2008

Pre- and post-admission criteria as predictors of academic success in an associate degree nursing program

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Pre- and post-admission criteria as predictors of academic success in an associate degree nursing program

by

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A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Education (Education Leadership)

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2008

UMI Number: 3307369

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DEDICATION

This dissertation is dedicated to my father, the late Dale C. Conzett. Although he did not physically walk this graduate degree path with me, nevertheless, he was with me. Although my dad's formal educational path was briefer than it should have been, he was a role-model for life-long learning—very well-informed, always thinking about something, contemplating a better way to do something else, or playing the devil's advocate to get his children and his contemporaries to think. My father and paternal grandfather instilled in me at a very early age the value of a good education and the importance of working hard to get everything out of every educational experience.

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ABSTRACT

Early identification of predictors of academic success or challenges assists faculty and staff in providing effective support to those who may need it. This study examined the relationship between selected pre- and post-admission criteria and two measures of academic success: successful completion of an associate degree registered nursing program (ADN), and first-attempt success on the National Council Licensing Examination for Registered Nurses (NCLEX-RN). The subjects were 404 students enrolled in the nursing program between 1998 and 2005. The nursing program was located at a small, private, health-system based institution in the Midwest.

There were six pre-admission independent variables and five post-admission independent variables used in the study. The two dependent variables were successful completion of the associate degree nursing program as measured by final grade point average and first-attempt success on the NCLEX-RN.

Two stepwise backward multiple linear regressions were estimated in which each of the six preadmission variables was used to predict final grade point average and each of the five progression variables was used to predict final grade point average. Two multiple logistic regressions were conducted examining the same pre- and post-admission variables on first-attempt NCLEX-RN passage. A one-way analysis of variance (ANOVA) was estimated using the pre- and post-admission variables in addition to a demographic variable of age at first semester, and a previous dependent variable of final grade point average on three groups: (1) students who completed the ADN program and passed the NCLEX-RN on first attempt; (2) students who completed the ADN program but did not pass the NCLEX-RN on

first attempt; and (3) students who did not complete the ADN program and therefore were not eligible to sit for the national certification examination. Subsequent post-hoc procedures were used to determine significant differences between the three groups of students.

Linear regression results revealed several pre- and post-admission predictors of final grade point average. Logistic regression results revealed that previous college grade point average and grade in the second semester nursing theory course along with graduating class and new ACT composite were statistically significant predictors of first-attempt NCLEX-RN success. ANOVA results, Bonferroni and Tamhane post-hoc results indicated several significant differences among the three groups of students.

CHAPTER 1. INTRODUCTION

Background of the Study

In a recent (July 2002) Health Resources and Services Administration report, 30 states reported shortages of registered nurses (RNs) in the year 2000, but 44 states and the District of Columbia are projected to have RN staffing shortages by the year 2020 (http://www.aacn.nche.edu/Media/shortageresource.htm#about). In the January/February issue of *Health Affairs*, Auerbach, Buerhaus, and Staiger (2007) projected an increase in the shortage of RNs in the U.S. to 340,000 by 2020. Although this is significantly fewer than earlier projections by the U.S. Bureau of Labor Statistics, which estimated that more than one million new and replacement nurses would be needed by the year 2012 (http://www.healthaffairs.org/press/ novdec0402.htm), the nursing shortage is still on track to increase by three times the current rate by 2020 (Auerbach et al., 2007).

Enrollment in the nation's college and university nursing programs is not growing fast enough to meet this projected demand. According to the National Council of State Boards of Nursing (NCSBN), the number of first-time, U.S.-educated nursing program graduates (diploma, associate, and bachelor's programs) sitting for the national nursing licensure examination decreased by 10% from 1995 to 2004 (www.ncsbn.org). Although the American Association of Community Colleges reported an increase of 7% in graduations from associate degree RN programs between 2001 and 2002 (http://www.aacc.nche.edu/ Content/NavigationMenu/HotIssues/Nursing), and the American Association of Colleges of Nursing (AACN) reported a 5% enrollment increase in entry-level baccalaureate programs in nursing from 2005 to 2006, following an average of 8.68% increase per year from 2001 to

2005 http://www.aacn.nche.edu/Media/NewsReleases/06Survey.htm), it has been determined that these increases will not be adequate to meet the projected demand for nurses.

The current and projected nursing shortage has placed unprecedented pressure on nursing programs to increase the number of qualified graduates. It is imperative that accredited nursing programs graduate as many well-educated and skilled nurses as possible, prepared to pass the national certification exam. Since this nation's associate degree programs continue to train the majority of registered nurses in the U.S. (http://www.ncsbn.org), private associate degree programs at schools such as St. Luke's College in Sioux City, IA (the location for this study), as well as community college ADN programs, would be best served with accurate data about their own students' academic and certification success.

Entry of competent nurses into the workforce is facilitated by first-time success on the National Council Licensure Examination for Registered Nurses (NCLEX-RN), the "gold standard" used in program and accreditation evaluations and by nursing school applicants to evaluate and compare programs. The most recent statistics from NCLEX-RN revealed a modest recovery in successful pass rates (from a low in 2000) for first-time, U.S.-educated candidates (NCSBN, 1995-2006). In 1995, 90.4% of all graduate nurse candidates for licensure from diploma, associate and baccalaureate programs successfully completed the NCLEX-RN. Licensure passage rates for subsequent groups of graduates continued to decrease until it appears to have bottomed out at 83.8% in the year 2000. In 2001 the trend reversed with an 85.5% passage rate. Rates have continued a mostly upward trend, and an 88.1% passage rate was recorded in 2006, which was close to the 90.4% high reported in 1995. Licensure pass rates in Iowa during the same time period for diploma, associate's

degree, and bachelor's degree first-time test-takers were 86.27 % in 1995, bottoming out at 80.45% in 2004, and recovering to 85.03% in 2006.

First-time pass rates for St. Luke's College ranged from 83% to 94% between 1995 and 1997, the last three years the college graduated students from a diploma program. The first three years of the associate degree level program (1998 to 2000) revealed first-time pass rates of 70%, 73%, and 73%. Those rates were reported as 93% in 2001 and 2005, more than 97% in 2002, 2003, and 2006, with an exception of 76% in 2004.

Examining the academic profiles of St. Luke's students could lead to the establishment of reliable predictors of academic success and corrective academic intervention(s) at the earliest possible point in the nursing student's individual curriculum. This could also potentially improve the almost 33% loss of students from the first semester of the ADN program to the second. Thus, enhancing the probability of all admitted nursing students realizing academic success and entry-level professional status is a worthy and necessary goal given our national RN shortage.

Statement of the Problem

Despite the national media's attention given to the on-going nursing shortage in the United States (U.S.) and high level initiatives to address this deficiency, the dearth of nurses is expected to intensify as the baby boomer cohort (those born between 1946 and 1964) ages and their need for health care services increases. In addition to the mounting health care needs of increasing numbers of elderly, the demand for registered nurses (RNs) is spurred by "…a growing population of hospitalized patients who are older, more acutely ill and in need of more skilled RNs per patient; the rapid expansion of front-line primary care to many sites

throughout the community; technological advances requiring more highly skilled nursing care; and an aging RN workforce" (http://www.aacn.nche.edu/ Education/career.htm). Nurse educators in the U.S. must increase the number of qualified nurse candidates by maximizing graduation rates and licensure examination pass rates to alleviate this crisis. To help address the shortage, St. Luke's College, a small, private, health-system based institution in the Midwest is growing their Associate degree nursing program and is changing their nursing curriculum—both of which are slated to commence Fall 2007. Unfortunately, the college has lacked the institutional data analysis regarding its current and former students to inform and guide the change process.

Purpose of the Study

The primary purpose of this study was to analyze preadmission criteria such as high school grade point average (HSGPA) and high school rank (HSR), ACT Composite score (ACTC), ACT Reading subject score (ACTR), number of college credits transferred that would directly apply to the student's program of study (PCCR), and grade point average on those credits (PCGPA), to predict final program grade point average (FGPA) and first-time passage on the NCLEX-RN (CERT). The study also examined post-admission criteria such as first-term grade point average on the required nursing course (N1), second term grade point average on the required nursing course (N2), and college grade point average on anatomy, physiology, and microbiology courses - three required college level co-curricular science courses. All these pre- and post-admission criteria were used to predict final program grade point average (FGPA) and first time passage on the national nursing certification exam (CERT). In addition, three distinct groups of students: those students who finished the ADN

program and passed the NCLEX-RN exam on first attempt, those who completed the ADN program but did not pass the NCLEX-RN on first attempt, and those who never finished the nursing program, and were therefore never eligible to take the NCLEX-RN, were analyzed to determine if there were significant differences on the independent variables listed above.

A secondary purpose was to provide an initial benchmark and research methodology for additional institutional research at St. Luke's College. The institutional research by this organization is scarce. Recently, a number of decisions, including curriculum decisions, have been based on survey information, best-practice information from other institutions, recommendations from accreditation organizations such as the Iowa Board of Nursing and the National League of Nursing, anecdotal information, and personal opinion. This study will provide base-line data on the college's largest associate degree program that is slated to grow with the increase from one to two entry and exit points per academic year beginning the fall of 2007. In addition, this study could be replicated with the other two associate degree programs degree programs at St. Luke's (radiology and respiratory care), providing a foundation and framework for institutional research that will better serve both the College and the students.

Research Questions

Three research questions guided the investigation:

1. Which pre- and post-admission variables are the best predictors of academic success as measured by final grade point average?
2. Which pre- and post-admission variables are the best predictors of academic success as measured by first-attempt passage on the NCLEX-RN?

3. Are there significant differences in the groups of students who finish the ADN program and pass NCLEX-RN on the first attempt, those who finish the program but don't pass the NCLEX-RN on first attempt, and those who never finish the program and therefore are never eligible to take the licensure exam?

Null Hypotheses

Three null hypotheses were formulated for the study:

1. There is no significant relationship between preadmission variables of high school grade point average, high school rank, ACT composite score, ACT reading score, pre-college credits, pre-college grade point average, as well as post-admission variables of 1st term nursing theory grade, 2nd term nursing theory grade, anatomy course grade, physiology course grade, microbiology course grade, and final grade point average for St. Luke's ADN students graduating between 1998 and 2005.
2. There is no significant relationship between the same pre- and post-admission variables and 1st attempt success on the NCLEX-RN for the same graduates.
3. There are no significant differences in mean values of the independent variables between students who finish the ADN program and pass the NCLEX-RN on the first attempt, those who finish the ADN program but do not pass the NCLEX on the first attempt, and those who do not finish the ADN program and therefore are not eligible to sit for the NCLEX-RN licensure examination.

Rationale for the Study

There is a current nursing shortage that is projected to continue into the future. Thus, there were several compelling reasons to undertake this study. While associate degree

nursing programs still train the majority of registered nurses in this country (www.aacc.nche.edu/Content/NavigationMenu/HotIssues/Nursing/Nursing.htm), the research specifically investigating associate degree nursing students is sorely lacking, and this study will help fill a gap in the literature. More specifically, this study will benefit future students at St. Luke's by providing an understanding of the preadmission predictors of academic success. It will also help the admissions decision makers at the College select students with the greatest likelihood of success. Understanding post-admission variables pertinent to their students will enable faculty and staff to determine the earliest possible point in a student's nursing program when the student might benefit from an intervention designed to remedy a deficiency. Finally, this study will establish an initial benchmark and research methodology for institutional research at an institution that is poised to grow to help meet the current and future nationwide demand for competent nurses.

Significance of the Study

This study helps fill a gap in the literature as most previous research has focused on baccalaureate degree nursing graduates. Associate degree nursing programs still train the majority of the registered nurses in the United States and will continue to train the greater portion of all registered nurses for the foreseeable future (NCSBN annual statistics). Therefore, admissions staff and faculty must have reliable predictors of the academic success of associate degree nursing students so these students can avail themselves of effective progression strategies that enable them to successfully complete programs and pass the national certification exam so they can practice in their field.

Much of the literature examining post-admission or progression factors examine predictors that occur during the later portion of baccalaureate programs, such as nursing theory courses at the end of the senior year (Horns, O'Sullivan, & Goodman, 1991; Younger & Grap, 1992). Other factors routinely studied include passage on the exit HESI examination taken during the last semester of the program (Daley, Kirkpatrick, Frazier, Chung, & Moser, 2003; Newman, Britt, & Lauchner, 2000), and final grade point average (Beeson & Kissling, 2001; Haas, Nugent, & Rule, 2003; Yin & Burger, 2003). This study will help determine the earliest possible point in a student's college career where he or she might benefit from an intervention designed specifically to remedy a deficiency so that graduation and passage on the NCLEX-RN are achieved in the originally planned timeframe.

Similarly, this study will benefit students at St. Luke's College. Understanding the preadmission predictors of academic success will help the admissions staff and faculty select students with more of a propensity to be successful. Students who have the greatest potential to graduate and pass the NCLEX-RN on their first attempt are the most cost-effective students to educate. Like most nursing programs nationwide, St. Luke's has enjoyed an ample applicant pool, but their long history has revealed a cyclical nature according to the public's interest in health careers and there will more than likely come a day when the applicant pool reflects fewer applicants from which to select highly qualified students.

Finally, identifying students at risk of not graduating and/or not passing the NCLEX-RN on first attempt at the earliest opportune time will enable faculty and staff to seek intervention(s) as the most cost-effective approach for students and the institution. Completing an associate degree nursing program in the prescribed timeframe is most cost-

effective for students, while full classrooms and clinical experiences are the most cost-effective for the college.

Delimitations and Limitations

This study was conducted in light of the following delimitations and limitations:

Delimitations

The scope of this study was delimited to:

1. Associate degree nursing students of a small, private, health-system based college in the Midwest; therefore, the results are specific to the institution.
2. Student reasons for attrition were not addressed.

Limitations

The scope of the study had several limitations:

1. The sample size was small. The college was small (average nursing graduation size of 35 over the last several years). Therefore, the data were used for graduates between the years 1998 and 2005 to provide an adequate number of complete student records.
2. The student database was not completely automated; records on students included inconsistent data, thus a high number of cases needed to be excluded due to missing data.
3. The score on the NCLEX-RN was reported to the candidate and the nursing program as pass or fail.
4. The literature reviewed primarily related to the success of recent baccalaureate nursing graduates.

5. Each nursing program has differing admission, progression, and graduation criteria, which make a national study challenging to perform.

Definition of Terms

The following terms were defined for use in this study:

ACT Composite (ACTC): The ACT is a test of educational development "designed to determine how skillfully students solve problems, grasp implied meanings, draw inferences, evaluate ideas, and make judgments in subject-matter areas important to success in college" (1997 ACT Technical Manual, p. 2). The ACT Composite score is the arithmetic average of four academic test scores in English, mathematics, reading, and science reasoning reported on a scale of 1 to 36. This is a continuous variable.

ACT Reading (ACTR): The ACT Reading test does "not test the rote recall of facts from outside the passage, isolated vocabulary questions, or rules of formal logic…the test focuses upon the complex of complementary and mutually supportive skills that readers must bring to bear in studying written materials across a range of subject areas" (1997 ACT Technical Manual, p. 5). The total reading test score is made up of a sub score from a Social Sciences/Sciences reading skills section and a sub score from an Arts/Literature reading skills section. Scores are reported on a scale of 1 to 36. This is a continuous variable.

Academic Success: Successful completion of the nursing program with a cumulative grade point average of 2.00, or a "C" grade, as well as first-attempt passage on the NCLEX-RN.

Anatomy Grade (A): Grade received in college level anatomy course. This is a continuous variable with values from 0.00 to 4.00.

Associate Degree Nursing Program (ADN): The ADN program provides curricula designed to prepare graduates to competently and compassionately provide direct patient care. The program requires 71 total credit hours for completion, with 41of these credit hours being derived from nursing theory and clinical courses.

Final Program Grade Point Average (FGPA): Cumulative grade point average on the courses required to complete the nursing program including general education and nursing courses. This is a continuous variable, with values from 0.00 to 4.00.

First term Nursing Course Grade (N1): Grade received in the first semester nursing theory course; similarly, the *Second term Nursing Course Grade (N2)* is the grade received in the second semester nursing theory course. Both are continuous variables.

First-Time Passage on the National Nursing Certification Examination (CERT): First attempt passage on the NCLEX-RN. This is a dichotomous variable: 1 = passed on the first attempt, 0 = did not pass on the first attempt. (A nursing graduate is allowed to take the exam up to four times but the "gold standard" for accreditation and program evaluation is passage rate on the first attempt.

High School Grade Point Average (HSGPA): The arithmetic average of all course letter grades taken in high school for that individual. This is a continuous variable from 0.00 to 4.00.

High School Rank (HSR): The rank the applicant held when his/her high school grade-point-average was compared with that of all other students in the same high school graduation class. This is a continuous variable.

NCLEX-RN: The nationally approved licensing examination for registered nurses published by the National Council of State Boards of Nursing (NCSBN), which assesses the minimal

competency of candidates to practice professional nursing. Graduates of associate, and bachelor's degree programs take the identical examination. The NCLEX-RN was instituted in 1982.

Microbiology Grade (M): Grade received in college level microbiology course. This is a continuous variable, with values from 0.00 to 4.00.

Physiology Grade (P): Grade received in college level physiology course. This is a continuous variable, with values from 0.00 to 4.00.

Previous College Credits (PCCR): Number of college credits taken before entry into the nursing curriculum that can be used to fulfill general education or co-requisite requirements mandated by the nursing program. This is a continuous variable.

Previous College Grade Point Average (PCGPA): Grade point average limited to the credits defined above. This is a continuous variable.

CHAPTER 2. LTERATURE REVIEW

Many changes have occurred in nursing licensure over the years. According to the Iowa State Board of Nursing, hospitals in Iowa initially set their own educational standards as a condition of employment. On March 12, 1907, the state of Iowa took the first formal step to ensure that individuals providing nursing care were qualified to do so when the State Legislature passed a law requiring education and licensure by examination. In 1908, the State Board of Health created a 50-question essay exam covering five sections: medical, surgical, obstetrics, pediatrics, and psychological nursing (www.state.ia.us/nirsing/general_info/history.html).

In 1935, the State Board of Nursing was created as a separate entity from the Board of Health. This board constructed a 500-question, multiple-choice examination covering the aforementioned areas. This exam was utilized in Iowa until the first national State Board Test Pool (SBTPE) was adopted in 1946. By 1949, most states had accepted and utilized the SBTPE as the national standard (www.state.ia.us/nursing/general_info/history.html). Several studies regarding new graduates' success on this exam were conducted primarily in the 1970s until 1982, when the national outcome variable became the National Council Licensure Examination for Registered Nurses (NCLEX-RN), but they are not reported on here.

The NCLEX-RN exam currently tests the integrated practice of nursing rather than the traditional five content areas and the results were reported as numerical scores. After a job analysis of new nursing graduates in 1986, the National Council reduced the number of questions from 400 to 300 and changed the focus of the exam from locus of decision making to the assessment of client needs on the 1988 version. Results on this examination were

reported as pass or fail. In 1991, the National Council of State Boards of Nursing changed the NCLEX-RN from a paper and pencil format to one using a computer adapted testing (CAT) format. The CAT was implemented in 1994.

