2017

An Examination Of Correlation Between Preadmission Indicators Of College Readiness And Clinical Performance Of Nursing Students

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AN EXAMINATION OF CORRELATION BETWEEN PREADMISSION INDICATORS OF COLLEGE READINESS AND CLINICAL PERFORMANCE OF NURSING STUDENTS

A Dissertation Presented

by

Kenneth Allen

to

The Faculty of the Graduate College

of

The University of Vermont

In Partial Fulfillment of the Requirements
for the Degree of Doctor of Education
Specializing in Educational Leadership and Policy Studies

May, 2017

Defense Date: March 20, 2017
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ABSTRACT

A significant body of literature supports the proposition that the development of a culturally competent healthcare workforce is enhanced by diversity in the cohorts of students graduating from post-secondary educational programs related to careers in health and healthcare. However, increasing diversity in these programs is contingent upon increasing acceptance rates of historically disadvantaged students, such as students from racial/ethnic minority groups and/or low socioeconomic status, into highly selective post-secondary institutions, such as state flagship universities, and highly selective majors such as nursing. A significant barrier to increasing enrollment of disadvantaged students at more selective post-secondary institutions is the combined effect of admissions practices which rely heavily on scores associated with a group of pre-admission indicators of college readiness and generally lower scores on these indicators by students from disadvantaged backgrounds as compared to their more affluent counterparts.

A growing body of research is emerging concerning relationships between the traditional indicators of college readiness and subsequent academic performance; however, to date, little research exists concerning the relationships between the pre-admission indicators of college readiness and the clinical performance of students enrolled in clinically based health related majors. This study utilized a retrospective cross sectional observational design to examine the relationship between pre-admission indicators of college readiness at a state flagship university in New England and the clinical performance of nursing students in senior year clinical practica. The results of linear regression analysis failed to identify any statistically significant correlation between any of a group of five commonly used pre-admission indicators of college readiness and student's clinical performance. The findings raise new questions concerning the usefulness of these commonly used criteria in the selection of students for admission into programs of nursing.

DEDICATION

I dedicate this dissertation to all those with the talent and desire to pursue careers in health related majors. I also dedicate this dissertation to my lovely wife and daughter who have been amazingly supportive over the last six years. Sorry for all the missed events, late nights, and general stress. Thank you for your understanding and support.

ACKNOWLEDGEMENTS

I would like to acknowledge my advisor Dr. Deborah Hunter who agreed to help me with this crazy project. I would also like to thank my committee members Mercedes Avila, Jason Garvey, and Jill Tarule who got on board even though this study wasn't exactly their cup of tea. Thanks for being there for me.

I want to give a special thank you to Alan Howard who was a great help with the statistics. I could not have done this without you Alan. Thanks.

TABLE OF CONTENTS

Page

DEDICATION ii
ACKNOWLEDGEMENTS iii
LIST OF TABLES vii
CHAPTER 1: INTRODUCTION 1
1.1. Conceptual Framework 3
1.2. Purpose 6
1.3. Methods 7
1.4. Significance of the Study 11
1.5. Research Identity 12
CHAPTER 2: COMPREHENSIVE LITERATURE REVIEW 14
2.1. Disparities in Health 15
2.2. Conceptual Framework for Diversification of the Healthcare Workforce 24
2.3. Educational Attainment and the Healthcare Workforce 30
2.4. Assessing Clinical Performance 44
2.5. Conclusions from the Review of the Literature 47
CHAPTER 3: METHODS 49
3.1. Research Questions 49
3.2. Study Type 51
3.3. Research Participants 52
3.4. Research Setting 54
3.5. Data 55

3.6. Analysis Techniques 68
3.7. Limitations 82
3.8. Delimitations 86
CHAPTER 4: ANALYSIS AND RESULTS 88
4.1 Phase I: Univariate Analysis of Data 88
4.2 Phase II: Linear Regression Analysis 100
CHAPTER 5: DISCUSSION 115
5.1 Findings 116
5.2 Significance of findings 119
5.3 Conclusion 137
REFERENCES 142
APPENDICES 158
Appendix A Conceptual Model 159
Appendix B Nursing Program Curriculum at New England University 161
Appendix C Recruitment Letter to Gain Consent 162
Appendix D Leicester Clinical procedure Assessment Tool (Modified) 166
Appendix E Email Request to Clinical Preceptors 175
Appendix F GPA Conversion Table 176
Appendix G Distribution of Pre-admission Composite Scores 177
Appendix H Normality Test Components of Clinical Performance 178
Appendix I Q-Q Plots Related to the Components of Clinical Performance. 179
Appendix J Global Clinical Composite Score Distributions 184

Appendix K Test of Assumptions Five Variable Model....................................... 186

Appendix L Test of Assumptions Three Variable Model..................................... 187

Appendix M Distribution of Transformed Global Clinical Composite Scores 189

Appendix N Test of Assumptions Three Predictor Variables LrGCCS. 190

Appendix O Distribution of Student's Rank in High School Class....................... 196

Appendix P Distribution of Transformed Global Clinical Composite Scores 198

Appendix Q Distribution of ACT Scores.. 200

Appendix R Distribution of Students GPA in Selected Courses 203

Appendix S Distribution of Student's Pre-admission Composite Scores............. 205

Appendix T Regression Diagnostics Final Two Variable Model.......................... 207

LIST OF TABLES

Table 1: Stereotype Content Model 22
Table 2: Percent of 25-29 Year Olds Having Obtained a Bachelor's Degree in 2013 by Race/Ethnicity 38
Table 3: Categories and Number of Associated Items on LCAT 59
Table 4: Final Sample Size 63
Table 5: Variables for Linear Regression Analysis 70
Table 6: Registered Nurse National Council Licensure Examination Pass Rates 84
Table 7: Variables for Univariate Analysis 88
Table 8: Descriptive Statistics: Components of Clinical Performance 90
Table 9: Descriptive Statistics: Global Clinical Composite Scores 93
Table 10: Descriptive Statistics: Rank in High School Class 96
Table 11: Descriptive Statistics: Cumulative High School GPA 97
Table 12: Descriptive Statistics: ACT Scores 98
Table 13: Descriptive Statistics: Grade Point Average in Select Courses 98
Table 14: Descriptive Statistics: Pre-admission Composite Scores 99
Table 15: Five Predictor Regression 108
Table 16: Four Predictor Regression 110
Table 17: Two Predictor Regression 112

Table A1: GPA Conversion Table 176
Table A2: Distribution of Composite Scores for Students Initially Enrolled in 2012 B.S. in Nursing Major* 177
Table A3: Shapiro-Wilk Test of Normality for Components of Clinical Performance 178
Table A4: Shapiro-Wilk Test of Normality of Global Clinical Composite Scores 185
Table A5: Test of Assumptions Five Variable Model 186
Table A6: Test of Assumptions Three Variable Model 187
Table A7: Shapiro-Wilk Test of Normality for Residuals of Three Predictor Model. . 188
Table A8: Shapiro-Wilk Test of Normality for Transformed Global Clinical Composite Scores 189
Table A9: Test of Assumptions Three Variable Model with Transformed Global Clinical Composite Scores as Criterion 190
Table A10: Shapiro-Wilk Test of Normality for Residuals of Three Predictor Model. 191
Table A11: Shapiro-Wilk Test of Normality for Rank in High School Class 196
Table A12: Shapiro-Wilk Test of Normality for Cumulative High School GPA 198
Table A13: Shapiro-Wilk Test of Normality for ACT Scores 200
Table A14: Shapiro-Wilk Test of Normality for GPA in Select Courses 203
Table A15: Shapiro-Wilk Test of Normality for Pre-admission Composite Scores 205
Table A16: Statistical Test of Normality of Residuals for 2 Variable Model 208

LIST OF FIGURES

Figure 1. Box plots of average scores on the components of clinical competence. 92
Figure 2. Proposed scale for the assessment of student clinical performance. 133

Figure A 1. Conceptual Model Part 1.. 159
Figure A 2. Conceptual Model Part 2. 160
Figure A 3. Q-Q normality lots of expected vs observed values for average scores on communication items. 179
Figure A 4. . Q-Q normality plots of expected vs observed values for average scores on safety items. 180
Figure A 5. Q-Q normality plots of expected vs observed values for average scores on infection prevention items..181
Figure A 6. Normality plots of expected vs observed values for average scores on procedural competence items..182
Figure A 7. Q-Q Normality plots of expected vs observed values for average scores on team work items. 183
Figure A 8. Histogram of student's global clinical composite scores. 184
Figure A 9. Q-Q normality plots of expected vs observed value for student's global clinical composite scores. 185
Figure A 10. Histogram of residuals from the three predictor model.............................188
Figure A 11. Histogram of distributions of transformed global clinical composite scores..189
Figure A 12. Histogram of residuals from the three predictor model.............................191
Figure A 13. Linearity between cumulative high school GPA and transformed global clinical composite scores. 193
Figure A 14. Linearity between GPA in select courses and transformed global clinical composite scores. 194
Figure A 15. Linearity between ACT scores and transformed global clinical composite scores. 195
Figure A 16. Histogram of student's rank in high school class. 196
Figure A 17. Normal Q-Q plot of expected versus observed values for student's rank in high school class. 197
Figure A 18. Histogram of student's cumulative high school GPAs..............................198
Figure A 19. Normal Q-Q plot of student's expected versus observed values of cumulative high school GPA. 199
Figure A 20. Histogram of student's ACT scores...200
Figure A 21. Normal Q-Q plots of student's expected ACT scores versus observed ACT scores..201
Figure A 22. Box plots of students ACT scores. Note the relatively normal distribution and three outliers 202
Figure A 23. Histogram of student's GPA in select courses. 203
Figure A 24. Normal Q-Q plots of student's expected GPAs in select courses versus observed GPAs in select courses. 204
Figure A 25. Histogram of student's pre-admission composite scores. 205

Figure A 26. Normal Q-Q plots of student's expected pre-admission composite scores versus observed pre-admission composite scores. 206
Figure A 27. Normal Q-Q plot of standardized residuals versus expected values in the two variable model...207
Figure A 28. Test of normality: histogram of standardized residuals two variable model...208
Figure A 29. Test for heteroscedasticity: scatter plot of standardized residuals versus standardized predicted values in final two predictor variable model. 209
Figure A 30. Scatter plot of ACT scores versus transformed global clinical composite scores. 210
Figure A 31. Scatter plot of cumulative high school GPA versus transformed global clinical composite scores. 211

CHAPTER 1: INTRODUCTION

In 1955, Benjamin Paul set forth a new concept for improving the health of communities and individuals. His basic tenet was that if health professionals and others want to improve the effectiveness of medical care they must first understand the existing ethno medical beliefs and values of the community being served as well as the social and environmental conditions that so strongly contribute to health (Paul, 1955). Since Paul the need to develop a culturally competent health care work has continued to gain attention and significant efforts have been expended toward this goal. One important component believed necessary for creating a culturally competent[1] health care work force is increasing the racial and sociocultural diversity of the healthcare workforce (Betancourt, Green, Carrillo, & Ananeh-Firempong, 2003; Fiscella, Franks, Gold, & Clancey, 2000; Institutes of Medicine [IOM], 2014; LaVeist & Pierre, 2014; Liaison Committee on Medical Education, 2013; National Advisory Council on Nurse Education [NACNE], 2013; Smedley, 2003; Sullivan, 2004). However, increasing the diversity of the healthcare workforce is contingent upon increasing participation of students from disadvantaged and underrepresented backgrounds in the cohorts of students enrolled in, and graduating from, health professions and related programs (HPRP)[2], particularly at the

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[1] Cultural competence is a set of behaviors and attitudes within the business or operation of a system that respects and takes into account the person's cultural background, cultural beliefs, and their values and incorporates this perspective into the way health care is delivered to individuals (Betancourt et al., 2003).

[2] Health professions and related programs (HPRP) is the term utilized by the National Center for Educational Statistics (NCES) in the Classification of Instructional Programs (CIP). HPRP refers to "[Postsecondary] Instructional programs that prepare individuals to practice as licensed professionals and assistants in the health care professions and related clinical sciences and administrative and support services" (NCES, 2010).

level of 4-year degree granting institutions (Cohen, Gabriel, & Terrell, 2002; LaVeist & Pierre, 2014; NACNE, 2013; Smedley, 2003; Sullivan, 2004; United States Department of Health and Human Services [USDHHS], n.d.). Despite considerable investments in efforts to increase diversity in HPRP, the literature clearly demonstrates a relative lack of racial/ethnic diversity in HPRP. Similarly, although few studies have examined the degree to which socioeconomic diversity exists in HPRPs, information related to post-secondary enrollment of students from disadvantaged economic backgrounds suggests that socioeconomic diversity may lag even further behind that of racial/ethnic diversity (Bowen, Chingos, & McPherson, 2011; Gerald & Haycock, 2006; IOM, 2011; IOM, 2014; Krause-Wood, Reckelhoff, & Muntner, 2014; LaVeist & Pierre, 2014; Liaison Committee on Medical Education, 2013; NACNE, 2013; Villarruel, Bigelow, & Alvarez, 2014).

There are a number of factors that serve as barriers to increasing enrollment of students from disadvantaged backgrounds. One factor which has been consistently identified as a barrier to enrollment of students from minority racial/ethnic groups and/or lower socioeconomic status[3] (SES) into post-secondary institutions, particularly 4-year degree granting colleges and universities, is these student's performance on a set of factors commonly referred to as the indicators of college readiness[4] (Adelman, 2006;

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[3] According to The American Psychological Association [APA] (2015), "Socioeconomic status is commonly conceptualized as the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation. Examinations of socioeconomic status often reveal inequities in access to resources, plus issues related to privilege, power and control" (Socioeconomic Status section paragraph 1).

[4] According to the literature, commonly used indicators of college readiness include: American College Testing (ACT), Scholastic Assessment Test (SAT), and other standardize tests scores (Cabrera & La Nasa, 2001; Desjardins & Lindsay, 2008; Maruyama, 2012; Newton, Smith, Moore, & Magnan, 2007; Sternberg,

Bowen et al., 2011; Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010; Gerald & Haycock, 2006; Maruyama, 2012). Students from disadvantaged minority racial/ethnic groups and/or economically disadvantaged backgrounds, on average, score lower on these indicators in comparison to their more affluent counterparts. As a result, minority and low SES students are underrepresented in more selective post-secondary institutions and majors, such as the case with 4-year institutions and HPRP (Adelman, 2006; Bowen. et al.; Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010; Gerald & Haycock, 2006; Maruyama, 2012).

1.1. Conceptual Framework

A complex systems approach underlies the theoretical framework of this research. A complex systems approach allows for integration of the fundamental cause model which focuses on structural causation but also allows for consideration of mediating pathways which may reinforce or mitigate the effects of the fundamental cause (Diez Roux, 2012). The focus of the fundamental cause model is the underlying structural causes or 'meta-mechanisms' responsible for disparate outcomes (Diez Roux, 2012). Link and Phelan (1996) identified economic disadvantage as a fundamental cause of disparities in health and education. Similarly, Williams, Mohammed, Leavell, and Collins (2010) identified belonging to a minority racial/ethnic group, as well as belonging to a lower socioeconomic group, as fundamental causes underlying disparities in health status and the delivery of healthcare.

2007), high school grade point average (GPA) (Bowen et al., 2011; Maruyama, 2012; Newton et al., 2007), rank in class (Adelman, 2006; Bowen, et al., 2011; Desjardins & Lindsay, 2008), and specific course grades (Newton et al., 2007).

An important construct associated with the fundamental cause model is the acknowledgement of mediating pathways which result in multiple proximal and distal causes of differential outcomes (Diez Roux, 2012; Freese & Luftey, 2011; Link & Phelan, 1996). It is the fundamental cause or meta-mechanism that generates and maintains differential outcomes; however, it is through mediating pathways that proximal and distal causes, often associated with social institutions, such as the education and healthcare systems, where differences manifest (Diez Roux, 2012; Freese & Luftey, 2011; Link & Phelan, 1996). In other words, the meta-mechanism (i.e. socioeconomic disadvantage and/or systematic racism) is the underlying cause, while proximal and distal pathways such as the education and healthcare systems manifest the surface effects of disparities between more and less affluent groups. For example, in the context of health, Link and Phelan (1996) identified socioeconomic disadvantage as a fundamental cause of health disparities; however, it is through more proximal pathways such as differential access to the social determinates of health[5], such as high quality healthcare and educational opportunities, which directly manifest the surface effects related to disparities in health between persons in low versus high socioeconomic groups. Another important construct of the fundamental cause model is the acknowledgment that as conditions change, new pathways, both proximal and distal, continually emerge and these new pathways tend to maintain the net effect (i.e. disparities in health and educational attainment) of the fundamental cause (Diez Roux, 2012; Freese & Luftey, 2011; Link & Phelan, 1996).

[5] According to the DHHS (2014), the social determinates of health are conditions in the environment which affect a wide range of health, functioning, and quality of life outcomes and risks.

The fundamental cause theoretical framework guides the conceptual framework for this research. The conceptual framework begins with an acknowledgement that both belonging to a racial/ethnic minority group and/or a lower socioeconomic class are fundamental causes of disparities in educational attainment, health, and the delivery of healthcare. In the context of this research, the ability, or inability, of the healthcare system to provide care that is unbiased and culturally sensitive is considered a proximal mediating pathway for reducing, or maintaining, disparities in the delivery of health care. Further, increasing representation of persons from historically underrepresented groups in healthcare professions is viewed as a mediating factor which has the capacity to increase cultural competence, reduce bias in the deliver of care, and mediate the effects of the fundamental causes of health related disparities.

As stated in the landmark Sullivan Commission Report (Sullivan, 2004) report, “The rationale for increasing diversity in the healthcare workforce is evident…diversity in the health workforce will strengthen cultural competence throughout the [healthcare] system. Cultural competence profoundly influences how health professionals deliver health care” (p.3). However, the combined effect of a heavy reliance on measures associated with the indicators of collage readiness in admissions decisions and the disproportionately lower academic achievement of students from disadvantaged backgrounds has the effect of segregating students into more and less selective post-secondary institutions along racial/ethnic and socioeconomic lines (Adelman, 2006; Baldwin, Woods, & Simmons, 2006; Barfield, Folio, Lam, & Zhang, 2011; Bowen et al., 2011; Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010; Frenk et al. 2010; Gerald & Haycock, 2006). The net effect on the healthcare system is segregation of the healthcare workforce where persons from more affluent backgrounds are more likely to work in highly skilled/high impact professional occupations and persons from less affluent backgrounds are more likely working in lower skilled/lower impact occupations (Carnevale, Strohl, & Michelle, 2011; Frenk et al. 2010; LaVeist & Pierre, 2014; Ross, Svajlenka,, & Williams, 2014; Shipman, Jones, Erikson, & Sandberg, 2013).

In the context of the fundamental cause model, the conceptual framework underlying this research proposes that admissions criteria into selective colleges and universities is a distal, but none the less important, mediating pathway which serves to maintain disparities in health and the delivery of health care by perpetuating the status quo in terms of healthcare workforce diversity. See Figures A1 and A2 in Appendix A.

1.2. Purpose

The purpose of this research was to test the implicit assumption that higher scores related to pre-admission indicators of college readiness are correlated with academic outcomes in post-secondary health professions and related programs [HPRP] which makes them useful tools in admissions decisions. A body of literature is beginning to emerge which examines relationships between scores on the indicators of college readiness (e.g. cumulative high school grade point average, scores on standardized tests, and grades in specific coursework), and post-secondary academic performance; however, there is little research on the relationship between the indicators of college readiness and clinical performance of students enrolled in HPRP. In particular, the review of the literature failed to identify any studies which specifically looked at the relationships between these indicators of college readiness and student's performance in clinical practica. As such, the aim of this research was to address an apparent gap in the literature concerning the relationships between the indicators of college readiness and student's subsequent clinical performance.

1.3. Methods

Research Questions

To address this apparent gap in the literature, the following primary research question were proposed:

- To what extent do pre-admission indicators of college readiness correlate with or predict clinical performance of nursing students during *senior year* clinical practica in a 4- year baccalaureate degree program at a New England state flagship university?

To gain a more in-depth understanding of the ways in which individual indicators of college readiness are related to performance in senior year clinical practicums, a set of secondary research questions were also addressed. These include:

1. To what extent does high school cumulative grade point average correlate with or predict performance in senior year clinical practica?
2. To what extent does rank in high school class correlate with or predict clinical performance in senior year clinical practica?
3. To what extent does high school grade point average in the science and math courses required for admission into the nursing major at this University correlate with or predict clinical performance during senior year clinical practica?
4. To what extent do scores on standardized assessment test correlate with or predict clinical performance during senior year clinical practica?

5. To what extent does a University derived composite measure related to the pre-admission indicators of college readiness correlate with or predict clinical performance during senior year clinical practica?

Study Design

To address these questions, a descriptive study utilizing a cross-sectional retrospective observational design, exploratory data analysis, and linear regression analysis was performed. The primary research question was addressed through the use of multiple linear regression analysis in an effort to develop a regression equation that represented the relationships between the pre-admission indicators of college readiness and a measure of student's performance in senior year clinical practicums. The secondary research questions were addressed through the use of simple linear regression between the individual pre-admission indicators of college readiness and a measure of student's performance in senior year clinical practicums. Inferences were made about the relationships between the pre-admission indicators of college readiness and subsequent clinical performance based on the resulting correlation coefficients and tests of statistical significance. The Null hypothesis for each of these assessments was that the pre-admission indicators of college readiness were not linearly correlated with performance in senior year clinical practica (i.e. Ho: $\rho = 0$).

Participants

Nursing students were selected as the target population for this research due to the obvious importance of clinical competency as an important educational outcome and because of the relatively (i.e. in comparison to the other clinically based majors) large number of students enrolled in the major at the research setting. The target population for this research were consenting students who met the following inclusion criteria:

- Were enrolled as an undergraduate Bachelor of Science in Nursing [BSN] major at New England University during the Spring 2016 semester.
- Were participating in senior year clinical practicum at the University affiliated medical center where clinical performance was assessed through a clinical preceptorship overseen by program faculty.

Research Setting

The broad setting for this research was the Department of Nursing within a regionally accredited, medium-sized, 4-year, public, state flagship University in a New England state.

Data Sources

Data was collected from two primary sources. The first source of information came from the students' initial application to the University. Data from this source included information related to the student's scores on the pre-admission indicators of college readiness including:

a) Cumulative high school grade point average [GPA].
b) Rank in high school class.
c) Highest obtained composite score on standardized test, i.e. the Scholastic Aptitude Test or American College Testing[6] exams.

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[6] SAT Scores were converted to ACT Scores using concordance tables provided by the CollegeBoard (2009).

d) A University derived composite measure, referred to as “pre-admission composite score” for the purposes of this research.

e) Grades in select courses required for admission into the nursing major including:

    i. Biology

    ii. Chemistry

    iii. Pre-calculus

The second source of data was from clinical preceptor assessments of student’s senior year clinical performance. The instrumentation used for the assessment of clinical performance was based on the Leicester Clinical Procedure Assessment Tool [LCAT] (McKinley, Strand, Gray, Alun-Jones, 2008a). The LCAT was developed and validated in a multistage process involving a meta-analysis of source material referenced in the then current (2005) literature, the development and use of a systematic framework to identify key themes and subthemes, the development of a pilot version, testing of the pilot, and refinement through focus groups made up of practitioners from within the National Health Service of Great Britain and higher education institutions in the UK (McKinley et al., 2008 a; McKinley et al. 2008 b).

Limitations

Limitations of this study were primarily related to external validity. The principle limitations were related to the relatively small final sample size of 29 students and the somewhat unique research setting (i.e. a state flagship university in New England). Another potiential limitation of the study is related to the difficulty in assessing clinical performance. These limitations restrict the ability to generalize the findings from this research to the larger population of nursing students in all types of academic settings.

Delimitations

This study was undertaken as an exploratory examination into the relationships between pre-admission indicators of college readiness and subsequent clinical performance of nursing students. As such, the study did not propose a hypothesis for testing except to the extent that statistical test of significance was assessed against the Null hypothesis that the relationships were not linearly correlated. Otherwise, this study sought to determine if there were linear relationships between pre-admission indicators of college readiness and clinical performance in this population of students; and if so, what was the size correlation.

1.4. Significance of the Study

The study makes both conceptual and empirical contributions toward understanding an important determinate related to both post-secondary enrollment in HPRP and diversification of the healthcare workforce. The study makes a conceptual contribution to the literature by providing a research framework for what is believed to be a first time look at assessing the relationship between pre-admission indicators of college readiness and subsequent performance in clinical practica. The study makes an empirical contribution by quantitatively assessing the relationship between pre-admission indicators of college readiness and subsequent performance in clinical practicums for a cohort of nursing students in a 4- year bachelorette nursing program at a state flagship university.

Since clinical performance is arguably *the* most important educational outcome for students graduating from HPRP, such as nursing, it is problematic that we know so little about the relationship between what is clearly a barrier to increasing diversity in post-secondary education and the desired outcome of a diverse and culturally competent healthcare workforce (Cowen, Norman & Coopameh, 2005; Garside & Nhanachema, 2013; Kulatunga-Moruzi & Norman, 2002; Salvatori, 2001; Tilley, 2008). The findings from this analysis inform our understanding of the degree to which current institutional and organizational arrangements, such as admissions decisions based on commonly used measures of college readiness, are in useful and necessary.

1.5. Research Identity

The research's identity is relevant to this study as it likely contributes to the rationale for the study and the lens through which the findings were interpreted. I began my career as a nuclear medicine technologist in 1989 after graduating from an elite University in the Southeastern United States. Based on scores related to what I now refer to as the pre-admission indicators of college readiness, I realize that I would have never been admitted to this University without special considerations in the admissions process. My admission to this University lead to a career that has included work as a clinician, an administrator, and an educator.

Through these experiences I have come to recognize the need for the development of a diverse, culturally competent healthcare workforce and a realization of at least some of the barriers to doing so. My experience has lead me understand that even in relatively homogenous region such as the Appalachian foothills of East Tennessee and Northern New England, we see a vast spectrum of cultural identities rooted in race/ethnicity, economic class, sexual orientation and identity, country of origin, etc. In order for the healthcare system to provide high quality care in these and other diverse cultural environments, we must develop a healthcare workforce that reflects the diversity of the population throughout the spectrum of health related careers. Otherwise, we are left with a healthcare workforce that is incapable of recognizing and challenging bias and acknowledging the ways in which culture, environment, and privilege are so closely associated with health and the delivery of health care.

CHAPTER 2: COMPREHENSIVE LITERATURE REVIEW

The following review of the literature highlights findings which emerged from a thorough inquiry into our current understanding of the degree to which the educational system serves to mediate the development of a diverse healthcare workforce capable of reducing disparities associated with the delivery of healthcare services. The literature review begins with a discussion of disparities in health and the healthcare system and the need for increasing diversity within the healthcare workforce as a means to reduce these disparities. The review then transitions to an examination of how disparities related to race/ethnicity and socioeconomic status in education lead to lower levels of academic achievement for students from disadvantaged backgrounds. The review then presents a view into the ways in which the combined effect of lower scores related to commonly used indicators of college readiness and a heavy reliance on these scores in post-secondary admissions practices restrict the pipeline of students from disadvantaged background into post-secondarday education. The conclusions from the literature review provide the bases for the conceptual model that proposes that these admissions criteria serves to restrict the pipeline of students from disadvantaged backgrounds who matriculate into Health Profession and Related Programs [HPRP] in post-secondary institutions and therefore, restrict the development of a diverse healthcare workforce.

Additionally, the review of the literature revealed an apparent gap in our understanding of the relationships between the pre-admission indicators of college readiness and an important academic outcome related to HPRP. The review of the literature failed to identify any research that specifically examined the relationships between the indicators of college readiness and students' subsequent performance in clinical practica. This finding lead to an additional inquiry into methods for the assessment of clinical performance.

2.1. Disparities in Health

While agreeing upon a set of criteria for international comparisons of national healthcare systems is a topic of considerable debate, it is widely agreed that despite spending considerably more than any other nation on health care[7], the United States (US) ranks near the bottom of the Organization for Economic Cooperation and Development [OECD] countries in most measures of health care quality (Murry & Frenk, 2010; OECD, 2016; Kung, Hoyert, Xu, & Murphy, 2008; WHO, 2000). The often cited reasons for this low ranking are the large disparities in access to social determinates which promote health, a lack of access to the healthcare system for millions of citizens, bias among healthcare providers, and the inability of the healthcare system to address the overwhelming burden of chronic illness (Kung, Hoyert, Xu, & Murphy, 2008; OECD, 2016; WHO, 2000).

These conditions disproportionately affect persons from minority racial/ethnic/cultural backgrounds as well as those from economically disadvantaged backgrounds (Isaacs & Schroeder, 2004; Johnson et al. 2012; Kung, Hoyert, Xu, Murphy; 2008; OECD, 2013; WHO, 2000). As a result, pervasive disparities in health exists across a class gradient in the US where persons from disadvantaged groups are known to experience a higher incidence of disease and increased mortality and morbidity given

[7] 2.5 times more than the Organization for Economic Co-operation and Development (OCED) average and 50% more than the next highest spending nation (OECD, 2016).

similar clinical conditions (AHRQ, 2006; IOM, 2014; Isaacs & Schroeder, 2004; Kawachi, Daniels, & Robinson, 2005; Smedley, 2003).

Health Disparities and the Social Determinates of Health

The research literature indicates that powerful, complex relationships exist between health, biology, genetics, individual behavior, and what The World Health Organization [WHO] (2008), the US Department of Health and Human Services [USDHHS] (2014a), and others refer to as the social determinates of health (Herbert et al., 2008; Hoosienpoor, Williams, and Itani, 2012; Johnson, Schoeni, & Rogowski, 2012; Marmot & Bell, 2009). While researchers are still trying to identify the mechanisms by which these determinates actually influence health and the extent to which different variables affect health, the influence of the social determinates are now widely recognized as contributing greatly to one's health status (USDHHS, 2014a; Hoosienpoor et al., 2008; Johnson et al., 2012; Kaplan et al., 1996; Marmot & Bell, 2009; McNeill, Kreuter, & Subramanian, 2008; Smedley, 2003; WHO, 2008).

For example, in 2005 The WHO established the Commission on Social Determinants of Health to study the association between the social position of individuals and their health. In 2008 the Commission released a comprehensive report titled, *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health.* In this report, the authors concluded that the structural mechanisms which determine the social position of individuals are responsible for the majority of the global burden of disease. Further, the authors specifically identified those mechanisms which promote inequalities in *economic power* as being the root cause of inequities in health. Not only did The WHO (2008) identify a relationship between the economic wealth of nations and the health of their population, they also identified a graded relationship within countries, particularly in the US, where higher levels of income and education were closely correlated with better and longer health (WHO, 2008).

Other researchers have also demonstrated the graded relationship between socioeconomic status [SES] and health in the US. Alder and Rehkoph, (2008), Isaacs and Schroeder (2004), Johnson, et al. (2012), Marmot and Bell, (2009), and Murray et al. (2010) have all presented evidence that, in the US, inequities in health are systematic and are largely associated with disparities related to the social determinates of health. These researchers also found that studies of health disparities in the US tend to focus on racial/ethnic variables as opposed to economic/social variables. Alder and Rehkoph (2008), and Marmot and Bell (2009) attribute this to constraints of available data. Marmot and Bell (2009) describe how in the United Kingdom health information is keyed to the Registrar General's measure of social class; but, in the US, this level of fine grained hierarchical social ordering is not readily available. As a result, most studies of health disparities in the US focus on the variables of race and ethnicity.

This is not to say that persons from minority racial/ethnic backgrounds do not experience disparities in health which are related specifically to race/ethnicity. The literature is clear that disparities in health exists in greater proportion among those belonging to minority racial groups even after adjusting for economic disparities (Crimmins, Hayward, Seeman as cited in Anderson, Bulatao, & Cohen, 2004; Camera, 2000; Fiscella et al., 2000; Johnson et al., 2012; Smith et al., 1998; Sullivan, 2004; Smedley, 2003; Williams et al., 2010).

In 2003 Crimmins, Hayward and Seeman, as cited in Anderson et al. 2004, performed a meta-analysis of well-known national survey data[8] to examine the interactions between socioeconomics and racial/ethnic differences in health. Their analysis demonstrated that although persons from racial minority groups do not report higher disease prevalence in all disease categories, in comparison to their White counterparts, in general, persons from racial minority groups are significantly more likely to report a higher prevalence of illness. When controlling for SES, using either income or educational level, they found that racial differences in disease prevalence persisted for all minority groups. Consequently, they were explicit in noting that controlling for SES does not cause the racial differences in health to disappear. However, they also demonstrated that the differences were reduced significantly when controlling for variables such as education and income. As a result, they concluded that "Socioeconomic status is related to almost all health outcomes" (p. 347).

Hebert, Sisk, and Howell, (2008) discuss the complex nature of defining causal relationships in health inequities and the particularly difficult task associated with differentiating disparities which result from race, ethnicity, and/or culture from those associated with socioeconomic disadvantage. According to Hebert et al. (2008), disparities in health result from complex interactions involving multiple variables including, race/ethnicity, education, neighborhood, and other SES related factors which are associated with access to the social determinates of health.

[8] The surveys include the Assets and Health Dynamics of the Oldest Old (AHEAD), the National Health and Nutrition Examination Survey III, the National Health Interview Survey of 1994, the Longitudinal Study on Aging, and the Health and Retirement Study.

Similarly, Thomas, Eberly, Smith, Neaton, and Stamler (2005) also found a clear correlation between race (Black and White were the only racial categories analyzed), SES, and increased mortality from cardiovascular disease (CVD). They found that being Black, living in a low income zip code, and having lower levels of education were all significant variables associated with an increased risk of CVD. They also found that Black men in their study were far more likely to be in the low income group[9]. These findings lead the authors to conclude that it is the combination of race and income inequities that "formed a lethal combination for Black men" (p. 1421). In this context, it appears that race/ethnicity are not the causes of the vast majority of differences in health related outcomes, but serve as a proxy for factors which are—such as disparities in education, income, neighborhood, and systematic racism (Alder & Rehkoph, 2008, Cooper et al., 2005; Franks & Fiscella, 2008; Isaacs & Schroeder, 2004; Johnson et al., 2012; Kawachi, 2005; Merikangas & Risch, 2003; Smith, Neaton, Wentworth & Thomas, 2005; Ryn & Fu, 2003; William & Collins, 1995).

Disparities in the Delivery of Health Care

In addition to disparities in access to the social determinates which promote health, disparities in health are also associated with inequities related to the delivery of health care. The Agency for Healthcare Research Quality [AHRQ] (2009), the Centers for Disease Control and Prevention [CDC] (2009, 2011, 2013a, 2013b); the Institutes of Medicine [IOM] (Smedley et al. 2003), and others (Adler & Rehkopf, 2008; Betancourt, et al., 2003; Carlisle, 1997; Fascella et al., 2000; Peterson, Wright, Daley, Thibault, 1994; Philbin, et al., 2000; Thomas et al., 2005; Ryn & Fu, 2003; Williams et al., 1995;

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[9] 83% of Black men vs. 21% of White men were in the lowest income quartile.

Williams et al. 2010) have recognized that in the US, belonging to a racial and/or ethnic minority group or being economically disadvantaged have been specifically indicated as a basis for disparities in the delivery and quality of health care. These disparities in care result in differences in survival rates for persons from racial/ethnic minority and other disadvantaged groups when compared to the highest aspirational group--middle and upper class Whites.

Much of the literature and research concerning inequities associated with the healthcare system focus on disparities associated with race, culture, and ethnicity for good reasons. For example, the landmark IOM publication Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care (Smedley et al., 2003), provides rich documentation of examples of disparities related to the healthcare system. According to the authors,

> Although not all the evidence is equally convincing, disparities have been well documented in many areas [of healthcare services], such as cardiovascular care, cancer care, human immunodeficiency virus (HIV) infection and AIDS, mental health services, receipt of immunizations for influenza and pneumococcal disease, and renal disease and kidney transplantation. (p. 5)

However, in addition to minority status, economic status has been specifically linked to inequities related to the delivery of health care (Abramowits & Dokecki, 1977; Burgess et al., 2008; Fiscella, 2004; Garb, 1997; Hooper, Comstock, Goodwin, J.M. & Goodwin, J.S., 1982; Philbin et al., 2000; Pruit, Shim, Mullen, Vermon, & Amick, 2009; Smedley, 2003; Sullivan, 2004; Ryn & Burke, 2000; Ryn & Fu, 2003; Williams, et al., 1995;

Williams et al., 2010). This is not to say that economically disadvantaged Whites necessarily experience the same degree of inequity in the delivery of health care as economically disadvantaged minority groups, but that regardless of race, economic disadvantage predisposes one to experience inequities in health care delivery.

It is important to note that inequalities associated with the healthcare system are thought to be less associated with overt racism or socioeconomic stereotyping, which does still exists[10], than with unconscious stereotypes and bias (Cooper et al., 2005; Dovidio, Kawakami, & Gaertner, 2002; Dovidio & Fiske, 2012; Hooper et al., 1982). Even so, the results of unconscious stereotyping may be as bad as, or worse than, overt bias (Gaertner & Dovidio, 2005; Pearson, Dovidio & Gaertner, 2009; Dovidio & Fiske, 2012). Unconscious stereotypes are highly resistant to change because they are difficult to identify and are less likely to be exposed and recognized as bias (Burgess et al. 2006; Dovidio & Fiske, 2012; Kawakami, Dovidio, Moll, Hermsen, & Russin, 2000). In other words, stereotypes become habits of mind which influence perceptions and decision making, but which are unlikely to be cognitively scrutinized (Burgess et al., 2006; Kawakami et al., 2000; Pearson et al., 2009).

The Stereotype Content Model (SCM) from the field of Cognitive Social Psychology, provides a framework for understanding how provider/patient interactions may be effected by unconscious bias (Abele & Wojciszke, 2007; Cuddy, Fiske, & Glick, 2007; Dovidio & Fiske, 2012; Judd, James-Hawkins, Yzerbyt, & Kashima, 2005; Russell

[10] Explicit bias still exists and is frequently expressed directly. Research on medical decision-making shows that physicians recommend more advanced and potentially more effective medical procedures such as coronary bypass surgery for White than for Black patients and this disparity occurs because physicians assume that Black patients are less educated and less active (Davidio, 2012; Williams et al., 2010).

& Fiske, 2008). According to the SCM, when a healthcare worker, or anyone, encounters another person, stereotypes and emotions direct behavioral tendencies which reflect perceptions of social groups. In this process, two fundamental dimensions of social perception, i.e. warmth and competence, shape our stereotypes and ultimately regulate the amount and type of bias in our responses to individuals from different groups (Abele & Wojciszke, 2007; Cuddy et al., 2007; Dovidio & Fiske, 2012; Judd et al., 2005; Russell & Fiske, 2008). See Table 1.

