How Incoming Student Experiences, Attributes and Metrics are Related to Academic Performance in a Combined-Degree Medical Program: A Comparison of Holistic and Non-Holistic Admissions Practices

By

Alice Arredondo

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Chairperson, Dr. Lisa Wolf-Wendel

_____
Dr. Dongbin Kim

_____
Dr. Susan Twombly

_____
Dr. Marlesa Roney

_____
Dr. Meagan Patterson

Date Defended: April 9, 2015

The Dissertation Committee for Alice Arredondo
certifies that this is the approved version of the following dissertation:

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Chairperson, Dr. Lisa Wolf-Wendel

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Abstract

This study was conducted at the University of Missouri – Kansas City School of Medicine, where students enter medical school directly after graduating from high school rather than follow the more traditional path of four years of undergraduate education followed by four years of medical school. This study examines incoming student experiences, attributes and metrics and their relationship to student academic performance and retention in the combined-degree medical program. This study also investigated differences in outcomes for students admitted after holistic admissions policies were implemented. The sample included all students admitted between 2005 and 2013, and involved an analysis of outcomes for all students admitted, students admitted pre-holistic admissions (2005 to 2009) and students admitted post-holistic admissions (2010 to 2013). Correlations, comparison of means, chi-square analysis, linear regression and multinomial logistic regression were used to analyze the relationship between experiences, attributes and metrics and academic performance and retention in medical school. Results indicate that students who earned higher ACT scores and a higher high school GPA demonstrated a higher medical school GPA and were more likely to demonstrate success in the program. Additionally, students with a more rigorous high school curriculum were more likely to demonstrate a higher medical school GPA and success in the program. Gender, status as an underrepresented minority, geographic origin and parent level of education were all statistically significant in either predicting medical school GPA or in increasing or decreasing the odds of success. Furthermore, holistic admissions practices had a direct effect on retention rates and diversity in the medical school. In fact, holistic admissions practices resulted in a statistically significant

increase in retention and a statistically significant increase in the number of students underrepresented in medicine who entered the School of Medicine. The importance of this study lies in the need to understand what incoming student experiences, attributes and metrics predict student retention, and how we might identify and address those experiences, attributes and metrics at the point of admission and beyond. In addition, demonstrating that holistic admissions practices are achieving the goals of increased diversity and increased retention reaffirms its use in medical school admissions.

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How Incoming Student Experiences, Attributes and Metrics are Related to Academic Performance in a Combined-Degree Medical Program: A Comparison of Holistic and Non-Holistic Admissions Practices

Chapter One: Introduction

For the hundreds of thousands of prospective college students graduating from high school this year, the options for where to pursue higher education are vast. A number of these students enter college planning to enter medical school after completing an undergraduate degree. According to a 2012 survey depicting the norms of first time-full time freshman in the fall 2012, 19.3% of students entering college plan to pursue a pre-medical curriculum (Pryor, et al., 2012). Most students in the United States who desire to become physicians do so by pursuing a four-year undergraduate degree, followed by four years of medical education. Accelerated or combined-degree medical programs are available; 40 of the 141 accredited medical schools in the United States offer a combined-degree program to complete the undergraduate and medical degree in a six-year, seven-year or eight-year combined degree option (AAMC, 2013). Combined degree programs are not always accelerated programs, but in most cases offer students the opportunity of guaranteed admission to medical school so long as the student meets certain requirements.

Students who choose to enter a college or university because that school offers a combined-degree medical program do so because they have demonstrated a commitment to not only study medicine but to graduate as a physician. In fact, some of the earliest motivations for medical schools to begin combined degree programs were to attract the most academically talented students who were committed to medicine (Eaglen, et al.,

2012; Olson, 1992). These students are often high achievers in high school, and are admitted to combined-degree programs because of their outstanding academic performance and other characteristics evaluated in the admissions process, similar to those of more traditional medical school applicants. "In addition, these students are more likely to enter medical school and obtain the M.D. degree than are first-year college students who simply identify premedicine as a major and who follow a traditional academic course to obtain a bachelor's degree" (Olson, 1992, p. 783). Ultimately, students who are admitted to combined degree programs are admitted because they have demonstrated the early interest and capacity to become a physician.