Since 1982 many studies have been conducted related to performance on the NCLEX-RN examination in nursing as well as successful completion of the nursing program. Researchers have investigated mostly academic and limited nonacademic aspects of students from diploma, associate degree, and baccalaureate programs. Most studies have related primarily to baccalaureate degree graduate success but a few have covered associate degree graduate success. For the purposes of this study, research salient to both baccalaureate and associate degree programs and NCLEX-RN performance was reviewed. The studies examined are categorized by date due to content differences on the NCLEX-RN examination: studies prior to 1988; studies between 1988 and 1994; and studies since 1994.

Predictors of Success in College

Wolfe and Johnson (1995) revealed that high school grade point average accounts for 19% of the variance in college grade point average. Zheng, Saunders, Shelley, and Whalen (2002) determined that high school grade point average added an impressive amount of explained variance to a hierarchical regression model estimating nonacademic background variables, student attitudinal variables, and environmental variables of freshmen on first-year college grade point average. McGrath and Braunstein (1997) noted that college freshmen that were retained showed higher high-school grades and SAT scores than the students who were not retained. Other researchers have suggested that high school grades may be more subjective than standardized test scores because of differing standards among teachers and

the purposes teachers associate with grades (Stiggens, Frisbie, & Griswold, 1989). Some researchers have concluded that high-school rank may take into account differences across high schools in their curricula and grading standards (Astin, Korn, & Green, 1987), and may be better suited as a predictor variable. Thus, high-school grade point average and rank were included as the first two predictor variables in the current study.

Generally, ACT assessment scores are statistically associated with high-school grades although they are dissimilar measures. While grades measure educational achievement, ACT scores measure important academic skills needed to perform college-level work. These "tests of educational development are designed to determine how skillfully students solve problems, grasp implied meanings, draw inferences, evaluate ideas and make judgments in subject-matter areas important to success in college" (*ACT technical manual*, 1997, p. 2). The ACT composite score is the arithmetic average of four academic test scores on English, mathematics, reading and science reasoning reported on a Likert-type scale of 1 to 36.

Predictors of Success on the National Council Licensure Exam-Registered Nurse (NCLEX-RN)

Studies prior to 1988

Campbell and Dickson (1996) performed an integrated review and meta-analysis of 47 studies undertaken between 1981 and 1990, published in U.S. nursing journals and in unpublished dissertation studies, covering BSN graduates taking the NCLEX-RN before 1988. They described and evaluated nursing education research on predictors of retention, graduation, and NCLEX-RN success. Three of the studies were classified as experimental, and one used a quasi-experimental design. These same four studies were used in the meta-analysis portion of their investigation.

Findings of the integrative review showed that the largest single groups studied were senior-level students and recent graduates and, as a result, most of the studies focused on graduation and NCLEX scores. While many demographic characteristics were noted, characteristics such as parents' age, education level, and financial status most often predicted NCLEX success (Campbell & Dickson, 1996, p. 57). Preadmission variables studied included high-school grade point average, high-school rank, and college credit hours in addition to SAT and ACT scores. The aforementioned standardized tests were significantly correlated with graduate and NCLEX-RN success, but ACT scores most often predicted success on the NCLEX exam (p. 56). The National League of Nursing (NLN) pre-nursing exam was 100% predictive of success on the NCLEX exam, however, it was only used in one study. Post-admission variables most often investigated were college GPAs in science, liberal arts, pre-nursing, nursing, and the college cumulative. "All of the grade point averages demonstrated some significant correlation with graduation and NCLEX success" (p. 56), but GPAs for nursing, nursing clinical, and chemistry courses were almost equally significant in predicting student success.

The meta-analysis of four of the studies revealed significant effectiveness of the interventions used in the experimental studies, such as a support group, a special program (that was not described in much detail), computer-assisted instruction, and an individualized system of instruction, but only the support group was found to be predictive of NCLEX success. Campbell and Dickson (1996) noted that these studies were too dissimilar from one another for direct comparison but called for replicative studies.

Other studies revealed during this same time period, that were not included in the Campbell and Dickson (1996) review, examined similar predictor and outcome variables.

Several studies tended to focus on baccalaureate graduates' success in their nursing program as measured by final nursing grade point average (Feldt & Donahue, 1989; Fowles, 1992; Glick, McClelland, & Yang, 1986; McClelland, Yang, & Glick, 1992; Oliver, 1985), and on the NCLEX-RN exam (Feldt & Donahue, 1989; Foti & DeYoung, 1991; Fowles, 1992; Glick et al., 1986; Horns, O'Sullivan, & Goodman, 1991; Jenks, Selekman, Bross, & Paquet, 1989; Krupa, Quick, & Whitley, 1988; Lengacher & Keller, 1990; McClelland et al., 1992; McKinney, Small, O'Dell, & Coonrod, 1988; Mills, Becker, Sample, & Pohlman, 1992; Payne & Duffey, 1986; Quick, Krupa, & Whitley, 1985; Whitley & Chadwick, 1986; Yang, Glick, & McClelland, 1987; Younger & Grap, 1992).

Demographic variables such as sex (virtually all studies examined were predominantly female) and age (most nursing students at this time were traditional college ages of 18-22) were routinely noted but not always included as independent variables. Preadmission variables studied include high school percentile rank (Feldt & Donahue, 1989; Oliver, 1985; Yang et al., 1987), high school biology and English grades (Oliver, 1985), ACT composite scores (Feldt & Donahue, 1989; Fowles, 1992; Lengacher & Keller, 1990; McClelland et al., 1992; Yang et al., 1987), ACT sub scores (Fowles, 1992; McClelland et al., 1992), SAT verbal scores (Foti & DeYoung, 1991; McKinney et al., 1988; Payne & Duffey, 1986; Quick et al., 1985; Younger & Grap, 1992), and SAT quantitative scores (Younger & Grap, 1992).

Progression variables studied include a variety of college course grades including first semester chemistry grade (Feldt & Donahue, 1989), chemistry grade (Yang et al., 1987), anatomy and physiology lecture grade (Quick et al., 1985), anatomy and physiology grade (Feldt & Donahue, 1989; Fowles, 1992), biology grade (Glick et al., 1986), pathology grade

(Glick et al., 1986), psychology and sociology grades (Feldt & Donahue, 1989; Yang et al., 1987) prerequisite entry grade point average (Horns et al., 1991; McClelland et al., 1992; Oliver, 1985; Payne & Duffey, 1986; Whitley & Chadwick, 1986; Yang et al, 1987), grades at the end of the freshman year (Quick et al, 1985), introduction to nursing grade (Fowles, 1992; Krupa et al., 1988), nursing clinical course grades (Glick et al., 1986), nursing theory grades at various points in the nursing curriculum (Horns et al., 1991; Jenks et al., 1989; Krupa et al., 1988; Lengacher & Keller, 1990; Payne & Duffey, 1986; Younger & Grap, 1992), and assorted nursing achievement test scores such as the Mosby Assess Test (Foti & DeYoung, 1991; Fowles, 1992; Jenks et al., 1989; McClelland et al., 1992; McKinney et al., 1988), and the National League of Nursing Exam (Foti & DeYoung, 1991; Horns et al., 1991; Younger & Grap, 1992).

Post-graduation variables typically studied include cumulative nursing grade point average (Feldt & Donahue, 1989; Glick et al., 1986; Yang et al., 1987), cumulative college grade point average (McKinney et al., 1988; Mills et al., 1992), and scores on the NCLEX review course taken after graduation but prior to the NCLEX-RN examination (Younger & Grap, 1992).

Quick, Krupa, and Whitley (1985) conducted one of the first studies to examine factors that influence performance on the NCLEX-RN that examined 138 non-transfer baccalaureate students who received degrees in 1982, 1983, and 1984 from East Carolina University. The researchers looked at admissions indicators at the time of entry to a nursing program (at the end of the students' freshman year) to predict performance on the NCLEX-RN. The method of assessment was discriminate analysis:

> Because graduates can be divided into two distinct groups on the basis of their NCLEX-RN performance, discriminate analysis was used to determine the linear combination of variables that most accurately predicted the groups into which graduates fell. A forced entry method was used instead of a stepwise method to maximize the predictive power of the equation (Quick et al., 1985; p. 365)

Next, a classification procedure was carried out to determine the percentages of students who would have been expected to pass the national licensure exam given academic indicators at the point of admission into the nursing program.

The best predictors of success on the licensure exam were: grade point average (GPA) at the end of the freshman year, verbal scores on the SAT, and grades in the lecture portion of anatomy and physiology. "A classification procedure … resulted in the correct classification of 83.4 percent of the students on the basis of their NCLEX-RN performance" (Quick et al., 1985, p. 366).

Krupa, Quick, and Whitley (1988) conducted follow-up research with a similarly designed study that investigated the effectiveness of nursing course grades as predictors of performance on the NCLEX-RN. The study included transfer students who had been excluded from their initial study described above. The researchers' intent was to "test a method for predicting performance of students who entered the nursing program later in their college years so that members of this group who may be expected to have difficulty passing the NCLEX-RN could be identified as early as possible during their education" (p. 294). Data were analyzed for 359 BSN graduates, and included initial NCLEX-RN scores earned between 1982 and 1985 as well as grades in required nursing theory and practicum courses.

As in their previous study, Krupa et al. (1988) used discriminate analysis to determine the linear combination of nursing course grades that could be used to best predict

performance on the licensure examination. The findings revealed that graduates who passed the NCLEX-RN on the first attempt did indeed differ with respect to grades in nursing courses from their counterparts who failed. Grades earned in the introductory nursing course taken at the beginning of the program during the sophomore year made the greatest contribution to the prediction of NCLEX-RN performance. The Medical-Surgical II theory course during the junior year was the next most effective predictor of performance on the exam.

A classification procedure performed to determine the percentages of students who would have been predicted to pass the NCLEX-RN given their qualifications during the nursing program enabled the researchers to correctly classify 74.9% of the sample, which is a relatively high degree of accuracy. Thus, the researchers concluded that students at risk of failing the NCLEX-RN could be identified as early as their sophomore year in college (Krup et al., 1988).

A study was constructed by Feldt and Donahue (1989) to determine the best linear combinations of routinely available academic variables that would predict success in a nursing program (p. 416). Success was measured as final nursing grade point average and a passing score in the NCLEX-RN licensure exam. The researchers examined high school rank, ACT composite and subtest scores, grades for college psychology, sociology, general chemistry I & II, biology, zoology, microbiology, and anatomy courses for 155 completers between 1984 and 1986, and 34 noncompleters between 1978 and 1982 at a small private college in the Midwest.

Data for the entire sample were randomly divided into two approximately equal subgroups. A multiple regression analysis incorporating the backward elimination procedure was utilized to identify the best set of predictors for each criterion.

> Criteria for inclusion of each predictor in the best set included a statistically significant t test of the regression coefficient. The test indicated each predictor's contribution to the model when entered last. Residual analysis was employed to check the adequacy of the model. Effect of year of entry into the nursing program, based on multiple regression analysis with dummy coding for year, was not statistically significant for any criterion variable. (Feldt & Donahue, 1989, p. 417)

The best combination of predictors for final nursing grade point average included ACT composite score, first semester chemistry and first semester anatomy grades. The best combination of predictors for NCLEX-RN passage included "ACT composite score, high school percentile rank, nursing grade point average and first semester chemistry grade" (Feldt & Donahue, 1989, p. 418).

A comparison of students who withdrew versus those who completed as well as those who passed or failed the NCLEX-RN via discriminant analysis provided evidence that nursing grade point average provided the greatest amount of discrimination between groups. Classification into pass and fail categories was more accurate for those who did not complete the nursing program (82%) versus those who completed the program (66%), and was 66% for the NCLEX-RN pass group and 94% for the fail group. However, Feldt and Donahue (1989) noted that results of residual analyses indicated violations of the assumptions of normality and equal variance. A majority of students who either withdrew from the nursing program "or failed the NCLEX-RN exam had standardized residuals which exceeded 2.5 standard deviations, all negative, indicating over prediction for those groups" (p. 419). They

also indicated they had greater confidence in their results using multiple regression with continuous criteria as opposed to the discriminant analysis results.

An anomaly in the NCLEX-RN passage rates for the 1983 graduates of a 50-year-old BSN program at a private university in the Pacific Northwest was the impetus for a work systems framework designed study conducted by Whitley and Chadwick (1986). Data on 23 variables were collected from 176 student records of the class of 1983 (66% first-time pass rate on the NCLEX-RN) and the class of 1982 (94% first-time pass rate) for comparison purposes. While a "separate analysis was completed for each class, association with a specific class was not found to be significant" (p. 95).

Nonsuccessful candidates from both classes were found to have significantly lower SAT verbal and math scores, lower entry science grade point averages, lower cumulative entry grade point averages, lower nursing major course test scores, and lower exit grade point averages than their successful counterparts. Pearson correlations were computed on all variables with all other variables and "those variables whose correlations were significant at p less than or equal to 0.05 were then tested for causal significance using student's t" (Whitely & Chadwick, 1986, p. 95). Science and prerequisite entry grade point averages (before acceptance into the nursing program as a first semester junior) were determined to be the best predictors of success on the NCLEX-RN

A retrospective study by Payne and Duffey (1986) was performed on 283 baccalaureate graduates of the University of North Carolina Chapel Hill School of Nursing who graduated in 1983 and 1984 and took the NCLEX-RN exam. The dependent variable for the study was their NCLEX-RN score. The focus group of the study were those who failed the exam "plus those who were within chance level of failure … defined as approximately

one standard error of estimate above the failure mark" (p. 327). Predictor variables were grade point average at the time of entrance into the nursing program at the beginning of the junior year, SAT math score, SAT verbal score, and SAT total score, nursing grade point averages after each of the first, second, third and fourth semesters, and total nursing grade point average on all required nursing courses.

The primary objective of the study was to determine whether any of the predictor variables could be used to identify students who might need special intervention in order to pass the NCLEX-RN exam. A second objective was to determine at what point these students could be identified to maximize the benefits of an intervention. Descriptive statistics, including Pearson product moment correlations, were first calculated separately on the two classes and only minor chance fluctuations were revealed. "Data from the combined 1983 and 1984 classes were then analyzed to obtain more precise estimates of the various descriptive statistics" (Payne & Duffey, 1986, p. 329). Distributions were found to be normal or showed expected patterns.

A sequence of stepwise regression analyses were performed on the combined data, using NCLEX-RN score as the outcome variable. Using entrance data (entrance grade point average and SAT math, verbal and total scores), the entrance grade point and SAT verbal score accounted for 33.3 % of the variance in NCLEX-RN scores. Adding the mid-junior year nursing grade point average improved the prediction to where it explained 48.3 % of the variation in NCLEX score, and the addition of the mid-senior year nursing grade point average improved the prediction to where it accounted for 53% of the variance (Payne & Duffey, 1986).

A second series of analyses was done to determine the effect of applying results obtained from one class to the data of the next class. A cross-validation step "in which regression coefficients obtained from the 1983 data were used to predict NCLEX scores for the 1984 class" (Payne & Duffey, 1986, p. 330) indicated relatively small reductions. The final step in the study involved examining students from the 1984 class who were correctly targeted as at-risk students using the 1983 predictive coefficients. Fifty-five percent of the high-risk students could have been determined by the academic data available at the midpoint of the junior year and 65% could have been identified at the end of the junior year but there was little change reported after this point in the curriculum. The researchers concluded: "the optimal time to begin predictions and perhaps interventions is following the first semester of professional study" (p. 332) during the junior year.

Glick, McClelland, and Yang (1986) assessed the relationship of high school rank, high school cumulative grade point average, ACT composite and sub scores, and grades in pre-nursing and nursing courses, on achievement in a baccalaureate nursing program measured by clinical course grades, cumulative nursing grade point average, and success on the NCLEX-RN for 51 graduates of a large Midwestern university. The primarily female sample (96%) ranged in age from 21 to 33, with mean age of 23. More than half of the sample (53%) transferred in one or more prenursing courses from another institution. All 51 graduates completed the requisite nursing courses on campus.

There were no statistically significant correlations between high school rank, ACT test scores, and any of the dependent variables (clinical nursing grades, cumulative nursing grade point average, and NCLEX-RN scores). "The strongest predictors of academic success as measured by nursing grade point average in this study were biology grade point average

and grade point average in all required prenursing courses" (Glick et al., 1986, p. 100). A stepwise multiple regression analysis indicated that biology grade point average contributed 26% of the variance when prenursing grade point average was used as the criterion variable ($p \leq 0.001$ level) (p. 103). None of the predictor variables showed a statistically significant relationship with NCLEX-RN scores, which was not expected. However, "grades in the clinical nursing courses (except Nursing V) and the pathology course showed statistically significant correlation with performance on the NCLEX-RN" (p. 102). The Nursing III variable made the most statistically significant contribution ($p \leq 0.001$) to the NCLEX-RN scores.

Limitations such as small sample size and the inclusion of only one school led the same three researchers noted previously to undertake a similar study a year later. Yang, Glick, and McClelland (1987) examined the academic information on 210 graduates from a large Midwestern university receiving baccalaureate nursing degrees and sitting for the NCLEX-RN exam for the first time in 1983, 1984, and 1985. The purpose of the study was to investigate the relationship between admission variables (high school rank, ACT composite and subtest scores, cumulative grade point averages for chemistry, biological sciences, social sciences, and all pre-nursing courses) and achievement in the BSN program (as measured by grades earned in regular clinical nursing courses and cumulative nursing grade point average), and performance on the NCLEX-RN. The majority of the subjects were female (94.76 %) and their ages ranged from 21 to 41, with mean age of 23.63. Only 18.57% of the sample transferred in pre-nursing courses from another institution of higher education.

Statistically significant correlations were found between each of the predictor variables and achievement in the nursing program. Results indicated that "the highest

predictor of achievement on the NCLEX-RN was the ACT social science sub score (r = .48)" (Glick & McClelland, 1987, p. 301). The strongest predictors of the clinical grade point average were the pre-nursing grade point average (r = .64), social science grade point average (r = .58), and biological sciences grade point average (r = .54). The best predictors of nursing grade point average were pre-nursing grade point average (r = .65), social science grade point average (r = .57), and biological science grade point average(r = .56).

Two stepwise multiple regressions were then estimated using cumulative nursing grade point average and NCLEX-RN as dependent variables to ascertain the distinct contributions of each independent variable above and beyond remaining variables. When the dependent variable was identified as nursing grade point average, the largest *R* square increment among the independent variables tested was made by the ACT composite score, which accounted for 4% of the variance ($p \leq$ to .0001. Pre-nursing grade point average contributed 3% and chemistry grade point average accounted for 0.8%. Biology grade point average and social science grade point average had no additional predictive value. When the second regression was estimated with the NCLEX-RN as the dependent variable, ACT composite score accounted for 14% of the variance, high school rank accounted for 3% of the variance, as did chemistry grade point average. Pre-nursing added 2% of explained variance. Biology grade point average and social science grade point average did not provide additional explanatory power (Yang et al., 1987).

