack} + b_{male} X_{student} + b_{timetest} X_{other}$$

In this formula, Logit Y represents the log odds of an individual failing NCLEX-RN®, b_0 is the constant, and b_{1-13} represent the separate coefficients as labeled above.

Analysis of Assumptions

For logistic regression, the assumptions include independence of errors, linear relationships between variables, absence of outliers, and multicollinearity (Tabachnick & Fidell, 2013). Each of the assumptions were addressed during analysis. There were no outliers. I addressed multicollinearity by calculating Variance Inflation Factors (VIF)

for each variable prior to the logistic regression analysis. I used a VIF of less than 10 as the cut-off for multicollinearity (Casper & Hair, 2006). There were no variables removed on the basis of multicollinearity.

Measures of Model Fit

Traditional measures of model fit used in linear regression represent the proportion of variance in the dependent variable accounted for by the model (Simonetti, Sarnacchiaro, & González Rodríguez, 2017). Since logistic regression does not have a sum of squares measure, variance cannot be explained using traditional measures (Simonetti et al., 2017). Instead, pseudo-R^2 measures are often used to determine variance as a measure of improvement from a model without independent variables, or the null model (Chao-Ying, Kuk, & Ingersoll, 2002).

The McFadden pseudo-R^2 reflects the ratio of the full-model log-likelihood to the intercept-only log-likelihood subtracted from one (Smith & McKenna, 2013). According to McFadden (1979), a value of 0.2 to 0.4 represents a good fit. In my analysis, the McFadden pseudo-R^2 was 0.230.

The Cox-Snell pseudo-R^2 reflects a ratio of the improvement of the full model over the intercept model (Smith & McKenna, 2013). This number is raised to a power of two divided by the sample size then subtracted from one (Cox & Snell, 1989). The maximum value is less than one. The Cox-Snell pseudo-R^2 value in this logistic regression was 0.153. This is good, considering smaller ratios represent greater improvement from the null model (Smith & McKenna, 2013).

The Nagelkerke pseudo-R^2 measure adjusts Cox-Snell to a maximum possible value of one (Smith & McKenna, 2013). For this analysis, the Nagelkerke pseudo-R^2 value was 0.313. This value reflects a good model fit.

The final pseudo-R^2 measure used is Tjur's D. Tjur's D (2009) represents the difference between the mean predicted probabilities of each dependent variable category. The Tjur's D in this model was .199. In this model, all pseudo-R^2 measures used reflect a good fit, or improvement over the null model, with values between 0.153 and 0.313.

Classification

The overall classification rate of the logistic regression model was 89.54%, 190 of 225 (or 84.4%) failures accurately predicted. The high rate of prediction accuracy is important considering previous attempts to model failure were only able to correctly predict 30-50% of failures (Chen & Bennett, 2016; L. A. Seldomridge & Dibartolo, 2004; D. R. Spurlock & Hunt, 2008; Yeom, 2013). The model results include a 90.83% negative predictive value and 50.72% positive predictive value. The low positive predictive value is not surprising and supports the fundamental purpose of this research: using predictors of success to detect risk for failure yields a low negative predictive value, just as using predictors of failure to detect likelihood of success will yield a low positive predictive value.

Logistic Regression Results

The logistic regression analysis shows the strength and association of each variable in impacting the odds of NCLEX-RN® failure, controlling for all other variables in the model. Table 5 reflects the data from the logistic regression analysis, including the odds ratio, their associated standard errors, and significance measures.

Table 5

Odd Ratios of Independent Variables to NCLEX-RN® Failure

Variable	Odds Ratio	Standard Error	Significance
HESI A2	0.793	0.068	0.007
GPA	0.618	0.221	0.179
Medical-Surgical HESI	0.929	0.091	0.451
Foundations Course Grade	0.720	0.116	0.041
Med-Surg Course Grade	0.569	0.097	0.001
Critical Care Course Grade	0.612	0.094	0.001
HESI E2	0.583	0.061	0.000
Off-track	1.355	0.236	0.081
Male	2.415	0.451	0.000
Black	2.024	0.366	0.000
Delayed Test Time	1.471	0.240	0.018

Of the independent variables included in Table 5, all had a significance of $p<.05$ except Medical-Surgical HESI (p 0.451), GPA (p 0.179), and Off-track (p 0.081). Variables with odds ratio values less than 1 represent a negative relationship with NCLEX-RN® failure while odds ratio values greater than 1.0 reflect a positive or direct relationship with NCLEX-RN® failure. Those variables with negative odds ratios include: HESI A2, Admission GPA, Medical-Surgical HESI, Foundations Course Grade, Med-Surg Course Grade, Critical Care Course Grade, and HESI E2. Variables with a direct relationship to NCLEX-RN® failure include: off-track, male, Black, and delayed test time. In the following section, I discuss significant findings in each category associated with the logistic regression model.