Purpose of the Study

This study identifies which individual experiences, attributes and metrics of an incoming student, if any, predict a student's chances of successfully completing the first two years of the combined degree medical program at the University of Missouri-Kansas City. This study evaluates incoming student experiences, attributes and metrics, both those currently evaluated in the admissions process, such as standardized test scores, high school GPA and evaluation of a student's investigation of the profession, and those not evaluated, such as parent level of education and geographic origin. It is necessary to evaluate how such experiences, attributes and metrics may or may not predict student retention in the combined degree program or whether or not a student will be dismissed or will withdraw from the UMKC combined-degree program.

In addition, this study evaluated outcomes for students admitted pre-holistic admissions (between 2005 and 2009) and students admitted post-holistic admissions (between 2010 and 2013) to see if any significant differences occurred after the

implementation of holistic admissions. Holistic admissions is a time-intensive admissions process that allows an admissions committee to consider multiple experiences, attributes and metrics when deciding whom to admit. The goal of this process is to admit a diverse class of students who have the greatest potential for success. These goals should be met in order to appreciate the value of a holistic admissions process.

The outcome of this study will inform a number of future policies, including holistic admissions policies and requirements, support services offered to students during the first two years of the program, procedures for advising students as it relates to dismissal or withdrawal, and procedures for advising students who do not complete the program in the expected timeframe.

Context of the Study

The UMKC School of Medicine is unique in the world of medical education by offering students the opportunity to enter medical school directly after graduating from high school and complete both their baccalaureate and Doctor of Medicine degrees in six years. A primary goal of the UMKC School of Medicine is to graduate at least 100 physicians each year to assist with filling the gaps in health care in the state of Missouri and beyond. The mission of the medical school is driven by the need for healthcare providers in the state of Missouri and nationally, therefore the goals of the school are driven by the desire to graduate the largest number of physicians possible. Additionally, the vision of the medical school identifies diversity among its students as a goal in order to meet the diverse needs of the state, particularly in underserved areas. Ultimately, the

school wants to admit those students who have the greatest potential for success to graduate, become physicians and serve their communities.

Each year the school admits approximately 115 students into its incoming class, but throughout the 40-year history of the school only retains about 80% of any given class. Most of the student attrition occurs within the first two years of the program, with students who enter the program eventually separating into three groups:

- Those students who successfully complete the program in six years,
- Those students who enter the Alternate Program, a program designed for students who experience academic difficulty and may need to lengthen the program beyond the intended six years in order to repeat coursework and improve academic performance, and
- Those students who are dismissed or withdraw from the program, in most cases for poor academic performance.

Most students who enter the Alternate Program, or who withdraw or are dismissed from the program, do so in the first two years. Very rarely does a student in the final four years of the program enter the Alternate Program or encounter withdrawal or dismissal. For example, for the class that entered in 2006, 8% of the class withdrew or was dismissed after year one, another 9% after year two, 3% after year three and 1% between year four and graduation. For this class, 17% withdrew or were dismissed in the first two years of the program, versus 4% in the final four years.

Student retention in this program is a common topic of discussion among administrators within the UMKC School of Medicine. It is necessary to discuss how incoming individual student experiences, attributes and metrics may influence student

retention, or predict whether or not a student successfully completes the program, as an assumption is made that the students who are dismissed or enter the Alternate Program have a common characteristic that could have been identified and/or addressed at the point of admission. The perception is that incoming student experiences, attributes and metrics are the primary explanation for why a student leaves the program, and that leaving the program could have been prevented had the admissions committee identified and admitted students who were predicted to succeed.

Background of the Problem

Although research is available that informs retention policies for traditional undergraduates, there is a lack of research focused on retention of students who enter combined-degree medical programs. These students are entering college at the same time as other traditional college students, but are entering a professional program earlier than their undergraduate peers. These students may face many of the same challenges as a traditional undergraduate student acclimating to college life, but are also typically faced with more stringent expectations regarding curricular requirements and performance in coursework. At UMKC, students face the challenge of enrolling in 20-22 credit hours per semester, enrolling year-round all six years of the program, and have a higher expectation with regards to performance in courses, with 20% of students unable to demonstrate success when confronting these challenges. Although similar challenges may exist for more traditional medical students, only four percent of medical students in a traditional medical school are unsuccessful (AAMC, 2014).