Table 1: *Stereotype Content Model*

Social perception	Behavior
Warm-competent reactions	Elicit admiration resulting in helping/supportive behaviors on the part of the perceiver.
Warm-incompetent reactions	Elicit pity resulting in active helping and passive neglect.
Cold- competent reactions	Elicit envy resulting in active harm and passive association
Cold-incompetent reactions	Elicit dislike resulting in harassing, neglecting tendencies.

In the context of health care, these responses have a direct impact on clinical and policy related decisions (Cuddy et al., 2007; Dovidio & Fiske, 2012). Research demonstrates that healthcare providers have been shown to generally rate middle class Whites, Christians, and heterosexuals high on both warmth and competence scales (Dovidio et al., 2002; Dovidio & Fiske, 2012; Fiske, 2010). In terms of health status, collectively, these groups also represent the highest aspirational groups, and generally receive the most thorough, appropriate, and effective healthcare services (Dovidio & Fiske, 2012; Smedley, 2003, Ryn & Fu, 2003; Ryn et al., 2006). Conversely, poor Blacks, undocumented immigrants, Latinos, and poor Whites elicit low responses on both continuums of warmth and competence (Dovidio & Fiske, 2012; Clausell & Fiske, 2005; Harris & Fiske, 2006; Russell & Fiske, 2008). Not surprisingly, these groups are also most closely associated with disparities in the delivery of care and are among the lowest aspirational groups (Cooper. Beach, & Inui, 2006; Smedley, 2003, Ryn & Fu, 2003; Ryn et al., 2006).

As a result of the dynamics of stereotyping, healthcare providers likely fail to incorporate information specific to the individual and instead assign their beliefs, often incorrect beliefs, about the characteristics of the group from which the patient is ascribed, to the individuals within the groups (Cuddy et al., 2007; Dovidio & Fiske, 2012; Judd, James-Hawkins, Yzerbyt, & Kashima, 2005; Ryn & Fu, 2003). As Ryn and Fu. (2003) state:

> We expect [healthcare] providers to conduct encounters, make assessments, and recommend courses of action in a way that it is unaffected or unbiased by the sociodemographic characteristics of the people they serve. In addition, they are expected to be attuned to cultural differences and to be culturally sensitive as they work, in an unbiased manner, with various populations. Unfortunately, there is a massive body of research on social categorization and stereotyping demonstrating that humans universally apply stereotypes when making sense of other people. (p. 251)

This process depersonalizes care in ways which have profound effects on the quality of care received by patients who are perceived as lower on either of the two dimensions (Cuddy et al., 2007; Dovidio & Fiske, 2012; Judd et al., 2005; Ryn & Fu, 2003).

2.2. Conceptual Framework for Diversification of the Healthcare Workforce

One proposed intervention for reducing bias and disparities related to the healthcare system is to increase participation of persons from diverse backgrounds in the healthcare workforce (Alexander, 2009; Cohen, Gabriel, & Terrell, 2002; DHHS, 2010; Donini-Lenhoff & Brotherton, 2010; Mitchell & Lassiter, 2006; Sullivan, 2004). A substantial body of literature supports the proposition that increasing diversity in the healthcare workforce leads to reductions in disparities related to both population health and the delivery of healthcare. (Cohen et al., 2002; Donini-Lenhoff & Brotherton, 2010; IOM, 2011; IOM, 2014; Mitchell & Lassiter, 2006; Smedley et al., 2003; Sullivan, 2004; USDHHS, 2006). In 2004, the authors of the landmark "Sullivan Commission Report" (Sullivan, 2004) concluded that, a key component to addressing disparities in health and in health care is addressing the lack of racial-ethnic diversity in healthcare professions. The Commissioners concluded that,

> … increased diversity [in the healthcare system] will improve the overall health of the nation. This is not only true for members of racial and ethnic minority groups, but also for an entire population that will benefit from a health workforce that is culturally sensitive and focused on patient care. (p. 13)

Noting that the civil rights movements of the 1960s and the associated Civil Rights Act ended the more explicit racial and ethnic barriers found in the US, the Commission identified entrenched patterns of inequality which still remained in 2003. The Commissioners noted that racial and ethnic minority persons have historically been underrepresented in health professions in the US; and, that it is not in-coincidental that these groups have historically received lower quality of care and die at an earlier age as compared to White Americans. The Commissioners state, “The rationale for increasing diversity in the healthcare workforce is evident…diversity in the health workforce will strengthen cultural competence throughout the health system. Cultural competence profoundly influences how health professionals deliver health care.” (Sullivan, 2004, p.3).

The Commissioners go on to address the discordant relationship between the dominate Anglo-American cultural values and the cultural values of minority groups and how the underrepresentation of persons from minority backgrounds in the healthcare system perpetuates the dominance of the majority group values in health related practices. Further, while the Commissioners noted the need for increased diversity and cultural competence at the provider level, they also emphasized that diversity must increase throughout the healthcare system and throughout healthcare institutions—including educational institutions. The Commissioners (Sullivan, 2004) noted that the inclusion of minority healthcare professionals will increase the cultural competence of organizations across a broad section of functions including, “…the facilitation of clinical services, research, departmental management, staff development, policymaking, and organizational oversight and leadership” (p.18). Additionally, the Commissioners (Sullivan, 2004) contended that increasing the presence of minority health professionals would help to “…hold the system accountable” (p. 18) by bringing a community based cultural affinity to organizational processes and policy development that supports effective cross-cultural participation in operations and policy development. Consequently, the Commissioners called on colleges, universities, organizations within the healthcare system, government entities, and others to take efforts to increase diversity within the healthcare professions (Sullivan, 2004).

Interestingly, while the Commissioners clearly establish their rationale for increasing diversification of the healthcare workforce as a means of increasing the cultural competency of the healthcare workforce, they make no mention of healthcare workforce diversity in terms of the economic backgrounds. This seems like a glaring omission in the Commission's assessment of the nature of health disparities and the call for workforce diversify as a remedy. They seemingly ignore cultural differences related to differences in economic position and the fact the being poor, regardless of race, predisposes one to poor health and poor health care (Adler & Rehnkoph 2008; Bernheim et al., 2007; Duncan, 2002; Kreiger et al., 1993; Murray et al., 1999; Pruitt et al., 2009; Thomas et al., 2005; Williams et al., 2010). The Sullivan Commission (2004) never makes the connection that if diversification of the health care workforce in terms of race will help to reduce disparities related to race, by the same measure, diversification in terms of socioeconomics should also lead to a reduction in health disparities related to economic class.

Although there is certainly considerable overlap between racial minority groups and economic disadvantage, focusing specifically on race as a measure of diversification is problematic because it falsely leads policy makers to only consider one of the variables associated with inequities in the health. As Issaks & Schroder (2004), citing the works of Adler & Newman, (2002); Navarro, (1990), Smith et al., (1998), Williams & Collins, (1995) and others, contend:

> Race and class are both independently associated with health status, although it is often difficult to disentangle the individual effects of the two factors. We contend that increased attention should be given to the reality of class and its effect on the nation's health. Clearly, to bring about a fair and just society, every effort should be made to eliminate prejudice, racism, and discrimination. In terms of health, however, differences in rates of premature death, illness, and disability are closely tied to socioeconomic status. Concentrating mainly on race as a way of eliminating these problems downplays the importance of socioeconomic status. (p.1137)

If Issaks & Schroder (2004), and others (Alder & Rehkoph, 2008, Duncan et al., 2002; Franks & Fiscella, 2008; Johnson et al., 2012; Smith et al., 1998; Thomas, 2005; Ryn and Fu, 2003; William & Collins, 1995) are correct that the majority of health disparities are related to socioeconomics, then it would seem that diversification efforts, including policy instruments, would also consider the economic backgrounds of health care workers in a similar manner as race/ethnicity. However, I find no scholarly articles which specifically examine the economic backgrounds of health care workers in the US.

Reframing Diversity in Healthcare

More recently, two comprehensive reports have been released by the IOM, Health Professionals for a New Century, (IOM, 2014) and The Future of Nursing: Leading Change, Advancing Health (IOM, 2011), the former focused on the pipeline and practice of physicians and the later focused on nurses. The conclusions and recommendations of these reports are consistent with the two previous landmark reports [i.e. Unequal

Treatment: Confronting Racial and Ethnic Disparities in Health Care (Smedley et al., 2003) and Missing Persons: Minorities in the Health Professions (Sullivan, 2004]. These new reports point to a continued lack of racial/ethnic diversity within the healthcare workforce relative to the populations served; and, they focus predominately on issues of race when referring to diversity.

In essence, both of the newer reports reflect the conclusions of the two previous reports; however, in light of newer approaches to the delivery of healthcare services which emphasize greater consideration of community context and access to the social determinates of health, the new reports emphasize the need for cultural competence in broader terms than the previous reports.

The new reports concluded that realizing the vision of equity in health and healthcare requires the development of a culturally competent healthcare workforce which integrates the community, in its full cultural, social, and economic diversity, as a partner in changing the conditions for health (IOM 2011; IOM, 2014). The rationale for this conclusion is based on the belief that community context is important for providing effective health care and prevention services; and that a culturally competent healthcare workforce has the capacity for a greater understanding of the barriers to health which are specific to the community being served (IOM 2011; IOM, 2014). This view is less focused on issues of race and more focused on the ways in which community context as a whole creates the conditions for health. This shift in focus from race to community context is important because it begins to capture the broader aspects which result in health related disparities and opens the door for a broader consideration of what it means to diversify the healthcare workforce.

This sentiment is also reflected in the work of medical anthropologists such as Susan Scrimshaw (IOM, 2014) of the American Medical Association [AMA] and others (Auerbach et al., 2013); IOM, 2013; Morris, Leung, Ames, & Lickel, 1999; Rabinowitz, Diamond, Markham, & Santana, 2012; Sommerfeld, 1998) who have formalized the concept of the "insider vs outsider" perspectives in developing a culturally competent healthcare workforce. According to Scrimshaw, patterns of behavior are guided by shared ideas, meanings, and values which are socially learned not genetically transmitted (IOM, 2014). Because much of the healthcare provider's expression of his or herself and the context for interactions with individuals from communities is at the unconscious level, Scrimshaw emphasizes the importance of gaining the insider perspective as the critical element to providing culturally competent care. However, because the demographics of the health care workforce fail to reflect the diversity in the population served, healthcare providers often have a different community context than their patients; and therefore, a different context for viewing health, illness, and interventions. As Harrison and Falco (2005) so clearly and succinctly state:

> Research has clearly demonstrated that the White middle class ethos colors our perception to the point of cultural blindness. It results in flawed assessments, biased care, and is ultimately reflected in the suffering endured by our clients as well as increased morbidity and mortality in cases of disease or illness. (p.263)

Increasing Diversity in Health Related Professions

The literature clearly supports the notion that increasing diversity in the healthcare workforce is a necessary requirement for increasing the healthcare system's capacity to provide culturally competent care, reduce bias, and reduce disparities in the delivery of health care (AAMC, 2011, Auerbach et al., 2013; Bodenheimer, Chen, & Bennett, 2009; Grover & Niecko-Najjum, 2013; Frenk, et al., 2010; IOM, 2011; IOM, 2014; LaVeist & Pierre, 2014; Rabinowitz et al., 2012; Rosenblatt, 2010; Shipman, Jones, Erikson, & Sandberg, 2013, Smedley, 2003; Sullivan, 2004). However, increasing diversity in the healthcare workforce across the spectrum of healthcare careers is largely predicated on increasing enrollment of underrepresented minority students (URMS) and students from economically disadvantaged[11] backgrounds in health professions and related programs [HPRP] at colleges and universities (Baldwin, et al., 2006; Barfield, 2011; Cohen, Gabriel, & Terrell 2002; LaVeist & Pierre, 2014; Strayhorn, 2014; Sullivan, 2004; USDHHS, 2006; USDHHS, n.d.; Winkleby, Ned, Ahn, Koehhler, & Kennedy, 2009). As Cohen, Gabriel, and Terrell (2002), and more recently, LaVeist and Pierre (2014) have concluded, post-secondary diversity results in healthcare workforce diversity, healthcare workforce diversity results in increased cultural competency, and increased cultural competency results in better health and better health care for all.

2.3. Educational Attainment and the Healthcare Workforce

Much like the relationships between health and socioeconomic status, post-secondary educational outcomes are closely related to student's racial/ethnic and economic backgrounds. The literature is clear in this area, minority students and students

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[11] The U.S. Department of Health and Human Services (n.d.) defines disadvantaged background as one who comes from an environment that has inhibited the individual from obtaining the knowledge, skill, and abilities required to enroll in and graduate from a health professions school, or from a program providing education or training in an allied health profession; or comes from a family with an annual income below a level based on low income thresholds according to family size published by the U.S. Bureau of Census, adjusted annually for changes in the Consumer Price Index, and adjusted by the Secretary, HHS, for use in health professions and nursing programs.

from lower socioeconomic status matriculate to college at lower rates than their more affluent counterparts (Adelman, 2006; Bowen et al., 2011; Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010; Gerald & Haycock, 2006; United States Department of Education [USDE], 2007; USDE, 2013; USDE, 2015a; USDE, 2015b; USDE, 2015c). When students from minority racial/ethnic groups and other disadvantaged backgrounds do matriculate into post-secondary institutions, they are much more likely to enroll in non-degree granting programs and institutions, community colleges, and less selective colleges and universities (Adelman, 2006; Bowen et al., 2011; Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010; USDE, 2007; 2013; 2015a; 2015b; 2015c).

The practical effect of this dynamic is captured in the work of Ross, Svajlenka, and Williams (2014) who demonstrated that in terms of the racial diversity of the healthcare workforce, persons from racial minority groups are concentrated in healthcare careers which require lesser degrees of post-secondary education. In fact, while many organizations such as the American Association of Colleges of Nursing [AACN] (2013) and the Association of American Medical Colleges [AAMC] (2014) still indicate a relative lack of diversity in the cohorts of graduates entering the workforce, Ross et al. (2014) demonstrated that the lower rungs of the healthcare workforce career ladder are quite diverse.

This lack of diversity *throughout* the healthcare workforce is problematic because, if the objective is to create a culturally competent workforce, diversity must extend to *all* parts of the healthcare workforce. In fact, it is particularly important to have proportional representation of persons from disadvantaged background in those careers at the top of the career ladder which have the greatest impact on the delivery of care

(AAMC, 2011; Betancourt, et al. 2003; IOM, 2003; 2011; 2014; Rosenblatt, 2010; Smedley, 2003; Sullivan, 2004; USDHHS, 2006). To accomplish this, enrollment of students from disadvantaged groups must increase at competitive post-secondary institutions which serve as gateways to careers in the higher tiers of the healthcare workforce (LaVeist & Pierre, 2014; NACNEP, 2013; Salvatori, 2001; Sullivan, 2004). Principally, this requires increasing matriculation of high school students from disadvantaged backgrounds into 4-year baccalaureate degree granting institutions.

Post-secondary Matriculation and the Indicators of College Readiness

Any analysis concerning matriculation patterns from high school into post-secondary education must include consideration of the dynamics around admissions practices into institutions of higher education (Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010; Klasik, 2012; LaVeist & Pierre, 2014; Reisig & De Jong, 2005; Salvatori, 2001; Sullivan, 2004). A review of the literature indicates that admission practices into higher education are diverse; however, consistent among institutions is the use of a rather short list of achievement related variables (Adelman, 2006; Bowen et al., 2011; Cabrera & La Nasa, 2001; Desjardins & Lindsay, 2008; Didier, Kreiter, Buri, & Solow, 2006; Klasik, 2012; Maruyama, 2012; Mountford, Ehlert, Machell, & Cockrell; 2007; Reisig & De Jong, 2005; Sampson & Boyer, 2001). These variables include American College Testing (ACT), Scholastic Assessment Test (SAT), and other standardize tests scores (Cabrera & La Nasa, 2001; Maruyama, 2012; Newton, Smith, Moore, & Magnan, 2007; Sternberg, 2007), high school grade point average (GPA) (Bowen et al., 2011; Maruyama, 2012; Newton et al., 2007), rank in class (Adelman, 2006; Bowen, et al., 2011), and grades in specific coursework (Adelman, 2006; Newton et al., 2007).

These variables are often referred to collectively as pre-admission indicators of college readiness (Adelman, 2006; Bowen et al., 2011; Maruyama, 2012). Implicit in the use of these indicators of college readiness in admissions decisions is that the better students perform along these measures prior to post-secondary enrollment, the better students will perform in their post-secondary schooling (Adelman, 2006; Alexander, Chen & Grumbach, 2009; Altonji, 2012; Bowen et al. 2011; Didier et al., 2006; Kulatunga-Moruzi and Norman, 2002; Salvatori, 2001).

Differential patterns on the indicators of college readiness.

Part of the reason for the differential patterns of post-secondary matriculation between more and less affluent students is related to differential scores related to these indicators of college readiness where students from more affluent backgrounds generally score higher (Adelman, 2006; Alexander et al., 2009; Bowen et al., 2011; Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010). The level at which students ultimately demonstrate academic achievement in terms of the indicators of college readiness, is closely related to student's habitus (Cabrera & La Nasa, 2001; Bourdieu, 1973; Bourdieu, 1986; Dumais, 2002; Engberg & Wolniak, 2010; McDonough, 1994; Paulson & St. John, 2002; Perna & Titus, 2005). Habitus is the essential system of thoughts, beliefs, and perceptions which create a person's view of the world (Bourdieu, 1973, Bourdieu, 1986; Dumais, 2002). Habitus informs the student's, the family's, and the community's views on the value of education, their predisposition to attend college, their choice of college, and their choice of a particular major (Alloway & Gilbert, 1997; Bourdieu, 1973; Cabrera & La Nasa, 2001; Dumais, 2002; Engberg & Wolniak, 2010; McDonough, 1994; Paulson & St. John, 2002; Perna & Titus, 2005). As Macleod (2009) surmised in his ethnographic assessment of two groups of low income students (one predominately White, the other predominately Black), "…the boy's habitus shapes their view of the world so strongly, that they cannot see beyond the limits of their assumptions". (p.125)

In general, the factors of habitus which favor college readiness and enrollment are disproportionally lower for underrepresented minority students [URMS] and students from lower SES (Bourdieu, 1973; Cabrera & La Nasa, 2001; Dumais, 2002; Engberg & Wolniak, 2010; McDonough, 1994; Paulson & St. John, 2002; Perna & Titus, 2005). While the specific mechanisms by which habitus effects student's academic achievement and their outlook on post-secondary educational attainment remains somewhat controversial, it is well known that compared to their more affluent counterparts, URMS and students from low income families generally graduate from high school with lower scores related to the indicators of college readiness (Adelman, 2006; Cabrera & La Nasa, 2001; Engberg & Wolniak, 2010; McDonough, 1994; Paulson & St. John, 2002; Perna & Titus, 2005).

Curriculum intensity.

While noting the complexity associated with ascribing any one variable to the likelihood of obtaining a 4-year college degree, Adelman (2006), writing for the U.S. Department of Education [USDE], reported that the most important group of variables are related to the student's high school academic history. Adelman (2006) uses the term "academic curriculum intensity" to refer to a complex cluster of variables which indicate the level of high school coursework completed in core academic areas. He concluded that student's academic curriculum intensity, particularly in mathematics, is a far more powerful predictor of bachelor's degree attainment than race, ethnicity, or SES. However, he also noted that URMS and students from low income families are much less likely to have completed an intense academic curriculum as compared to their more affluent White counterparts. In fact, he notes that URMS and students from low income families are less likely to attend a school where advanced courses, like Calculus, are even offered.

Parental influence and educational attainment.

A person's educational attainment continues to be primarily predicated on the characteristics of the preceding generation (Bozick, Lauff,, & Wirt, 2007; Conklin & Dailey, 1981; Flint, 1992; Hossler, Schmit & Vesper, 1999; Stage & Hossler, 1989; Ma, 2009). Adelman (2006), found that whether or not a student's parents attended college was the single most predictive demographic variable for bachelor's degree attainment[12]. Adelman (2006) and others (Altonji et al., 2012; Bozick, et al., 2007; Conklin & Dailey, 1981; Stage & Hossler, 1989) have surmised that the parents of students from disadvantaged backgrounds are less likely than their more affluent counterparts to encourage and support their children in completing a curriculum of high academic intensity. Parents have their own habitus which defines their views about the value and requirements of post-secondary education. Parents with higher levels of educational attainment, are more likely to encourage and foster the same from their children (Cabrera & La Nasa, 2001; Conklin & Dailey, 1981; Hossler et.al, 1999; Stage & Hossler, 1989). As a result, parents with higher levels of education are more likely to inform their children's habitus with the expectation that admission into college is achievable and valuable, they are more likely to encourage their children to pursue a more intense

[12] First generation parameter estimate -0.9137, adjusted standard error 0.1420, p value 0.01

academic curriculum in secondary education, and they are more likely to resist their children being placed in lower performing groups (Cabrera & La Nasa, 2001; Conklin & Dailey, 1981; Flint, 1992; Hossler et.al, 1999; Stage & Hossler, 1989).

Structural context of schooling.

Other researchers have identified how school officials inform student's views on the value of education and the likelihood of completing a curriculum of high academic intensity (Altonji, 2012; Alexander & Eckland, 1975; Dumais, 2002; Engberg & Wolniak, 2010; Hill, 2008; Mehan, 1992; Perna & Titus, 2005; Rogoff, Gauvain, & Ellis, 1984; Rosenbaum, 1978; Shields, 2004). These researchers concluded that the structural context of schools and the bias of school officials, disproportionately constrains the academic curriculum intensity and academic achievement of students from disadvantaged backgrounds. One of the ways in which schools create structural constraints for disadvantaged students is by rewarding what sociologists Basil Bernstein (1973, 1981), Pierre Bourdieu (1973; 1986), and Nell Keddie (1971) describe as the social and cultural capital of the middle and upper classes. These authors describe hidden middle class assumptions within the structural context of schools which underlie the paradigms of teachers and other school officials. These paradigms allow school officials to predispose their personal biases and hidden assumptions into their perceptions of student's capabilities (Bernstein, 1981; Bourdieu, 1973; Keddie 1971). As Bernstein (1981) states, "…codes are culturally determined positioning devices. More specifically, class regulated codes position subjects with respect to dominating and dominated forms of communication and to the relationships between them" (p. 327). In other words, students who do not speak, dress, or act in a manner which is consistent with these hidden middle class assumptions are often systematically grouped according to non-academically related variables such as behavior and conformity in class, physical appearance, gender, and the alignment between the student's cultural norms and those of teachers and other school officials (Blackmore, 2002; Dumais, 2002; Kerckoff, 1986; Oakes, 1992; Rosenbaum, 1978; Troman, 1988).

This dynamic disproportionately results in disadvantaged students, who do not conform to the cultural norms of teachers and school officials, being placed in lower performing groups. Once placed in these lower performing groups, differentiation-polarization theory suggests that students are likely to remain in these group and continue upon a trajectory of low academic achievement (Alexander, Entwisle, Blyth, & McAdoo, 1988; Dumais, 2002; Hammersley, 1985). While students from disadvantage are often successful in overcoming the effects of lower expectations, the associated dynamics of structural context result in students from disadvantage generally completing high school at lower rates, completing high school with lower academic curriculum intensity, and performing at lower levels in terms of the indicators of college readiness (Altonji, 2012; Blackmore, 2002; Dumais, 2002; Engberg & Wolniak, 2010; Hill, 2008; Fiscella & Kitzman, 2009; Mehan, 1992; Perna & Titus, 2005; Rogoff et al., 1984; Rosenbaum, 1978; Shields, 2004).

Post-secondary Enrollment Patterns of URMS

The U.S. Department of Education [USDE] has published, through the National Center for Educational Statistics [NCES], data related to enrollment and degree granting patterns in post-secondary education. USDE (2007, 2015a) data related to post-secondary education attainment demonstrates significant variability between racial/ethnic groups, particularly in relationship to bachelor's degree attainment or higher. The USDE (2015b) reported that in 2013 approximately 66.1% of recent high school graduates attended either a 2- or 4-year post-secondary degree granting institution. Of those students graduating from high school, 67.2% of White, 56.5% of Black, 65.6% of Hispanic students, and 80.8% of Asian students enrolled in either a 2- or 4-year post-secondary degree granting institution within 12 months of graduation (USDENCES, 2015b). While the USDE did not explicitly report the percentage of recent high school graduates enrolled in 2- *versus* 4-year degree granting institutions by race/ethnicity, they did report the percentage of persons 25-29 years who had obtained at least a bachelor's degree. According to the USDE (2015a), the proportion of 25-29 year old Asians and Whites who completed at least a bachelor's degree in 2012 was more than two times higher in comparison to Blacks and Hispanics[13] (USDE, 2015a). See Table 2.

Table 2: *Percent of 25-29 Year Olds Having Obtained a Bachelor's Degree in 2013 by Race/Ethnicity*

Category	Percent
Asian	60
White	40
Black	20
Hispanic	16

Source: NCES, 2015a

This seemingly indicates a relatively large differential in the rate of 4- year degree granting institution enrollment between URMS and their Asian and White counterparts.

[13] These are the racial/ethnic categories as described by the U.S. Department of Education.

Although some of this differential is also likely related to differential retention and graduation rates of URMS.

Additionally, a USDE special report found that recent Black and Hispanic high school graduates were far more likely, as compared to their White counterparts, to enroll in non-degree granting and community colleges, which do not utilize secondary school records, grades, college preparation courses, or standardized admission test scores as part of admissions/eligibility requirements (Kewal-Ramani, Gilbertson, Fox, & Provasnik, 2007). The NCES (Kewal-Ramani et al., 2007, USDE, 2015c) and others (Bowen et al., 2011) indicated that when URMS do enroll in 4-year degree granting institutions, they are more likely to enroll in private-for-profit institutions, are less likely to enroll in more selective colleges and universities, and are less likely to enroll in colleges and universities which participate in research activity.

Post-secondary Enrollment Patterns of Economically Disadvantaged Students

The USDE (2015d) has also reported statistics on recent high school graduate enrollment at 2- or 4- year post-secondary degree granting institutions by student's family income. This data (USDE, 2015d) demonstrated differences in post-secondary matriculation patterns of recent[14] high school graduates where 50.9% of low income, 64.7% of medium income, and 80.7% of high income students enrolled in either a 2- or 4-year post-secondary degree granting institution. In 2012, the differential matriculation rate between low and high family income students was 29.4% (USDE, 2015d).

[14] At the time of this writing the most recent year for which data was reported was 2012 (NCES, 2015d).

Incidentally, this differential is roughly the same as in 1975 when the differential was 29% (USDE, 2015d).

In 2006, NCES researchers examined differentials between low and high family income student matriculation into 2- year *versus* 4- year degree granting institutions. Using the receipt of a Pell Grant[15] as a proxy for SES, the researchers found that in 2004 Pell grant recipients were more likely to enroll in 2- year as opposed to 4-year institutions (USDE, 2006). They also found that when Pell grant recipients did enroll in 4- year degree granting institutions they were less likely to enroll at state flagship or other highly selective schools (USDE, 2006).

According to USDE (2015a) research, while differentials in post-secondary matriculation still exist where URMS are still less likely than their White counterparts to matriculate into post-secondary institutions, this gap has narrowed somewhat over the last 10 years—albeit at least some of the gains are related to URMS enrolling in and graduating from less selective institutions. Conversely, while data related to the socioeconomic backgrounds of matriculating students is limited, the available data suggest that the gap between lower SES students and their more affluent counterparts is much greater than the differentials between URMS and White students, and the gap related to income has remained consistently wide over the last two decades (USDE, 2015d). These differential enrollment patterns are consistent with the findings of Gerald and Haycock (2006) and Bowen et al. (2011). Their findings suggest that the combined effect of differences in institutional selectivity and lower scores on the indicators of

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[15] Define Pell Grants are federally funded grants for students determined to have sufficient financial need (USDE, 2006, p.1)

college readiness results in students from disadvantaged backgrounds generally enrolling in lower level (i.e. 2-year versus 4-year) and less selective colleges and universities.

Importance of High School Academic Performance in HPRP

According to Barfield, Folio, Lam, and Zang (2011), and Bastedo and Jaquette (2011) the importance of academic performance related to the indicators of college readiness may be an even more important consideration in HPRP than in college enrollment generally. Barfield et al. (2011), and Bastedo and Jaquette (2011) conclude that the combined effect of high demand[16] for enrollment in HPRP and programmatic accreditation requirements which often place strict limits on enrollment capacity in HPRP, result in a highly selective acceptance processes where schools turn away many qualified, but lower achieving[17] applicants. Consequently, because the academic preparation of students from disadvantaged backgrounds is known to be, on average, lower than that of more affluent students, students from disadvantaged backgrounds may voluntarily, or involuntarily, choose to enroll in less selective programs and majors in a manner that is even more pronounced than for college enrollment generally (Barfield et al., 2011; Bastedo & Jaquette, 2011).

Pre-admissions Data and Subsequent Nursing Student Performance

Academic performance has a somewhat different meaning in areas of study which include clinical performance, such as the case with many HPRP including nursing education (Didier et al., 2006; Kulatunga-Moruzi and Norman, 2002; Salvatori, 2001). In

[16] Indicated by a large number of applicants.
[17] In terms of the indicators of college readiness.

this setting, the implied assumption would include the construct[18] that the indicators of college readiness are related to future performance in the clinical setting, arguably the most important educational outcome related to professional health related majors (Cowen, Norman & Coopameh, 2005; Garside & Nhanachema, 2013; Kulatunga-Moruzi & Norman, 2002; Salvatori, 2001; Tilley, 2008).

A search of the English Language educational literature using common databases and search engines including CINAHL, Cochrane Information, ERIC, Medline, and Web of Science reveals a limited but relevant body of literature related to admissions criteria into nursing programs and subsequent academic performance. The literature reveals that preadmission GPA is consistently identified as a reliable predictors of academic 'success' in nursing and other health professional educational programs (Didier et al., 2006; Salvatori, 2001; Timer & Clauson, 2010, Watson, Stimpson, Topping, & Porock, 2002); however, 'success' has generally been defined in terms of retention or persistence, and scores on post-graduation licensing examinations. Few articles in the literature specifically address the question of clinical performance (Salvatori, 2001; Timer & Clauson 2011).

One study, Kulatunga-Moruzi and Norman (2002), found college GPA to be predictive of clinical competency in medicine; however, as Salvatori (2001) states, "The relationship of pre-admission academic performance to clinical performance has been studied less often and is far less clear [in comparison to didactic performance]" (p. 162).

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[18] Construct is a term used in psychology to describe something that is not directly observable, but is literally constructed to summarize or account for the consistency in an individual's behavior (Thorndike and Hagen, 1977).

Since Salvatori (2001), few studies have sought to further examine the relationship between preadmissions data and student's clinical performance. However, a study by Timer and Clauson (2011) examined correlations between preadmission variables, including pre-admission GPA in science courses and GPA in prerequisite college courses, and academic outcomes which included clinical performance in a Canadian advanced standing baccalaureate nursing program. Noting the lack of research and clarity around the relationship between preadmission variables and clinical performance, the authors concluded:

> Because pre-admission GPA was found to be predictive of the course grade mean and because some of the courses evaluated for this research were clinical in nature, or were academic with a clinical component, we tentatively conclude that admission GPA is a valid predictor of clinical success. (p. 605)

It should be noted that Timer and Clauson (2011) did not directly assess clinical performance. They utilized grades in six courses, three of which had a clinical component, as the dependent variable; however, the clinical component was graded only as pass/fail. Consequently, the relationship to clinical performance was primarily established through grades in academic courses which had a secondary relationship to clinical performance. This is problematic because as Turnwald, Spafford, and Edwards (2001) concluded from a review of the literature related to clinical performance, tools which may predict academic performance well, lose their validity when predicting clinical performance (p.119).

2.4. Assessing Clinical Performance

A central issue related to this research is determining how to assess student's clinical performance. Performance assessment is a broad term that essentially describes most forms of educational appraisal where a student's ability to perform clinical tasks are measured (Kane, 2001; Woodward & McAuley, 1983). Clinical performance is determined by the assessment of clinical competence[19], which has been described by Tilley (2008) as the student's ability to demonstrate skills in the performance of tasks and behaviors in a manner consistent with professional standards. Others in the scholarly literature identify additional measures, such as personal qualities and moral character, as items which should be included as part of an assessment of clinical competency (Bradshaw, 1998; Bradshaw, 2000; Cohen, Norman, & Coopamah, 2005; Garside & Nhemachena, 2011).

Garside and Nhemachena (2011) undertook a systematic review of the literature in an effort to examine the concept of clinical competence and how it is interpreted in nursing education. One of their findings was a lack of consensus as to which variables should be included in an assessment of clinical competence. They concluded that the existence of so many variables which represent professional skills and behaviors has created a conundrum around the concept. This conundrum is central to the difficulty and complexity of assessing clinical competence. To assess clinical competence, we must first identify and agree upon those variables which are essential determinates of

[19] Competence may be used to summarize consistency in the professional behavior of individuals and to anticipate how they will behave in future professional situations. However, it can only be inferred through observation of behaviors thought to be indicative of the construct. (Cross, Hicks & Barwell, 2001).

professional skills and behaviors (Bradshaw, 2000; Cohen, et al., 2005; Garside & Nhemachena, 2011). This issue alone is creates a significant challenge.

Determination of Competence

A second difficulty in assessing clinical competence is related to different definitions and perspectives of what competent performance looks like for a particular predetermined essential determinate of competent performance (Cohen et al., 2005; Garside & Nhemachena, 2011; Watson et al. 2002). For example, we may define the use of appropriate aseptic technique as an important variable in the assessment of clinical competency; however, we must then define what appropriate aseptic technique looks like in a given context. As stated by Watson et al., 2002, "…competence is a somewhat nebulous concept which is defined in different ways by different people" (p.422). To address these issues, Garside and Nhemachena (2011) undertook a concept analysis following a strategy defined by Walker and Avant (2005). Garside and Nhemachena (2011) concluded that due to the overwhelming number of definitions of competence, it is unlikely that we will ever have a universally accepted definition.

Instrumentation

A search of the English Language medical and educational literature was performed using common databases and search engines including CINAHL, Cochrane Information, ERIC, Medline, and Web of Science for instruments and methodologies used to assess clinical competence. While the search of the literature reveled many articles concerning the evaluation of clinical performance across many health related disciplines, only one assessment tool was identified that was developed through a systematic, rigorous, and iterative process and was considered to be valid, reliable, and practical for quantitative assessment of clinical nursing performance. This tool is the Leicester Clinical Procedure Assessment Tool [LCAT] (McKinley, Strand, Gray, & Alun-Jones, 2008a). The LCAT was developed and validated in a multistage process involving a meta-analysis of source material referenced from the then current (2005) literature, the development and use of a systematic framework to identify key themes and subthemes, the development of a pilot version, testing of the pilot, and refinement through focus groups made up of practitioners from within the National Health Service of Great Britain and higher education institutions in the UK (McKinley et al., 2008 a; McKinley et al. 2008 b).

The final version of the LCAT contains five categories of clinical competency made up of 38 associated component competencies. The final version of the LCAT was assessed for validity and reliability in 21 Trusts[20] . While the authors did not find enough evidence to confirm the absolute reliability of the tool, they did conclude that its use will lead to a more valid assessment of skills than what has been previously obtainable. Further, they conclude that:

> Although we cannot yet recommend LCAT for high stakes regulatory assessments, it is a generic clinical procedural skills assessment tool which enables valid, holistic, multi-professional, multi-level and multi-modal assessment of skills which is likely to be reliable. We believe it has great potential for the teaching and formative assessment of clinical procedure

[20] Trust are comprehensive health systems in the NHS which are similar to medical centers in the US (National Health Service Confederation, 2016).

skills and would encourage others to include it in their assessment programs. (p.626)

2.5. Conclusions from the Review of the Literature

The literature review for this study crossed a wide range topics. This wide ranging review was necessary due to interconnectedness of multiple relevant areas of research concerning the conceptual framework of this study. As part of this review, areas of interest spanned across the topics of disparities in education, health, and the delivery of healthcare, the rationale for diversification of the healthcare workforce, barriers to workforce diversification related to the education system, gaps in the literature, and the difficulty associated with assessing clinical performance. This review of the literature yielded the following key concepts:

- In the US, disparities in health and the delivery of healthcare services are substantial and are linked to relative social disadvantage.
- Diversification of the healthcare workforce is considered to be an essential component necessary for eliminating disparities in health and the delivery of healthcare.
- Increasing diversity throughout the healthcare workforce is contingent upon increasing the diversity of students participating in post-secondary majors related to HPRP.
- There are a number of factors that serve as barriers to increasing enrollment of students from disadvantaged backgrounds in HPRP.
- One factor which was consistently identified as a barrier to enrollment of students from disadvantaged backgrounds into post-secondary institutions,

particularly 4-year degree granting colleges and universities which offer HPRP, is these student's performance on a set of factors commonly referred to as the pre-admission indicators of college readiness.

- There is an implied assumption that the higher student's scores on these indicators, the better they will subsequently perform in post-secondary education.
- An apparent gap in the literature concerns the validity of the assumption that scores on pre-admission indicators of college readiness are associated with better clinical performance --an important academic outcome in many HPRP.
- A key concern related to assessing the relationship between scores on pre-admission indicators of college readiness and clinical performance is the difficulty associated with assessing clinical performance.

To address this gap in the literature, a research protocol was proposed and completed. The following chapter describes this research protocol.

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CHAPTER 3: METHODS

Underlying this research is a conceptual framework which proposes that admissions criteria into selective colleges and universities serves to maintain disparities in health and the delivery of health care by perpetuating the status quo in terms of healthcare workforce diversity. This conceptual framework was developed after a thorough review of the literature and is founded in the fundamental cause model. The fundamental cause model suggests the presence of underlying structural causes or 'meta-mechanisms' that are responsible for disparate outcomes in areas such as education and healthcare (Diez Roux, 2012).

According to the fundamental cause model, it is the meta-mechanism that generates and maintains differential outcomes; however, it is through mediating pathways, often associated with social institutions, where differences in outcomes manifest. In the context of this research, conceptual model proposes that the education and healthcare systems are social institutions which serve as mediators for the disparate outcomes between more and less affluent groups. It is from this model that a set of research questions arise which challenge the assumption that higher scores related to a set of pre-admission indicators of college readiness are necessary and useful tools for the selection of students into post-secondary education related to health professions.

3.1. Research Questions

The purpose of this research was to test the implicit assumption that higher scores related to the indicators of college readiness are correlated with better academic outcomes in post-secondary health professions and related programs [HPRP]. Given the importance of clinical performance as an outcome of post-secondary education in HPRP, the aim of this research was to address the following primary research question:

> To what extent do pre-admission indicators of college readiness correlate with or predict clinical performance of nursing students during senior year clinical practica in a 4- year baccalaureate degree program at a New England state flagship university?

The Null hypothesis was that student's scores on the pre-admission indicators of college readiness were not predictive of student's global clinical composite scores.

