OUTCOMES OF HOLISTIC REVIEW IN A MEDICAL SCHOOL OFFERING A SIX-

YEAR COMBINED BACCALAUREATE AND MEDICAL DEGREE PROGRAM AND

TRADITIONAL FOUR-YEAR MEDICAL DEGREE PROGRAM


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OUTCOMES OF HOLISTIC REVIEW IN A MEDICAL SCHOOL OFFERING A SIX-YEAR COMBINED BACCALAUREATE AND MEDICAL DEGREE PROGRAM AND TRADITIONAL FOUR-YEAR MEDICAL DEGREE PROGRAM

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ABSTRACT

The purpose of this ex-post facto quantitative study was to examine the outcomes of holistic review in the BA/MD program and the MD program at the University of Missouri-Kansas City School of Medicine. Outcomes were evaluated based on the type of admission review students received (either pre-holistic review or holistic review) for each separate degree program (BA/MD or MD). Outcomes studied were learning, developmental, and professional outcomes of the graduates as they related to the mission of the medical school and the diversity rationale. Specifically, the outcomes measured included graduating GPA, graduation rate, licensure exam performance, and answers to eight questions from the Association of American Medical Colleges' Graduation Questionnaire containing survey items addressing diversity-related attitudes, experiences, and perceptions. The sample included BA/MD students admitted in 2007, 2008, and 2009 (pre-holistic review) and 2010 and 2011 (post-holistic review) as well as MD students admitted in 2009 and 2010 (pre-holistic review) and 2011, 2012, and 2013 (post-holistic review). Means, frequencies, chi-square test for homogeneity, independent samples T-tests, Hotelling's $T^2$, and two-way

ANOVA were used to examine differences between type of admission, and in some cases by race/ethnicity, for each dependent variable and for each degree program.

Findings showed that implementing holistic review resulted in an increase in the academic measures of Step 1 and Step 2 CK licensing exam scores for MD students when examined separately, and an increase in graduating GPA, Step 1, and Step 2 CK scores for MD students when examined together. Additionally, significant differences seen in degree attainment for BA/MD students among racial/ethnic identity prior to holistic review were eliminated once holistic review was used. Students' participation in diversity-related experiences also increased for both the BA/MD and MD programs once holistic review was utilized, and gaps previously seen among racial/ethnic identity in career plans to work with underserved populations were closed. No significant decreases in outcomes measures were found in any of the variables when holistic review was utilized.

This study filled a gap in holistic review literature, as few studies exist examining graduation outcomes of holistic review processes in medical schools.

APPROVAL PAGE

The faculty listed below, appointed by the Dean of the School of Education have examined a dissertation titled "Outcomes of Holistic Review in a Medical School Offering a Six-Year Combined Baccalaureate and Medical Degree Program and Traditional Four-Year Medical Degree Program," presented by Cary Chelladurai, candidate for the Doctor of Education degree, and certify that in their opinion it is worthy of acceptance.

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CHAPTER 1

INTRODUCTION

Each year, medical school admission committees strive to admit a class of applicants who will succeed in medical school and join the physician workforce. The racial and ethnic composition of that workforce has been scrutinized for some time, as critics say the workforce does not mirror the ethnic and racial diversity of the patient population (Association of American Medical Colleges, 2009; Robert Wood Johnson Foundation, 2013; Smedley, Butler, & Bristow, 2004). As recently as 2016, African-American, Latinx, Native American, and Alaska Native populations made up 32.4% of the American population (United States Census Bureau, 2017). However, in 2013, only 8.9% of physicians were from those populations (AAMC, 2014b).[1] Studies show that patients of color perceive they receive better medical treatment when their providers are of a similar ethnicity (Ferguson & Candib, 2002; Marrast, Zallman, Woolhandler, Bor, & McCormick, 2014; Saha & Shipman, 2008). As such, the difference in racial diversity between the general population compared to the physician workforce is cited as one of the many causes leading to American health disparities (Smedley, Stith, & Nelson, 2003).

Holistic review, or the process of reviewing a college applicant beyond grade point average and test scores, is a common admissions strategy employed by institutions of higher education (Espinosa, Gaertner, & Orfield, 2015; Urban Universities for HEALTH, 2014). In medical education, holistic review gained traction in 2007, and is currently used by a number

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[1] Conversely, Asian populations are overrepresented, as Asian populations make up 11.7% of the physician population but only 5.7% of the American population (AAMC, 2014b; United States Census Bureau, 2017).

of medical schools (AAMC, 2014a; Urban Universities for HEALTH, 2014). One of the goals of holistic review in medical education is to diversify the student body, eventually leading to more diversity in the physician population (AAMC, 2013b). Another goal is to diversify the learning environment, which can benefit all students by allowing them to work alongside peers with varying backgrounds and experiences. This belief is called the "diversity rationale" and serves as the conceptual framework for this study.

As holistic review is still a rather new process in medical school admissions, evaluation of its outcomes is timely. This study examines the outcomes of using holistic review at a public, urban-serving, Midwestern medical school, the University of Missouri-Kansas City School of Medicine (UMKC), through the lens of the mission of the school and the diversity rationale. Additionally, as this medical school is unique in admitting the majority of its students to a six-year combined bachelor and medical degree program directly from high school, the examination of holistic review in this setting provides a distinctive element to the growing body of literature.

This chapter provides further evidence supporting the purpose of this study, the proposed research questions and conceptual framework, definitions of important terms, and limitations and delimitations. It closes with the significance of how this study will contribute to holistic review and medical education literature.

## Statement of the Problem

Meeting the healthcare needs of the increasingly diverse American population is an issue at the forefront of medical education (AAMC, 2009; Nivet, 2011; Urban Universities for HEALTH, 2014). Studies have shown health disparities continue to plague patients of color living in the United States (AAMC, 2009; AAMC, 2016a; Smedley et al., 2003).

Specifically, these health disparities are, "racial or ethnic differences in the quality of healthcare that are not due to access-related factors or clinical needs, preferences, and appropriateness of intervention" (Smedley et al., 2003, p. 32). Many believe that diversifying the medical student population and increasing the number of medical students of color will ultimately produce a physician workforce better prepared to meet the needs of all patients, thereby having a direct effect on reducing the severity of racial health disparities in the United States (AAMC, 2009; Smedley et al., 2003; Smedley et al., 2004).

Previous studies examined multiple ways in which to diversify the medical student population. Specific programs were established to attract students of color to medical school with varying success (Bailey & Willies-Jacobo, 2012; Deas, et al., 2012; Jacob, 2015; Lupton, Vercammen-Grandjean, Forkin, Wilson, & Grumbach, 2012; Toney, 2012). Many schools highlight a commitment to diversity by integrating cultural competency methods into curriculum, or by providing an office or high-level administrator specifically focused on diversity, believing those actions will also attract diverse applicants (Nivet, 2011). More recently, medical schools have focused on revising the ways in which they review applications to ensure numerical measures alone, such as grade point average and test scores, do not prevent students from diverse backgrounds in advancing through the stages of the application process. This type of review, called holistic review, assesses an applicant's experiences, attributes, and metrics, and is believed to have an impact on the composition of the medical school class in a way that advances the goals of diversifying the physician workforce (AAMC, 2013a; Urban Universities for HEALTH, 2014).

Holistic review is relatively new in medical admissions. The Association of American Medical Colleges (AAMC), the professional organization for MD-granting institutions,

began the Holistic Review Project (HRP) in 2007 to provide resources and support to medical schools specifically "to create and sustain diversity" (AAMC, 2014a, p. 2). Since then, the AAMC has continued to support this project through multiple publications to assist schools in implementing and evaluating holistic review (e.g. AAMC, 2010; AAMC, 2013a; AAMC, 2014c). Since the HRP began 10 years ago, the support and resources have continued to grow; therefore, it is reasonable that the time has come to evaluate the effectiveness of holistic review in medical schools.

However, studies examining holistic review in medical schools are rare. Though the AAMC created resources to support the evaluation of holistic review, only a few published studies are available that examine the outcomes of holistic review at medical schools (Arredondo, 2015; Ballejos, Rhyne, & Parkes, 2015; Witzburg & Sondheimer, 2013). Moreover, these studies focused on outcomes of holistic review in the context of the composition of the incoming class, but not on outcomes upon graduation. When a literature search is expanded to other health professional programs within higher education such as dentistry and nursing, the number of studies is still surprisingly small (Lacy, McCann, Miller, Solomon, & Reuben, 2012; Price & Grant-Mills, 2010; Urban Universities for HEALTH, 2014; Wilson, Sedlacek, & Lowery, 2014). Therefore, an exploration of the outcomes of holistic review in medical education is needed and contributes to the body of knowledge on this important topic.

One such medical school using the holistic review model to evaluate applications for admission is the University of Missouri-Kansas City School of Medicine (UMKC). The UMKC School of Medicine is unique in the medical education field, in that the majority of its students pursue a combined degree program in which they earn both a bachelor degree

and medical degree (BA/MD) within a six-year timeframe. Most medical schools offer students a four-year medical degree after a student has obtained their bachelor degree, and though UMKC offers this degree option as well, the number of students pursuing that option is smaller compared to those pursuing the combined degree. Thus, the combined degree is the hallmark of UMKC's School of Medicine. While the BA/MD program at UMKC admits approximately 110 students per year, the MD program admits only around 15 (A. Arredondo, personal communication, April 6, 2017). Still, examining the outcomes of holistic review in both programs within one educational environment provides data that can be applied to both combined degree programs as well as traditional programs.

Arredondo (2015) found that when holistic review was adopted at UMKC's School of Medicine, the ethnic and racial diversity of the cohorts admitted to the BA/MD program increased. Studies have shown that when the ethnic and racial diversity of a medical school class increases, students rate themselves as better prepared to work with a diverse patient population upon graduation (Niu, et al., 2012; Saha, Guiton, Wimmers, & Wilkerson, 2008). The diversity rationale, the conceptual framework of this study, asserts that all students benefit when learning with diverse peers. When the diversity rationale holds true, one expects to find results indicating that learning with diverse peers increases positive perceptions of diversity.

UMKC School of Medicine began reviewing applicants using the holistic review model for the 2010 matriculating class for BA/MD students, and for the 2011 matriculating class for MD students. The first class of BA/MD students admitted through holistic review graduated in May 2016, and the second class graduated in May 2017. The first class of MD students admitted through holistic review graduated in 2015, the second class graduated in

2016, and the third class graduated in May 2017. With the important milestone of graduation achieved for several cohorts admitted through holistic review, it is appropriate to examine the outcomes of holistic review with both programs.

## Purpose of the Study

The purpose of this ex-post facto quantitative study was to examine the outcomes of holistic review in the BA/MD program and the MD program at UMKC by evaluating the relationship between the type of admission review a cohort received and the learning, developmental, and professional outcomes of the graduates as they relate to the mission of the medical school and the diversity rationale.

Matriculating students were divided into cohorts admitted prior to the implementation of holistic review (pre-holistic), and those admitted after (post-holistic). For BA/MD students, three cohorts of students admitted pre-holistic review and two cohorts admitted post-holistic review were examined: entering classes in Fall 2007, Fall 2008 and Fall 2009 for pre-holistic review, and Fall 2010 and Fall 2011 for post-holistic review. For MD program students, two cohorts were reviewed for pre-holistic review, and three cohorts were reviewed for post-holistic review since one more MD class graduated in that timeframe compared to the BA/MD class. For the MD cohort, the entering classes in Spring 2009 and Spring 2010 were pre-holistic review, and Spring 2011, Spring 2012, and Spring 2013 were post-holistic review. Together, these groups represent the five graduating classes of 2013, 2014, 2015, 2016, and 2017.

Evaluation of holistic review should consider learning, developmental, and professional outcomes associated with learning in a diverse student body, and as defined in an upcoming section (AAMC, 2013b; Camara, 2005a). In addition, evaluation of holistic

review should be tied to the mission of the individual institution being studied (AAMC, 2013b; Espinosa, Gaertner, & Orfield, 2015). For the purpose of this study, the specific outcomes used to evaluate holistic review at UMKC were guided by the mission of the UMKC School of Medicine and the diversity rationale.

The findings of this study can inform holistic review at the UMKC School of Medicine, but more importantly contribute to the growing body of literature regarding holistic review in medical education, as few studies on this topic exist. In addition, as UMKC provides a unique combined degree program as well as a traditional program, this study gives insight into outcomes of holistic review in each type of program within one academic learning environment. Thus, this study investigates the following research questions:

1. How did changing to a holistic review admissions process affect the academic success of medical students?

   a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized?

   b. How did the graduation rate change for students of color after holistic review was utilized?

2. How did self-perceived measures of diversity-related competencies and experiences change in cohorts admitted using holistic review?

   a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized?

To answer the first research question, institutional data were used to examine graduation rate, graduating GPA, and licensing exam scores. Specific data from the AAMC Graduation Questionnaire (GQ), a national survey administered to graduating medical

students across the country, were used to answer the second research question. Those GQ questions regarding diversity competencies and experiences of graduates were examined. Data from the first and second research question were examined by admission type (pre-holistic review vs. post-holistic review), and in some cases by racial/ethnicity identity, for each program type (BA/MD program and MD program).

**Conceptual Framework**

The underlying principle of holistic review is the "diversity rationale" (AAMC, 2013b). As presented in *Regents of University of California v. Bakke* (1978), the idea that universities have a compelling interest in student body diversity, and that this diversity improves the educational experience of all students, has been termed the "diversity rationale." The *Bakke* decision provided the legal standing for using race in admissions review, as universities have a compelling interest for creating racially diverse cohorts. In medical schools, studies have shown the benefits of diversity on a group of learners include a better understanding of diversity in healthcare, an increased concern for underserved populations, and increased self-perceived level of preparedness to work with diverse populations (Niu, et al., 2012; Whitla, et al., 2003).

By using holistic review, medical schools strive to admit cohorts that contain a greater variety of compositional diversity, including racial diversity, than in previous years. Indeed, Arredondo (2015) showed that at the UMKC School of Medicine, the percentage of students of color for the BA/MD cohorts rose from 12.3% of admitted students during the five years prior to holistic review to 20.1% of admitted students during the four years immediately after holistic review was implemented. What effect did the increase in diversity have on the experiences of students in these cohorts? Did the diversity rationale hold true for

medical students in this environment? This study examines the effect an increased number of students of color in the medical student population can have on the diversity-related experiences and attitudes of all students upon graduation.

<div align="center">**Definition of Terms**</div>

**Holistic Review**

The most significant term used in this study is "holistic review." As this study focuses on holistic review in medical education, the definition provided by the AAMC is particularly important. They define holistic review as, "a flexible, highly-individualized process by which balanced consideration is given to the multiple ways in which applicants may prepare for and demonstrate suitability as medical students and future physicians" (AAMC, 2010, p. ix).

The term "holistic admissions" is sometimes used interchangeably with holistic review, but instead describes the full process of admissions rather than just the review of the applicant's file. Other terms found in the literature as a synonym for holistic review are "whole-file" or "full-file" review (Kent & McCarthy, 2016; Price & Grant-Mills, 2010).

**Students of Color**

As this study focuses on diversifying the healthcare field, the term "students of color" is used often to describe students and racial groups who are underrepresented in medicine compared to their proportion in the general United States population, as described previously. When appropriate, the term "patients of color" is also used. Specific to the present study, the definition of students of color follows the UMKC School of Medicine definition, which includes students who self-identify on their UMKC application as members of the following racial groups: "African-American/Black, Hispanic/Latino, American Indian/Native American, Native Hawaiian or Pacific Islander, or Asian-Underrepresented. For the purposes

of Asian-Underrepresented, the category is defined as those who do NOT identify as Chinese, Japanese, Filipino, Korean, Asian Indian, or Thai" (UMKC School of Medicine, 2017b, p. 2).

In the literature on health disparities and holistic review, the terms, "underrepresented minority," "underrepresented in medicine," and "minority" are often used (AAMC, 2009; Robert Wood Johnson Foundation, 2013; Smedley et al., 2003; Smedley et al., 2004; Sullivan Commission on Diversity in the Healthcare Workforce, 2004; Urban Universities for HEALTH, 2014; Witzburg & Sondheimer, 2013). The term, "students of color" will be used throughout the present study when describing previous studies in order to avoid using pejorative terms and deficit language to describe students and patients. However, it should be noted that the terms used as synonyms for students of color in other studies might not have the same definition as the one above. For instance, several studies describe students who are underrepresented in medicine as identifying as Black/African American, Latinx/Hispanic, and Native American or Alaska Native, ignoring other populations that the above definition includes (AAMC, 2009; Smedley et al., 2003). In other studies, additional populations were included in this definition such as Native Hawaiian, Pacific Islander, and Asian countries underrepresented in medicine (Arredondo, 2015; Sullivan Commission, 2004).

**Outcomes**

The AAMC describes three types of outcomes important when evaluating holistic review (AAMC, 2013b). *Learning outcomes* assess academic success factors of the medical school environment such as GPA or licensing exam score. *Developmental outcomes* focus on the way in which the learning environment shapes students' values and attitudes towards patients and medicine. Finally, *professional outcomes* relate to graduates' choice of specialty

and the professionalism they exhibit in the profession. The first research question in this study examines learning outcomes while the second research question examines developmental and professional outcomes.

**Admission Type**

In this study, the primary independent variable for both research questions is the type of admission review students received. Those cohorts admitted prior to the implementation of holistic review are described as "pre-holistic review," while those cohorts admitted with a holistic review are described as "post-holistic review."

**Program Type**

Outcomes for this study are separated by the curricular program to which the student was admitted. Those admitted to the six-year combined bachelor and medical degree program are listed as BA/MD students while those admitted to the traditional four-year medical degree program are described as MD students.

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**Limitations and Delimitations**

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**Limitations of the Study**

When the AAMC's Advancing Holistic Review Initiative began in 2007, the focus was on admission into medical school. As the initiative evolved, the purpose expanded to include the process elements and institutional policies and practices that are needed to produce a culturally competent physician workforce (AAMC, 2014a). This study does not examine the process elements and institutional policies and practices at the UMKC School of Medicine. More data collection initiatives are needed in order to analyze this aspect of medical education, and those collection points should be longitudinal over several years. As

those data do not currently exist, this study focuses on testing the concept of the diversity rationale within student experiences at the UMKC School of Medicine.

Additionally, utilizing the GQ presents a few limitations. Data from the GQ are limited to those graduating students who chose to complete the optional survey. For the survey years included in this study, survey response rates ranged from 69% to 94% per cohort (J. Quaintance, personal communication, October 17, 2017). Therefore, the data available do not include responses from all students in the sample. The questions on the GQ also ask students to respond about the experiences they had while in medical school as well perceptions about their abilities and their preparation for their future. As these data include perceptions, the accuracy of the answers relies on each individual student's self-reflection and self-awareness.

**Delimitations of the Study**

This study is conducted with data from only one medical school. Best practices for evaluation of holistic review state that the evaluation should be conducted with the mission of the institution guiding the study (AAMC, 2013b; Espinosa, Gaertner, & Orfield, 2015). Due to this parameter, it is appropriate to include only one school within the evaluation. Since there are limited data on the outcomes of holistic review in medical schools, and this study evaluates outcomes of both a BA/MD and MD program, generalizations of the study could be applied to each type of program.

This study is delimited to students at the UMKC School of Medicine entering the BA/MD program from Fall 2007 through Fall 2011, and those entering the MD program from Spring 2009 to Spring 2013. Combined, these cohorts represent the graduating classes of 2013 through 2017.

Finally, as this study focuses on increasing the racial and ethnicity diversity of the physician population, the data analysis examines several of the variables along racial and ethnic lines, but not gender. Due to the small sample size of this study, collecting both racial/ethnic identity information along with gender identity could have allowed participants to be identified. Therefore, due to the focus of the study and the sample size, this study is delimited to examine variables according to racial/ethnicity identity and does not examine results by gender.

## Significance of the Study

Holistic review in medical education is a relatively new process, as the initiative to change to holistic review was published only ten years ago (AAMC, 2014a). Considering the length of time it has taken medical schools to learn about this new initiative, implement the necessary admissions processes, and then matriculate, educate, and graduate students, it is understandable that little data exist regarding the graduation outcomes of holistic review. Studies regarding the impact of holistic review in medical schools demonstrated positive outcomes, but mainly focused on outcomes in the matriculating class instead of outcomes of graduates (Arredondo, 2015; Witzburg & Sondheimer, 2013).

At UMKC School of Medicine, holistic review was not adopted until 2010. Due to the six-year curriculum of the BA/MD program, the first class of holistic admission matriculates did not graduate until May 2016, and the second class recently graduated in May 2017. Since the MD program is shorter, the third class of students who matriculated under holistic admissions recently graduated in May 2017. Therefore, evaluating the results of holistic review at the UMKC School of Medicine is timely. Since UMKC has both a BA/MD program and MD program, results of the study could be applied to other medical schools

with each type of program. Therefore, this study is significant to other medical schools, regardless of type of program, and adds to the much needed body of literature regarding the outcomes of holistic review in medical schools.

### Summary

Holistic review, which aims to increase the diversity of an admitted educational cohort and, in turn, the diversity of the physician workforce, is a rather new approach in medical education. It is believed that using this approach will increase the diversity of the physician workforce and help to eliminate health disparities in the United States. This study examines the outcomes of holistic review admission processes used to admit students into the BA/MD combined program and MD traditional program at the UMKC School of Medicine. Using the diversity rationale, the underlying conceptual frame of this study and a key component in evaluating holistic review, this study investigates graduation outcomes related to the use of holistic review in medical education.

Looking forward, Chapter Two of this study provides supporting evidence to the claims made in this chapter by expanding upon the topics of diversity within health care, holistic review in higher education and medical schools specifically, the diversity rationale used in the learning environment, and the structure of medical degree programs. Chapter Three describes how the study was conducted, while Chapter Four lists the findings of the study. Finally, Chapter Five discusses the results of the study in the context of holistic review and the diversity rationale, as well as presents implications for the use of holistic review in medical school admissions.

CHAPTER 2

REVIEW OF LITERATURE

**Introduction**

This chapter reviews literature on diversity within health care, followed by the conceptual framing of this study: holistic review and the diversity rationale. A discussion of the practice of holistic review in higher education follows with a specific focus of the practice in medical school admissions and how its effectiveness has been evaluated. The history of medical education is then discussed, differentiating between combined degree programs and traditional programs. Finally, the chapter concludes by reviewing the gaps in the extant literature and showing the need for the present study, which will provide an evaluation of how holistic review in medical education impacts the success and diversity-related experiences of graduates.

**Diversity within Health Care**

**Disparities in Treatment and Representation**

The difference in racial diversity within the health care workforce compared to the American patient population has been a topic in healthcare for approximately two decades (AAMC, 2009; Robert Wood Johnson Foundation, 2013; Smedley et al., 2003; Smedley et al., 2004; Sullivan Commission, 2004). Of top concern are health disparities, which are, "racial or ethnic differences in the quality of healthcare that are not due to access-related factors or clinical needs, preferences, and appropriateness of intervention" (Smedley et al., 2003, p. 32). The seminal work, *Unequal Treatment*, issued by the Institute of Medicine, provided a comprehensive assessment of health disparities in the United States, including the role of healthcare systems, sources of discrimination, and possible solutions (Smedley et al.,

2003). Health disparities in the United States stem, in part, from long-standing social structures affecting equitable access to care for all patients. Discrimination and communication barriers resulting from this inequity have led to differences in appropriate treatment options for illnesses, such as cardiovascular disease, cancer, or asthma, all of which can lead to increases in mortality rates in patients of color.

A multitude of strategies have been suggested to eliminate disparities. Some of those strategies include increasing the knowledge of disparities among health students and providers, increasing students' exposure to underserved settings while in school, enhancing cultural competency, and improving the quality of clinical interactions with diverse patients (AAMC, 2009; Betancourt, 2006; Smedley et al., 2003). Another common strategy is diversifying the health care provider workforce (AAMC, 2009; Cohen, 1997; Cohen, 2003; Cohen, Gabriel, & Terrell, 2002; Smedley et al., 2004).