While research regarding incoming student characteristics (both cognitive and non-cognitive) and their relationship to academic success or retention exists for first-year

undergraduate students (Camara, 2005; Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008; Laird, 2005; Linn, 2005; Mattern & Patterson, 2009; Mattern, Marini, & Shaw, 2013; Radunzel & Noble, 2012; Sawyer, 2007; Sawyer, 2010; Schmitt, et al., 2011; Sedlacek, 2004; Thomas, Kuncel & Crede, 2007; Zwick, 2002), additional research is needed to investigate the relationship between incoming student experiences, attributes and metrics for students in a combined-degree medical program and retention in that program. We need to understand any commonalities among the 20% of students who are not successful in the UMKC program.

Additionally, the processes of admission to an institution of higher education are as vast and diverse as the institutions themselves. From a basic process requiring the simple submission of an application to the elaborate process of supplying high school transcripts, standardized test scores, essays, résumés, letters of recommendation and participating in an interview process, what is required from each university varies drastically. Though students must understand and adhere to the different processes of admission, as an admissions officer in an institution of higher education one is also responsible for understanding the complex processes of college admissions. While colleges and universities in the United States have varying admissions policies, it is the responsibility of the individual institution and/or academic program to research and develop admissions policies that are effective and practical for that particular institution or academic program.

For the purposes of this study, the combined-degree program being evaluated utilizes a holistic admissions process to evaluate applicants for admission. The purposes of holistic admissions for the program at UMKC are to identify those students who have

the greatest chance of succeeding and to increase the diversity of each incoming class. Several incoming student experiences, attributes and metrics, both cognitive and non-cognitive, were evaluated in hopes of understanding each individual student and his/her motivation and preparation for a career in medicine, as well as how he/she might contribute to the diversity of the school, community and profession. What is unknown is whether or not any of the incoming student experiences, attributes and metrics evaluated in the admissions process have any relationship to retention in the combined-degree accelerated medical program.

Overview of the UMKC School of Medicine Combined-Degree Program

As one of only a handful of American medical schools that offers a six-year combined degree program (AAMC, 2013), UMKC medical students enter medical school directly from high school and complete both the baccalaureate degree and medical degree in six years as opposed to the more traditional eight. The following description of the program was developed from a number of resources including the UMKC School of Medicine website, marketing publications, and the knowledge of the author who currently serves as the Assistant Dean of Admissions and Recruitment at the School of Medicine.

Curriculum overview. Students at the UMKC School of Medicine simultaneously enroll in both undergraduate and medical school coursework during the first four years of the program, with the last two years devoted solely to clinical coursework. During the first two years of the program, students spend approximately three-fourths of their time completing undergraduate degree requirements and one-fourth of their time completing medical school coursework. In years three through six, students

spend the majority of time completing medical school coursework. Most students complete the undergraduate portion of the curriculum by the end of year four, and spend the final two years in the program engaged in medical school clinical rotations.

Students in the combined-degree program pursue degrees in liberal arts, biology or chemistry and enroll in 20 – 22 credit hours each semester. In the first two years, students adhere to the university's semester-based calendar. Students are enrolled in a 15-week fall term and 15-week spring term in year 1, followed by an 8-week summer term, 15-week fall term and 15-week spring term in year 2. In year 3, the schedule shifts and students begin to follow the medical school calendar, an 11-month academic calendar where courses and clinical clerkships are taught in 4-week, 8-week or 12-week sections.

A unique distinction of the UMKC medical curriculum is the integration of clinical experiences throughout all six years of the program. A hallmark of the program, the "early exposure to clinical medicine in the first two years of the curriculum introduces students who are recent high school graduates to patients, hospital settings, and courses designed to teach communication skills, professionalism, and clinical problem-solving and to build, early on, a full understanding of the language and culture of medicine" (Drees, Arnold, & Jonas, 2007, p. 362). When entering the program, students are assigned to a docent team of ten to fifteen students from their year 1 class. A docent is a teaching physician who practices in one of the school's affiliate hospitals, and the docent team concept is designed to provide "ready access to patient-centered teaching, mentoring, and role modeling" (Drees, et al., 2007, p. 362). The docent team experience is unmatched in other U.S. medical schools, and is a foundation of the school's curriculum.