Secondary Research Questions

To gain a more in-depth understanding of the ways in which individual indicators of college readiness are related to performance in senior year clinical practicums, a set of five secondary research questions were addressed. These questions include:

1. To what extent does high school cumulative high school grade point average correlate with or predict performance in senior year clinical practica?
2. To what extent does rank in high school class correlate with or predict clinical performance in senior year clinical practica?
3. To what extent does the high school grade point average in the science and math courses required for admission into the nursing major at this University correlate with or predict clinical performance during senior year clinical practica?
4. To what extent do scores on standardized assessment test correlate with or predict clinical performance during senior year clinical practica?

5. To what extent does a University derived composite measure related to the pre-admission indicators of college readiness correlate with or predict clinical performance during senior year clinical practica?

The Null hypothesis tested was that student's scores on the pre-admission indicators of college readiness were not linearly correlated with their clinical performance assessments.

3.2.Study Type

To address these questions, a descriptive study was undertaken utilizing a cross-sectional retrospective observational design. Descriptive studies generally provide information about the world as it exists and about associations between variables in the world around us (Bickman & Rog, 2009). Data may be obtained from a variety of people, subjects, or phenomena (Bickman & Rog, 2009; Hulley, 2007). Observational studies are carried out with no interventions on the part of the researcher, i.e. the researcher does not control the independent variable(s) nor does the researcher group the participants into control or intervention groups (Mann, 2003). Cross-sectional studies yield information specific to a particular point in time or a relatively short period of time (Hulley, 2007; Mann, 2003). Retrospective observational studies look backward in time for information (Hulley, 2007; Sullivan, 2012). Therefore, a cross sectional retrospective observational design is a study in which data is collected at only one time, i.e. in the past, without any researcher intervention or experimentation.

Sometimes, as is the case with this study, these studies are referred to as correlational studies as they may provide information concerning the relationships between different variables of interest in an effort to describe the world as it exists

(Bickman & Rog, 2009; Mann, 2003). Observational studies cannot establish cause and effect, although they may be used to infer causation (Bickman & Rog, 2009; Hulley, 2007). These types of studies are often done before an experiment to gain knowledge that will be used to inform the design of future experimental studies (Bickman & Rog, 2009; Hulley, 2007).

In one aspect, this study may seem to differ from the strict definition of a cross sectional study. The classic definition of a cross sectional study design suggests that information is collected relative to a particular point in time (Bickman & Rog, 2009; Hulley, 2007). This study seeks to examine the relationships between variables which were known at two different points in time. The first point in time being prior to admission into the University. The second at the point being when all didactic and clinical course work had been completed. However, this is not a longitudinal study because the study does not seek to examine changes related to a particular variable over time. In this study, all of the data is related to unique variables whose values were known at a specific time, was collected over a relatively short period, and the investigator made no attempt to control the independent variables. For these reasons, the study, for all practical purposes, meets the criteria of a cross-sectional observational study.

3.3. Research Participants

Nursing students were selected as the target population for this research due to the obvious importance of clinical competency as an important educational outcome and because the Bachelors of Science in Nursing major is the largest clinically focused major at the setting for the research. The target population for this research was consenting students who meet the following inclusion criteria:

- Were enrolled as an undergraduate Bachelor of Science in Nursing [BSN] major at New England University during the Spring 2016 semester.
- Were participating in senior year clinical practicum at the University affiliated medical center where clinical performance was assessed through a clinical preceptorship overseen by program faculty.

All students were participating in the final semester of a 4- year curriculum which required a minimum of 127 credit hours of coursework (New England University, n.d.). The coursework included a wide range of studies including the basic sciences, behavioral science, humanities, and nursing specific courses (New England University, n.d.). See Appendix B for curriculum sheet.

In the second year of this curriculum, students began participating in direct clinical experience and continued gaining clinical experience throughout the remainder of curriculum. Prior to the senior year, students had completed a minimum of 594 hours of direct faculty-supervised clinical instruction throughout the affiliated medical center (New England University, n.d.). During this clinical experience, students were expected to "…apply theoretical knowledge [in the clinical setting] drawn from the arts and sciences and based on evidence" (New England University, n.d.).

All students in this study were completing the remaining didactic components of the curriculum as well as a 126 hour senior year clinical practicum. Most of these students participated in their senior year clinical practicum in a variety of locations throughout the same University affiliated medical center. During this practicum, students were allowed to choose a preferred area of interest based on their previous clinical experience and future career interest (Program Director, personal communication, September 5, 2016). After choosing an area of interest, students were placed in the clinical rotation which most closely aligned with their interest and matched to a clinical preceptor. The clinical preceptors were registered nurses employed by the medical center who provide direct clinical oversight and assessment of students during the student's clinical practicum. Indirect administrative oversight of the senior practicum is provided by a clinical coordinator who is a faculty member in the Department of Nursing (Program Director, personal communication, September 5, 2016).

3.4.Research Setting

The broad setting for this research was at a regionally accredited, medium-sized, 4-year, public, state flagship university offering Bachelor's, Master's, and Doctoral degrees with enrollment of approximately 11,000 total undergraduates and 1,900 graduate students (CollegeBoard, n.d.). More specifically, the research subjects were students enrolled in the Department of Nursing at this University. The Department of Nursing at this University enjoys a strong clinical affiliation with a neighboring level I trauma center which services a population of more than one million people from New England and New York state (New England Medical Center, 2016). The affiliated medical center offers a full range of tertiary-level inpatient, outpatient, and psychiatric services (New England Medical Center, 2016).

The Department of Nursing hosts two undergraduate nursing programs leading to a Bachelor's of Science degree in professional nursing, two Master's level nursing programs, and three doctoral level nursing programs (New England University, n.d.). The Bachelor's and Master's level nursing programs were accredited by the Commission on Collegiate Nursing Education for the period in which this research was conducted (New

England University, n.d.). As stated in the program's Self Study for Accreditation by the Commission on Collegiate Nursing Education (New England University, 2014), the graduates of the baccalaureate nursing program are expected to be able to:

1. Use empirical, personal, esthetic, and ethical knowledge to practice professional nursing with clients based on understanding of human experiences;
2. Incorporate theory and research into practice;
3. Collaborate with others to promote and preserve health;
4. Incorporate leadership principles into practice; and,
5. Use the American Nursing Association Standards and the Code of Ethics to practice as an accountable professional.

3.5.Data

The study utilized information related to consenting nursing students' scores related to the pre-admission indicators of college readiness from the student's initial application for admission; and, students scores on a clinical performance assessements during senior year clinical practica. No data was collected prior to approval from the University's Institutional Review Board [IRB] to conduct the research and no data was collected without student's informed consent.

Institutional Review

Prior to requests for any data, approval to perform the research was sought and granted by the University's IRB. As part of the institutional review process, the procedures and materials for gaining informed consent were described in detail as was the procedure for gathering preceptor feedback on student's clinical performance and the procedure for gathering preadmission data from the student's initial application for admission into the University. Special emphasis was placed on acquiring, transferring, and storing information through secure processes in order to protect students' right to confidentiality in accordance with the Family Educational Rights and Privacy Act.

Gaining Consent

After gaining approval from the University's IRB to conduct the research, students were contacted during a regularly scheduled meeting of PRNU 240. All of the students who met the inclusion criteria were also enrolled in a common course—PRNU 240 Professional Nursing Leadership and Contemporary Issues. This course provided a convenient setting for meeting with students to provide informed consent for participation in the research.

Students were provided with an Informed Consent Form containing detailed information related to the research project. See Appendix C. Next the project purpose, rationale, and specific data request were explained to the students. Students were informed that a survey would be sent to their clinical preceptor a part of an assessment of their clinical performance and that a review of their initial application to the University, including their high school transcripts, would be performed. Students were informed that data related to these inquiries would be transferred and stored via an IRB approved process. They were informed that the risk of harm as a result of participation was low. Students were informed that their personal information would remain confidential and that no one, including the faculty of the nursing program, other than those directly involved in the research would have access to this information. Students were also informed that they had the right to opt out of the study at any time by simply contacting the investigator via the provided contact information.

After informing students about the nature of the research and requesting their participation, students were provided with an opportunity to ask questions. Students were then informed that they would receive an incentive gift, valued at $10, for their participation in the research project. Sixty-four of 77 students consented to participate in the research.

Sampling Period

In accordance with the procedure outlined in the research protocol submitted to the IRB, no data was collected from preceptors until after all students had completed the entire senior year clinical practicum (i.e. May 4, 2016). On May 12th, 2016 surveys were electronically distributed to the clinical preceptors of the 64 consenting students. The survey period closed on June 15th, 2016 one week after a final request to preceptor who had not yet completed the survey.

Assessment of Clinical Performance

The Leicester Clinical procedure Assessment Tool (LCAT) was utilized as the basis for the assessment of student's clinical performance. Permission to utilize the LCAT for the purpose of this research was provided via email by the author and copyright holder. A copy of the LCAT was obtained through a review of the literature and was reconfigured as a LimeSurvey® for the purpose of this research. See Appendix D. The LCAT contains five categories of clinical competency and a total of 38 components of competency. The LimeSurvey® version of the LCAT contains each of the 38 components of competency and provides the opportunity to assess subject's performance via a 10 point Likert scale on each component. The survey was designed to allow the preceptors to skip items when the preceptor believed that the question was not applicable to the student's clinical experience or when the preceptor believed that they lacked adequate information to assess the student on the item.

A few slight modifications were made to the questionnaire to make it applicable for an assessment of student clinical performance in a US based medical center. The LCAT was intended to assess the performance of practicing nurses; as such, it was necessary to state in the evaluation criteria that the standard for comparison was practicing nurses, not other students nurses. Instructions to rate the student relative to that of an experienced nurse was added to the survey instructions. Additionally, because the LCAT was developed for use in the National Health Service of Great Britain it contains terms which are unique to the system in Great Britian. For example, the LCAT referred to "Trust". This term was replaced with medical center.

Variables related to the assessment of clinical performance.

As previously mentioned, the LCAT contains five categories of clinical competency (see Table 3) and a total of 38 components of competency. To prepare the raw data for assessment in relationship to the research questions, the scores on the individual component competencies where averaged together to create a categorical average. The five categorical scores were then averaged together to create a global clinical performance score [GCCS]. Given the large number of clinically related variables and the relatively small number of subjects in the study, only the GCCS was utilized as a dependant variable in relationship to the primary and secondary research questions.

Table 3: *Categories and Number of Associated Items on LCAT*

Category	Number of Items
Communication	9
Safety	7
Infection prevention	6
Procedural competence	12
Team work	4
Global composite clinical score	Average of five categorical scores

Collection of clinical performance assessments.

Clinical performance assessments were obtained via an electronic survey distributed to the students' senior year clinical preceptors. Students' preceptors were identified by each consenting student on the Informed Consent Form. The survey was then sent to these preceptors via email with introductions which specifically named the participating student and explained the research purpose. See Appendix E. The survey was developed using a web-based interface, i.e. LimeSurvey®, which was supported by the University's information technology services. Upon completion of the survey, the results were automatically stored in a University supported secure network ID/password protected structured query language database. An incentive gift valued at $20 was offered to all preceptors who completed the survey.

Preceptor sampling.

Of the 77 students in the senior nursing cohort who were participating in the senior year nursing practicum at the University affiliated medical center, 64 provided informed consent. The preceptors of these 64 students were subsequently contacted via email, informed of the purpose and rationale of the study, and asked to participate in the study by completing the survey. Thirty one student assessments were completed. On the basis of these 31 assessments, one student was excluded because the student completed the practicum in the psychology department, thus the assessment tool was not appropriate for this clinical experience.

Assessment of Pre-Admission Indicators of College Readiness

The variables chosen to represent pre-admission indicators of college readiness were explicitly linked to the secondary research questions and are consistent with those identified by Adelman (2006), Bowen et al., (2011), Gerald and Haycock (2006), Timmer and Clausen (2011) and other researchers as variables typically used as measures of college readiness in college admissions decisions. Variables associated with the pre-admission indicators of college readiness used in this study included:

a) Cumulative high school grade point average [GPA].
b) Rank in high school class.
c) Highest obtained composite score on standardized test [ACT Score] i.e. the Scholastic Aptitude Test or American College Testing[21] exams.
d) A composite measure, referred to as the "pre-admission composite score" for the purposes of this research. This score is derived from a University developed algorithm consisting of student's scores related to cumulative high school GPA, rank in high school class, and composite standardized test scores (Director of

[21] SAT Scores were converted to ACT Scores using concordance tables provided by the CollegeBoard (2009).

University Admissions, April 25, 2016). The composite score also utilizes a measure of the "quality" of the high school from which the student graduated that is provided by a third party vendor (Director of University Admissions, April 25, 2016)

e) Grades in select courses including:

    i. Biology

    ii. Chemistry

    iii. Pre-calculus

These courses, in addition to trigonometry were identified as prerequisites for admission into the nursing major, and were in addition to the requirements for admission to the University at large (New England University, 2016). Grades in these course were included in the list of variables for analysis because these additional courses likely represent an additional barrier to admission that is more pronounced in the population of disadvantaged students. This is consistent with the research of Barfield et al., (2011), as well as Bastedo and Jaquette (2011) who found that these additional curricular requirements may force many otherwise capable students to apply to less selective schools with lower high school curriculum intensity requirements. This is also consistent with the conclusions of Adelman (2006) who found that students from lower socioeconomic backgrounds were far less likely to attend high schools which offered these advanced courses.

Gathering pre-admission data.

Pre-admission data was provided by two sources: (1) the University's Office of Institutional Research [OIR], (2) the University's Office of Undergraduate Admissions. A request for data, which included the names of 30 students, along with documentation of IRB approval to conduct this research, was sent forward to the OIR and the University's Office of Undergraduate Admissions. The OIR was able to extract data from the student's application for admission related to student's cumulative high school GPA, rank in high school class, and highest obtained standardized test scores, as well as the university derived pre-admission composite score. This data was sent to the investigator via the University's secure file transfer system (no data was sent via email) and saved on a network ID/password protected server.

Grades in individual high school courses were not available in a retrievable digital format and could not be provided by the OIR. Data related to grades in select high school courses had to be extracted manually from the students' high school transcripts. These transcripts were provided by University's Office of Admissions. All data was transferred to the investigator via a secure password protected University supported file transfer system.

Upon review of this data, it was determined that one additional student should be excluded from the research. This student transferred from another institution and was not evaluated for admission on the same criteria as the other students in the study and this student's application did not contain the same information as the other students.

Final Sample Size

The final sample size for the research was 29 students. See Table 4.

Table 4: *Final Sample Size*

Total number of students in cohort	Number providing informed consent	Number of students evaluated by preceptors	Number of students excluded	Total number of students in sample
77	64	31	2	29

Organization of Data

Data related to these 29 students was received from three separate sources (i.e. preceptor evaluations, the OIR, and the Office of Undergraduate Admissions). Data from these sources was initially stored in three different data files and organized by student name. To combine these data files, the file from OIR was opened along with the file from the Office of Undergraduate Admissions. The grades in select high school math and science courses were manually extracted from the high school transcripts provided by the Office of Undergraduate Admissions and typed into the data file provided by the OIR. This created a single data file which contained the pre-admission indicator information. Prior to combining the files containing the preceptor evaluations and pre-admission indictor information, both files were checked to ensure that they were correctly organized alphabetically by student’s name and that there were the correct number of files in the dataset. At this point, the dataset containing pre-admission indicator information was combined with the dataset containing clinical survey data using a copy and paste function.

Reliability of Data

In an effort to insure the reliability of the data, two quality control measures were performed. First, to ensure that the information from the OIR was properly attributed to the correct student, the GPAs for each student provided by the OIR were cross referenced with the GPAs indicated on each student's high school transcripts. No inconsistencies were discovered between the GPAs provided by the OIR and the GPAs on the student's transcript. Based on this finding, it was assumed that the data provide by the OIR was reliable.

Second, the data was examined to ensure that the information related to pre-admission indicators of college readiness were correctly matched to the data from the preceptor survey. This was performed by cross referencing the names from the combined pre-admission dataset with names entered by the preceptors in the survey dataset. No inconsistencies were noted.

De-identifying Data

Once it was confirmed that the data from the three datasets had been correctly matched, a copy of the combined dataset was created and the names of the students in this dataset were deleted and replaced with numbers ranging from 1-29. This de-identified dataset was then saved onto a University owned, password protected and encrypted personal computer in a Microsoft Excel file for further analysis.

Data Conversions

Certain data conversions were required of the raw data before it could be used quantitatively. The following are descriptions of the conversions.

Cumulative high school GPA.

Student's cumulative high school GPA is simply an average score for all high school courses; however, not all high schools report GPA on the same scale. According to the CollegeBoard (2016), the 4.0 GPA scale is the most commonly used scale by both high schools and colleges. Most of the high schools attended by subjects in the study reported GPA on a 4.0 scale. Seven of the high schools did not. The grades from these schools were converted to the 4.0 scale using the conversion table recommended by the CollegeBoard (2016). See Table A1 in Appendix F.

Grades in select courses.

One of the secondary research questions is related to grades in select science and math courses (i.e. biology, chemistry, trigonometry, pre-calculus)[22] and senior year clinical performance. As such, grades in each of these courses were extracted from high school transcripts and an average grade in these select courses was calculated for use as a variable (i.e. GPA in select courses). However, after an examination of the transcripts it was apparent that grades in trigonometry would be difficult to determine. The reason for this was the inconsistent manner in which trigonometry was reported on the transcript and the number of students in the cohort who did not have a score in a course which could easily be identified as trigonometry. Of the 29 students in the study, 12 had a course that was clearly identified as trigonometry, five had no course that could be identified as having any relationship to trigonometry, six had a course identified as

[22] Specific science and math courses which were identified by the University as minimum requirements for admission into the nursing major (NEU, 2016).

Algebra/Trig, four had a course identified as Algebra II/Trig, and two had a course identified as Algebra III/Trig on the transcript.

Due to the uncertainty as to whether these student's courses truly represented a trigonometry course or some type of hybrid course, the decision was made to remove trigonometry as a variable for inclusion into the average score representing the GPA in select courses variable. This decision was based on the rationalization that including only the students files with a clearly defined trigonometry course would eliminate 17 students from the analysis of GPA in select courses and that inclusion of these 17 students was more important than including the score in trigonometry.

The determination of a pre-calculus course grade also proved to be problematic. Seventeen students in the sample had a course indicated specifically as pre-calculus on their transcript, (i.e. the minimally required level of calculus). Ten students had only a calculus course on their transcript (i.e. no pre-calculus). Four of these 10 took an advanced placement calculus course. Two students had no course on their transcript identified as pre-calculus or calculus. For the purpose of this research, when students had only a calculus course on their transcript, the grade in calculus was recorded as the grade in pre-calculus. When a student had both a pre-calculus and calculus course on their transcript, the higher score was recorded as the pre-calculus grade.

Standardized test scores.

To create a variable representing student's pre-admission standardized test scores, composite SAT scores were converted to composite ACT scores using concordance tables published by and derived from research conducted by the CollegeBoard (2009). According to the CollegeBoard (2009), these concordance tables were calculated through research which compared the scores of students who took both exams. While the authors caution that a student who receives a score on one test would not necessarily have received the concordat score on the other test, the scores should help educators to understand how students of comparable ability would score on the two test.

Clinical performance.

Prior to data analysis, certain data conversions related to the clinical performance data were necessary. As previously mentioned, data from the 38 items on the LCAT were averaged together to create five categorical values. These five categorical components were then averaged together to create the GCCS. It should be noted that an alternative technique for determining a single measure of clinical performance would have been to simply derive an average of the 38 clinical components. This would have been a viable technique, but using this method would have given categories with more questions, more weight in the composite score calculation. For example, Team Work would have contributed four values to the composite score while Procedural Competence would have contributed 12 values. While this may have been a reasonable decision, there was nothing in the literature concerning the LCAT to indicate that any one of the categories of assessment was more important than the others and therefore, should be weighted more heavily than the other categories (McKinley, 2008a; McKinley, 2008b). As such, by deriving the GCCS as an average of each categorical score, each category is given equal weight in the composite score.

Missing values on clinical assessments.

The design of the survey allowed preceptors to skip items when the preceptor believed the item was not applicable in the student's clinical setting or when the preceptor lacked adequate information to assess the student on the item. As previously mentioned, one student was excluded from the study because most of the assessment items were not applicable to that student's clinical experience in psychology. The question remained as to how to handle missing values for the other items.

The raw survey data related to student's clinical performance was analyzed for missing data. Of the 1102 individual item responses in the survey (i.e. 38 items per survey multiplied by the 29 completed surveys), only 15 responses were missing. The item with the greatest number of missing values was "Labels sample printouts correctly" which had four missing values. Other than the one excluded participant, the individual with the greatest number of missing values had seven missing values of the 38 items. The missing values for this participant were spread out across the component categories so that each component had a minimum of four values from which to derive an average. Based on these findings, a decision was made to simply exclude the missing values from the calculated averages for each category of assessment. This seemed like a reasonable decision based on the relatively low number of missing variables, the difficulty in estimating missing values given the low number of participants, and the widely dispersed nature of the missing values (i.e. the missing values were not concentrated with a single component).

3.6. Analysis Techniques

Descriptive Exploratory Data Analysis [EDA] underlies the approach to addressing the research questions and analysis of the data. EDA is a philosophical approach to data analysis originally introduced by John Tukey in 1977 (Howell, 2010). Over the years the approach has been widely adopted as the preferred approach to descriptive data analysis (Howell, 2010). The underlying philosophy of EDA is that close examination of the data allows the researcher to maximize insight into the results, uncovering the underlying structure of the data, and inferring meaning from the data in terms of the research questions (Velleman & Hoaglin, 2004).

The techniques utilized in EDA vary depending on the nature of the data, underlying assumptions, the research questions, and the judgement of the investigator (Tukey, 1977; Velleman & Hoaglin, 2004). Commonly employed techniques in EDA include the use of visual graphical displays such as box plots, histograms, and plots of observed versus expected values to reveal the underlying nature of the data through pattern recognition (Velleman & Hoaglin, 2004). EDA techniques may also include the use of bivariate correlation, simple, and multiple regression analysis to explore the relationships between variables (Mosteller & Tukey, 1977).

Analysis Framework and Techniques

All data analysis was performed utilizing Statistical Package for the Social Science Version 24 [SPSS V24] statistical software for Windows based machines from IBM Corporation accessed via a licensing agreement with New England University. Consistant with the principles of EDA, a variety of data analysis techniques were utilized. The techniques were utilized in two broad phases. Phase I consisted of utilizing univariate descriptive statistical analysis to explore the raw data. The primary and secondary research questions were addressed in Phase II of data analysis. The primary and secondary research questions were addressed through the use of linear regression analysis where the pre-admission indicators of college readiness served as the predictor variables and student's GCCS served as the criterion variable. See Table 5.

Table 5: *Variables for Linear Regression Analysis*

Independent Variables	Criterion Variables
Cumulative high school GPA	Global clinical composite scores[23]
Rank in high school class	
GPA in select courses (i.e. biology, chemistry, pre-calculus)	
ACT scores[24]	
Preadmission composite scores	

Phase I: univariate analysis.

Phase I analysis was performed in three stages. The first stage consisted of calculating descriptive statistics for each of the variables which included the mean, range, standard error of the mean, standard deviation, variance, skewness. The second stage consisted of utilizing a variety of data display techniques, described by Tukey (1977) and Velleman and Hoaglin (2004) as methods of visually representing data in meaningful ways. These techniques include the use of histograms, Q-Q normal distribution graphs, scatter plots, and box plots. The third phase involved inferential analysis of the results which are discussed in Chapter IV.

Phase II: regression analysis.

The primary research question was addressed through the use of multiple linear regression analysis and the secondary research questions were addressed through simple linear regression analysis to examine bivariate correlations between each individual pre-admission indicator of college readiness and the GCCS. However, from a practical

[23] An average of the 5 categorical scores.
[24] For students who took only the SAT, SAT scores were scaled to ACT scores.

standpoint, it made more sense to perform the analysis related to the secondary questions first then progress into multiple linear regression to address the primary research question. The rationale for this was that bivariate analysis of correlation would be helpful in understanding the nature of the relationships between the individual predictor variables and the criterion variable that was necessary for the construction of a meaningful multiple regression equation (Howell, 2010; Plichta, Kelvin & Munro, 2012). A discussion of the techniques used follows.

Phase II Stage 1: addressing the secondary research questions.

The objective of the first stage of phase II analysis was to address the secondary research questions. All of the secondary questions sought to explore the degree of correlation between the individual indicators of college readiness and the student's senior year clinical performance as measured by the GCCS. It should be noted that strictly speaking, correlation and regression refer to different techniques (Howell, 2010). According to Howell (2010), when the purpose is to express the degree of linear relationship between two random[25] variables, the correct terminology is to speak of correlation. Regression is the more accurate term when the investigator seeks to predict Y on the basis of a fixed X (Howell, 2010). However, in practice the distinction between the two terms often breaks down particularly when the investigator is interested in determining if a variable or group of random variables is predictive of a certain outcome (Howell, 2010). Because these variables are used by the University in admissions

[25] According to Howell (2010), variables are random when they vary from one replication to another and when sampling error is associated with both the X and Y variables. In other words, if the data in this study were replicated in another iteration of the study, the values, and sampling errors, associated with both the X and Y values would be different in the replicated study as compared to the original study.

decisions as a means of predicting future academic success, the use of linear regression techniques to analyze the relationships seemed appropriate.

In the context of the stated research questions, the intent was to obtain a statistic which expressed the degree to which two variables, (i.e. a pre-admission indicator of college readiness and the GCCS) were correlated (i.e. were linearly dependent). Because the variables were random, the correct terminology is correlation; thus, the appropriate technique/terminology would be the use of a bivariate normal model to calculate Pearson's product-moment correlation coefficient (r) to assess the degree of linear dependence between two random variables. The calculation of Pearson's r is accomplished by the formula $r = cov\ (x,y) / s_x s_y$. Where:

$$cov(x,y) = \sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) \;/\; (n-1)$$

However, simple linear regression may be used to calculate Pearson's r by standardizing the deviations in the distribution of the variables. Linear regression analysis is based on a mathematical approach to finding the best fit line where the sum of the distances (i.e. the deviations) between each of data coordinates for (N) data points and the best fit line are minimized (Howell, 2010; Plichta et al., 2012). The best fit line is called the regression line. By definition, the regression line passes through the point ($\bar{x}$, $\bar{y}$) and has the equation:

$$y = c + b*x$$

Where y is the predicted dependent variable, c is a constant (i.e. the value when the independent variable x is zero), b (i.e. the regression coefficient) is the slope of the regression line, and x is the value of the independent/predictor variable. The slope (*b*) is equal to:

$$b = \sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) \,/\, \sum_{i=1}^{n}(x_i - \bar{x})^2$$

or, $b = cov\,(x,y) / s_x^2$. Recall that $r = cov\,(x,y) / s_x\, s_y$. Thus, if the deviations of x and y are standardized such that $s_x = s_y$, then:

$$r = cov\,(x,y) / s_x^2 = b$$

Therefore, when the deviations between two variables are standardized, the standardized beta coefficient beta (*b*) is equivalent to Pearson's *r*. Thus, both the standardized coefficient (*b*) and Pearson's *r* are measures of the strength of the linear relationship between two variables (Howell, 2010). For the purpose of this research the term describing the degree of correlation will be referred to as Pearson's *r* or (*r*).

The range of possible values of Pearson's *r* is equal to +1 (i.e. a perfect direct correlation such that as one variable increases, the other increases in exactly the same proportion) to -1 (i.e. a perfect inverse correlation such that as one variable increases the other decreases in exactly the same proportion). A Pearson's *r* of 0 means the variables are not correlated at all.

Other measures of correlation calculated for this study include R^2 and Adjusted R^2. R^2, also referred to as the coefficient of determination, is simply Pearson's *r* squared. R^2 describes correlation in terms of the percentage of variability in one variable that is attributable to the variation in another (Howell, 2010).

Adjusted R^2, takes into consideration the number of measurements in the sample which is important when there is a relatively small number (<30) of subjects in the sample (Howell, 2010), such as the case with this study. R^2 is a biased estimate of the population correlation (ρ). Adjusted R^2 provides a relatively unbiased estimation of correlation by accounting for the sample size. The calculation of Adjusted R^2 is:

$$\text{Adjusted } R^2 = 1-[(1- R^2)\ (N-1) / N-2]$$

Where (N) is the number of matching data pairs.

For the purpose of this study, Cohen's standards where used to evaluate the correlation coefficient (i.e. Pearson's *r*). Correlation coefficients between ±0.20 were considered negligible, correlation coefficients between ±0.21 and 0.29 were considered weak, correlation coefficients between ±0.30 and 0.49 were considered moderate and correlations above ±0.50 were considered strong. Scatter plots[26] were also derived to visually describe the relationship between each of the measures of college readiness and clinical performance.

There are a number of benefits to using SPSS to perform simple linear regression analysis in the determination of correlation between two variables. Specifically, the use of SPSS allows for the quick calculation of Pearson's *r*, R^2, and Adjusted R^2. As such, techniques employed for analysis of the research questions included the use of SPSS to calculate Pearson's *r*, R^2 and Adjusted R^2 to assess the degree to which the student's GCCS are linearly dependent on the variables related to the student's pre-admission indicators of college readiness.

Pearson's *r*, R^2 and Adjusted R^2 describe the effect size in terms of correlation between two variables. Statistical significance is a measure of the likelihood that the

[26] According to Howell (2010), "In a scatterplot, each experimental subject in the study is represented by a point in a two-dimensional space. The coordinates of this point (Xi, Yi) are the individual's scores on variables X and Y, respectively". (p. 247)

calculated degree of correlation may have arisen merely by chance (Howell, 2010). The calculation of statistical significance takes into account the effect size, the standard deviation of the estimate, and the number of pairs in our sample to determine how likely it is that the obtained correlation coefficient occurred by chance (Howell, 2010). The calculation of statistical significance involves the calculation of a test statistic (t) as a test of the Null hypothesis (i.e. correlation coefficient in the population (ρ) is equal to zero or statistically insignificant from zero (Ho: $\rho = 0$).

The test statistic (t) is equal to: $t = b_j / s_{bj}$. Where b_j is the regression or correlation coefficient, and s_{bj} is its standard deviation. The test statistic (t) measures the size of the correlation or regression coefficient, relative to the amount of variation in the sample data. The greater the size of the test statistic (t), the greater the likelihood that the relationship described by the coefficient is not by chance (i.e. evidence to reject the Null hypothesis). Consistent with the conventions of statistical analysis (Howell, 2010), the results of the test of significance (t) were interpreted on the basis of the corresponding p-value. The p-value represents the probability that a value equal to or greater than the test statistic (t) would have been obtained if the Null hypothesis were true (i.e. $H_0: \rho = 0$). In other words, larger p-values represent a higher likelihood that the Null is true (i.e. the correlation in the population is zero) and that the degree of correlation is likely due to chance.

Significance of the p-value was established at $\alpha = .05$ for all analyses. This represents the threshold for the willingness to make a Type 1 statistical error (i.e. a rejection of the Null hypothesis when it is in fact true). The Null hypothesis tested was that student's scores on the preadmission indicators of college readiness are not correlated with their clinical composite scores (i.e. Ho: $\rho = 0$). When the p-value was found to be less than $\alpha = .05$ then the Null was rejected and the conclusion was reached that the indicator(s) of college readiness was/were linearly correlated with student's GCCS. Conversely, if the p-value was above $\alpha = .05$, it was concluded that insufficient evidence exists to reject the Null and the conclusion was reached that insignificant evidence exists to support a linear correlation between the indicator of college readiness and clinical performance.

Phase II Stage 2: addressing the primary research question.

In an effort to address the primary research question, multiple linear regression analysis was used to examine the relationships between multiple pre-admission indicators of college readiness and senior year clinical performance. Multiple linear regression is the most commonly used form of regression analysis (Howell, 2010, Sullivan, 2012). Multiple linear regression allows for the use of two or more predictor variables to predict a criterion variable (i.e. dependent variable). Similar to simple linear regression, the multiple regression equation describes a linear equation which represents a line of best fit for the observed data by minimizing the sum of the squares of the deviations (i.e. the residuals) from each of the data points and the best fit line. The equation of the line takes the form of:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n + \varepsilon_i$$

Where β_0 is the regression constant, or y intercept, i.e. the value of y when the predictor variables are zero. $\beta_1, \beta_2 \ldots \beta_n$ are the regression coefficients for each of the predictor variables in the model, and ε_i represents the residuals or the deviations of the observed values of y from their means. The size of the regression coefficients represents the amount of change in the criterion variable as a result of a 1 unit change in the specified predictor variable.

In addition to determining regression coefficients for the individual predictor variables, multiple linear regression analysis also provides a measure of correlation between the predicted values (i.e. y) and the observed values (i.e. the x's) in the data set. The degree of correlation between the predicted and observed values is referred to as the correlation coefficient [*R*]. The range of possible values for *R* are from zero to +1. A value of zero indicates that the predicted values are not correlated at all with the observed values. A value of 1 indicates a perfect correlation such that predicted and observed values are the same. When *R* is high (i.e. closer to 1) this indicates that there is a high degree of linear correlation between the predicted and observed values.

The results of regression analysis are often reported in terms of *R* or R^2 (Howell, 2010; Sullivan, 2012). R^2 is referred to as the multiple correlation coefficient and is interpreted as the amount of variation in the criterion variable that is explained by the regression equation (Howell, 2010). In other words, if R^2 is .250, this would be interpreted as 25% of the variability in the criterion variable is explained by the regression equation. The values of *R* and of R^2 are terms which describe the effect size of the regression equation (Howell, 2010; Sullivan, 2012).

In other words, the effect size of the regression equation is the ability of the equation to explain the variability in the criterion variable based on the values of predictor variables. A regression equation with a large *R* and/or R^2 is one that explains much of the variation in the criterion variable. As such, the values of *R* and R^2 were used in this study to describe the degree to which the predictors explained variation in the criterion. More specifically, the values of *R* and R^2 were used to explain the degree to which the pre-admission indicators of college readiness explain variation in GCCS; or stated differently, the values of *R* and R^2 describe the degree to which the pre-admission indicators of college readiness predict student's senior year clinical performance.

The ability of the regression equation to predict the criterion variable (i.e. student's GCCS) was assessed for statistical significance utilizing analysis of variance [ANOVA] techniques. To determine whether or not the effect size of the regression equation was statistically significant, an F-test statistic was calculated. The F-test considers the size of the regression coefficients relative to the standard errors in the sample, and the number of participants in the sample to determine whether or not the calculated correlation coefficient was so large that it was unlikely to have occurred by chance. The F-test statistic tends to be larger as the amount of variance explained by the model increases relative to the standard deviations of the variables; therefore, larger F-test statistics provide evidence in support of rejecting the Null hypotheses. The Null hypothesis tested in this study was that the student's scores on the preadmission indicators of college readiness were not predictive of student's GCCS (i.e. H_0: R = 0).

The advantage of using ANOVA, as compared to the t –test as a test of significance, is that ANOVA allows for the test of more than one Null hypothesis at once; however, because of the use of multiple predictor variables, the test of significance must also account for the degrees of freedom associated with multiple predictors. Otherwise the likelihood of a Type 1 error (i.e. rejection of the Null hypothesis when it is true) is increased. According to Howell (2010), the simplest way to calculate the F-test statistic is to test the multiple correlation coefficient (R^2) for significance. Using this approach, the F-test statistic is equal to:

$$F = (N – p -1) R^2 / p (1- R^2)$$

Where (N) is the sample size, p is the number of predictor variables, and R^2 is the multiple correlation coefficient. This F-test statistic is then compared to an F distribution table with 1 degree of freedom [DF] in the numerator and N-2 DF in the denominator to determine a p-value which represents the probability that the observed effect was the result of chance. For this study, a p-value which is below $\alpha = .05$ supports rejection of the Null hypothesis.

In multiple linear regression analysis, a test of statistical significance may also be performed on the regression coefficients associated with each individual predictor (i.e. the independent) variables. The significance test for the individual predictor variables is the t-test and the calculation of the corresponding p-value as was described as part of the analysis in simple linear regression. Larger p-values represent a higher likelihood that the Null is true (i.e. the correlation between the predictor and criterion variables in the population is zero) and that the degree of correlation is likely due to chance.

For this study, significance of the p-value was established at $\alpha = .05$ for all analyses. The Null hypothesis tested was that there was no statistically significant relationship between students' scores on the preadmission indicators of college readiness and their GCCS (i.e. Ho: ρ = zero). When the p-value was found to be less than $\alpha =.05$ then the Null was rejected and the alternative hypothesis that the indicator(s) of college readiness were linearly related to student's GCCS was accepted. Conversely, if the p-value was above .05, it was concluded that insufficient evidence exists to reject the Null.

Development of Multiple Regression Model.

Part of the work of multiple linear regression is to develop a model that best represents the relationships between the predictors and the criterion variables (Howell, 2010; Sullivan 2012). For this study, backward elimination was utilized to develop the regression equation that best represents the relationships between the predictor and criterion variables. The backward elimination procedure is an iterative process which involves including each of the potentially meaningful predictors in a multiple linear regression model, evaluation of the results for effect size, statistical significance, and for the ability to meet the assumptions of linear regression, then eliminating unwanted variables one at a time and repeating the analysis (Howell, 2010). The process is repeated until all of the remaining predictor variables are statistically significant, a suitable model which conforms to the assumptions of linear regression is determined, or all of the reasonable combinations are exhausted without finding a meaningful model which meets the assumptions of regression (Howell, 2010).

Regression Diagnostics.

As part of Phase I analysis, the data was evaluated for the presence of outliers that could result in undue leverage in regression analysis. The data was also evaluated for the presence of missing data that could have a significant impact on the ability to establish correlations. Additional diagnostics were required to detect problems which make the use of linear regression inappropriate. For the regression model to represent the relationships between variables, certain assumptions must be meet. These assumptions include independence of errors, linearity between the predictors and the criterion, normality of residuals, and homoscedasticity of observed verses predicted values. The following list describes the nature of these assumptions and the ways in which they were assessed as part of this study:

- Independence is assumed. That is, predictor variables do not have significant collinearity, i.e. the errors associated with one observation are not correlated with the errors of the other observations (Howell, 2010). Independence was assessed through analysis of tolerance or the degree to which two variables are related to each other. The degree of tolerance associated with each predictor variable is part of the standard output for regression analysis using SPSS. Tolerance describes the degree of overlap between variables. When there is significant overlap between two variables, the inclusion of both variables in the regression model does little in regards to explaining variability in the criterion but has the potential to inflate instability in the model (Howell, 2010; Sullivan, 2012). Tolerance values are reported on a scale of zero to 1. Values of tolerance of less than 0.2 were considered to be highly indicative of collinearity and required that at least one of the collinear predictors be removed from the model. Tolerance values less than 0.5 suggest a problem with collinearity and suggest that at least one of the collinear predictors should be removed from the model.
- Linearity is assumed. That is, the relationships between the predictor variables and the criterion have a linear nature (Howell, 2010; Sullivan, 2012). Linearity was assessed by examination of a scatter plot of each of the predictor variables versus the criterion. The degree to which the results meet the assumption of linearity was inferred from the distribution of the plots. A non-random pattern would indicate a lack of linearity between the predictors and the criterion.