Pre-Program Variables

HESI A2 score was the only pre-program variable that was significant. Controlling for all other variables, the odds of NCLEX-RN® failure for students scoring one standard deviation above the mean A2 HESI score are just 79% of those who scored at the mean. Students with a mean HESI A2 score are 1.26 times as likely to fail NCLEX-RN® than students who scored one standard deviation above the mean. This finding fills a gap in the literature related to HESI A2 scores and NCLEX-RN® outcome. Previous research related to HESI A2 scores is associated with a correlation between HESI A2 scores and first-semester GPA (Hinderer et al., 2014; Underwood et al., 2013). In a study comparing HESI A2 scores with another commonly used admission exam, HESI A2 scores accounted for 15.9% of the variance in program completion (Manieri et al., 2015).

Program Variables

Higher grades in all three courses included in the model were associated with a decrease in the likelihood of NCLEX-RN® failure. This is particularly important for the Fundamentals course (3632), which is the first course in the program. Students with Fundamentals course grades at the mean are 1.39 times as likely to fail NCLEX-RN® than students who score one standard deviation above the mean. Similarly, students with Medical-Surgical course grades at the mean are 1.76 times as likely to fail NCLEX-RN® as those who score one standard deviation above the mean. Given the emphasis on early intervention and previous literature emphasizing the use of HESI E2 as a predictor of licensure outcome, it is important to note the similarities in odds ratios among student performance at the beginning of the program and the end of the program. The odds of NCLEX-RN® failure for students scoring one standard above the

HESI E2 mean are 58% of those scoring at the mean. In other words, students with a mean HESI E2 score are 1.72 times as likely to fail NCLEX-RN® than students who score one standard deviation above the mean. The similarities between odds ratio of 3632 and E2 HESI suggest that early academic performance has approximately the same association as exit exam performance.

Student Characteristics

Findings associated with NCLEX-RN® failure among Black students create a much clearer picture than previous research, which highlighted lower pass rates among programs with a higher proportion of Black students (Sayles et al., 2003). In this study, Black students were 2.02 times more likely to fail NCLEX-RN® than students who were not Black. In addition, male students were 2.4 times more likely to fail their initial licensure attempt than females. This finding supports previous research regarding the disproportionate representation of males among NCLEX-RN® failures (Seago & Spetz, 2005; Taylor et al., 2014).

Other Variables

Students who waited longer than 45 days to take NCLEX-RN® were 1.47 times more likely to fail than those whose initial licensure attempt occurred within 45 days of graduation. While off-track was not significant based on the p value cut-off (*p* .082), these findings warrant further discussion. According to the odds ratio, off-track students were 1.35 times more likely to fail their initial licensure attempt than students who graduated on time, which is not completely unexpected. While many of these students did not graduate on time as a result of a course failure, some took time off from the program despite being in good academic standing. There is no literature associated with NCLEX-RN® failure among students who take longer than expected to complete

nursing programs. The implications of these results are discussed in more detail in Chapter 5.

Theoretical Perspective

Astin's Theory of Involvement serves as a theoretical framework for this research and provides important context for understanding how licensure outcomes reflect program quality. Traditionally, nursing programs have focused on the recruitment of highly qualified applicants rather than developing the talent of students who could be successful if given the chance. Many commonly used application criteria and progression policies are used on the basis of selecting students with a high likelihood of NCLEX-RN® success. However, there is little evidence related to the impact of student characteristics and factors outside of program control on licensure outcomes. Astin (1999) posited that student behaviors serve a mediating role in educational outcomes and programs should focus on talent development rather than more selective admission criteria. These results support the notion that while admission criteria may predict students with a high likelihood for success, they are not necessarily substantive predictors of failure. In this study, student-controlled factors such as delayed persistence to graduation and delays in initial licensure attempt were better predictors of failure than commonly-utilized scoring parameters on exams validated to predict licensure success.