The researchers concluded that "success in a baccalaureate nursing program and NCLEX-RN licensure examination may be predicted on the basis of performance in high school, on college entrance tests, and pre-nursing grade point averages" (Yang et al., 1987, p.

305). They suggested that their research be replicated with larger sample sizes in other baccalaureate nursing programs.

McKinney, Small, O'Dell, and Coonrod (1988) scrutinized a number of predictors of first-time success on the NCLEX-RN examination for 136 baccalaureate nursing graduates from a private, church-affiliated liberal arts college in the eastern part of the United States. The years 1983 to 1985 were chosen because adequate data were available on these graduates. Predictor variables included preentrance test scores such as SAT verbal, SAT math, and SAT total. Twenty-seven subjects reported ACT scores that were converted to SAT scores through the use of a 1980 University of Illinois conversion chart. Other predictor variables included cumulative prenursing grade point average on all courses taken before admittance into the nursing program at the beginning of the sophomore year, cumulative college grade point average, cumulative nursing grade point average (all theory and clinical courses), nursing theory grade point average, nursing clinical grade point average, repeated courses, age of subjects at graduation, Mosby Assess Test results (taken during the last semester), and Type A behavior as measured by the Jenkin's Activity Survey, also administered during the second semester of the Senior year. The criterion variable was performance on the NCLEX-RN exam.

The study revealed that the SAT total score, prenursing grade point average, nursing theory grade point average, cumulative college grade point average, cumulative college grade point average (including transfer courses), repeat courses, and Mosby Assess Test scores each indicated a significant correlation with NCLEX-RN scores ($p < 0.001$). When a multiple regression analysis was conducted, a combination of predictor variables including cumulative college grade point average, SAT verbal, Mosby Assess Test scores, and nursing theory

grade point average most accurately predicted success on the NCLEX-RN (McKinney et al., 1988).

Younger and Grap (1992) looked at 388 graduates of an upper-division baccalaureate program who took the NCLEX-RN exam between 1984 and 1987 to determine statistically significant predictors on the NCLEX-RN exam and "the earliest point in a student's academic career that the student's NCLEX-RN score could be predicted" (p. 25). A stepwise regression equation was run with information known at four distinct points: at admission; at the end of the sophomore year and before entry into the nursing program; at the end of the nursing program and after a National League of Nursing (NLN) composite test near the end of the program; and after an NCLEX-RN review course. Preadmission variables entered at the first point included SAT verbal, quantitative, and combined scores, as well as high school rank. Independent variables added at the second point were college grade point average and a college grade point average adjusted to control for differences in grading among the school's colleges. Variables added at the third point included individual grades earned in specific nursing courses and a CORE variable made up of grades earned in four nursing courses. Variables added at the fourth point were the composite score on a National League of Nursing (NLN) exam and on the NCLEX-RN review course.

"CORE was the strongest predictor of NCLEX-RN scores, explaining 55% of the variance in NCLEX-RN" (Younger & Grap, 1992, p. 25). The combined verbal and quantitative score on the SAT was the next best predictor, which increased explained variance to 59%, and the third best predictor was the composite NLN score, which increased the explained variance to 62%. The researchers concluded that interventions during nursing school could have the potential to positively affect performance on the NCLEX-RN and that

future research should look at those at risk by SATs and/or at risk as a result of poor junior course grades.

Jenks, Selekman, Bross, and Paquet (1989) examined a convenience sample of 407 graduates of another upper-divisional, baccalaureate nursing program at a university in the East and attempted to answer the same research questions as noted above: to identify the significant predictors for the NCLEX exam and the high-risk student at the earliest possible time. Both the regression and discriminate analyses introduced data at three points in time. The first point came immediately after admission and included such preadmission dependent variables as previous university grade point from their transfer school(s) as all students transferred in from other schools, total number of credits earned prior to matriculation into the nursing program, previous college science grade point average, and level of previous university type (2^{nd} or 4^{th} year). The second point was at the end of the junior year and included age, as well as the post admission variables of individual grades in the first three clinical nursing courses. The last point was after the entire nursing program was finished and included sex as well as progression variables such as grades in individual senior level nursing courses, and score on the Mosby Assess Test, a standardized nursing examination expressly designed for predictive purposes. “Nursing theory courses at the junior and senior year and the Mosby Assess Test were strongly correlated with NCLEX performance” (p. 112). A discriminant analysis indicated successful classification of 62% of the sample directly after admission, 81% by the end of the junior year, and 86% by the end of the senior year. The study indicated that high-risk students could be identified as early as the end of the junior year and interventions to support student success at that point would be appropriate.

Results of a similar study were revealed by Horns, O'Sullivan, and Goodman (1991), who examined 394 baccalaureate nursing student records from a university in the South completing the NCLEX-RN between February 1985 and July 1986. The purpose of the study was to identify which prenursing and nursing components made significant contributions to NCLEX-RN performance. Preadmission variables were sex, age, race and admission grade point average which was calculated from all prenursing courses attempted including three semesters of chemistry, three of biology, and one each of English, psychology, sociology and anthropology. Progression variables for year two were grades in the student's first two clinical courses; year three variables were grades earned in mental health, adult health, and maternal child health courses; year four variables were grades in two nursing process courses, percentile rank on the NLN comprehensive examination, and graduation grade point average based only on courses taken at the university.

Regression analyses with the forward method were conducted with the NCLEX-RN score as the criterion variable. Independent variables were entered in a hierarchical manner according to the student's progression through the program and significant predictors at each step in the regression were retained in the analysis for the following regression. "In NCLEX-RN scores, 67% of the variance scores was accounted for by admission GPA and race (33%), one 2nd year grade (an additional 14%), the 3rd year adult health grade (an additional 11%), one 4th year theory grade, and the NLN comprehensive exam (an additional 9%)" (Horns et al., 1991, p. 9). Results of the study supported other work in the field and suggested that there are preadmission and early predictors of NCLEX-RN success that could be used as early intervention points for students at risk of failing the NCLEX-RN.

A similar study was conducted by Foti and DeYoung (1991) from 1985 to 1988 on 298 nursing students at a state-supported baccalaureate-granting program in the Northeast. The dependent variable was the NCLEX-RN. Preadmission variables studied were SAT verbal and quantitative scores. Progression variables studied were overall grade point average, GPA in the major, GPA in science, the Mosby Assess Test score, and the NLN Baccalaureate Achievement Test score. The Mosby Assess Test yielded a correlation of .66, whereas overall GPA and GPA in the major each generated a nearly identical correlation of .59. The SAT verbal correlation was reported as .46. "Multiple regression results indicated that the most useful combination of predictors were the Mosby Assess Test score, SAT verbal score, and overall GPA" (Foti & DeYoung, 1991, p. 101) that collectively produced an R^2 of .49. The Mosby Assess Test and SAT verbal by themselves produced an R^2 of .46. The study confirmed the faculty's' long-held belief that reading and verbal abilities relate to success in the nursing program and success on the NCLEX. The researchers concluded that the Mosby Assess Test, administered at the beginning of the last semester would continue to allow interventions with the at risk student.

Fowles (1992) undertook a similar study with two dependent variables: final grade point average in the nursing curriculum and success on the NCLEX-RN exam. The sample included 192 seniors who graduated from a church-affiliated, upper-division nursing college between 1985 and 1988. Preadmission variables were ACT Composite, and ACT sub scores on English, math, social science and natural science; lower division GPA average after required courses but before entry into the nursing program; lower division GPA in science courses; and lower division GPA in liberal arts courses. Post-admission or progression variables included grade in Anatomy & Physiology (A&P) I; grade in A&P II; GPA at end of

nursing curriculum level I; GPA at end of nursing curriculum level II; and Mosby Assess Test score.

Stepwise multiple regression results suggested that either ACT composite or social science subscale scores, Anatomy & Physiology II course grade, GPA at the end of level I nursing courses, and percent correct on Mosby Assess Test were the best predictors of success in the nursing curriculum. The best predictors of success on the NCLEX were percentile scored on the Mosby Assess Test, GPA at the end of level I nursing courses in the program, and either the ACT Composite score or social studies subscale score. The recommendation was made by the researcher that "each nursing program should examine its own predictors of success … and develop an early intervention program to enhance performance within the nursing program and on the NCLEX-RN for high-risk students" (Fowles, 1992, p. 57).

The study by McClelland, Yang, and Glick (1992) is especially noteworthy in that it was a large, statewide, examination of 1,069 graduates from nine baccalaureate nursing programs and their success on the NCLEX-RN between 1985 and 1989. Pre-admission variables were high school GPA, ACT subtest and composite scores, and grades in chemistry, biology, anatomy and physiology, microbiology, psychology, and sociology—all completed by the time of admission into the nursing program. Criterion variables were grades from required clinical nursing courses, cumulative nursing GPA, Mosby Assess Test scores, and NCLEX-RN scores.

The study included three parts. The first addressed the relationship between admission predictor variables and actual achievement in the nursing program, performance on a standardized nursing achievement test, and performance on the NCLEX-RN. All

correlation coefficients had statistically significant relationships ($p \leq .001$) with NCLEX-RN scores. The second part examined the degree to which achievement in nursing courses predicted actual performance on the NCLEX, and in the third, “a path analysis was used to formulate a casual model describing the relationships among the variables in the study” (McClelland et al., 1992, p. 342). Results demonstrated that prenursing GPA was the best predictor of achievement in the nursing program. ACT social studies, reading, and English sub scores best predicted performance on the standardized nursing achievement test, and the ACT composite score was the strongest predictor of success on the NCLEX-RN followed by prenursing grade point average. The researchers called for careful admission selection per each individual nursing program based on valid predictors of academic success.

Mills, Becker, Sample, and Pohlman (1992) studied 328 graduates from an accelerated baccalaureate nursing program (completed in three semesters) at a private, Midwestern university between 1982 and 1990. While a completed undergraduate degree was required for admission, making these students very different from most studied at the time, some of the same variables were examined to see when in the curriculum intervention might best be initiated to influence student success on the NCLEX-RN. Preadmission variables studied included the student’s sex, transfer grade point average, and whether or not the student was previously educated in the United States. Post-admission variables studied were cumulative grade point average after each of the three terms.

Stepwise logistic regression models were run using data available at admission and at the end of each of the three terms. Based on the transfer grade point average at admission, the probability of passing the NCLEX-RN was lower for students previously educated in a foreign country than for American-educated students. By the end of the first semester,

foreign-educated students and male nurse candidates had a lower probability of passing the NCLEX based on their cumulative grade point average. At the end of the second semester, sex was not significant but "the probability of passing the NCLEX remained lower for nurse candidates whose prior education had been in another country" (Mills et al., 1992, p. 355). However, by the end of the third semester or at the completion of the program, cumulative grade point average was the only predictor of NCLEX success (p. 355).

Far less has been published on associate degree graduates' program and NCLEX-RN success. Associate degree studies are important because, as noted earlier, Associate degree graduates have always constituted the majority of the exam test takers since its inception.

Oliver's (1985) study is noteworthy in that she attempted to identify individual and cluster variables that best predicted first quarter grade point average and successful completion of a community college associate degree nursing program in the southeast. Independent variables included high school rank, grades in 11th and 12th grade English, grade in Algebra I, and grades in high school biology courses. Other independent variables included sex, race, age, and marital status upon admission to the nursing program, part- or full-time status during the first quarter, previous experience in college, previous experience as a licensed practical nurse, and nursing faculty member's prediction of first quarter grade point average and prediction of program completion (both based on the applicant's achievement record and a personal interview).

The study population was composed of 141 students admitted to a community college between 1977 and 1979. A convenience sample with complete data yielded 67 cases (Oliver, 1985). Statistical analyses showed that high school rank, high school biology, and high school English grades separately showed a significant relationship with academic success. In

a multiple regression, biology grade, age, and faculty prediction of first quarter GPA significantly predicted first-quarter grade point average. A second multiple regression revealed that twelfth grade English grade, part-time status, and faculty prediction of first-quarter grade point average were the best predictors of ADN success. The study also indicated that the successful student was “older, attending school part-time, and had previously attended college” (p. 205). Data analysis also indicated that a disproportionate number of black students were noncompleters as compared to White students. Finally, cluster variables did not predict as well as the single independent variables.)

The purpose of Lengacher and Keller’s (1990) study was to examine the relationship between selected preadmission variables and several progression variables including perception of role strain on NCLEX success in July of 1987 and 1988 for 146 Associate degree students at a public community college. Again, this was one of the first studies to examine Associate degree students. In addition, it was one of the first studies to include perception of role strain (as measured by the Lengacher Role Strain Inventory) as an independent variable. Pearson product moment correlations and stepwise multiple regression analyses were used to identify the relationship between the preadmission predictor variables of age, entering GPA, ACT sub scores in math and English along with the composite score, and the progression variables of perception of role strain, achievement in clinical and nursing courses, achievement on 4 NLN examinations given by the end of the first summer, exit GPA, and the criterion variable scores on the on NCLEX-RN.

The best predictor among preadmission variables was the ACT composite score. The best predictors among progression variables were the two nursing theory courses in the second year of the program, the NLN Basics Two Examination, and the NLN Psychiatric

Nursing Examination. The first stepwise linear regression analysis revealed that exit grade point average and ACT composite were the best predictors of achievement on the NCLEX-RN. The second regression analysis revealed that two nursing theory courses—medical/surgical and maternal and child theory—made the most contribution to the prediction of achievement on the NCLEX-RN, accounting for 59% of the variance. The third linear regression indicated that achievement on the NLN psychological and Basic one exams accounted for 44% of the variance on the NCLEX-RN. The authors called for the initiation of intervention procedures for those predicted to be at risk at admission or early on in the program, as well as more studies examining associate degree nursing students, as these students have distinct characteristics and continue to constitute the largest group of graduates sitting for and passing the NCLEX-RN.

Studies from 1989 to 1994

A higher passing standard was implemented with the NCLEX-RN administered in 1988. In addition, the scores began being reported as pass/fail only. Several researchers actively involved in the nursing education field suggested that predictors of NCLEX-RN success on the post 1988 exam would probably differ from those for the earlier exam (Beeson & Kissling, 2001; Wall, Miller, & Widerquest, 1993; Waterhouse, Carroll, & Beeman, 1993). In fact, results from the first sitting of the exam in 1988 indicated a slight drop in the national pass rate to 16.4% (Poorman & Martin, 1991) when the test was purposefully constructed so that a failure rate of about 10% is expected (Dell & Valine, 1990).

Waterhouse et al. (1993) designed a study “to identify variables that might be used as predictors for success on the post 1988 version of the National Council Licensure Exam, NCLEX-RN and to identify those students at risk of failing the examination” (p. 278). Two hundred fifty seven graduates of the baccalaureate nursing program at a university in the Northeast were classified into two groups—those who passed the exam and those who failed. Three separate discriminant analyses were used to ascertain the influence of 15 independent variables at varying points in time: at the end of the first year of nursing (junior year), between the fall and spring semesters of the senior year, and at graduation. Predictor variables examined at the first point in time included preadmission variables such as high school percentile rank, SAT verbal, and SAT math scores. Other predictor variables examined at this point included “grades for physiology, pathophysiology, and a second junior-level nursing course; along grade point index for the end of the sophomore year, as well as current grade point index for the end of the junior year; and data pertaining” (p. 280) to the student’s history of probation, transfer status, or major changes. The mid-senior year analysis included the aforementioned variables in addition to the student’s grade in the first senior-level nursing course and number of years taken to complete the program. The analysis at graduation added the grade in the last clinical course and participation in the American Nursing Review course.

The researchers reported that 86.38% of students were correctly classified by the analysis done at the end of the junior year. Results of the mid-senior year discriminant function indicated correct classification of 92% of the students who passed and 69% of those who failed. Results of the graduation discriminant analyses identified seven significant predictors that led to the correct classification of 93% of the students who passed and 80% of

the students who failed. Grades in the first senior-level nursing course and final grade point average were the two best predictors of NCLEX success, but accurate predictions at graduation are not optimal in terms of remaining time for intervention. The researchers concluded that there were reasonably accurate predictive data by the end of the student's junior year that should be used to implement interventions for at-risk students.

One year later Waterhouse, Bucher, and Beeman (1994) attempted to cross-validate the procedure used in the study described above. Their second study looked at 135 nursing students who graduated from the same university noted above in 1991 and 1992. It was determined that these subjects differed considerably from their earlier counterparts in that their SAT verbal and math scores, high school ranks, physiology grades, and nursing course grades were all lower on average. These students were also more likely to have been on probation, to have participated in an American Nursing Review course, and to have changed majors. Researchers applied the classification procedure developed with the first study to both classes. The discriminant function estimated at graduation used the same 15 variables noted above to correctly categorize 87% of the passes and more than 62% of the failures on the NCLEX-RN. These findings were acceptable to the researchers given the significant differences in the two samples and the dichotomous data. These researchers called for other baccalaureate nursing programs to develop valid predictor equations to identify at-risk students in their own programs better, and to implement the most effective combinations of interventions for those students.

A retrospective prediction study by Wall et al. (1993) looked at 92 baccalaureate nursing students from a private, church-affiliated liberal arts college in the Midwest to identify academic variables both before and during their nursing program that predicted their

success or failure on the NCLEX-RN between 1988 and 1991. Prenursing predictor variables incorporated high school rank, SAT verbal and math scores, sophomore GPA, and science GPA. Nursing program predictor variables included GPA in junior year nursing courses, GPA in senior year nursing courses, scores on the Mosby Assess Test, scores on a number of NLN tests taken at the end of each nursing course in the curriculum, and cumulative GPA at graduation.

When examining *t*-test results, the means of the independent variables for students who passed the NCLEX were higher than the means of those students who failed except on high school rank. The SAT verbal and math scores were the only variables that were not significant at the .05 level and were not used in subsequent testing. “Discriminant function analysis was used to indicate which variables were the most important in accounting for the differences between the groups of graduates who passed the NCLEX-RN #2 those who failed” (Wall et al., 1993, p. 635). A stepwise approach revealed that by the end of the senior year 94% of the graduates were classified correctly as passers and 53.3% were correctly classified as failures, for a total of over 88% classified. However, research results also demonstrated that data obtained before admission to the college and data obtained during each year during the program could be used to predict performance on the NCLEX exam as high school rank was shown to be a significant preadmission predictor, as were sophomore GPA and science GPA. The principals called for research that addresses whether specific interventions can improve the pass rates of at-risk students and research on non-academic predictor variables.

Mills, Sample, Pohlman, and Becker (1992) undertook a study that directly addressed the problem of doing research when characteristics of the dependent variable change within

the time frame of the study. They examined the records of 534 first-time nurse candidates who took the NCLEX-RN exam between 1982 and 1990 to identify academic predictors of first-attempt NCLEX-RN success (dependent variable). They were aware that a design change had resulted in an observable decrease in the national pass rate but observed no variation in performance at the private baccalaureate nursing program being studied. To control for this abnormality, they created a dummy variable as an independent variable representing two time frames addressed in their study: 1982 to 1987 and 1988 to 1990.