Studies show that when health care providers, such as doctors and nurses, are of the same racial group as patients, patients believe they are more likely to receive appropriate care from those providers (Ferguson & Candib, 2002; Marrast et al., 2014; Saha & Shipman, 2008). Currently, though, specific racial and ethnic groups are underrepresented in the health care work force. In 2016, the general population of the United States was 13.3% African American, 17.8% Latinx, and 1.3% Native American or Alaskan Native (United States Census Bureau, 2017). However, the percentage of providers from these groups was substantially lower than the general population. In 2013, the nursing workforce was estimated to be 6% African-American, 3% Latinx, and 1% Native American or Alaska Native (Budden, Zhong, Moulton, & Cimiotti, 2013). In the same year, the physician workforce had an even lower representation; 4.1% African American, 4.4% Latinx, and 0.4%

Native American or Alaska Native allopathic (M.D.) physicians (AAMC, 2014b). Across the health care workforce, specific racial groups continue to be underrepresented as health care providers.

For a number of years, health professional schools have focused on recruiting, admitting, retaining, and graduating students of color (Robert Wood Johnson Foundation, 2013; Smedley et al., 2004; Sullivan Commission, 2004; Terrell & Beaudreau, 2003). Due to the licensing structure of health care in the United States, the only way to become a provider is to first be admitted to a health professional school. Therefore, these schools are the gatekeepers to the physician workforce and hold a large responsibility for diversifying it (AAMC, 2013b).

**Strategies to Diversify the Health Professions**

Health professional schools employ a number of strategies to increase diversity within their student population. Pipeline programs, curricular programs focused on the health of underrepresented communities, and mentorship programs with faculty of color are popular strategies (Bailey & Willies-Jacobo, 2012; Deas, et al., 2012; Jacob, 2015; Lupton et al., 2012; Sullivan Commission, 2004; Toney, 2012). One additional strategy that received more focus in the last decade is an admissions strategy known as holistic review, which involves changing the admissions processes that health professional schools use to review an applicant to include factors beyond test scores and GPA. The AAMC (2009) argued that diversifying the physician workforce starts with the admissions process and that all qualifications of an applicant should be reviewed during admission in order to gain a broad understanding of an applicant's strengths. Holistic review, an independent variable of this study, and its supporting principle, the diversity rationale, are described in the next section.

**Holistic Review and the Diversity Rationale:**

**Conceptual Frameworks for this Study**

Holistic review in higher education admissions is a process aimed at reviewing an applicant's cognitive and non-cognitive attributes in order to make an admissions decision (AAMC, 2010; *Grutter v. Bollinger et al.*, 2003; Kent & McCarthy, 2016; Urban Universities for HEALTH, 2014). Including a review of the non-cognitive aspects of an applicant has been shown to increase racial diversity in a matriculating class, thus bringing more diverse students into higher education (Arredondo, 2015; Ballejos et al., 2015; Price & Grant-Mills, 2010; Urban Universities for HEALTH, 2014; Wilson, Sedlacek, & Lowery, 2014; Witzburg & Sondheimer, 2013). As increasing the racial diversity of a class is often one of the goals of holistic review, the way in which universities, specifically medical schools, include race as one of an applicant's many non-cognitive factors is of close concern when utilizing a holistic review process (*Fisher v. University of Texas at Austin et al.*, 2013; *Gratz et al. v. Bollinger et al.*, 2003; *Grutter v. Bollinger et al.*, 2003; *Regents of Univ. of California v. Bakke*, 1978).

The underlying principle of holistic review in medical education is the diversity rationale (AAMC, 2013b; Urban Universities for HEALTH, 2014). The diversity rationale is the concept that when racially and ethnically diverse students learn together, all students benefit. The appreciation for diversity within learning is present in the philosophical teachings of Aristotle, Mill, and Dewey, though the use within higher education is often attributed to Justice Powell in the important United States Supreme Court case of *Regents of University of California v. Bakke* described below (Moses & Chang, 2006).

In this section, the legal underpinnings of holistic review and the diversity rationale are presented, followed by studies showing the effects of student body diversity within the medical education setting. The following sections then discuss the theory and application of holistic review in higher education and in medical education, specifically.

**Legal Precedent for Holistic Review**

Holistic review and the use of race as a non-cognitive factor in the process of holistic review has been at the center of several major United States Supreme Court cases spanning the last fifty years. In each of these cases, the ways in which race or ethnicity was used in admissions were questioned, and the resulting opinions shaped the admission processes in higher education and professional schools (AAMC, 2014c; Kent & McCarthy, 2016; Price & Grant-Mills, 2010).

In the first landmark case on this issue, *Regents of University of California v. Bakke* (1978), Justice Powell laid the framework for the current concept of holistic review while also promoting the diversity rationale within education. Bakke, a white student applying to the School of Medicine at University of California-Davis, was denied admission in 1973 and again in 1974. He sued the university, claiming that less-qualified students of color were admitted under the use of a quota system, which guaranteed a specific number of seats in the incoming class be given to students of color.

The court ruled in favor of Bakke, ordered the university to admit him, and declared the use of a quota system under which the university was operating was in violation of the Equal Protection clause of the 14th Amendment (*Regents of Univ. of California v. Bakke*, 1978). However, in Justice Powell's opinion on the case where he cast the swing vote in support of Bakke, he laid the groundwork of holistic review when he stated, "the diversity

that furthers a compelling state interest encompasses a far broader array of qualifications and characteristics, of which racial or ethnic origin is but a single, though important, element" (p. 315). He went on to list examples of these qualifications and characteristics, such as, "exceptional personal talents, unique work or service experience, leadership potential, maturity, demonstrated compassion, a history of overcoming disadvantage, ability to communicate with the poor, or other qualifications deemed important" (p. 317). These characteristics, key to holistic review, are termed non-cognitive factors of admission. In stating that race was one of a number of factors important for university admissions committees to review, Powell laid the framework for legally considering race when making higher education admission decisions.

Within the same opinion, Justice Powell also introduced the idea of the benefits of diversity for all students, the diversity rationale, stating medical schools had a compelling interest to admit and enroll a diverse group of learners in order to achieve their mission (*Regents of Univ. of California v. Bakke*, 1978). Specifically, Powell stated:

> Physicians serve a heterogeneous population. An otherwise qualified medical student with a particular background -- whether it be ethnic, geographic, culturally advantaged or disadvantaged -- may bring to a professional school of medicine experiences, outlooks, and ideas that enrich the training of its student body and better equip its graduates to render with understanding their vital service to humanity. (*Regents of Univ. of California v. Bakke*, 1978, p. 314).

Powell's description of the benefits that all students can gain by learning with diverse peers, particularly those studying medicine, forms the basis for the diversity rationale within medical education.

The decision from *Bakke* (1978) guided race-conscious admission practices for over two decades until the next two landmark cases in university admissions, *Grutter v. Bollinger et al.* (2003) and *Gratz et al. v. Bollinger et al.* (2003), which both involved admissions at the University of Michigan. In the first case, Grutter, a white student, was denied admission to the University of Michigan's law school and sued the university over its consideration of race as one of many aspects of diversity in its admission practices (*Grutter v. Bollinger et al.*, 2003). In the second case, the petitioners, both white, sued the university over a point system utilized in the undergraduate admissions process in which applicants of color were automatically awarded 20 points toward the 100 points needed in order to secure guaranteed admission (*Gratz et al. v. Bollinger et al.*, 2003).

The court upheld the use of holistic review in the law school's admission practices *(Grutter v. Bollinger et al.*, 2003) while simultaneously ruling the point system used in the undergraduate admissions process was unconstitutional (*Gratz et al. v. Bollinger et al.*, 2003). The admission processes of the law school at the University of Michigan were upheld due to the "highly individualized, holistic review of each applicant's file, giving serious consideration to all the ways an applicant might contribute to a diverse educational environment" (*Grutter v. Bollinger et al.*, 2003, p. 337). The university's consideration of a multitude of diverse characteristics, such as the ones outlined in Powell's decision in *Bakke*, is what made their consideration of race as but one of those many characteristics constitutional.

In addition, the Supreme Court determined the law school's admissions processes were narrowly tailored, meaning that in their processes, the race of the applicant did not become the defining characteristic of that applicant (*Grutter v. Bollinger et al.*, 2003).

Finally, and as in *Bakke*, the diversity rationale continued to play a role in supporting holistic review when the Supreme Court upheld that the university continued to have a compelling interest in considering the race of an applicant due to the educational benefits of having a diverse class of students. Specifically, Justice O'Connor cited the amicus brief submitted by the American Educational Research Association which showed substantial benefits of diversity to student learning and engagement *(Brief for AERA as Amici Curiae, Grutter v. Bollinger et al.*, 2003; *Grutter v. Bollinger et al.*, 2003).

Most recently, *Fisher v. University of Texas at Austin et al.* (2013) and *Fisher v. University of Texas at Austin et al.* (2016) reaffirmed the legal support for using race in higher education admissions. Fisher, a white student who did not gain admission to the undergraduate program at University of Texas, sued the university claiming discrimination in their holistic review processes that considered race as one of many factors in making admission decisions (*Fisher v. University of Texas at Austin et al.*, 2013). The initial court case was remanded from the Supreme Court back to a lower court so that strict scrutiny could be applied to the case (Fisher v. University of Texas at Austin et al., 2013). However, the final opinion from the court supported the use of race in the holistic review practices of the University of Texas, and also confirmed the university had a continued compelling interest to do so based on the university mission and data supporting that mission in relation to diversity (*Fisher v. University of Texas at Austin et al.*, 2016).

These landmark cases established the criteria for how higher education institutions may consider race as one of many factors of an applicant when employing holistic review admission practices. Additionally, the cases all cited that universities have a compelling interest in enrolling a diverse student body to attain educational benefits. The diversity

rationale serves as the basis for this compelling interest and thus is central to the concept of holistic review in higher education.

**Studies of the Diversity Rationale in Medical Education**

Several studies examining the diversity rationale within higher education generally showed the benefits of diversity in the undergraduate setting (Chang, 1999; Gurin, Dey, Hurtado, & Gurin, 2002; Milem, 2003). Milem (2003) separated these benefits into four dimensions: individual, institutional, economic and private-sector, and societal. Individual benefits included enhanced critical thinking skills and a higher level of cultural competency and understanding. Institutional benefits included a more diverse curriculum and more research focused on issues of diversity. Economic and private-sector benefits included a workforce better able to work with diverse populations and increased problem-solving skills. Finally, societal benefits included greater equity and engagement in society. Considering the broad range of benefits a diverse student body brings to students, the institution, and the greater public, the compelling interest of having a diverse class in higher education is apparent. For those working toward eliminating health disparities, the benefits of each of the four dimensions play a role in medical education as well.

As this study focuses specifically on medical education, it is important to review the impact of diversity within the student body at medical schools. The AAMC asserted that the benefits of the diversity rationale in medical schools are seen in core educational goals such as academic excellence, an enhanced learning environment for all students, and a future physician workforce equipped and prepared to serve a diverse patient population (AAMC, 2013b). Several studies on the educational benefits of diversity in medical schools supported the concept of the diversity rationale. One such study examined the perspectives of medical

students at one institution to learn more about the effects of diversity on their perceptions of diversity-related issues (Hung et al., 2007). Of 216 student respondents, 83.8% felt that their medical school experience was improved by learning within a diverse student body. Other important perceptions included that 95.8% of students felt it was important to know societal conditions and cultural values of patients, and 80.1% agreed that cultural diversity benefitted the institution. Overall, the students expressed an appreciation for and recognized the importance of diversity in the classroom, at the institution, and with their future patient population.

Another study seeking student opinion on diversity was conducted with students across all four years of enrollment at Harvard Medical School and the University of California, San Francisco, School of Medicine (Whitla, et al., 2003). In a telephone survey, 639 participants responded to diversity-related questions presented on a Likert scale. Researchers found that as the students had progressed from childhood, to adolescence, to college, and then medical school that their frequency of contacts with peers of other races or ethnicities increased. Additionally, 86% of respondents felt classroom diversity led to discussion in which alternate views were presented, and 77% felt their medical knowledge was enhanced when the student body was diverse. Finally, diversity in the student body led to positive results in how students viewed diversity in healthcare, as 84% felt the diversity increased their concern for treating a diverse group of patients, 78% felt it affected their view of equity in the healthcare system, and 76% felt it impacted their concern for underserved populations being able to access care. Overall, students felt diversity in their class enhanced their medical education and supported the continued use of admission practices that enhance diversity.

Several studies examined the effects of the diversity rationale among schools with varying levels of diversity to determine the differences among schools. An oft-cited national study examined data from the 2003 and 2004 AAMC Graduation Questionnaire (GQ), a national study administered to all seniors graduating from medical schools each year (Saha et al., 2008). Schools were separated into quintiles according to their composition of students of color, and measures of interactional diversity from the GQ, such as institutional climate and engagement in diversity-related activities, were examined.

The results showed that white students who studied in schools with the highest quintile of students of color were more likely to feel highly prepared to care for patients of color (61.1%) than those white students who went to schools with the lowest quintile of students of color (53.9%), a difference that was statistically significant (Saha et al., 2008). Additionally, these same students were more likely to rate themselves as highly culturally competent and having strong attitudes supporting equity of care, compared to white students who attended schools with lower quintiles of students of color. The research also found evidence for a "critical mass," or threshold effect, in that having at least 10% of students of color and 36% of nonwhite students (students of color and Asian students, combined) led to increased measures of diversity-related perceptions in white students. Finally, the study found that students of color were much more likely than their peers to have plans to serve in underserved areas upon graduation, a finding consistent with other large-scale studies (Smedley et al., 2004).

While this study provided national level data on the effects of learning in diverse environments, the authors outlined several limitations. First, it was possible that students who chose more diverse medical schools already had more positive attitudes related to diversity

(Saha et al., 2008). Additionally, as a wide variety of schools were studied, the commitment of each institution to diversity was unknown, and likely to affect students' experiences and perceptions.

Another study of medical schools compared the composition of a medical school class to diversity-related attitudes and perceptions, but on a much smaller scale. This study surveyed 441 fourth-year medical students from three medical schools, each with varying percentages of enrollment of students of color (Guiton, Chang, & Wilkerson, 2007). The researchers found that an increased level of compositional diversity in the class, faculty, and patient populations led to positive increases on the students' diversity-related perceptions and attitudes. This was the first study to examine how interactions with diverse patients influenced students' attitudes and the result was that those interactions, "strongly influenced students' attitudes about both affirmative action and the societal value of diversity" (p. S87). Additionally, the authors noted that informal interactions regarding curriculum issues with a diverse group of peers contributed to all diversity attitudes measured for all three schools. The findings from this study suggested that medical students' attitudes about diversity, culture, health, and societal aspects of diversity are all influenced by the experiences they have in medical school.

While previous studies showed that interactions with diverse groups impacted diversity-related attitudes, a study at Harvard Medical School aimed to identify the specific types of interactions that occur in medical school that positively impact those attitudes. (Niu, et al., 2012). The researchers found that almost half of all students studied or socialized with peers of racial backgrounds different than their own more than 75% of the time. Additionally, the study showed that students who had a higher number of voluntary interactions with

diverse peers also rated themselves as more prepared to work with diverse populations. Specifically, students who spent more time studying with diverse peers, and students who participated in three or more voluntary extracurricular medical activities, felt more prepared to work with diverse patients than did those who spent less time studying with diverse peers and who had less diversity-related extracurricular involvement. This study helped to identify the types of interactions medical students have with diverse peers that lead to educational benefits of diversity in the medical education setting.

Overall, studies on the diversity rationale in medical education show enhanced learning outcomes when medical students learn in diverse settings. Increased diversity in the learning environment enhanced interactions among members of varying racial groups resulting in more positive attitudes toward diversity. These positive attitudes translated to the way students viewed patients of color. Thus, there is supporting evidence from these studies that diversity within the student body in medical school has an effect on cultural competency of physicians and could ultimately reduce health disparities.

**Linking Holistic Review and the Diversity Rationale to Health Disparities**

The studies above demonstrated that increasingly diverse educational environments positively impacted the diversity-related perceptions of future physicians. These perceptions can increase cultural competency among medical students, which is one of the tactics used to eliminate health disparities (AAMC, 2009; Betancourt, 2006; Smedley et al., 2003). Since holistic review is one strategy used by admissions committees to increase diversity within healthcare, it is appropriate to evaluate outcomes of holistic review through the lens of the diversity rationale (AAMC, 2013b).

Beyond using holistic review to simply diversify the student body, diversity within medicine is seen as part of institutional excellence and outstanding patient care (Nivet, 2011; Nivet, 2015). Several studies have shown that diverse groups create better solutions than groups without diversity (Page, 2008; Phillips, 2014). Therefore, it is appropriate to view diversity within a medical school cohort as one approach in achieving excellence and solving large-scale problems in health care such a health disparities (Kent & McCarthy, 2016; Nivet, 2011; Nivet, 2015).

## Holistic Review in Higher Education: Theory and Application

The decisions rendered in the aforementioned court cases provided the legal framework for considering race in admission decisions in institutions of higher education. Colleges and universities wishing to consider race in the admissions process must do so in accordance with state and national law, and in a way in which all applicants receive an individual, holistic review. The way holistic review is utilized within higher education is discussed here, followed by a discussion of how it is specifically used in medical schools.

### Cognitive and Non-Cognitive Factors of Admission

Holistic review often refers to the process of reviewing a wide-range of criteria and attributes for each applicant to a university (AAMC, 2013a; Espinosa, Gaertner, & Orfield, 2015; Urban Universities for HEALTH, 2014). The criteria and attributes considered for admission are a combination of the more traditional measures of academic success, such as GPA and test scores, as well as non-academic factors of admission, such as motivation and work-ethic, which have been shown to help predict success in college and give admissions committees a more well-rounded view of an applicant.

Historically, the predominant method of admitting students to higher education institutions involved the use of grade point average (GPA) and test scores, commonly called cognitive factors of admission. Both GPA and test scores are predictors of an applicant's ability to succeed in college (Camara, 2005a). However, studies have also shown that racial group differences on standardized tests used in college admissions, such as the SAT or GRE, exist and can impact an applicant of color's chance of being admitted to college (Miller & Stassun, 2014; Sackett, 2005). Another study suggested that using test scores may not accurately predict performance in fields that are service professions, such as social work, in which performance of the applicant in relation to others is of utmost importance (Milner, McNeil, & King, 1984). In addition, GPA can be influenced by a number of outside factors, such as motivation, attendance, and difference in grading practices among instructors, making it difficult to know what constructs GPA actually assesses (Camara, 2005a).

In order to gain a more well-rounded view of an applicant and better predict a student's success in college, the use of non-cognitive factors has become prevalent in college admissions and is used in holistic review. Sedlacek (2005), a leading researcher on the use of non-cognitive variables in college admissions, defined non-cognitive variables as, "variables relating to adjustment, motivation, and student perceptions, rather than the traditional verbal and quantitative (often called cognitive) areas typically measured by standardized tests" (p. 180). Non-cognitive variables encompass a wide-variety of attributes of an applicant such as personal experiences, biographical data, personality traits, background characteristics, and high school education (Camara, 2005b). In assessing those types of variables, admissions committees consider experiences and characteristics such as an applicant's involvement in activities, leadership experiences, gender, race, state of residence, persistence, and citizenship

(Camara, 2005a; Camara, 2005b; Price, Crout, Mitchell, Brunson, & Wearden, 2008; Sedlacek, 2005). These factors are assessed through interviews, personal statements, letters of reference, portfolios, and by asking the applicant to self-report such data (Camara, 2005b; Price, Crout, Mitchell, Brunson, & Wearden, 2008).

**Variations in Holistic Review**

Variations occur in the implementation of holistic review, specifically in health professional programs. One variation found in the execution of holistic review is the weight admission committees give to cognitive versus non-cognitive factors when reviewing applicants. A study by Urban Universities for HEALTH (2014) found that 36% of health professional programs using holistic review deemed cognitive metrics as somewhat more important than non-cognitive factors during the initial screening process, while 43% believed non-cognitive criteria were of equal importance to cognitive criteria during the initial screening process.

Another variation found in holistic review is at which stages cognitive and non-cognitive factors are reviewed during admission processes. Depending on the selectivity of the school or program, the admissions review may consist of several stages, such as deciding which applicants will be invited to complete a secondary application, determinations of who to interview, and making final decisions regarding admission after conducing interviews. As an over-reliance on either cognitive or non-cognitive factors at beginning stages might exclude promising applicants, an admissions process rooted in holistic review should incorporate both cognitive and non-cognitive review at each stage of the admissions process. (AAMC, 2010).

Despite the variances in implementation, utilizing holistic review by reviewing both cognitive and non-cognitive attributes throughout the admissions process helps universities to broaden their admission criteria beyond test scores and GPA. Sedlacek (2005) contended that by using non-cognitive measures in the admissions review process, institutions can achieve racial diversity in their incoming classes, "by virtue of considering variables that reflect race, culture, gender, and the other aspects of non-traditionality" (p. 189). Thus, programs and fields of study interested in increasing racial diversity within their workforce, such as the health professions, should be especially interested in their schools using holistic review whether or not they are specifically considering race in the admissions process.

**Use of Holistic Review in Undergraduate and Graduate Programs**

Holistic review is of interest to higher education programs at all levels seeking to increase diversity within admitted classes. To gain an understanding of how holistic review is used throughout higher education, three recent large-scale studies provided information on the use of holistic review in undergraduate, graduate, and health professional schools. Those studies will be discussed here, followed by an in-depth examination of the use of holistic review in medical schools.

**Undergraduate admissions.** A study by the American Council on Education surveyed four-year institutions to learn how race and ethnicity were utilized in undergraduate college admissions in light of the attention brought about by the Fisher case (Espinosa, Gaertner, & Orfield, 2015). 338 nonprofit four-year schools, reflecting a mix of public and private institutions that enroll over 2.7 million students, participated in the study.

Schools were asked to list their use of various admissions strategies to diversify the student body, and then to also list those strategies they thought were most effective

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(Espinosa, Gaertner, & Orfield, 2015). Holistic review was used by 76% of institutions, and was also rated by 67% of respondents as being highly effective, making it the only strategy in the survey that was both widely used and widely perceived as effective. Of those schools that considered race in admissions, 97% of institutions used holistic review and 85% perceived it as effective in increasing racial diversity, compared to schools who did not consider race, of which 69% used holistic review and 57% found it to be an effective strategy. Holistic review was rated as the most frequently used strategy and the most effective strategy to diversify the student body of those undergraduate institutions that did consider race in admissions.

**Graduate admissions.** Kent and McCarthy (2016) writing on behalf of the Council of Graduate Schools recently produced a report on the use of holistic review in graduate school admissions across the United States. Their one-year study reviewed existing literature on holistic review, and surveyed the 560 U.S. and Canadian graduate institutions that belong to the Council of Graduate Schools about their admission practices. 250 schools provided at least one response to the survey, for a response rate of roughly 45%. 857 individuals from graduate school staff and faculty outside of a graduate school responded, indicating that schools submitted multiple surveys. Presumably, multiple responses from individuals from the same institutions represented different academic programs, though the authors indicated that a limitation of the study was the possibility that individuals provided information on identical programs.

The study found that a majority of graduate schools viewed holistic review as a valuable strategy for improving the diversity of their classes (Kent & McCarthy, 2016). However, a majority of respondents expressed a desire for a better understanding of what holistic review processes should be for masters and doctoral programs. Additionally, they felt

that limited time and personnel were the greatest hindrances for advancing holistic review practices. The time and resources required to implement holistic review have been noted by other researchers (Urban Universities for HEALTH, 2014; Wall, et al., 2015).

**Health professions.** A recent study regarding holistic review in the health professions also provided a high-level view of current practices. The group Urban Universities for HEALTH (2014) surveyed health professional schools to learn about the utilization of holistic review admission processes. Urban Universities for HEALTH, a partnership involving the Coalition of Urban Serving Universities, the Association of Public and Land-Grant Universities, the AAMC, and the National Institute on Minority Health and Health Disparities, aims to improve information about practices that will, among other things, increase the diversity of the health care workforce and improve health equity. Dr. Betty Drees, former dean of the UMKC School of Medicine (the site of the present study), was a co-principal investigator for the study.