- Normality of residuals is assumed. That is, the residuals (i.e. the difference between the predicted values and the observed values) are normally distributed (Howell, 2010; Sullivan, 2012). Normality was inferred from inspection of the Q-Q plots of the unstandardized residuals, inspection of the histogram of the residuals, and analysis of the histogram of the residuals using the Shapiro-Wilk statistical test of normality. Normality was assumed when a p-value of significance was greater than α =.05 (i.e. rejection of the Null hypothesis that the residuals are not normally distributed). The Q-Q plots were evaluated on the basis of how closely the observed values matched the expected values indicated by a diagonal reference line through the center of the distribution. In a normal distribution the points on the plot should fall close to a diagonal reference line.
- Homoscedasticity is assumed. That is, the amount of variance remains consistent across the values of predictors (Howell, 2010; Sullivan, 2012). Homoscedasticity was assessed by examination of a scatter plot of residuals versus predicted values from the regression analysis. The degree to which the results meet the assumption of homoscedasticity was inferred from the distribution of the plots around the center of the distribution. Ideally the residuals do not grow larger as the predicted value becomes larger.

3.7. Limitations

This study has challenges associated with external validity. External validity refers to how well the sample statistics represent the population and the degree to which the results are generalizable to the entire population (Howell, 2010).

Sample Size.

The principle challenge to external validity is related to the relatively small sample size (29 subjects). This limitation represents a challenge to inferential statistics related to the parameters of interest—namely the clinical performance of nursing students in relationship to their pre-admission indicators of college readiness in this cohort of students. In other words, it is questionable as to whether or not the statistics related to the 29 subjects reflect the true statistical relationships between the variable of interest in the full population.

This limitation also presents a problem with using multiple predictors in the regression equation. While there is no formula to determine exactly how many subjects are required per predictor, in general, as the number of subject increases relative to the number of predictors, the power of the model decreases (Howell, 2010; Plichta, 2012). According to Howell (2010) a general rule of thumb requires at least 10 participants (i.e. observations) per predictor. Others, Darlington (1990), Cohen, Cohen, West, and Aiken (2003) suggest that the number of cases per predictor should be much higher, (i.e. on the order of 40-124).

In general, with low numbers of subjects, it is recommended that the number of predictors be restricted (Howell, 2010; Plichta et al., 2012). As such, the final multiple regression model was reduced to two predictor variables which yielded 14.5 subjects per variable. The decision to use these two variables was the result of an iterative process of backward elimination which involved testing of the regression model with various combinations of predictor variables and testing these models for size of effect, statistical significance, and adherence to the assumptions of linear regression.

Uniqueness

A second limitation to external validity is related to the uniqueness of the research setting. As previously mentioned, this study is being conducted at a single public state flagship University in New England. Because the data was collected at a single institution which has unique features and characteristics, broad generalizations to other nursing programs may be inappropriate.

On the other hand, this setting may be highly representative of nursing programs nationally. According to the New England University Nursing Program's web site, graduates from this baccalaureate nursing program have been successful on the National Council Licensure Examination for Registered Nurses (NCLEX-RN) at approximately the same rate as nursing students nationally for the period between 2013-2015—the most recent reporting period (New England University, n.d.). See Table 6.

Table 6: *Registered Nurse National Council Licensure Examination Pass Rates*

Period	New England University Pass Rate	National Average
2015	85%	87%
2014	84%	85%
2013	92%	85%

While pass-rates on national certification exams rates may not be directly reflective of clinical performance (Timmer &Clausen, 2001), according to the National Council of State Boards of Nursing [NCSBM] (2013) the NCLEX-RN exam is a valid and reliable exam which measures the competencies needed to perform safely and effectively as a newly licensed, entry-level nurse. If this is true, then nursing graduates from this program generally possess basic nursing competency at approximately the same level as nursing graduates nationally.

A second limitation related to the unique setting is that the students in this study may not be representative of students in other nursing programs. For the results to be broadly generalizable, the student population in this study should be representative of students broadly enrolled in programs of nursing. While we do not know the degree to which students in other programs would have scored relative to the indicators of college readiness, it is likely that the pre-admission scores of students in this study may be skewed toward the higher end on most measures.

This presumption is based on a number of findings. First, the University reports that 97% of admitted students finished in the top 50% of their high school class; 77% finished in the top 25%; and 40% finished in the top 10% (New England University, 2016). The nursing program is highly selective with an admission rate of only 12% (Associate Director of Admissions, personal communication, December 3, 2015) compared to 75% for the University at large. Data provided by the Office of Undergraduate Admissions (Associate Director of Admissions, personal communication, December 3, 2015), indicates that the pre-admission composite scores for this cohort of nursing students was approximately normally distributed with a mean of 6 (on a 9 point scale) and a range from 4 to 9. See Table A2 in Appendix G. This placed the cohort of nursing students among the highest in the entire University (Associate Director of Admissions, personal communication, December 3, 2015).

The summation of this data indicates that the students enrolled at this University were generally among the top high school students and that students enrolled in this major were among the top students admitted to this University. This suggests that the students in this study are a very select group and may not be representative of students enrolled in nursing programs generally.

Validity of the Clinical Assessment Tool

Another challenge to external validity is related to validity of the assessment of clinical performance. The validity of the assessment is unknown because of uncertainty around the preceptors' interpretation of clinical competence and by uncertainty associated with the evaluation instrument (i.e. the LCAT). This instrument was validated in the healthcare system of another country by a different population of evaluators working within a different culture of care. The instrument was also validated in the assessment of practicing nurses, not students of nursing. Therefore, the clinical assessment procedure is open to question.

3.8. Delimitations

The aim of this study was to explore descriptive statistics related to the pre-admission indicators of college readiness and student performance in senior year clinical practicums. The study does not propose a hypothesis about the nature of the relationships between the pre-admission indicators of college readiness and clinical performance nor does it propose an experiment to test any causal relationship with differential measures of clinical performance should they be correlated. Obviously, the discussion portion of this paper (i.e. Chapter 5) will seek to make inferences concerning the underlying mechanisms which may be responsible for the degree of correlation or the lack of correlation between the variables; however, this research seeks to first understand what the nature of the relationships are and to provide a framework for future research.

CHAPTER 4: ANALYSIS AND RESULTS

This Chapter presents results of Phase I and II data analysis. Phase I presents the results of univariate Exploratory Data Analysis. [EDA]. Phase II presents the results of assessments of correlation and regression which are specifically related to the primary and secondary research questions.

4.1 Phase I: Univariate Analysis of Data

Univariate descriptive statistical analysis was performed for each of the variables associated with the pre-admission indicators of college readiness, the categorical clinical performance assessment scores, and the global clinical composite scores [GCCS]. See Table 7.

Table 7: *Variables for Univariate Analysis*

Indicators of College Readiness	Indicators of Clinical Performance[27]
High school cumulative GPA	Communication
Rank in high school class	Safety
GPA in select science and mathematics courses (i.e. biology, chemistry, pre-calculus)	Infections prevention
	Procedural competency
Highest obtained composite SAT or ACT score[28]	Team work
Composite score of college readiness	Global clinical composite score[29]

Descriptive statistics for each of these variables, including mean, median, range, standard error, standard deviation, and skewness were calculated using SPSS V24. Additionally,

[27] Indicators of Clinical Performance as measured by preceptors using the LCAT.
[28] For students who took only the SAT, SAT scores were scaled to ACT scores.
[29] An average of the 5 categorical scores.

tests of normality and assessment of observed versus expected values were also performed and analyzed.

Univariate Analysis of Clinical Performance Indicators

It should be noted that for Phase II analysis of the relationships between the independent and dependent variables, only the GCCS was utilized as the dependent variable; however, as part of this univariate data analysis each of the categorical averages of clinical performance were analyzed. This was done in an effort to better understand the nature of the distributions that went into the calculation of the GCCS. This is consistent with the principles of EDA (Velleman & Hoaglin (2004). Velleman and Hoaglin (2004) indicate that for some sets of data, the analysist's judgement and the circumstances surrounding the data play an important role in determining the usefulness of alternative analysis. Because the LCAT has never been utilized for assessing the performance of nursing students, it seems reasonable to consider the distribution of responses that lead to the calculation of the GCCS.

As part of the request for assessment of clinical performance, the clinical preceptors were instructed to: "…score your student's performance according to a 10 point scale with (1) indicating complete incompetence and (10) indicating performance above that of an experience nurse". The mean and median values for each of the components were found toward the upper end of the scales with mean values between the range of 6.95 (Procedural Competence) and 7.84 (Teamwork) and median values falling between the range of 7.58 (Procedural Competence) and 9.0 (Infection Prevention). See Table 8.

Table 8: *Descriptive Statistics: Components of Clinical Performance*

Component		Statistic	Std. Error
Communication	Mean	7.746	.343
	Median	7.777	
	Std. Deviation	1.848	
	Minimum	2.111	
	Maximum	10.00	
	Range	7.888	
	Skewness	-1.093	.434
Safety	Mean	7.620	.389
	Median	8.142	
	Std. Deviation	2.098	
	Minimum	3.333	
	Maximum	10.00	
	Range	6.666	
	Skewness	-.638	.434
Infection Prevention	Mean	7.772	.467
	Median	9.00	
	Std. Deviation	2.515	
	Minimum	2.833	
	Maximum	10.00	
	Range	7.166	
	Skewness	-.897	.434
Procedural Competence	Mean	6.954	.453
	Median	7.583	
	Std. Deviation	2.444	
	Minimum	2.166	
	Maximum	10.00	
	Range	7.833	
	Skewness	-.637	.434
Teamwork	Mean	7.839	.363
	Median	8.250	
	Std. Deviation	1.955	
	Minimum	3.50	
	Maximum	10.00	
	Range	6.50	
	Skewness	-.764	.434

None of the distributions related to the components of clinical performance passed the Shapiro-Wilk test of normality[30]. See Table A3 in Appendix H. Additionally, as can be seen in Table 8, scores on each of the components of clinical performance were negatively skewed but none so much that the value of skewedness was greater than twice the standard error. Visual analysis of the Q-Q plots of observed versus expected values related to each of the components of clinical performance indicated generally poor agreement between the observed and expected scores with the exception of the Communication scores. See Figures A1-A5 in Appendix I. For each of the other components of performance, in comparison to the expectation of a normal distribution, the assessments seemingly understate performance at the very low end of the scale and overestimate performance at the upper end of the scale. Box plots of the distributions of clinical performance scores indicates similar patterns for each of the components of clinical performance. See Figure 1.

[30] At $\alpha = .05$.

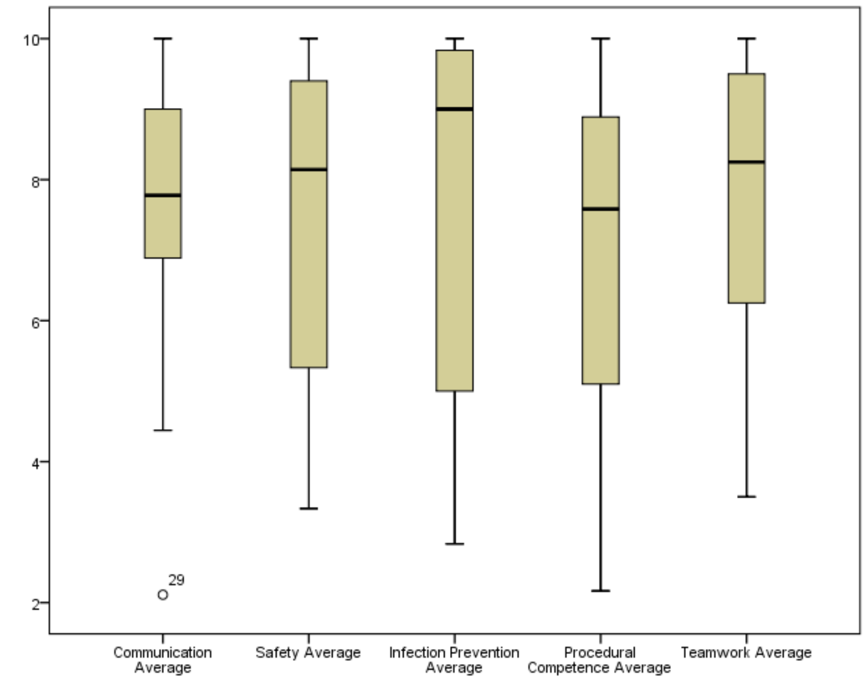

Figure 1. Box plots of average scores on the components of clinical competence based on preceptor evaluations using the Leicester Clinical procedure Assessment Tool (LCAT).

While the variance and range of responses are variable between the different components, the median values are all toward the upper end of the scale resulting in compression of the scores on the higher end. For each of the components, the maximum score is 10 on a 10 point scale; and, with the exception of Communication average, the distributions demonstrate a long tail of scores below the median (i.e. negatively skewed).

Univariate Analysis of Global Clinical Composite Scores

The distributions associated with the individual components of clinical performance carry over into the calculation of the GCCS. As a reminder, the GCCS were computed as the average of the five clinical component scores. As would be expected given the distribution of the individual components of clinical performance, in general, the student's GCCS were quite high as indicated by the mean and median values of 7.6

and 8.2, respectively. The scores were slightly negatively skewed (i.e. negative but less than -1.0 and less than twice the value of the standard error). See Table 9.

Table 9: *Descriptive Statistics: Global Clinical Composite Scores*

Component		Statistic	Std. Error
Global clinical composite score	Mean	7.586	.381
	Median	8.202	
	Std. Deviation	2.052	
	Minimum	4.023	
	Maximum	9.977	
	Range	5.953	
	Interquartile Range	3.610	
	Skewness	-.631	.434

Evaluation of the histogram of GCCS demonstrates the skewness but also indicates that the distribution is roughly bi-modal. See Figure A6 in Appendix J. Tests of normality indicate that the composite scores were not normally distributed. See Table A4 in Appendix J. The Q-Q plots of observed verses expected values indicate a general lack of agreement throughout the scale, but particularly at the far ends of the scale. See Figure A7 in Appendix J.

Preliminary test of assumptions of linear regression.

A lack of normality associated with criterion variables often result in violations of the assumption of normality for regression analysis. Because of the lack of normality in the distribution of GCCS, the decision was made to run some test analysis using multiple linear regression with the GCCS as the criterion variable and the pre-admission indicators of college readiness as the predictors. The purpose of the test analysis was to determine if the normal distribution of GCCS would result in violations of the assumptions necessary for the use of linear regression analysis. The initial test with five pre-admission variables identified a severe problem with collinearity. See Table A5 in Appendix K. The collinearity problems were resolved by removing two variables (i.e. rank in high school class and pre-admission composite scores) and another multiple linear regression analysis was performed using three predictor variables (i.e. cumulative high school GPA, ACT scores, and GPA in select courses). See Table A6 in Appendix L. The results were then tested for normality of the residuals, homoscedasticity, and linearity between predictors and criterion variables.

Transformation of the Global Clinical Composite Scores.

As was suspected, the residuals were not normally distributed in the regression equasion using cumulative high school GPA, ACT scores, and GPA in select courses as predictors and GCCS as the criterion. See Figure A9 and Table A7 in Appendix M. As such, the decision was made to attempt a data transformation of the GCCS to create a more normal distribution. The transformation that was most successful resulted from the formula:

Log base 10 (9.78+1-global clinical composite score)[31]

This transformation is equivalent to taking the log base 10 of the reflected value of the global clinical composite score using the formula:

9.78 +1 – global clinical composite score

as the reflection function for data having a highest score of 9.78. The transformed variable was labeled log r global clinical composite scores [LrGCCS]. This transformation resulted in a distribution that while still not Gaussian, conforms much more closely to the normal distribution. See Figure A8 in Appendix N. The distribution

[31] 9.78 was the highest score in recorded for the variable.

of transformed values passed the test of normality. See Table A8 in Appendix N. Consequently, a second round of multiple regression analysis was performed as a test of the assumptions of linear regression using the same three predictor variables (i.e. cumulative high school GPA, ACT scores, GPA in select courses) with LrGCCS as the criterion. These results indicated compliance with the assumptions necessary for linear regression. Tolerance values indicated that the test of independence of errors was passed. See Table A9 in Appendix O. Examination of the histogram of the residuals and the test for normality of the residuals indicated that the assumption of normality of the residuals was meet. See Figure A10 and Table A10 in Appendix O. The assumption of homoscedasticity was seemingly met from inference of the scatterplot of the residuals versus the predicted values. See Figure A11 in Appendix O. Similarly, the existence of a linear relationship between the predictor and criterion variables was inferred from the scatter plots of predictor versus criterion variables which lack a specific pattern. See Figures A12-A14 in Appendix O.

Univariate Analysis of Pre-admission Indicators of College Readiness

As part of EDA, descriptive statistics were calculated and analyzed for each of the variables associated with the pre-admission indicators of college readiness using SPSS V24. The results are presented below and are organized by variable.

Rank in high school class.

The mean and median values of student's rank in high school class were found toward the far upper end of the scale (i.e. 89^{th} and 87^{th} percentile respectively). See Table 10. Shapiro-Wilk test of normality indicated that the scores meet the assumption of a normal distribution. See Table A11 in Appendix P. Evaluation of the histogram and Q-Q plot of observed verses expected values indicate that the data was roughly normal in its distribution with a fair degree of agreement between observed and expected values. See Figures A15 and A16 in Appendix P. There were no outliers identified with this variable.

A problem with using rank in high school class as a variable in Phase II regression analysis was the large number of missing values. The dataset only contained values for 15 of the 29 participants in the study. Using this variable as part of multiple regression would have been problematic because it would lead to elimination of those cases which lacked a value for rank in class from the analysis.

Table 10: *Descriptive Statistics: Rank in High School Class*

Component		Statistic	Std. Error
Rank in HS Class	Mean	89.07	1.336
	Median	87.00	
	Std. Deviation	4.99	
	Minimum	82	
	Maximum	98	
	Range	16	
	Interquartile Range	9	
	Skewness	-.666	.597

Cumulative high school GPA.

The mean and median values of student's high school GPA were both found to be within the upper 10% of the scale of scores (i.e. 3.6 and 3.7 respectively on a 4.0 scale). See Table 11. Of particular note was the relatively narrow overall range of scores (i.e. 3.0 to 3.98). This indicates that all of the scores are confined to the upper quartile of the range of possible GPAs. The distribution is negatively skewed with significant compression of scores into the last 10% of the scale. The Shapiro-Wilk test of normality indicates that the distribution of scores did not conform to a normal distribution. See

Table A12 in Appendix Q. Evaluation of the histogram and Q-Q plot of observed verses expected values indicates a modest amount of agreement between the observed and expected values in the center of the distribution. However, there were more high scores at the upper end of the scale than would be expected with a normal distribution. See Figures A17 and A18 in Appendix Q. There were no outliers identified with this variable.

Table 11: *Descriptive Statistics: Cumulative High School GPA*

Component		Statistic	Std. Error
High School GPA	Mean	3.609	.0810
	Median	3.686	
	Variance	.092	
	Std. Deviation	.303	
	Minimum	3.00	
	Maximum	3.98	
	Range	.98	
	Interquartile Range	.29	
	Skewness	-1.029	.597

ACT scores.

As with rank in high school class and cumulative high school GPA, ACT scores tended toward the higher end of the scale; however, not to the same extent. In fact, no students in the sample scored the maximum. The mean and median were at approximately 67% of the scale with values of 24.6 and 24 respectively. See Table 12. The Shapiro-Wilk test of normality supports the assumption of a normal distribution. See Table A13 in Appendix R. There was a slightly positive skewedness in the distribution. See Table 12. The histogram and Q-Q plot of observed verses expected values revealed good alignments throughout the scale except at the very far ends of the scale. See Figures

A19 and A20 in Appendix R. One potential problem with the data, identified from box plots of the distribution, was the presence of three outliers (i.e. two at the upper end of the scale and one at the lower end). See Figure A21 in Appendix R.

Table 12: *Descriptive Statistics: ACT Scores*

Component		Statistic	Std. Error
ACT Scores	Mean	24.64	.626
	Median	24.00	
	Variance	5.478	
	Std. Deviation	2.341	
	Minimum	20	
	Maximum	30	
	Range	10	
	Interquartile Range	2	
	Skewness	.341	.434

Grade point average in select courses.

Descriptive statistics related to student's GPA in select courses required for admission to the major indicates a relatively wide range (e.g. as compared to rank in high school class and cumulative high school GPA) of scores (i.e. 2.67 to 3.80) with a mean of 3.25 and median of 3.23. See Table 13. The Shipiro-Wilk test of normality support the assumption of a normal distribution. See Table A14 in Appendix S. The data had a slightly positive skew. See Table 13. The histogram and Q-Q plot of observed versus expected values demonstrate good agreement throughout the scale with the exception of one value at the far lower end of the distribution. See Figures A22 and A23 in Appendix S. There were no outliers identified with this variable.

Table 13: *Descriptive Statistics: Grade Point Average in Select Courses*

Component		Statistic	Std. Error
GPA Select Courses	Mean	3.250	.097
	Median	3.233	

	Variance	.133	
	Std. Deviation	.364	
	Minimum	2.67	
	Maximum	3.80	
	Range	1.13	
	Interquartile Range	.64	
	Skewness	.233	.597

Pre-admission composite scores.

Descriptive analysis related to the University derived pre-admission composite scores of college readiness indicate a mean of 6.43 and median of 6.5 on a scale of 1-9. See Table 14. The distribution is slightly skewed toward higher scores (i.e. -.093). See Table 14. The Shipiro-Wilk test of normality support the assumption of normality. See Table A15 in Appendix T. The histogram and Q-Q plots of observed versus expected values indicate good agreement with the normal distribution throughout the range of values. See Figures A24 and A25 in Appendix T. There were no outliers identified with this variable.

Table 14: *Descriptive Statistics: Pre-admission Composite Scores*

Component		Statistic	Std. Error
Pre-admission composite score	Mean	6.43	.441
	Median	6.50	
	Variance	2.725	
	Std. Deviation	1.651	
	Minimum	4	
	Maximum	9	
	Range	5	
	Interquartile Range	3	
	Skewness	-.093	.597

Summary of Descriptive Statistics Associated with Pre-admission Indicators

EDA revealed that generally speaking the scores related to the pre-admission indicators of college readiness for this cohort of students tends to:

- Be skewed toward the upper end of scale (i.e. negatively);
- Roughly conform to a normal distribution;
- Demonstrate better agreement between observed verses expected values in the middle of ranges;
- Have considerably more values at the upper end of the scales with slightly more lower values than would be expected;
- Contain few outliers.

4.2 Phase II: Linear Regression Analysis

The focus of Phase II analysis was to specifically address the primary and secondary research questions through an examination of the relationships between the preadmission indicators of college readiness and student's performance in senior year clinical practicums. To answer these questions, data was obtained and transformed where necessary according the descriptions in Chapter 3. Analysis of this data was conducted in two distinct stages. In the first stage, simple linear regression analysis was performed using SPSS V24 to address each if the secondary research questions. In the second stage, multiple linear regression analysis was performed using SPSS V24 to address the primary research question. In both stages, the transformed values of the GCCS were used as the criterion. As previously stated, transformation of the global clinical composite scores was performed by calculating the log base 10 of the reflected original values. The decision to use log 10 reflected global clinical composite scores [LrGCCS] was based on previous analysis which indicated that the transformed values had a favorable distribution which meet the assumptions necessary for the use of linear regression techniques. The results of these analysis follow and are organized by research question.

Phase II Stage 1: Secondary Research Questions

Secondary research question 1.

The first of the secondary research questions asks: *To what extent does high school cumulative grade point average [HS GPA] correlate with or predict performance in senior year clinical practica?* To address this question, simple bivariate liner regression was performed using student's cumulative high school GPA as the predictor and student's LrGCCS as the criterion. Pearson's correlation coefficient (r), R^2, and Adjusted R^2 were calculated to assess the size of effect and a test of significance was performed. The results indicate a very low degree of correlation with a Pearson's correlation coefficient of just .065, R^2 of .004, and an Adjusted R^2 of -.033. The results of linear regression indicate that student's cumulative high school GPA was a poor predictor of student's LrGCCS. The regression equation was:

Log r global clinical composite score = .064(HS GPA) + 0.216

This indicate that for every one point increase in cumulative high school GPA (i.e. a relatively large increase in GPA) we should expect a negligible .064 point increase in LrGCCS. The standardized regression coefficient was calculated as .065; therefore, for every one standard deviation change in HS GPA one would expect a very modest .065 standard deviation increase in LrGCCS. This indicated that the effect size of cumulative high school GPA was negligible (e.g. compared to Cohen's standard) in the prediction of clinical performance. Additionally, the calculated value of significance ($> \alpha = .05$) indicate that we may not reject the Null hypothesis that the correlation between cumulative high school GPA and assessment of clinical performance in the population was zero. Therefore, on the basis of this assessment, there was insufficient evidence to conclude that student's cumulative high school GPA was linearly correlated with performance in senior year clinical practica.

Secondary research question 2.

The second of the secondary research question asks: *To what extent does high school rank in class correlate with or predict clinical performance in senior year clinical practica?* To address this question, a simple bivariate liner regression was performed using student's rank in high school class (i.e. as a percentile) as the predictor and the student's LrGCCS as the criterion. Pearson's correlation coefficient (r), R^2, and Adjusted R^2 were calculated to assess the size of effect and a test of significance was performed. The results of correlation analysis indicate a very low degree of correlation with a Pearson's correlation coefficient of .189, an R^2 of .036, and an Adjusted R^2 of -.038. The results of linear regression analysis indicate that student's rank in high school class was a poor predictor of student's LrGCCS. The regression equation was:

Log r global clinical composite score = -.011(Rank in class) + 1.414

This indicates that for every one point increase in rank in high school class we should expect virtually no increase in LrGCCS. The standardized coefficient was calculated as .189; therefore, for every one standard deviation change in rank in high school class one should expect a negligible (compared to Cohen's standard) .189 standard deviation decrease in LrGCCS. Additionally, the calculated value of significance ($> \alpha = .05$) indicates that we may not reject the Null hypothesis that the correlation between rank in high school class and clinical performance assessments in the population was zero. Therefore, on the basis of this assessment, there was insufficient evidence to conclude that student's rank in high school class was linearly correlated with the assessment of clinical performance in senior year clinical practica.

Secondary research question 3.

The third secondary research question asks: *To what extent does the high school grade point average in the science and math courses required for admission into the nursing major at this University correlate with or predict clinical performance during senior year clinical practica?* To address this question, a simple bivariate liner regression was performed. Pearson's correlation coefficient, R^2, and Adjusted R^2 were calculated using student's GPA in select courses (i.e. average score in chemistry, biology, and pre-calculus) and the student's LrGCCS as variables. The calculations of correlation analysis indicated negligible (compared to Cohen's standard) correlation with a Pearson's Correlation Coefficient of .029, R^2 of .001, and an Adjusted R^2 of -.039. The results of linear regression analysis indicated that a student's GPA in select courses was a poor predictor of that student's LrGCCS. The regression equation was:

Log r global clinical composite score = .02(GPA in Select Courses) + .379

This indicated that for every one point increase in students GPA in select courses (i.e. a relatively large increase) we should expect a negligible (compared to Cohen's standard) increase in LrGCCS. The standardized coefficient was calculated as .029; therefore, for every one standard deviation change in GPA in select courses one would expect almost no change in LrGCCS. This indicates that the effect size of GPA in select courses was extremely small in the prediction of clinical performance and the relationship was inverted.

Additionally, the calculated value of significance (> $\alpha = .05$) indicates that we may not reject the Null hypothesis that the correlation between GPA in select courses and clinical performance assessments in the population is zero. Therefore, on the basis of this assessment, there is insufficient evidence to conclude that student's grades in select high school courses that are prerequisites for admission into the nursing major at this University were not linearly correlated with clinical performance assessments in senior year clinical practica.

Secondary research question 4.

The fourth secondary research question asks: *To what extent do scores on standardized assessment test correlate with or predict clinical performance during senior year clinical practica?* To answer this question, a simple liner regression was performed. Pearson's correlation coefficient (*r*), R^2, and Adjusted R^2 were calculated using student's composite ACT[32] scores as the predictor and student's LrGCCS as the criterion. Simple linear regression analysis was conducted to determine if student's GCCS could be predicted from student's composite ACT scores.

The calculations of correlation indicated a negligible correlation with a Pearson's correlation coefficient of .263, R^2 of .069, and an Adjusted R^2 of .035. The results of the bivariate linear regression analysis indicate that student's composite ACT scores were a poor predictor of student's LrGCCS. The regression equation was:

Log r global clinical composite score = .034(ACT Score) - .416

[32] For students who took the SAT, SAT composite scores were converted to ACT composite scores using concordance tables calculated from CollegeBoard (2009) research.

This indicate that for every one point increase in students ACT score (i.e. a relatively large increase) one would expect a negligible .034 increase in LrGCCS. The standardized coefficient was calculated as .263; therefore, for every one standard deviation increase in ACT score one would expect a modest .263 standard deviation increase in LrGCCS. This indicates that the effect size of ACT scores was negligible (compared to Cohen's standard) in the prediction of clinical performance. Further, the calculated value of significance ($> \alpha = .05$) indicate that we may not reject the Null hypothesis that the correlation between GPA in select courses and clinical performance assessments in the population is zero. Therefore, on the basis of this assessment, there was insufficient evidence to conclude that student's scores on standardized test were linearly correlated with clinical performance assessments in senior year clinical practica.

Secondary research question 5.

The fifth secondary research question asks: *To what extent does a University derived composite measure of pre-admission indicators of college readiness correlate with or predict clinical performance during senior year clinical practica?* To answer this question, a simple liner regression was performed. Pearson's correlation coefficient (*r*), R^2, and Adjusted R^2 were calculated using a University derived pre-admission composite score of college readiness and student's LrGCCS as variables. Simple bivariate linear regression analysis was conducted to determine if student's LrGCCS could be predicted from student's pre-admission composite scores. Consequently, the calculations of correlation analysis indicate a negligible correlation with a Pearson's correlation coefficient of .064, R^2 of .004, and an Adjusted R^2 of -.034. The results of linear regression analysis indicate that students' scores on the University derived pre-admission composite scores were a poor predictor of LrGCCS. The regression equation was:

Log r global clinical composite score = .064(Pre-admission composite score) + .367

This indicate that for every one point increase in students pre-admission composite score (i.e. a relatively large increase) one would see virtually no change in LrGCCS. The standardized coefficient was calculated as .064; therefore, for every one standard deviation change in pre-admission composite score one would expect a negligible (compared to Cohen's standard) .064 standard deviation increase in LrGCCS. This indicate that the effect size of the pre-admission composite score was relatively small in the prediction of clinical performance. Additionally, the calculated value of significance ($> \alpha = .05$) indicate that we may not reject the Null hypothesis that the correlation between student's pre-admission composite score and clinical performance assessments in the population is zero. Therefore, on the basis of this assessment, there is insufficient evidence to conclude that the University derived pre-admission composite scores were linearly correlated with clinical performance assessments in senior year clinical practicums.

Phase II: Stage 2: Primary Research Question

The primary research question for this study asks: *To what extent do pre-admission indicators of college readiness correlate with or predict clinical performance of nursing students during senior year clinical practica in a 4- year baccalaureate degree program at a New England state flagship university?*

The result of bivariate correlation between the indicators of college readiness and the global clinical composite scores suggests that the answer to the primary research question was "no". None of the identified measures of college readiness were found to have a sizable or statistically significant effect on correlation with the variability in clinical performance assessments. However, it was worth exploring these relationships through multiple linear regression analysis to examine how, or if, the indicators of college readiness may work together in combinations to explain the variation in global clinical composite scores. As such, a series of multiple linear regressions were performed in an effort to develop a regression model to quantitatively address the primary research question.

Five predictor model. The backward elimination procedure was utilized as the basis for multiple regression analysis. The backward elimination procedure began with the simultaneous variable entry (i.e. entering all five of the predictor variables: cumulative high school GPA, rank in high school class, GPA in select courses, composite ACT scores, and the pre-admission composite scores into the model at once) with the criterion variable being the LrGCCS. The Null hypothesis was that the scores on students' pre-admission indicators of college readiness were not linearly related to, and therefore not predictive of LrGCCS. This model yielded an R of .392, R^2 of .154, Adjusted R^2 of .375, an F (5, 8) = 0.339, and a corresponding p-value of 0.876.

The calculated value of significance ($> \alpha = .05$) indicates that we may not reject the Null hypothesis that the scores on student's pre-admission indicators of college readiness were not linearly correlated with, and therefore not predictive of LrGCCS. On the basis of this assessment, there was insufficient evidence to conclude that the pre-admission indicators of college readiness were linearly correlated with performance in senior year clinical practicums.

It was worthwhile to consider the regression coefficients, in particular the standardized regression coefficients associated with each predictor to determine if one or more of the predictors may contribute to the prediction of student's LrGCCS after controlling for all of the other predictors in the model. This could help us to identify variables which could be predictive of clinical performance even when the entire model is not. See Table 15.

Table 15: *Five Predictor Regression*

Coefficients[a]							
	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	p	Tolerance	VIF
(Constant)	1.253	4.347		.288	.780		
Rank in class	.000	.044	-.005	-.006	.995	.210	4.754
HS GPA	-.125	.436	-.121	-.287	.782	.595	1.680
ACT score	.016	.104	.116	.150	.885	.177	5.659
Pre-admission composite	.026	.173	.138	.151	.883	.127	7.865
GPA select courses	-.282	.385	-.328	-.733	.484	.529	1.891

a. Dependent Variable: log r global clinical composite scores

Based on this regression analysis, none of the predictors seems to have a sizeable effect in explaining the variation in clinical composite scores. We also see that none of the variables were associated with a p-value that would indicate a statistically significant relationship with LrGCCS at $\alpha = .05$.

These results, as well as the results from bivariate analysis of correlation, would seemingly indicate that not only is the five predictor model a poor predictor of clinical performance, it would imply that none of the predictors in the model are linearly correlated with clinical performance. However, there are problems with this regression model and the assumptions with the use of linear regression techniques. Specifically, there are far too many predictors relative to the number of subjects (i.e. 5.8 subjects per predictor); and, as would be expected given the variables that were included, the values for tolerance and VIF indicate significant problems with collinearity between rank in high school class, ACT scores, and the pre-admission composite scores. Both of these problem have the potential to increase the standard error of the regression coefficient which has the effect of decreasing statistical significance.

Consequently, the decision was made to drop at least two of the predictors from the model to meet Howell's (2010) general rule that there be at least 10 cases per predictor. The result of univariate analysis indicated that only 14 of the 29 students in the study had a value reported for rank in high school class. Because listwise deletion was utilized to handle missing values in the regression analysis, the sample size in the regression was reduced to 14 subjects by the use of rank in high school class. It was possible that the low number of students with a value for this variable was so severely reducing the statics in the sample that the results were insignificant. Consistent with the backward elimination procedure, a second multiple regression analysis was performed after removing rank in high school class from the model.

Four predictor model. Using the simultaneous variable entry method, multiple regression analysis was performed using the four remaining predictor variables. This analysis produced an *R* of .307, R^2 of .094, Adjusted R^2 of -.071, an F (4, 22) = .571, and p-value of .687. Again, at α = .05, the results fail to provide statistically significant evidence to reject the Null.

It is worthwhile to consider the regression coefficients associated with each predictor value to determine if one or more of the predictors may contribute to the prediction of student's LrGCCS. See Table 16.

Table 16: *Four Predictor Regression*

Coefficients[a]							
	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	p	Tolerance	VIF
(Constant)	-.745	1.071		-.696	.494		
HS GPA	.007	.263	.007	.028	.978	.596	1.679
ACT score	.050	.034	.375	1.464	.157	.627	1.594
Pre-admission composite	-.035	.062	-.177	-.576	.570	.439	2.279
GPA select courses	.037	.161	.052	.230	.821	.798	1.252

a. Dependent Variable: log r global clinical composite scores

Even with the addition of 14 subjects resulting from the elimination of rank in high school class from the model, the p-values associated with the t-test of each predictor indicate that none of the variables in this study were a significant predictor of the LrGCCS at α = .05. Removing the rank in high school class variable did remove much of the problem associated with the calculation of collinearity; however, the tolerance value of 0.439 for the pre-admission composite score suggests a problem with collinearity.

This seems rationale given that the pre-admission composite score is a composite based on the other values. Consequently, the pre-admission composite score was removed from the model and a third multiple linear regression was performed with the three remaining variables.

Three predictor model. The three variable model contained the predictor variables of cumulative high school GPA, ACT scores, and GPA in select courses. This analysis produced an R of .283, R^2 of .08, and an Adjusted R^2 of -.040, an $F(3, 23) = .669$, and p-value of .579. Again, at $\alpha = .05$, the results failed to provide statistically significant evidence to reject the Null. The three variable model still contained a ratio of cases to predictors of only 9.66:1 which is slightly below the minimum recommended value according to Howell's (2010) Rule of Thumb. As such, a final multiple regression was performed once more with only two predictor variables.

Two variable model. Using the simultaneous variable entry method, multiple regression analysis was performed using only cumulative high school GPA and ACT scores as predictor variables. The decision to exclude GPA in select sources, as opposed to either of the other predictors, was based on the desire to retain as many of the cases as possible. Recall from Chapter 3 Methods that two of the students in the final sample were missing a score in one of the select courses used to calculate the average GPA in select courses variable. Including GPA in select courses in the model would have resulted in losing two cases from the analysis. Given that the regression coefficients for the three remaining variables were all too small to indicate that one of the variables had a significant linear correlation with LrGCCS, it made sense to drop GPA in select courses to maintain the sample size at 29. Multiple regression analysis of the two variable model containing cumulative high school GPA and ACT scores produced an *R* of .266, R^2 of .071, Adjusted R^2 of .000, an F(2,26) = .995, and corresponding p-value of .384. Again, at α = .05, the results fail to provide statistically significant evidence to reject the Null hypothesis that the scores on student's pre-admission indicators of college readiness were not linearly correlated with; and therefore, not predictive of LrGCCS.

Table 17: *Two Predictor Regression*

Coefficients[a]							
	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	p	Tolerance	VIF
(Constant)	-.317	.782		-.405	.689		
HS GPA	-.043	.203	-.043	-.210	.836	.852	1.174
ACT	.037	.027	.280	1.367	.183	.852	1.174

a. Dependent Variable: Log r global clinical composite score

Model diagnostics.

It could be argued that because the analysis did not yield a statistically significant relationship between the pre-admission indicators of college readiness and the LrGCCS, there is no need to perform diagnostics related to the assumptions for linear regression. However, the results from these analysis did provide information that was useful in addressing the primary and secondary research questions. Before drawing final conclusions from this analysis, it was important to examine the results to ensure that the conditions for the use of multiple linear regression were met. Otherwise, conclusions could be drawn from models where the data did not conform to the assumptions necessary for the use of the technique used to draw the conclusions, i.e. linear regression.