Additional independent variables examined included preadmission variables such as age at the time of the NCLEX-RN exam, sex, high school GPA, scores on the ACT subtests, and transfer student status. Other independent variables included nursing cumulative GPA after each year of school (4 total). Age was inversely related to successful performance on NCLEX in models 1 through 3. Interaction effects were examined and a series of five logistic regression models were tested to determine predictor variables and odds for first-time NCLEX-RN success.

The first model examined the students' profile on admission to the university and included the independent variables of age at exam, sex, high school grade point average, the four ACT subscores, transfer status, the dummy year variable, and the interactions between high school gpa, sex, and age. The model revealed age and ACT social science subscore to be significant, but age was later determined to be nonsignificant by the students' fourth year of the program. The value of the social science score was also low and the researchers determined it had little practical meaning. The second model was estimated at the end of the freshman year and independent variables included age, sex, cumulative nursing gpa at the end of the freshman year, the dummy variable for year, and the interaction effect between

cumulative nursing grade, and age and sex. This model revealed age and cumulative nursing GPA to be significant. The third model, run at the end of the sophomore year, replaced freshman year cumulative nursing gpa with the sophomore gpa and adjusted the interaction terms. The model correctly identified 77.6% of the nurse graduates who passed and 68.4% of those who failed. The fourth model, run at the end of the junior year produced a correct 74.7% classification of passers and 75.4% of failures and the researchers concluded that identifying at-risk students could be best achieved at this point, and that age was not any longer a significant variable in predicting performance. In the final model "the sensitivity and overall correct classification decreased slightly" (Mills et al., 1992, p. 406). "Results show[ed] that even with the best model, nearly 25% of the success-failure performance could not be predicted" (p. 407). These authors suggested that future research examine the role of nonacademic predictors of performance such as attitude and/or motivation.

Research by Alexander and Brophy (1999) was one of the few studies during this time period that looked at Associate degree nursing students. The students were in a unique program that allowed them to exit after two years of school with an Associate degree in nursing or stay to complete a Bachelor's degree in nursing. Of the 188-student sample size, 94 had failed the NCLEX-RN on the first attempt sometime between July, 1988 and February, 1994. The other 94 were students randomly selected from the rolls of those Associate degree graduates who had passed during the identical time period.

The dependent variable was performance on the NCLEX-RN (pass or fail). "Admission variables included high school rank, SAT scores, years of high school chemistry and math, admission status (direct, indirect, and transfer), GPA, number of credits and age" (Alexander & Brophy, 1999, p. 444). Progression variables were grades in seven nursing

courses, grades in nine cognate courses (required science and social science courses), GPA after first-year courses, and GPA after second-year course work. The graduation variable was the score on the NLN Comprehensive Achievement Test taken at the end of the sophomore year. *T*-tests revealed that the group that passed was significantly different from the group that failed in terms of SAT scores, course grades, and the exit variable of NLN Comprehensive Achievement Test, but that age, years of high school chemistry, and admission status were not statistically significant. Three logistic regression models were tested with NCLEX-RN as the dependent variable. The first model used a forward stepwise procedure with 22 admission, progression, and exit variables. The Nursing Adult 1 and Introduction to Sociology course grades contributed to the overall correct prediction rate of 88.24%. The second model introduced SAT verbal and math and found that SAT verbal could predict correctly 68.2% overall. The final model "tested the fit of six nursing course grades and the score on the NLN Comprehensive Achievement Test … and predicted accurately 80.63%. Success on the NCLEX-RN could be predicted as effectively with the GPA after the first year as it could be with the GPA after the second year. While the NLN Comprehensive Achievement Test contributed significantly to successful performance on the NCLEX-RN, by the time the students would sit for this exam, it would be too late for faculty to identify and intervene with at-risk students.

Lewis and Lewis (2000) examined another understudied population—transfer nursing students. They studied 168 transfer students to a midsize Midwestern university between the years 1991 and 1994 and attempted to identify at-risk students at the point of program admission. The dependent variable was academic success, defined as a 2.5 or better (on a 4.0 scale) at the end of the junior year. Predictor variables included number of transferred college

level social science courses, number of transferred college level natural science courses, number of transferred college level physical science courses, total number of transferred college courses, transfer GPA, and type of institution from which the student transferred (two- or four-year).

A correlation matrix revealed that most correlations were below .20 and the only two related to success were type of transferring institution (r =. 34, $p \leq .001$) and number of anatomy and physiology courses (r =. 36, $p \leq .001$). “The logistic regression model suggested that successful students are more than twice as likely to come from a four-year institution and five times as likely to have taken two or more anatomy/physiology courses than unsuccessful students”(Lewis & Lewis, 2000, p. 235). The researchers called for continued study of transfer nursing students.

Lamm and McDaniel (2000) studied a third understudied population—that of practical nursing graduates. These students studied nursing for one year and then sat for the NCLEX-PN, the national certification exam for practical nurses (PN). The researchers examined 667 practical nurses from a public, statewide, open access, community-based technical college in the Midwest from 1992 through 1996. The dependent variable was first-time passage on the PN version of the NCLEX. The first category of independent variables were demographic, the second category was made up of academic measures, and the third was composed of five scores on tests within the PSB Aptitude for Practical Nursing Examination given to all applicants to the program.

When analyzed alone, race (White vs. African-American), one of the demographic variables, was found to have a significant relationship with success on the NCLEX-PN but race, as per the correlation coefficient, was not a significant predictor when other variables

were analyzed simultaneously in the logistic regression. “College GPA was found to be the most accurate predictor of passage on the NCLEX-PN” (Lamm & McDaniel, 2000, p. 316), and the General Mental Ability (GMA) subtest on the PSB Aptitude Examination for Practical Nurses was the strongest predictor among the aptitude variables. The percentage of graduates predicted to pass who actually did pass was 87.2%, but the percentage of graduates predicted to fail who did in fact fail was only 67.3%, for an overall predictive value of 77.3%. The researchers put forth that the GMA subscale could be used to identify students at risk of failing the NCLEX-PN at the beginning of the program when intervention was more likely to be effective.

Endres (1997) was one of the first researchers who intentionally chose to study a diverse population of baccalaureate nursing graduates from four schools in Texas between 1987 and 1992. She compared predictors of success on the NCLEX-RN for three small, random samples of African-American, foreign-born, and White graduates totaling 150. The nine predictor variables included the preadmissions variable of admissions GPA and prior licensed vocational nursing status; a progression variable of medical-surgical nursing GPA, and exit variables of Nursing GPA, percentile rank on the Mosby Assess Test, final cumulative GPA, age at the time of the NCLEX examination, number of Ds and Fs received in nursing courses, and number of semesters needed to finish the program.

Endres (1997) found no significant differences between the passing and failure rates of the three samples on the NCLEX-RN. Students who had earned a D or F in a nursing course were more likely to fail the licensing exam, as were those who failed the Mosby Assess Test. The number of semesters required to complete the nursing program and the relationship to passing the exam varied among ethnic groups, but, overall, ethnicity was

shown to be unrelated to NCLEX-RN performance. Endres also determined that there were no significant differences between individuals with and without previous licensure as a vocational nurse and pass/fail status on the NCLEX-RN. “The number of Ds/Fs received in nursing courses was the only variable that significantly contributed to predicting the pass/fail group of African American graduates. The two variables that significantly contributed to identifying pass/fail group membership of foreign-born and white graduates in their order of predictive ability were the number of semesters needed to complete the nursing curriculum and the number of Ds/Fs received in nursing courses” (p. 368).

A fall 1990 study (Griffiths, Bevil, O’Connor, & Wieland, 1995) looked at whether factors related to anatomy and physiology (A&P) could predict a C or better in a clinical nursing course required in the spring of students’ junior year during a 2-year, upper divisional nursing program for transfer students in the East (N=98). Griffiths et al. designed a two-part study to determine: (a) how well six variables predicted success on a criterion referenced A&P exam developed as a screening instrument, and (b) if the score on the screening exam was correlated with the final grade earned in a required clinical nursing course (which demanded a solid A&P foundation) in spring of the students’ junior year.

Part one involved using “a stepwise multiple regression to determine how well the measures identified by the investigators predicted students’ success on a criterion referenced A&P test” (Griffiths et al., 1995, p. 64). The six pre-admission and progression predictor variables included: type of A&P course(s) (anatomy only, physiology only, or a combination of the two); focus of the course (mammalian or human); type of institution (2-year public or other) in which the course(s) were taken; number of earned credits in A&P; mean final grade in A&P); and time lapse between completion of the A&P course(s) and matriculation into the

nursing program. Only two of the variables were related to the grades on the screening A&P exam: mean final grade in A&P course(s) and type of college where the A&P course(s) were taken, but together only explained 18% of the variance.

In part two of the study, score on the screening exam was correlated with the final grade earned in the clinical course required spring of the junior year. “Simple regression of final scores in the second nursing course on the A&P screening test accounted for 9% of the variance. Since 91% of the variance remained unexplained, the six pre-admission and progression variables as well as score on the screening exam were regressed on student grades in the clinical course. Researchers reported that “mean final grade in prerequisite A&P course(s), type of college in which these courses were taken, and the number of credits earned in A&P explained 39% of the variance in the final” (Griffiths et al, 1995, p. 64) clinical course grade.

A study by Poorman and Martin (1991) was one of the first studies to address the impact of nonacademic variables on NCLEX-RN success. The purpose of this research was to determine the relationship of test anxiety, cognitions, and general academic performance on the NCLEX-RN success of 102 second-semester seniors, age 25 or younger, from two Bachelor’s degree-granting nursing programs in western Pennsylvania. The independent variables examined were SAT combined score, and cumulative GPA, “Test Anxiety Inventory (TAI) total score, TAI emotionality and worry subscales, self-perceived student grades, self-predicted NCLEX scores, concentration, negative and positive cognitions” (p. 27) (as measured by the Cognitive Assessment Tool), physical symptoms, and biggest worry related to the NCLEX exam as determined by the subjects themselves. Subjects were

interviewed, completed the self-report measures, and took the NCLEX-RN exam within a three-month time period.

"Pearson's product moment correlation, a stepwise regression, and chi square statistics were used to analyze the data" (Poorman & Martin, 1991, p. 25). Correlation results indicated that test anxiety was inversely related to a passing score on the NCLEX. The multiple regression revealed that self-predicted NCLEX score while self-perceived student grades were the best predictors of the actual NCLEX score and the score on the anxiety index was the third best predictor. The researchers called for further research on the role of nonacademic variables and NCLEX success.

Studies since 1994

Another major change to the NCLEX-RN exam took place in 1994 when "graduates were no longer tested by using paper and pencil format but took the test by using the computer adaptive testing format" (Beeson & Kissling, 2001, p. 121). Roncoli, Lisanti, and Falcone (2000) compared a stratified random sample of ethnically and racially diverse graduates from four graduating classes of a large, private northeastern university. A random sample of 19 graduates from the four classes who passed the NCLEX-RN were compared with 19 students for whom no record of passing was available. The students with no record of NCLEX passage were contacted and asked if they completed the NCLEX-RN in any state. If they had not, they were asked to share their perceptions of why they had not passed, and if English was their first language—strictly anecdotal information, not used in the study. Thirty-eight student records were retrospectively reviewed and information on several progression and exit predictor variables were determined: age at graduation, GPA at

graduation, science and nursing course grades, whether a student repeated science or nursing courses, if the student was a transfer student or not, and whether or not the student transferred from a community college or another baccalaureate program.

Chi-square results suggested there was “no significant difference in age between those who passed and for those for whom no passing record existed” (Roncoli et al., 2000, p. 18). Results showed that there was a significant GPA difference between the two groups, a significant difference “in the frequency of those getting As and Bs and those receiving Cs in science prerequisites, and a significant difference in frequency between those earning As and Bs in science prerequisites and those earning Cs” (p. 18). These data suggested that students who receive lower grades in science and nursing courses are not as likely to pass on the NCLEX-RN. Because the sample size was small, this investigation did not address “presence or absence of passing grades based on ethnicity or race” (p. 19).

The purpose of a large retrospective study by Beeson and Kissling (2001) was to discover predictors of success for upper-divisional baccalaureate nursing graduates on the NCLEX-RN. The 505 subjects were graduates of a nursing program in the southeastern United States from 1993 to 1998. The independent or preadmission variables included in the study were gender, type of admission (freshman, transfer, or second degree), and performance on specific prenursing courses; progression variables such as performance on sophomore, junior and senior nursing courses, and score on the Mosby Assess Test; and exit variables such as cumulative GPA at graduation, and age at the time of the licensing examination. The dependent or outcome variable was passage or failure on the NCLEX-RN on first attempt.

A two-sample *t*-test and the nonparametric Mann-Whitney test were used to identify possible predictors of the NCLEX-RN and results were similar. Noteworthy findings included the fact that nontraditional age students (23 years or older) tended to have a higher passing rate (95.7%) than did traditional age students (88.3%). Chi-square tests "were used to explore the associations between the categoric characteristics such as gender, entry status, number of Cs, Ds, and Fs, and outcome of the NCLEX-RN" (Beeson & Kissling, 2001, p. 123). Logistic regression (using stepwise variable selection) was used to predict outcome on the NCLEX-RN and demonstrated that "the number of Cs, Ds, and Fs in nursing courses through the junior year, the Mosby Assess Test scores from the end of the first semester of the senior year, and age group (traditional/nontraditional) were the best combinations of variables for predicting whether a person would fail the NCLEX-RN" (pp. 123-124).

The researchers cautioned that "as student populations become more diverse, predictors might change or previously unidentified variables may become important predicting successful completion of a nursing program and NCLEX-RN success" (Beeson & Kissling, 2001, p. 126). They also implored nurse educators to examine whether specific interventions might help at-risk students achieve better success on the NCLEX-RN.

Haas, Nugent, and Rule (2003) revealed findings from another upper-divisional nursing program study. Predictor variables of gender, race, age, verbal and quantitative SAT scores, transfer undergraduate GPA, cumulative undergraduate grade point average, campus location, in addition to nursing cumulative GPA, and dependent variable data on NCLEX-RN success were examined for 351 students who graduated from a nursing school in the southeastern United States between 1991 and 2001. The sample included primarily Caucasian women between the ages of 22 and 50 at the time of graduation.

Chi-square analysis of the relationship between NCLEX-RN success and a student's gender, race, or campus location and results indicated that women passed the examination at a significantly higher rate than men. Results indicated that Caucasian students pass at a significantly higher rate than African American students, who had a higher passing rate than the Asian students, but the pass rates for the Hispanic students were the highest. Fisher's exact test (two-sided) was implemented to diminish the effect of small numbers of Asian and Hispanic students in the study. There was no statistically significant difference in the pass rates of the two campus locations.

Interval data comparisons were performed on merit scores (developed and assigned by the Admission's office), verbal and quantitative SAT scores, transfer undergraduate GPA, cumulative GPA, nursing cumulative GPA, and age. The only statistically significant differences found were that passers on the exam exceeded failers in verbal and quantitative SAT scores, on nursing cumulative GPAs, and were younger than failers. In addition, a discriminant function analysis was performed in a stepwise manner with SAT scores, nursing GPA, age, race (converted to two categories), campus location, and gender. True passers were correctly identified 71% of the time and true failers were identified correctly 61.2% of the time. The researchers concluded, "if one assumes that intervention could have prevented the failure of just more than half of these 'true failers,' the NCLEX-RN pass rate for the institution would increase 3%" (Haas et al., 2003, p. 444).

Yin and Burger (2003) undertook a retrospective study examining the relationship of a number of variables evident at admission (to an ADN program) to the outcome variable of success on the NCLEX-RN on the first attempt. Independent variables "included age at admission; gender; race (white, Asian, African American, Hispanic, Native American, and

other); type of student (freshman admission/non freshman admission, LPN/non-LPN status, transfer student/non-transfer student status, and previous degrees); high school cumulative grade point average, high school class rank, ACT composite score; college grade point average and number of college credit hours prior to entering the nursing program; grade point average at graduation; and performance in required nonnursing courses (e.g., grades in English, introduction to psychology, and natural sciences such as anatomy and physiology, chemistry and microbiology)" (Yin & Burger, 2003, p. 233).

The sample included Associate degree graduates from 1997-2001, 285 of whom passed the NCLEX-RN on first attempt and 40 who did not, for a total of 325. Descriptive statistics indicated that the sample was 95% female and that the majority of graduates (94%) were white. The average age at admission was 26.7 with an age range from 18 to 55.

T-tests and chi-square tests were run to compare the characteristics of the group that passed the NCLEX-RN on first attempt and those who did not. No statistical differences between the groups were noted except college grade point average prior to admission (3.20 vs. 2.99), grade in introductory psychology (3.11 vs. 2.69), and grade average in natural science courses (3.11 vs. 2.85). Bivariate correlations were run on all continuous variables and GPA was determined to be significantly correlated with NCLEX-RN success (r =0.15, p < 0.01), as was overall natural science grade point average, and grade in introductory psychology, but these two correlations were not reported.

Several logistic regressions were performed and college grade point average prior to admission and high school rank were found to be significant. "Other variables such as age, gender, race, high school grade point average, ACT composite, and number of credit hours prior to entering the nursing program were not statistically significant predictors" (Yin &

Burger, 2003, p. 235). The findings indicated that when making admission decisions, admissions committees should look at college grade point average prior to admission and high school rank. Grades received in college-level biology, chemistry, anatomy, physiology, and psychology could also be examined, particularly if taken early in the student's ADN program. The researchers speculated that the small number of non-White students in the sample could have impacted the findings and that the higher attrition rate for non-White students, limiting the number included in the study, should be examined as well.

A national survey to identify predictors of success and interventions that enhance NCLEX-RN success was undertaken by Crow, Handley, Morrison, and Shelton (2004) which yielded electronic survey data from programs representing 38 states and the District of Columbia. Descriptive data included enrollment ranges from 15 to 485 in the professional portions of the programs. Sixty-eight percent of the programs were in urban areas, mean age at graduation was 25.47, and women comprised 91.34% of total enrollment. "The ethnic distribution was 81% White, 10.7% African American, 5.28% Hispanic, 5.7% Asian, and 2.11% Native American" (p. 276). First-time pass rate on the NCLEX-RN was 87.37 %.

Common admission requirements (and mean score required) included the college cumulative GPA (2.6), ACT score (20.11), high school GPA (2.59), SAT score (939.41), and letters of recommendation. Typical progression criteria (and survey frequencies) were course grades (98.10%), clinical performance (89.4%), and college cumulative GPA (66.30%). Only 16.25% of schools reported using NLN predictor tests as a progression criterion.

"Total number of credit hours required for graduation ranged from 120 to 144 with a mode of 128 and a mean of 127.34" (p. 177). Most schools required a 2.0 for graduation. Nearly one-half of the programs surveyed required demonstration of clinical proficiency and

almost 60% required an exit examination before graduation. More than one-fourth required students to participate in an NCLEX-RN review course, the most common ones being from Educational Resources, Inc., or Kaplan.