Summary

The purpose of this study is to develop a predictive model for NCLEX-RN® failure. In the resultant model, variables of Black and Male had a positive relationship with NCLEX-RN® failure. The following variables were found to have a negative relationship with NCLEX-RN® failure: HESI A2 (admission), Med-Surg-HESI, HESI E2

(exit), admission GPA, Foundations course grade, Medical-Surgical course grade, and Critical Care course grade. HESI A2, Admission GPA, Medical-Surgical HESI, Foundations Course Grade, Med-Surg Course Grade, Critical Care Course Grade, and HESI E2While there is a dearth of literature on predictors of NCLEX-RN®, this is the first study to develop a predictive model for NCLEX-RN® failure. Most importantly, the variables used to predict NCLEX-RN® success do not accurately predict NCLEX-RN® failure. Given the similar association between NCLEX-RN® outcomes and academic performance in courses early in the program and at the end of the program, early intervention is possible. In Chapter 5, I discuss these findings in more detail, review implications for nursing program administrators, and conclude with recommendations for future research.

Chapter 5: Discussion

I begin this chapter with an overview of the research study and findings. I then discuss implications for research, policy, and practice. I conclude the chapter with a review of opportunities for future research and how this study contributes to the body of evidence associated with NCLEX-RN outcomes.

Summary

First-time NCLEX-RN® pass rates are the primary indicator of nursing program quality across the nation. The national first-time pass rate is around 90% with accreditation and funding risks for programs falling below 85%. Current literature addresses predictors of NCLEX-RN® success. Approximately 65% of nursing programs have progression policies based on exit exam scores, preventing at-risk students from taking the NCLEX-RN® exam (Harding, 2010; Hinderer, DiBartolo, & Walsh, 2014; National League for Nursing Board of Governors, 2012). Admission and progression decisions based on predictors of success are problematic because they are often founded on the assumption that students who are not highly likely to pass NCLEX-RN® are at imminent risk for failure. Nurse educators must have a clear picture of both NCLEX-RN® success and failure. Studying NCLEX-RN® failure is difficult due to small samples of NCLEX-RN® failures in nursing programs and frequent NCLEX-RN® exam changes. For this study, I used existing student data to evaluate NCLEX outcomes of 2,214 graduates whose initial NCLEX attempt occurred between May 2013 and July 2017. The sample included 1,977 graduates who passed NCLEX on their initial attempts and 237 graduates who failed NCLEX on their initial attempt. I used the following research questions to guide this study:

1. What pre-admission factors are associated with NCLEX-RN® outcome?

2. What program factors are associated with NCLEX-RN® outcome?

3. What student characteristics are associated with NCLEX-RN® outcome?

4. Can a combination of pre-admission, program, and student characteristic factors be used to predict NCLEX-RN® outcome?

Limitations

The major limitation of this research study is that it occurs in a single setting. While this provides assurance that students are subjected to the same curriculum, it limits the generalizability of results to other nursing programs. However, high enrollments aided in establishing the largest sample of NCLEX-RN® studied to date. This research sample only includes students who graduated, which is not a complete picture of at-risk nursing students. There were approximately 180 students between 2013 and 2017 who did not progress to graduation which warrants further study related to non-persistence among nursing students. This study provides insight into specific pre-program and program measures of academic performance as well as student characteristics associated with NCLEX-RN® failure. There is much more of the story to be told in order to make positive strides in workforce readiness while also maintaining the quality of nursing education.

Findings

Through correlational analysis, I found the following variables to be positively correlated with NCLEX-RN® failure: Delayed Test Time, Male, Black, and Off-Track. In addition, the following variables were negatively associated with NCLEX-RN® failure: GPA, HESI A2, Foundations course grade, Medical-Surgical course grade, and Critical Care course grade. In the logistic regression model, variables with negative odds ratios

include: HESI A2, Admission GPA, Medical-Surgical HESI, Foundations Course Grade, Med-Surg Course Grade, Critical Care Course Grade, and HESI E2. Variables with a direct relationship to NCLEX-RN® failure include: off-track, male, Black, and delayed test time. The logistic regression model correctly predicted 89.54% of NCLEX-RN® failure, which is significantly higher than previous attempts at modeling failure. Previous attempts to model failure correctly yielded much lower predictive accuracy. Chen and Bennett (2016) used a decision tree analysis using 33 failures with a 46% failure classification accuracy. Seldomridge and Dibartolo (2004) correctly classified 25% of the 36 NCLEX-RN® failures used in their study.

Pre-Admission Considerations

GPA and standardized nursing admission exams such as HESI A2 are the most common criteria used in admissions decisions. Both have been previously correlated with program completion and NCLEX-RN® success, but no research to date has illustrated an empirical link between these measures and NCLEX-RN® failure. In my logistic regression model, only HESI A2 admission exam scores were significant in predicting NCLEX-RN® failure. Students with a mean HESI A2 admission exam score are 1.26 times more likely to fail NCLEX-RN® than students who scored one standard deviation above the mean. This finding provides some context for score ranges but does little to guide the development of minimum cut scores for admission criteria. Nurse educators must continue to refine admission criteria to provide more holistic measures of student preparation for nursing and ensure students who can be successful are given the opportunity.