Diagnostic tests were performed to screen the results for evidence that the data did or did not conform to the assumptions of a) independence of errors, b) linearity of predictive relationships, c) normality of the error distributions, and d) homoscedasticity of residuals.

- Independence of errors was assessed by examination of the collinearity statistics. See Table 17. The values of tolerance and VIF (i.e. 0.852 and 1.172, respectfully) did not indicate any problems with collinearity; therefore the assumption of independence of errors was meet.
- Normality of the residuals was assessed by a visual examination of the Q-Q probability plot of the residuals of the expected versus the observed values (See Figure A26 in Appendix U), examination of the histogram of the unstandardized residuals (See Figure A27 in Appendix U), and the test of normality of the residuals (See Table A16 in Appendix U). Results of this assessment indicated that the data minimally met the assumptions of normality of residuals. There was a significant amount of agreement between the expected and observed values on the Q-Q probability plots, the histogram described rough agreement with the normal curve, and the test of normality provided sufficient evidence to reject the Null hypothesis that the distribution was not normal ($p > .05$).
- Homoscedasticity of residuals, was assessed by examination of a scatter plot of the standardized residuals verses predicted values for the two variable model. See Figure A28 in Appendix U. There was no pattern to the plots that would indicate heteroscedasticity (i.e. the residuals do not seem to grow larger as the expected value grows larger).

- Linearity was assessed by examination of a scatter plot of each of the predictor variables in the two variable model (i.e. cumulative high school GPA and ACT scores) versus the criterion variable (i.e. LrGCCS). See Figures A29 and A30 in Appendix U. The degree to which the results met the assumption of linearity was inferred from the distribution of the plots around the center of the distribution. The plots for both predictors are distributed somewhat symmetrically with roughly constant variance, indicating a roughly linear relationship; however, the distribution of ACT scores relative to LrGCCS indicates some non-linearity toward the upper end of the scale. These distributions were difficult to assess with certainty due to the low number of participants.

Overall, the test of the assumptions necessary for the use of linear regression analysis suggest that the data, and the results from linear regression, support the use of linear regression as an appropriate technique.

CHAPTER 5: DISCUSSION

The purpose of this research was to test the implicit assumption that higher scores related to a group of commonly used indicators of college readiness are correlated with better academic outcomes in post-secondary education. Specifically, the study aimed to address an apparent gap in the literature concerning the relationships between five indicators of college readiness and clinical performance of students enrolled in post-secondary health professions and related programs [HPRP]. Thus, the central question is whether commonly used indicators of college readiness such as cummulative high school grade point average (HS GPA), rank in high school class, scores on standardized test (i.e. the American College Testing [ACT] and the Scholastic Aptitude Test [SAT]), and grades in select high school math and science courses, are useful tools in admissions decisions.

This study challenges the basic assumptions associated with admissions practices into competitive clinically based HPRP at selective colleges and universities. Principally, the study challenges the assumption that the pre-admission indicators of college readiness are useful in predicting future clinical performance, an important academic outcome of these programs. As such, the study consisted of six research questions, (i.e. a primary question and five related secondary questions). The primary research question was:

> To what extent do pre-admission indicators of college readiness correlate with or predict clinical performance of nursing students during senior year clinical practica in a 4- year baccalaureate degree program at a New England state flagship university?

The Null hypothesis was that student's scores on the pre-admission indicators of college readiness were not predictive of student's clinical performance assessments.

The secondary questions were:

1. To what extent does high school cumulative high school grade point average correlate with or predict performance in senior year clinical practica?
2. To what extent does rank in high school class correlate with or predict clinical performance in senior year clinical practica?
3. To what extent does the high school grade point average in the science and math courses required for admission into the nursing major at this University correlate with or predict clinical performance during senior year clinical practica?
4. To what extent do scores on standardized assessment test correlate with or predict clinical performance during senior year clinical practica?
5. To what extent does a University derived composite measure related to the pre-admission indicators of college readiness correlate with or predict clinical performance during senior year clinical practica?

The Null hypothesis tested was that student's scores on the pre-admission indicators of college readiness were not linearly correlated with their clinical performance assessments.

5.1 Findings

To address these questions, data related to nursing students' pre-admission indicators of college readiness and their subsequent performance in senior year clinical practica were collected at a state flagship university in New England and its affiliated medical center. The relationships between the five commonly used pre-admission indicators of college readiness and subsequent clinical performance were evaluated utilizing a cross-sectional retrospective observational study design. The methodology included exploratory data analysis, simple regression analysis, and multiple linear regression analysis.

Given this study design and methodology, there were a variety of approaches and alternative techniques that could have been used in the analysis. As is consistent with the conventions of statistical analysis, the analyist's judgement came into play in the development of a multiple linear regression model for addressing the primary research question. For example, a decision was made subsequent to perform initial diagnostics of preliminary regression models to transform the criterion variable of global clinical composite scores by calculating the log of the reflected values of these scores [LrGCCS]. This transformation resulted in a more normal distribution of scores which, when utilized as the criterion in the regression model, resulted in a distribution of residuals which meet the assumption of normality, a requirement for the use of linear regression techniques.

Additionally, because of problems with collinearity and with the low number of research participants relative to the number of potential predictors, decisions regarding which variables to include/remove from the regression equation had to be made. These decisions were made through backward elimination, an iterative process where variables are removed one at a time after simultaneous variable entry of all of the relative predictors to determine how the results change based on the variables that are included and excluded. Fortunately, for the purpose of drawing conclusions from the findings, the result of analysis did not change significantly depending on which variables were included or removed from the model.

In the final analysis, a two variable model was presented which contained cumulative high school GPA and ACT scores as the predictors and the LrGCCS as the criterion. The results of this analysis failed to identify a sizable regression coefficient or a statistically significant relationship at $\alpha = .05$ that could be useful in predicting future clinical performance on the basis of scores on the pre-admission indicators of college readiness. Additionally, simple regression analysis between each of five individual pre-admission indicators of college readiness and LrGCCS were analyzed for correlation. The results of this analysis were surprisingly consistent. None of the correlation coefficients between any of the five indicators of college readiness were associated with more than a negligible degree of correlation with clinical performance assessments. For example, the Pearson's correlation coefficient between student's cumulative high school GPA and LrGCCS was found to be only .065 and not statistically significant at $\alpha = .05$. Further the results of regression analysis demonstrated that for every one point increase in high school GPA there was a negligible .064 increase in global clinical composite scores. These results suggest that within this cohort of students, cummulative high school GPA was not predictive of scores on clinical performance assessments.

This is likely a significant finding given that the review of the literature pointed to high school GPA as the most likely predictor of clinical performance. As mentioned in the review of the literature, Timer and Clauson (2011) tentatively conclude that high school GPA was a valid predictor of clinical success. However, Timmer and Clausen did not specifically assess clinical performance directly. They did have access to a larger dataset with more participants.

As for the other relationships in question in this study, the lack of a significant correlation was a consistent finding. For each of the other four indicators of college readiness, there was no statistically significant difference in scores on clinical performance assessments in relationship to the scores on the pre-admission indicators of college readiness. None of the relationships between the individual pre-admission indicators and scores on the LrGCCS were found to be statistically significant at $\alpha = .05$.

5.2 Significance of findings

Even with the consistency in findings between each of the pre-admission indicators of college readiness clinical assessement scores, there are questions that remain as to the significance of the findings. Principally, the findings raise questions in regard to the nature of the data which underlies these finding, the implications for admission practices/policies, and the next steps for future research. These questions and the relevance of the findings to the conceptual model are addressed in the following sections.

Nature of the Data

To infer what the findings mean in terms of admissions practices, it is important to understand the underlying structure of the data and to critically evaluate the validity of the results before making any generalizations or recommendations.

Concerns related to the assessment of clinical performance.

Underlying the study findings is the assumption that the clinical performance assessments provided a reliable and valid representation of student's actual clinical performance. The results of univariate analysis of the distribution of global clinical composite scores suggest that caution should be applied in regard to this assumption.

Prior to data analysis it was assumed that the mean scores on clinical performance assessments would be above the mid-point of the scale. The basis for this assumption was that by the time students are in their final senior year clinical practica they are on the verge of graduation and will soon be entering into the workforce. As such, their clinical performance should at least approach that of a practicing, if not an experienced, nurse. Additionally, it was assumed that students who were not performing up to the standards of the medical center and/or the nursing program would presumably have either undergone remediation to improve their performance, or they would have been dismissed from the program. The combined effect would presumably raise the mean scores above the mid-point on the scale. This was found to be the case.

On average, students in the study received high scores on the assessment of clinical performance. The mean and median global clinical composite scores were 7.6 and 8.2, respectively on a 10 point Likert scale. Nine of the 29 (i.e. 31%) students scored between 9 and 10, 16 students scored between 8 and 10 (i.e. 55%), and 75% of students scored 6.3 or higher. See Table 9.

Further, it was also assumed that the distribution of scores would conform to a roughly normal distribution. The basis of this assumption was that students' clinical performance was as likely to fall below the mean of the cohort as above, resulting in a normal distribution. This was not the case. The distribution of global clinical composite scores was roughly bi-modal with a higher concentration of scores at the very low end of the scale and a progressively skewed distribution toward higher scores at the upper end of the scale with the highest frequency of scores within the range of 9-10. See Figure A8 in Appendix J.

Looking more deeply into the component scores that went into the calculation of the global clinical composite scores, we find that none of the distributions related to the individual components of clinical performance passed the Shapiro-Wilk test of normality. See Table A3 in Appendix H. Similarly, there was generally poor agreement in the Q-Q plots of the observed versus expected values throughout the distribution of the individual components underlying the global clinical composite scores. See Figures A3-A7 in Appendix I. Consequently, there was little agreement in the Q-Q plot of expected verses observed global clinical composite scores throughout the range of composite scores. See Figure A9 of Appendix J. The Q-Q plot distributions suggests that the low scores are too low and the high scores are too high. Of course, this assessment of Q-Q plots, assumes that the distribution of actual clinical performance in the population was normally distributed which may not have been the case.

In hindsight, it is certainly plausible that the assumption of a normal distribution of clinical performance in this cohort was flawed. Given that the instructions to the preceptors for evaluating students was "…score your student's performance according to a 10 point scale with (1) indicating complete incompetence and (10) indicating performance above that of an experience nurse", the results indicate that the vast majority of the students in the sample performed at the level of, or above that of an experienced nurse. This was an unexpected and confusing result. It doesn't make sense that the most frequent assessment of student clinical performance would yield a result (i.e. 9-10) that indicates that the students performed better than an experienced nurse.

Reflection on the assessment tool.

We know from the review of the literature that assessing clinical performance is a difficult and uncertain task. The literature cites two primary concerns with assessing clinical performance (1) determining which items should be included in the assessment; and (2) determining what competence on these items look like and quantifying it? Questions related to these two concerns are certainly salient in regard to the clinical performance assessments in this study. While the authors/developers of the Leicester Clinical Assessment Tool [LCAT] indicated that the instrument was assessed for reliability and validity, they concluded that the instrument was reliable and they believed that it was a valid measure of important nursing competencies; however, they further concluded that there was insufficient evidence to demonstrate validity (McKinley et al., 2008 a; McKinley et al. 2008 b). Another concern with the use of the LCAT for this study is that the LCAT was derived as an assessment tool for use in the United Kingdom's National Health System for *practicing* nurses (McKinley et al., 2008 a; McKinley et al. 2008 b). It is plausible that the instrument loses some reliability and validity when used in a US medical center for the assessment of *students*' clinical performance. Consequently, the 38 items contained in the instrument may not be applicable for assessment of participants in the study.

Alignment of the LCAT with objectives of the nursing program.

An important consideration for the use of the LCAT as the basis for clinical performance assessment is whether or not the LCAT measures the expected outcomes associated with the nursing program that is the setting of this research. Essentially, this brings into question the validity of the instrument in the specific population of students.

There is some question concerning the alignment of the components of performance contained in the LCAT and the stated programmatic goals of the nursing program. All of the items and components of competency associated with the LCAT seem to be in alignment with the goals for student outcomes. However, it is unclear as to whether the items on the LCAT fully capture the outcome goals. For example, #1 Use empirical, personal, esthetic, and ethical knowledge to practice professional nursing with clients based on understanding of human experience, in the list of program outcomes seems well aligned with the items in the component competency categories of Communication and Safety; #3 Collaborate with others to promote and preserve health, seems will aligned with the component competency category of Teamwork; and #5 Use the American Nursing Standards and the Code of Ethics to practice as an accountable professional, seem well aligned with all of the components of competency but particularly well aligned with the items in Infection Prevention and Procedural Competency.

On the other hand, the LCAT seemingly fails to capture some of the desired programmatic outcomes. The items on the LCAT do not seemingly address program outcome #4 incorporate leadership principles into practice. It is questionable as to whether the LCAT captures program outcome #2 incorporate theory and research into practice. It could be argued that the items in each of component competency categories of the LCAT require the application of theory into practice, but this is not clear. The incorporation of research is not explicitly indicated in any of the items associated with the

LCAT. It could also be stated that objective #2 is somewhat confusing as it is unclear what incorporation of research into practice means. Does it mean incorporating the conclusions from research into practice or does it mean incorporation of a research agenda into practice?

Overall, the conclusion was that based on an assessment of the alignment between items on the LCAT and the program's outcome goals, the items contained on the LCAT were consistent with the program's goals, but the instrument may not fully capture all of the expected student outcomes. So, while the instrument seems useful for this assessment it may fail to capture particular constructs that are emphasized as important components of clinical practice as defined by nursing program faculty.

Inter rater reliability in performance assessments.

A bigger concerns with the use of this instrument for the assessment of clinical performance is related to inter rater reliability and the uncertainty associated with determining a criteria for quantitatively assessing competence. No explicit criteria was established to identify what competency would look like for most of the items assessed on the LCAT; and, while many of the preceptors in this study have experience with evaluating student competency, there is no evidence that what they assert to be competency at the level of an experienced nurse, or any other level, represents actual competence at that level.

For many of the items contained in the LCAT, such as item 2.3 "Labels samples/printouts correctly", assessment seems straight forward. The student either labeled vials correctly according to medical center standards or did not. Conversely, items such as 2.4 "Applies procedure-specific safety measures correctly" seems to allow for considerable subjectivity in evaluation. It seems possible that a student may not have actually applied procedure specific safety measures correctly according to some professional standard such as the guidelines of the American Nursing Association [ANA][33], but could have been scored high on the scale by merely meeting the standards of the preceptor. In other words, the preceptor may have set a standard that is inconsistent with professional standards creating a student rating that lacks validity and reliability in regard to standards of the profession.

Clinical procedure manuals or best practice guidelines could provide guidance to preceptors in the assessment of student's performance. However, there is no evidence that the preceptors in this study evaluated students in relation to these guideline or that the preceptors followed, or were aware of, the guidelines themselves. It should be noted that the LCAT does provide some limited examples of what competence might include for certain items; however, the examples are far from comprehensive or descriptive. Additionally, there is no evidence that the examples from the LCAT, the guidelines of the ANA, the standards of the nursing program, or the standards of the medical center are aligned. This lack of standardization seems to be fundamental to the difficulty of ever establishing a valid and reliable instrument for assessment of clinical performance.

Personal bias in evaluation of clinical performance.

Another complicating issue related inter rater reliability in the assessment of clinical performance is the potential for bias in the assessments. From personal experience with evaluating student's clinical performance, it is evident that students and

[33] The nursing program indicated in its expectations for student outcomes that graduates would "Use the American Nursing Standards and the Code of Ethics to practice as an accountable professional" (New England University, 2014).

preceptors develop relationships that are, at least somewhat, predicated on personality traits and alignment with similar personal and cultural norms. It is plausible that clinical performance assessment were influenced by the nature of these personal relationships rather than solely on the merits of clinical performance. It is possible that the personal nature of preceptorships was at least somewhat responsible for the bi-modal distribution of clinical assessment scores and the poor alignment between the expected and observed scores. Bias in assessment of clinical performance based on alignment with personality or cultural norms would explain the relatively high, and unexpected, number of scores on the extreme ends of the scale. In cases where there was a high degree of alignment in the personal relationship, the scores could have been inflated and where there was lack of alighnment the scores understated clinical performance.

Bias in the responses does not necessarily imply that preceptor's intent was to punish or reward students based on the nature of the personal relationship. It should be noted that the instructions to the preceptors clearly indicated that the results of assessment would remain confidential and would in no way be made available to program faculty. Nor does it imply that bias in the evaluation was the result of conscious decisions. As was discussed in the review of the literature, unconscious bias by healthcare providers toward patients from different racial, social, cultural/ethnic backgrounds is well documented. It seems reasonable that these same biases would manifest toward students who did and who did not align well with the norms of the preceptors.

Support for the use of the LCAT.

All of the above mentioned concerns with the assessment of clinical performance provide basis for caution in the interpretation of the results and the applicability of the results in admissions decisions. However, it should also be noted, that while the validity of the LCAT may be questionable, based on the review of the literature, the instrument may also have been completely adequate for the purpose of this research. We know that the authors intended the instrument to be used in a broad array of settings. The instrument was developed through a rigorous multistage process based on the feedback of experienced practitioners and was tested, revised, and implemented in multiple diverse setting, albeit in another country and with a different population of participants.

We also see evidence in the collected data related to this study which supports the validity of the LCAT in this population. We observed in the distribution of responses that there were a very low number of missing values on the assessments. The instructions for the assessment indicated that the preceptors could skip any questions that did not seem applicable. It seems reasonable that if the items were not applicable for the assessment of students in a US based medical center, there would have been a large number of missing values. This was not the case. With the exception of the assessment of one student who performed a psychiatry rotation during the final practicum[34], there were very few (i.e. 15 out of 1,102) missing values in the data and seven of these were associated with one student.

[34] As was indicated previously, this student was exclude from the study.

Even acknowledging the potential problems with the assessment instrument and the difficulty associated with performance assessments generally, at the time of the research, the review of the literature indicated that the LCAT was almost certainly the best clinical performance assessment tool available. There is no explicit evidence that would cause us to reject the LCAT as a viable assessment tool for the purpose of this research, only reason for caution.

Assumptions and distributions related to pre-admission data.

Prior to data collection and analysis, the analyst's assumption was that the mean scores on the pre-admission indicators of college readiness would tend toward the higher end of the respective scales and that the distribution would be negatively skewed. Given what was learned from the review of the literature concerning admissions practices into college in general and health related majors in particular, the rationale for these assumptions was that admission into selective universities, such as the setting for this research, tend to yield higher scores relative to the population of high school students as a whole. Additionally, acceptance into majors where limited clinical capacity combined with a large number of aspiring candidates creates a competitive admissions process, selection is based largely on scores associated with the pre-admission indicators of college readiness and this process tends to yield students with high scores on these indicators.

It makes sense that selection bias in the admissions process would yield a distribution of scores that would tend to cluster toward the upper end of the scales. This was found to be generally true for each of the five pre-admission indicators of college readiness, but particularly so for rank in high school class and cumulative GPA. All of the students in the study were above the 89th percentile for rank in high school class. See Table 10. Similarly, the scores related to student's cumulative high school GPA were compressed into the range of 3.0 to 4.0 (on a 4.0 scale) with a slightly skewed distribution toward the upper end of the scale. See Table 11. In these distributions we *only* have students in the population having scores which were within the upper quarter of the entire scale.

While the distribution of ACT scores, and scores on select courses were not nearly as skewed toward the upper end of the respective scales as rank in class and cumulative high school GPA, they were overly representative of students who scored in the upper end of the scales. This narrow range of scores creates a problem with Phase II analysis of correlation and in drawing broad conclusions related to the research questions. We simply do not have a sufficient distribution of students with low scores on the pre-admission variables to compare against students with high scores. Essentially the analysis became a comparison between students with good scores on the indicators of college readiness and students with excellent scores. This limits the generalizability of the findings beyond the range of scores for which we have data.

Implications for Admissions Practices/Policies

As mentioned above, the findings from analysis of correlation suggest that in general, scores related to the pre-college admission indicators of college readiness were not correlated with assessments of clinical performance during the senior year clinical practica. On the basis of these findings, the conclusion from this research is that for these nursing students, enrolled in this state flagship university, scores on the pre-admission indicators of college readiness were not correlated with or predictive of clinical performance assessments in senior year clinical practica. In regard to the research questions and implications on admissions decisions, the limitations to the study should be acknowledged. These limitations include:

- the uniqueness of the research setting which limits the generalizability of the results to other nursing programs
- the relatively low number of participants in the study (i.e. 29)
- uncertainty with the validity and reliability of the clinical performance assessment
- The limited range of scores on the pre-admission indicators

Due to the combined effect of these limitations, it would be unwise to generalize the finding to the entire population of nursing students in other settings or to other clinically based majors. However, diagnostic tests of the data and the results did not indicate any clear violations of the assumptions for the use of multiple linear regression techniques. Further, the consistency of results across all of the predictors, regardless of the combination of predictors used, lends confidence to the finding that the pre-admission indicators were not linearly correlated with clinical performance assessments and therefore, were not predictive of subsequent clinical performance in this population of students.

In the opinion of the analyst, the results do not provide enough evidence to be utilized as the basis for high stakes policy decisions regarding admission practices. However, the study does provide useful insights into the relationships between five commonly used indicators of college readiness and subsequent clinical performance. One interpretation of the results is that because no significant correlations were observed between the pre-admission indicators of college readiness and subsequent clinical performance assessment; these commonly used indicators of college readiness are not predictive of future clinical performance and their use in admission practices should not be given undue weight. A competing interpretation of the results is that the selection process worked as intended and supports the use of pre-admission indicators as the basis of selecting students for admission into clinically based majors. In this interpretation, an argument could be made that the process yielded a cohort of students with high scores on the pre-admission indicators of college readiness who subsequently performed quite well on senior year clinical performance assessments.

Regardless of which interpretation we might favor, we must acknowledge that we do not know how students with lower scores on the pre-admission indicators would have performed in senior year clinical performance assessesments because we do not have data related to these students. It is conceivable that if we had students in the study from the lowest quartile of the GPA scale, or similarly, lower scores on any of the pre-admission indicators, we would have seen stronger correlations with clinical performance as these students might have performed worse than the students in this study. All that we know for sure is that there was no statistically significant differences observed in this cohort of studens in regards to the relationships in question.

Next Steps for Future Research

While the purpose of this study was not to test the validity of the LCAT, the concerns raised in this discussion give rise to new complicated questions related to clinical performance assessments and indicate the need for additional research in this area.

Developing a scale for clinical performance assessment.

In order to improve the detection of correlation using linear regression, a different scale and criteria may have allowed for the creations of a more normal distribution of scores and a more meaningful interpretation of the results. As mentioned previously, the resultant global clinical composite scores were heavily clustered in the range of 8-10 with the most frequent response in the range of 9-10 on the 10 point Lykart scale. It seems that the preceptors wanted to score students higher than was allowed as the top of the range, i.e. that of an experienced nurse.

In hindsight it appears that the assessment of clinical performance would have been improved through the use of a revised and more clearly delineated scale. Additional research is needed to determine just how to do this. A suggested starting place would be to align the value at the center of the distribution with the most frequently noted response. Based on the responses in this study, this would indicate placing “Performance above that of an experienced nurse” in the center of the distribution. However, this does not seem to make sense because there is no clear indication of what would justify a response that is above this level.

Another approach would be to reframe the comparison criteria from that of an “experienced nurse” to that of “clinically competent” and placing “clinically competent” at the center of the scale. The remainder of the scale would be constructed in relationship to this criteria on a 9 point rather than a 10 point scale. See Figure 2.

1	2	3	4	5	6	7	8	9
Far below expectations for clinical competency		Below expectations for clinical competency		Clinically competent		Exceeds expectations for clinical competency		Far exceeds expectations for clinical competency

Figure 2. Proposed scale for the assessment of student clinical performance.

Constructing the scale in this manner would seemingly result in the highest frequency of responses in the middle of scale and allow for scoring students who fail to meet and who exceed competency expectation to be scored in a more graded fashion. A key assumption with this proposed scale is that the majority of students in the senior year of training will be assessed as clinically competent with fewer students either far below or far exceeding expectation of competency.

The addition of more detail in the scale would also seemingly allow for a clearer interpretation of the results. For example, if the mean score in the cohort was found to be seven, the result could be interpreted as: on average students in the cohort exceeded the expectation for competency. This is consistent with the conclusion of Tilley (2008) who asserted that clinical performance is determined by the assessment of clinical competence in relationship to the student's ability to demonstrate skills in the performance of tasks and behaviors in a manner that is consistent with professional standards.

Standardization of clinical performance assessment.

Another recommendation is that work should begin toward the development of universally accepted instruments for assessment of clinical performance of students, and practicioners in US based clinical environments. It is problematic that we really have no validated and widely accepted instruments or processes to evaluate the performance/competency of nursing students. Other than the current practice of requiring graduates of nursing programs to pass a national licensure examination (i.e. National Council Licensure Examination), which does not directly assess clinical performance, there is no clear way of assessing or certifying nursing clinical competency. Clearly, central to the development of a valid and reliable instrument is the need to define widely accepted standards of what basic clinical competency looks like. Findings from this study could serve as a basis for other research with the intent of improving the validity of such assessments.

Mixed methods and clinical simulation.

One approach for developing a standard assessment technique would be to start by reframing the assessment scale as described above, ask the preceptors to use the tools for assessing other cohorts of students, then use a mixed methods approach to assess the results in relationship to the preceptor's rationale for responses. The use of qualitative techniques could help to uncover the basis/rationale for the distribution of scores and could lead to valuable insights into the establishment of a baseline for what competency looks like.

This approach could be used in conjunction with the use of of clinical simulation laboratories to test assessment techniques which seek to measure student's clinical actions against established clinical guidelines. There are many opportunities to develop standard protocols from established guidelines of professional organizations that could be tested in the controlled environment of clinical simulation laboratories. Clinical simulation could provide opportunities for multiple reviewers to view and assess the same clinical interaction. Minimally, clinical simulation could be used as the basis for assessing the reliability of assessments and there could be opportunities for establishing measures of validity as well. Still, reaching agreement on what is “poor/good” or “competent/incompent”, and scaling these judgments is a difficult construct particularly when the objective is to create a reliable instrument for use across multiple diverse settings.

Clinical simulation could also be used as the basis for assessment of clinical performance. Students could be asked to perform certain clinical task in the controlled simulation environment while being evaluated by multiple reviewers, ideally reviewers who were not the student’s preceptors. This could allow for removal of much of the subjectivity and bias in the assessments of performance and would allow for measuring performance according to predefined guidelines.

This method of assessment of clinical performance would be quite different from the clinical assessment technique used as part of this study. In this study, preceptors were asked to score students retrospectively. Preceptors had to reflect back on student’s performance over an 8 week time frame and relate that performance, which occurred over multiple patient encounters, to the 38 assessment items. Evaluating students as they perform a specific procedure or limited number of procedures on a limited number of patients in a clinical simulation laboratory would result in a more immediate assessment of clinical performance. The two approaches would certainly have pros and cons which could be the basis of new research in and of itself.

Hypothesis testing

In order to draw broad conclusion related to admission practices, we need to explicitly test hypotheses concerning the relationships in question using experimental study designs. However, the ideal sorts of experiments are unlikely to ever occur. These experiments are unlikely because in a competitive admissions environment, it does not seem likely that we would ever see a distribution of students which representation of students who performed poorly on the pre-admission indicators. In order to truly test the hypothis that scores on the pre-admission indicators are linearly correlated with performance in clinical practica, we need to admit students with low scores on the pre-admission indicators to test relative to the higher scoring students. Without these low scoring students we will continue to lack the range of scores necessary to truly test the relationships experimentally. Further complicating hypothesis testing is the afore mentioned problems with the assessment of clinical performance. Given these limitation we are unlikely to have ideal data from which to conduct a truely experimental study which would yield conclusive results.

Still, we could develop new ways to test specific hypothesis in way which build upon this study, but may lack the ideal distribution of data. For example, this research could be continued with the recommendations for improving the assessment tool across other institutions, and in larger propulations. One important question that arises from these findings is: Is there a particular threshold score on the pre-admission indicators above which students perform in a consistent manner in clinical practica?

Identifying such a threshold could allow admissions directors to select students with scores above this threshold even though they may not be the top scoring students in the applicant pool. For example, if we could confirm that students with a high school GPAs of 3.0 are as likely to succeed in clinically based majors as students with higher scores, rather than selecting students on the basis of the highest GPA we could accept students so long as they meet the threshold of 3.0. This would allow for much more flexibility in accepting students from diverse backgrounds and would seemingly strike a balance between the often competing goals of accepting highly qualified students who have the background pre-requisite knowledge and skills necessary for academic success and the acceptance of a diverse cohort of students.

5.3 Conclusion

This study was conducted after an extensive review of the literature which crossed a broad spectrum of topics including social justice, disparities in health, the delivery of health care, educational attainment, admission practices into higher education, and the assessment of clinical performance. The results of this review led to the development of a conceptual model founded in a complex systems framework. This model is based on the acknowledgement that in the United States, disparities related to race/ethnicity and socioeconomic status exist in the areas of health, the delivery of health care, and the education system. The conceptual model further proposes that admissions practices used by institutions of higher education, particularly those associated with health professions and related programs at selective universities, serve to perpetuate these disparities by maintaining the status quo in terms of healthcare workforce diversity.

The rationale for this assertion comes from the review of literature. The review of the literature indicated the importance of developing a culturally competent healthcare workforce as a necessary step in addressing disparities associated with the delivery of health care. Further, the literature points to the need for increasing the diversity of the healthcare workforce as a necessary step toward the development of a cultural competency healthcare workforce. The literature also indicated that the combined effect of a heavy reliance on the use of indicators of college readiness in post-secondary admissions practices at selective post-secondary institutions and generally lower scores on these indicators for students from disadvantaged backgrounds serve to further restrict the pipeline of academically qualified students from disadvantaged backgrounds in HPRP. These practices have the net effect of restricting the development of a diverse healthcare workforce, restricting the development of a culturally competent healthcare workforce and therefore, perpetuating disparites in the delivery of health care. Further, these practices restrict the ability of persons from disadvantaged background from participating equally in health related careers.

From this conceptual model a set of research questions emerged which challenged the implied assumption that higher scores related to a set of pre-admission indicators of college readiness were correlated with and predictive of academic performance. These questions focused specifically on the relationship between commonly used pre-admissions indicators of college readiness and clinical performance. The rationale for focusing on these relationships was that clinical performance is a seemingly important academic outcome in health related programs and the review of the literature identified a significant gap in our understanding of the relationships.

As was indicated in this discussion, no significant correlations were found between the indicators of college readiness and clinical performance assessments of students in a Bacholors of Science in nursing program at a selective New England University. While the findings of this study do contribute to our empirical knowledge around the subject and provide support for the conceptual model, the study's limitations prevent broad generalizations that could be the basis for policy changes in regards to admissions practices. Nonetheless, the findings of the study raise additional questions worthy of further investigation. Certainly the methodology for the assessment of clinical performance needs improvement, a much larger number of participants is necessary in order to reach more reliable, valid, and generalizable findings. However, this research is significant as it is foundational to balancing the need for selecting highly capable students who have the capacity to be successful, competent graduates and healthcare providers with the acknowledgement that scores on the pre-admission indicators are restricting the admission of diverse cohorts of students into clinically based health care majors.

If we determine through additional research that lower scores on the commonly used indicators of college readiness preclude students from being successful in these highly competitive schools and majors, then selection of students based on pre-admission scores may be necessary in the absence of support systems to help students who are likely to struggle academically in post-secondary education. However, if we determine that these scores are not so predicative of success as we have previously presumed, then we must conclude that our current admissions practices exclude students from educational opportunities not because they incapable, but because they lacked the social advantage that is so closely associated with higher scores on the commonly used indicators of college readiness. We must also acknowledge that as long as we continue to see disparities in education related to social class, students from disadvantaged backgrounds will disproportionately present with lower scores related to the indicators of college readiness in comparison to their more affluent counterparts.

The findings from this research suggest that nursing students who scored high on the commonly used pre-admission indicators of college readiness performed well in senior year clinical practica. However, better scores on these indicators were not necessarily correlated with better clinical performance. These findings seem to suggest some type of threshold effect in terms of scores on the pre-admission indicators, above which students perform well on clinical performance assements. Identifying such a threshold could be quite useful in balancing the often competing goals of identifying capable students and admitting a diverse cohort of students.

Of course, even if we do identify such thresholds through additional research, there are still forces that would resist changing admissions practices to allow for the selection of students on any criteria other than having the highest scores on these indicators. Some would argue that selecting students on grounds other than the pure "merits" of their scores would represent some type of injustice toward the highest performing students who might be supplanted in the admitted cohort by lower performing students. One logical argument which is related to this concern is that the real solution to increasing diversity in the cohorts of students admitted into HPRP is to address the underlying inequities in the educational system which manifest as differiential educational outcomes based on social class. While this argument is logical, it is flawed. It suggests that we as a society are faced with a choice of one or the other (i.e. equitable admissions practices into competitive HPRP or development of an equitable education system). We are not.

Obviously, we should strive to remedy the injustice associated with an educational system that produces disperate outcomes related to social class, race/ethnicity, and other causes of disadvantage. However, until these injustices are systematically addressed and everyone has the same opportunity to demonstrate whatever it is that “merits” the opportunity to pursue post-secondary education throughout the continuum of the HPRP, we must continue to look for ways to balance the admissions processes in ways that will achieve often competing goals.

These goals include: (1) the selection of students who have the capacity to become competent healthcare providers; (2) creating a workforce that is as diverse as the population it serves; (3) allowing students who have the capacity for success in health care careers the opportunity to do so without regard to the social group into which they were born. The literature is clear, presently we lack diversity across the continuum of health related careers that reflects the diversity of society. This lack of diversity is an impediment to the development of a culturally competent healthcare workforce capable of responding to the nation’s greatest health care needs such as chronic illnesses. This study takes a step in examining the usefulness of commonly used criteria in admissions practices which have the effect of hindering the development of a diverse healthcare workforce. The question still remains as to whether or not these critieria are truly necessary to select highly qualified students who are likely to be successful in post-secondary HPRP; or, are they uncessarily restricting the admission of students from disadvantaged backgrounds into competitive health related educational programs and thus unnecessarily restricting the development of a diverse and culturally competent healthcare workforce.

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APPENDICES

Appendix A   Conceptual Model

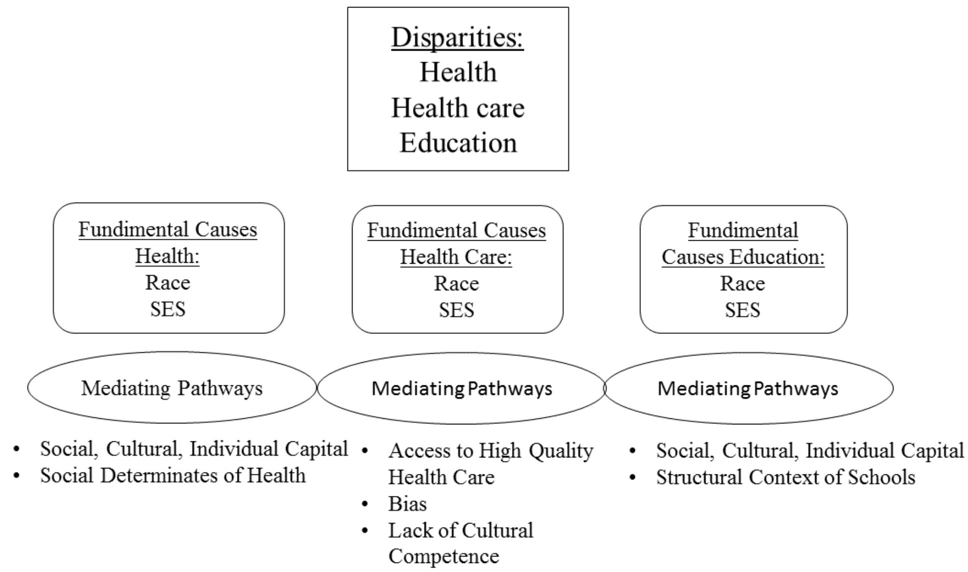


Figure A 1. Conceptual Model Part 1. In the U.S. racial and socioeconomic inequalities are fundamental causes of disparities in population health, in the delivery of health care, and in education. These disparities manifest through mediating pathways as indicated in the figure.

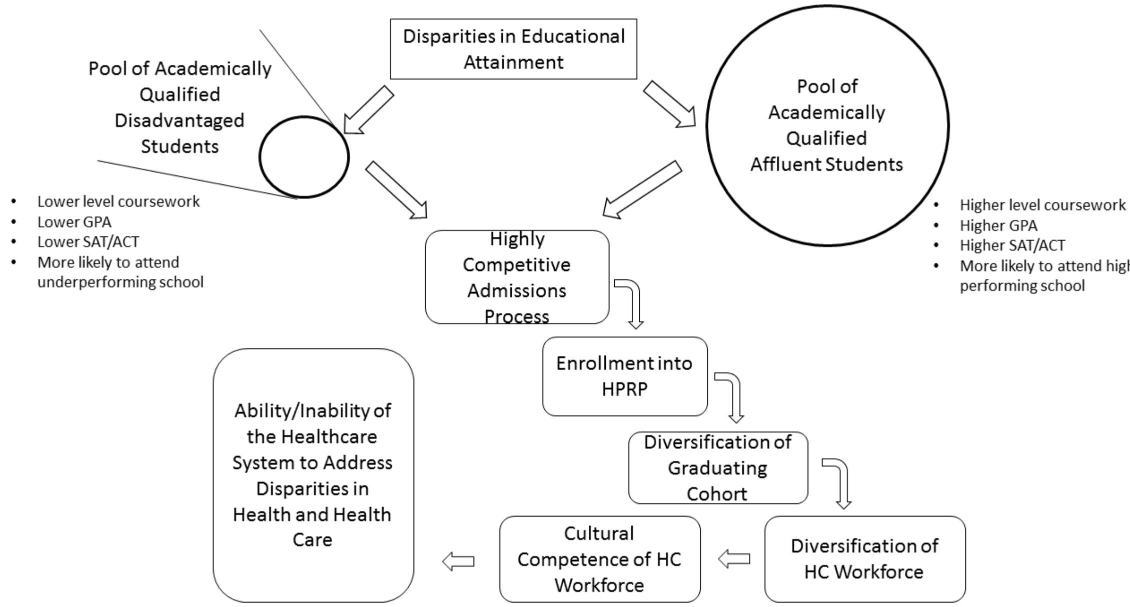


Figure A 2. Conceptual Model Part 2. Disparities in educational attainment manifest as a diminished pool of academically qualified college applicants from disadvantaged backgrounds who also generally have lower scores on a group of pre-admission indicators of college readiness. In a highly competitive admissions practices such as in HPRPs at selective colleges, this dynamic serves to restrict the development of a diverse healthcare workforce with the cultural competency needed to address healthcare disparities that are related to race and socioeconomic status.