The need for Urban Universities for HEALTH (2014) to conduct their study came from a yearning to learn more about the growing practice of holistic review in health professional schools, and how that might impact diversity within the health professions workforce. Their 46-question electronic survey was sent to presidents of 163 public universities that contained at least two health professional programs, including medicine, dentistry, pharmacy, nursing, and public health. Responses were collected from 104 universities throughout 45 states, resulting in a response rate of 64% and representing 228 individual health professions programs from the 104 schools.

93% of dental programs and 91% of medical programs reported using holistic review in their admission processes (Urban Universities for HEALTH, 2014). Public health

programs, pharmacy, and nursing programs were lower at rates of 82%, 78%, and 47%

respectively. The survey also asked programs to report the extent to which they utilized a

holistic review process by asking which components of holistic review the school had

adopted. Results indicated that 38% of the programs reported using many elements of holistic

review, while 48% reported using some elements.

The findings of the Urban Universities for HEALTH (2014) study indicated that

medical and dental schools lead the way in holistic review in the health professions. They

credited this to effective initiatives by both the AAMC and American Dental Education

Association (ADEA), which aimed to help medical and dental schools diversify their student

bodies.

The proliferation of dental schools using holistic review can be credited to a 2001

initiative funded by the Robert Wood Johnson Foundation. The initiative, *Pipeline,*

*Profession, and Practice: Community Based Dental Education Program*, provided funding to

11 dental schools to create and support community-based clinical programs as well as

increase the racial and economic diversity of incoming dental school classes (Robert Wood

Johnson Foundation, 2013). The focus on diversifying the incoming dental school classes,

which included a mandatory workshop for all participating schools on how to conduct

holistic review, led to the increased use of holistic review at participating schools (Atchison,

Friedman, & Freed, 2009; Price & Grant-Mills, 2010; Thind, et al., 2009). In conjunction, the

ADEA implemented a workshop on holistic review that was presented at 27 dental schools

between 2004 and 2011 (Wells, Brunson, Sinkford, & Valachovic, 2011). The combined

efforts of the *Pipeline* initiative and the ADEA provided a variety of dental schools across

the United States with support to understand and implement holistic review.

**Holistic Review at Medical Schools: Theory and Application**

As the Urban Universities for HEALTH (2014) report showed, medical schools reported a high usage of holistic review in their admissions practices. The popular use of holistic review may be attributed to the support medical schools have received from the AAMC in implementing holistic review. The AAMC leads the academic medicine community consisting of all 147 U.S. MD-granting schools, 17 Canadian schools, almost 400 teaching hospitals, over 50 Department of Veterans Affairs medical centers, and over 80 academic societies (AAMC, 2017b). Their vision includes preparing physicians to meet the nation's health care needs and ensuring the health system meets the needs of the public, both of which explain their involvement in supporting medical schools to implement holistic review of applicants.

In 2007, the AAMC began the Holistic Review Project, now the Holistic Review Initiative, to assist medical school admissions committees in creating and sustaining diversity in ways specific to each school's mission (AAMC, 2014a). The initiative is attentive to the multiple processes and policies that affect admissions not only to medical school, but to training after medical school and continued education. The AAMC developed three in-depth documents to assist medical schools in implementing holistic review, focusing on: 1) developing mission-specific holistic review practices throughout all aspects of the admissions process, 2) implementing evaluation of holistic review in medical school, and 3) legal and educational policy regarding the use of holistic review in admissions (AAMC, 2010; AAMC, 2013b; AAMC, 2014c).

The AAMC (2010) defines holistic review by a medical school as, "a flexible, highly-individualized process by which balanced consideration is given to the multiple ways in

which applicants may prepare for and demonstrate suitability as medical students and future physicians" (p. ix). This definition is heavily influenced by language from the aforementioned *Grutter v. Bollinger et al.* case (AAMC, 2014c). Specifically, four core principles underline the definition of a holistic review process set forth by the AAMC (2014c):

1. In a holistic admissions process, selection criteria are broad-based, are clearly linked to school mission and goals, and promote diversity as an essential element to achieving institutional excellence.

2. A balance of experiences, attributes, and academic metrics (E-A-M) is

    a. Used to assess applicants with the intent of creating a richly diverse interview and selection pool and student body;

    b. Applied equitably across the entire candidate pool; and

    c. Grounded in data that provide evidence supporting the use of selection criteria beyond grades and test scores.

3. Admissions staff and committee members give individualized consideration to how each applicant may contribute to the medical school learning environment and the practice of medicine, weighing and balancing the range of criteria needed in a class to achieve the outcomes desired by the school.

4. Race and ethnicity may be considered as factors when making admission-related decisions only when such consideration is narrowly tailored to achieve mission-related educational interests and goals associated with student diversity, and when considered as part of a broader mix of factors, which may include personal

attributes, experiential factors, demographics, or other considerations [under

federal law and where permitted by state law]. (p. 13)

These four principles guide medical schools to ensure they implement a holistic review process that meets the AAMC's definition of holistic review while at the same time adhering to the guidelines set forth by Supreme Court's determination on the use of holistic review in admissions.

The second AAMC principle mentions experiences, attributes, and academic metrics (E-A-M), which is another way to describe cognitive and non-cognitive criteria. Metrics are cognitive criteria that include GPA and test scores (AAMC, 2010). Experiences are non-cognitive criteria, and include educational background, research, shadowing in a healthcare setting, and the journey or path taken by an applicant throughout their life. Attributes are also non-cognitive criteria that include skills, abilities, characteristics, and demographic factors, such as race or ethnicity. It is clear with the four principles above and the usage of the E-A-M model that race and ethnicity become only a small part of many factors used in the process of holistic review.

Finally, the AAMC asserts that the process of holistic review must occur throughout the admissions process in order for a university to meet its stated mission and goals with holistic review (AAMC, 2010). The admissions process at a medical school commonly involves at least three stages: screening, interviewing, and selecting. The purpose of the screening process is to reduce the initially large applicant pool to a smaller number with which to interview. This could be done swiftly by using metrics to narrow an applicant pool first, and then spending time reviewing experiences and attributes with a smaller number of applicants. However, if the screening process does not involve reviewing the E-A-M of each

applicant at that stage, a school may reject a student who actually is a great fit to the mission of the school. Therefore, in order to appropriately implement holistic review, consideration of E-A-M must be conducted at all stages of the admission process.

A 2008 study of admissions practices in medical schools found that while medical schools made strides in implementing holistic admission practices, on average, they still did not follow the best practices as currently laid out by the AAMC (Monroe, Quinn, Samuelson, Dunleavy, & Dowd, 2013). The study was designed to learn how medical school admissions practices had changed over the last two decades, comparing the results of the study to those of a 1989 study by Johnson and Edwards (1991), which reviewed admission practices across the United States (Monroe et al., 2013). The updated study found more than twice as many schools included diversity as a primary goal of their admission process in 2008, compared to 1989, with 57% of schools including it in the updated survey, as opposed to 28% previously. Additionally, the data in the updated study showed that non-cognitive factors had a more important role than in the past, pointing to an increased use of holistic review. However, the usage of non-cognitive factors was highest in deciding who to accept, and less important in deciding who to invite for secondary applications or who to interview. Overall, the study found that the use of holistic review in medical schools had increased since the 1989 study. By the time the aforementioned Urban University for HEALTH report was conducted several years later, 91% of medical programs who responded to the survey reported using holistic review in their admission processes (2014).

As evidenced, since the implementation of the Holistic Review Project in 2007, the AAMC provided a wealth of tools and guidance on how to properly implement holistic review in medical education. The Council on Graduate Studies report and the Urban

Universities for HEALTH both cited the AAMC initiative specifically in their discussion of holistic review. In addition, national organizations for nursing, pharmacy, and dentistry all incorporate information from the AAMC's resources in their own initiatives regarding the use holistic review, showing that AAMC was a leader in the holistic review movement in the health professions (American Association of Colleges of Nursing, 2016; Wall, et al., 2015; Wells, Brunson, Sinkford, & Valachovic, 2011).

## Evaluation of Holistic Review

As shown by the recent nationwide studies by the American Council on Education, Council on Graduate Studies, and Urban Universities for HEALTH, holistic review within higher education is a current topic receiving national attention (Espinosa, Gaertner, & Orfield, 2015; Kent & McCarthy, 2016; Urban Universities for HEALTH, 2014). Outcome measures of the effectiveness of holistic review are important to examine given the emphasis on implementing the practice. This section outlines types of outcome measures common to holistic review, existing studies measuring its effectiveness, and the need to continue to research this important topic.

### Measuring Outcomes of Holistic Review

As stated previously, holistic review processes should be guided by the mission and goals of the institution (AAMC, 2010; AAMC, 2014a; AAMC, 2014c; Urban Universities for HEALTH, 2014). Likewise, the evaluation of holistic review outcomes should be framed within the mission and goals of the institution (AAMC, 2013b; Espinosa, Gaertner, & Orfield, 2015). This makes it difficult to apply large-scale studies on the outcomes of holistic review to a particular school, though generalizations can be made if the goals, resources, and

mission of the university match those identified in the study (Espinosa, Gaertner, & Orfield, 2015).

The AAMC has provided a framework for evaluating the learning, developmental, and professional outcomes of holistic review in medical school admissions (AAMC, 2013b). Learning outcomes focus on the core academic competencies of graduates, particularly in cognitive factors like GPA or licensing exam scores. Developmental outcomes track the way in which the school shapes its students' values and attitudes related to the practice of medicine. Finally, professional outcomes relate to the specialty choice and location of a graduate's practice, but also include professional behavior and conduct of graduates throughout their time as physicians. The AAMC suggests multiple data sources to examine each of the three types of outcomes, such as institutional records, surveys, and focus groups, and believes these data can be examined either quantitatively or qualitatively.

The three categories of outcomes encompass both cognitive and non-cognitive measures of success. Traditional methods of evaluating the effectiveness of admissions goals include cognitive measures such as graduating GPA and graduation rates (Schmitt, Oswald, & Gillespie, 2005). However, this definition of academic success ignores the many traits important to succeeding in a profession such as leadership, integrity, citizenship, and social responsibility. The lack of outcome measures in these non-cognitive realms is described in industrial and organizational psychology as "criterion deficiency." Schmitt, Oswald, and Gillespie (2005) suggested that measuring the outcomes of non-cognitive attributes and experiences will address the criterion deficiency. Therefore, the evaluation framework provided by the AAMC serves as a guide to address this deficiency by including both

cognitive and non-cognitive components in measuring the outcomes of holistic review (2013b).

**Outcomes of Holistic Review in the Health Professions**

Several studies examined the outcomes of holistic review in the health professions despite the practice of holistic review being relatively new. Some focused on the outcomes of the holistic review process at matriculation while others focused on long-term outcomes at graduation. A common theme was how holistic review affected student body diversity, showing that diversity within a class was an important component of initiating holistic review as an admissions strategy.

In the nation-wide Urban Universities of HEALTH (2014) report, findings showed that the majority of health professional schools who reported using holistic review also reported an increase in the diversity of the student body. They also found a statistically significant increase in diversity between programs utilizing few elements of holistic review and those utilizing many elements with those utilizing many elements having increased diversity in their matriculating classes.

The Urban Universities of HEALTH (2014) report also showed that the cognitive measures of GPA and test scores either improved or stayed the same for programs that used holistic review. Similar results were found upon graduation, as 97% of programs using holistic review reported improvements or no changes in graduating GPA, and 91% of programs reported that the average number of attempts for students to pass the licensing exams were either improved (a decrease in the number of attempts prior to passing) or unchanged. Further, 96% of schools using holistic review saw either increased change or no change in graduation rates. Therefore, the implementation of holistic review produced

students who maintained or enhanced the level of academic achievement experienced prior to the implementation.

Additionally, the Urban Universities of HEALTH (2014) report found evidence that holistic review contributed toward outcomes that were non-cognitive in nature. Of the schools tracking such outcomes, 70% found that student engagement with the community had increased, 66% found that cooperation and teamwork had increased, and 75% found that students' openness to ideas and perspectives different from their own had increased. These types of measures are important to study if the mission of a university admissions committee is to positively affect the diversity of the workforce and graduate providers who are competent in working with a variety of patients. These outcomes are in line with outcomes expected by the diversity rationale.

**Outcomes of holistic review in dental schools.** In dentistry specifically, studies regarding the impact of the Robert Wood Johnson Foundation's Pipeline program often cited holistic review as having an effect on increasing the diversity of matriculating dental classes (Atchison, Hewlett, & Friedman, 2009; Jackson, 2009; Price & Grant-Mills, 2010). These studies, however, did not explore the effect of holistic review separated from the other aspects of the *Pipeline* initiative that also aimed to increase diversity such as targeted recruitment of students of color, post-baccalaureate programs, and changes in curriculum. Therefore, it is difficult to determine the outcomes of implementing holistic review at these schools in particular, though one school cited it as one of their strongest commitments to diversify their class (Lacy, McCann, Miller, Solomon, & Reuben, 2012). Additionally, a dental school implementing holistic review and weighing non-cognitive criteria heavier than cognitive criteria saw a large jump in enrollment of students of color, leading researchers to

believe that utilizing holistic review and increasing the importance given to non-cognitive factors helped the university meet its mission (Wilson, Sedlacek, & Lowery, 2014).

The outcomes measures of the aforementioned ADEA-sponsored workshops on implementing holistic review also showed an increase in enrollment of students of color at those dental schools who hosted the workshops (Price, Wells, Brunson, Sinkford, & Valachovic, 2011). However, the growth and size of the increase varied among schools, and it is possible that those schools were also a part of the *Pipeline* program and therefore were undergoing other diversity-related endeavors at the time. As in the *Pipeline* outcomes, it is difficult to determine if the effect was due to holistic review alone or other factors at those schools.

All of the studies of holistic review in dental schools cited above focused on the composition of the matriculating class. Absent from these studies were outcomes measures of holistic review beyond admission such as licensing exam passage rates, graduation rates, and perceptions related to diversity. These outcomes need to be studied in order to determine if the goal of diversifying the dental profession, and not just the student body, has been reached through the implementation of holistic review.

**Outcomes of holistic review in medical schools.** Like dental schools, several studies examined the outcomes of implementing a holistic review admission process in medical schools. A brief report from Boston University School of Medicine described their transition from a metrics-based admission process to a holistic process and the outcomes found from that transition (Witzburg & Sondheimer, 2013). Their systematic change in admission process included aligning the admissions committee's mission with that of the institution, as well as developing a tool to assess characteristics and behaviors important to the mission.

These changes resulted in a higher number of students of color admitted after holistic review was implemented up from 11-12% before the implementation to 20% afterward. In addition, faculty members reported anecdotally that students admitted through holistic review were more engaged, more collegial, more open to new perspectives, and pursued a broader range of specialties than those students admitted prior to holistic review. Providing measurements for these types of non-cognitive outcomes would strengthen the literature on the impact of holistic review.

The differences in weight between cognitive and non-cognitive factors used in admissions decisions has also been examined in a medical school utilizing holistic review. A study from the University of New Mexico School of Medicine examined how changing the weight given to cognitive and non-cognitive factors changed the racial diversity within a class (Ballejos et al., 2015). Their study used historical applicant data from the applicants to the 2007, 2008, and 2009 entering classes, when the admission committees used a process of weighing cognitive scores and non-cognitive scores equally to each other in a 50/50 ratio when making admissions decisions.

Researchers found that modifying the university's existing model of weighing cognitive and non-cognitive factors equally affected the number of students of color who qualified for admission (Ballejos et al., 2015). When researchers gave non-cognitive factors more weight, the number of students of color qualifying for admission increased. When the ratio of cognitive to non-cognitive weights reached 35% to 65%, respectively, the percentage of students of color qualifying for admission represented a statistically significant difference compared to the percentage of students of color qualifying for admissions when cognitive and non-cognitive factors were equal. Over the three years studied, this change would have

resulted in 15 more students of color qualifying for admission. In addition, the overall mean Medical College Admission Test (MCAT) score and the mean undergraduate GPA were not statistically significantly different from each other between the 50/50 weighing model and the 35/65 weighing model indicating that academic rigor of applicants did not decrease as more students of color qualified for admission.

The findings from this study showed the effects of weighing cognitive criteria and non-cognitive criteria differently on the number of students of color admitted (Ballejos et al., 2015). In addition, when more students of color qualified for admission, the academic credentials of the class did not decrease. These findings are especially important to show how variation in implementing holistic review can affect admission rates for students of color and to show how admission rates of students of color can be increased without changing the academic credentials of an incoming class. While these findings point to the importance of holistic review and non-cognitive criteria during admissions, they are limited to the composition of an entering class and lack information beyond admission.

**Outcomes after matriculation.** The studies above provided descriptive statistics on racial diversity within an incoming class, but did not provide measurements on the effect of holistic review on diversity and mission-related outcomes past the admission stage. A study at the UMKC School of Medicine, the site of the present study, examined the impact of holistic review on academic success in the first two years of the six-year combined baccalaureate and medical degree program described in more detail in an upcoming section (Arredondo, 2015). The primary goal of the study was to learn which admission factors predicted success in the combined degree program. A secondary goal was to determine if

there were any differences in GPA attainment and status in the program for students after implementing holistic review.

The study found that in the five years prior to holistic review, 12.3%, or 65, students of color were admitted to the school, compared to 20.1% in the first four years of holistic review, in which 87 students of color were admitted (Arredondo, 2015). Over the same time period, there was a slight increase in mean test score and mean high school GPA between pre- and post-holistic review, indicating the academic standards of the matriculating cohorts were similar. Additionally, a t-test found no statistically significant difference in the first-year GPA and the second-year GPA between those admitted with pre-holistic review compared to post-holistic review. Thus, the school diversified its student body with holistic review while also maintaining the academic performance within the first and second year.

One key academic outcome, however, appeared in the academic success status of students after finishing the first two years of the six-year program. Namely, students admitted under holistic review were more likely to be on-track after the first two years of the combined degree program than those admitted prior to holistic review (Arredondo, 2015). Before holistic review, 69.8% of students completed the first two years on-track while 78.5% of students admitted through holistic review were on track after two years. This important outcome may confirm that holistic review did a better job of selecting students who could be successful at the school and shows a positive impact of holistic review on early program retention. As in previous studies mentioned, this study did not include data on the impact of holistic review on graduates, but instead focused on success midway through degree completion. Graduation data are essential to determine if holistic review is meeting its intended goals.

**Continued Need for Evaluation for Holistic Review**

Despite the studies above providing information on the outcomes of holistic review, recent reports on holistic review continued to call for more data. The aforementioned report from the Council on Graduate Schools found that 81% of graduate school staff responding to their survey would like more data showing how admission requirements align with student success, particularly when deciding to use holistic review approaches (Kent & McCarthy, 2016, p. iii). Espinoza, Gaertner, and Orfield (2015) found undergraduate institutions requested an alignment of research practices in the larger field of diversity and admissions to practical approaches that could be enacted on their campuses. The authors suggested further research practices should focus on how to communicate findings in a straightforward way, as well as suggesting that research on diversity benefits be specific to individual campuses. Finally, in medical education, the AAMC suggested that rigorous evaluation is needed to analyze the benefits of newer admission practices, such as holistic review (Mahon, Henderson, & Kirch, 2013, p. 1810).

**Summary of Outcomes of Holistic Review**

In addition to a need for more studies in general, there is a lack of data on the outcomes of holistic review beyond admission. Many of the extant studies focused only on the composition of the matriculating class, and not on the performance of those classes throughout the curriculum and at graduation. Tracking outcomes past admission to graduation and entering the workforce is important to understanding how changing admission practices might eventually affect the health of the population as a whole (AAMC, 2013b; Urban Universities for HEALTH, 2014). Extant studies on holistic review in medicine focused on the beginning of that pipeline, but not through to graduation.

The AAMC asserted that evaluation is critical to determine if the utilization of holistic review has helped the medical school meet its mission of diversifying its student body and eventually improving the health of patients (AAMC, 2013b; Nivet, 2012; Nivet, 2015). In order to answer these questions, non-cognitive outcomes need to be measured beyond the admissions stage. The present study aims to provide a more complete picture of the holistic review pipeline by examining cognitive and non-cognitive outcomes of graduates who were admitted using holistic review in both a combined and traditional medical degree program at UMKC School of Medicine.

**Medical Degree Programs**

To illuminate how medical degree programs differ from other higher education programs, this section describes medical education in the United States, including the varying ways in which programs are structured. As the site of the present study includes both a combined degree program and a traditional degree program, both are discussed. In addition, the development of the medical education programs at the study site location, UMKC School of Medicine, is reviewed as the combined degree program model it offers is less common in American medical education than the traditional degree program model. The section ends with a discussion of how holistic review is used at UMKC with both its combined and traditional program.

Traditionally in the United States, medical degrees are obtained in an eight-year timeline, consisting of four years of undergraduate education resulting in a bachelor's degree, and then four years of medical education resulting in a medical degree (Norman & Calkins, 1992; Callahan et al., 1992). As of the 2016-2017 school year, there were 145 accredited Doctor of Medicine (M.D.) degree programs (Liaison Committee on Medical Education,

2016) and 33 accredited Doctor of Osteopathic Medicine (D.O.) degree programs in the

United States (American Association of Colleges of Osteopathic Medicine, 2016). Both

program types lead to licensure to practice medicine, with the M.D. being the more common

of the two degrees. The present study focuses on medical schools leading to the M.D. degree.

The historical structure of medical school curriculum in the United States was

suggested by Abraham Flexner (1910) in a landmark study and commentary, "The Flexner

Report," on the state of American medical education at the beginning of the twentieth

century. This report shaped the way medical schools offered medical education for the next

fifty years (Hopkins, Pratt, Bowen, & Regehr, 2015; Olson, 1992). This historical model can

be described as distinct segments of curriculum comprised of premedical (undergraduate

degree) coursework, two years of basic science coursework in medical school, two years of

clinical instruction in medical school, and then post-graduate residency training after receipt

of the medical degree (Olson, 1992). In this model, students spend approximately four years

obtaining the premedical coursework and a bachelor's degree prior to entering medical

school.

**Combined Degree Programs**

In the 1950's and 1960's, medical schools began to review the traditional curriculum

structure of medical education in response to federal reports predicting a need for more

physicians in the United States (Mallon, 2007). Western Reserve University was one of the

first medical schools to integrate the separate parts of medical curriculum, the basic medical

sciences and the clinical instruction (Olson, 1992). Soon after, several medical schools such

as Boston University, Northwestern University, and Jefferson Medical College-Pennsylvania

State University constructed the first combined degree programs that sought to link the

undergraduate and medical science curriculum together (Norman & Calkins, 1992). By offering a degree program that resulted in both a bachelor's degree and medical degree, these schools reduced duplication between the premedical and basic sciences curriculum and shortened the bachelor's and medical degree timeframe from eight years down to five or six years, graduating physicians into the community at a faster pace than the traditional medical education model.

In an oft-cited study, Norman and Calkins (1992) reviewed all combined degree programs in the United States to examine the curricular and size variations in such programs. At the time of the study, 33 combined degree programs existed at 28 of the 125 medical schools in the United States. Motivating factors for creating these combined programs included recruiting talented students interested in medicine directly from high school, avoiding duplication in the science coursework, shortening the length of medical education and graduating more physicians for the community. While the earliest combined programs were accelerated in nature, combined degree programs in the early 1990s were between six to eight years in length, likely a result of a decrease in the national need to graduate physicians quickly at the time. The size of the combined program class at each school varied, but it was rarely the predominant program at any school. Thus, it was more common for a select group of students to be involved with a combined program, while the majority of medical students at those particular schools were educated through the traditional model of four years of medical education following a bachelor's degree.

More recently, an updated study of combined degree medical programs found 81 combined degree programs at 57 medical schools in the United States (Eaglen, et al., 2012). The motivations for having combined programs remained similar to those of the 1990s, with

an added desire to reduce the stress of applying to medical school and to improve the experience of the premedical education component. Almost 80% of the programs were eight years in length; thus, only 14 schools shortened the length of medical education down to six or seven years through their combined programs. Most schools continued to offer the combined program to only a small percentage of their overall medical school enrollment (Eaglen, et al., 2012).