Docent teams begin in the third week of year one, and include ten to fifteen students from the year one class and the docent. In docent teams, students spend three to four hours each week with the docent in the hospital where the docent practices. This experience is connected to a course, the Fundamentals of Medical Practice, students are enrolled in during each semester of the first two years. As a part of the docent team, students begin to interact with patients and others in the health care team, they participate in hospital rounds with the physician, they learn to take a patient's medical history and begin to take a patient's history on their own, and learn other skills that would be associated with the fundamentals of medicine.

In years three through six, the docent team experience changes and becomes a more robust clinical experience. When students are promoted from year two to year three, they join a new docent team that is comprised of 12 to 15 students from the final four years of the program, the docent, a pharmacologist, a clinical medical librarian and an academic advisor. As a part of this docent team, students will work a half day a week every week for the last four years of the program in an outpatient clinic. Docent teams will also spend two months out of the year on an Internal Medicine clinical rotation, which is in addition to the other clinical rotations required in the curriculum – Family Medicine, Emergency Medicine, Surgery, Pediatrics, Obstetrics and Gynecology and Psychiatry. In addition to the clinical experience, students in years three through six also complete the required basic medical science coursework necessary to graduate from medical school.

The overall goal of both the clinical component and basic medical science component of the curriculum are to assist a student in further developing the core competencies of the School of Medicine:

- Interpersonal skills, including verbal and non-verbal communication, and an understanding of the doctor-patient relationship and the relationships that exist within the healthcare team,
- Medical knowledge, including application of the basic sciences and problem solving,
- Practice-based learning and improvement skills, including how to assess and evaluate patient information leading to effective and efficient patient care,
- Systems-based practice, which allows students to evaluate a patient within the psychological, social, cultural and economic contexts of that patient and his/her community, and
- Patient care experiences which facilitate the acquisition of attitudes, knowledge and skills necessary to care for a full range of patient problems in a variety of health care settings.

These core competencies drive the medical education offered at UMKC, and are the foundation for every clinical and basic science experience a student will encounter. In addition, these competencies drive the admissions process and selection of students so that the admissions committee considers these competencies when selecting students who have the potential to further develop them.

Holistic admissions and selection criteria. As an individual academic unit at the University of Missouri—Kansas City, the School of Medicine is responsible for

conducting its own admissions process. Though the university does assist with the physical processing of applications, it is the sole responsibility of the medical school to set minimum admissions requirements, develop its own admissions policies and select the applicants with the greatest potential for success.

In order to effectively and efficiently carry out the admissions process, the School of Medicine has formed a Council on Selection, the admissions committee for the medical school. This Council is comprised of 21 members of the medical school faculty, administration and student body, and these members have been charged with the major responsibility of selecting students for admission to the School of Medicine. In addition, the Council reviews and makes recommendations on policies and procedures that relate to the selection process and may also recommend programs and activities to be undertaken by the School of Medicine that relate to the recruitment and selection of new students.

Because the school receives over 1000 applications each year for the 115 positions in the class, the process of selecting students from an extremely qualified and competitive applicant pool is detailed and requires significant involvement from all involved. The Council on Selection is the body of decision-makers who actively participate in the selection process, and they must establish appropriate policies and procedures with regards to the selection of students for medical school. These admissions policies must guarantee a competitive review process, the individual review of applicants, and an open assessment of what the applicant may potentially contribute to the medical community. This process must be applied equally and consistently to all applicants. Therefore, the process must be holistic and individualized for each student.

Holistic admissions. For several years, the Association of American Medical Colleges (AAMC) has been encouraging medical schools to employ a holistic, individualized review of applicants to medical school. The goals of holistic admissions are to align "admissions policies, processes, and criteria with institution-specific mission and goals" and to sustain and benefit from "medical student diversity (as defined by the school) in support of those mission and goals" (AAMC, 2010, p. vii). Ultimately, holistic admissions policies should broadly define diversity and be implemented in alignment with institutional mission and goals.

This holistic approach is intended to replace the traditional method of reviewing applicants for admission, which would include the review of standardized test score and GPA as the primary basis for an admissions decision. Supporters of holistic admissions propose that such a review of metrics only offers a limited evaluation of an applicant, and neglects other characteristics and attributes that are important in medical education and the practice of medicine (AAMC, 2010; AAMC, 2013; Camara, 2005; Laird, 2005).