Appendix B Nursing Program Curriculum at New England University

Academic Year: 2015-2016

First Year

Fall Semester	Credits	Spring Semester	Credits
CHEM 023: Outline of General Chemistry	4	CHEM 26: Outline of Organic &Biochemistry	4
ENGS 001: English	3	SOC 001-099*	3
PSYS 001: General Psychology	3	PSYS 170: Abnormal Psychology	3
HDFS 005: Human Development	3	NFS 43: Fundamentals of Nutrition	3
NH 050: Applications to Hlth: Person to System	1	Philosophy/Religion/Ethics Course	3
Total Credits: 14		*Total Credits: 16*	

Second Year

Fall Semester	Credits	Spring Semester	Credits
ANPS 019: Anatomy/Physiology	4	ANPS 020: Anatomy/Physiology	4
MMG 65: Microbiology & Pathogenesis	4	PRNU 111: Research in Nursing	3
STAT 111: Elements of Statistics	3	PRNU 113: Health Assessment	3
PRNU 110: The Art and Science of Nursing	3	PRNU 114: Introduction to Clinical Practice	3
		Elective	3
Total Credits: 14		*Total Credits: 16*	

Third Year

Fall Semester	Credits	Spring Semester	Credits
NURS 120: Pathophysiology	3	PRNU 131: Health Alterations	3
PRNU 121: Gerontology	3	PRNU 134: Adult Health Nursing I	6
PRNU 128: Pharmacology	4	PRNU 132: Child & Adolescent Nursing	5
PRNU 129: Women and Newborn Nursing	4	**OR**	
Elective	3	PRNU 235: Psychiatric & Mental Health Nursing	5
		Elective	3
Total Credits: 17		*Total Credits: 17*	

Fourth Year

Fall Semester	Credits	Spring Semester	Credits
PRNU 241: Public Health Nursing	3	PRNU 231: Chronic and End of Life Care	3
PRNU 234: Adult Health Nursing II	6	PRNU 240: Contemporary Issues & Leadership in Professional Nursing	6
PRNU 132: Child & Adolescent Nursing	5	PRNU 242: Public Health Nursing Practicum	3
OR		PRNU 243: Transition to Professional Practice	1
PRNU 235: Psychiatric & Mental Health Nursing	5	Elective	3
Total Credits: 14		*Total Credits: 16*	

Total Credits for Program: 124

Appendix C Recruitment Letter to Gain Consent

Title of Research Project:	AN EXAMINATION OF CORRELATION BETWEEN PREADMISSION INDICATORS OF COLLEGE READINESS AND CLINICAL PERFORMANCE OF NURSING STUDENTS
Principal Investigator:	Kenneth Allen Address: 302 Rowell Building, 106 Carrigan Street, University of Vermont, Burlington VT, 05405 Telephone Number: 802.656.3265
Faculty Advisor:	Deborah Hunter Chair: *Leadership and Development Sciences*
Sponsor:	Principal Investigator

Introduction
You are being invited to participate in this study because you are a senior student in the UVM nursing program and you are either are currently participating in you senior clinical practicum or have recently completed your senior year practicum.

Why is This Research Study Being Conducted?
The purpose of this project is to examine the correlation, or lack of correlation, between indicators of college readiness (such as high school GPA, scores on standardized test, rank in class, GPA in prerequisite courses) and subsequent performance in clinic practicums

How Many People Will Take Part In The Study?
My goal is to enroll 30-40 students from the University of Vermont nursing program in this study.

What Is Involved In The Study?
Study participation will require no effort on your part. Should you provide your consent to participate in this research, your clinical preceptor will be asked to complete a survey related to your clinical performance. Additionally, a review of your initial application to the University of Vermont will be conducted by the principle investigator (Kenneth Allen) to determine and record your performance related to the preadmission indicators of college readiness. This review will be limited, to the greatest extent possible, to your admissions application record, transcript of academic work, standardized test scores and your composite score which is calculated according to a UVM proprietary algorithm from high school record and test scores. All data will remain confidential and secure. In no way will your personal information be made available to nursing faculty or anyone outside of the research team.

As a potential participant you should understand that:

- Your participation is voluntary.
- **No time or effort is required on your part.**
- You may withdraw from the study at any time.
- Collected data will be limited to this research study.
- You will not be identified by name in any product that is the result of this research.

What Are The Benefits of Participating In The Study?
There is no anticipated direct benefit to you from participating in this study. However, it is hoped that the information gained from the study will help to improve our understanding of factors which may contribute to success in clinically related health science majors and may improve our ability to assess clinical performance.

What Are The Risks and Discomforts Of The Study?
Your participation in this study does not involve any physical or emotional risk to you beyond that of everyday life; however, should you feel that you have been injured in anyway, it is important that you promptly tell the researcher. If you believe that you have been injured because of taking part in this study, you should contact Kenneth Allen in person in Rowell Building office number 302, or call him at 802.656.3265, or via email Kenneth.allen@uvm.edu.

What Other Options Are There?
You may choose not to participate in this study.

Are There Any Costs?
There are no cost to you to participate in the study.

What Is the Compensation?
Participants will receive a gift card valued at $10.

Can You Withdraw or Be Withdrawn From This Study?
You may discontinue your participation in this study at any prior to the matching of personally identifiable information from admissions and your clinical preceptor. Once the data is matched, all identifiable information will be removed, at which time it will not be possible to remove your data. Should you wish to withdraw from the study you should contact Kenneth Allen in person in Rowell Building office number 302, or call 802.656.3265, or via email Kenneth.allen@uvm.edu.

What About Confidentiality?
Your study data will be handled as confidentially as possible. If results of this study are published or presented, individual names and other personally identifiable information will not be used.

To minimize the risks to confidentiality, identifiable data will only be stored on password protected, encrypted University of Vermont servers. Should data need to be transferred via any external storage device that device will also be encrypted.

The sponsor(s) or their appointed designees as well as the Institutional Review Board and regulatory authorities will be granted direct access to your original research records for verification of research procedures and/or data.

If your record is used or disseminated for government purposes, it will be done under conditions that will protect your privacy to the fullest extent possible consistent with laws relating to public disclosure of information and the law-enforcement responsibilities of the agency.

Retaining Research Records
Once data from admissions and clinical preceptors have been matched, all identifiable data will be deleted from all storage devices. When the research is completed, I may save the de-identified data for use in future research done by myself or others. I will retain this study information for up to 3 years after the study is over. The same measures described above will be taken to protect confidentiality of this study data.

Contact Information
You may contact the Investigator, Kenneth Allen (kenneth.allen@uvm.edu), or the Dissertation Advisor, Dr. Deborah Hunter (dhunter@uvm.edu), for more information about this study. If you have any questions about your rights as a participant in a research project or for more information on how to proceed should you believe that you have been harmed as a result of your participation in this study you should contact the Director of the Research Protections Office at the University of Vermont at 802-656-5040.

Statement of Consent
You have been given and have read or have had read to you a summary of this research study. Should you have any further questions about the research, you may contact the person conducting the study at the address and telephone number given below. Your participation is voluntary and you may refuse to participate or withdraw at any time without penalty or prejudice.

You agree to participate in this study and you understand that you will receive a signed copy of this form.

____ _____________

Signature of Subject (18 yo of age or older) Date

____

Name of Subject Printed

____ ____________________________
Name of your clinical preceptor(s) Primary location (floor) of preceptor

____ __________

Signature of Principal Investigator or Designee Date

____

Name of Principal Investigator or Designee Printed

This form is valid only if the Committees on Human Research's current stamp of approval is present below.

Please indicate which incentive you would prefer:
_____ $10 gift certificate to iTunes
_____ $10 gift card to UVM Dinning Services
_____ $10 give card to Henderson's Café
_____ I decline the incentive gift

Name of Faculty Sponsor: Deborah Hunter
Address: 210C Mann Hall, University of Vermont, Burlington, VT, 05405
Telephone Number: 802.656.2030

Appendix D Leicester Clinical procedure Assessment Tool (Modified)

Welcome. You will be prompted to respond to 38 statements concerning the clinical performance of your most recent senior nursing student from the University of Vermont. You will score your student's performance according to a 10 point scale with (1) indicating complete incompetence and (10) indicating performance above that of an experience nurse. Each statement is accompanied by an example related to the statement.

Please compare the performance of your student in relation to that of an experienced nursing professional. Given that this is an assessment of students who are ready to enter the nursing profession, we expect to see variation in the level of clinical performance. We would like to know how well these students perform relative to highly competent working professionals.]

[note: first question is fill in the blank]

Please indicate the name of the student you are evaluating:

[note: from this point the following statements will be presented to the evaluator with radio buttons label 1-10.]

Worst									Best
1	2	3	4	5	6	7	8	9	10

1.0 Communication and working with the patient and/or representative

Category and component competence	Examples
1.1 Introduces self to patient and/or their family	• Introduces self by given and family name. • Establishes how patient prefers to be addressed. • Ensures the patient knows and understands the student's role.
1.2 Shares information about the procedure appropriately	• Explains the procedure in terms the patient understands.
1.3 Listens attentively	• Demonstrates listening by using appropriate body language and maintaining eye contact.

Category and component competence	Examples
1.4 Answers questions honestly	• For example 'Yes this will be uncomfortable but I will use local anesthetic to make sure it does not hurt too much'.
1.5 Checks patient's understanding	• Ask the patient 'Do you understand what I am going to do?' if the answer is no explain again using different terminology.
1.6 Obtains valid and continuing consent	• For most generic (bedside) skills this would be verbal +/- implied consent: i.e. 'May I perform this procedure on you now?' • Gives the patient a chance to withdrawn consent: 'If you want me to stop, just say so' or '[May] I continue?'
1.7 Works with the patient to maintain co-operation	• Maintains dialogue with patient throughout procedure or examination. • Gives patient clear concise instructions during procedure.
1.8 Use of communication skills	• Maintains both verbal & eye contact where possible. • Gives clear, concise and jargon free explanations.
1.9 Performs procedure in a compassionate and patient-centered manner.	• Maximizes privacy/minimizes exposure of the patient within constraints of infection. • Covers the patient after procedure or examination (if required). • Reassures the patient that the procedure or examination is complete. • Explains the next step / limitations imposed on the patient after the procedure or examination. • Thanks the patient for their co-operation after the procedure or examination is complete.

2.0 Safety

Category and component competence	Examples
2.1 Checks patient's identity correctly	• Checks verbally and with wrist band (if available) – name, unit number, date of birth and compares them with the prescription, consent form, or notes depending on the procedure to be performed.
2.2 Checks/completes request and/or documentation correctly.	• Ensures that any request form or prescription chart includes sufficient patient identification information. • Signs request forms as necessary.
2.3 Labels samples/printouts correctly.	• Ensures samples are labelled at the bedside with minimum dataset. • Provides sufficient clinical information as requested. • Labels printouts immediately with required data.
2.4 Applies procedure-specific safety measures correctly.	• Check to see if you are likely to encounter any difficulties e.g. difficult veins or abnormal anatomy in patient for urinary catheter. • If problems are anticipated, seeks advice from supervisor before continuing.
2.5 Is aware of limitations of personal competence and role, and acts appropriately.	• Does not undertake any procedure beyond competence level. • If unsure of ability to perform a procedure, requests assistance/input from supervisor before continuing. • If unexpected difficulties are experienced, seeks assistance from a supervisor. • Seeks to reassure patient if assistance is required.
2.6 Maximizes own and others' safety.	• Undertakes procedure in an appropriate clinical environment. • Utilizes safety devises as appropriate.

Category and component competence	Examples
2.7 Offers appropriate post-procedure care to the patient.	• Explains what the patient needs to do following the procedure (You can wash the wound in warm soapy water in x days). • Explains likely consequences of procedure to patient and their expected duration. • Explains likely time-course e.g. time required for results to be available... • Explains how to seek further advise if necessary.

3.0 Infection Prevention

Category and component competence	Examples
3.1 Washes and/or decontaminates hands.	• Washes hands or employs alcohol rub correctly.
3.2 Prepares patient's skin appropriately	• Employs appropriate skin cleansing agent and procedure according to policy
3.3 Uses anti-infection barriers as required.	• Uses sterile gloves if required for procedure. • Uses non-sterile gloves to protect from body fluids. • Uses apron when necessary. • Uses a mask if indicated for precaution level.
3.4 Displays appropriate practice of aseptic technique.	• Plans procedure to maintain asepsis. • Employs procedure-appropriate methods to maintain asepsis e.g. urinary catheterization. • Maintains a sterile field with strict separation of sterile and potentially contaminated items. • Takes care with placement of potentially contaminated items.
3.5 Disposes of waste appropriately	• Disposes of sharps promptly and safely. • Disposes of clinical waste appropriately. • Takes personal responsibility for disposal of waste from procedures as necessary.
3.6 Optimizes infection prevention within environmental limitations	• Maintains hygienic practice between patients before & after procedures. • Uses skin cleansing agents as local protocol dictates.

4.0 Procedural Competence

Category and component competence	Examples
4.1 Assesses the patient appropriately	• Checks patient's ability to give valid consent. • Anticipates potential difficulties with encounters.
4.2 Appropriately assesses the indications for and contra- indications to the proposed procedure	• Checks for contra-indications to procedure e.g. patient with dialysis fistula or absent ulnar artery for blood gases, ' • As necessary, asks questions such as, 'Does this patient have renal or liver impairment?'.' • Considers allergies.
4.3 Plans the procedure with respect to patient factors	• Preferable to insert IV cannula in patient's non-dominant arm away from a joint. • Checks for presence of infusions before venipuncture. • Checks for pain before initiating an examination. • Checks for contraindication to lying flat during an examination or procedure e.g. breathlessness.
4.4 Prepares the patient appropriately	• Provides an adequate clear concise jargon free explanation to the patient. • Positions and exposes the patient correctly.
4.5 Selects and checks equipment, disposables, and consumables	• Plans the procedure by 'thinking it though' to identify the equipment and disposables needed. • Collects all necessary equipment and disposables before starting the procedure. • Checks all equipment (e.g. correct needle or catheter) and its expiry dates.

Category and component competence	Examples
4.6 Performs procedure fluently	• Undertakes the steps of the procedure or examination in a logical order; avoid retracing steps. • Maximizes the patient's confidence in student's ability.
4.7 Displays familiarity with equipment	• Undertakes any necessary checks of equipment before commencing the procedure or examination. • Rehearses the use of the equipment before the procedure.
4.8 Displays knowledge of the procedure.	• Ensures that they are aware of why a particular procedure is needed, of contraindications to it, and or problems which may arise during or after. • Inspires confidence in the patient when answering questions.
4.9 Uses assistance appropriately.	• Employs a chaperone when indicated. • Requests assistance to aid in transportation
4.10 Handles samples/ensures quality control of outputs correctly.	• When using equipment, ensures the settings are correct e.g. ECG machine, intravenous pumps. • If available/appropriate use test/calibration function. • Takes the necessary steps to prevent contamination e.g. follow order of draw for blood samples. • Follows protocols appropriately. • Minimize handling of samples. • Check that samples/outputs are correctly labelled before leaving the bedside.

4.11 Deals appropriately and sensitively with the evolving situation	• Reassures patient when necessary, including if difficulties arise, or if abnormal findings emerge. • Requests assistance from supervisor when necessary. • Responds to patient needs quickly and efficiently (e.g. lying patient down if s/he feels faint).
4.12 Demonstrates respect for tissue	• Take steps to minimize tissue damage. • Handle samples according to local protocols.

5.0 Team Work

Category and component competence	Examples
5.1 Displays understanding and respect for the roles of team members	• Respects roles of all team members in relation to procedure e.g. BLS, ACLS.
5.2 Communicates effectively with the team	• Records that the procedure was performed immediately after performing it. • Includes necessary information regarding further management. • Shares information regarding procedure with team members involved in caring for the patient e.g. handover in BLS or ALS. • Indicates any special considerations relating to the patient with other team members. • Shares indications for further action with members of the team verbally and by recording them in the patient's notes.
5.3 Leaves clinical area clean and tidy.	• Clears used equipment away and dispose of it appropriately.
5.4 Documents procedure correctly	• Records procedure or examination in patient notes together with indications and any triggers for further action. • Sign & date all entries as appropriate. • Notes indicate all relevant information.

Appendix E Email Request to Clinical Preceptors

Subject: UVM Nursing Research Request

Dear <name>, my name is Kenneth Allen. I am conducting a research project titled:

AN EXAMINATION OF CORRELATION BETWEEN PREADMISSION INDICATORS OF COLLEGE READINESS AND CLINICAL PERFORMANCE OF NURSING STUDENTS

You have been selected to participate in this research project because you have been identified by a senior nursing student at UVM as his/her preceptor. < name> has provided consent for me to contact you to request that you complete an assessment of final semester clinical performance. You are not the subject of this research, but your input is critical to the success of this project. My request is that you would complete this https://survey.uvm.edu/index.php/795886/lang-en assessment of <name> in her senior clinical practicum.

The assessment is composed of 38 short questions and should require approximately 15 to 30 minutes to complete. You may complete a portion of the survey then return later to complete it. This survey utilizes one of only a few validated assessment tools related to clinical nursing. Your input will allow us a first time look at the utility of this tool in the assessment of nursing student's clinical performance.

Please note that the results of your assessment will remain strictly confidential. Assessments will not be shared with anyone outside of the research team including nursing department faculty.

At the conclusion of the assessment you will be given the opportunity to inter you name and receive a **gift certificate valued at $20**. Should you encounter any problems related to this survey or have any questions, please contact me at Kenneth.Allen@uvm.edu. Thank you in advance for your participation in this survey.

Appendix F GPA Conversion Table

Table A1: *GPA Conversion Table*

Letter Grade	Percent Grade	4.0 Scale
A+	97-100	4.0
A	93-96	4.0
A-	90-92	3.7
B+	87-89	3.3
B	83-86	3.0
B-	80-82	2.7
C+	77-79	2.3
C	73-76	2.0
C-	70-72	1.7
D+	67-69	1.3
D	65-66	1.0
E/F	Below 65	0

CollegeBoard (2016).

Appendix G   Distribution of Pre-admission Composite Scores

Table A2: *Distribution of Composite Scores for Students Initially Enrolled in 2012 B.S. in Nursing Major**

Composite score	Number of enrolled students
4	11
5	23
6	29
7	18
8	14
9	4

*includes students who withdrew from the major or who were dismissed from the major

Associate Director of Admissions, Personal Communication, December 3, 2015.

Appendix H   Normality Test Components of Clinical Performance

Table A3: *Shapiro-Wilk Test of Normality for Components of Clinical Performance*

Component	df	Statistic	p
Communication	29	.919	.029
Safety	29	.883	.004
Infection Prevention	29	.799	.000
Procedural Competence	29	.909	.017
Teamwork	29	.904	.012

$\alpha = 0.05$

Appendix I Q-Q Plots Related to the Components of Clinical Performance.

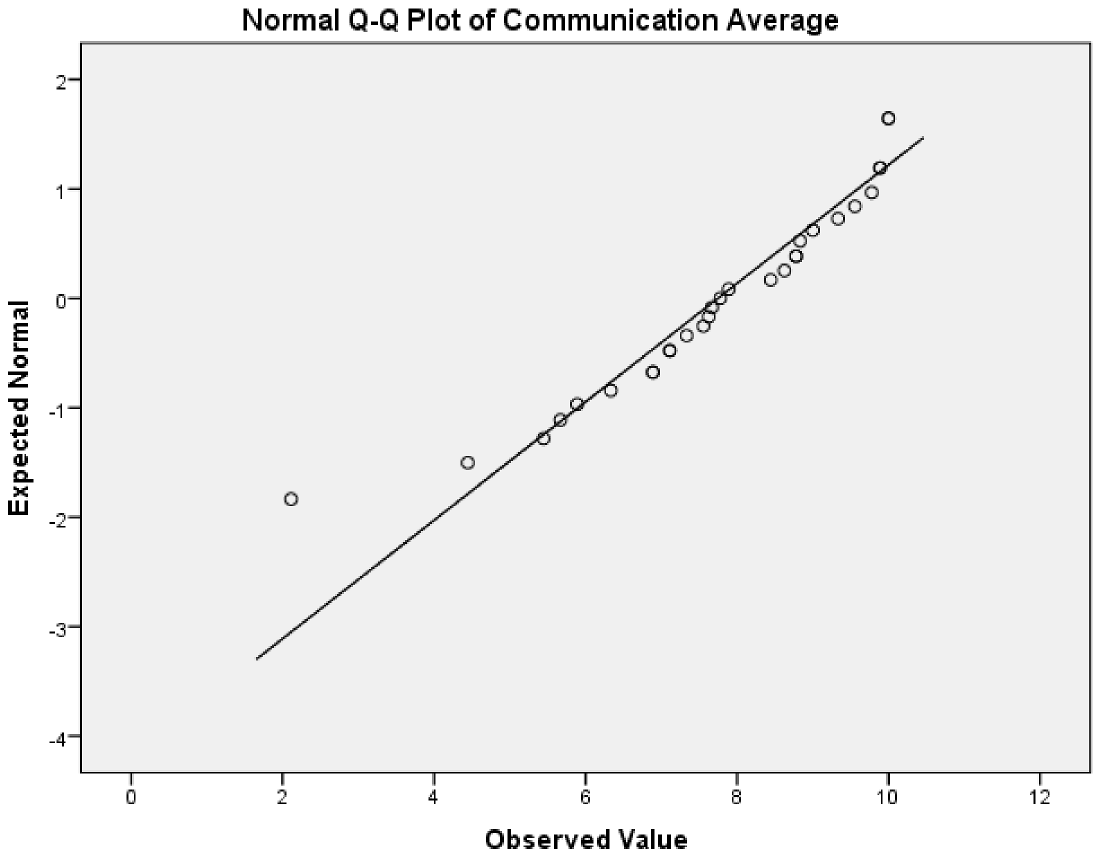


Figure A 3. Q-Q normality lots of expected vs observed values for average scores on communication items. Close adherence to the reference line indicates a normal distribution. Deviations from the reference line indicate the values where the assumption of normality are not meet

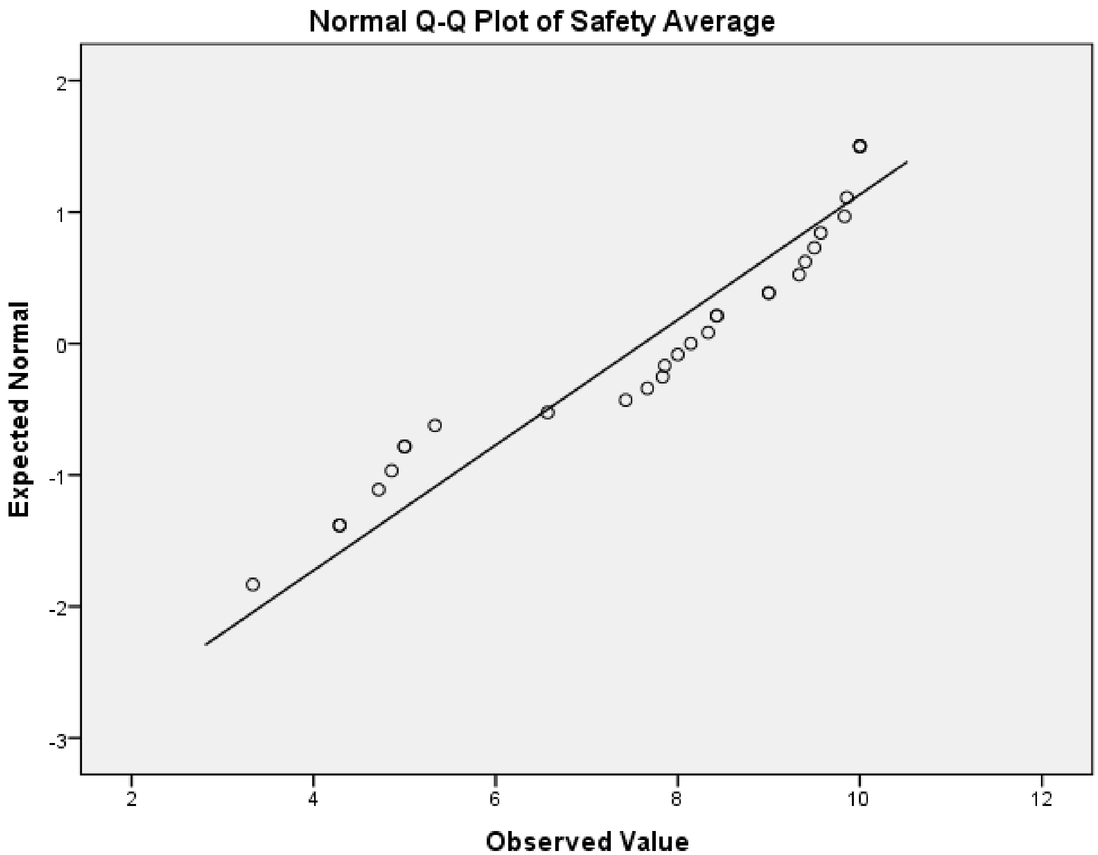


Figure A 4. . Q-Q normality plots of expected vs observed values for average scores on safety items. Close adherence to the reference line indicates a normal distribution. Deviations from the reference line indicate the values where the assumption of normality are not meet.

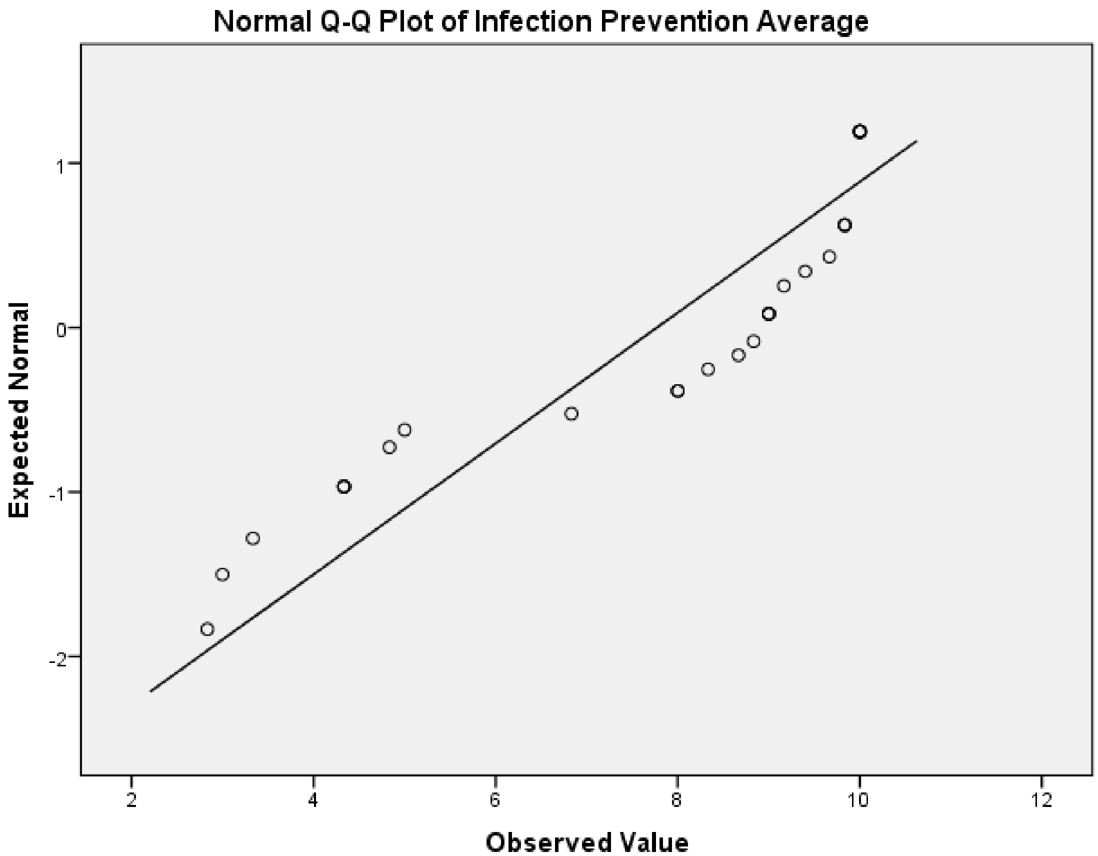


Figure A 5. Q-Q normality plots of expected vs observed values for average scores on infection prevention items. Close adherence to the reference line indicates a normal distribution. Deviations from the reference line indicate the values where the assumption of normality are not meet.

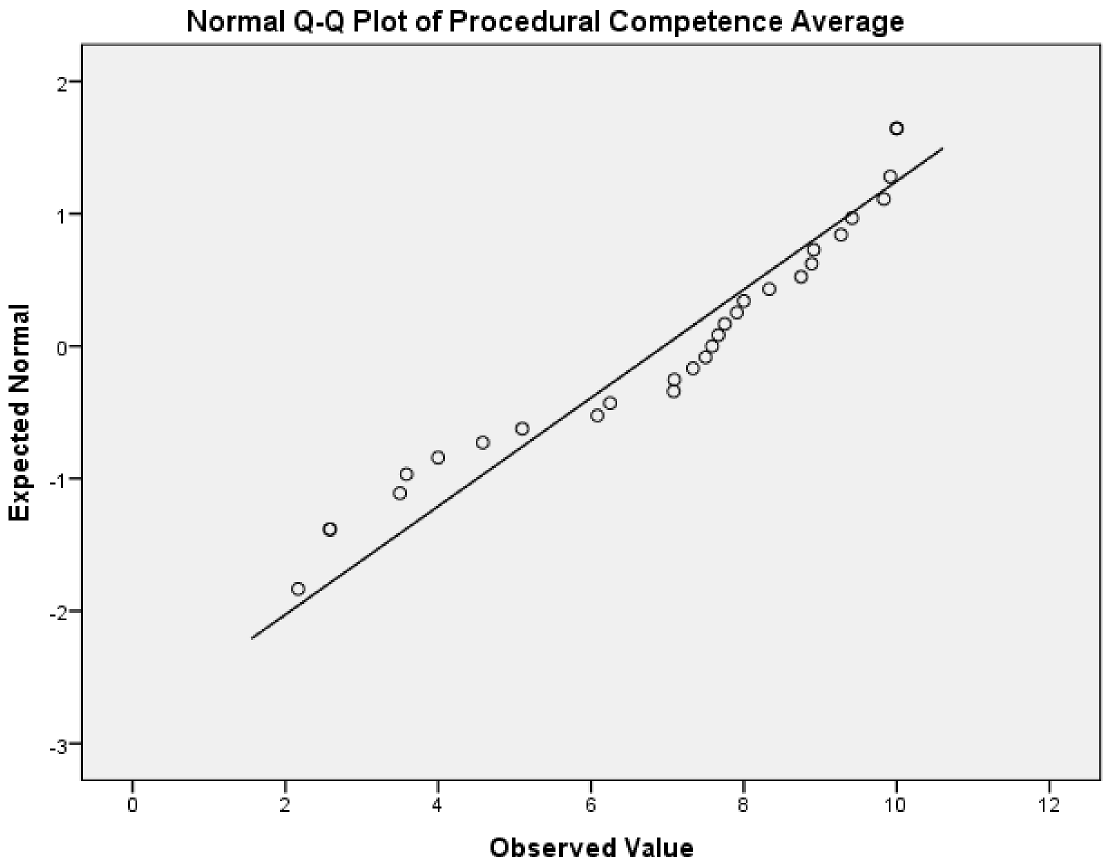


Figure A 6. Normality plots of expected vs observed values for average scores on procedural competence items. Close adherence to the reference line indicates a normal distribution. Deviations from the reference line indicate the values where the assumption of normality are not meet.

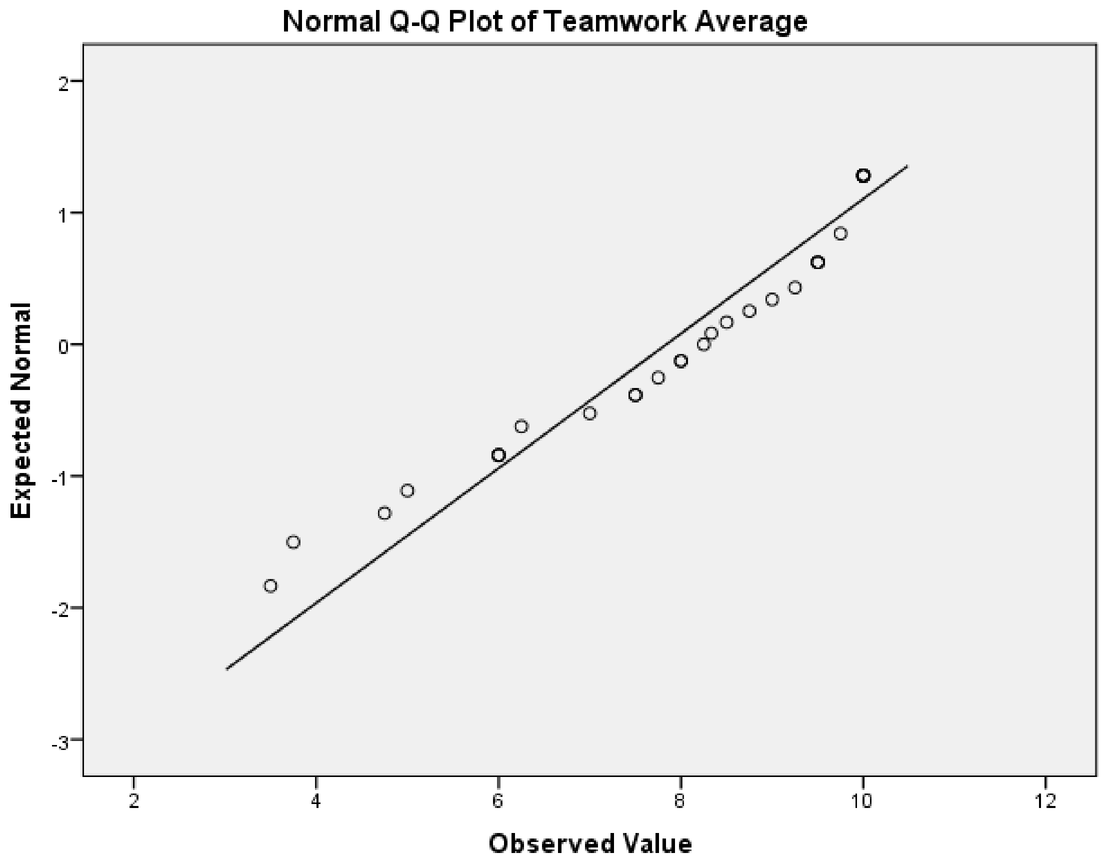


Figure A 7. Q-Q Normality plots of expected vs observed values for average scores on team work items. Close adherence to the reference line indicates a normal distribution. Deviations from the reference line indicate the values where the assumption of normality are not meet.

Appendix J Global Clinical Composite Score Distributions

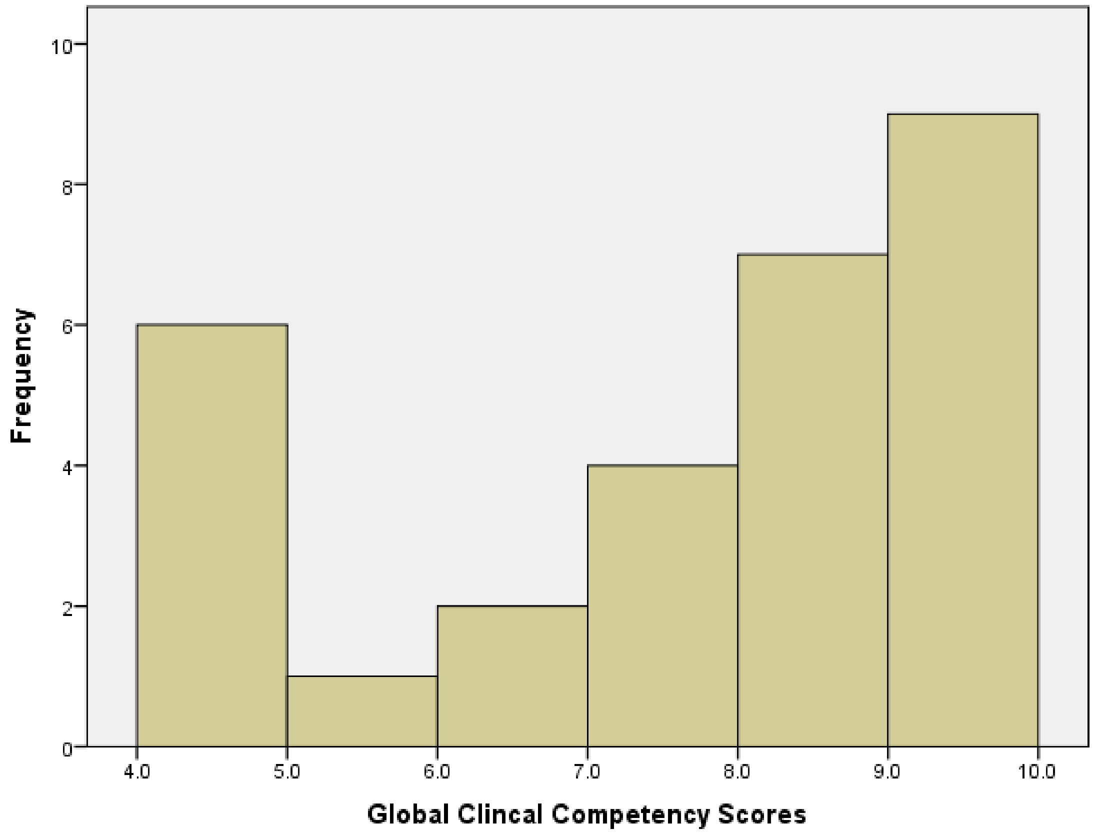


Figure A 8. Histogram of student's global clinical composite scores. A roughly bi-modal distribution with a lack of normality is noted throughout.

Table A4: *Shapiro-Wilk Test of Normality of Global Clinical Composite Scores*

Component	df	Statistic	p
Global clinical composite score	29	.876	.003

At $\alpha = 0.05$, the p value provides evidence to reject the Null hypothesis that the values are normally distributed.