Critics of combined programs voiced concern regarding high school graduates entering such programs and committing to the medical profession at a young age, but proponents of combined degree programs asserted there was a small group of high school graduates for whom this structure is appropriate (Daubney, Wagner, & Rogers, 1981; Olson, 1992). In addition, since the majority of combined programs are eight years in length, the students are of similar age as a student completing medical education in the traditional format (Eaglen, et al., 2012). Previous studies have found that students in and graduates of combined programs perform similarly on measures of academic performance as their peers who have completed a more traditional medical education (Callahan, et al., 1992; Green, Welty, Thomas, & Curry, 2016; Loftus, Willoughby, & Connolly, 1997).

**University of Missouri-Kansas City School of Medicine**

The University of Missouri-Kansas City School of Medicine began in 1971 with founder Dr. E. Grey Dimond leading the charge for a combined baccalaureate and medical degree program. This innovative and non-traditional approach to medical education had a goal of admitting students directly from high school and offering a curriculum that would lead to both a baccalaureate degree and medical degree in only six years (Mauro, 2014). The school was established at a time of tremendous change in the medical and educational

landscape of Kansas City, which included the restructure of the city's indigent public hospital, the relocation of Children's Mercy Hospital and the UMKC School of Dentistry adjacent to the public hospital, and the merging of the University of Kansas City with the University of Missouri system (Noback, 2014). Given this transformation, an innovative plan such as Dr. Dimond's fit in with the changing times.

Four key features define the UMKC School of Medicine: "(1) a combined baccalaureate/MD program, (2) early exposure to clinical medicine, (3) small-group learning through the docent system, and (4) a continuing ambulatory care clinic experience for four years" (Drees, Arnold, & Jonas, 2007). The curriculum includes a mix of both undergraduate and medical courses throughout the six years. The first two years includes three-fourths undergraduate coursework and one-fourth medical coursework, then the proportion reverses for the final four years (Dimond, Sirridge, & Drees, 2009).

Among other combined degree programs, the six-year timeframe is rare. As of 2012, only five medical schools offered a combined program six years in length (Eaglen, et al., 2012). In addition, the size of combined degree programs varies widely in some cases admitting 10 or fewer students to the program annually. At these schools, the most popular curriculum is the traditional route, and the combined degree program is the exception. UMKC is the opposite: it is one of only three schools in which combined degree program students comprise the majority of the incoming class (Eaglen, et al., 2012). UMKC also offers a traditional route to a small number of students each year as well, but the majority of the students at UMKC participate in the six-year curriculum (A. Arredondo, personal communication, April 6, 2017; Dimond et al., 2009).

Overall, the six-year combined degree program, coupled with early and repeated clinical encounters in a supportive small-group learning docent system, defines UMKC's School of Medicine. Its distinctiveness is furthered by the fact that undergraduate and medical coursework runs tangent throughout the six years, instead of separated into different years of the curriculum (Eaglen, et al., 2012) These defining characteristics make UMKC's combined degree program unlike other combined degree programs in the United States.

**Admissions and Holistic Review at the UMKC School of Medicine**

As stated above, UMKC School of Medicine has both a six-year combined degree program, commonly called the BA/MD program, as well as a traditional four-year MD program. The BA/MD program commonly admits between 109 and 115 students to its incoming class beginning in the fall semester each year (A. Arredondo, personal communication, April 6, 2017). The more traditional four-year program, commonly called the MD program, admits between 12 and 20 students to its incoming class beginning in the spring semester each year. Students admitted to the MD program join the BA/MD students in the spring semester of the second year of their curriculum. Since the MD students have completed a bachelor's degree before joining UMKC's medical school, they tend to be older than the BA/MD students and have more college experience. However, once the two groups join together as described above, they are educated together in the same classroom, are on docent teams together, and serve in the clinic together. In short, the majority of their medical education is the same despite their differences in background.

All UMKC School of Medicine students are admitted through processes and reviews designed by the Council on Selection. The Council on Selection utilizes holistic review when selecting applicants, and bases their model on the AAMC's aforementioned holistic review

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model (UMKC School of Medicine, 2017a). The school implemented holistic review with the BA/MD class that matriculated in Fall 2010 and the MD class that matriculated in Spring 2011 (A. Arredondo, personal communication, April 6, 2017).

The Council on Selection aims to admit students who will succeed in developing the six UMKC School of Medicine core competencies: communication skills, professionalism, medical knowledge, practice-based learning, systems-based practice, and patient care (UMKC School of Medicine, 2017a). In addition, the Council on Selection addresses diversity in their description of their processes, striving to admit students who can contribute diverse perspectives to both the classroom environment and the medical profession. Further, the Council believes that diversity among the class throughout the educational process prepares all students to be effective providers to diverse populations upon entering the workforce.

The aforementioned study of the outcomes of holistic review at UMKC focused on the BA/MD program specifically, and the success and retention of BA/MD students in the first two years of the six-year program (Arredondo, 2015). Arredondo's study showed that the implementation of holistic review positively affected the racial diversity of the incoming class and the success of students the first two years of the BA/MD program. The present study builds on Arredondo's by focusing on outcomes of graduates who were admitted using holistic review. The study will compare learning, developmental, and professional outcomes of students who were admitted pre-holistic review and those who were admitted post-holistic review. Differences for the BA/MD graduates and MD graduates will be examined separately.

**Dearth of Evaluation of Outcomes of Holistic Review in Medical Education**

In searching the medical literature for this literature review, there was a lack of studies on the outcomes of holistic review in medical schools and none in combined degree programs in medical education. A search for "holistic admission", "holistic admissions," and "holistic review" in the medical education journals *Academic Medicine*, *Teaching and Learning in Medicine*, *Journal of the American Medical Association*, and *the New England Journal of Medicine* resulted in only one study regarding holistic review outcomes: the aforementioned study at Boston University School of Medicine by Witzburg and Sondheimer (2013). AAMC staff involved with the *Advancing Holistic Review Initiative* were also not aware of studies examining the outcomes of holistic review at the individual school level outside of the Witzburg and Sondheimer (2013) study (S. Conrad, personal communication, March 28, 2017). Despite several large-scale studies highlighting a need for holistic review outcomes data, and best practices indicating that this needs to be at the individual school level, there are few published studies answering the call (AAMC, 2013b; Espinosa, Gaertner, & Orfield, 2015; Kent & McCarthy, 2016).

The few studies on holistic review in medical education have focused on outcomes of the admissions process and outcomes assessed mid-way through the curriculum, but studies have not been published regarding the outcomes of graduates from medical schools who were admitted using holistic review (Arredondo, 2015; Ballejos et al., 2015; Witzburg & Sondheimer, 2013). While the Urban Universities for HEALTH (2014) report showed that the majority of schools using holistic review practices reported increased or unchanged outcomes in graduation rates, GPA, and licensing exam rates for graduates, these data were

not presented for each degree program studied. Therefore, it is unknown how these measures were affected by holistic review processes specifically in medical education.

Further, there is a lack of data about the non-cognitive outcomes of holistic review in medical education. Witzburg and Sondheimer (2013) alluded to an increase in student engagement, collegiality within the class, and openness to new ideas among students after diversifying the class through holistic review, but did not provide data measuring these observations. The Urban Universities for HEALTH (2014) report showed that student engagement within the community, cooperation and teamwork, and openness to new ideas increased in health professional schools with the utilization of holistic review, but did not provide these data specifically for medical schools. Measuring these types of non-cognitive outcomes is supported by the AAMC best practices and provides a way for schools to evaluate the outcome of their admission goals when those goals are non-cognitive in nature (AAMC, 2013b; Schmitt, Oswald, & Gillespie, 2005). However, studies that measure non-cognitive outcomes in graduates of medical schools that utilize holistic review are scarce or non-existent.

The American Council on Education, Council of Graduate Schools, and Urban Universities for HEALTH all have recently called for further evaluation to better inform the holistic review literature in undergraduate, graduate and health professional school admission (Espinosa, Gaertner, & Orfield, 2015; Kent & McCarthy, 2016; Urban Universities for HEALTH, 2014). Specifically, the AAMC has also called for this type of evaluation in medical education (AAMC, 2013b; S. Conrad, personal communication, March 28, 2017; Mahon, Henderson, & Kirch, 2013; Nivet, 2012). The call for evaluation of holistic review in medical education is timely. The AAMC initiative is only 10 years old, and it is realistic to

assume that medical schools are just now producing graduates admitted under initial efforts at holistic review. Studying the outcomes of holistic review at the UMKC School of Medicine provides a unique opportunity to study both a six-year combined baccalaureate and medical degree program with a four-year traditional medical degree program within the same setting. Therefore, this study will provide an evaluation that is essential to both the literature and in the medical education community.

The present study will contribute to the literature by answering the following research questions:

1. How did changing to a holistic review admissions process affect the academic success of medical students?

   a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized?

   b. How did the graduation rate change for students of color after holistic review was utilized?

2. How did self-perceived measures of diversity-related competencies and experiences change in cohorts admitted using holistic review?

   a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized?

**Summary**

The health care workforce in the United States does not represent the racial and ethnic diversity of the country. In addition, patients of color suffer from health disparities. Increasing the diversity of the health care workforce is one way to impact and reduce health disparities, but diversifying the workforce can only be done by admitting and graduating

students of color from health professional schools. Utilizing holistic review during the admissions process is one attempt health professional schools can take to diversify their student body. Additionally, as the diversity rationale asserts that diversifying the student body benefits the learning of all students, utilizing holistic review can also increase the cultural competency of all students which is an additional strategy used to eliminate health disparities.

AAMC has put many resources into supporting the implementation of holistic review at medical schools. The few published studies evaluating the effect of holistic review at medical schools mainly focused on the composition of the admitted class, but did not go beyond admissions to evaluate graduation outcomes. Studies examining the diversity rationale within medical education provided support for the impact of diverse student bodies upon students' attitudes regarding diversity and patient care. As the diversity rationale is the underlying principle of holistic review, it is appropriate to examine how students' attitudes, values, and perceptions regarding diversity have been affected by the adoption of holistic review within an institution.

This study will test the diversity rationale by examining both cognitive and non-cognitive outcomes of graduates from a medical school utilizing holistic review. Outcomes will focus on learning, developmental, and professional outcomes, such as GPA and graduation rates, effective communication with a variety of people, and awareness of social issues impacting medicine. The outcomes will be compared for graduates admitted prior to holistic review and after holistic review to determine if the implementation of holistic review affected those outcomes. In addition, since the UMKC School of Medicine offers two paths to a medical degree, the outcomes of students in each degree program will be examined

separately to determine the differences in outcomes, if any, for the two types of degree programs. The results of this study will provide an evaluation of cognitive and non-cognitive outcomes of graduates of a program that utilizes holistic review upon admission. In addition, by evaluating both a combined degree and traditional-degree program, results could be generalized to medical schools that offer either or both types of programs.

In the following chapter, I discuss the research questions for this study, the hypothesis for each question, and the reasoning supporting each hypothesis. In addition, the design of the study is outlined, including data sources, variables used to answer each research question, and data analysis methods

CHAPTER 3

METHODOLOGY

The purpose of this study is to examine diversity-related outcomes of holistic review at a medical school offering a six-year combined baccalaureate and MD degree program as well as a traditional four-year MD degree program. Both cognitive and non-cognitive outcomes will be examined by focusing on learning, developmental, and professional outcomes, such as academic measures, self-perceived competencies in diversity-related topics, and activities completed during medical school. Specific dependent variables described in this chapter were selected in accordance with the mission of the university and guided by previous studies examining the diversity rationale. This chapter outlines the hypotheses and design of this study, describes the study sample, data selection, and variables, and explains data analysis.

**Research Questions and Hypotheses**

This section presents the research questions for this study and provides each question's hypothesis and rationale.

*Research Question 1.* How did changing to a holistic review admissions process affect the academic success of medical students?

    a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized, as measured by graduation rate, graduating GPA, and licensing exam performance?

    b. How did the graduation rate change for students of color after holistic review was utilized?

*Hypothesis 1.* I hypothesize that changing to a holistic review admissions process resulted in improved academic success as measured by graduation rate, graduating GPA, and licensing exam performance. Additionally, I hypothesize that graduation rates increased for students of color.

*Rationale 1.* While studies examining the graduation outcomes of those admitted under holistic review are rare, previous studies have shown that academic metrics such as graduation rates, GPA, and licensure pass rates either stay the same or improve in students admitted through holistic review (Arredondo, 2015; Urban Universities for HEALTH, 2014). Additionally, the AAMC asserts that a diverse educational setting assists medical schools in attaining academic excellence goals (AAMC, 2013b).

Additionally, examining the outcomes for the BA/MD program and MD program separately will provide confirmatory data for medical schools that have both types of programs at their school.

Finally, as one of the goals of holistic review is to admit and graduate more students of color to increase the number of physicians of color, it is important to examine the graduation rate for students of color.

*Research Question 2.* How did self-perceived measures of diversity-related competencies and experiences change in cohorts admitted using holistic review?

   a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized?

*Hypothesis 2.* I hypothesize that self-perceived measures of diversity-related competencies and experiences will be improved in those students admitted through a holistic review admissions process compared to those admitted prior to holistic review.

*Rationale 2.* The few studies that have examined diversity-related outcomes of holistic review describe increases in student engagement, teamwork, and openness to new ideas (Urban Universities for HEALTH, 2014; Witzburg & Sondheimer, 2013). Additionally, the AAMC asserts that increasing the diversity of the student body will create future physicians who are more skilled at meeting the needs of diverse patients (AAMC, 2013b). As in the first research question, examining the outcomes for the BA/MD program and MD program separately will provide confirmatory data for medical schools that have both types of programs at their school.

## Design of the Study

This ex-post facto quantitative study was conducted in accordance with best practices outlined in the AAMC's document, *Roadmap to Excellence: Key Concepts for Evaluating the Impact of Medical School Holistic Admissions* (2013b). Ex-post facto was an appropriate approach for this study as the intervention, holistic review, was introduced prior to the involvement of the researcher, and the participants in the study were not randomly assigned (Silva, 2010). As this study focused on outcomes at graduation, existing data were used since participants had graduated and left the institution at the time of the present study.

As mentioned previously, the AAMC's framework for evaluating the impact of holistic review in medical schools includes measuring learning, developmental, and professional outcomes (AAMC, 2013b). Learning outcomes include cognitive and non-cognitive outcomes related to the core competencies of graduates; developmental outcomes include students' values and attitudes; and professional outcomes include specialty choice and practice location. Cognitive and non-cognitive measures can be used to assess all three types of outcomes and are used in this quantitative study.

Additionally, and in accordance with AAMC guidelines, this study evaluated holistic review by studying outcomes important to the mission of the UMKC School of Medicine (AAMC, 2013b). UMKC aims to admit students who will be successful at the institution, defining success as meeting the six core competencies of the institution and graduating from the program (A. Arredondo, personal communication, April 6, 2017). Additionally, UMKC strives, "to admit a class of students who can contribute to the diversity of the UMKC medical community, as well as to the profession of medicine" (UMKC School of Medicine, 2017a). Therefore, the goals of UMKC's School of Medicine are both cognitive and non-cognitive in nature.

This study considered learning, developmental, and professional outcomes that related to the UMKC School of Medicine's mission as dependent variables. Further, the diversity rationale was examined through those dependent variables which addressed diversity, culture, and working with underserved populations. Some of these variables related both to the UMKC School of Medicine mission and the diversity rationale. Outcomes were compared between students admitted pre-holistic review and their peers admitted post-holistic review in each type of degree program.

## Data Source and Instrument

Data from this study came from both institutional data as well as a national dataset. Institutional data were used to answer the first research question, while data from a national graduation questionnaire were used to answer the second research question. Both data sources and instruments are described below.

**Institutional Data Source**

Institutional data for this study came from student records held in the Office of Assessment and Quality Improvement at the UMKC School of Medicine. Student record data included date of matriculation, date of graduation, licensure exam scores, and type of degree program. Additional institutional data, specifically the graduating GPA, came from the Office of Institutional Research at UMKC.

**AAMC Graduation Questionnaire**

Data regarding attitudes, experiences, and preferences of graduates came from the Graduation Questionnaire (GQ) administered by the AAMC. The GQ is a national survey of graduating medical students. The AAMC began issuing the survey in 1978 as a way for medical schools to assess the experience of students as well as to garner feedback about their degree program (AAMC, 2017c). In 2016, 81% of graduates nation-wide responded to the survey (AAMC, 2016b).

At UMKC, students from both the BA/MD and MD programs were invited by the AAMC to participate in this national survey, though they were not required to do so. The questions on the survey cover a wide-range of topics, including pre-clinical and clinical experiences, preparedness for residency, medical education experiences, student services, financial aid, indebtedness, and career plans (AAMC, 2017a).

Data from the GQ are commonly used to evaluate medical education (Andriole, Klingensmith, & Jeffe, 2006; Jeffe, et al., 2006; Pugnaire, Purwono, Zanetti, & Carlin, 2004). Further, two studies described previously, which tested the diversity rationale in medical education, used either data from the GQ or questions from the GQ in their research (Niu, et al., 2012; Saha et al., 2008). Eight GQ questions were used in this study, including questions

such as, "I have the communication skills necessary to interact with patients and health professionals," and "I believe I am adequately prepared to care for patients from different backgrounds," both measured on a Likert scale (AAMC, 2017a). The eight questions were grouped into four categories and those categories were the variables of interest in the second research question, as shown in the next section.

## Independent and Dependent Variables

The primary independent variable in this study was holistic review, comparing student outcomes from student cohorts admitted pre-holistic review to those admitted with holistic review in order to determine if changing to holistic review affected outcomes.

The second independent variable in this study was the racial/ethnic identity of the participant, as recorded from institutional data. Students were separated into one of three categories as described in Appendix A: Students of Color, White and Asian students, and Not Reported[2]. Several of the dependent variables were examined by race/ethnicity to identify variances, if any, among racial lines.

The dependent variables, listed below, were chosen in accordance with the mission of the UMKC School of Medicine and factors related to the diversity rationale.

*Research Question 1.* How did changing to a holistic review admissions process affect the academic success of medical students?

    a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized, as measured by graduation rate, graduating GPA, and licensing exam performance?

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[2] At the time the participants in this study completed their admission application, which included indicating their racial/ethnic identity, applicants could only choose one race, which may have led applicants to not respond with their racial/ethnic identity if they identified with more than one category.

b. How did the graduation rate change for students of color after holistic review was utilized?

The variables used to assess the first research question on academic success were examined by admission and program type and included:

a. Graduation rate

b. Graduation rate for Students of Color

c. Graduating GPA

d. United States Medical Licensing Exam (USMLE) Step 1 first-attempt score

e. USMLE Step 2 Clinical Knowledge first-attempt score

f. USMLE Step 2 Clinical Skills first-attempt score

The selection of these variables to measure academic outcomes was based on the mission of the UMKC School of Medicine to admit students who are successful candidates for graduation and in accordance with guidance from the AAMC in measuring learning outcomes (AAMC, 2013b). The selection of these variables is also in alignment with the Urban Universities for HEALTH (2014) study, which assessed graduation rate, graduating GPA, and licensing exam pass rates as markers of academic success.

Data used to answer the first research question were institutional-level data and were obtained from the UMKC School of Medicine Office of Assessment and Quality Improvement as well as the UMKC Office of Institutional Research.

*Research Question 2*. How did self-perceived measures of diversity-related competencies and experiences change in cohorts admitted using holistic review?

a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized?

The variables used to assess the second research question of diversity-related competencies and experiences were questions asked on the AAMC GQ survey (AAMC, 2017a). Eight questions were chosen from the survey for their relevance to diversity-related competencies and experiences. In order to reduce the number of variables for data analysis, the eight questions were grouped into four categories. Appendix A describes the measurement scale for each question. The GQ questions used in this study to answer the second research question were:

a. Preparedness for Residency

    1. "I have the communication skills necessary to interact with patients and health professionals."

    2. "I have a fundamental understanding of the issues in social sciences of medicine (e.g., ethics, humanism, professionalism, organization and structure of the health care system)."

    3. "I believe I am adequately prepared to care for patients from different backgrounds."

b. Diversity Rationale

    4. "My knowledge or opinion was influenced or changed by becoming more aware of the perspectives of individuals from different backgrounds."

    5. "The diversity within my medical school class enhanced my training and skills to work with individuals from different backgrounds."

c. Diversity-Related Experiences

6. "Indicate the activities you will have participated in during medical school on an elective (for credit) or volunteer (not required) basis: Experience related to health disparities."

7. "Indicate the activities you will have participated in during medical school on an elective (for credit) or volunteer (not required) basis: Experience related to cultural awareness and cultural competence."

    d. Career Plans:

8. "Regardless of location, do you plan to care primarily for an underserved population?"

The variables used to answer the second research question were taken from the Preparedness for Residency, Medical Education Experiences, and Career Plans sections of the AAMC GQ (AAMC, 2017a). These variables were chosen to examine learning, development, and professional outcomes as they relate to the UMKC School of Medicine's mission to construct a diverse learning environment and produce competent professionals. In addition, they provided outcomes important to testing the diversity rationale

**Sample**

The population for this study was comprised of students admitted to the BA/MD and MD programs at the UMKC School of Medicine during the years immediately before and after the implementation of holistic review.

For BA/MD program students, holistic review was implemented with the class entering Fall 2010 (A. Arredondo, personal communication, April 6, 2017). Therefore, this study reviewed data from those admitted from Fall 2007 through Fall 2011 as those admitted in 2011 graduated in Spring 2017. Those matriculating in 2007, 2008, and 2009 were

admitted prior to holistic review and those matriculating in 2010 and 2011 were admitted after the implementation of holistic review. Therefore, this sample provided three years of cohorts prior to holistic review and two years of cohorts after implementation of holistic review.

For MD program students, holistic review was implemented with the class entering Spring 2011. Therefore, this study reviewed data from those admitted from Spring 2009 through Spring 2013 as those admitted in 2013 graduated in Spring 2017. Those matriculating in 2009 and 2010 were admitted prior to holistic review and those matriculating in 2011, 2012, and 2013 were admitted after implementation of holistic review. Therefore, this sample for MD program students provided two years of cohorts prior to holistic review and three years of cohorts after implementation of holistic review.

Combined, the sample of students represented the cohorts graduating in 2013, 2014, 2015, 2016, and 2017.

As this study focused on diversifying the healthcare field, the sample sometimes was separated according to one of the following three ethnic identification categories: Students of Color, White and Asian students, and students not reporting their ethnicity. Specific to the present study, the definition of Students of Color followed the UMKC School of Medicine definition, which included students who self-identified on their UMKC application as members of the following racial groups: "African-American/Black, Hispanic/Latino, American Indian/Native American, Native Hawaiian or Pacific Islander, or Asian-Underrepresented. For the purposes of Asian-Underrepresented, the category is defined as those who do NOT identify as Chinese, Japanese, Filipino, Korean, Asian Indian, or Thai" (UMKC School of Medicine, 2017b, p. 2). As the term "Students of Color" represented the

five ethnic categories above and was used in comparison to the term "White and Asian students," both terms are capitalized when comparing data from the two categories.

**Student Demographics for Research Question 1**

Data for the first question were institutional-level data and therefore, data for all students were available. The institutional data for all students admitted to the BA/MD program in 2007 through 2011 and the MD program in 2009 through 2013 resulted in a total of 615 participants, though one student was removed from the analysis due to death while in the program. Therefore, the final sample size for this research question was 614 participants.

As shown in Table 1, 543 participants were in the BA/MD program with 332 admitted pre-HR and 211 admitted post-HR. Students of color comprised 12.7% of the student population in the pre-HR group and increased slightly to comprise 13.3% of the post-HR group.