In 2010, the Association of American Medical Colleges released a report regarding the integration of holistic review practices into the medical school admissions process. In this report, the AAMC outlined ways in which to integrate and implement holistic admissions into current admissions practices, establish admissions criteria that balance experiences, attributes and metrics, and establish criteria by which to assess applicants (AAMC, 2010). The goal of new holistic admissions models was to align admissions practices and decisions with institutional mission, while also supporting short-term and long-term outcomes and goals (AAMC, 2013), such as increasing retention and achieving diversity.

The holistic review of applicants in the admissions process focuses on academic achievement and ability, but also provides an open review of other talents and experiences that relate to potential success in medical school. It is necessary to review applicants in terms of their potential academic success in medical school, but also in terms of their potential contribution to the medical school community and to the learning experiences of others around them.

Admission at UMKC School of Medicine. At UMKC, the current holistic admissions process was implemented in 2010, based on recommendations from the Association of American Medical Colleges, and includes an assessment of experiences, attributes and metrics. UMKC uses the Experiences – Attributes – Metrics model, which provides guidance to medical schools on how to incorporate a candidate's experiences, attributes and metrics into the admissions decision. This model also understands diversity to be an important part of interactions, learning and developing cultural competency while in medical school. To that end, UMKC reviews experiences, attributes and metrics, including a review of cognitive variables (e.g. standardized test score, core high school grade point average and rigor of the high school curriculum) and non-cognitive variables (e.g. personal statement, involvement and leadership in co-curricular activities, health experiences and references),which are both given equal consideration. In addition, candidates are evaluated for how they might contribute to the diversity of the class, school and medical community, with diversity broadly defined to include such characteristics as gender, race/ethnicity, geographic origin, educational background or family background. This holistic process is implemented at each step in the process, from selecting candidates for interview to making final admissions decisions.

To be considered for initial review, all applicants must meet the minimum academic standards of the College of Arts and Sciences. Once an applicant meets these minimum requirements, the application is then sent to and reviewed by the School of Medicine Council on Selection. The application review and selection process involves several steps in selecting students for admission to the program.

First, all applicants are initially evaluated by the School of Medicine Office of Admissions. Once the initial evaluation has been completed, all applicants receive additional review by at least two members of the Council on Selection. The goal of this review is to consider all experiences, attributes and metrics of a student, and determine whether or not the student has demonstrated the potential to not only succeed in medical school, but also to contribute to his/her peers and colleagues in the medical community. The results of this evaluation determines whether or not an applicant is offered an interview.

Applicants invited to interview attend a School of Medicine interview day. During this day, students participate in a variety of activities to assess the student's capacity for medical school, the most important of which is the interview. The standard interview has historically included two 30-minute interviews, with the interviewer asking questions with a goal of evaluating additional non-cognitive traits including communication skills, moral reasoning, compassion, maturity, self-awareness and motivation for the profession. At the conclusion of the interview, the interviewer provides a score and comments to assist the admissions committee in making decisions.

Once interviews are complete, the Council on Selection meets to deliberate on which applicants will be offered admission. The Council on Selection, when making

admission decisions, has full access to the applicant's file including all academic records, additional application materials and interview results. The goal of the application process is to select students who will be academically successful as medical students and bring diverse experiences and backgrounds to the medical community, while also graduating from UMKC as physicians passionate about medicine and oriented to direct, patient care.

Requirements for promotion. Once a student is admitted to the UMKC School of Medicine, he/she must meet specific requirements in order to promote routinely from year to year. If a student does not meet promotion requirements, he/she may be placed on probation and/or placed in the alternate program. If academic performance is significantly low, the student may be dismissed from the school.

In order to routinely be promoted from year to year, students must complete the required coursework expected for the academic year and earn both a cumulative GPA and science GPA of 2.8. Students eligible for dismissal are those students who:

- Do not maintain a minimum 2.499 cumulative GPA,
- Do not maintain a minimum 2.499 science GPA,
- Earn failing grades in two required courses in one semester, or
- Earn a failing grade in a required course while on probation (UMKC School of Medicine, 2011).

Students who perform academically between the requirements for promotion and the conditions of dismissal are often placed on academic probation and enter the alternate program.