Programs to predict success on the NCLEX-RN exam used a variety of data. Ninety percent of programs used a comprehensive exam, the most frequent of which was the Mosby Assess Test (31.9%). Approximately one-third (29.4%) of the programs used cumulative GPA as a predictor of success, and slightly over one-third (36.3%) used specific course grades as a predictor of licensure exam success. The most frequently cited interventions used by the programs to help prepare graduates for NCLEX-RN success were academic referral (82.5%), commercial review courses (57.5%), social support referrals (56.7%, and computerized reviews (53.8%). Faculty-led reviews were reportedly used by only 26.3% of the programs surveyed (Crow et al., 2004, p. 182).

"The only admission criteria significantly correlated with passing NCLEX were use of a standardized entrance examination and SAT scores" (Crow et al., 2004, p. 183). Use of at-risk scores on the mental health NLN and the community health nursing NLN content exams were significant. In addition, two graduation requirements were significantly correlated with passing NCLEX—clinical proficiency and use of an exit examination (p. 183). Ethnicity was the only demographic variable significantly correlated with NCLEX passage with the percentage of Hispanic students negatively correlated and the percentage of White students positively correlated. The researchers noted that since their survey "did not include information related to specific students, therefore, it was not possible to determine what other variables"(p. 184) such as ESL, test anxiety, or number of hours worked per week

were perhaps contributing to the negative finding between NCLEX success and Hispanic ethnicity.

Daley, Kirkpatrick, Frazier, Chung, and Moser (2003) undertook one of the first studies to directly compare the Mosby Assess Test and Health Education Systems, Inc. Exit Examination, both standardized achievement tests. They also examined whether the differences existed between successful and unsuccessful students on first-attempt NCLEX-RN. A total of 224 graduating baccalaureate nursing students (from one school but) in two cohorts participated in this study. Most students were White women in their early twenties who graduated with a B+ cumulative GPA. The 1999 cohort (N=121) was required to take the Mosby Assess test before graduating but the 2000 cohort (N=103) was only strongly encouraged to take the HESI and 80 did so. Both groups sat for the NCLEX-RN after graduation. Demographic and academic characteristics of the two cohorts who took the NCLEX-RN in 1999 and 2000 and were successful or unsuccessful in their initial attempt of the exam were compared. Preadmission variables included student age, gender, ethnicity, prerequisite grade point average, and ACT scores. Progression variables included grades from courses taken during the freshman year prior to admittance into the nursing program such as grades in organic chemistry, inorganic chemistry, human anatomy, introduction to sociology, and zoology. Nursing course grades in pathophysiology, the senior medical-surgical theory course, and the senior medical-surgical clinical course. Independent *t*-tests or chi square tests were used to examine differences in demographic variables, program variables, and standardized test scores. No significant differences existed between the two cohorts ($p > .05$) for all variables.

However, there were significant differences within each cohort between the passers and failers. In the Mosby Assess Test cohort students successful on the NCLEX-RN were older, had earned a higher GPA on prerequisite courses required for admission, and had scored significantly higher on the ACT than those in the unsuccessful group. Specifically, students within the Mosby Assess Test cohort who were successful on first-attempt NCLEX-RN demonstrated better grades in anatomy, pathophysiology, and both the theory and clinical senior medical-surgical nursing courses, and, had higher cumulative grade point averages than the unsuccessful students.

In the HESI Exit Examination cohort, successful students demonstrated higher final course grades in the theory portion of the senior level medical-surgical course and higher overall cumulative grade point averages. “Ethnicity was the only (other) statistically significant variable between students who were successful on the NCLEX-RN and those who were not” (Daley et al., 2003, p. 394), but the validity of this finding was questioned because so few non-White students were in the group.

Students in the HESI Exit Examination cohort who were successful on the NCLEX-RN demonstrated higher final grades in the didactic portion of the senior level medical surgical course and higher cumulative GPAs. Both standardized examination scores (Mosby and HESI) were significantly different in students who were successful on the NCLEX-RN and those who were not. When the Mosby Assess Test and the HESI Exit Examination were compared, the latter examination “provided greater sensitivity, specificity, positive and negative predictive value, and test efficiency” (p. 394).

Seldomridge and DiBartolo (2004) conducted a retrospective study on recent graduates (N=186) of a rural, mid-Atlantic public institution between 1998 and 2002 who

took the computerized version of the NCLEX-RN initiated in 1994. The 174 women and 12 men began their college careers at the university where the study took place (n=95 or 51%), or had transferred to the university (n=91, or 49%). The dependent variable was first-attempt passage on the NCLEX-RN. Examination passers accounted for 80.6% of the total and failures accounted for 19.3%. Pre-admission independent variables were cumulative grade point average prior to the nursing program, individual grades in college level anatomy and physiology I, pathophysiology, chemistry, statistics, and total number of C or lower grades in these prerequisite courses. Progression variables at the end of the junior year were cumulative grade point average after first semester junior nursing courses, number of C grades in junior year nursing courses, and test scores in Adult Health I and Adult Health II. Progression independent variables studied during the senior year included number of Cs in all nursing courses, and percentile score on the NLN Comprehensive Achievement Test for Baccalaureate Students (NLN-CATBS), normed nationally, which students take two weeks prior to graduation.

Correlation coefficients determined for the continuous variables, and percentile score on the NLN revealed the highest correlation with NCLEX-RN success (r = .452, p=.000). The next highest correlation coefficients were for "grade in pathophysiology (r =.377, p=.000), and test average in the advanced medical/surgical course (r = .303, p =.000)" (p.363). Two variables were negatively correlated with NCLEX-RN success: patterns of low grades in prerequisites (r = -.245, p =.002), and nursing courses (r = -.342, $p \leq .000$).

A two-sample t-test or the nonparametric Mann-Whitney test was used to examine the differences between the passers and failures. "Those successful on the NCLEX-RN had significantly higher test averages in both medical/surgical nursing courses, had higher GPAs

(upon entry to nursing courses, at the end of 1 semester of nursing courses, and on program completion), and performed at a higher level on the NLN-CATBS" (pp. 363-364).

Stepwise regression analyses were performed using the aforementioned pre-admission variables, progression variables from the end of the junior year, and progression variables from the senior year. Performance in pathophysiology was the only statistically significant preadmission variable. "Students who passed the NCLEX-RN were correctly classified 100% of the time based on their grade in pathophysiology…For each letter grade increase in pathophysiology, the odds of passing the NCLEX-RN improved by nearly 5 times" (p.364). The second logistic regression model used data from the end of the junior year. The test averages from the medical/surgical theory and medical/surgical clinical courses correctly predicted NCLEX-RN passage 98.7% of the time but correctly predicted failure only 5.6% of the time for an overall prediction accuracy rate of 80.6%. "For every one-point increase in each test average, the odds of passing improved by 1 time" (p. 364). The third model, using data from the senior year, revealed scores on the NLN-CATBS correctly predicted 94.7% of the passers on the NCLEX-RN and 25% of the failures. "For every one point increase in percentile score, the odds of passing the NCLEX-RN increased by nearly 11 times" (p. 365). Overall correct prediction rate was 84.2%. The average for Adult Health II was also significant, correctly predicting 94% of passers and 33% of failures for an overall correct prediction rate of 82.3%.

A final regression model used variables from all three time periods and revealed that during step 1, score on the NLN-CATBS correctly predicted passage on the NCLEX-RN 94.7% of the time, and failure 25% of the time. On step 2, grade in pathophysiology

improved the prediction of failures to 50% but correct prediction of passers fell to 93.3% for an overall prediction success rate of 84.9%.

Admission criteria have been revised at the researchers' institution as a result of this study and more focus is being placed on native (to the university) versus nonnative status and on an applicant's grades on 60 credits of prerequisites. In addition, a computerized intervention tool is required of all students beginning with the first semester of the nursing program.

Summary

Although predictors of academic and NCLEX-RN success in baccalaureate nursing programs have been well documented, far fewer studies have addressed pre- and post-admission predictors of success for associate degree nurses. Prior studies identified a variety of predictors of nursing program and first-attempt NCLEX-RN success for baccalaureate and associate degree nurses.

Demographic variables such as parents' age, educational levels, financial status (Campbell & Dickson (1996), and race (Horns, O'Sullivan, & Goodman, 1991) were found to be predictors of NCLEX-RN success for baccalaureate nursing graduates. Pre-admission variables such as ACT scores were found to predict NCLEX-RN success (Campbell & Dickson, 1996) for these same students. A number of studies found ACT composite to predict final nursing grade point average (Feldt & Donahue, 1989; Fowles, 1992; Yang, Glick, & McClelland, 1987) and NCLEX-RN success (Feldt & Donahue, 1989; Fowles, 1992; McClelland, Yang, & Glick, 1992). Several studies revealed that SAT verbal (Foti & DeYoung, 1991; Haas, Nugent, & Rule, 2003; McKinney, Small, O'Dell, & Coonrod, 1988; Payne & Duffey, 1986; Quick et al., 1985), and SAT quantitative (Haas et al., 2003) were

predictive of NCLEX-RN success. High school rank was found to be a predictor of NCLEX-RN success (Feldt & Donahue, 1989; Oliver, 1985; Wall, Miller, & Widerquist, 1993; Yin & Burger, 2003) as were grades in high school biology and English (Oliver, 1985). A large number of studies found pre-nursing grade point average to be a predictor of nursing program success (Glick, McClelland, & Yang, 1986; McClelland et al., 1992; Yang et al., 1987) and NCLEX-RN success (Payne & Duffey, 1986; Quick et al., 1985; Whitley & Chadwick, 1986; Yang et al., 1987; Yin & Burger, 2003) for baccalaureate nursing graduates.

Progression variables found to be significant predictors of nursing program success and/or NCLEX-RN success for baccalaureate nursing graduates included science course grades: biology (Glick et al., 1986; Yang et al., 1987), chemistry (Campbell & Dickson, 1996; Feldt & Donahue, 1989; Yang et al., 1987;), anatomy and/or physiology (Feldt & Donahue, 1989; Fowles, 1992; Quick et al., 1985), pathology (Glick et al., 1986), pathophysiology (Seldomridge & DiBartolo, 2004), and a composite of science grades (Wall et al., 1993; Younger & Grap, 1992). In addition, a large number of studies revealed nursing grade point average to be significant predictors of nursing program and/or NCLEX-RN success for these same graduates. Krupa, Quick, and Whitley (1988) found grades in the introductory nursing course to be the greatest contribution to NCLEX-RN success as did Fowles (1992). Grades in the second level nursing courses (Beeson & Kissling, 2001; Horns et al., 1991; Wall et al., 1993), third-level nursing courses (Beeson & Kissling, 2001; Griffiths, Bevil, O'Conner, & Wieland, 1995; Horns et al., 1991; Jenks, Senkleman, Bross, & Paquet, 1989; Payne & Duffey, 1986, Seldomridge & DiBartolo, 2004), and fourth-year nursing courses (Beeson & Kissling, 2001; Jenks et al., 1989; Payne & Duffey, 1986; Waterhouse, Bucher, & Beeman, 1994) in baccalaureate programs were found to be

significant predictors as well. Final nursing grade point average made a contribution to NCLEX-RN success for baccalaureate graduates in studies reviewed by Campbell & Dickson, 1996; Mills, Becker, Sample, & Pohlman, 1992, Waterhouse, Carroll, & Beeman, 1993). Finally, grades earned on nationally normed nursing achievement exams typically administered during the latter part of a nursing program were found to be predictors of baccalaureate nursing program success (Fowles, 1992;) or NCLEX-RN success (Alexander & Brophy, 1997; Beeson & Kissling, 2001); Foti & DeYoung, 1991; Horns et al., 1991; Jenks et al., 1989;McKinney, Seldomridge & DiBartolo, 2004, Small, O'Dell, & Coonrod, 1988; Wall et al., 1993).

Studies of associate degree nursing graduates revealed that high school rank, grades in high school biology courses and high school English courses (Oliver, 1985) showed a significant relationship with academic success. Lengacher & Keller (1990) found that year two (of two years) nursing theory grades made the most significant contribution to NCLEX-RN performance. Alexander & Brophy (1997) revealed that grade point average at the end of the first year of the associate degree nursing program was equally effective in predicting NCLEX-RN success as was grade point average at the end of the second year of the program. Finally, Yin and Burger (2003) found that an associate degree students' high school rank in addition to college grade point average prior to admission were significant contributors to NCLEX-RN success. The literature clearly suggests that academic success as measured by nursing program final grade point average and first attempt NCLEX-RN passage can be predicted by a number of pre-admission and progression variables. The best predictors tend to be program specific.

CHAPTER 3. METHODOLOGY

A predictive tool would be useful in identifying associate degree nursing students who have the potential to successfully complete an associate degree registered nursing program and pass the National Council Licensure Examination for Registered Nurses (NCLEX-RN) on their first attempt. The purpose of this study was to evaluate the predictive ability of six preadmission variables and five progression variables on final grade point average and first attempt success on the NCLEX-RN for St. Luke's ADN students graduating between 1998 and 2005. This chapter discusses the methodology used in determining the correlational predictive study. This chapter addresses: (1) Research Design; (2) Study Population; (3) Procedures; (4) Protection of Human Rights; and (5) Data Analysis.

Research Design

The present exploratory study was conducted using a quantitative nonexperimental design. The dependent variables were measures of academic success, including final grade point average in the ADN program and first-attempt passage on the national certification examination for registered nurses. Independent variables included preadmission and progression variables suggested by past studies as noted in the literature review and my own experience as an administrator in a health science college. Preadmission variables included high school grade point average, high school rank, ACT composite score, ACT reading score, number of college credits transferred into the College that directly applied to the nursing program of study, and grade point average on those credits. Progression variables included college grade on each of three required college level co-curricular sciences courses,

first-term grade on the only required nursing theory course for that semester, and second term grade on the only required second term nursing course.

Study Population

The population included nursing graduates and non-completers from a small private, health-system based associate degree granting college in the Midwest from 1998 through 2005, or 404 students. The student population was basically homogeneous, and comprised primarily of female (91%), Caucasian (98%), and in-state (92%) students**.**

Procedures

Descriptive statistics were generated for the 11 predictor variables. Scatterplots for relationships on the independent or predictor variables (continuous) were examined for evidence of linear relationships and outliers. Scatterplot results were confirmed by examining the intercorrelations among predictor variables. Because the variables were used in regressions, it was necessary to examine the extent of multicollinearity among predictors.

Criterion variable descriptive statistics were run as well as a Pearson correlation for final grade point average and certification passage on first attempt. Predictor-criterion correlations were generated and examined for statistical significance.

Two stepwise backward multiple linear regressions were run in which each of the six preadmission variables was used to predict final grade point average and each of the five progression variables was used to predict final grade point average. Two multiple logistic regressions were conducted examining the same pre- and progression variables on first attempt passage on board exams.

A one-way analysis of variance (ANOVA) was estimated using the aforementioned 11 predictor variables in addition to a demographic variable of age at first semester, and a previous dependent variable of final grade point average for each of three groups: (1) students who completed the ADN program and passed the NCLEX-RN on first attempt; (2) students who completed the ADN program but did not pass the NCLEX-RN on first attempt; and (3) students who did not complete the ADN program and therefore were not eligible to sit for the national certification examination.

Statistics were generated with the use of SPSS. Formerly known as "Statistical Package for the Social Sciences," it is now "Statistical Product and Service Solutions," a Chicago-based firm.

Human Subjects Approval

The college Registrar supplied the data for this research. Students' names were assigned a number according to their graduation year and the results of the study were determined with this system. Permission to complete the study was obtained from the Chancellor of the college, and the methods were reviewed by the researcher's University's Institutional Review Board (Appendix A). Correspondence affirming consent to conduct the study at St. Luke's and utilize archival data appear in Appendix B.

Data Analysis

Several assumptions regarding the data were made to make valid interpretations of the data using multiple linear and logistic regressions. The first assumption relates to the sampling technique. Creating a random and independent sample was not a concern to this

researcher. No sampling techniques were used for this study as data included all members of the student population graduating and non-completers who attended between 1998 and 2005.

Regarding multiple linear regression, it was assumed that the relationships between variables were linear. Scatterplots of the variables were examined for violations of the assumption. It was also assumed that the residuals (predicted minus observed values) were normally distributed. Histograms of the residuals were examined for all variables.

Conversely, logistic regression makes no assumption about the distribution of the independent variables. They do not have to be normally distributed, linearly related or of equal variance.

A one-way analysis of variance assumes that sample or population distributions are approximately normal and have the same variance. The data used for this study constitute a "sample in time," for which eight years of students' data from the college were studied. The different classes of students appear to be independent from each other in that new sets of students are enrolled each year and there are statistical differences between classes as noted in this study.

CHAPTER 4. RESULTS

The purpose of this study was to analyze pre-admission and post-admission criteria on St. Luke's College ADN students to predict final program grade point average and first-time passage on the national nursing certification examination for registered nurses (NCLEX-RN). Another purpose was to determine if there were any differences between the group of students who successfully finished the program and passed the NCLEX-RN exam on the first attempt, those who finished the program but did not pass the exam on the first attempt, and the group of students who did not finish the program and were not eligible to take the certification exam.

The objective of the study was to identify predictors of success as early as possible in the student's career. There were three research questions guiding the investigation:

1. Which pre- and post-admission variables are the best predictors of academic success as measured by final grade point average?
2. Which pre- and post-admission variables are the best predictors of academic success as measured by first-attempt passage on the NCLEX-RN?
3. Are there significant differences in the groups of students who finish the ADN program and pass NCLEX-RN on the first attempt, those who finish the program but don't pass the NCLEX-RN on first attempt, and those who never finish the program, and therefore are never eligible to take the licensure exam?

Characteristics of the Population

The subjects in this study were 404 graduates and non-completers of a nursing program between 1998 and 2005 from a private, health-system based, associate degree-

granting college in the Midwest. The student population was basically homogeneous during this time—primarily female (91.3%), Caucasian (98%), and instate (92%). The average age at first semester during this eight-year time period was 22.60 years, with a standard deviation of 6.24 years. Two hundred forty-three (58.55%) of those who started had finished the program, and graduated with a collective mean 3.0828 grade point average (*SD* = .4743). The 11 students who withdrew or were dismissed and then returned later to graduate were counted twice, once as non-completers and again as completers, making a total of 415 usable observations. Of the 242 graduates who sat for the NCLEX-RN (one did not attempt the exam), 206 (85%) passed on the first attempt.

Of the 172 non-completers, 1 had a missing file, 11 (6.83%) eventually completed, 12 (7.45%) were dismissed, 4 (2.5%) matriculated but never showed up (*n* = 3) to take classes or died (*n* = 1) while enrolled as a student, and the remaining 133 (83%) withdrew. Of the students who withdrew, 46 (34%) exited during the first term, 58 (43%) did so during or in the early summer following the second semester, 18 (13%) exited during the third semester, 9 (7%) left during the fourth semester, and 5 (3%) withdrew during the fifth or sixth semesters of an atypically elongated program (the prescribed time to degree is four semesters).