Table 1
*Admitted BA/MD Class Composition, by Race/Ethnicity (N=543)*

| Race/Ethnicity | Pre-HR (n=332) | Post-HR (n=211) |
| --- | --- | --- |
| Students of Color (n=70) | 12.7% | 13.3% |
| White and Asian students (n=414) | 75.3% | 77.7% |
| Not reported (n=59) | 12.0% | 9.0% |

The MD program had a total of 71 participants with 20 admitted pre-HR and 51 admitted post-HR, as shown in Table 2. Within this sample, Students of Color comprised 10.0% (n=2) of the pre-HR population, and dropped slightly to 7.8% (n=4) of the post-HR population. It should be noted that due to the small number of MD students in the pre-HR

cohort, and the small number of students of color in both admission groups, results from this

subsection of participants should be interpreted with this small sample size in mind.[3]

Table 2

*Admitted MD Class Composition, by Race/Ethnicity (N=71)*

| Race/Ethnicity | Pre-HR (n=20) | Post-HR (n=51) |
|---|---|---|
| Students of Color (n=6) | 10.0% | 7.8% |
| White and Asian students (n=56) | 75.0% | 80.4% |
| Not reported (n=9) | 15.0% | 11.8% |

**Student Demographics for Research Question 2**

Data for the second question came from the AAMC Graduation Questionnaire. As

this survey is optional and it occurs in the semester of graduation, the participants involved in

this aspect of data collection were limited to those students from the matriculation years

above who reached the final semester of the curriculum and who completed the survey.

Participation in the survey varied between 69% and 94% for the years studied (J. Quaintance,

personal communication, October 17, 2017). This resulted in a final sample size of 354

participants, 337 of whom completed all of the eight questions studied in the second research

question with the remaining 17 answering at least one of the eight questions.

Tables C3 and C4 show that 491 of the 614 students involved in the sample for the

first research question graduated. Therefore, the response rate of the GQ for the years studied

was 354 GQ participants divided by 491 graduates, or 72%.

As shown in Table 3, 311 participants were in the BA/MD program with 188 of them

admitted pre-HR and 123 admitted post-HR. Students of Color comprised 9.6% of the

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[3] Admission information by year for both BA/MD and MD is available in Tables C1 and C2, respectively.

student population in the pre-HR group and increased slightly to comprise 11.4% of the post-HR group, as shown in Table 3.

Table 3
*BA/MD Respondents to GQ, by Race/Ethnicity (N=311)*

| Race/Ethnicity | Pre-HR (n=188) | Post-HR (n=123) |
|---|---|---|
| Students of Color (n=32 ) | 9.6% | 11.4% |
| White and Asian (n= 245) | 78.2% | 79.7% |
| Not reported (n=34 ) | 12.2% | 8.9% |

To determine if these respondents were a representative sample of the population shown in the first research question, the percentages of students in each of the categories in Tables 1 and 3 above were compared. There were no significant differences in the percentages of students in the BA/MD group for pre-HR students along race/ethnicity categories ($x^2$=1.119; p=0.571), nor were there any significant differences for the post-HR respondents ($x^2$=0.258; p=0.879).

The MD program had a total of 43 participants who completed the relevant questions on the GQ, with 10 of them admitted pre-HR and 33 admitted post-HR, as shown in Table 4. Due to low sample size, the AAMC did not release information on the race/ethnicity of participants. Therefore, GQ data for participants in the MD program were not able to be analyzed with race/ethnicity as a variable.

Table 4
*MD Respondents to GQ (N=43)*

| | Pre-HR | Post-HR |
|---|---|---|
| Students | 10 | 33 |

To determine if these respondents were a representative sample of the population shown in the first research question, the number of respondents in the pre-HR and post-HR

categories in Tables 2 and 4 above were compared. There were no significant differences in the percentages of students in the MD group between the two datasets ($x^2$=0.333; p=0.564).

## Data Collection

Institutional data provided by the UMKC School of Medicine Office of Assessment and Quality Improvement, as well as the UMKC Institutional Research office, were used to answer the first research question. Staff from both offices provided data upon request and with approval from the School of Medicine and IRB.

To answer the second question, AAMC GQ data were needed from those students who matriculated in the years of the study and who completed the survey. De-identified individual response data from the GQ were available from the AAMC (Matthew, 2016). Staff within the UMKC School of Medicine Office of Assessment and Quality Improvement assisted in obtaining this data from the AAMC to ensure data stayed de-identified from the researcher.

## Data Analysis

Data analysis consisted of both descriptive and inferential analyses as discussed below.

### Descriptive Analysis

The first level of data analysis included descriptive statistics such as means, standard deviations, and frequency analysis to understand the academic performance and attitudes of each admission group (pre-HR and post-HR), and in some cases each racial/ethnic group, for each program type (BA/MD and MD).

**Inferential Analysis**

The second level of data analysis utilized inferential statistical analysis. First, the chi-square test for homogeneity was used for dichotomous variables that produced rates, while independent samples t-tests with a Holm-Bonferroni error correction were utilized for each continuous dependent variable. Further, Hotelling's $T^2$ test with a Bonferroni error correction was used for groups of related, continuous dependent variables within each research question, to determine relationships between pre-HR data and post-HR data for each of the two program types (BA/MD and MD). Finally, a two-way ANOVA was utilized to examine significance in a continuous dependent variable when both admission type and race/ethnicity were examined together. When assumptions of the tests were violated, the tests were still conducted as they remained strong statistical analysis methods for the variables (Laerd, 2015a; Laerd, 2015b; Laerd, 2016; and Laerd, 2017).

**Chi-square test for homogeneity.** The chi-square test for homogeneity, also referred to as the test of two proportions, was utilized in the first research question with the variables of graduation rate, graduation rate by ethnicity, and Step 2 CS pass rate. Additionally, it was used in the second research question to analyze the variables of Diversity-Related Experiences and Career Plans. The chi-square test for homogeneity was appropriate to use with these variables as they all were dichotomous and produced a rate from two independent groups (Laerd, 2016).

One of the assumptions of the chi-square test is a sample size of greater than five for each cell in the test (Laerd, 2016). When that was not achieved in the graduation rate variable for the MD program, the Fisher's exact test was used to determine significance rather than

the chi-square test, as Fisher's test can be used when cell sizes are five or smaller. (Laerd, 2016).

**Independent samples t-test.** The independent samples t-test was utilized in the first research question with the variables of graduating GPA, Step 1 score, and Step 2 CK score. Additionally, it was used in the second research question with the variables of Preparedness for Residency and the Diversity Rationale. Prior to conducting each independent samples t-test, the assumptions of independent samples t-tests were reviewed (Laerd, 2015a). First, outliers were identified and if they existed, they were removed one-by-one, starting with the most extreme outlier first. The data were then re-examined until no outliers remained in an effort to include as many of the original data points as possible. Second, the data were reviewed to determine if they were normally distributed. If the data were not normally distributed, it was noted, but the t-test was still conducted as the t-test is a robust test regardless of normality (Laerd, 2015a). Third, the homogeneity of variances was tested through Levene's test. If the result of Levene's test was not significant ($p>0.05$), equal variances were assumed, and if the result of Levene's test was significant ($p<0.05$), equal variances were not assumed. For all independent samples t-tests, the Holm-Bonferroni correction was utilized within each research question, as described below.

**Holm-Bonferroni correction.** In order to correct for Type 1 error that can occur when performing multiple independent samples t-tests, the Holm-Bonferroni error correction was utilized to determine significance for each continuous variable. The Holm-Bonferroni correction divides the standard significance level of 0.05 by the number of t-tests conducted within a data set to create a new significance level that is then compared to the smallest p-value found from the t-tests (Holm, 1979). If that p-value is found to be significant, the

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standard significance level of 0.05 is again divided by the remaining number of tests (one less than before), and the smallest remaining p-value is compared against this new significance level to determine significance for the next test. When a p-value is found to be greater than the level of significance, the procedure stops and all remaining t-test results are determined to not be significant. Significance levels for the Holm-Bonferroni correction can be found in Appendix Table B1.

In the first research question, three continuous variables were examined with independent samples t-tests: graduating GPA, Step 1 score, and Step 2 CK score. Thus, the p-value results were ranked from smallest to largest, and then the correction was applied to determine significance. The smallest p-value was compared against a level of $p<0.0167$ (0.05/3), the next p-value was compared against a level of $p<0.025$ (0.05/2), and the largest p-value was compared against a level of $p<0.05$ (0.05/1).

The second research question examined two continuous variables through independent samples t-tests: Preparedness for Residency score and Diversity Rationale score. Again, the p-values were ranked by value, and the correction was then applied to determine significance. The smaller p-value was compared against a level of $p<0.025$ (0.05/2), and the larger p-value was compared against a level of $p<0.05$ (0.05/1).

**Hotelling's $T^2$ test.** Hotelling's $T^2$ test was chosen to analyze the continuous dependent variables together for each research question. Hotelling's $T^2$ test is an extension of the independent samples t-tests and is a type of one-way MANOVA, which incorporates a two-grouped independent variable and two or more dependent variables (Laerd, 2017). Specific to the first research question, the two-grouped independent variable was pre-/post-HR, and the three dependent variables were graduating GPA, Step 1 score, and Step 2 CK

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score. For the second research question, the two-grouped independent variable was, again, pre-/post-HR, and the two dependent variables were the Preparedness for Residency and the Diversity Rationale scores. Hotelling's $T^2$ was conducted once for the BA/MD program data and a second time for the MD program data for each research question. As each Hotelling's $T^2$ test involved several dependent variables, the Bonferroni correction was applied. Therefore, the significance level for this test was set at $p<0.0167$ (the standard 0.05 significance level divided by three) for the first research question using three variables, and $p<0.025$ (0.05 divided by two) for the second research question using two variables, in order to correct for error (Laerd, 2017).

Several factors supported using the Hotelling's $T^2$ test to examine these dependent variables (Laerd, 2017). First, the dependent variables in each research question assessed related measures. For the first research question, all three variables assessed academic knowledge; for the second research question, both variables assessed diversity-related perceptions. Second, by considering the dependent variables grouped together, there may be a statistically significant change between the pre-HR and post-HR groups that was not seen through t-tests alone. Finally, considering the dependent variables together may control for Type 1 error that could occur when running multiple t-tests.

Hotelling's $T^2$ test encompasses multiple assumptions, which were examined prior to conducting the test. Those included a linear relationship between all of the dependent variables in each group, no multicollinearity, no univariate or multivariate outliers, multivariate normality, adequate sample size, homogeneity of variance-covariance matrices, and homegenity of variances (Laerd, 2017). The results of these assumptions and the Hotelling's $T^2$ test will be presented in Chapter 4.

**Two-Way ANOVA.** A two-way ANOVA was utilized in the second research question to compare the continuous variable of the Diversity Rationale score by two independent variables: pre-/post-HR and racial/ethnic category. This was chosen in order to allow a comparison of the means along two independent variables, and to determine if there was an interaction effect between the two independent variables (Laerd, 2015b). The significance level for this test was set at 0.05. All assumptions described for the independent samples t-test above were reviewed for the two-way ANOVA and will be noted in the data analysis section.

**Coding and Modifying Data**

Data were coded and modified in order to perform the data analysis. After initial cleaning of data, modification included such steps as calculating a cumulative GPA for BA/MD students by combining their undergraduate and medical statistics, and combining responses from the GQ into their respective categories. Detailed descriptions of the coding used for each variable, including modifications made in coding, are found in Appendix A.

As mentioned earlier, one participant was removed from the data for the first research question due to death while in the program. No other participants were removed from the study, though outliers were removed for aspects of data analysis, based on the criteria stated above.

<div align="center">

**Summary**

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The purpose of this study was to examine the relationship between type of admission review and indicators of success and diversity at the UMKC School of Medicine. As holistic review is a newer admission strategy designed to improve the diversity of the medical student body and eventually the healthcare workforce, it was appropriate to examine outcomes of

holistic review in the medical school setting. This chapter provided information regarding study design and the rationale for choosing the dependent variables needed to assess outcomes related to the independent variable of holistic review. Additionally, the sample, data collection, and data analysis were described. The goal of these methods was to examine if and how learning, developmental, and professional outcomes have been affected by holistic review in both a six-year combined BA/MD program and traditional MD program at a single institution.

CHAPTER 4

RESULTS

The purpose of this study was to identify if changing admissions strategy to a holistic review process resulted in changes to academic success and self-perceived measures of diversity-related competencies and experiences. These results were examined in two separate medical school degree programs at the same university: a combined degree BA/MD program and traditional MD program. Academic success was examined using graduation rates for all students and students of color, graduating GPA, Step 1 first-attempt licensing exam score, Step 2 CK first-attempt licensing exam score, and Step 2 CS first-attempt licensing exam pass rate. Additionally, self-perceived measures of diversity-related competencies and experiences were examined through eight questions taken from the AAMC national Graduation Questionnaire of graduating medical students. Specifically, the questions examined preparedness for residency, the diversity rationale, diversity-related experiences, and career plans related to underserved populations. All data were analyzed using Excel and SPSS software.

This chapter presents the results for each research question along with accompanying hypotheses. For each research question, results are discussed by variable; first for the BA/MD program, followed by the MD program.

**Research Question 1**

*Research Question 1.* How did changing to a holistic review admissions process affect the academic success of medical students?

a. What differences exist, if any, for students in the BA/MD program and MD program after holistic review was utilized, as measured by graduation rate, graduating GPA, and licensing exam performance?

b. How did the graduation rate change for students of color after holistic review was utilized?

*Hypothesis 1.* I hypothesized that changing to a holistic review admissions process would result in improved academic success as measured by graduation rate, graduating GPA, and licensing exam performance. Additionally, I hypothesized that graduation rates would increase for students of color.

**Graduation Rate**

The first dependent variable I examined was the graduation rate of students between pre-HR and post-HR. Data were separated into one of two categories: 1) withdrew or separated, and 2) currently enrolled or graduated. More information on the coding of this variable is in Appendix A. The following analysis for graduation rate considered any student who was currently enrolled as a "graduated" student and counted them in the graduation rate.

For the BA/MD program, 78.3% of pre-HR students graduated, compared to 78.2% who graduated in the post-HR group, (see Table 5). Though this decline appeared to be slight, decreasing by only 0.1%, proportions were compared to ensure there was no significant difference between groups. A chi-square test of homogeneity confirmed there was no significant difference between the two graduation rates ($x^2=0.001$; p=0.975).

Table 5

*Graduation Rates of BA/MD students, pre- and post-Holistic Review (N=543)*[a]

|  | Pre-HR (n=332) | Post-HR (n=211) |
|---|---|---|
| Graduation Rate (n=425) | 78.3% | 78.2% |

[a] "N" represents the population for the present study, "n" represents the total number of students in the category (graduation rate, pre-HR, and post-HR, respectively). The percentage shown represents the graduation rate among all students for the noted group. Withdrawal rates are not shown.

For students in the MD program, 100% graduated in the pre-HR cohort compared to 90.2% in the post-HR cohort, as shown in Table 6; however, this decline was not statistically significant as measured by Fisher's exact test (p=0.312). Although this finding showed a decline in the graduation rates, the small number of participants in the pre-HR group (n=20) should be noted.

Table 6

*Graduation Rates of MD students, pre- and post-Holistic Review (N=71)*[a]

|  | Pre-HR (n=20) | Post-HR (n=51) |
|---|---|---|
| Graduation Rate (n=66) | 100% | 90.2% |

[a] "N" represents the population for the present study, "n" represents the total number of students in the category (graduation rate, pre-HR, and post-HR, respectively). The percentage shown represents the graduation rate among all students for the noted group. Withdrawal rates are not shown.

**Summary of overall graduation rate.** In both degree programs, graduation rates did not change significantly with the use of holistic review. Therefore, the hypothesis that graduation rates would increase with holistic review was rejected.

**Graduation Rate for Students of Color**

To further answer research question 1, I examined the graduation rate of Students of Color, as graduating more students of color is one of the goals of holistic review. As defined in Chapter 1, "Students of Color" described students identifying with the following racial groups: "African-American/Black, Hispanic/Latino, American Indian/Native American,

Native Hawaiian or Pacific Islander, or Asian-Underrepresented. For the purposes of Asian-Underrepresented, the category is defined as those who do NOT identify as Chinese, Japanese, Filipino, Korean, Asian Indian, or Thai" (UMKC School of Medicine, 2017b, p. 2). As the term "Students of Color" represented the five ethnic categories above and was used in comparison to the term "White and Asian students," both terms are capitalized and considered proper nouns when comparing data from the two categories, as was done with this variable. More information regarding Students of Color in the BA/MD and MD sample is shown in Tables 1 and 2.

As described above regarding graduation rate, the participants were grouped into one of two categories, withdrew or separated at any time in the program and currently enrolled or graduated. Therefore, these data assumed that any student currently enrolled would graduate, and those students were described in this analysis as "graduated."

The composition of the graduating BA/MD cohorts showed what appeared to be an increase for Students of Color from 9.6% of the pre-HR group to 12.1% of the post-HR group (see Table 7). However, a chi-square test of homogeneity showed the change was not statistically significant ($x^2$=2.092; p=0.351).

Table 7
*Graduation Composition for Graduated BA/MD students, by Race/Ethnicity (N=425)*

| Race/Ethnicity | Pre-HR (n=260) | Post-HR (n=165) |
|---|---|---|
| Students of Color (n=45) | 9.6% | 12.1% |
| White and Asian students (n=325) | 75.8% | 77.6% |
| Not reported (n=55) | 14.6% | 10.3% |

The graduation rates for Students of Color in the BA/MD program appeared to increase from 59.5% to 71.4% with the introduction of holistic review, as shown in Table 8.

Despite what appeared to be an increase, a chi-square test of homogeneity showed there was no significant difference between the two graduation rates ($x^2$=1.037; p=0.309).

Table 8

*Graduation Rates for Students of Color for BA/MD cohorts (N=70)[a]*

|  | Pre-HR (n=42) | Post-HR (n=28) |
|---|---|---|
| Graduation Rate (n=45) | 59.5% | 71.4% |

[a] "N" represents the population for the present study, "n" represents the total number of students in the category (graduation rate, pre-HR, and post-HR, respectively). The percentage shown represents the graduation rate among all students for the noted group. Withdrawal rates are not shown.

While the change in graduation rate for Students of Color was not statistically significant, it was important to examine the exact number graduating from the BA/MD program, as a goal of holistic review is to produce more physicians of color. Specifically, for the years studied, the three years of pre-HR resulted in 25 Students of Color graduating from the BA/MD program, while the two years of post-HR resulted in 20 Students of Color graduating. This meant that on average, each year of the post-HR group produced more physicians of color (10 physicians per year) than each year of the pre-HR group (8.3 physicians per year).

To better understand how graduation rate changed by race/ethnicity, I conducted further analysis examining graduation rates of all students in the BA/MD program, by admission type and ethnicity. First, in replication of the test described above, I ran a chi-square test of homogeneity for White and Asian students and for students not reporting their ethnicity. This analysis showed no significant changes in graduation rates for White and Asian students ($x^2$=0.033; p=0.856), nor for students not reporting their ethnicity ($x^2$=0.622; p=0.430).

Lastly, I tested if graduation rates among the three ethnic categories differed significantly from one another within the pre-HR group and/or within the post-HR group. When graduation rates of BA/MD students pre-HR were compared among the three ethnic categories, 59.5% for Students of Color, 78.8% for White and Asian students, and 95.0% for students not reporting, there was a statistically significant difference ($x^2$=15.324; p<0.0005). Specifically, a comparison of column proportions found significant differences among each category compared to each of the other categories[4]. In other words, prior to holistic review, there were statistically significant differences in the graduation rates of students based upon their ethnic identity, with Students of Color graduating with the lowest frequency (p<0.0005). However, when the post-HR rates were compared among the three ethnic categories, 71.4% for Students of Color, 78.0% for White and Asian students, and 89.5% for students not reporting, a chi-square test of homogeneity showed no significant difference in the graduation rates among the three groups ($x^2$=2.172; p=0.338). Thus, although the change in graduation rates were not significant within each ethnic category, there appeared to be more parity in the likelihood of graduation for Students of Color and their peers (see Table 9).

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[4] Post-hoc test with a Bonferroni correction.

Table 9

*Graduation Rates for BA/MD students, by Holistic Review Status and Race/Ethnicity (N=543)[a]*

| | Pre-HR (n=332) | | | Post-HR (n=211) | | |
|---|---|---|---|---|---|---|
| | Students of Color (n=42) | White and Asian (n=250) | Not Reported (n=40) | Students of Color (n=28) | White and Asian (n=164) | Not Reported (n=19) |
| Graduation Rate (n=425) | 59.5%* | 78.8%* | 95.0%* | 71.4% | 78.0% | 89.5% |

*p<0.05;

[a] "N" represents the population for the present study, "n" represents the total number of students in the category (graduation rate, pre-HR, and post-HR, respectively). The percentage shown represents the graduation rate among all students for the noted group. Withdrawal rates are not shown.

Though I had hoped to examine the data for MD students of color, the sample sizes were too small to ensure student confidentiality. As such, I have not included the MD graduation rates for the pre-HR cohort (N=2), nor the post-HR cohort (N=4) for Students of Color.

**Summary of graduation rates of Students of Color.** Overall, with the utilization of holistic review, the graduation rate for students of color appeared to increase in the BA/MD group. However, the change was not significant for the BA/MD group and the sample size was too small to test for the MD group. Additionally, there was a gap in degree attainment in the BA/MD program prior to the utilization of holistic review among ethnic groups, which was closed following the implementation of holistic review. As the hypothesis specifically stated that graduation rates would increase for students of color, and the change in graduation rates for students of color was not statistically significant, the hypothesis was rejected.

**Graduating GPA**

Research question 1 also focused on differences in graduating GPA. Only participants who had graduated from either program were included in the analysis. This section first

describes the assumptions of the independent samples t-test, then the results of the t-tests for each group[5].

The graduating GPA used for BA/MD students was a combination of their undergraduate and medical education coursework. No outliers were identified in the data, but it was determined through the Shapiro-Wilk test that both the pre-HR group and post-HR group were not normally distributed (p<0.0005, and p=0.001, respectively). A review of histograms and normal Q-Q plots revealed that the data were negatively skewed in the pre-HR group with both groups showing negative kurtosis. The assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances (p=0.001).

Prior to the implementation of holistic review, the average graduating GPA of BA/MD students was 3.487 (SD=0.333), as shown in Table 10. Following the implementation of HR, the average GPA increased slightly to 3.551 (SD=0.276), a difference of 0.064. As the graduating GPA was the first of three continuous variables analyzed in the first research question, the significance level was determined using the Holm-Bonferroni correction after the p-values were found for all three variables for the BA/MD program, as shown in Table B2. For graduating GPA, the third level of the Holm-Bonferroni correction was used (p=0.0167), and the increase in GPA was not significant (t=-2.038, p=0.042). As the smallest p-value was found to not be significant, the Holm-Bonferroni correction means

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[5] When assumptions of independent samples t- tests, Hotelling's $T^2$, and two-way ANOVA were violated, the tests were still conducted, as they remain the best tests for the given variables and are robust against violations of their assumptions (Laerd, 2015a; Laerd, 2015b; Laerd, 2017).

that the p-values found in the following two continuous variables of Step 1 score and Step 2 CK score for the BA/MD program were also not significant.

Table 10
*Graduating GPA (combined undergraduate and medical GPA) for BA/MD students (N=401)*

|  | Pre-HR (n=259) | Post-HR (n=142) | Difference |
|---|---|---|---|
| Mean (SD) | 3.487 (0.333) | 3.551 (0.276) | 0.064 |

The graduating GPA for MD students was a calculation of only their coursework once they entered the MD program. Regarding assumptions, no outliers were identified in the data. Further, I determined through the Shapiro-Wilk test that the pre-HR group was normally distributed, but that the post-HR group was not (p=0.114, and p=0.010, respectively). A review of histograms and normal Q-Q plots for the post-HR group revealed that the data were negatively skewed and showed negative kurtosis. The Levene's test for equality of variances was not significant (p=0.498), indicating homogeneity of variances.

The graduating GPA of MD students appeared to increase from a mean of 3.298 (SD=0.333) pre-HR to 3.485 (SD=0.362) post-HR, as shown in Table 11. The p-value for this variable was the largest of the three p-values found from the continuous variables analyzed in this research question for the MD program (see Table B3). Thus, it was compared to the first level of the Holm-Bonferroni table which is p=0.05. The difference found in the graduating GPA was not statistically significant (t=-1.960, p=0.055).

Table 11
*Graduating GPA (only medical GPA) for MD students (N=64)*

|  | Pre-HR (n=20) | Post-HR (n=44) | Difference |
|---|---|---|---|
| Mean (SD) | 3.298 (0.333) | 3.485 (0.362) | 0.187 |

**Summary of graduating GPA.** Overall, students in both the BA/MD group and the MD group appeared to show an increase in the graduating GPA with the utilization of holistic review. However, neither change in graduating GPA was significant. Therefore, the

hypothesis of an increased graduating GPA with the use of holistic review was rejected for both programs.