Overview of the alternate program. The Alternate Program is designed for students who may require additional time to complete required coursework and

academically perform at the level of expectation. Students may enter the Alternate Program at varying points in the curriculum, but the majority of students who enter the Alternate Program do so within the first two years. Some students may self-identify the need to enter the Alternate Program based on their academic performance, while other students may be required to enter the Alternate Program because they meet the requirements for academic probation.

Alternate program entrance during year one. To enter the Alternate Program in the first year, a student would meet one of the following requirements at the end of the first semester or end of the first year:

- Earn at least a 2.5 cumulative and science GPA, but did not earn the required 2.8 cumulative and science GPA for routine promotion, or
- Earn a failing grade in one required course (UMKC School of Medicine, 2011).

Once in the Alternate Program, students must select an undergraduate major of biology or chemistry and must follow the designated curriculum set forth by both the School of Medicine academic advisor and the undergraduate program academic advisor. Students must enroll in two science courses per semester, and the student must repeat any science coursework for which they have previously earned a failing grade.

Students who enter the Alternate Program are placed in a two-year probationary period, in which they must achieve a 2.8 science GPA each semester. Alternate Program students may not withdraw from coursework, or earn failing grades in courses while in the alternate program. In addition, alternate students must earn a grade of B- or better in any science coursework that is being repeated.

After successful completion of the year one Alternate Program, students may resume coursework in year two of the medical school curriculum. These students remain on probation until successful promotion to year three in the medical school curriculum.

Alternate program entrance during year two. Some students who succeed academically in year one may face academic difficulty during year two of the six-year curriculum, and thus enter the Alternate Program at that time. To enter the Alternate Program in the second year, a student would meet one of the following requirements:

- Earn at least a 2.5 cumulative and science GPA, but did not earn the required 2.8 cumulative and science GPA for routine promotion, or
- Earn a failing grade in one required course (UMKC School of Medicine, 2011).

Once in the Alternate Program, students are placed on probation and must also achieve a 2.8 science GPA each semester. Year two alternate students may not withdraw from coursework, may not earn failing grades in any courses and must achieve a grade of B- or better on all repeat coursework. These students must take one required science course each semester, as opposed to two required for year one alternate students, and must also participate in a weekly clinical experience. After successful completion of the year two Alternate Program, students will resume coursework in year three of the medical school curriculum.

All students in the Alternate Program, whether they enter in year one or year two, must complete the year one and two curriculum within three years or be dismissed from the program. Students who do not meet the requirements of the Alternate Program, are eligible for dismissal from the program.

Research Questions

The fundamental goal of this study is to identify those experiences, attributes and metrics that predict the retention of combined-degree medical students. This goal leads to the following research question:

- What incoming student experiences, attributes and metrics predict whether or not a student will demonstrate success, enter the Alternate Program, or encounter dismissal or withdrawal from medical school?

Though this is the primary question guiding the study, there are additional, more focused questions that assist with answering this question.

Additional questions guiding the study. The following questions served as a guide for data collection and data analysis:

1. What is the relationship between the following student admissions application metrics and experiences and retention?
    a. Standardized test score;
    b. High school core GPA;
    c. Overall rigor of high school curriculum, including Advanced Placement, International Baccalaureate, dual-enrollment or honors courses completed in high school;
    d. Involvement in high school activities and leadership;
    e. Investigation of the medical profession while in high school;
    f. References;
    g. Interview results;
    h. Admission status (e.g. full admission v. provisional admission).

2. What is the relationship between the following individual student attributes and retention?
    a. Race/ethnicity;
    b. Gender;
    c. Geographic origin, including state residency and rural versus urban status;
    d. Parent level of education.

These questions are designed to address the fundamental issue—to identify those experiences, attributes and metrics that have a predictive relationship with student success and retention in an accelerated combined-degree program.

Additional research question. A secondary goal of this study was to identify any differences in retention, student academic performance, or diversity outcomes for students admitted pre-holistic admissions (2005 – 2009) or post-holistic admissions (2010 – 2013), leading to the following research question:

- Are there any differences in outcomes for students admitted between 2010 and 2013, after current holistic admissions practices were implemented?

Although not the primary focus of this study, this study is interested in whether or not retention has improved and diversity has increased since the implementation of holistic admissions in its current format in 2010.