Program Considerations

Higher scores on the following program variables were associated with lower probability of NCLEX-RN® failure: Medical-Surgical HESI, Foundations Course Grade, Med-Surg Course Grade, Critical Care Course Grade, and HESI E2 exit exam scores. One of the most important findings in this research is the similarity in predictive power among early program variables and late program variables. Specifically, students with Foundations course grades at the mean are 1.39 times more likely to fail NCLEX-RN® than students who score one standard deviation above the mean. In comparison, students with a mean HESI E2 exit exam score are 1.72 times as likely to fail NCLEX-RN® than students who score one standard deviation above the mean.

Student Characteristics Considerations

Higher education administrators must engage in critical self-examination of their admission practices and institutional climate to foster student success and improve persistence. Conversation about at-risk student groups should remain focused on how learning environments can better support the needs of diverse learners rather than how admission criteria can aid in the selection of better students. In this study, two student characteristics were positively associated with NCLEX-RN® failure: Black and Male. These findings highlight the need to enact robust student support programs specifically designed to meet the needs to diverse student populations.

In this study, Black students were 2.02 times more likely to fail NCLEX-RN® than students who were not Black. Previous research highlighted lower pass rates among nursing programs with a higher proportion of Black students (Sayles et al., 2003). However, only knowing Black students are at increased risk is counter-productive to narrowing the opportunity gap and feeds the deficit narrative that has

plagued the equity debate in higher education. Nationwide increases in Black student enrollment has not resulted in a subsequent increase in completion rates (Nichols & Evans-Bell, 2017). Rather than continue to focus only on the educational preparation or academic qualifications of Black students, colleges should change the narrative to reflect how learning environments can be adapted to foster success and facilitate student engagement. Astin's Theory of Engagement informs this student success paradigm shift by addressing the issue of racial equity through strategies to improve learning environments rather than adopting more restrictive admission policies. Embracing high-impact strategies to promote student engagement and a critical examination of the learning environment will narrow the persistence gap among Black students.

There is a dearth of literature associated with equity in higher education access and educational attainment among Black students. One strategy to address equity in representation among Black college students is ensuring adequate representation of Black faculty and key campus leaders (Harper & Simmons, 2019). Mentoring programs can connect Black students to other Black students as well as Black faculty and advisors. Appraisal of learning environment inclusivity includes examining the cultural relevance of what is taught as well as addressing faculty mindsets often resulting in micro-aggressions that only serve to perpetuate inequity (Harper & Simmons, 2019; Nichols & Evans-Bell, 2017). Strategies specific to promoting the success of Black nursing students include pre-entry immersion programs and early participation in health-related events designed to expose students to the rigor of nursing school and the role of nurses in society (Williams, Bourgault, Valenti, Howie, & Mathur, 2018). In addition to early immersion and exposure, additional strategies to promote success

among Black nursing students include skills development and fostering social connectedness. Strategies to support Black students include study skills development, faculty mentoring through student organizations and academic advising, and reducing financial barriers (Williams et al., 2018).

Pervasive inequities in postsecondary access and completion among Black students are well-research. However, less is known about gender inequities in nursing education programs. I found that male students were 2.4 times more likely to fail their initial licensure attempt than females. Males in nursing and other female-dominated professions such as teaching face stereotype threats that can only be addressed through increased awareness and formal risk assessments (Jupp & Slattery, 2012; Powers, Herron, Sheeler, & Sain, 2018; L. A. Scott & Alexander, 2018; S. V. Scott & Rodriguez, 2015). The clinical experience of male students varies greatly from their female counterparts, especially in areas such as pediatrics and obstetrics (DeVito, 2016; Powers et al., 2018; L. A. Scott & Alexander, 2018). Strategies to promote success among male nursing students include fostering social connectedness through student organizations and ensuring adequate representation of male faculty (DeVito, 2016; Powers et al., 2018). Nursing faculty wishing to better meet the needs of male students must support and partner with male nursing student associations to promote success.