**Step 1 Score**

The next variable I examined was the first-attempt score obtained on the USMLE Step 1 licensing examination. Only participants who had completed Step 1 were used in this analysis. This section first describes the assumptions of the independent samples t-test, then the results of the t-tests for each group.

In the BA/MD group, two outliers lower than the mean were identified in the data for the post-HR group and removed. The Shapiro-Wilk test showed that the pre-HR group was not normally distributed while the post-HR group was (p=0.031, and p=0.748, respectively). A review of histograms and normal Q-Q plots for the pre-HR group revealed that the data were slightly negatively skewed. The Levene's test for equality of variances was not significant (p=0.184), indicating homogeneity of variances.

For BA/MD students, the Step 1 first-attempt score appeared to increase slightly from an average of 221.44 (SD=20.47) in the pre-HR cohort to 223.04 (SD=19.24) in the post-HR cohort, as shown in Table 12. However, I did not find a statistically significant difference, as shown in Table B2 (t=-0.806, p=0.421).

Table 12
*Step 1 score, first attempt, for BA/MD students (N=430)*

|  | Pre-HR (n=265) | Post-HR (n=165) | Difference |
| --- | --- | --- | --- |
| Mean (SD) | 221.44 (20.47) | 223.04 (19.24) | 1.60 |

In the MD group, three outliers, each lower than the mean, were identified in the data for the post-HR group and removed. I determined through the Shapiro-Wilk test that both the pre-HR group and the post-HR group were normally distributed (p=0.229, and p=0.903,

respectively). The assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances (p=0.007).

The average Step 1 first-time attempt score for MD students appeared to increase with holistic review, with a mean of 219.85 (SD=19.80) in the pre-HR cohort and a mean of 233.57 (SD=13.44) in the post-HR cohort (see Table 13). Of the three continuous variables analyzed in this research question for the MD program, this p-value was the smallest. Thus, it was compared to the third level of the Holm-Bonferroni p-value of 0.0167 as shown in Table B3. The increase in Step 1 first-attempt score from the pre-HR group to the post-HR group was statistically significant (t=-2.807, p=0.009). Once again, the smaller sample sizes in the MD groups should lead to caution in interpreting this finding.

Table 13
*Step 1 score, first attempt, for MD students (N=62)*

|  | Pre-HR (n=20) | Post-HR (n=42) | Difference |
|---|---|---|---|
| Mean (SD) | 219.85 (19.80) | 233.57 (13.44) | 13.72* |

*p<0.0167

**Summary of Step 1 score.** Overall, both the BA/MD and MD groups appeared to show increases in the average Step 1 first-attempt score when holistic review was utilized. Since only the increase in the MD group was found to be significant, the hypothesis that holistic review would result in an increased Step 1 score average was rejected for the BA/MD program and accepted for the MD program.

**Step 2 Clinical Knowledge Score**

The next variable I examined was the first-attempt score obtained on the USMLE Step 2 Clinical Knowledge (CK) licensing examination. Participants in this analysis were limited to those who had attempted the exam. This section first describes the assumptions of the independent samples t-test, then the results of the t-tests for each group.

In the BA/MD group, no outliers were identified. The Shapiro-Wilk test showed that the pre-HR group was not normally distributed while the post-HR group was (p<0.0005, and p=0.663, respectively). A review of histograms and normal Q-Q plots for the pre-HR group revealed that the data were slightly negatively skewed. The Levene's test for equality of variances was not significant (p=0.697), indicating homogeneity of variances.

For BA/MD students, the Step 2 CK first-attempt score appeared to increase slightly from an average 233.24 (SD=17.91) in the pre-HR group to 234.70 (SD=17.67) in the post-HR group, as shown in Table 14; however, the difference was not statistically significant, as shown in Table B2 (t=-0.816, p=0.415).

Table 14
*Step 2 CK score, first attempt, for BA/MD students (N=422)*

|  | Pre-HR (n=260) | Post-HR (n=162) | Difference |
| --- | --- | --- | --- |
| Mean (SD) | 233.24 (17.91) | 234.70 (17.67) | 1.46 |

In the MD group, two outliers lower than the mean were identified in the data for the post-HR group and removed. I determined through the Shapiro-Wilk test that both the pre-HR group and the post-HR group were normally distributed (p=0.406, and p=0.910, respectively). The Levene's test for equality of variances was not significant (p=0.815), indicating homogeneity of variances.

For the MD students, first-attempt Step 2 CK score average increased, from 235.55 (SD=14.48) in the pre-HR group to 244.36 (SD 13.54) in the post-HR group (see Table 15). Of the three continuous variables analyzed in this research question for the MD program, this p-value was the second-smallest. Thus, it was compared to the second level of the Holm-Bonferroni p-value of 0.025, as shown in Table B3. A statistically significant increase was found between the Step 2 CK scores of the two groups (t=-2.363, p=0.021). Once again,

caution should be used in interpreting these results due to the smaller sample sizes in the MD

groups.

Table 15
*Step 2 CK score, first attempt, for MD students (N=64)*

|  | Pre-HR (n=20) | Post-HR (n=44) | Difference |
|---|---|---|---|
| Mean (SD) | 235.55 (14.48) | 244.36 (13.54) | 8.81* |

*p<0.025

**Summary of Step 2 CK score.** Overall, both the BA/MD and MD groups appeared

to show increases in the average Step 2 CK first-attempt score when holistic review was

utilized. However, only the difference in the MD group was significant. Thus, I rejected the

hypothesis that scores on the first-attempt of Step 2 CK would increase with holistic review

for the BA/MD group and accepted the hypothesis for the MD group.

**Step 2 Clinical Skills Pass Rate**

The final variable I examined was the first-attempt score on the Step 2 Clinical Skills

(CS) licensing examination. Participants for this variable were limited to those who had

attempted this exam. This exam is a pass or fail examination; therefore, the passing

frequencies were calculated to determine the pass rate for each group of participants.

For the BA/MD program, the percentage of students who passed Step 2 CS on the

first-attempt appeared to increase from 93.8% for the pre-HR group to 95.1% for the post-HR

group (see Table 16). However, a chi-square test of homogeneity confirmed there was no

significant difference between the two pass rates ($x^2$=0.291; p=0.590).

Table 16

*Step 2 CS first-attempt pass rate for BA/MD students (N=423)*[a]

|  | Pre-HR (n=260) | Post-HR (n=163) |
|---|---|---|
| Pass Rate (n=399) | 93.8% | 95.1% |

[a] "N" represents the population for the present study, "n" represents the total number of students in the category (pass rate, pre-HR, and post-HR, respectively). The percentage shown represents the pass rate among all students for the noted group. Failure rates are not shown.

For the MD program, the percentage of students who passed Step 2 CS on the first-attempt appeared to increase slightly from 95.0% for the pre-HR group to 95.6% for the post-HR group (see Table 17). However, a chi-square test of homogeneity confirmed there was no significant difference between the two pass rates ($x^2=0.010$; $p=0.922$).

Table 17

*Step 2 CS first-attempt pass rate for MD students (N=65)*[a]

|  | Pre-HR (n=20) | Post-HR (n=45) |
|---|---|---|
| Pass Rate (n=62) | 95.0% | 95.6% |

[a] "N" represents the population for the present study, "n" represents the total number of students in the category (pass rate, pre-HR, and post-HR, respectively). The percentage shown represents the pass rate among all students for the noted group. Failure rates are not shown.

**Summary of Step 2 CS pass rate.** While it appeared that the average Step 2 CS pass rate increased for both degree programs with the introduction of holistic review, neither of those increases was statistically significant. Therefore, the hypothesis that the Step 2 CS first-attempt pass rate would increase was rejected for both degree programs.

**Understanding the Relationship among Graduating GPA, Step 1 score,**

**and Step 2 CK score**

The three dependent variables of graduating GPA, Step 1 score, and Step 2 CK score are all continuous variables assessing academic knowledge. In addition, both the BA/MD and the MD program showed that with holistic review, apparent increases were seen in all three variables, though not all increases were statistically significant. To further examine the

relationship that might exist among the three variables, I conducted an additional analysis, Hotelling's $T^2$.

The analysis was restricted to only those who had graduated, the same restriction applied in analyzing the graduating GPA to provide consistency in the sample. Additionally, only those participants who had a graduating GPA, Step 1 score, and Step 2 score were utilized. If a data outlier had been omitted during the previous t-tests for these variables, it was also omitted in this analysis. Finally, as each Hotelling's $T^2$ test involved three dependent variables, the significance level for this test was set at $p<0.0167$ (the standard 0.05 significance level divided by three to correct for Type 1 error).

Hotelling's $T^2$ test encompasses multiple assumptions, which were examined prior to conducting the test. The results of these assumptions and the results of Hotelling's $T^2$ test will be presented for the BA/MD program first, and then the MD program.

**BA/MD assumptions.** For the BA/MD program, the data met most of the assumptions of the Hotelling's $T^2$ test. Specifically, there appeared to be a linear relationship among the three dependent variables, as assessed by a scatterplot as well as no evidence of multicollinearity, as assessed by the Pearson correlation (Laerd, 2017). There was adequate sample size with 259 participants in the pre-HR group and 141 in the post-HR group. Finally, Box's test of equality of covariance matrices showed there was homogeneity of variance-covariance matrices ($p=0.017$ where $p<0.001$ implies significance).

Of the remaining assumptions that were not met, one additional univariate outlier was found in the Step 1 score for the post-HR group. It was below the mean for the Step 1 score and was removed. No multivariate outliers were identified, as assessed by Mahalanobis distance ($p>0.001$). The Shapiro-Wilk test of normality was run with a Bonferroni correction

for the six groups studied (p=0.008) and three groups failed the test of normality; the pre-HR group for graduating GPA (p<0.0005), the post-HR group for graduating GPA (p=0.001), and the pre-HR group for Step 2 CK score (p<0.0005). Finally, there was homogeneity of variances, as assessed by Levene's Test within the Step 1 score (p=0.087) and Step 2 CK score (p=0.385), but not within the graduating GPA (p=0.001). In spite of the failures of these assumptions, the Hotelling's $T^2$ was conducted due to the robust nature of the statistic (Laerd, 2017).

**BA/MD results.** Hotelling's $T^2$ showed that there was not a significant difference between the pre-HR group and post-HR group for BA/MD students among the three dependent variables of graduating GPA, Step 1 score, and Step 2 CK score, $F(3, 396)=1.398$, p=0.243; Wilks' $\Lambda$=0.990; partial $\eta^2$=0.010. In other words, no significant change was seen in the academic measures of GPA, Step 1 score, and Step 2 score, combined, when holistic review was introduced in the BA/MD program.

**MD assumptions.** For the MD program, the data, again, met most of the assumptions of the Hotelling's $T^2$ test. There appeared to be a linear relationship among the three dependent variables, as assessed by a scatterplot as well as no evidence of multicollinearity, as assessed by the Pearson correlation (Laerd, 2017). There was adequate sample size with 20 participants in the HR group and 37 in the post-HR group. The Shapiro-Wilk test of normality was run with a Bonferroni correction for the six groups studied (p=0.008) and all dependent variables were normally distributed (p>0.008). Finally, Box's test of equality of covariance matrices showed there was homogeneity of variance-covariance matrices (p=0.099 where p<0.001 implies significance).

Of the remaining assumptions that were not met, two additional outliers were found in the Step 2 score for the post-HR group. Both were above the mean for the Step 2 score and were removed. No multivariate outliers were identified, as assessed by Mahalanobis distance (p>0.001). Additionally, there was homogeneity of variances, as assessed by Levene's Test, within the graduating GPA (p=0.866) and Step 2 CK score (p=0.274), but not within the Step 1 score (p<0.0005). In spite of the failures of these assumptions, the Hotelling's $T^2$ test was conducted (Laerd, 2017).

**MD results.** Hotelling's $T^2$ test showed that there was a significant difference between the pre-HR group and post-HR group for MD students among the three dependent variables of graduating GPA, Step 1 score, and Step 2 CK score, $F_{(3, 53)}=3.850$, p=0.014; Wilks' $\Lambda=0.821$; partial $\eta^2=0.179$. A pairwise comparison showed that the difference in means was significant for all three of the dependent variables, as shown in Table 18. In other words, there was a statistically significant increase in academic performance in the MD cohort with the utilization of holistic review (as measured by graduating GPA, Step 1 score, and Step 2 CK score, combined together).

Table 18
*Pairwise Comparisons for Hotelling's $T^2$ test, MD students, RQ1 (N=57)*

| Dependent Variable | Mean Difference (Post HR-Pre-HR) | Std. Error | Significance |
|---|---|---|---|
| Graduating GPA | 0.226 | 0.091 | 0.015* |
| Step 1 first-attempt score | 13.231 | 4.044 | 0.002* |
| Step 2 CK first-attempt score | 8.531 | 3.442 | 0.016* |

*p<0.0167

**Summary**

After conducting the data analysis for the first research question, the following variables were found to be significantly increased from pre-HR to post-HR:

- Step 1 first-attempt score in the MD program

- Step 2 CK first-attempt score in the MD program

- Graduating GPA, Step 1 score, and Step 2 CK score, combined, in the MD

  program.

Further, no significant decreases were discovered. Therefore, I accepted the hypothesis for the first research question for the variables and programs listed above, and rejected the hypothesis for all remaining variables.

An additional analysis involved the graduation rate for Students of Color. Prior to holistic review, significant gaps existed in the graduation rates among the three racial/ethnic categories of Students of Color, White and Asian students, and students not reporting their ethnicity in the BA/MD program, with Students of Color achieving the lowest graduation rates. However, after holistic review was utilized, these gaps were no longer significant. In other words, after the implementation of holistic review all students were graduating at similar rates, regardless of their race/ethnicity.

### Research Question 2

*Research Question 2.* How did self-perceived measures of diversity-related competencies and experiences change in cohorts admitted using holistic review?

a. What differences exist, if any, for students in the BA/MD program and MD

  program after holistic review was utilized?

*Hypothesis 2.* I hypothesized that self-perceived measures of diversity-related competencies and experiences would improve in those students admitted through a holistic review admissions process compared to those admitted prior to holistic review.

**Preparedness for Residency**

First, I examined the Preparedness for Residency measure, which contained responses to the following three questions from the AAMC GQ survey:

- "I have the communication skills necessary to interact with patients and health professionals."

- "I have a fundamental understanding of the issues in social sciences of medicine (e.g., ethics, humanism, professionalism, organization and structure of the health care system)."

- "I believe I am adequately prepared to care for patients from different backgrounds."

Initial responses to each of the three questions were given a code, as described in Appendix A, and then averaged to create a score for this variable, with 1, defined as strongly disagree, to 5, defined as strongly agree. For data analysis, this value was treated as a continuous variable. Overall, 348 participants answered all three questions, two participants answered only two of the three questions and four participants answered none of the three questions. This section first describes the assumptions of the independent samples t-test, then the results of the t-tests for each group.

In the BA/MD group, one outlier in pre-HR and one outlier in post-HR, which were both lower than the mean, were identified in the data and removed. The Shapiro-Wilk test showed that both the pre-HR and the post-HR groups were not normally distributed ($p<0.0005$ for both). A review of histograms and normal Q-Q plots for both the pre-HR and post-HR groups revealed negative skewness. The Levene's test for equality of variances was not significant ($p=0.237$), indicating homogeneity of variances.

For BA/MD students, the Preparedness for Residency score appeared to increase slightly from an average of 4.47 (SD=0.56) in the pre-HR cohort to 4.52 (SD=0.53) in the post-HR cohort, as shown in Table 19. As the Preparedness for Residency score was the first of two continuous variables analyzed in the second research question, the significance level was determined using the Holm-Bonferroni correction after the p-values were found for both variables for the BA/MD program, as shown in Table B4. For this variable, the first level of the Holm-Bonferroni correction was used (p=0.05), and the increase in the Preparedness for Residency score was not significant (t=-0.818, p=0.414). In other words, there was no significant difference in BA/MD students' self-rated preparedness for residency from pre- to post-HR.

Table 19
*Preparedness for Residency score for BA/MD students (N=305)*

|  | Pre-HR (n=183) | Post-HR (n=122) | Difference |
|---|---|---|---|
| Mean (SD) | 4.47 (0.56) | 4.52 (0.53) | 0.05 |

In the MD program, one outlier, lower than the mean, was identified in the data for the post-HR group and removed. The Shapiro-Wilk test determined that the pre-HR group was normally distributed, but the post-HR group was not (p=0.070, and p<0.0005, respectively). A review of histograms and normal Q-Q plots for the post-HR group revealed that the data were negatively skewed. The assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances (p=0.036).

The average Preparedness for Residency score for MD students appeared to increase with holistic review, with a mean of 4.33 (SD=0.65) in the pre-HR cohort and a mean of 4.70 (SD=0.41) in the post-HR cohort, (see Table 20). The p-value for this variable was the smaller of the two p-values found from the continuous variables analyzed in this research question for the MD program (see Table B5). Thus, it was compared to the second level of

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the Holm-Bonferroni table which is p=0.025. Despite what appeared to be an increase in the

Preparedness for Residency score, the difference was not statistically significant (t=-1.678,

p=0.121). As the smallest p-value was found to not be significant, the Holm-Bonferroni

correction means that the p-value found in the other variable for the MD program was also

not significant.

Table 20

*Preparedness for Residency score for MD students (N=42)*

|  | Pre-HR (n=10) | Post-HR (n=32) | Difference |
|---|---|---|---|
| Mean (SD) | 4.33 (0.65) | 4.70 (0.41) | 0.37 |

**Summary of Preparedness for Residency score.** Overall, both the BA/MD and MD

groups appeared to show increases in the average Preparedness for Residency score when

holistic review was utilized. However, neither change was significant. Therefore, the

hypothesis that holistic review would result in an increased Preparedness for Residency

average was rejected for both the BA/MD and the MD program.

**Diversity Rationale**

The second variable I examined was the Diversity Rationale measure, which

contained responses to the following two questions from the AAMC GQ survey:

- "My knowledge or opinion was influenced or changed by becoming more aware

  of the perspectives of individuals from different backgrounds."

- "The diversity within my medical school class enhanced my training and skills to

  work with individuals from different backgrounds."

Initial responses to the two questions were given a code, as described in Appendix A,

and then averaged to create a score for this variable, with 1, defined as strongly disagree, to

5, defined as strongly agree.

For data analysis, this value was treated as a continuous variable. Overall, 348 participants answered both questions, one participant answered only one of the two questions and five participants answered neither of the questions. This section first describes the assumptions of the independent samples t-test, then the results of the t-tests for each program.

In the BA/MD group, ten outliers all lower than the mean were identified in the data for the pre-HR group. Those outliers were removed and the data were reexamined, with a result of an additional four outliers lower than the mean in the same group. Due to the high number of outliers all concentrated below the mean, I decided to leave them in the analysis in order to maintain the integrity of the data. The Shapiro-Wilk test showed that both the pre-HR and the post-HR groups were not normally distributed ($p < 0.0005$ for both). A review of histograms and normal Q-Q plots revealed that the data were negatively skewed for both groups. The Levene's test for equality of variances was not significant ($p = 0.092$), indicating homogeneity of variances.

For BA/MD students, the Diversity Rationale score appeared to decrease slightly from an average of 4.05 (SD=0.75) in the pre-HR cohort to 3.97 (SD=0.80) in the post-HR cohort, as shown in Table 21. However, no statistically significant difference was found in the Diversity Rationale score as shown in Table B4 ($t = 0.939$, $p = 0.348$). These results confirmed that although the Diversity Rationale score seemed to decrease slightly in the post-HR group, the decrease was not significant.

Table 21
*Diversity Rationale score for BA/MD students (N=306)*

|  | Pre-HR (n=184) | Post-HR (n=122) | Difference |
|---|---|---|---|
| Mean (SD) | 4.05 (0.75) | 3.97 (0.80) | -0.08 |

In order to determine if the Diversity Rationale score differed significantly among the three ethnic categories and between admission types within the BA/MD program, a two-way ANOVA was conducted.

A total of eleven outliers were identified in the data for the pre-HR group with four in the Students of Color category, six in the White and Asian student category, and one in the students not reporting category. In the post-HR data, no data outliers appeared.

The Shapiro-Wilk test showed that all three racial/ethnic categories in the pre-HR group were not normally distributed ($p=0.024$, $p<0.0005$, and $p=0.003$, respectively). A review of histograms and normal Q-Q plots revealed that the data were negatively skewed for all three groups. In the post-HR data, the Shapiro-Wilk test showed that the data for the Students of Color and the White and Asian groups were not normally distributed, but the data for those not reporting their ethnicity was ($p=0.023$, $p=<0.0005$, and $p=0.163$, respectively). A review of histograms and normal Q-Q plots revealed that the data for the Students of Color group contained negative kurtosis while the data for the White and Asian student group was negatively skewed. Finally, the Levene's test for equality of variances was not significant ($p=0.174$), indicating homogeneity of variances.

The Diversity Rationale scores for the pre-HR group appeared to vary slightly from the overall mean with an average of 4.06 (SD=0.84) for Students of Color, 4.08 (SD=0.69) for White and Asian students, and 3.89 (SD=1.01) for students not reporting their ethnicity, as shown in Table 22. In the post-HR group, the Diversity Rationale scores appeared to vary slightly from the overall mean with an average of 4.04 (SD=0.82) for Students of Color, 3.97 (SD=0.81) for White and Asian students, and 3.86 (SD=0.74) for students not reporting their ethnicity.

The two-way ANOVA showed no significant difference in the Diversity Rationale score by admission type (F=0.145, p=0.704), nor by race/ethnicity (F=0.504, p=0.605) for the BA/MD program. Further, the two-way ANOVA showed no significant interaction between admission type and race/ethnicity for the Diversity Rationale score, (F=0.072, p=0.931) for the BA/MD program.

Table 22

*Diversity Rationale score for BA/MD students, by Holistic review Status and Race/Ethnicity, (N=306)*

|  | Pre-HR (n=184) | | | Post-HR (n=122) | | |
|---|---|---|---|---|---|---|
|  | Students of Color (n=18) | White and Asian (n=143) | Not Reported (n=23) | Students of Color (n=14) | White and Asian (n=97) | Not Reported (n=11) |
| Mean (SD) | 4.06 (0.84) | 4.08 (0.69) | 3.89 (1.01) | 4.04 (0.82) | 3.97 (0.81) | 3.86 (0.74) |

In the MD group, three outliers were identified in the pre-HR group, two of which were above the mean, and one below the mean. Further, the post-HR group contained one outlier below the mean. These four outliers represented almost 10% of the data points. Due to the number of outliers in this group, and due to the earlier decision to retain outliers for this variable for the BA/MD group, the outliers were retained in the data. It was determined through the Shapiro-Wilk test that the pre-HR group was normally distributed, but the post-HR group was not (p=0.197, and p=0.001, respectively). A review of histograms and normal Q-Q plots for the post-HR group revealed that the data were negatively skewed. The Levene's test for equality of variances was not significant (p=0.658), indicating homogeneity of variances.

The average Diversity Rationale score for MD students appeared to remain steady with holistic review, with a mean of 3.90 (SD=0.77) in the pre-HR cohort and a mean of 3.91 (SD=0.86) in the post-HR cohort, (see Table 23). This slight increase was not significant, as

shown in Table B5 (t=-0.030, p=0.976). As ethnicity data were not obtained on MD students, further analysis by ethnic category was not possible.

Table 23
*Diversity Rationale score for MD students (N=43)*

|  | Pre-HR (n=10) | Post-HR (n=33) | Difference |
|---|---|---|---|
| Mean (SD) | 3.90 (0.77) | 3.91 (0.86) | 0.01 |

**Summary of Diversity Rationale score**. Overall, neither the BA/MD nor MD groups showed any significant change in the Diversity Rationale score with the utilization of holistic review. Additionally, Diversity Rationale scores did not change between or within racial/ethnic categories for the BA/MD program with holistic review. Of note, these data showed a higher number of outliers than other data analyzed in this study, and those outliers were retained in the analysis. Due to these findings, I rejected the hypothesis that holistic review would result in an increased Diversity Rationale score for the BA/MD and MD programs.