To address the first research question, the study examined the population of ADN students and their scores on 11 independent variables (with some missing data): high school grade point average (HSGPA), high school rank (HSR), ACT composite scores (ACTC), ACT reading scores (ACTR), college credits successfully transferred in prior to the start of the nursing curriculum (PCOLCR), college grade point average on those transfer credits (PCOLGPA), grade in Nursing I theory course (N1), grade in Nursing II theory course (N2), grade in anatomy course (A), grade in physiology course (P), and grade in microbiology

course (M). These continuous values were used as predictor variables in a stepwise backward elimination multiple regression analysis (in which all independent variables are entered at the initial step and in successive steps the independent variable with the highest *p*-value is eliminated) predicting the continuous dependent variable of final grade point average in the associate degree nursing program.

To address the second research question, the study examined the same pre- and post-admission information available on all students who completed the ADN program. In addition, these data were used as independent variables in a logistic regression, with the dichotomous yes/no outcome on first attempt passage success as the dependent variable.

The third research question was addressed by examining the results of a one-way analysis of variance (ANOVA) model. The ANOVA used all of the aforementioned 11 predictor variables in addition to a demographic variable of age at first semester, and a previous dependent variable of final grade point average, for each of three groups: (1) students who completed the ADN program and passed the NCLEX-RN on the initial attempt, (2) students who completed the ADN program but did not pass the NCLEX-RN on the first attempt, and (3) students who did not complete the ADN program and therefore were not eligible to sit for the national certification examination.

Null Hypotheses

Three null hypotheses were formulated and tested for this study:

1. There is no significant relationship between preadmission variables of high school grade point average, high school rank, ACT composite score, ACT reading score, pre-college credits, and pre-college grade point average, as well as post-admission

variables of first-term nursing theory grade, second-term nursing theory grade, anatomy course grade, physiology course grade, microbiology course grade, and final grade point average for St. Luke's ADN students graduating between 1998 and 2005.

2. There is no significant relationship between the same pre- and post-admission variables and first-attempt success on the NCLEX-RN for the same graduates.
3. There are no significant differences in mean values of the independent variables between students who finish the ADN program and pass the NCLEX-RN on the first attempt, those who finish the ADN program but do not pass the NCLEX on the first attempt, and those who do not finish the ADN program and therefore are not eligible to sit for the NCLEX-RN licensure examination.

Results

SPSS was used for interpreting the data in this exploratory study. Descriptive statistics were generated for the 11 independent variables and the two dependent variables. Scatterplots were produced for all bivariate relationships between independent and dependent variables and for each pair of independent variables. Pearson product-moment correlations among the independent variables and between the independent and dependent variables were estimated.

A stepwise backward elimination multiple regression model was estimated in which all 11 independent variables were used to predict final grade point average. In addition, a multiple logistic regression model was estimated using the 11 independent variables in addition to age at first semester and final grade point average to predict first-attempt NCLEX-RN board passage. Finally, a one-way ANOVA model was estimated to determine

if there were significant differences between three groups: completers and passers, completers and nonpassers, and noncompleters who were not eligible to take the NCLEX-RN exam.

Descriptive statistics

Descriptive statistics for the 11 independent variables are shown in Table 1. The mean high school grade point average and mean high school rank were 2.92 and 56%, respectively. The mean for college credits transferred in was 11.47, and the mean grade point average for those credits was 3.01. The mean ACT composite score (20.54) for the sample was lower than the national mean (20.89) for college-bound students who took the ACT exam at the beginning of the 12^{th} grade (between 1995 and 2002). The sample standard deviation of 3.67 was smaller than the standard deviation for the same national population

Table 1. Descriptive statistics for the predictor variables

Predictors	Mean	S.D.	*N*
HSGPA	2.93	.59	384
HSR	.5594	.23	374
PCOLCR	11.47	10.22	414
PCOLGPA	3.01	.56	327
ACTCOMP	20.54	3.67	320
ACTR	20.99	4.90	316
N1	2.73	1.02	362
N2	2.75	.95	282
A	2.73	1.01	392
P	2.69	1.00	338
M	2.85	.85	281

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

taking the exam during the fall of those years, 4.68 (ACT High School Profile Reports 1995–2003, www.act.org/news/data.html).

Missing data on several variables were a concern. Thirty-one cases (11%) were missing a high school grade point average and 41 cases (13%) were missing a high school rank. Seven students had GED scores submitted in place of high school grade point average and rank, and 8 students completed high school in another country. Therefore, it was not possible to infer comparable high school grade point average or rank from these 15 cases. Ninety-six cases (23%) were missing or never included ACT composite and/or reading ACT scores. Sixty of these students had taken the ASSET test in place of the ACT, but ASSET assesses only reading, English, and mathematics whereas no composite score is calculated for the assessment. In addition, there is no published conversion table that equates ASSET scores to ACT scores, and psychometric professionals for each instrument do not recommend attempting to do so as they are not equivalent measures (1997 ACT Technical Manual, p. 82).

The registrar and staff at the college made a concerted effort to examine other databases, such as their annual Integrated Postsecondary Education Data System (IPEDS) report for the missing information. They also contacted high schools for the missing information, and even checked the hard copy admission files in case the original information had been overlooked. These efforts recovered 31 high school grade point averages and 41 high school ranks, but no additional ACT scores. Missing data on ACT composite scores were addressed by using a regression equation to estimate the missing scores from the predictor variables. These data have the strongest relationship with ACT composite (excluding other ACT subscores because of high collinearity): high school grade point

average (b = .575, p <.01 [two-tailed]), grade in college anatomy (b = .375, p <.01 [two-tailed]), and previous college grade point average (b = .311, p <.01 [two-tailed]). The three predictor variables combined explained 40.8% of the variance; however, previous college grade point average was not significant. A regression estimated without previous grade point average indicated that high school grade point average combined with grade in anatomy explained 37.2% of the variance in ACT composite score, and a regression estimated with high school grade point average alone predicted 33% of the variance in ACT composite score. This extrapolation produced data for 69 cases that were combined with the cases with original ACTC scores for a new variable, termed NewACTC, with a mean of 21.15, 0.61 points higher than the mean of the original ACTC and a standard deviation of 3.67 which was .0149 higher than the original ACTC standard deviation.

Intercorrelations

Scatterplots were constructed for all relationships among the independent or predictor variables (all continuous). The researcher was looking for linear relationships among each pair of variables and for outliers. Most of the scatterplots looked acceptable in that they suggested linear relationships. Scatterplot information was confirmed by examining intercorrelations among the predictor variables. Scatterplots of the original ACT composite and the new ACT composite (paired with the other predictor variables) appeared very similar, and intercorrelations were very similar except for previous college credits, which changed from a significant r = .402 correlation for the original ACT composite to a nonsignificant r = -.031 with the new ACT composite.

The intercorrelations among the predictor variables are shown in Table 2. Because these variables were used in subsequent regressions, it was necessary to examine the extent of multicollinearity among predictors. Correlations ranged from *r* = -.031 (HSR with PREVCOLC) to *r* = .842 (NewACTC with ACTR). Two-thirds of the correlations were greater than .30, and 31% were greater than .40. The three highest (and significant) correlations among predictor variables (NewACTC with ACTR [*r* = .842], HSGPA with HSR [*r* = .662], and N1 with N2 [*r* = .671]), impacted later decisions regarding which

Table 2. Intercorrelations among the predictor variables

Subscale	1	2	3	4	5	6	7	8	9	10	11
1. HSGPA	-	.662*	-.043	.401*	.609*	.474*	.358*	.310*	.378*	.322*	.317*
2. HSR		-	-.031	.308*	.467*	.332*	.287*	.254*	.321*	.295*	.189*
3. PCOLCR				-.117	-.063	-.068	.271*	.260*	-.147	-.029	.065
4. PCOLGPA					.362*	.320*	.364*	.367*	.530*	.412*	.393*
5. New ACTC						.842*	.407*	.270*	.380*	.338*	.264*
6. ACTR							.323*	.226	.339*	.300*	.246*
7. N1								.671*	.486*	.352*	.402*
8. N2									.474*	.500*	.540*
9. A										.589*	.369*
10. P											.542*
11. M											

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

* Denotes (1-tailed) significance ($p \leq .001$).

variables to take out of the regression models. Consequently, the correlations among predictors were mixed overall, with 9 very small to small (from r = -.031 to r = .189), 42 medium (from r = .226 to r = .589), and only 4 large (> r = .60). Lower correlations among predictor variables help with interpretation of regression weights.

Final GPA and first-attempt success on NCLEX-RN

Students' mean final grade point average at the end of the associate degree program was 3.08 (SD = .474, N = 243). A total of 206 (85 %) of these students passed their certification exam on the first attempt.

Final GPA and passage on 1st attempt

The Pearson correlation between final grade point average and certification passage on first attempt was r = .372 ($p \leq .01$ two-tailed). This would be considered a medium-sized positive correlation.

Predictor-criterion correlations

The predictor-criterion correlations are presented in Table 3. As shown in Table 3, 10 of the 11 predictor variables—high school grade point average, high school rank, new ACT composite, ACT reading, previous college transfer grade point average, Nursing 1, Nursing 2, Anatomy, Physiology, and Microbiology—were statistically significantly related to final grade point average. These correlations suggest that final grade point average is related to 10 out of 11 hypothesized predictors.

Table 3. Correlations of predictor variables with final grade point average

Measures	Correlation	Significance
HSGPA	.402*	< .001
HSR	.324*	< .001
PCOLCR	.004	.953
PCOLGPA	.644*	< .001
NewACTC	.461*	< .001
ACTR	.455*	< .001
N1	.757*	< .001
N2	.820*	< .001
A	.687*	< .001
P	.718*	< .001
M	.672*	< .001

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

* Denotes (1-tailed) significance ($p \leq .001$).

The correlations among the 11 predictors and the board passage rate on the first attempt variable are shown in Table 4. Eight of the 11 predictors had a statistically significant correlation with NCLEX-RN passage on first attempt.

Table 4. Correlations of predictor variables with 1st attempt passage on certification exam

Measures	Correlation	Significance
HSGPA	.124	.062
HSR	.067	.316
PCOLCR	.031	.634
PCOLGPA	.644*	< .001
NewACTC	.232*	< .001
ACTR	.230	.001
N1	.341*	< .001
N2	.327*	< .001
A	.258*	< .001
P	.284*	< .001
M	.236*	< .001

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

* Denotes (1-tailed) significance ($p \leq .001$).

Inferential statistics

Regression of final grade point average on predictor variables

Null hypothesis 1: No significant relationship exists between pre- and post-admission variables on final grade point average for St. Luke's ADN students.

The results of stepwise backward multiple linear regression in which all of the pre- and post-admission variables were used to predict final grade point average are shown in Table 5. Model 1 accounted for over 91% of total variance in final grade point average. It is important to note that when individual variables were removed during the regression, the change in R^2 between the models was very small. In Model 7, previous college credits, previous college grade point average, grade in Nursing I theory, grade in Nursing II theory, and grades in Anatomy, Physiology, and Microbiology together predict as well as the original predictor variables in addition to the three demographic variables. Grade in Nursing II makes more of a difference in determining final grade point average than do grade in Nursing I, previous college GPA, grade in Physiology, grade in Microbiology, grade in Anatomy, and previous college credits.

In summary, this regression model verifies that almost 92% of the variance in final cumulative grade point average can be predicted with 8 of the pre- and post-admission variables—at least three of which are pre-admission variables for most applicants—available prior to acceptance. Thus, one can reject the null hypothesis of no significant relationship of pre- and post-admission variables with final grade point average for St. Luke's ADN students.

Table 5. Prediction of final GPA

Model	Predictor Variables	Betas	Significance
1	Constant	.021	<.001
	ID Categories		.420
	SEX	-.012	.629
	AGE 1st Semester	.011	.689
	HSGPA	.000	.995
	HSR	.025	.445
	NEWACTC	-.018	.729
	ACTR	.057	.203
	PCOLCR	-.092*	<.001
	PCOLGPA	.186*	<.001
	N1	.247*	<.001
	N2	.369*	<.001
	A	.102	.004
	P	.162*	<.001
	M	.165*	<.001
	R^2	.915	
2	Constant		.001
	ID Categories	.021	.418
	SEX	-.012	.619
	AGE 1st Semester	.011	.662
	HSR	.025	.382
	NEWACTC	-.018	.710
	ACTR	.057	.201
	PCOLCR	-.092*	<.001
	PCOLGPA	.186*	<.001
	N1	.247*	<.001
	N2	.369*	<.001
	A	.102	.004
	P	.162*	<.001
	M	.165*	<.001
	R^2	.915	
3	Constant		<.001
	ID Categories	.822	.412
	SEX	-.012	.616
	AGE 1st Semester	.011	.684
	HSR	.021	.423
	ACTR	.044	.103
	PCOLCR	-.091	.001
	PCOLGPA	.085*	<.001
	N1	.245*	<.001
	N2	.370*	<.001
	A	.102	.004
	P	.161*	<.001
	M	.165*	<.001
	R^2	.915	

Table 5. (Continued).

Model	Predictor Variables	Betas	Significance
4	Constant		<.001
	ID Categories	.022	.383
	SEX	-.014	.565
	HSR	.020	.440
	ACTR	.044	.101
	PCOLCR	-.089	.001
	PCOLGPA	.185*	<.001
	N1	.247*	<.001
	N2	.372*	<.001
	A	.102	.004
	P	.162*	<.001
	M	.164*	<.001
	R^2	.915	
5	Constant		<.001
	ID Categories	.022	.378
	HSR	018	.489
	ACTR	.045	.094
	PCOLCR	-.090	.001
	PCOLGPA	.182*	<.001
	N1	.246*	<.001
	N2	.372*	<.001
	A	.105	.003
	P	.163*	<.001
	M	.164*	<.001
	R^2	.915	
6	Constant		<.000
	ID Categories	.021	.410
	ACTR	.048	.066
	PCOLCR	-.090	.001
	PCOLGPA	.185	.001
	N1	.248*	<.001
	N2	.373*	<.001
	A	.106	.002
	P	.166*	<.001
	M	.163*	<.001
	R^2	.915	
7	Constant		<.001
	ID Categories		
	ACTR	.045	.080
	PCOLCR	-.091	.001
	PCOLGPA	.185*	<.001
	N1	.243*	<.001

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

* Denotes (1-tailed) significance ($p \leq .001$).

Regression of first-attempt passage on board exams on predictor variables

Null hypothesis 2: No significant relationship exists between pre- and post-admission variables and first-attempt NCLEX-RN passage for St. Luke's ADN students.

A multiple logistic regression model was estimated regressing 3 demographic variables, the 5 pre-admission variables, and 4 of the 5 post-admission variables on first attempt board passage. Microbiology grade was excluded because, while a few students take microbiology before enrolling at St. Luke's, some students take it early in their program of study and many take it the fourth, or last, semester. One hundred sixty-seven cases (40.2%) without missing data were included in the analysis.

Block 1 included three demographic variables: sex, age at first semester, and ID category (each graduating class between 1998 and 2005). The three collectively were not significant. The .067 Naglekerke R^2 value (with a maximum possible value of 1.0) indicates that first-attempt passage could be accounted for only minimally by these three variables. The classification table indicated that the regression could not predict correctly any of those who did not pass.

Block 2 added the preadmission variables of high school grade point average, high school rank, New ACT Composite, the ACT Reading score, previous college credits, and previous college grade point average to the model. The block was not significant by itself, but the combined effect of Blocks 1 and 2 was barely significant (p = .034. The Naglekerke R^2 value improved to .177, indicating that first-attempt passage could be accounted for more adequately by all 9 predictor variables. The classification table for the block indicated correct classification of 3.8% of the non-passers but 99.3% of the passers.

Block 3 added information known by the end of the first semester of the nursing program—the first nursing theory course grades and anatomy grades—to the regression. Blocks 1, 2, and 3 collectively were significant (p = <.001). The Naglekerke R^2 value improved to .366 and the classification table indicated correct prediction of 38.5% of the nonpassers and 97.2% of the passers.

Block 4 added nursing theory II grades and physiology grades to the model, information known at the end of the second semester. For all 4 blocks collectively p = < .001. Table 6 depicts the full model whereas Table 7 depicts the limited model. After Block 4, the Naglekerke R^2 value improved to .458, indicating that the dependent variable could be

Table 6. Full regression model

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	SEX	1.430	.895	2.553	1	.110	4.178	.723	24.132
	AGE1SEM	.121	.128	.890	1	.345	1.129	.878	1.452
	IDRCD	-.337	.145	5.394	1	.020	.714	.537	.949
	HSGPA	-.196	.866	.051	1	.821	.822	.150	4.489
	HSR	-2.923	1.889	2.395	1	.122	.054	.001	2.180
	NewACTC	.454	.191	5.655	1	.017	1.574	1.083	2.288
	ACTR	-.116	.098	1.397	1	.237	.890	.735	1.079
	PCOLCR	-.069	.040	2.943	1	.086	.934	.863	1.010
	PCOLGPA	-1.846	.675	7.476	1	.006	.158	.042	.593
	N1	.928	.574	2.612	1	.106	2.529	.821	7.793
	A	.634	.471	1.811	1	.178	1.885	.749	4.743
	N2	1.753	.687	6.516	1	.011	5.771	1.502	22.166
	P	.350	.456	.588	1	.443	1.419	.580	3.469
	Constant	-8.280	3.902	4.503	1	.034	.000		

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

Table 7. Limited regression model

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)									
	IDRCD	-.337	.145	5.394	1	.020	.714	.537	.949
	NewACTC	.454	.191	5.655	1	.017	1.574	1.083	2.288
	PCOLGPA	-1.846	.675	7.476	1	.006	.158	.042	.593
	N2	1.753	.687	6.516	1	.011	5.771	1.502	22.166
	Constant	-8.280	3.902	4.503	1	.034	.000		

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

accounted for much more successfully by all included predictor variables. The classification table for the full model (Table 8) indicates that one could now correctly classify 12 of 26, or 46.2% of the nonpassers and 99.3% of the passers. The overall rate of correct classification with the full model was 91%.

Table 8. Classification table for the limited regression model

	Observed		Predicted		
			CERT		
			not pass	pass	Percentage Correct
Step 1	CERT	not pass	12	14	46.2
		pass	1	140	99.3
	Overall Percentage				91.0

Cut value = .500.

Five cases did not pass when they were expected to pass. A closer examination of the cases did not reveal any consistent themes except that all were female. There was no high school grade point average and rank for 2 cases, no high school rank on 1, no ACT scores for 4 of the 5 cases, and 4 of the 5 earned a 2.0 in the first nursing theory course while 1 earned a 2.5 grade in the same course. One can reject the null hypothesis of no significant relationship between pre- and post-admission variables on first attempt NCLEX-RN passage for St. Luke's ADN students.