Other Considerations

Students who wait longer than 45 days after graduation to take NCLEX-RN® were 1.47 times more likely to fail than those whose initial licensure attempt occurred within 45 days of graduation. Previous research associated with NCLEX-RN® testing lag time found an inverse relationship between pass rate and lag time (Woo et al.,

2009). Much of the education literature related to exam performance factors highlights student-controlled factors such as state and trait anxiety, quality and amount of preparation, and recall memory (Burnham & Makienko, 2018; Leahy & Sweller, 2019). Students who delay testing are at increased risk of knowledge depletion, state anxiety, and increased cognitive load, all of which could impact their performance on exam day (Burnham & Makienko, 2018; Leahy & Sweller, 2019; Pietro, 2013)While nurse educators may have minimal control over how or if students continue to study after they graduate, this finding highlights an opportunity to mitigate program-controlled barriers to testing. This includes delaying graduation on the basis of exit exam cut scores and ensuring there are no delays in providing candidate information for testing eligibility to state boards of nursing. Schools can also adopt faculty coaching models to ensure at-risk students have continued support through focused retrieval practice access to NCLEX-RN® preparation resources. Students should be encouraged to participate in formal NCLEX-RN® prep courses although these resources are cost-prohibitive to many students facing loan repayment and entry into the workforce.

Research Implications

Studies related to NCLEX-RN® outcomes have focused on predictors of success. This is the first research study to model NCLEX-RN® failure. The variables chosen for this study were largely based on known predictors of success. However, these findings pave the way for additional research related to why students fail NCLEX-RN® and what programs can do to mitigate risk through early intervention and student support programs.

Student Factors

The use of predictive analytics in higher education focused solely on the institution and not the student is a short-sighted approach to student success and may actually be counter-productive (Gagliardi, Parnell, Carpenter-Hubin, & Swing, 2018). As noted in Astin's student engagement theory, labeling students as at-risk using their academic metrics as inputs and attainment as output only serves to perpetuate the over-reliance on ranking and sorting (Astin, 1999a). Instead, learning analytics should focus on what students know and how educators can enhance the learning environment. The greatest opportunity for future research is a more robust understanding of how student behaviors and intrinsic factors relate to licensure failure. The variables used in this study are primarily academic metrics and student demographics. In order to move beyond the overly simplistic focus on only admitting students with the highest likelihood of success, nursing education programs must continue the pursuit of discovering which students could be successful if given the opportunity. Studying student factors such as motivation, critical thinking, emotional intelligence, and self-regulation will provide a more holistic understanding of student success and may better suit the needs of the profession (Codier & Odell, 2014; Glazer et al., 2016; Hackney, 2017; Jones-Schenk & Harper, 2014). Research including measures of student motivation in future research will provide insight into how both students and faculty can capitalize on intrinsic student strengths to foster licensure success and workforce readiness.

Replication

Another opportunity for future research related to NCLEX-RN® failure lies in replicating this study at different sites across the country with varying pass rates and

demographic diversity. Although most schools include a course similar to Foundations early in the program, course grades have limited value in generalizing the findings of this research to other settings. In this regard, using a standardized measure other than course grade would broaden our understanding of early indicators of academic risk. Scores on third party standardized course content exams such as ATI and HESI would be useful in comparing outcomes across sites.

Admission Criteria

Overall, there are still more questions than answers in regards to admission criteria. As long as nursing programs are turning away highly-qualified applicants, admission criteria will likely continue to favor students with only the highest academic qualifications using measures such as GPA and standardized exams known to be a better reflection of socioeconomic status than academic strength and readiness (Brunn-Bevel & Byrd, 2015; Chalhoub-Deville, 2016). However, programs must continue to seek a clearer understanding of which students can be successful if given the chance. In this study, I included variables associated with groups of students who receive admission considerations such a second- degree students, students employed by a partner healthcare facility, and Veterans. These students are often admitted with lower admission scores on academic metrics but did not have an increased risk of NCLEX-RN® failure in this study. Nurse educators involved in admission decisions should feel comfortable “taking a risk” on admitting these students. Future research should be focused on how new and different admission criteria can be used to predict NCLEX-RN® failure and additional student populations who could be successful if given the opportunity.

Practice Implications

The findings of this study underscore major changes to the practice of nursing education. Nurse educators and program administrators can use the results of this research study to inform curricular and program re-design, student interventions, and the development of support programs for specific student populations. With advancements in technology and analytics, educators must ensure predictive data is also prescriptive. Just knowing a student is at-risk does little to get them the help they need and mitigate knowledge deficits.

Early Intervention

Previous research associated with NCLEX-RN® outcomes is primarily focused on using end-of-program predictor exam scores to target at-risk students and delay graduation to re-test until benchmark scores are met. Requiring students to meet benchmark scores, especially when the scores do not accurately classify risk of NCLEX failure, is unethical and ineffective. In this study, students need support and intervention could be identified after the first semester based on low grades in the Foundations course. Based on the foundational learning that occurs in this course and is often scaffolded throughout the curriculum, educators should implement strategies for individualized remediation and support when students demonstrate early knowledge deficits. This is also an important time to work with students on developing good study habits, especially those that have relied on rote memorization in early prerequisite courses such as anatomy and physiology.