**Diversity-Related Experiences**

The third variable I examined was the Diversity-Related Experiences measure, which contained responses to the following two questions from the AAMC GQ survey:

- "Indicate the activities you will have participated in during medical school on an elective (for credit) or volunteer (not required) basis: Experience related to health disparities."

- "Indicate the activities you will have participated in during medical school on an elective (for credit) or volunteer (not required) basis: Experience related to cultural awareness and cultural competence."

Initial responses to the two questions were assigned a code, as described in Appendix A, and then grouped into one of two categories: 1) participated in neither of the experiences,

or 2) participated in one or both of the experiences. Overall, 353 participants answered both questions and only one participant answered neither of the two questions. This dichotomous variable was analyzed as a frequency.

For the BA/MD program, 68.6% of pre-HR students participated in either one or both experiences as shown in Table 24. However, that participation increased significantly to 82.0% in the post-HR group ($x^2$=6.832; p=0.009).

Table 24
*Diversity-Related Experiences for BA/MD students (N=310)*

|  | Pre-HR (n=188) | Post-HR (n=122) |
|---|---|---|
| Neither Experience (n=81) | 31.4% | 18.0% |
| One or Both Experiences (n=229) | 68.6% | 82.0%* |

*p<0.05

In the MD program, 60.0% of pre-HR students participated in one or both experiences compared to 87.9% in the post-HR group, as shown in Table 25. A chi-square test of homogeneity showed this increase was significant ($x^2$=3.939; p=0.047). It should be noted, however, that one of the four cells had less than expected counts, which may have affected the chi-square calculation.

Table 25
*Diversity-Related Experiences for MD students (N=43)*

|  | Pre-HR (n=10) | Post-HR (n=33) |
|---|---|---|
| Neither Experience (n=8) | 40.0% | 12.1% |
| Both Experiences (n=35) | 60.0% | 87.9%* |

*p<0.05

**Summary of Diversity-Related Experiences score.** Overall, both the BA/MD and MD groups showed a significant increase in involvement in diversity-related experiences when holistic review was utilized. Therefore, I accepted the hypothesis that holistic review

would result in increased participation in diversity-related experiences for both the BA/MD and MD program.

**Career Plans**

The fourth and final variable was the Career Plans measure, which was the response to the following question from the AAMC GQ survey:

- "Regardless of location, do you plan to care primarily for an underserved population?"

The results were coded to group "no" and "undecided" responses together, and leave "yes" as a second category, as described in Appendix A. Overall, 342 participants answered this question while 12 participants did not. This dichotomous variable was analyzed as a frequency.

For the BA/MD program, the percentage of students who indicated they planned to care for an underserved population appeared to increase from 28.7% for the pre-HR group to 37.3% for the post-HR group, as shown in Table 26. However, a chi-square test of homogeneity confirmed there was no significant difference between the groups ($x^2$=2.400; p=0.121).

Table 26
*Career Plans with Underserved Populations for BA/MD students (N=299)*

| Plans | Pre-HR (n=181) | Post-HR (n=118) |
|---|---|---|
| No or Undecided (n=203) | 71.3% | 62.7% |
| Yes (n=96) | 28.7% | 37.3% |

For the MD program, the percentage of students who indicated they planned to care for an underserved population appeared to decrease from 40.0% for the pre-HR group to 24.2% for the post-HR group, as shown in Table 27. However, a chi-square test of

homogeneity confirmed there was no significant difference in this decrease ($x^2$=0.947; p=0.330).

Table 27

*Career Plans with Underserved Populations for MD students (N=43)*

| Plans | Pre-HR (n=10) | Post-HR (n=33) |
|---|---|---|
| No or Undecided (n=31) | 60.0% | 75.8% |
| Yes (n=12) | 40.0% | 24.2% |

To further explore if the race/ethnicity of the respondent was related to their plans to work with underserved populations when holistic review was utilized, I conducted further analysis. As race/ethnicity information was not available for the MD respondents, only those responses from the BA/MD program were examined.

When the rates of BA/MD students who wanted to work with underserved populations were compared among the three ethnic categories in the pre-HR group, 41.2% of Students of Color, 30.5% of White and Asian students, and 8.7% of students not reporting their ethnicity wanted to work with underserved populations, as shown in Table 28. Among these percentages, there was found to be a significant difference ($x^2$=6.010; p=0.05) with Students of Color being more likely to plan to work with underserved populations than their colleagues who did not report ethnicity, though there was not a significant difference between Students of Color and their White and Asian counterparts. However, when the post-HR career plans frequencies were compared among the three ethnic categories, 46.2% for Students of Color, 38.3% for White and Asian students, and 18.2% for students not reporting, a chi-square test of homogeneity showed there was no significant difference among the three groups ($x^2$=2.195; p=0.334). In the post-HR group, however, two of the six cells had less-than-expected counts, which may have affected the accuracy of the chi-square calculation.

Additionally, when the pre-HR rates were compared to the post-HR rates for each ethnicity category, no significant differences were found ($x^2$=0.074; p=0.785 for Students of Color, $x^2$=1.538; p=0.215 for White and Asian students, and $x^2$=0.645; p=0.422 for not reported). In other words, students' reported plans to work with underserved populations did not change with the implementation of holistic review.

Table 28

*Career Plans with Underserved Populations for BA/MD students, by Holistic Review Status and Race/Ethnicity (N=299)*

| | Pre-HR (n=181) | | | Post-HR (n=118) | | |
|---|---|---|---|---|---|---|
| Plans | Students of Color (n=17) | White and Asian (n=141) | Not Reported (n=23) | Students of Color (n=13) | White and Asian (n=94) | Not Reported (n=11) |
| No or Undecided (n=203) | 58.8% | 69.5% | 91.3% | 53.8% | 61.7% | 81.8% |
| Yes (n=96) | 41.2%* | 30.5% | 8.7%* | 46.2% | 38.3% | 18.2% |

*p=0.05; Students of Color were more likely to say they would work with underserved populations compared to those peers who did not report their race/ethnicity.

**Summary of Career Plans.** Since there were not significant differences found in the percentage of students who expressed interest in caring for underserved populations between pre-HR and post-HR for both the BA/MD and MD groups, I rejected the hypothesis for this variable. However, there was a significant difference found in the plans of students depending upon their race/ethnicity. Specifically, prior to holistic review, the percentage of Students of Color in the BA/MD program who planned to work with underserved populations was significantly higher than those students who did not report their ethnicity. However, that gap was not present after holistic review was utilized.

**Understanding the Relationship between Preparedness for Residency and Diversity Rationale**

The two dependent variables of Preparedness for Residency and Diversity Rationale were both continuous variables assessing perceptions related to diversity. To further examine the relationship that might exist between the two variables, an additional analysis, Hotelling's $T^2$, was conducted.

The analysis was restricted to only those who had both a Preparedness for Residency score and a Diversity Rationale score. If a data outlier had been omitted during the previous t-tests for these variables, it was also omitted in this analysis. Of note, the Diversity Rationale score had multiple outliers, which were all retained for this analysis just as they were previously. Finally, as each Hotelling's $T^2$ test involved two dependent variables, the significance level for this test was set at $p<0.025$ (the standard 0.05 significance level divided by two to correct for error).

Hotelling's $T^2$ test encompasses multiple assumptions, which were examined prior to conducting the test. The results of these assumptions and the results of Hotelling's $T^2$ test will be presented for the BA/MD program first, and then the MD program.

**BA/MD assumptions.** For the BA/MD program, the data met several of the assumptions of the Hotelling's $T^2$ test. There appeared to be a linear relationship between the two dependent variables, as assessed by a scatterplot as well as no evidence of multicollinearity, as assessed by the Pearson correlation ($|r| < 0.9$). There was adequate sample size with 181 participants in the pre-HR group and 121 in the post-HR group. Finally, Box's test of equality of covariance matrices showed there was homogeneity of variance-covariance matrices ($p=0.055$ where $p<0.001$ implies significance).

Of the remaining assumptions that were not met, two involved outliers. As mentioned previously, the univariate outliers found in earlier data analysis for the Diversity Rationale score were retained due to the high number of outliers below the mean. However, one multivariate outlier was identified in the pre-HR group, as assessed by Mahalanobis distance (p>0.001) and was removed. The Shapiro-Wilk test of normality was run with a Bonferroni correction for the four groups studied (p=0.0125), and all groups failed the test of normality (p<0.0005), showing negative skewness. Finally, there was homogeneity of variances, as assessed by Levene's Test, within the Preparedness for Residency score (p=0.121), but not within the Diversity Rationale score (p=0.036). In spite of the failures of these assumptions, the Hotelling's $T^2$ was conducted.

**BA/MD results.** Hotelling's $T^2$ showed that there was not a significant difference between the pre-HR group and post-HR group for BA/MD students among the two dependent variables of Preparedness for Residency and Diversity Rationale, $F(2, 299)=2.557$, p=0.079; Wilks' $\Lambda$=0.983; partial $\eta^2$=0.017.

**MD assumptions.** For the MD program, several of the assumptions of the Hotelling's $T^2$ test were met. There appeared to be a linear relationship between the two dependent variables, as assessed by a scatterplot. There was adequate sample size with 10 participants in the HR group and 32 in the post-HR group. Finally, Box's test of equality of covariance matrices showed there was homogeneity of variance-covariance matrices (p=0.147 where p<0.001 implies significance).

Of the remaining assumptions that were not met, three univariate outliers were found in the Diversity Rationale score for the pre-HR group and one in the post-HR group, but all were retained to be consistent with earlier analysis. The pre-HR group contained two outliers

above the mean, while the remaining one in the pre-HR group as well as the one in the post-HR group were both below the mean. No multivariate outliers were identified, as assessed by Mahalanobis distance (p>0.001). No evidence of multicollinearity existed in the pre-HR group, as assessed by the Pearson correlation (|r| < 0.9), but there was evidence in the post-HR group (r=-0.037). The Shapiro-Wilk test of normality was run with a Bonferroni correction for the four groups studied (p=0.0125) and both Diversity Rationale score groups failed the test of normality (p<0.0005 for pre-HR and p=0.002 for post-HR), showing negative skewness for both. Additionally, there was homogeneity of variances, as assessed by Levene's Test, within the Diversity Rationale score (p=0.599), but not within the Preparedness for Residency score (p=0.036). In spite of the failures of these assumptions, the Hotelling's $T^2$ test was conducted.

**MD results.** Hotelling's $T^2$ showed that there was not a significant difference between the pre-HR group and post-HR group for MD students among the two dependent variables of Preparedness for Residency and Diversity Rationale, F(2, 39)=2.229, p=0.121; Wilks' $\Lambda$=0.897; partial $\eta^2$=0.103.

**Summary**

After conducting the data analysis for the second research question, the only significant finding was an increase in the participation in at least one of the two diversity-related experiences had by both BA/MD and MD students after holistic review was implemented. Therefore, I accepted the hypothesis for the second research question for the variable of diversity-related experiences in the BA/MD and MD program and rejected the hypothesis for all remaining variables.

An additional result of this analysis involved the frequencies at which students in the BA/MD program planned on working with underserved populations. Prior to holistic review, Students of Color indicated they planned to work with underserved populations at a significantly higher rate than those not reporting their ethnicity. However, after holistic review was utilized, the gap was no longer significant.

Chapter Five further discusses these findings by placing the results in context. Additionally, I offer implications of these findings and suggestions for future research.

CHAPTER 5

DISCUSSION

The purpose of this study is to examine the learning, developmental, and professional outcomes of medical students after a holistic review admissions process was introduced. As the implementation of holistic review in medical schools is a rather new process, not many studies have analyzed the effects of holistic review on graduation outcomes. This study added to the needed body of literature on this topic. Additionally, this study was conducted at a medical school that offers both a six-year combined BA/MD degree program and a traditional four-year MD program allowing the results of this study to inform schools that offer both types of programs.

Quantitative research methods were used to analyze the academic and diversity-related outcomes of student learning between groups admitted prior to holistic review, and groups admitted after the implementation of holistic review. Students admitted to the BA/MD program in 2007, 2008, and 2009 comprised the pre-HR cohort, while students admitted to the BA/MD program in 2010 and 2011 comprised the post-HR cohort. For the MD program, students admitted in 2009 and 2010 were considered pre-HR and students admitted in 2011, 2012, and 2013 were considered post-HR. Differences between the two groups were examined for each degree program, separately. Both institutional data and data from a national questionnaire for graduating students were utilized to examine outcomes.

The diversity rationale is a central component to holistic review and was used as a supporting conceptual framework for this evaluation. While diversity-related outcomes were assessed as part of this study, it is important to remember that this study was limited to perceptions at graduation and did not examine the practices and culture of the institution that

may shape these outcomes, nor did it assess what perceptions students brought to the school upon their admission. As holistic review is seen as an avenue to increase the number of students of color at medical schools who will ultimately become physicians of color, this study paid special attention to the graduation rate and number of students of color graduating, as well as how several diversity-related outcomes differ among racial/ethnic groups.

This chapter reviews the findings for each research question and discusses how those findings impact the purpose of this study. Recommendations for further study into holistic review and the diversity rationale within medical education conclude this chapter.

## Summary of Research Questions and Findings

### Holistic Review and Academic Success

The first research question asked how changing to a holistic review admissions process affected the academic success of medical students, also defined as learning outcomes. In particular, I wondered what differences existed for students in the BA/MD program and MD program after holistic review was utilized, as measured by graduation rate, graduating GPA, and licensing exam performance, and how the graduation rate changed for students of color after holistic review was utilized. I hypothesized that changing to a holistic review admissions process would result in improved academic success as measured by graduation rate, graduating GPA, and licensing exam performance. Additionally, I hypothesized that graduation rates would increase for students of color.

The present study found that two of the variables measuring academic success significantly increased when holistic review was utilized. Specifically, the first-attempt Step 1 and Step 2 CK scores for the MD students increased significantly. When graduating GPA, Step 1 score, and Step 2 CK score were considered together, there was a significant increase

in academic performance in the MD program with the implementation of holistic review. The changes found in the remaining academic performance variables of graduating GPA, Step 1 score, Step 2 CK score, and Step 2 CS pass rates, all appeared to be increases for both degree programs, but the increases were not statistically significant. Importantly, none of the scores decreased when holistic review was utilized. These findings align with prior studies indicating that academic performance either increases or remains unchanged when holistic review is utilized (Arredondo, 2015; Urban Universities for HEALTH, 2014)

Regarding overall graduation rates, it first appeared that students in the BA/MD group had decreased graduation rates following the utilization of holistic review, though only slightly. However, this decrease was not statistically significant. The MD group had a graduation rate of 100% in the two years included in pre-HR, ensuring that if even one student withdrew in the post-HR group, the graduation rate would decrease. In fact, five of the 51 students withdrew or were separated in the post-HR group, resulting in a decreased graduation rate for the MD program when holistic review was utilized. Likewise, this decrease was not statistically significant.

The graduation rate for students of color appeared to increase in the BA/MD program with the utilization of holistic review, changing from 59.5% to 71.4%. However, the increase was not statistically significant. Those percentages represented 25 of 42 students of color in pre-HR and 20 of 28 students of color post-HR. As educating and graduating physicians of color is an important goal of holistic review, it was important to examine the real number of students becoming physicians. In this study, the group of students admitted after holistic review was implemented produced an average of 10 physicians of color per year while the pre-HR group produced about 8 physicians of color per year. Though not statistically

significant, this was a practically significant difference that supports evidence that holistic review increases the amount of physicians of color in the physician workforce.

Additionally, I found that Students of Color comprised 9.6% of the pre-HR graduating cohort, and 12.1% of the post-HR graduating cohort in the BA/MD program. Though this apparent increase was not significant, in practical terms both percentages were higher than the current representation rate of 8.9% physicians of color in the United States (AAMC, 2014b).

Finally, a further examination of the graduation rates for BA/MD students found that when the individual graduation rates were compared for the three categories of ethnicity in this study, significant differences were found among those rates prior to the introduction of holistic review. Specifically, the graduation rates of 59.5% for Students of Color, 78.8% for White and Asian students, and 95.0% for students not reporting, were all significantly different from one another. However, when holistic review was utilized, the gaps in degree attainment lessened, showing no significant difference among the graduation rates of 71.4% for Students of Color, 78.0% for White and Asian students, and 89.5% for students not reporting. This reduction in the achievement gap supports the use of holistic review in medical admissions, where the goal is to increase the number of physicians of color in the workforce. The implication of the graduation rates of Students of Color will be discussed in an upcoming section.

As sample sizes were too small for analysis in the MD students of color cohort, I was unable to examine graduation rates by ethnicity for MD students pre-HR (N=2) or post-HR (N=4).

**Holistic Review and Diversity-Related Competencies**

The second research question asked how changing to a holistic review admissions process affected the self-perceived measures of diversity-related competencies and experiences of medical students, also defined as developmental and professional outcomes. In particular, I wondered what differences existed, for students in the BA/MD program and MD program after holistic review was utilized. I hypothesized that changing to a holistic review process would result in improved self-perceived measures of diversity-related competencies and experiences.

The present study found that participation in diversity-related experiences increased significantly in both the BA/MD and MD populations when holistic review was utilized. However, the remaining dependent variables for both programs did not show any significant changes. As in the first research question, no significant decreases were found in any of the variables.

Specific to differences found in populations based upon race/ethnicity categories, results showed that a significantly higher percentage of Students of Color had plans to work with underserved populations than did students not reporting their ethnicity in the BA/MD program prior to holistic review. However, that gap closed after holistic review was introduced with apparent gains in the percentage of students in all categories indicating a desire to work with underserved populations, and the previously seen difference was no longer significant. Additionally, when the Diversity Rationale score was compared along racial/ethnic categories, no significant differences were found prior to or after holistic review in the BA/MD program. As the MD sample had few students, it was not possible to complete analysis for those participants based on race/ethnicity.

## Implications of the Findings

**Students and Physicians of Color**

Holistic review aims to diversify the student body in medical education which, in turn, should lead to a diversification of the physician population in the United States (AAMC, 2013b). As such, one of the important contributions of this study was the examination of the admission rates and graduation rates for Students of Color. As a reminder, this study defined the term "Students of Color" as those students and racial groups who are underrepresented in medicine compared to their proportion in the general United States population. The definition for this study followed the definition of "Students of Color" for the UMKC School of Medicine, which includes those who identify as "African-American/Black, Hispanic/Latino, American Indian/Native American, Native Hawaiian or Pacific Islander, or Asian-Underrepresented. For the purposes of Asian-Underrepresented, the category is defined as those who do NOT identify as Chinese, Japanese, Filipino, Korean, Asian Indian, or Thai" (UMKC School of Medicine, 2017b, p. 2). Those who identify as White or Asian are over-represented in the physician population compared to the general American population, as discussed in Chapter One, and were grouped together as a second category in this study. The third category of ethnicity was those who did not disclose that information on their admission paperwork, and were labeled in this study as "not reported."

In this study, higher admission rates for students of color were seen in the BA/MD cohorts following the enactment of holistic review, specifically 12.7% in pre-HR and 13.3% in post-HR (see Table 1), compared to the MD cohorts, which were 10.0% pre-HR and 7.8% post-HR (see Table 2). A previous study at the same institution focused only on BA/MD students also found that rates of admission for students of color increased with holistic

review (Arredondo, 2015). At first glance, the admission rates found in this study suggest that students of color have a higher likelihood of being admitted to the BA/MD program than the MD program. Much of the work of diversifying healthcare education has focused on pipeline programs which introduce healthcare careers to students in middle or high school and continue to engage with students until it is time to apply to the health professional school (Atchison, Friedman, & Freed, 2009; Atchison, Hewlett, & Friedman, 2009; Robert Wood Johnson Foundation, 2013). However, studies show that as students, particularly Students of Color, move through the pipeline from K-12 education through college and into medical school, attrition occurs and is termed "the leaky pipeline" (Alexander, Chen, & Grumbach, 2009; Barr, Gonzalez, & Wanat, 2008; Freeman, Landry, Trevino, Grande, & Shea, 2016). For Students of Color, causes of attrition include negative experiences in college or college courses, societal barriers, and inadequate advising and mentoring while in college (Alexander et al., 2009, AAMC, 2015, Barr et al., 2008; Freeman et al., 2016). Since the BA/MD program admits students directly from high school, it effectively shortens the length of that pipeline allowing for fewer chances of "leaking", and may be one of the reasons that higher admission rates for students of color are seen in the BA/MD program compared to the MD program, though further investigation is warranted.

Regarding the graduation of Students of Color, the overall composition of the graduating cohorts in the BA/MD program showed a rate of 9.6% pre-HR, and 12.1% post-HR, both higher than the current percentage of physicians of color in the United States population which is 8.9% (AAMC, 2014b). Though the increase seen after the implementation of holistic review was not statistically significant, the increase was practically significant. One of the goals of holistic review is to produce more physicians of

color and at the site of the present study, the graduating classes placed more physicians of color in the field relative to the overall national rate. However, considering the proportion of patients of color in the United States is 32.4%, the difference in representation between physicians and their patients continues to be a glaring one (United States Census Bureau, 2017). The modest gains made in the percent of physicians of color graduating at this study's site are a good first step, but more investment is needed if the goal of a representative physician population is to be attained.

Specifically, regarding the graduation rates for students of color, the importance of those graduation rates appearing to increase in the BA/MD program while the graduation rates of the institution held steady should not be understated. The institution was able to diversify the student body and graduate more students of color, while maintaining the overall graduation rate of the institution. Further, an unanticipated finding in this study showed that prior to the utilization of holistic review in the BA/MD program, there were significant differences in graduation rates among Students of Color, White and Asian students, and students not reporting their ethnicity. However, an examination of the graduation rate once holistic review was utilized showed no significant difference among the three ethnic categories. Essentially, the gap in degree attainment among the three groups was closed with the utilization of holistic review, and a student of color now has the same chance of graduating as their peer. Overall, these three findings together - increased diversity of the student body in conjunction with a steady overall graduation rate and a reduction in differences in degree attainment rates among various ethnic groups - are notable achievements. Future research should investigate whether these achievements were due solely to holistic review or if other moderating factors are playing a role.

At the same time, as notable gains were seen in the BA/MD cohort, the smaller MD cohort lagged behind in admitting similar percentages of students of color. These groups are inherently small since only between 10 and 22 students were admitted into the MD program during each of the years studied, as shown in Table C2. However, the number of students of color is so few that statistical analysis could not even be completed on their graduation rates. While the MD cohorts are smaller compared to the BA/MD cohorts, there remains the potential to increase the admissions rates, and hopefully the graduation rates, of students of color in the MD program.

**Academic Achievements**

Regarding academic success, statistical analysis showed that for the post-HR MD group, the three variables of graduating GPA, Step 1 first-attempt score, and Step 2 CK first-attempt score were statistically significant when considered together as a group. The smaller sample sizes for both pre-HR and post-HR may have affected the findings, though these groups are inherently small as described previously. The increases in these academic markers of success are substantial in raw numbers alone, and since combined together they were significant, the academic improvement in this group of students is considerable. Due to the improved academic success of the students in this program, future research should examine why academic improvement was seen in the MD program, but not the BA/MD program, when the students are educated together in integrated teams and throughout the classroom and clinical setting. Future research could also consider other admission-related factors that may have affected the MD program outcomes, such as the recruitment strategies used in this population, how their application and interview were structured, and the background of the students in the MD program.

**Diversity-Related Experiences, Serving the Underserved, and the Diversity Rationale**

In reviewing the diversity-related outcomes of students, the major finding was that students in both the BA/MD and MD program reported more participation in experiences related to health disparities, cultural awareness, and cultural competence after holistic review was utilized. Having diversity-related experiences has been shown to positively impact diversity-related attitudes in medical students (Niu, et al., 2012). The two questions on the GQ used to assess this variable asked for experiences that were conducted either for credit or on a volunteer basis, but it is not possible to discern from the answer to the question if the student took part in the experience for credit or voluntarily. Perhaps school-led changes in curriculum included more of these experiences embedded into required coursework. Conversely, if more experiences were had on a volunteer basis, were there partnerships with student organizations that facilitated these experiences, or did students seek these on their own? The GQ data does not answer these questions, but a qualitative review could assist schools in learning the role these other factors played in students' increased participation in diversity-related experiences.