Importance of the Study

Retention of medical students in a traditional medical school program is of little concern considering that the retention and graduation rates for these students is 96 percent (AAMC, 2014). In a combined-degree program, such as the program at UMKC, the retention rate is more aligned with retention rates of undergraduate students at some

institutions, with UMKC retaining and graduating approximately 80 percent of its admitted students. This may not be a concern for a more traditional, undergraduate program, but twenty percent attrition for a professional, medical program is significant in terms of ability to graduate physicians and place them into practice.

Ultimately, while this study assists one combined degree program in identifying which incoming student experiences, attributes and metrics can predict success in the program, the real importance of the study lies in why it is important to identify these experiences, attributes and metrics that predict success in the first place. There are a number of reasons why the retention of students in a combined-degree program are important, and a number of issues that are directly linked to the retention of students:

- Limited space in the program,
- Projected physician shortages in the United States,
- Financial incentives and/or repercussions,
- Admissions policies and procedures.

Limited space in the program. At the UMKC School of Medicine, the capacity of the incoming class is 115 students. To achieve capacity, UMKC utilizes an extensive admissions process to narrow the applicant pool from approximately 1200 applications to the 115 members of the incoming class. Though the process is time-consuming and requires significant involvement from all members of the admissions committee, the goal is to admit those students who will have the greatest chance of success. Each year, a number of talented students remain on the alternate list and never receive an offer of admission. The school would like to guarantee, as much as possible, that the students offered admission are the students who have demonstrated the greatest potential for

success, especially with such limited space in the class and the inability to replace students who are not successful.

Physician shortages in the United States. In a time when physician shortages are imminent, the only way for a medical school that is unable to grow its class size to graduate more students is to retain more of the students it originally admitted. According to the U.S. Census Bureau, there will be a 36 percent growth in the population of people over the age of 65, a population that tends to utilize healthcare services more than any other age group (AAMC, 2010). This, along with new healthcare reform granting access to healthcare to millions more Americans, the need for doctors will only increase. The Association of American Medical Colleges, through its Center for Workforce Studies, predicts physician shortages in the areas of primary care, surgery and other medical specialties (AAMC, 2010). Over the next ten years, the number of physicians in practice is not expected to increase to meet the needs of the U.S. population (AAMC, 2010). Retention of medical students in a combined-degree program, while only a small part of the solution, is still a way for medical schools to increase their number of graduates who ultimately practice in this country.

Financial incentives or repercussions. There are several financial implications when a student leaves the combined-degree medical program. There are incentives for the school to retain students, repercussions if the school does not, and repercussions for the student who leaves without earning a medical degree. Retaining more students in the combined-degree program will have a positive financial influence on both student and medical school.

School of Medicine budget model and tuition revenue. The budget model for the UMKC School of Medicine is based upon projected enrollment and projected tuition dollars available from that enrollment. When a student is admitted to the combined-degree program, the tuition generated from that student is calculated into a model expanding six years. When a student leaves the program, the tuition dollars that would have been generated from continuation and graduation are no longer available.

For example, if a student leaves UMKC after year 1, the school will lose:

- $25,000 per year in tuition, for a total of $125,000 for the remaining five years - in-state student.
- $45,000 per year in tuition, for a total of $225,000 for the remaining five years - regional student.
- $65, 000 per year in tuition, for a total of $325,000 for the remaining five years - out-of-state student.

If the school admits 100 students, and loses twenty in-state students, the financial loss would be approximately $2,500,000 over the course of the remaining five years these students were no longer in the program. Granted, this is assuming that all twenty students leave after year 1, when it is known that some may withdraw or be dismissed after the second year.

State support. The UMKC School of Medicine is a public, state institution that receives funding from the state. The School of Medicine is often reviewed for its ability to graduate the expected number of physicians each year and to place those physicians into practice in the state of Missouri. While there is no direct link in terms of accountability for state funding, there are some state funds that are tied to performance of

medical students, graduation rates and physician practice patterns. In order to meet the expectations of the state to graduate a certain number of physicians, the School of Medicine must retain a larger number of its students through graduation.