Targeted Remediation

Recent advances in technology have made targeted remediation more efficient and effective. While most learning management systems lack the functionality to track student performance longitudinally, both HESI and ATI use formative assessment data

to develop individualized learning plans for students. Student engagement and resource usage indicators can differentiate students who may be experiencing challenges balancing school with other commitments from those who may have high engagement with low comprehension. Program administrators must consider curricular and formal faculty support processes designed to facilitate early student remediation in key content areas. Astin (1985) informs this approach and fundamental purpose of my research with an increased emphasis on designing more effective learning environments over choosing students most likely to succeed. Faculty should embrace learning analytics to streamline personalized interventions for at-risk students and develop comprehensive tracking systems as well as automated nudges for student engagement (Anema & McCoy, 2010; Gagliardi et al., 2018; Kei Daniel & Butson, 2016). There is great promise in leveraging new educational technology such as adaptive quizzing, longitudinal competency and concept performance tracking systems, and embedded personalized remediation based on students' individual formative assessment results.

Clinical Experiences

In addition to targeted remediation, nurse educators can better harness the clinical experience to support student learning. Many students entering nursing school are not prepared to spend one or more full days a week in the clinical setting in addition to a full-time course load. Currently, student learning outcomes in the clinical setting vary greatly depending on setting and clinical instructor familiarity with didactic content. Since clinical experiences are state-mandated at a 1:10 faculty to student ratio, educators can also explore innovative ways to better align the classroom and clinical experiences to ensure struggling students have the opportunity to apply what

they are learning. Nurse educators should foster interprofessional partnerships with colleagues in education to ensure pedagogical effectiveness as adopt best practices in educational psychology. Findings from this research support the need to clearly define learner outcomes and minimize content overload so as not to miss foundational learning opportunities. The similarities between odds ratio of Foundations course grade, Medical-Surgical course grade, and HESI E2 exit exam suggest that early academic performance has approximately the same association with NCLEX-RN® failure as exit exam performance. Early program intervention to address knowledge deficits and ineffective study skills can mitigate risk associated with continued academic struggles.

Student Support Faculty

Given the relatively small numbers of at-risk students and the high stakes of licensure success, nursing program administrators should consider innovative faculty coaching and advisor roles. Many programs, including this research setting, use dedicated student success faculty in a coaching model to support the needs of struggling students. Predictive modeling can be used to target specific exams or assignments closely associated with course grade. Programs using HESI or ATI have access to robust learner data to identify and intervene when a student is struggling. Faculty can use assessment feedback from course and content specific third-party standardized exams, including national and program percentile rankings and individual longitudinal performance in specific NCLEX-RN® content areas. Dedicated faculty working with struggling students outside of individual courses can drill down and provided personalized remediation and retrieval practice. This can and should be done collaboratively with student affairs personnel to ensure student success goes beyond

content-based remedial learning. Developing the role of dedicated student success faculty presents a unique interdisciplinary research partnership opportunity between student and academic affairs to ensure the intrinsic and extrinsic needs of nursing students are met. Further, nursing programs should empirically validate the outcomes effect and cost-benefit of dedicated student success faculty to counter enrollment-based workload and funding model pressures. As nursing programs look at ways to increase enrollments, dedicated student success faculty can serve an important role in ensuring students are fully supported in their learning.

Student Support

In this research, two groups of students are identified who could potentially benefit from additional academic and social support: male students and Black students. Most importantly, nursing programs should not institute more restrictive admission policies since students of color and males are underrepresented in the profession. Males represent 52.8% of the total US workforce, but only 9.2% of registered nurses. More research is needed to better understand specific support strategies for Black students and male students. One of the most commonly researched support systems is student associations with faculty mentors (Alameida et al., 2011; Hackney, 2017; Nichols & Evans-Bell, 2017; Powers et al., 2018; Williams et al., 2018). Interestingly, the site of this research study has both a male nursing student association and a Black nursing student association. In addition, faculty mentors of the same gender and race serve as positive role models for students in formal support programs. Across the state of Texas, the percentage of Black nursing faculty is slightly greater than the general population (Texas Department of State Health Services, 2017). Little is known about

the rates of male faculty. Further research is needed to guide support programs for Black and male students.