Regarding underserved populations, Students of Color in the pre-HR BA/MD sample were significantly more likely to indicate a desire to work with underserved populations during their medical career than those not reporting their ethnicity. Previous studies have also found that students of color were more likely than peers to serve underserved populations (Saha et al., 2008; Smedley et al., 2004). The gap in career plans between Students of Color and students not reporting closed post-holistic review; future research could explore what might have influenced this change. Upon first glance, it appeared that all three race/ethnicity categories increased their desire to work with underserved populations after holistic review,

but that increase was not statistically significant. One of the goals of increasing the diversity of the medical student population, and ultimately the physician population, is to influence change in health outcomes and decrease health disparities seen in U.S. healthcare (AAMC, 2009; Smedley et al., 2003; Smedley et al., 2004). Further study on career plans regarding underserved populations and how this topic is discussed during courses and clinical experiences would provide better information as to why this gap has closed.

The lack of additional significant findings within the second research question regarding preparedness for residency and learning from diverse peers points to a lack of change in these important elements when holistic review was utilized. Though more students of color seemed to be admitted and seemed to be graduating at higher rates, the mere existence of a more diverse student body likely did not, alone, positively affect diversity-related competencies and experiences as predicted in previous studies (Saha et al., 2008; Whitla, et al., 2003). It appears from these data that additional action is required on the part of the school to enact the core tenets of the diversity rationale. Indeed, support is needed from the faculty, staff, administration, and curriculum in order to facilitate critical thinking and dialogue about diversity in healthcare and in the patient population in order to enact the diversity rationale within a student body (Chang, 2005; Milem, Chang, & Antonio, 2005). Additionally, it appears there may be a threshold or critical mass of students of color needed within a learning environment before benefits of the diversity rationale are seen in students' perceptions of their education.

To remedy this, and for the diversity rationale to take effect in medical education, faculty development and improved training on various pedagogical approaches is likely needed to address how to teach and discuss issues of race, health disparities, the social

aspects of medicine, and underserved populations. As the diversity rationale is dependent upon the students themselves teaching each other from their own lived experiences, perhaps opportunities for facilitated reflection and sociological-based discussions would assist students in making connections with their peers (Chang, 1999; Gurin, Dey, Hurtado, & Gurin, 2002). Finally, though not examined in this study, the effect of physician faculty of color, or lack thereof, on how all students perceive diversity should be evaluated, including plans to increase the number of physician faculty of color at medical institutions, if needed (Xierali, Fair, & Nivet, 2016).

**Additional Limitations**

As discussed in Chapter One, limitations to the study included the GQ response rate which ranged from 69% to 94% per cohort (J. Quaintance, personal communication, October 17, 2017). This means in a given year, data were not collected from between 6% to 31% of the class and therefore, the data available did not include perceptions from the entire population of students. While statistical analysis showed that GQ responses for BA/MD students were representative of the overall BA/MD sample as far as ethnicity, I did not have that information for the MD group, nor did I have additional ways in which to ensure the sample was representative of the population. Since elements of the diversity rationale were not seen in the GQ data, I wonder how this might be different if responses were available for all students in the population.

An additional limitation which may have affected the results were the years available to study. While increasing the number of student cohorts in the pre-HR groups for both programs would have provided more data, especially for the MD groups, it also could have increased the chance that any changes seen could be due to changes in recruitment strategies,

curricular changes, or promotion criteria, to name a few. Further studies could examine how these other variables may support or conflict with the goals of holistic review.

Also of interest is the MD class who began in Spring 2011 and whether they should have been considered pre-HR instead of post-HR, as was done in this study. The matriculating class of MD students in Spring 2011 joined with the BA/MD students admitted in Fall 2009 to become the graduating class of 2015. While the MD cohort was admitted with holistic review, their learning environment was with a class that was not admitted with holistic review. Therefore, this conflict may have affected the MD results.

### Future Recommendations

This study was a first step in assessing graduation-level outcomes of holistic review. Medical schools offering either type of degree program that have recently adopted holistic review will soon have several graduating classes in which they, too, can examine data to study the impact that holistic review has had on their school's learning, developmental, and professional outcomes.

One of the conclusions of this study was that the BA/MD program appeared to be admitting students of color at higher rates than the MD program, despite these programs being at the same institution. Further research at this institution and at others may aid in understanding and closing this gap. It could be that despite using holistic review in both programs, that recruiting practices and admissions processes differed and had an effect. Also, the suggestion that the BA/MD program shortens the pipeline for students of color should be explored, and can be studied in conjunction with other programs that also shorten the pipeline through combined programs or early acceptance programs.

Related to the gap in admissions between the BA/MD and MD program for students of color, the graduation rate for students of color should also continue to be examined. This study found that differences in degree attainment among ethnic categories in the BA/MD program that were significant prior to holistic review, were not statistically significant after holistic review was introduced. Certainly, an increase was seen in the percentage of physicians of color graduating from the BA/MD program after holistic review; however, the graduation rate for students of color continued to appear to be somewhat lower than the graduation rates of peers. While holistic review seemed to have made a positive, practical contribution toward the effort of graduating more physicians of color and closing the gap in degree attainment, further examination of this topic to determine the extent holistic review played would benefit medical schools and their efforts toward meeting this essential mission.

Considering the increase in graduating GPA, Step 1 first-attempt score, and Step 2 first-attempt score for MD students post-HR, further examination of additional causes is warranted. Was holistic review on its own responsible for this increase, or were other changes made that might cause this significant change? Further studies at other schools, or a more intensive study at the present site, could reveal impactful changes that, either by themselves or in addition to holistic review, have contributed toward this increase.

Additionally, more opportunities exist to study the diversity rationale within medical education cohorts. At UMKC specifically, the use of the docent teams in which students are in teams of 12-14 students with a mentor physician over the course of several years provides another cohort environment in which the diversity rationale could be studied. Other schools utilizing similar learning environments could provide additional sites for further study.

Future studies on the interaction of the diversity rationale and holistic review should include data collection points at the beginning of and throughout students' enrollment to understand how the diversity rationale might be at play within a group of students and within the larger school culture. In addition to the GQ, the AAMC also offers the Matriculating Student Questionnaire, and the Year Two Questionnaire, which can help medical degree programs assess aspects of diversity perceptions along the curriculum continuum (AAMC, 2018a). UMKC does not participate in these surveys as the unique structure of the six-year BA/MD program does not often match with the wording or intent of the survey questions that focus on the pre-medical undergraduate experiences or traditional entry into medical school (AAMC, 2017e). Given there are many combined programs in the country, revising these two AAMC questionnaires for use by combined programs would provide additional AAMC support to administer such curricular endeavors. As they currently stand, however, traditional four-year programs can benefit from the data collected on these surveys and track how responses to diversity-related questions change as a cohort of students moves through the curriculum.

The AAMC has shown wide support for holistic review through its publications and workshops on the topic, and has just recently created a Holistic Review Resource Bank to provide more open access and information sharing for medical schools (AAMC, 2018c). These resources, combined with the multiple surveys that AAMC administers, provide a wealth of support for future researchers studying holistic review in medical schools. I recommend that medical schools request their individual-level survey data from the AAMC each year after survey results are published so they can investigate the influence of holistic review throughout their curriculum.

An emerging area of study related to holistic review in medicine is how holistic review is used in graduate medical education, and its potential for effective use in the future. Graduate medical education comprises the residency portion of a medical graduate's career journey and is the next step recent medical graduates must take to train and complete their licensure. Entry into residency is competitive and discussions are now being had at the national level as to how holistic review processes in medical school admissions might impact admission into graduate medical education, which currently relies heavily on the cognitive measure of the USMLE Step 1 score (AAMC, 2018b; Moynahan, 2018). The Step 1 score is often used to rank applicants for interviews, even before programs can see more information about the student such as grades, past evaluations, personal statements, and letters of recommendation. This tactic is in conflict with the spirit of holistic review, and alignment of the two practices is a current topic in the field and literature (AAMC, 2018b; Moynahan, 2018). If students, particularly students of color, who previously would have been denied admission to medical schools are now matriculating and graduating from medical schools due to holistic review, we must verify that these students are also being accepted into graduate medical education (residency training program). In other words, are residencies reversing the goal of holistic review by not accepting those students into the next step? If the answer is yes, the effect of holistic review at the undergraduate medical education level is moot, since these students cannot then enter a residency program and become practicing physicians. The development of support tools from the AAMC and further exploration of how graduate medical education can implement holistic review in their admissions will assist in increasing the percentage of physicians of color.

**Summary**

This study reviewed academic and diversity-related outcomes of holistic review admissions processes utilized in a medical school with a combined bachelor and medical degree program as well as a traditional medical degree program. Significant academic outcome findings included increased Step 1 and Step 2 CK scores for MD students, as well as a combined increase in graduating GPA, Step 1, and Step 2 CK score together for MD students. Additionally, and importantly, this study found that when holistic review was utilized in the BA/MD program, the previously significant gap in graduation rates among Students of Color, White and Asian students, and students not reporting their ethnicity was erased. Significant diversity-related findings include increased participation in diversity-related experiences for both BA/MD and MD students, and a reduction in gaps for those planning to practice with underserved populations among racial/ethnic lines. Among all variables, no significant decreases in outcomes measures were found when holistic review was utilized.

This study provided graduation-level outcomes data for those admitted with a holistic review process, contributing to the body of literature that currently lacks graduation-outcome studies for holistic review in medical education. With this knowledge, further studies can be conducted on diversity-related practices and teaching throughout the curriculum to enact the diversity rationale, as well as how programs shortening the pipeline to an MD degree for students of color affect graduation rates for students of color. As other medical schools who have either combined or traditional medical degree programs begin to produce graduates who were admitted through holistic review practices, this study should be replicated and expanded

upon to further study the learning, developmental, and professional outcomes of medical

school graduates.

APPENDIX A

DATA CODES

Each variable was coded as described below prior to data analysis.

**Admission Type**

Each participant was given a code for either pre-holistic review or post-holistic review, abbreviated in the analysis as pre-HR and post-HR. Those in the BA/MD program admitted in 2007, 2008, and 2009 and those in the MD program admitted in 2009 and 2010 were pre-HR. Those in the BA/MD program admitted in 2010 and 2011, and those in the MD program admitted in 2011, 2012, and 2013, were post-HR.

- Pre-holistic review (0)

- Post-holistic review (1)

**Program Type**

- BA/MD program (0)

- MD program (1)

**Students of Color**

When the data for the first research question was initially received, race/ethnicity was coded with the following definitions:

- Native American (1)

- Black (2)

- Hispanic (3)

- White (4)

- Asian (5)

- Not reported (6)

- Underrepresented Asian (7)

- Native Hawaiian/Other Pacific Islander (8)

To aid in data analysis, this was recoded in the following way:

- Students of Color; 1, 2, 3, 7, and 8 (0)

- White and Asian; 4 and 5 (1)

- Not reported; 6 (2)

When GQ data were requested from the AAMC for the second research question, the eight race/ethnicity codes above were combined into the three recoded categories. Therefore, when the AAMC data were received, it was already divided into the three recoded categories.

**Graduation Rate**

To calculate the graduation rate, each participant was coded into one of the following categories:

- Withdrew or separated in years 1 or 2 (0)

- Withdrew or separated in years 3 through 6 (1)

- Currently enrolled (2)

- Graduated (3)

These codes were assigned based on the variable listing the status of the student in the program. If the student had withdrawn or separated, a second variable listed the level they were at when they exited the program. This information was used to determine whether the student left in years 1 and 2 or 3 through 6. In the case of one participant whose level was not listed, it was determined by the low number of credit hours accumulated at the undergraduate level (less than 12), that the participant withdrew in years 1 and 2.

Initial review of the data showed that the latest admission year of BA/MD students, those admitted in 2011, had a large percentage of currently enrolled students (17.7%) compared to all of the previous cohorts of BA/MD students (between 0 and 3.1%), as shown in Table C3. Similar results were found in the MD population as well (see Table C4). I assumed these students had extended their curriculum and were expected to be on track to graduate due to the high number of hours they had obtained.

Further, I determined that separating students into two withdrew or separated categories was not important to this particular study or calculation, though it was noted that more students did withdraw in Year 1 and 2 of the BA/MD program than in Years 3-6 (see Table C3). Therefore, I determined that the two withdrew/separated categories would be combined together, and the currently enrolled and graduated categories would be combined. This resulted in the following recoding:

- Withdrew or separated (0)

- Currently enrolled or graduated (1)

The analysis on graduation rate and graduation rate of students of color includes any student who is currently enrolled as a "graduated" student and counts them in the graduation rate.

The calculation of the graduation rate for students of color is the same as described above for graduation rate, but the analysis was restricted just to students of color. When further analysis was needed to determine the graduate rates of the other race/ethnicity categories, that analysis was restricted to those categories.

## Graduating GPA

The measure of GPA is a continuous variable and is an average of all hours and grade points earned in the program.

For students in the BA/MD program, data were obtained for credit hours, grade points, and GPA in both their undergraduate career and medical career. The undergraduate career represents all work completed in the first two years in addition to one undergraduate semester in the fourth year of the six-year curriculum. The medical career GPA information reflects all work done in the other years and semesters. For the purposes of this study, the graduating GPA for BA/MD students was defined as all work completed in the BA/MD program, therefore the data for the undergraduate career and medical career needed to be combined only for those participants who were a part of the BA/MD program. The hours for both careers were combined into a new field titled, "Graded units combined," the points for both careers were combined into a new field titled, "Grade Points Combined," and a new, combined GPA was calculated using those two fields, resulting in a third new field titled, "GPA Combined."

In order to ensure a fair calculation of graduating GPA for MD students, any undergraduate credit hours, points, or GPA listed for students in the MD program were removed. Some MD students completed undergraduate work at the institution while others did not, resulting in unequal academic information if these data were to be included. Since this study focuses on the academic success of students once in the medical program, only the credit hours and grade point information from the medical career was of importance to the research for those in the MD program. Removing these extraneous undergraduate data

ensured the graduating GPA of MD students reflected only the work completed in the MD program.

### United States Medical Licensing Exam (USMLE) Step 1 First-Attempt Score

The first-attempt USMLE Step 1 score is a three-digit number and a continuous variable. No recoding was conducted on this variable.

### USMLE Step 2 Clinical Knowledge First-Attempt Score

The first-attempt USMLE Step 2 CK score is a three-digit number and a continuous variable. No recoding was conducted on this variable.

### USMLE Step 2 Clinical Skills First-Attempt Score

The first-attempt USMLE Step 2 CS score is either a pass or fail and as such, is a dichotomous variable. In order to analyze the status of the Step 2 CS exam result, all results were recoded in the following way:

- Failed on first attempt (0)
- Passed on first attempt (1)

### Preparedness for Residency

The first variable from the GQ data combined the results of the following three questions.

- "I have the communication skills necessary to interact with patients and health professionals."
- "I have a fundamental understanding of the issues in social sciences of medicine (e.g., ethics, humanism, professionalism, organization and structure of the health care system)."

- "I believe I am adequately prepared to care for patients from different backgrounds."

These three questions asked respondents to choose their answer on a 5-point Likert-scale with answers ranging from strongly disagree (1) to strongly agree (5). The sum of the three answers was averaged to create a score for this variable using the same scale. For data analysis, this value was treated as a continuous variable.

### Diversity Rationale

The second variable from the GQ data combined the results of the following two questions.

- "My knowledge or opinion was influenced or changed by becoming more aware of the perspectives of individuals from different backgrounds."
- "The diversity within my medical school class enhanced my training and skills to work with individuals from different backgrounds."

These two questions asked respondents to choose their answer on a 5-point Likert-scale with answers ranging from strongly disagree (1) to strongly agree (5). The sum of the two answers was averaged to create a score for this variable using the same scale. For data analysis, this value was treated as a continuous variable.

### Diversity-Related Experiences

The third variable from the GQ data combined the results of the following two questions.

- "Indicate the activities you will have participated in during medical school on an elective (for credit) or volunteer (not required) basis: Experience related to health disparities"

- "Indicate the activities you will have participated in during medical school on an elective (for credit) or volunteer (not required) basis: Experience related to cultural awareness and cultural competence"

Each question asked the respondent to answer either no or yes. Answers were coded in the following way:

- No (0)

- Yes (1)

Each response code then was added together to form a score of 0, 1, or 2. As this question was focused on increasing experience with diversity and cultural competency, the scores were recoded in the following way:

- Did not participate in either experience with a total score of 0 (0)

- Participated in one or both of the experiences with a total score of 1 or 2 (1)

## Career Plans

The fourth and final variable of the GQ data was a single question inquiring about career plans of graduating students.

- "Regardless of location, do you plan to care primarily for an underserved population?"

The answer to this question was coded in the following way:

- "No" or "Undecided" (0)

- Yes (1)

APPENDIX B

HOLM-BONFERRONI TABLES

Table B1
*Holm-Bonferroni Correction Levels*

| Level | Original Alpha | H-B Corrected Alpha |
|---|---|---|
| 1 | 0.05 | 0.05 |
| 2 | 0.05 | 0.025 |
| 3 | 0.05 | 0.0167 |

Table B2
*Holm-Bonferroni Correction Results for Research Question 1 for BA/MD students*

| Level | Original Alpha | H-B Corrected Alpha | Ranked p-values | Dep. Variable | Result |
|---|---|---|---|---|---|
| 1 | 0.05 | 0.05 | 0.421 | Step 1 | Not Sig. |
| 2 | 0.05 | 0.025 | 0.415 | Step 2 CK | Not Sig. |
| 3 | 0.05 | 0.0167 | 0.042 | Grad. GPA | Not Sig. |

Table B3
*Holm-Bonferroni Correction Results for Research Question 1 for MD students*

| Level | Original Alpha | H-B Corrected Alpha | Ranked p-values | Dep. Variable | Result |
|---|---|---|---|---|---|
| 1 | 0.05 | 0.05 | 0.055 | Grad. GPA | Not Sig. |
| 2 | 0.05 | 0.025 | 0.021 | Step 2 CK | Sig. |
| 3 | 0.05 | 0.0167 | 0.009 | Step 1 | Sig. |

Table B4

*Holm-Bonferroni Correction Results for Research Question 2 for BA/MD students*

| Level | Original Alpha | H-B Corrected Alpha | Ranked p-values | Dep. Variable | Result |
|-------|----------------|---------------------|-----------------|---------------|--------|
| 1 | 0.05 | 0.05 | 0.414 | Prep. for Res. | Not Sig. |
| 2 | 0.05 | 0.025 | 0.348 | Div. Rat. | Not Sig. |

Table B5

*Holm-Bonferroni Correction Results for Research Question 2 for MD students*

| Level | Original Alpha | H-B Corrected Alpha | Ranked p-values | Dep. Variable | Result |
|-------|----------------|---------------------|-----------------|---------------|--------|
| 1 | 0.05 | 0.05 | 0.976 | Div. Rat. | Not Sig. |
| 2 | 0.05 | 0.025 | 0.121 | Prep. for Res. | Not Sig. |

APPENDIX C

SUPPLEMENTAL TABLES

Table C1
*Admitted BA/MD Class Composition, by Race/Ethnicity for all years (N=543)*

| Matriculation Year | Students of Color (n=70) | White and Asian (n=414) | Not reported (n=59) |
|---|---|---|---|
| *Pre-HR (n=332)* | *12.7%* | *75.3%* | *12.0%* |
| 2007 (n=124) | 12.1% | 72.6% | 15.3% |
| 2008 (n=100) | 15.0% | 81.0% | 4.0% |
| 2009 (n=108) | 11.1% | 73.1% | 15.7% |
| *Post-HR (n=211)* | *13.3%* | *77.7%* | *9.0%* |
| 2010 (n=98) | 10.2% | 84.7% | 5.1% |
| 2011 (n=113) | 15.9% | 71.7% | 12.4% |

Table C2
*Admitted MD Class Composition, by Race/Ethnicity for all years (N=71)*

| Matriculation Year | Students of Color (n=6) | White and Asian (n=56) | Not reported (n=9) |
|---|---|---|---|
| *Pre-HR (n=20)* | *10.0%* | *75.0%* | *15.0%* |
| 2009 (n=10) | 10.0% | 80.0% | 10.0% |
| 2010 (n=10) | 10.0% | 70.0% | 20.0% |
| *Post-HR (n=51)* | *7.8%* | *80.4%* | *11.8%* |
| 2011 (n=11) | 0.0% | 63.6% | 36.4% |
| 2012 (n=18) | 16.7% | 77.8% | 5.6% |
| 2013 (n=22) | 4.5% | 90.9% | 4.5% |

Table C3

*Withdrew/Separated (W/S), Currently Enrolled (CE), and Graduation (G) Rates of BA/MD students, all years (N=543)*

| Matriculation Year | W/S in Years 1-2 (n=88) | W/S in Years 3-6 (n=30) | CE (n=24) | G (n=401) |
|---|---|---|---|---|
| *Pre-HR (n=332)* | *16.0%* | *5.7%* | *0.3%* | *78.0%* |
| 2007 (n=124) | 21.8% | 8.1% | 0.0% | 70.2% |
| 2008 (n=100) | 16.0% | 7.0% | 0.0% | 77.0% |
| 2009 (n=108) | 9.3% | 1.9% | 0.9% | 88.0% |
| *Post-HR (n=211)* | *16.6%* | *5.2%* | *10.9%* | *67.3%* |
| 2010 (n=98) | 13.3% | 1.0% | 3.1% | 82.7% |
| 2011 (n=113) | 19.5% | 8.8% | 17.7% | 54.0% |

Table C4

*Withdrew/Separated (W/S), Currently Enrolled (CE), and Graduation (G) Rates of MD students, all years (N=71)*

| Matriculation Year | W/S in Years 1-2 (n=N/A) | W/S in Years 3-6 (n=5) | CE (n=2) | G (n=64) |
|---|---|---|---|---|
| *Pre-HR (n=20)* | *N/A* | *0.0%* | *0.0%* | *100%* |
| 2009 (n=10) | N/A | 0.0% | 0.0% | 100% |
| 2010 (n=10) | N/A | 0.0% | 0.0% | 100% |
| *Post-HR (n=51)* | *N/A* | *9.8%* | *3.9%* | *86.3%* |
| 2011 (n=11) | N/A | 9.1% | 0.0% | 90.9% |
| 2012 (n=18) | N/A | 11.1% | 11.1% | 77.8% |
| 2013 (n=22) | N/A | 9.1% | 0.0% | 90.9% |

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VITA

Cary (Lyon) Chelladurai was born in August 1982, in Nebraska. As a child, she grew up in Warrensburg, Missouri where she graduated from Warrensburg High School in 2000. Cary obtained a Bachelor of Science in Education with a major in chemistry in 2004, and completed a Master of Science in College Student Personnel Administration in 2006, both from University of Central Missouri (UCM). In 2006, she was named the Rising Star Graduate Student for the state of Missouri from NASPA Region IV-West.

Beginning in 2001, she served as a student staff member in the Graduate School and the Office of Student Affairs at UCM, gaining invaluable experience in her future career. In 2006, a project she was closely involved in with the Office of Student Affairs won a national Noel-Levitz retention award.

Cary began her professional career in 2007 at the University of Missouri-Kansas City as Director of Pre-Health Programs for the College of Arts and Sciences. In 2010, she transitioned to the School of Medicine, serving as a senior advisor specializing in Year 1 and 2 students in the 6-year combined BA/MD program. In 2012, she became the Manager of Student Affairs for the School of Medicine, overseeing advising, wellness, financial literacy, and academic support services, and continues to serve in that position.

Throughout Cary's time in her current role, she has served on numerous campus-wide committees including the Strategic Enrollment Management Team, Advising Leadership Team, and several scholarship review committees. She has presented at the Missouri College Personnel Association regional conference, the Noel-Levitz National Conference on Student Recruitment, Marketing, and Retention, and, most recently, at the Association of American Medical Colleges Group on Student Affairs national conference. She currently is working

closely with the AAMC as a subject-matter expert on their Group on Student Affairs

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Cary's interest in higher education includes medical student populations and their

success, transitioning students from high school to college, access to higher education, team

dynamics, and staff development.