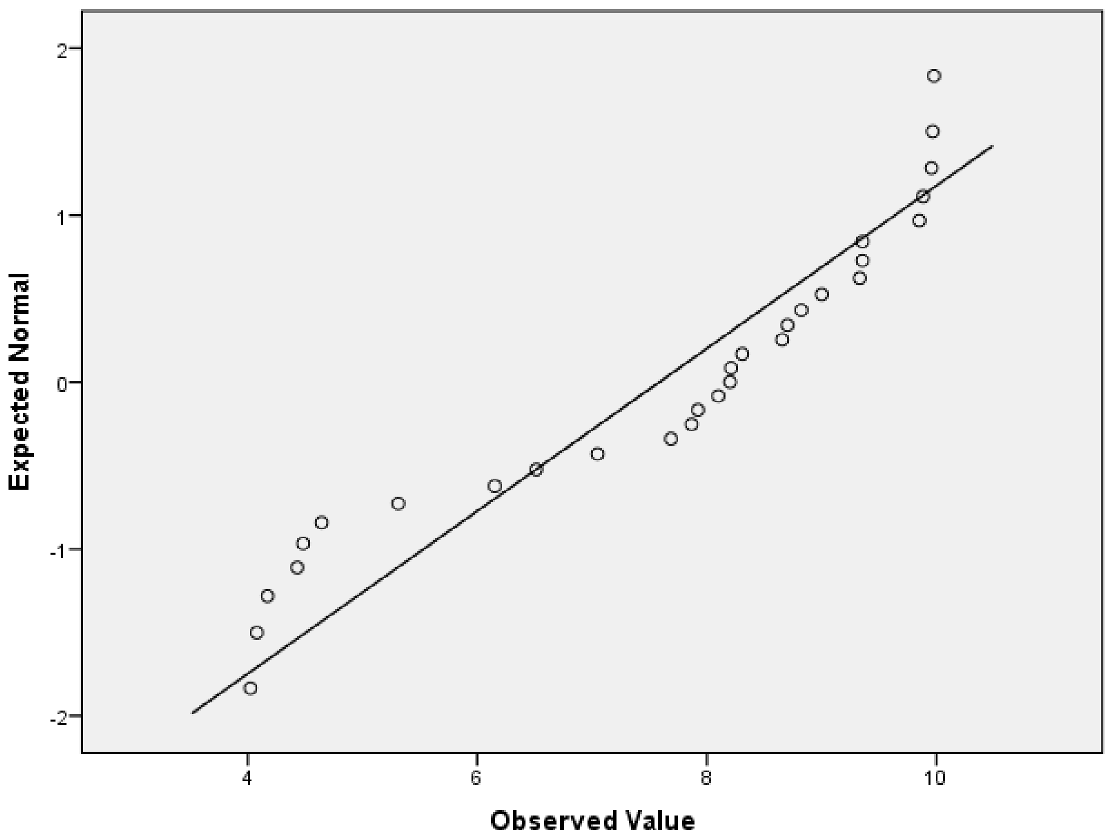


Figure A 9. Q-Q normality plots of expected vs observed value for student's global clinical composite scores. Close adherence to the reference line indicates a normal distribution. Deviations from the reference line indicate the values where the assumption of normality are not meet. Note the lack of normality throughout the distribution.

Appendix K   Test of Assumptions Five Variable Model

Table A5: *Test of Assumptions Five Variable Model*

Coefficients[a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
(Constant)	-12.665	31.146		-.407	.695		
Rank in class	.111	.319	.244	.349	.736	.210	4.754
High school GPA	1.657	3.122	.221	.531	.610	.595	1.680
ACT scores	.145	.742	.150	.196	.850	.177	5.659
Pre-admission composite	-.492	1.241	-.357	-.397	.702	.127	7.865
GPA select courses	1.255	2.757	.201	.455	.661	.529	1.891

a. Dependent Variable: global clinical composite scores

No predictor variable is statistically significant at $\alpha = 0.05$.

Tolerance values of less than .5 indicate a potential problem with collinearity.

Appendix L Test of Assumptions Three Variable Model

Table A6: *Test of Assumptions Three Variable Model*

Coefficients[a]							
	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	10.246	6.494		1.578	.128		
High school GPA	1.025	1.734	.140	.591	.560	.738	1.356
ACT scores	-.215	.218	-.219	-.988	.333	.847	1.181
GPA select courses	-.291	1.139	-.056	-.255	.801	.859	1.164

a. Dependent Variable: global clinical composite scores

No predictor variable is statistically significant at $\alpha = 0.05$.

Tolerance values indicate that no remaining variables have a collinear relationship.

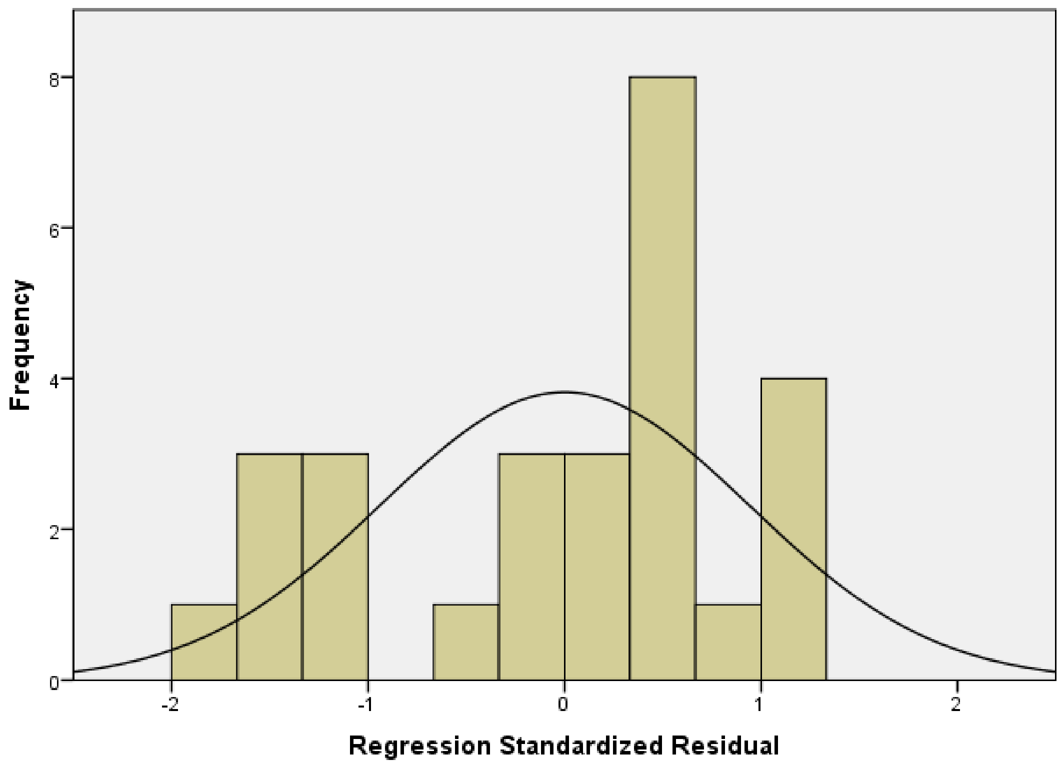


Figure A 10. Histogram of residuals from the three predictor model. Predictor variables of cumulative high school GPA, ACT scores, GPA in select courses and global clinical composite scores as the criterion.

Table A7: *Shapiro-Wilk Test of Normality for Residuals of Three Predictor Model. Predictor Variables of Cumulative High School GPA, ACT Scores, GPA in Select Courses with Global Clinical Composite Scores as the Criterion*

Component	df	Statistic	p
Standardized Residuals	27	.881	.005

At α = 0.05, the p value provides evidence to reject the Null hypothesis that the values are normally distributed.

Appendix M Distribution of Transformed Global Clinical Composite Scores

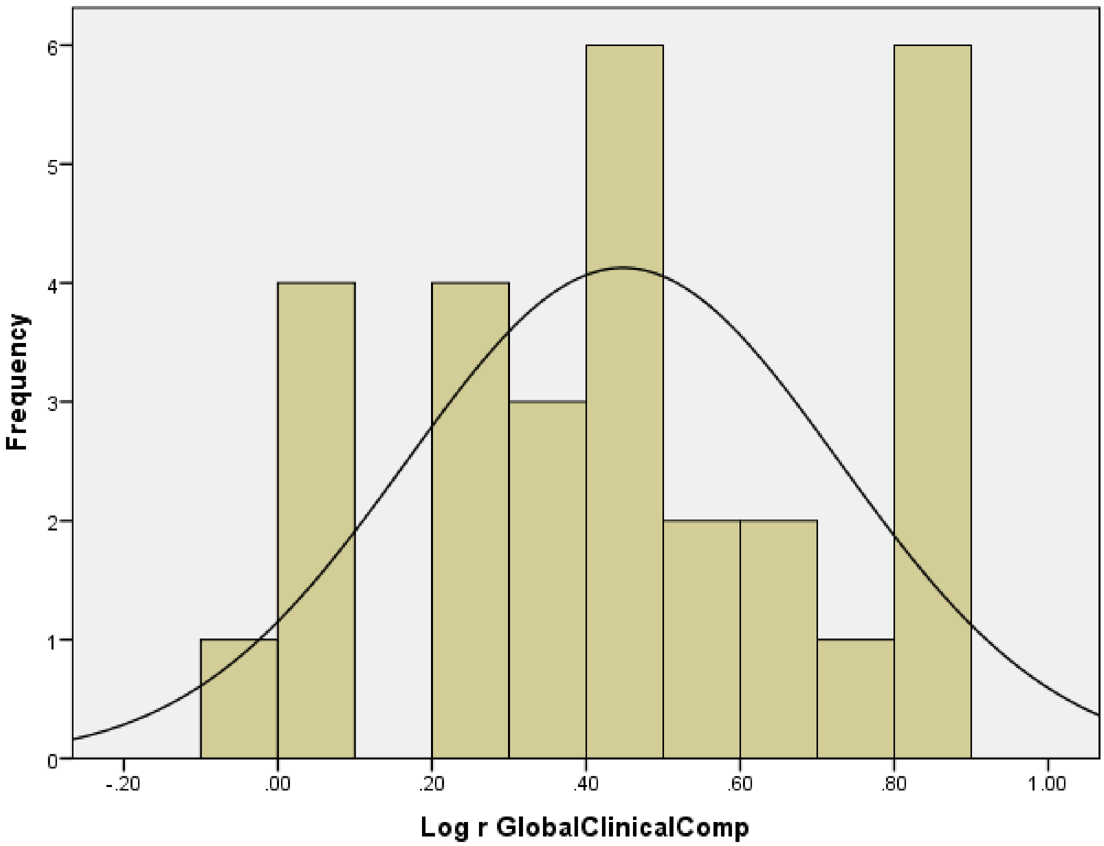


Figure A 11. Histogram of distributions of transformed global clinical composite scores.

Table A8: *Shapiro-Wilk Test of Normality for Transformed Global Clinical Composite Scores*

Component	df	Statistic	p
Standardized Residuals	29	.929	.053

At α = 0.05, the p value fails to provide evidence to reject the Null hypothesis that the values are normally distributed.

Appendix N Test of Assumptions Three Predictor Variables LrGCCS.

Table A9: *Test of Assumptions Three Variable Model with Transformed Global Clinical Composite Scores as Criterion*

Coefficients[a]							
	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	-.397	.872		-.456	.653		
High school GPA	-.059	.233	-.059	-.254	.802	.738	1.356
ACT scores	.040	.029	.300	1.380	.181	.847	1.181
GPA select courses	.012	.153	.017	.081	.937	.859	1.164

a. Dependent Variable: Transformed global clinical composite scores

No predictor variable is statistically significant at $\alpha = 0.05$.

Tolerance values indicate that no remaining variables have a collinear relationship.

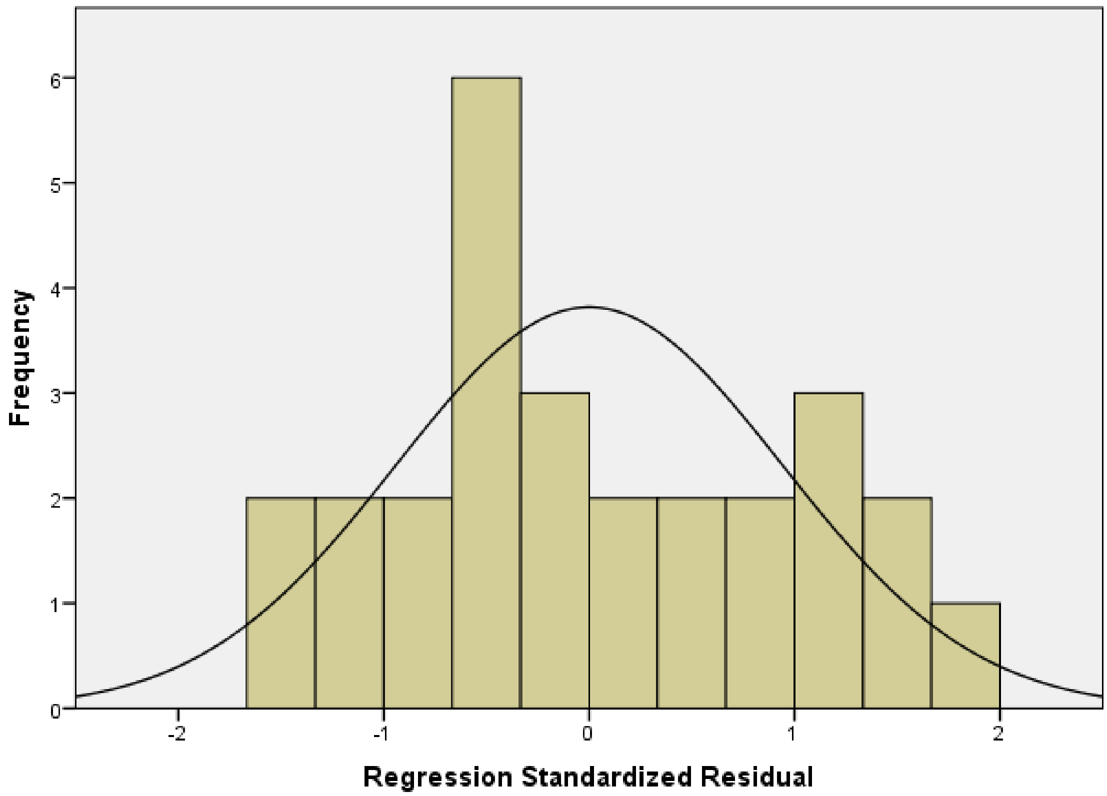
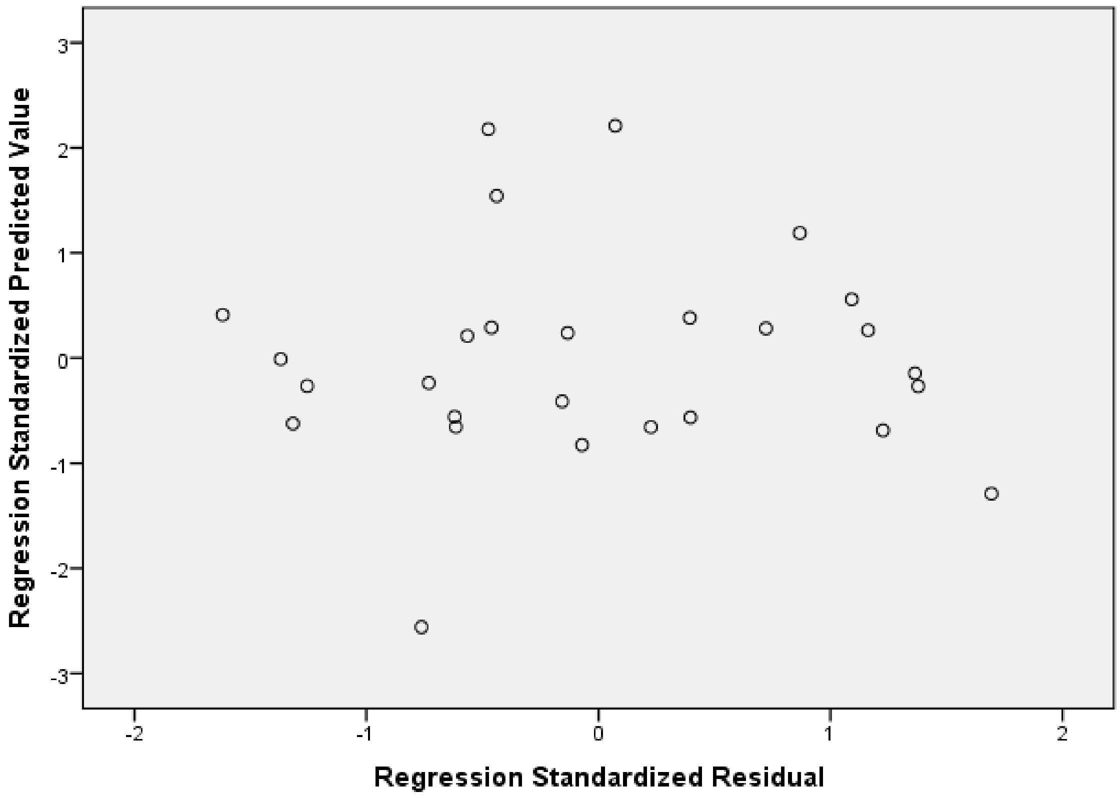


Figure A 12. Histogram of residuals from the three predictor model. Predictor variables of cumulative high school GPA, ACT scores, GPA in select courses and transformed global clinical composite scores as the criterion.

Table A10: *Shapiro-Wilk Test of Normality for Residuals of Three Predictor Model. Predictor Variables of Cumulative High School GPA, ACT Scores, GPA in Select Courses and Transformed Global Clinical Composite Scores as the Criterion*

Component	df	Statistic	p
Standardized Residuals	27	.959	.342

At $\alpha = 0.05$, the p value fails to provide evidence to reject the Null hypothesis that the values are normally distributed.


Regression Standardized Predicted Value
3
2
1
0
-1
-2
-3
-2
-1
0
1
2
Regression Standardized Residual

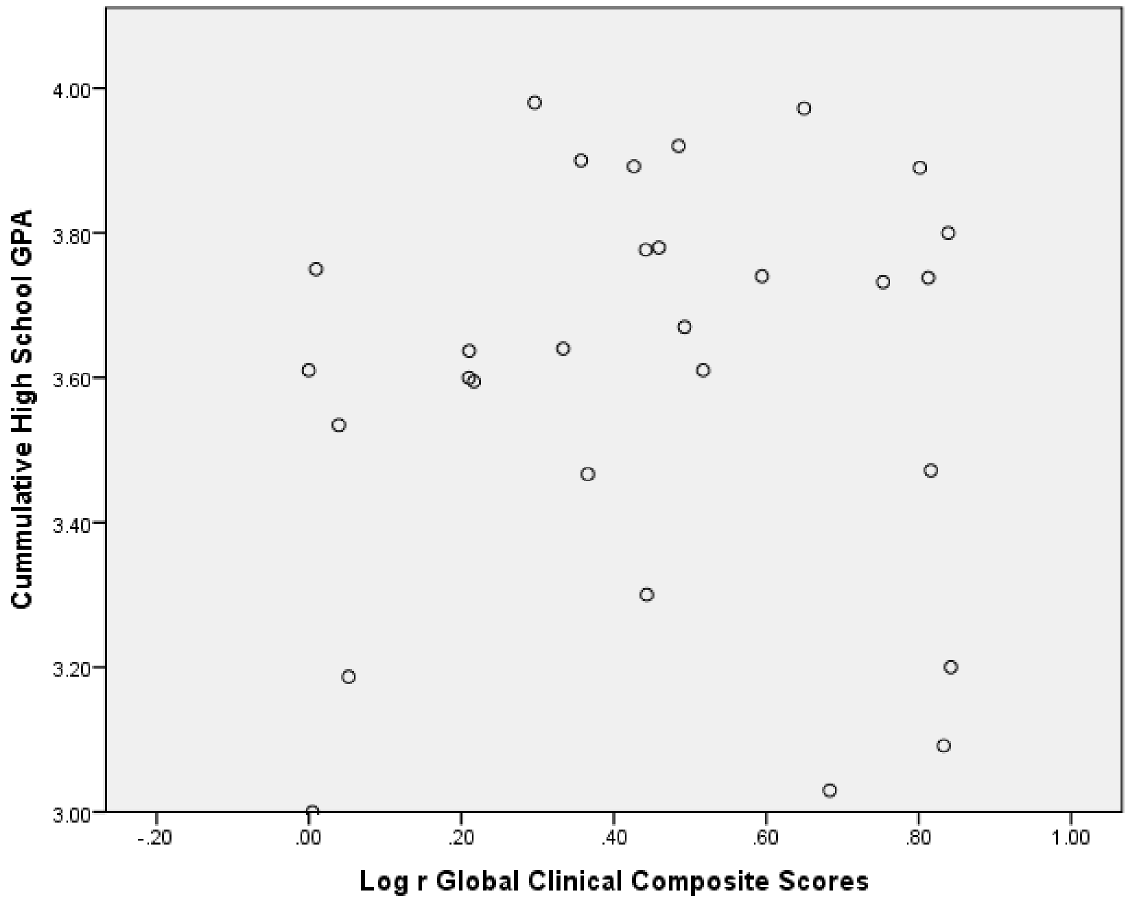


Figure A 13. Linearity between cumulative high school GPA and transformed global clinical composite scores.

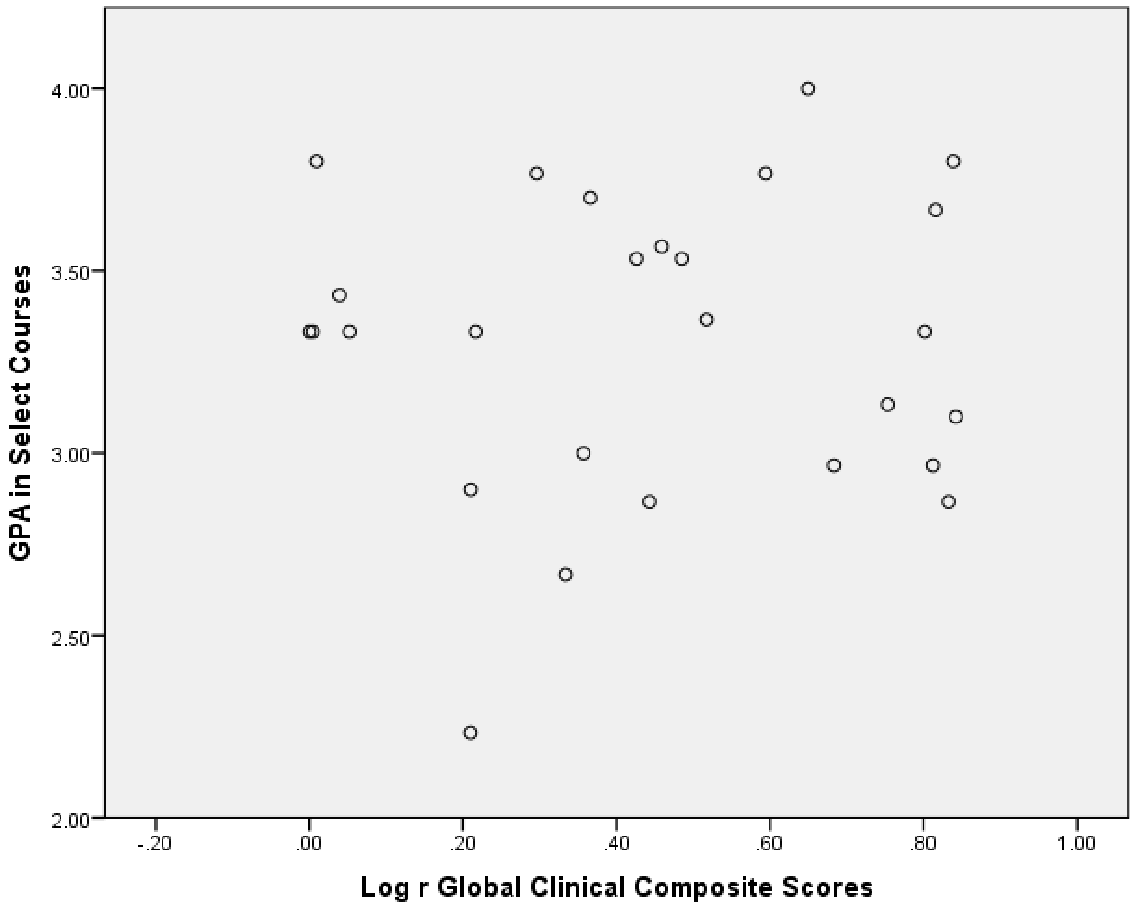


Figure A 14. Linearity between GPA in select courses and transformed global clinical composite scores.

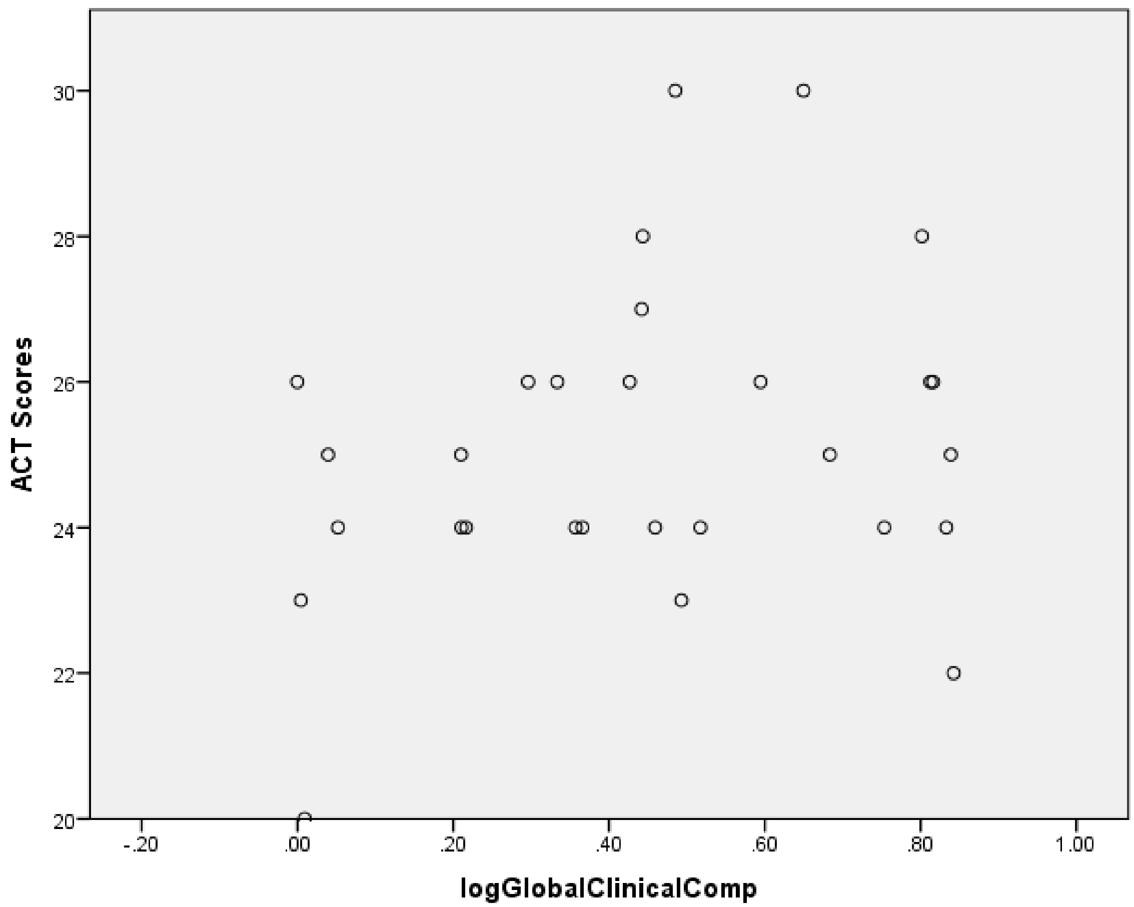


Figure A 15. Linearity between ACT scores and transformed global clinical composite scores.

Appendix O   Distribution of Student's Rank in High School Class

Table A11: *Shapiro-Wilk Test of Normality for Rank in High School Class*

Component	df	Statistic	p
Rank in HS Class	15	.901	.099

At $\alpha = 0.05$, the p value fails to provide evidence to reject the Null hypothesis that the values are normally distributed.

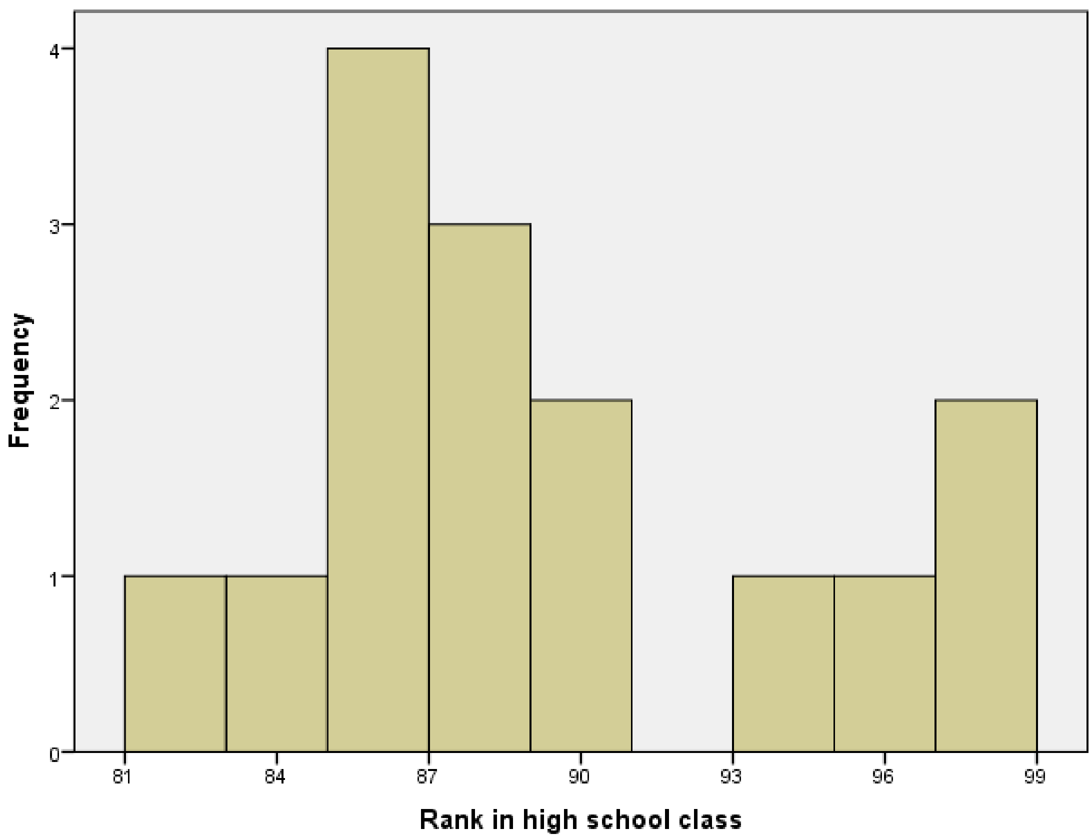


Figure A 16. Histogram of student's rank in high school class.

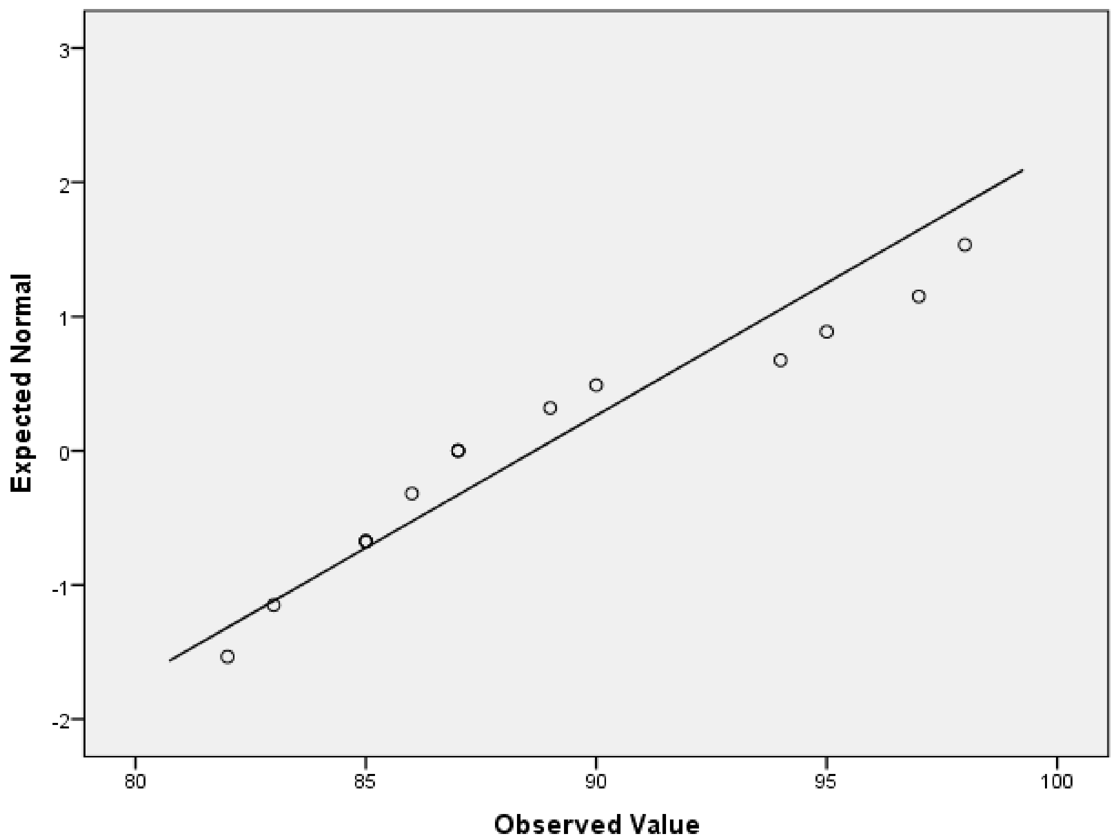


Figure A 17. Normal Q-Q plot of expected versus observed values for student's rank in high school class.

Appendix P Distribution of Transformed Global Clinical Composite Scores

Table A12: *Shapiro-Wilk Test of Normality for Cumulative High School GPA*

Component	df	Statistic	p
Cumulative High School GPA	29	.911	.018

At α = 0.05, the p value provides evidence to reject the Null hypothesis that the values are normally distributed.

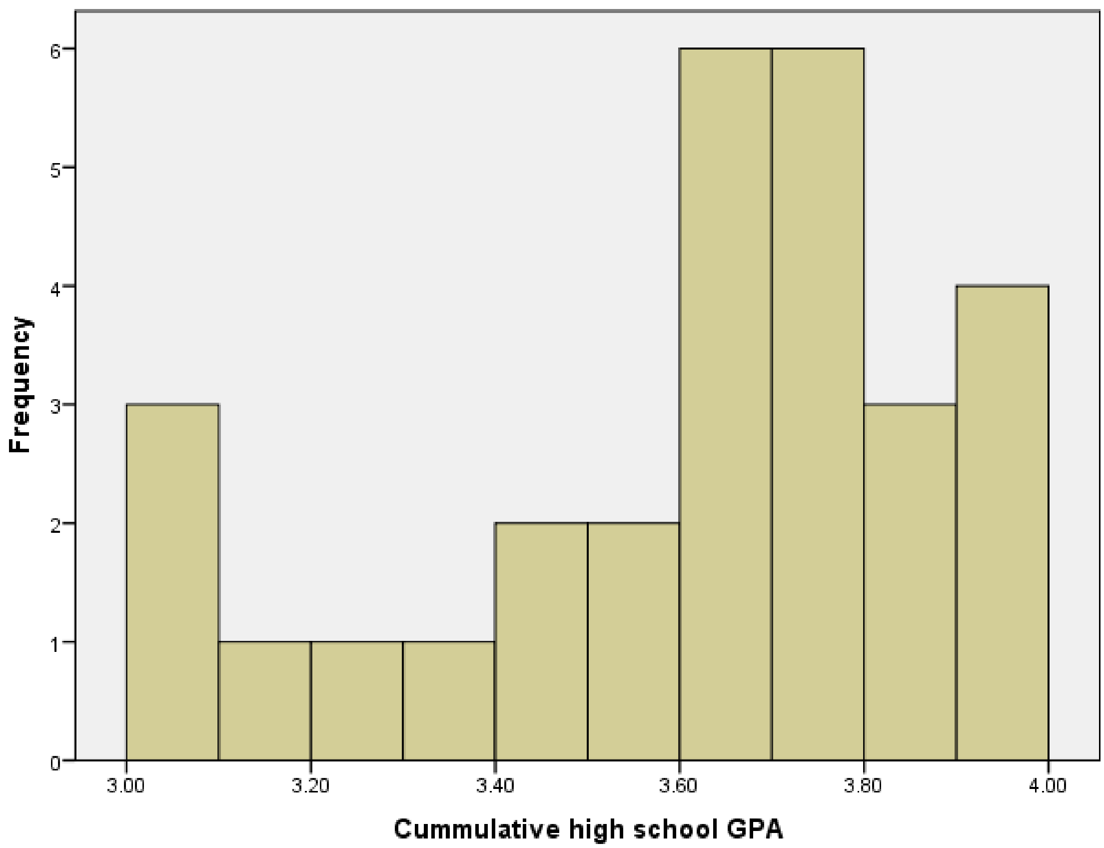


Figure A 18. Histogram of student's cumulative high school GPAs.

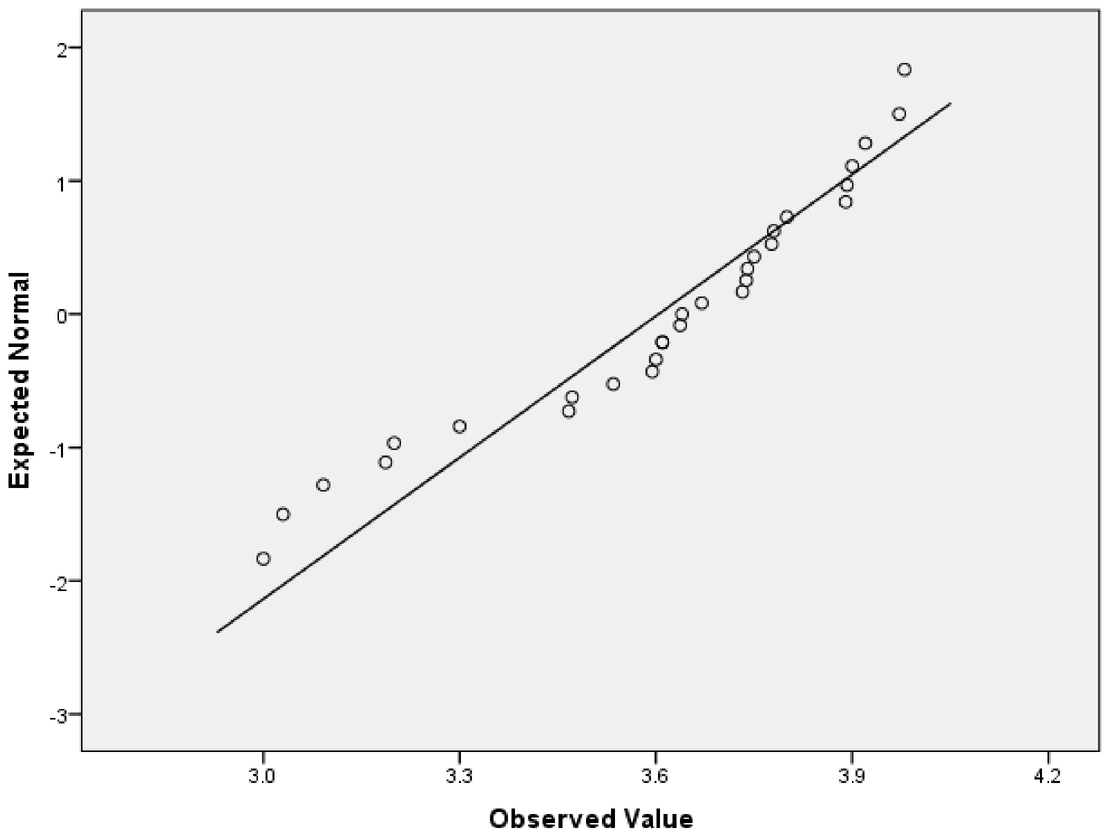


Figure A 19. Normal Q-Q plot of student's expected versus observed values of cumulative high school GPA.