The findings associated with embodied student characteristics such as race and gender shed light on a dire need for educators to face pervasive inequities in education. Nurse educators must remain diligent in their pursuit of creative strategies to ensure these students can be successful. To adequately address these inequities in educational attainment, nurse educators must be willing to apply educational research outside of nursing and commit to future qualitative and quantitative research to better understand the experiences of male and Black nursing students. Nurse educators should engage in continued dialogue to foster critical thinking about how to limit the risk of failure related to embodied student characteristics.

Diversity

The use of admission and progression criteria focused solely on measures of academic achievement may screen out individuals who possess the social attributes required for successful nursing practice and contribute to a more diverse workforce (Kavanagh & Szweda, 2017; Noone, 2017; Taylor et al., 2014). Decades of educational research highlights the ways in which standardized exams used as measures of academic achievement disadvantage students of color and students from low socioeconomic status families (Amankwaa et al., 2015; Brunn-Bevel & Byrd, 2015; Green & Griffore, 1980; Mendoza-Denton, 2014; National Center for Education Statistics, 2012; Sackett et al., 2008).Nursing programs are challenged to increase overall admissions and produce a more ethnically diverse workforce to meet the demands of a changing healthcare delivery system and a diverse population. In recent years, programs have struggled to rise to the call to increase the number of graduates

from under-represented groups such as students of color, students with a previous degree, and students from low socioeconomic status and first-generation college families (Carrick, 2011; Colville et al., 2015; Giddens, 2009; Harris et al., 2014; Murray et al., 2016; Taylor et al., 2014).

Nurses from underrepresented and disadvantaged backgrounds improve the quality of healthcare through enhanced cultural competence and improved access to care for patients of the same ethnicity and background (Murray et al., 2016). While children of color represent more than half of the K-12 student population in many states, only 29% of students enrolled in baccalaureate nursing programs represent a racial or ethnic group other than Caucasian (American Association of Colleges of Nursing, 2016). Many universities consider race as part of a broad, holistic review process to ensure students and faculty are adequately represented and institutional barriers to persistence are mitigated (Ackerman-Barger & Hummel, 2015; Harper & Simmons, 2019; Nichols & Evans-Bell, 2017; Seago & Spetz, 2005). Nursing programs should also pursue intentional holistic reviews to address barriers to equity. The hyper-focus on NCLEX-RN® success in nursing programs does little to create a more diverse workforce and deters programs from admitting students from underrepresented racial and ethnic groups.

Policy Implications

The results of this study elucidate the long-standing debate over the use of cut scores on exit exams to determine students who are at risk of failure. In addition to the assurance of fairness in high-stakes testing, educators must also consider the broader implications in the use of learning analytics to automate student support interventions.

Nursing program administrators must also continue to advocate for more diverse measures of program quality since student-controlled factors are stronger predictors of failure than academic measures of achievement. This research guides policy development related to program progression policies, the use of learning analytics and risk modeling to determine academic risk, and the use of program quality indicators other than NCLEX-RN® pass rates.

Progression Policies

One of the most important policy implications of this research is the need to re-think restrictive program progression policies based on predictor exam scores. The findings of this study support the notion that setting exit exam benchmark scores unfairly and inaccurately label students as at-risk. Programs using cut scores on these exams for progression policies have a legal and ethical responsibility to accurately interpret scores. While these predictor exams serve a purpose in identifying students with a high likelihood of NCLEX-RN® success and targeted individual learning needs, they give little indication of a student's actual risk for failure. Educators in support of policies requiring students to achieve a cut score on an end-of-program predictor exams should consider the negative impact of delayed testing on NCLEX-RN® outcomes. Given the unethical nature of using high-stakes exams without assurance of validity and the counter-productive result of delayed testing, the use of end-of-program predictor exams for progression decisions should be eradicated.

The Ethics of Learning Analytics

With the birth of big data and machine learning, nursing program administrators are in continuous pursuit of risk modeling systems to guide intervention. While a data-driven approach to education has unquestionable value, it is also important to

recognize the potential negative consequences of labeling students as “at-risk”. Framed in Foucouldian analysis is the notion of a greater societal impact of educational power sources such as classification and normalization that may produce the “ideal schooled subject” but do little to produce lifelong learners who engage in critical discourse at the bedside (Springer & Clinton, 2015). It is possible that an overemphasis on labeling students as at-risk becomes a self-fulfilling prophecy that does little to foster educational attainment and eliminate barriers in opportunity that negatively affect educational equality (Murray et al., 2016). Nurse educators must continue to balance rigorous academic measures associated with employability with the fostering intrinsic values associated with work in a caring profession.