As shown in Table 9, examination of a cross-tabulation of sex by certification revealed that females in the study were about 4 times as likely as males to pass the NCLEX-RN on first attempt as compared to not pass. This indicates proportionately a much higher success versus not success rate for females than for males, confirming the odds ratio indicated in Table 9. A cross-tabulation of IDRecode by certification revealed that the pass rate ranged from a low of 84.58% to a high of 84.86%, and the not pass rate from a low of 15.13% to a high of 15.41%. A cross-tabulation of new ACT composite by certification (CERT) revealed that students with one unit higher score on new ACT composite were approximately 57.4% more likely than students with one unit less to pass the NCLEX-RN on first attempt. A cross-tabulation of grades in the second semester nursing theory course (N2) by certification (CERT) revealed that, for every one-unit grade increase (C to B, B to A), a student was approximately 6 times more likely to pass than not pass for that higher grade confirming the odds ratio indicated in Table 9. The odds were almost 6 to 1 that students would be more likely to pass than not pass if they had one unit higher N2 grade. A cross-tabulation of previous college grade point average (PCOLGPA) by certification (CERT) revealed that as PCOLGPA increases by 1 unit (say from a 2.0 to a 3.0), the odds of passing

Table 9. Classification summary for 1998 to 2005 graduates

Predictor Variables	Significance Sample (n = 167) Intercept	Odds Ratio
SEX	.110	4.178
AGE 1st Semester	.345	1.129
IDRCD (class)	.020	.714
HSGPA	.821	.822
HSR	.122	.054
NEWACTC	.017	1.574
ACTR	.237	.890
PCOLCR	.086	.934
PCOLGPA	.006	.158
N1	.106	2.529
A	.178	1.885
N2	.011	5.771
P	.443	1.419
Constant	.034	.000

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

are only about 15.8% as large as the odds of not passing. A cross-tabulation of grades in the first semester nursing theory course (N1) by certification (CERT) revealed that for every one unit grade increase, a student was about 2.5 times more likely to pass than not pass the NCLEX-RN on first attempt. A cross-tabulation of grades in Anatomy (A) by certification (CERT) revealed that, for every one unit grade increase, a student was about twice as likely to pass than not pass the NCLE-RN on first attempt. Finally, a cross-tabulation of grade in Physiology (P) by certification (CERT) revealed that, for every one unit grade increase, a student was about 1.5 times as likely to pass than not pass the certification exam on first attempt.

One-way analysis of variance

Null hypothesis 3: There is not a significant difference among students who finish the ADN program and pass the NCLEX-RN on the first attempt, those who finish the ADN program but do not pass the NCLEX on the first attempt, and those who do not finish the ADN program and therefore are not eligible to sit for the NCLEX-RN licensure examination.

The third research question was addressed by examining the results of one-way analysis of variance using the 11 predictor variables in addition to a demographic variable of age at first-semester, and a previous dependent variable—final grade point average for three groups: (1) completed the ADN program and passed the NCLEX-RN on the initial attempt (*n* = 206); (2) completed ADN program but did not pass the NCLEX-RN on the first attempt (*n* = 37); and (3) did not complete the ADN program and therefore were not eligible to sit for the national certification examination (*n* = 172).

The results of this ANOVA are shown in Tables 10 – 12. Table 10 displays the descriptive statistics for each of the independent variables. As expected, the group of noncompleters/nonNCLEX-RN takers, did not contain any cases with a final grade point average.

The tests by Brown, Forsythe (1974), and Welch (1947) for homogeneity of variances indicated that differences among groups were significant on age at first semester, new ACT composite, grades in N1, grades in N2, and final grade point average. These results indicate that one cannot assume equal variance on all variables.

To determine whether the overall ANOVA was significant, the test of between group effects was examined. The results shown in Table 11 reveal that the tests were significant on all variables, with the exception of Age at first semester, which means we can reject the null hypothesis of no significant differences between the three groups on every variable but age.

Table 10. Descriptive statistics for the three groups

Dependent Variable	Group	N	Mean	Std Dev.
Age 1Sem	1	206	22.9466	6.7479
	2	37	20.5405	2.8440
	3	172	22.6453	6.0647
	Total	415	22.6072	6.2355
HSGPA	1	193	3.1216	.5269
	2	35	2.9334	.6388
	3	156	2.6906	.5825
	Total	384	2.9293	.5954
HSR	1	192	.6195	.2214
	2	33	.5776	.2239
	3	149	.4779	.2309
	Total	374	.5594	.2347
ACTCOMP	1	173	21.6185	3.6844
	2	32	18.8750	2.7090
	3	115	19.3913	3.3787
	Total	320	20.5438	3.6738
NewACTC	1	196	21.2723	3.6974
	2	35	18.9100	2.6679
	3	158	18.8565	3.2358
	Total	389	20.0785	3.6307
ACTR	1	172	22.1163	5.0597
	2	32	18.9375	4.0396
	3	112	19.8661	4.4428
	Total	316	20.9968	4.9019
PCOLCR	1	206	13.2694	10.4853
	2	37	12.3784	10.2804
	3	171	9.1082	9.4484
	Total	414	11.4710	10.2239
PCOLGPA	1	178	3.1068	.5540
	2	32	3.0028	.5945
	3	117	2.8721	.5354
	Total	327	3.0126	.5605
N1	1	205	3.2378	.6143
	2	37	2.6351	.5224
	3	120	1.8958	1.1557
	Total	362	2.7314	1.0293
N2	1	206	3.0583	.6728
	2	37	2.4324	.5292
	3	39	1.4103	1.2715
	Total	282	2.7482	.9575
A	1	205	3.1878	.7883
	2	37	2.6014	.8132
	3	150	2.1467	1.0225
	Total	392	2.7341	1.0127

Table 10. (Continued).

Dependent Variable	Group	N	Mean	Std Dev.
P	1	204	3.0846	.8188
	2	37	2.4054	.9001
	3	97	1.9923	.9726
	Total	338	2.6967	1.0015
M	1	204	3.0172	.7646
	2	37	2.4865	.9316
	3	40	2.3375	.8871
	Total	281	2.8505	.8488
FinalGPA	1	207	3.1574	.4553
	2	37	2.6670	.3504
	3	0		
	Total	243		

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course, Group 1 = Completers and Passers, Group 2 = Completers and Nonpassers, Group 3 = Noncompleters and Nonpassers.

Because all but one of the *F* tests were significant, follow-up tests were conducted to evaluate pairwise differences among the means. A decision was made to use both the Bonferroni post-hoc procedure or the Tamhane procedure because equal variances could not be assumed for all variables. The Tamhane post-hoc procedure was appropriate for the following variables: Age at first semester, New ACT composite, grades in N1, grades in N2, and final grade point average. The Bonferroni post-hoc procedure, which is conservative and thus does not overstate differences between groups, was used to control for Type 1 error across the multiple pairwise comparisons on all of the remaining variables. As shown in Table 12, the asterisks in the mean differences columns indicate which pairwise comparisons are significant. All three groups of students differed significantly from each other on their mean grades in Nursing 1, Nursing 2, Anatomy, and Physiology courses. In addition, the

Table 11. ANOVA summary for differences among the three groups for age at first semester, pre- and post-admission variables, and final grade point average

Variable	*Df*	*F*	Sig.
Age1Sem Between Groups	2	2.356	.096
Within Groups	412		
Total	414		
HSGPA Between Groups	2	25.480	.000
Within Groups	381		
Total	383		
HSR Between Groups	2	16.673	.000
Within Groups	371		
Total	373		
ACTC Between Groups	2	18.119	.000
Within Groups	317		
Total	319		
NewACTC Between Groups	2	23.874	.000
Within Groups	386		
Total	388		
ACTR Between Groups	2	10.938	.000
Within Groups	313		
Total	315		
PCOLCR Between Groups	2	8.174	.000
Within Groups	411		
Total	413		
PCOLGPA Between Groups	2	6.402	.002
Within Groups	324		
Total	326		
N1 Between Groups	2	99.848	.000
Within Groups	359		
Total	361		
N2 Between Groups	2	79.214	.000
Within Groups	279		
Total	281		
A Between Groups	2	60.069	.000
Within Groups	389		
Total	391		
P Between Groups	2	53.611	.000
Within Groups	335		
Total	337		
M Between Groups	2	16.234	.000
Within Groups	278		
Total	280		
Final GPA Between Groups	1	38.757	.000
Within Groups	241		
Total	242		

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

$p < .05$.

Table 12. Multiple comparisons (Bonferroni or Tamhane) for differences among the three groups

Dependent Variable	(I) Group	(J) Group	Mean Dif. (I-J)	Std. Error	Sig.
Age1Sem (t)	1	2	2.4058*	.6647	.001
		3	.3011	.6611	.957
	2	1	-2.4058*	.6647	.001
		3	-2.1048*	.6576	.005
	3	1	-.3011	.6611	.957
		2	2.1048*	.6576	..005
HSGPA (b)	1	2	.1881	.1030	.206
		3	.4309*	.0604	<.001
	2	1	-.1881	.1030	.206
		3	.2428	.1049	.063
	3	1	-.4309*	.0604	<.001
		2	-.2428	.1049	.063
HSR (b)	1	2	.04200	.0425	.972
		3	.1416*	.0246	<.001
	2	1	-.0420	.0425	.972
		3	.0997	.0434	.066
	3	1	-.1416*	.0246	<.001
		2	-.0997	.0434	.066
ACTC (b)	1	2	2.7435*	.6718	<.001
		3	2.2272*	.4201	<.001
	2	1	-2.7435*	.6718	<.001
		3	-.5163	.6978	1.000
	3	1	-2.2272*	.4201	<.001
		2	.5163	.6978	1.000
NewACTC (t)	1	2	2.3534*	.5232	<.001
		3	2.4070*	.3697	<.001
	2	1	-2.3534*	.5232	<.001
		3	.0536	.5193	.999
	3	1	-2.4070*	.3697	<.001
		2	-.0536	.5193	.999
ACTR (b)	1	2	3.1788*	.9153	.002
		3	2.2502*	.5773	<.001
	2	1	-3.1788*	.9153	.002
		3	-.9285	.9530	.992
	3	1	-2.2502*	.5773	<.001
		2	.9286	.9530	.992
PCOLCR (b)	1	2	.8910	1.7946	1.000
		3	4.1612*	1.0398	<.001
	2	1	-.8910	1.7946	1.000
		3	3.2709	1.8224	.220
	3	1	-4.1612*	1.0398	<.001
		2	-3.2702	1.8224	.220
PCOLGPA (b)	1	2	.1040	.1059	.980
		3	.2348*	.0656	.001
	2	1	-.1040	.1059	.980
		3	.1308	.1101	.706
	3	1	-.2348*	.0656	.001
		2	-.1308	.1100	.706

Table 12. (Continued).

Dependent Variable	(I) Group	(J) Group	Mean Dif. (I-J)	Std. Error	Sig.
N1 (t)	1	2	.6014*	.0961	<.001
		3	1.3407*	.1141	<.001
	2	1	-.6014*	.0961	<.001
		3	.7393*	.1360	<.001
	3	1	-1.3407*	.1141	<.001
		2	-.7393*	.1360	<.001
N2 (t)	1	2	.6261*	.0990	<.001
		3	1.6483*	.2090	<.001
	2	1	-.6261*	.0990	<.001
		3	1.0222*	.2214	<.001
	3	1	-1.6483*	.2090	<.001
		2	-1.0222*	.2214	<.001
A (b)	1	2	.5865*	.1585	.001
		3	1.0411*	.0954	.001
	2	1	-.5865*	.1585	.001
		3	.4547*	.1629	.017
	3	1	-1.0411*	.0954	<.000
		2	-.4547*	.1629	.017
P (b)	1	2	.6792*	.1562	<.001
		3	1.0923*	.1078	<.001
	2	1	-.6792*	.1562	<.001
		3	.4131*	.1689	.045
	3	1	-1.0923*	.1078	<.001
		2	-.4131*	.1689	.045
M (b)	1	2	.5307*	.1440	.001
		3	.6797*	.1394	<.001
	2	1	-.5307*	.1440	.001
		3	.1490	.1839	1.000
	3	1	-.6797*	.1394	<.001
		2	-.1490	.1839	1.000

KEY: HSGPA = high school grade point average, HSR = high school rank, PCOLCR = previous college credits, PCOLGPA = previous college grade point average, ACTCOMP = ACT composite, ACTR = ACT reading subscore, N1 = grade in nursing I theory course, N2 = grade in nursing II theory course, A = grade in anatomy course, P = grade in physiology course, M = grade in microbiology course.

*Sig. at p <.005.

(b) = Bonferroni post-hoc test used (assuming equal variances).
(t) = Tamhane post-hoc test used (assuming unequal variances).

students who graduated and passed the NCLEX-RN on first attempt differed from the students who graduated but did not pass the NCLEX-RN on first attempt on Age 1st semester, ACT composite, new ACT composite, ACT reading, and grade in Microbiology. Additionally, students who graduated and passed NCLEX-RN on first attempt differed significantly from those students who never graduated and never sat for the NCLEX-RN on high school GPA, high school rank, ACT composite, New Act composite, previous college credits, previous college grade point average, and grade in Microbiology. Thus, one can reject the null hypothesis of no significant differences between the three groups of students: completers and passers, completers and nonpassers, and noncompleters and nonpassers.

Summary

Following a review of 415 records, descriptive statistics were used to describe the ADN students graduating between 1998 and 2005 as well as noncompleters from St. Luke's College. Females, Caucasians, and in-state students comprised the majority of the population. Multiple linear regression was used to determine predictors of program success; logistic regression was used to predict NCLEX-RN success; and one-way analysis of variance with subsequent Bonferroni post-hoc procedure was used to determine significant differences between three groups of students—completers and passers, completers and non-passers, and non-completers and nonpassers.

Linear regression results revealed that grade in first semester nursing theory course, grade in second semester nursing theory course, previous college grade point average, grade in college physiology course, grade in college microbiology course, grade in college anatomy course, and previous college grade point average were predictors of ADN program success.

Logistic regression results revealed that previous college grade point average and grade in the second nursing theory course along with graduating class and new ACT composite were statistically significant predictors of first attempt NCLEX-RN success. ANOVA results and Bonferroni post-hoc results indicate that differences among three groups of students were significant for age at first semester, New ACT Composite, grades in N1 and, N2, and final grade point average.

CHAPTER 5. SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The current nursing shortage nationwide is expected to intensify. Thus, nurse educators in the U.S. must maximize graduation and licensure examination pass rates to help alleviate this shortage. Greater knowledge about factors associated with ADN student success would assist faculty and staff responsible for making admissions, curriculum, and remediation decisions.

The purpose of this study was to analyze pre- and post-admission criteria on final grade point average and first-time passage on the national nursing certification examination for a group of ADN nursing graduates between 1998 and 2005. An additional purpose was to determine if there were any significant differences on the pre- and post-admission criteria among three groups: those who successfully completed an ADN program and passed the NCLEX-RN on first attempt, those who successfully completed the ADN program but did not pass the NCLEX-RN on first attempt, and those who did not complete the ADN program and were not eligible to take the licensure examination.

This chapter summarizes the study and discusses the findings detailed in Chapter 4. Conclusions, limitations, and recommendations based upon these findings are also presented.

Summary

In this ex-post facto study, 404 records of students who were admitted to an associate degree nursing program between 1998 and 2005 were reviewed. Data were collected on high school grade point average, high school rank, ACT composite score, ACT reading score, number of college credits transferred into the college that directly applied to the nursing

program, grade point average on those credits, grade point average on the three required college level co-curricular sciences courses, grade point average in the required first-term nursing theory course, and grade point average on the required second-term nursing theory course. All were used as independent variables. Data on final grade point average in the nursing program, and first-time success on the NCLEX-RN were used as dependent variables.

Correlation coefficients were first obtained to determine the relationship among the pre-admission variables and subsequent performance variables while in the program, at the end of the program, and performance on the NCLEX-RN after program completion. Although passing or failing the NCLEX-RN is classified as a dichotomous variable, a Pearson correlation coefficient is an acceptable calculation (Hinkle, Wiersma, & Jurs, 2003, p. 526). The continuous values on the 11 independent variables, in addition to several demographic variables (sex, age at first semester, and entering class) were used as predictor variables in a stepwise backward elimination multiple regression analysis to predict the strongest combination of variables predictive of final grade point average in the associate degree nursing program. Ten of the 11 original pre- and post-admission variables, and 3 demographic variables, were used as independent variables in a logistic regression analysis with the dichotomous outcome on first attempt passage success as the dependent variable. Finally, the results of a one-way analysis of variance on the original 11 predictor variables, a new ACT Composite variable, and the previous dependent variable of final grade point average, comparing across the 3 groups of completers and passers, completers and nonpassers, and noncompleters and nonpassers, were examined for significant differences.

The research questions that guided the study were:

1. Which pre-and post-admission variables are the best predictors of academic success, as measured by final grade point average?
2. Which pre- and post-admission variables are the best predictors of academic success, as measured by first attempt passage on the NCLEX-RN?
3. Are there significant differences in academic outcomes among the groups of students who finish the ADN program and pass the NCLEX-RN on the first attempt, those who finish the program but do not pass the NCLEX-RN on first attempt, and those who do not finish the program and therefore are not eligible to take the licensure exam?

Findings

The results of this study demonstrated that previous college credits, previous college grade point average, grade in Nursing I theory, grade in Nursing II theory, and grades in Anatomy, Physiology, and Microbiology accounted for approximately 92% of the variance in final grade point average. The results also indicated that previous college grade point average, grade in the second semester nursing theory course, new ACT composite, and specific graduating class were significant predictors of first-attempt success on the NCLEX-RN exam; together, the 4 significant independent variables correctly classified 46.2% of the nonpassers and 99.3% of the passers, for an overall correct percentage of 91%. Finally, the study revealed that the completers and passers, the completers but nonpassers, and the noncompleters and nonpassers differed significantly from each other on mean grades in Nursing I, Nursing II, Anatomy, and Physiology courses. In addition, the completers and

passers group differed significantly from the completers but nonpassers group on ACT Composite, New ACT Composite, ACT Reading, and grade in Microbiology.

The results from this study were partially consistent with the results of previous studies. While most previous studies cited utilized success or failure of the NCLEX-RN on first attempt as the dependent variable measuring success, a few defined successful completion of the nursing program (ADN or BSN) as a measure of success, as was done in this study. The best predictors of academic success as measured by final grade point average in this study were grades in N2, N1, previous college grade point average, and grade in physiology, followed by grade in microbiology, grade in anatomy, number of previous college credits transferred into the program, and ACT reading score. Similar results were revealed by Glick, McClelland, and Yang (1986), who determined that the strongest predictors of academic success (as measured by final grade point average) for a group of BSN students were biology grade point average and grade point average in all required prenursing courses. A subsequent study by Yang, Glick, and McClelland (1987) revealed that the best predictors of nursing grade point average in a BSN program were prenursing grade point average, social science grade point average, and biological science grade point average. A study by Fowles (1992) identified ACT composite score and social science sub-score, along with Anatomy and Physiology II grade, and grade point average at the end of level one nursing courses, as the best predictors of success in the BSN nursing curriculum. Finally, a study by McClelland, Yang, and Glick (1992) revealed that prenursing grade point average was the best predictor of achievement in the nursing program.

The linear regression model in this study suggested that approximately 92% of the variance in final cumulative grade point average could be predicted with 8 of the pre- and

post-admissions variables. This result is much higher than the results reported in the literature. Nevertheless, fewer linear regressions have been estimated using final grade point average as the dependent variable than NCLEX-RN as the dependent variable.