Appendix Q   Distribution of ACT Scores

Table A13: *Shapiro-Wilk Test of Normality for ACT Scores*

Component	df	Statistic	p
ACT Scores	29	.936	.081

At $\alpha = 0.05$, the p value fails to provide evidence to reject the Null hypothesis that the values are normally distributed.

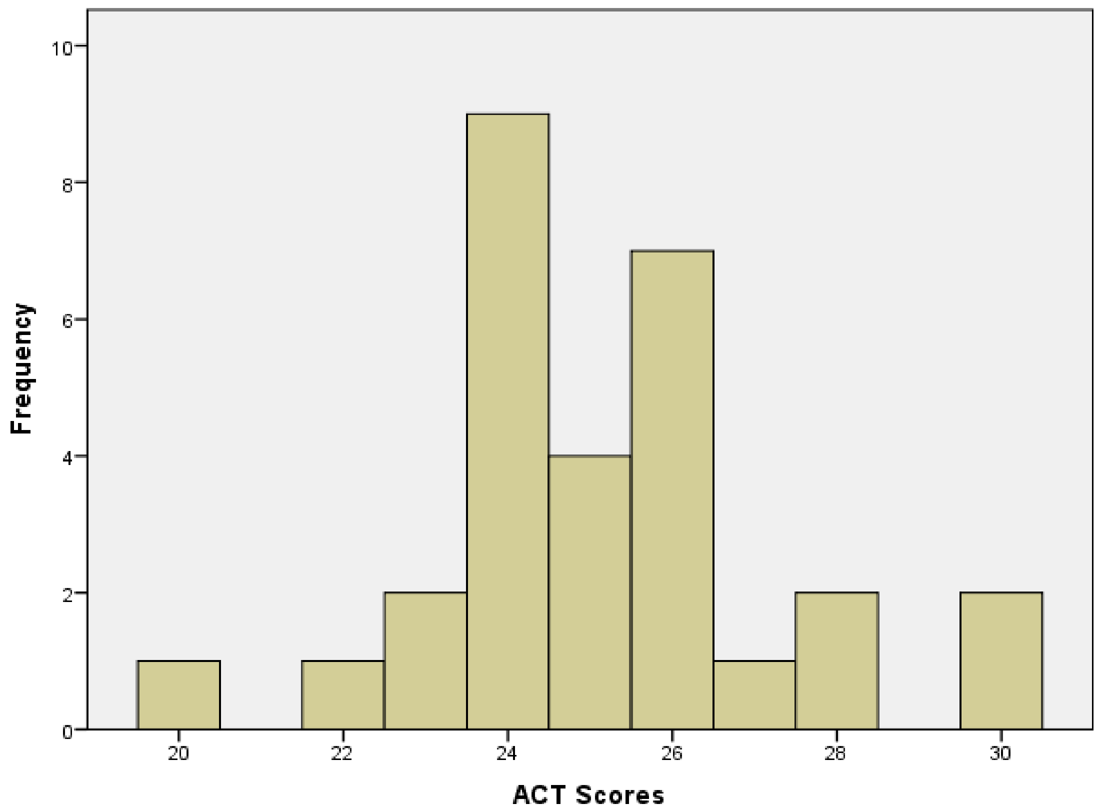


Figure A 20. Histogram of student’s ACT scores.

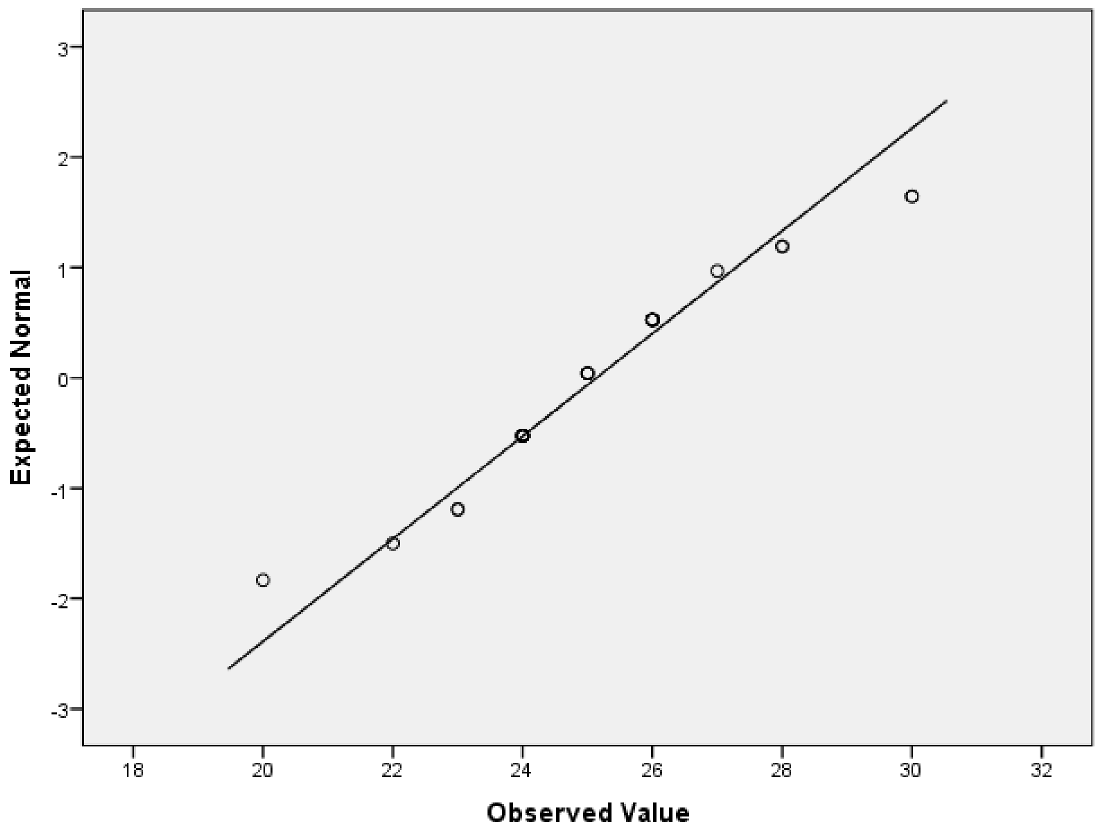


Figure A 21. Normal Q-Q plots of student's expected ACT scores versus observed ACT scores.

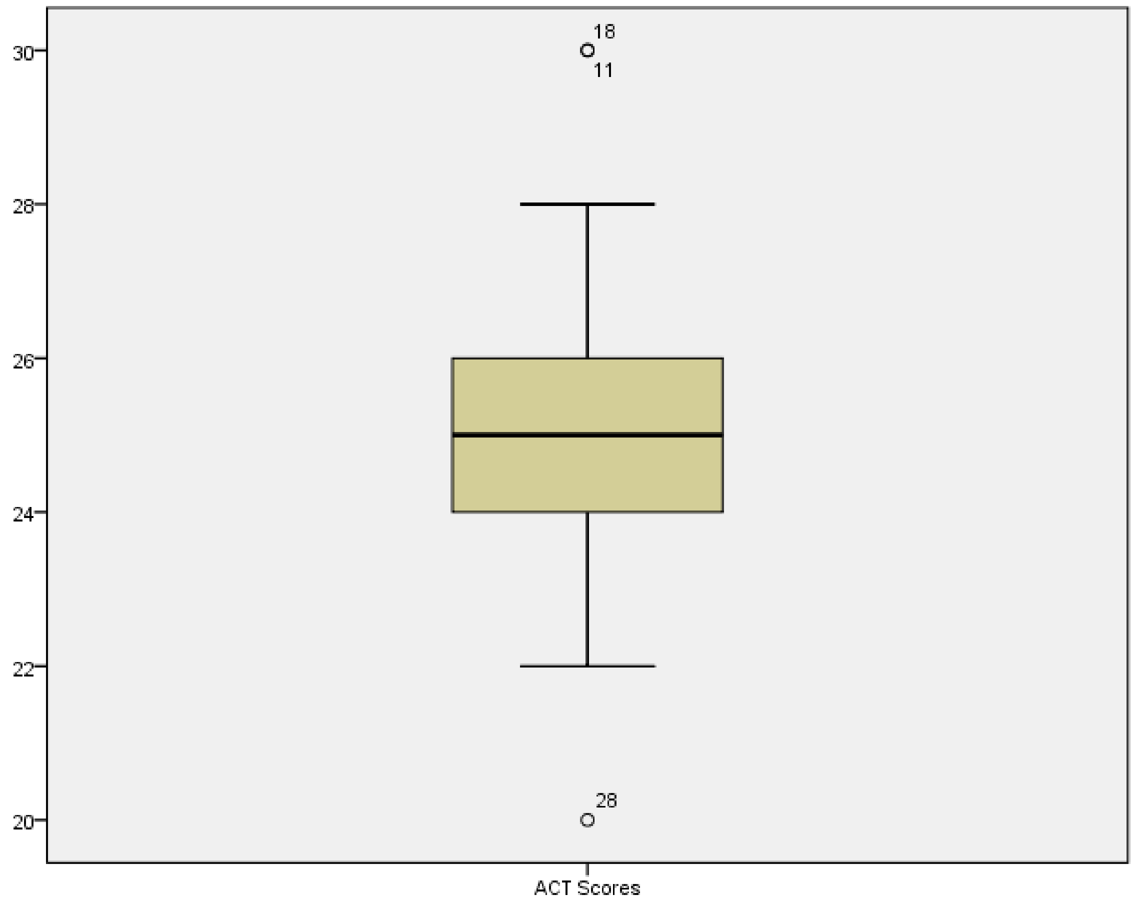


Figure A 22. Box plots of students ACT scores. Note the relatively normal distribution and three outliers (e.g. one one the lower and two on the upper end of the scale).

Appendix R Distribution of Students GPA in Selected Courses

Table A14: *Shapiro-Wilk Test of Normality for GPA in Select Courses*

Component	df	Statistic	p
GPA in Select Courses	29	.961	.399

At α = 0.05, the p value fails to provide evidence to reject the Null hypothesis that the values are normally distributed.

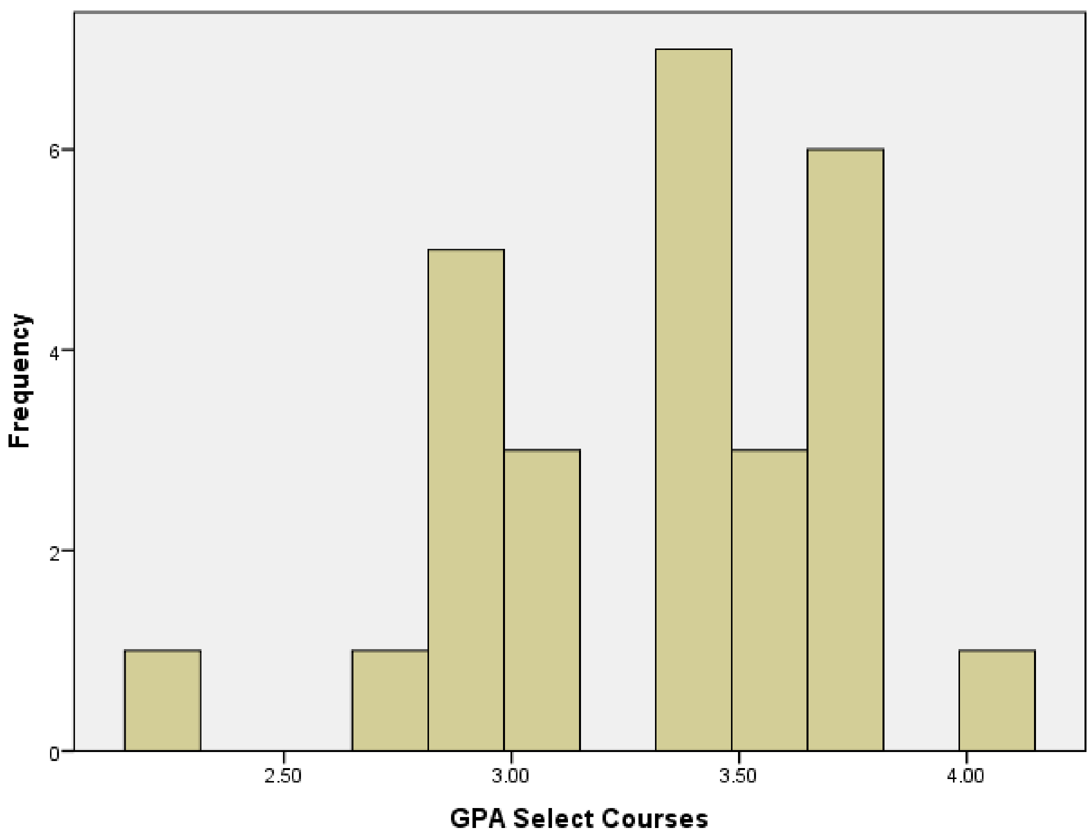


Figure A 23. Histogram of student's GPA in select courses.

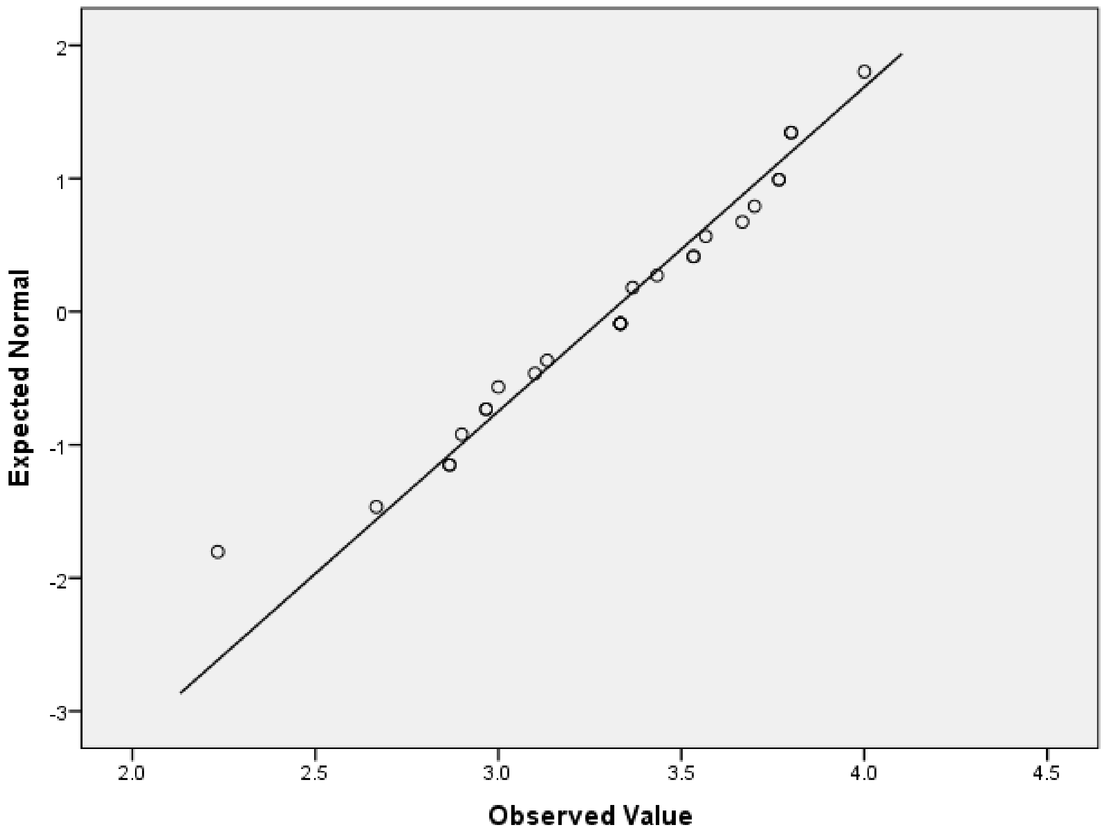


Figure A 24. Normal Q-Q plots of student's expected GPAs in select courses versus observed GPAs in select courses.

Appendix S Distribution of Student's Pre-admission Composite Scores

Table A15: *Shapiro-Wilk Test of Normality for Pre-admission Composite Scores*

Component	Df	Statistic	p
Global clinical composite score	29	.939	.092

At α = 0.05, the p value fails to provide evidence to reject the Null hypothesis that the values are normally distributed.

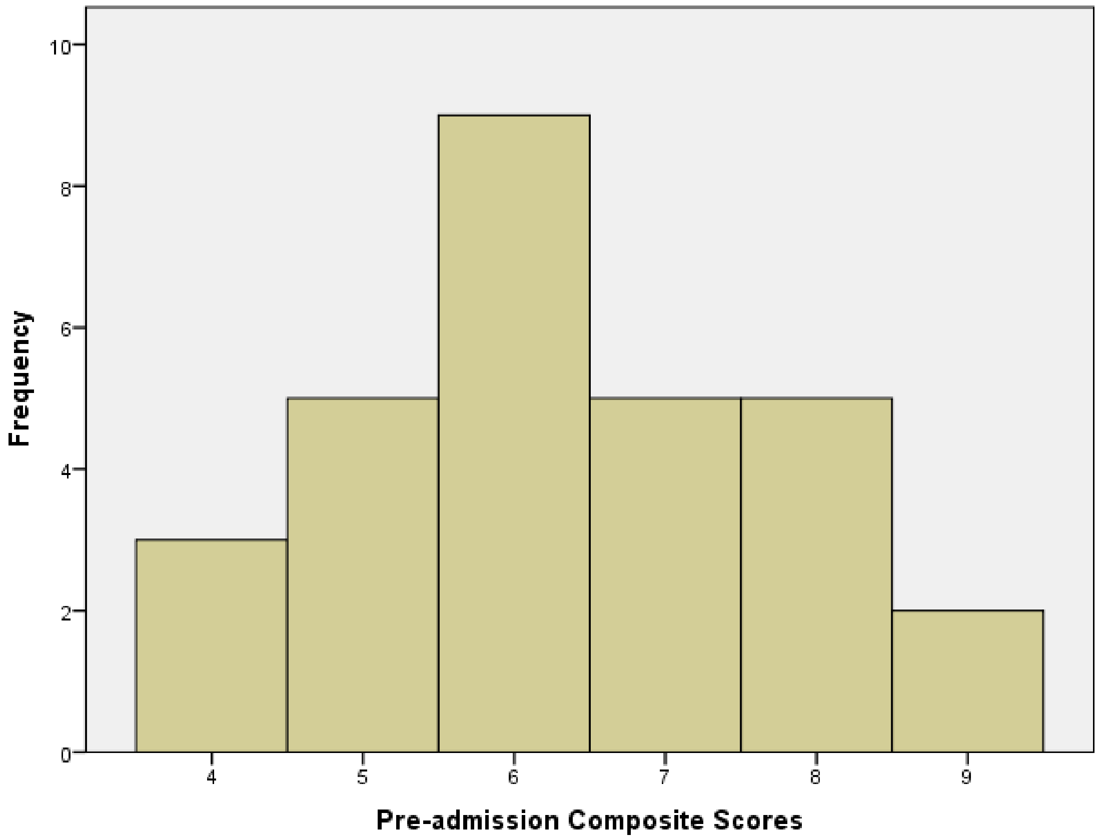


Figure A 25. Histogram of student's pre-admission composite scores.

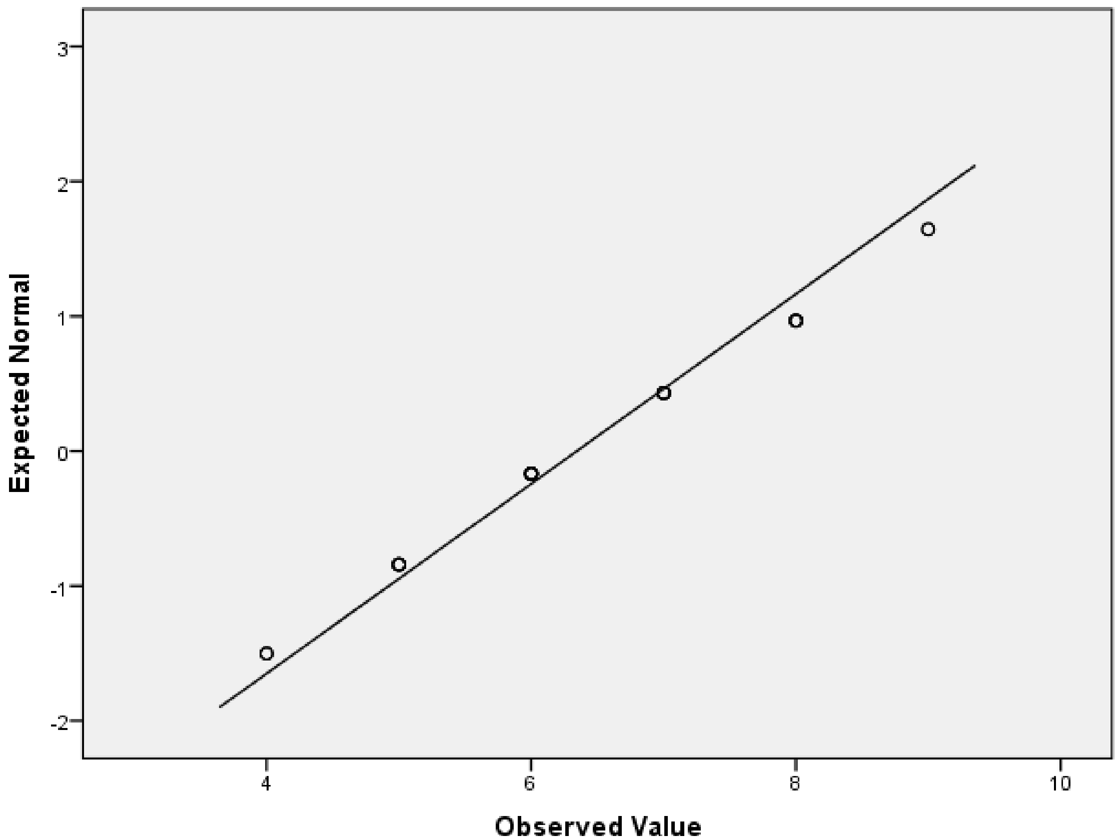


Figure A 26. Normal Q-Q plots of student's expected pre-admission composite scores versus observed pre-admission composite scores.

Appendix T Regression Diagnostics Final Two Variable Model

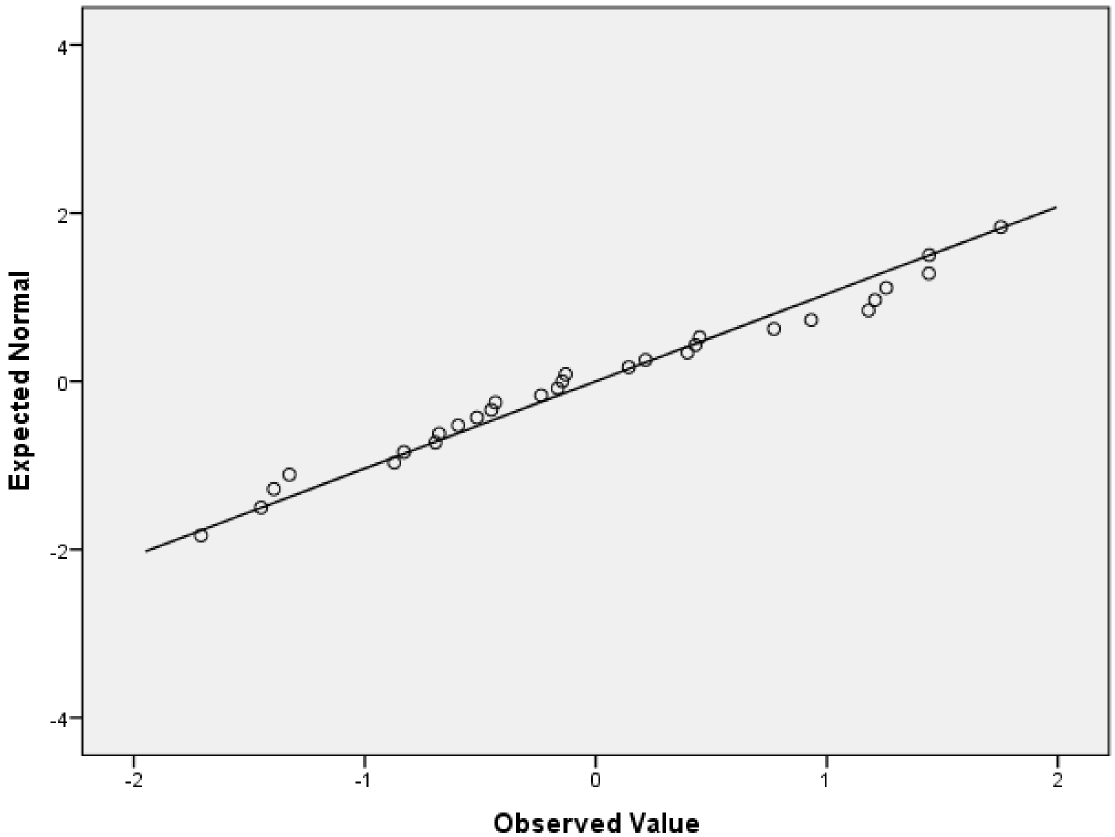


Figure A 27. Normal Q-Q plot of standardized residuals versus expected values in the two variable model (i.e. cumulative high school GPA and ACT scores).

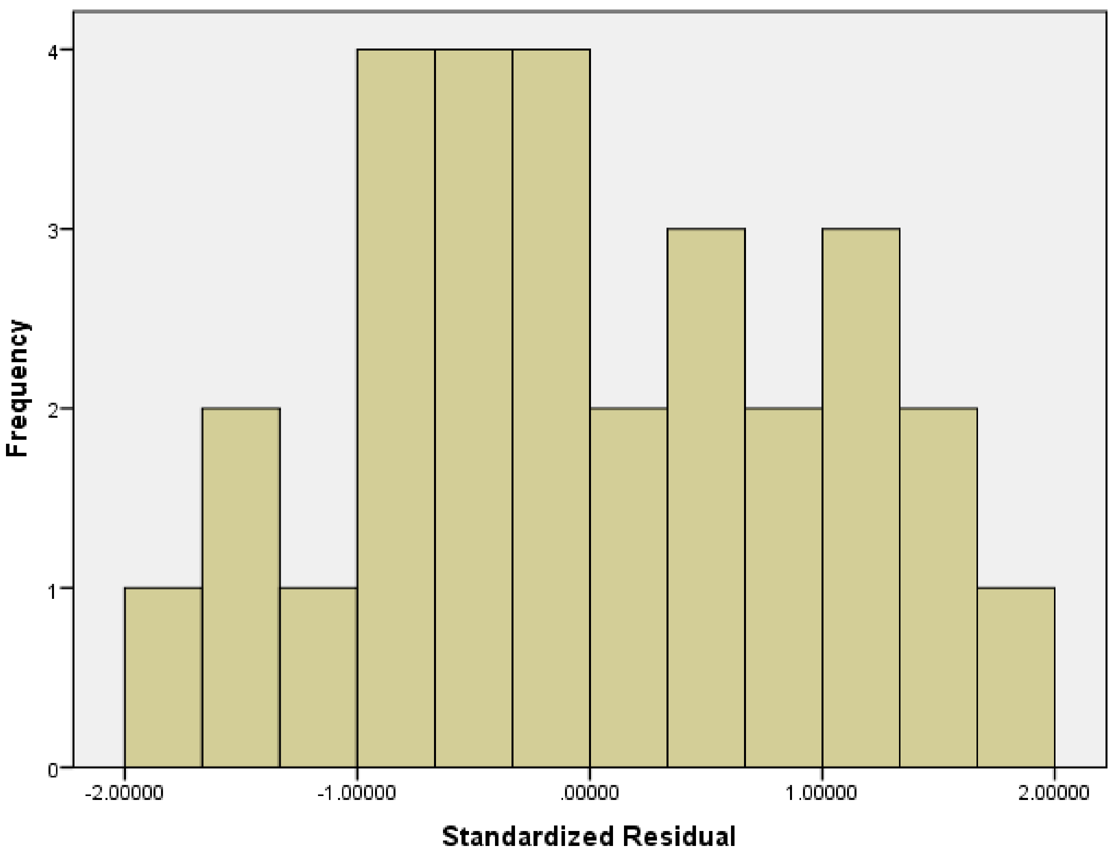


Figure A 28. Test of normality: histogram of standardized residuals two variable model (i.e. cumulative high school GPA and ACT scores).

Table A16: *Statistical Test of Normality of Residuals for 2 Variable Model (i.e. Cumulative High School GPA and ACT Scores).*

Component	df	Statistic	p
Standardize Residuals	29	.966	.450

At $\alpha = 0.05$, the p value fails to provide evidence to reject the Null hypothesis that the values are normally distributed.

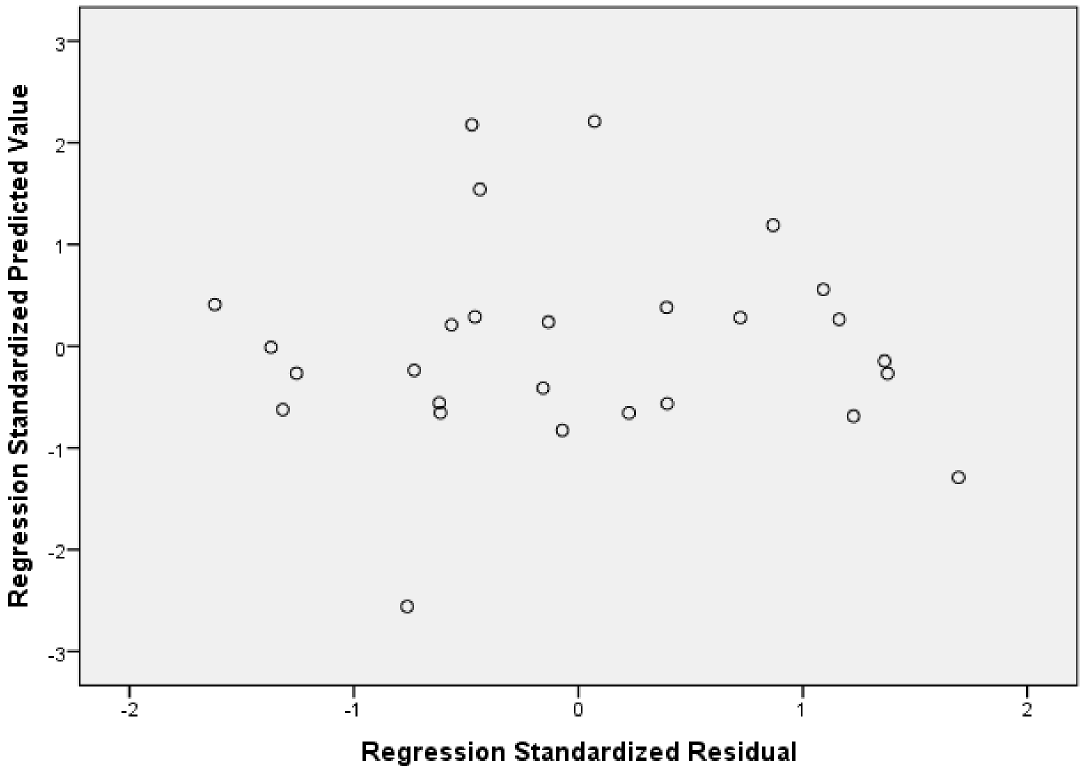


Figure A 29. Test for heteroscedasticity: scatter plot of standardized residuals versus standardized predicted values in final two predictor variable model.

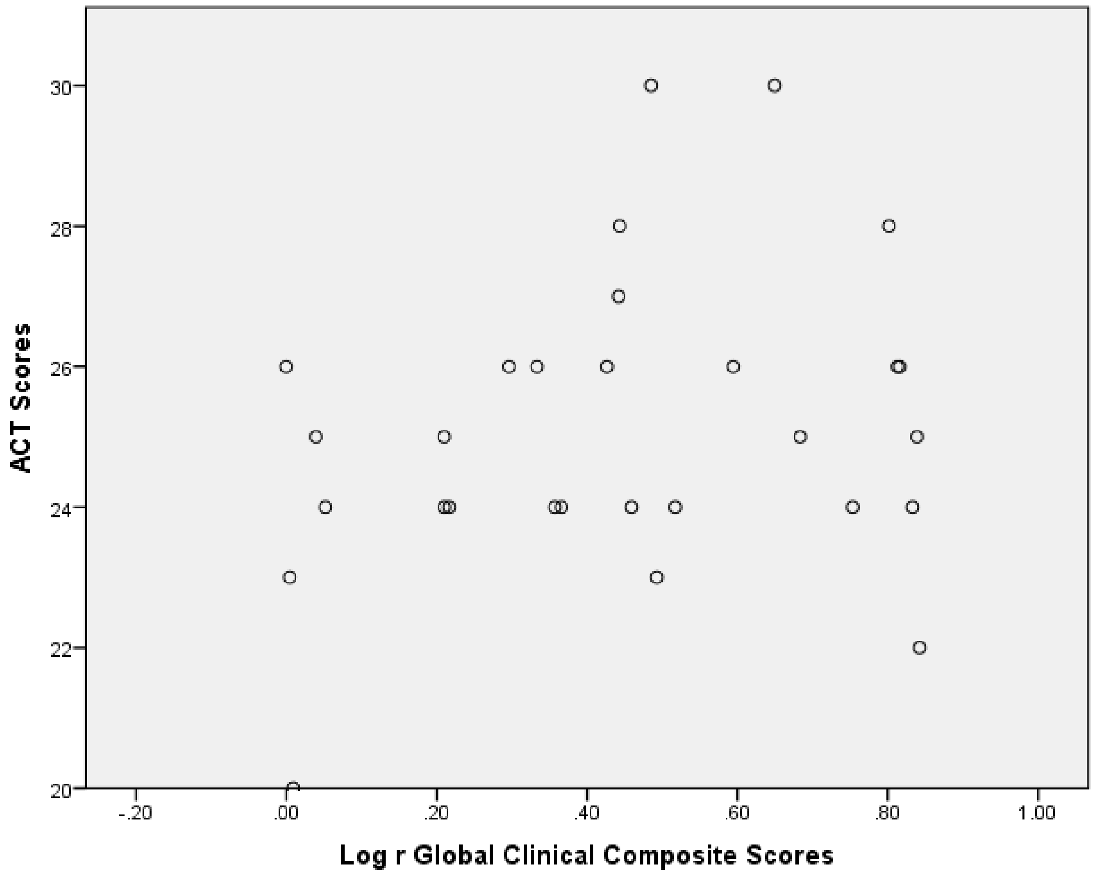


Figure A 30. Scatter plot of ACT scores versus transformed global clinical composite scores.

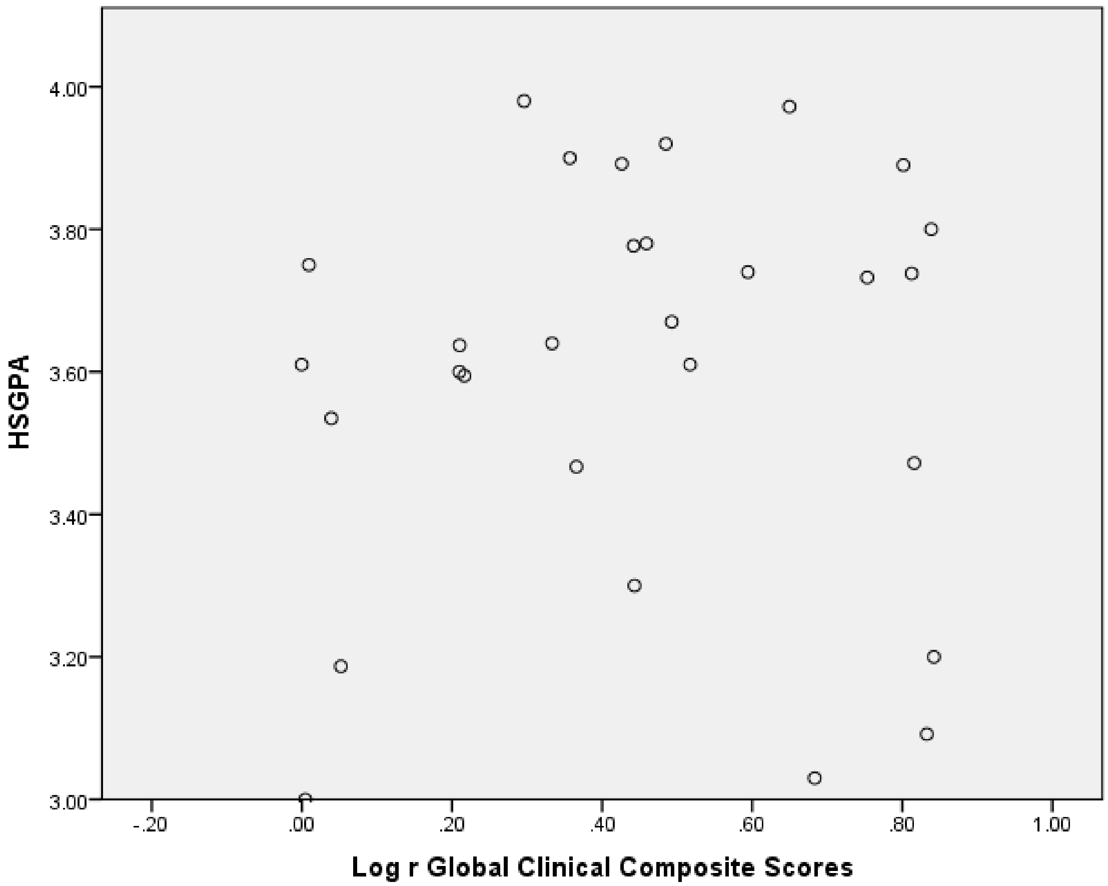


Figure A 31. Scatter plot of cumulative high school GPA versus transformed global clinical composite scores.