NCLEX-RN® Cultural Bias

There is a long-standing debate among nurse educators about cultural bias of the NCLEX-RN® exam as a potential cause for variations in outcome. The National Council of State Boards of Nursing (2017) maintains the potential for cultural bias is mitigated through the use of a review panel and differential item functioning. However, there is indisputable evidence of variations in performance among international testers as well as findings from this research associated with race and gender as predictors of failure. Nurse researchers must continue to investigate factors associated with variations in NCLEX-RN® performance related to race, ethnicity, and gender.

Data Sources

In order to move forward with findings from this study associated with factors placing students at risk of NCLEX-RN® failure, educators must continue to dig deeper into the empirical analysis of licensure outcomes and program delivery. This includes an evaluation of specific program factors such as course grades shown to predict

NCLEX-RN® failure. Educators should seek a deeper understanding of additional predictors such as assessments and performance measures to guide work associated with instructional design and assessment validity. Program administrators can purchase Mountain Measurement reports associated with program-level knowledge deficiencies identified from NCLEX-RN® performance among graduates. Information associated with content area deficiencies from actual NCLEX-RN® performance can be used in combination with third-party predictors exam results to identify course-specific opportunities for instructional improvement. However, in order to use this data to affect change educators must advocate for more thorough NCLEX-RN® performance reporting beyond pass/fail status of graduates.

Measures of Program Quality

Nursing education is at a crossroads in establishing our place in the academy. We have worked hard to ensure the work of our profession is not reduced to vocational skills checklists and simplistic knowledge measured with a multiple-choice exam. In the landmark Carnegie study *Educating Nurses: A Call for Radical Transformation*, Benners (2009) posited that nurses should be educated as knowledge brokers who can function safely in an increasingly complex healthcare environment. It is time for nursing program administrators to question the use of NCLEX-RN® success as the core measure of program quality. The findings in this research supports recent calls from leaders in nursing education to find program quality measures other than first time pass rates. Nurse educators must question the use of NCLEX-RN® success as the primary measure of program quality given the undisputable influence of non-cognitive and non-program factors on exam performance (Carrick, 2011; Giddens, 2009; Taylor, Loftin, & Reyes, 2014). Findings from this research support the notion that student-

controlled factors greatly impact licensure outcomes. To ensure educational attainment can continue to positively impact society, higher education administrators must ensure educational programming meets the needs of employers while also fostering civic engagement and critical discourse to produce better thinkers who are well-positioned to innovate and transform healthcare.

Researcher Standpoint

Over the years, I have witnessed nursing education closing the door of opportunity on students who are desperately needed in our profession. Having served as a clinical educator hiring and training newly graduated nurses, I believe the best nursing students do not always make the best nurses. Until nursing education is willing to abandon our over-reliance on academic measures, we will continue to produce a workforce that is ill-prepared for the profession.

Conclusion

Basing admission and progression decisions on the highest likelihood for success instead of truly understanding risk for failure leads to an inaccurate picture of the program's contribution to student achievement and creates an incomplete and unfair picture of students at risk for NCLEX-RN® failure. The effectiveness of any academic program should be based in sound empirical evidence and measurable gains in educational attainment. Without a clear understanding of students who can be successful with intervention, program evaluation and policy will continue to fall short in accurately identifying program attributes that lead to licensure failure. This research is an essential first step in the development of more holistic evaluation criteria to measure program and

learner success. Examining admission criteria in the context of NCLEX-RN® failure rather than NCLEX-RN® success sets the stage for conversations about how gate-keeping measures may hinder program efforts to create a more diverse workforce. A broader view of NCLEX-RN® failure is necessary to fully understand nursing education's role in student achievement and the adoption of innovative pedagogies that support deeper learning and the formation of a diverse and competent workforce.

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Biographical Information

Meagan Rogers is a Clinical Assistant Professor in the College of Nursing and Health Innovation at the University of Texas at Arlington. She received her Bachelors of Science in Nursing from Texas Christian University in 2005 before working as a pediatric emergency department nurse at a large urban pediatric hospital in Dallas. Her passion for education led her to a role in clinical education and staff development, where she worked collaboratively with instructional design and human resource professionals to develop performance analysis metrics for clinical competency and quality initiatives. She completed her Masters in Nursing Education from Walden University in 2011 and began working as an adjunct pediatric clinical instructor before transitioning full time to academia in 2013. Her research interests include simulation and innovative pedagogy to support clinical learning as well as an outcomes approach to nursing education. She earned a PhD in Educational Leadership and Policy Studies in 2019 from the University of Texas at Arlington. Her future plans include conducting additional nursing education research to support educational attainment among under-represented student populations and guide program policy. She plans to remain actively engaged in state and national initiatives aimed at improving the quality and efficacy of nursing education.