Glick, McClelland, and Yang (1986) found that Biology grade point average accounted for 26% of the variance ($p \leq .001$) in grade point average at the end of the student's first year of nursing. Chemistry grade point average contributed 3% of the variance ($p \leq .001$), and Sociology grade point average contributed an additional 2% ($p \leq .001$). When final (BSN) grade point average was the dependent variable, only Pathology grade accounted for 10% of the variance in grade point average at the end of the nursing program. Grades at the end of the first year of the nursing program made no unique contribution to final nursing grade point average.

Another study done by the same three researchers (1987) examined 5 independent variables in a multiple regression predicting final nursing grade point average. ACT Composite explained 4% of the variance ($p \leq .0001$), prenursing grade point average 3% of the variance ($p \leq .0001$), and Chemistry grade point average not quite 1% of the variance ($p \leq .001$). Sociology grade point average and biology grade point average were not significant.

Fowles (1992) did not report percentage of explained variance on final grade in nursing, but revealed the stepwise multiple regression indicated that grade point average at the end of level one nursing, percentile score on a mid-nursing curriculum nationally standardized assessment, and grades in Anatomy and Physiology II were significant in the prediction equation.

Finally, a study by McClelland, Yang, and Glick (1992) revealed that, when final nursing grade point average in a BSN program was the dependent variable and High School

grade point average, ACT Composite score, Chemistry grade point average, Biology grade point average and Sociology grade point average were entered as independent variables, the largest R^2 square increments were observed for Biology grade point average and Sociology grade point average—each of which accounted for approximately 5% of the variance ($p \leq .001$), and high school grade point average accounted for 2% ($p \leq .001$).

The best predictors of first-attempt passage of the national registered nurses examination, the second dependent variable in this study, were previous college grade point average on all courses transferred into the ADN nursing program, followed by grade received in the second semester nursing theory course. New ACT composite score was also a predictor but was partially extrapolated due to missing data. Consequently, this researcher is not confident about the validity of the results related to ACT composite scores; further research is encouraged, using more complete ACT records and appropriate forms of interpolation of missing ACT data. In addition, idrecode, or graduating class, was determined to be a predictor of first-attempt passage on the NCLEX-RN, as some graduating classes performed better on the exam than others. However, the differences in exam performance from class to class were negligible.

These results were also consistent with results found in the literature. Feldt and Donahue (1989) revealed that the best predictors of first-attempt passage in their study of BSN graduates were ACT composite score, high school percentile rank, nursing grade point average, and first-semester chemistry grade. Whitley and Chadwick (1986) revealed that the best predictors of first-attempt NCLEX-RN success in their study of BSN graduates were science grade point average and grade point average in the prerequisite courses prior to admission into the nursing program. A study by Payne and Duffy (1986) of BSN graduates

determined that entrance grade point average along with SAT verbal score were the best predictors of first-attempt NCLEX-RN success. Similar results were reported by Yin and Burger (2003) a number of years later in their study of ADN graduates when college grade point average prior to admission and high school rank were found to be significant predictors of first attempt success on the RN qualifying examination.

McKinney, Small, O'Dell, and Coonrod (1988) posited that nursing theory grade point average was one of the prominent predictors of first-attempt NCLEX-RN success in their study of BSN graduates. In a study of BSN graduates, Younger and Grap (1992) determined that a variable made up of grades earned in four nursing courses was the strongest predictor of NCLEX-RN success. Jenks, Selekman, Bross, and Paquet (1989) revealed that nursing theory courses at the junior and senior year were strongly correlated with NCLEX-RN performance after a regression analysis. One of the strongest predictors of NCLEX-RN success in a BSN study by Fowles (1992) was grade point average at the end of level-1 courses in the program. Finally, a BSN study conducted by Beeson and Kissling (2001) which included a logistic regression analysis, revealed that the number of Cs, Ds, and Fs in nursing courses through the junior year were part of a combination of variables that best predicted NCLEX-RN success or failure.

Discussion

The results of the current study indicated that data obtained before admission to this college and during each semester of the curriculum can be used to predict nursing program success and first-attempt performance on the NCLEX-RN. In fact, a very large amount of variance in final grade point average was explained for many students with preadmission and

progression data through the second semester of the program. The only variable that was not available on all students after the second semester was grade in microbiology, but many of the students take it well before the last semester of the program. The logistic regression results indicated that one could correctly classify 46.2% of the NCLEX-RN nonpassers and 99.3% of the passers with four variables: new ACT composite, previous college grade point average, grade in second-semester nursing theory, and graduating class. ANOVA results suggested that students who successfully complete the nursing program and the NCLEX-RN exam on first attempt, indeed, do differ from those who finish the nursing program but are not successful on their first NCLEX-RN attempt, and that both groups differ from the group of noncompleters and non- NCLEX-RN-takers.

Identifying students at risk for failure is a worthy goal. It would enable nurse educators and program support staff to assist these students to successfully complete an expensive program of study, successfully pass the licensing examination, and enter the field of professional nursing as a competent registered nurse.

Limitations

The conclusions of the study should be viewed in light of several limitations. One limitation of the study was the small size of the college. Eight years worth of data had to be used to provide an adequate number of complete student records. A second limitation of the study was missing data, which decreased the number of observations available for some variables. In addition, the difficulty encountered in the collection of data for this study was the result of some information being located in two different databases, and some still in hard copy in the admissions files. A large number of cases needed to be excluded due to missing

data. A third limitation was that the score on NCLEX-RN during this period was reported only as pass or fail, which required the use of a dichotomous dependent variable and a logistic regression. Fourth, the study was conducted using data from only one school, therefore, the results cannot be generalized to all associate degree nursing programs. Finally, the vast majority of the literature cited was the result of studies done on baccalaureate degree nurses.

Conclusions

The following conclusions are based on the findings of the study:

1. Grade in Nursing II is an accurate predictor of final grade point average.
2. Grade in Nursing I is an accurate predictor of final grade point average.
3. Previous college grade point average is an accurate predictor of final grade point average in the program.
4. Grade in Physiology is an accurate predictor of final grade point average.
5. Grade in Microbiology is an accurate predictor of final grade point average.
6. Grade in Anatomy is an accurate predictor of final grade point average.
7. The number of previous college credits that directly pertain to and transfer in to the nursing program at St. Luke's are an accurate predictor of final grade point average.
8. In a regression model, almost 92% of the variance in final cumulative grade point average could be predicted with 8 of the pre- and post- admission variables.
9. The best predictors of academic success as measured by final grade point average are grades in N2, N1, previous college grade point average, grade in physiology, followed by grade in microbiology, grade in anatomy, number of previous college credits transferred into the program, and ACT reading score.
10. Previous college grade point average is predictive of whether or not an individual will pass the NCLEX-RN on first attempt.

11. Grade in N2 is predictive of whether or not an individual will pass the NCLEX-RN on first attempt.

12. New ACT Composite is predictive of whether or not an individual will pass the NCLEX-RN on first attempt.

13. An individual's graduating class is predictive of whether she or he will pass the NCLEX-RN on first attempt.

14. These 4 independent variables – previous college grade point average, grade in second semester nursing theory course, new ACT composite, individual's graduating class - collectively could predict 46.2% of the nonpassers and 99.3% of the passers, for an overall correct prediction percentage of 91.5%.

15. A cross tabulation of N2 grades by certification revealed that for every one unit grade increase in the second nursing theory course, a student was about 2.5 times more likely to pass than not pass the certification exam on first attempt.

16. A cross tabulation of previous college grade point average by certification revealed that for every one unit increase in grade point average, a student was .15 times more likely to pass than not pass the NCLEX-RN. This result seems counterintuitive but could be a result of the relatively sparseness of the distribution of previous college grade point average, or multicollinearity due to high intercorrelations with other predictor variables.

17. A cross tabulation of New ACT composite score by certification revealed that for every one-point increase in score, a student was 1.5 times more likely to pass than not pass the NCLEX-RN. However, since the New ACT Composite variable was partially estimated because of missing data, this may not be a meaningful result.

18. A cross tabulation of idrecode (or graduating class between 1998 – 2005) revealed that students in certain graduating classes had a better or worse chance of passing the NCLEX-RN exam on first attempt than did students in other graduating classes but the difference was negligible

19. The results of a one-way analysis of variance and the Brown, Forsythe & Welche's test for homogeneity of variances on 13 predictor variables revealed that differences among the three groups (completers and passers, completers and nonpassers, and noncompleters and noncertification exam takers) were significant on all variables except Age at first semester.

20. Follow-up tests using the Bonferoni and Tamhane post hoc procedures to evaluate pairwise differences among the means indicated that each of the three groups differed significantly from the other two groups on their mean grades in Nursing I, Nursing II, Anatomy, and Physiology.

Recommendations

The following recommendations are made for practice and future research based on the findings of this study:

Recommendations for practice

On the basis of these results and the findings of other studies, faculty and staff at St. Luke's College are advised to implement changes that could improve the admission decisions, the retention rate, and the graduation rates of students by:

1. Establishing a tradition of institutional research at the College. Identify a qualified faculty or staff member, such as the Chief Academic Officer, to conduct periodic reviews of student progression through the program.
2. Reevaluating admission criteria with perhaps a greater emphasis placed on previous college grade point average.
3. Focusing attention on nursing program performance in the second semester nursing theory nursing course and previous college grade point average on courses transferred in to the nursing program. These variables are the best predictors of NCLEX-RN success and attention should focus on these indicators when looking for potential at-risk students.
4. Establishing academic and other interventions that will enable students to address and remediate weak areas well before graduation and first-attempt on the NCLEX-RN exam. Evaluate these interventions on a regular basis.
5. Examining additional demographic and nonacademic variables not included in this study such as ethnicity, English-as-a-learned-language status, socio-economic status,

hours worked per week, number of dependents, single-parent status, test-taking ability or response to stress, to determine their relationship to first-attempt NCLEX-RN success.

Recommendations for future research

The following research studies should be carried out to extend the findings of the current study.

1. Repeat this study (or one similar) in several years due to the curriculum change in Fall 2007 to identify students at higher risk for failure.
2. Engage in research that focuses on the most effective combinations of interventions for St. Luke's students before attempting the NCLEX-RN for the first time.
3. Engage in research that focuses on the most effective combinations of interventions for St. Luke's students who fail NCLEX-RN on first attempt.

Recommendations for policy

While nurse educators need to identify ways to assist all nursing graduates in passing the NCLEX-RN, especially on first-attempt, local, state and national entities need to address ways to increase the number of students enrolled in all types of nursing education programs. While this issue is a multifaceted one, several recommendations are fundamental.

At the local level:

1. Urge healthcare facilities to expand tuition reimbursement programs and scholarships for current non-nursing and nursing staff, especially from underrepresented populations, who are interested in pursuing a nursing credential or the next nursing

credential (to LPN, from LPN to ADN, from ADN to BSN, from BSN to MSN, and from MSN to PhD).

2. Establish a pay differential that rewards nurses for additional education. Nurses will choose to further their education when it means a significant increase in wages.
3. Provide flexible scheduling options and/or predictable work schedules, and maintain health benefits for those who wish to attend school to prepare for nursing licensure or advanced credentials and degrees. Many adult students need to continue to work while in school to maintain support to dependents.
4. Recognize the limits within which nurses can practice safely. Health care administrators should address two of the primary reasons for current nurse dissatisfaction - high patient/low staffing ratios and mandatory overtime. Increasing patient safety and reducing the stress nurses experience on the job, could help with nurse recruitment and retention.
5. Recruit nursing students from diverse backgrounds so that adequate representation in the workplace and the classroom becomes a reality. “According to the U.S. Census Bureau, one in every three U.S. residents is classified as a member of a minority population,” (AACN Annual Report, 2007, p. 2). In Iowa, the only growing populations between the census reports for 1990 and 2000 were immigrants and ethnic groups (U.S. Census, 2000) mostly from Mexico, but others from the former Soviet Union, Yugoslavia, Africa, and Southeast Asia (Yehieli, Grey, Vander Werff, & Whitaker, 2005). “Students from diverse racial and ethnic backgrounds now comprise up to 25% of those enrolled in entry-level baccalaureate programs, 22.7% of those enrolled in master’s programs, and 19.9% enrolled in research-focused

doctorate programs" (AACN Annual Report, 2007, p. 2). While these national statistics are encouraging, more needs to be done. Better representation in the workplace and the classroom will encourage members of underrepresented groups to enter nursing education programs and the field of nursing.

At the state level:

1. Provide more state funding for loans and scholarships that will assist nursing students pursuing initial or additional nursing education and training.
2. Provide more funding to colleges and universities, especially the community colleges that continue to train the majority of RN's that sit for the NCLEX-RN.
3. Reward health care facilities that implement and adhere to safe yet attractive patient/nurse ratios and no mandatory overtime policies with significant additional funding for scholarships.

At the national level:

1. Increase federal funding for loans and scholarships. The Nurse Reinvestment Act (NRA) has provided loan and scholarships, but it is not enough. "Under the NRA, only $31 million was allocated for loans and scholarships, instead of the $283.5 million needed to support all applicants. According to Robert Rosseter, associate executive director of the American Association of Colleges of Nursing, of 3,379 applicants for NRA scholarships this year, only 212 (6%) were funded" (Editorial, AJN, 2006).
2. Address the nursing faculty shortage by developing master's and doctoral programs that allow nurses to maintain their clinical skills as many nurses are loath to lose their clinical skills and the pay they receive for those skills in the private sector. "There are

already a number of faculty who teach part time and maintain a clinical practice, but the idea of a clinically focused doctorate may be one whose idea has come" (Roberts, 2005, p.24).

3. Support the implementation of programs that will assist immigrant nurses in learning the English language well enough and quickly enough to pass the NCLEX-RN.

In conclusion, given the current and projected nursing shortage in the U.S., it is paramount that local, state, and national entities do as much as possible to address our nation's need for well-trained nurses. Nurse educators also have a critical role in helping to address this need. They have the dual responsibility of admitting qualified students into their nursing programs and doing everything possible to give all students the tools to successfully complete their programs and pass the NCLEX-RN. Early identification of the unique factors that restrict academic achievement and subsequent success on the NCLEX-RN would be a critical part of regular and on-going research for each and every program.

APPENDIX A. HUMAN SUBJECTS APPROVAL

IOWA STATE UNIVERSITY

Institutional Review Board Office of
Research Assurances Vice Provost
for Research 1138 Pearson Hall
Ames, Iowa 50011-2207

515 294-4566 FAX
515 294-4267

DATE: March 21, 2005

TO: Nancy Muecke

FROM: Office of Research Assurances

RE: **IRB ID** # 05-126
STUDY REVIEW DATE: March 21, 2005

The Institutional Review Board has reviewed the project, "An Analysis of the Relationship Between ACT Scores and the Success of Students at St. Luke's College" requirements of the human subject protections regulations as described in 45 CFR 46.101 (b)(1). The applicable exemption category is provided below for your information. Please note that you must submit all research involving human participants for review by the IRB. Only the IRB may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

The IRB determination of exemption means that this project does not need to meet the requirements from the Department of Health and Human Service (DHHS) regulations for the protection of human subjects, unless required by the IRB. We do, however, urge you to protect the rights of your participants in the same ways that you would if your project was required to follow the regulations. This includes providing relevant information about the research to the participants.

Because your project is exempt, you do not need to submit an application for continuing review. However, you must carry out the research as proposed in the IRB application, including obtaining and documenting (signed) informed consent if you have stated in your application that you will do so or required by the IRB.

Any modification of this research must be submitted to the IRB on a Continuation and/or Modification form, prior to making any changes, to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.

cc: ELPS
Mack Shelley

ORC 04-21-04

APPENDIX B. CORRESPONDENCE

ST. LUKE'S COLLEGE
IOWA HEALTH SYSTEM

2720 STONE PARK BOULEVARD
SIOUX CITY, IOWA 51104
712-279-3149
FAX 712-233-8017

March 22, 2007

Institutional Review Board
Office of Research Compliance
Vice Provost for Research
1138 Pearson Hall
Iowa State University
Ames, IA 50011

Dear Board Members:

I am writing this letter to confirm that Nancy L. Muecke, a Ph. D. student in the Educational Leadership & Policy Studies department and a former employee of St. Luke's College, has my permission to utilize archival data for her dissertation during the 2006-2008 academic years.

She will be looking at admissions and post-admissions data on Associate Degree Nursing students who graduated from St. Luke's College between May of 1998 and May of 2006. The data will be presented from the Registrar in such a way that there are not any personally identifying features associated with the individual data.

We appreciate the fact that she is doing a dissertation study that will benefit our future students.

Sincerely,

[redacted]

Michael D. Stiles
Chancellor

September 7, 2005

Institutional Review Board
Office of Research Compliance
Vice Provost for Research
1138 Pearson Hall
Iowa State University
Ames, IA 50011

Dear Board Members:

I am writing this letter to confirm that Nancy L. Muecke, a Ph. D. student in the Educational Leadership & Policy Studies department and an employee of St. Luke's College has my permission to utilize archival data for her dissertation during the 2005-2006 academic year.

She will be looking at admissions and post-admissions data on Associate Degree nursing students who graduated from St. Luke's College between May of 1998 and May of 2005. The data will be presented from the Registrar in such a way that there are not any personally identifying features associated with the individual data.

We appreciate the fact that she is doing a dissertation study that will benefit our future students.

Sincerely,

Michael D. Stiles
Chancellor

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ACKNOWLEDGMENTS

I would like to acknowledge the many people who assisted me along this path. First, my husband, Ron, who is an extraordinary life partner. He truly gives meaning to the cliché "giving one hundred and ten percent," as he has given me constant support and encouragement—more than I've asked for and more than I deserved. I want to thank my sons, Jonathan and David, who probably don't remember when their mother wasn't going to school. They became colleagues of sorts once they were in undergraduate school and have been two of my biggest supporters. I am looking forward to traveling their graduate school journeys with them. Thanks also to my mom and wonderful siblings: Milly, Julie, Lynn, Kathy, Jon and Amy—your support was unconditional, timely, and unsurpassed.

I wish to express my sincere appreciation to Dr. Larry Ebbers for his assistance throughout my program of study. His words of wisdom and encouragement were always just what I needed to hear when I needed to hear them. I am especially grateful to Dr. Mack Shelley, one of the very best teachers I've ever had the pleasure of learning from and working with. You "rock!"

Thanks also to the other members of my committee: Drs. Daniel Robinson, Sharon Drake, and Beverly Kruempel—each will be long remembered for their many contributions throughout my program of study and their role in this research and dissertation. A special thank you goes to Dr. Soko Starobin for filling in at the eleventh hour. In addition, I'd like to thank the inaugural community college PhD cohort, especially Lisa Stock and Terry Gaalswyk. The journey was much more interesting and enjoyable because of you!

I would also like to thank the Chancellor of St. Luke's College, Michael D. Stiles, for allowing me to undertake this study, and Danelle Johannsen, the Department Chair of Student and Administrative Services, for all her work in helping me gather the data. Finally, I am especially grateful to the nursing students at St. Luke's College, some of whom I had the pleasure of knowing between 2004 and 2006—their individual stories and collective dedication to becoming competent, caring, and compassionate registered nurses were inspiring.