Repercussions from the student perspective. As mentioned previously, a medical student is paying the medical school tuition rate of $25,000 per year to $65,000 per year. Medical students in the combined-degree medical program at UMKC never pay the undergraduate rate of tuition, but rather pay the medical school rate of tuition from the first year. Very few students in the combined-degree program pay the medical school tuition rate out of pocket, but rather use a combination of loans, grants and scholarships to financially support medical education. Students who leave the combined-degree program after one or two years often have already obtained significant debt, at least for a student who has spent only two years in college. Students are often willing to initially incur the debt due to an expectation that graduation from medical school will produce a sufficient salary to repay the debt. When a student leaves with debt, but with no medical degree, it may be difficult to realize the same salary that would have been achieved as a physician.

Admissions policies and procedures. The admissions process at the UMKC School of Medicine requires an individualized and holistic review of each applicant. The admissions committee has determined which experiences, attributes and metrics are necessary to review in the admissions process, but this determination has been made with little information regarding what experiences, attributes and metrics might relate to success in the program. The outcome of this study and the ability to identify which experiences, attributes and metrics, if any, may predict success in the combined-degree

medical program at UMKC will inevitably have an influence on future admissions requirements, policies and procedures. In addition, identifying whether or not differences exist between pre- and post-holistic admissions outcomes provides insight into whether or not holistic admissions is a valuable and meaningful tool for selecting students for medical school. With the results of this study, future decisions regarding admissions policies and procedures will be data-driven while remaining in alignment with institutional mission.

The importance of this study is grounded in the notion that retention influences the mission of the school to place more students in the practice of medicine, has financial implications that effect both school and student, influences future policies and procedures as it relates to the admission of students, and contributes to the outcomes of holistic admissions. Improving the retention rate will positively influence each of these outcomes.

Summary

This research project explores a holistic admissions process as it relates to student retention in UMKC's combined-degree medical program, a program that offers incoming students the opportunity to enter medical school directly from high school and complete both an undergraduate and medical degree in six years as opposed to the more traditional eight year path. This study looks at incoming student experiences, attributes and metrics, both those used in the holistic review process as well as those not currently considered by the admissions committee, and how those student experiences, attributes and metrics may or may not predict a student's success in the combined-degree program.

The problem requires an understanding of incoming student experiences, attributes and metrics, and a deeper understanding of how each may influence success. It also requires an understanding of the holistic admissions process itself, the goal of holistic admissions in alignment with the mission of the medical school, and what outcomes may exist from the implementation of holistic admissions. Although previous research may provide insight into how individual student experiences, attributes and metrics influence retention in an undergraduate program, this study provides a specific look at how incoming student experiences, attributes and metrics of traditionally-aged college students influence retention in a non-traditional medical program. As the study progressed, topics considered important for consideration included why a need exists to retain students in a combined-degree medical program; the nature and history of combined-degree medical programs; holistic admissions, including history and current practice in medical schools; and predictors of college success, both cognitive and non-cognitive, as related to admissions data. Further discussion of these topics are presented next in chapter two.

Chapter three outlines the statistical methods used to answer the research questions, which address incoming student experiences, attributes and metrics and their relationship to student retention. Chapter four presents an interpretation of the results of the statistical analysis in order to provide insight into how individual student experiences, attributes and metrics influence retention. Chapter four will also identify any differences that may exist in pre-holistic versus post-holistic admissions processes. Finally, chapter five will discuss any limitations of the study, implications for future research, how the

results may influence policy at the UMKC School of Medicine, and a final summary of the study.

Chapter Two: Literature Review

This study evaluates how the experiences, attributes and metrics of an individual student, both cognitive and non-cognitive, at the point of admission may or may not predict success in a combined-degree medical program. The following review of the literature will provide a foundation for the importance of this study: the need to address the physician shortages facing the United States in the coming years, as well as an understanding of the history of combined-degree programs and their purpose and role within medical education. Due to the relationship between the Association of American Medical Colleges (AAMC) and medical schools in the United States, it is also necessary to understand the expectations of the AAMC as they relate to holistic admissions practice and policy.

As a part of this review, it was important to understand the role of both cognitive attributes, such as standardized test score and high school grade point average, and non-cognitive attributes, such as motivation, background experiences and other personal characteristics, and their ability to better predict a student's success in college. Because many of the students who enter combined-degree programs are traditional aged college students, much of the research outlined here is related to the retention and success of students in their first year of college rather than the success of students pursuing a more traditional path to medicine.

The information presented in this chapter further illustrates the need for additional evaluation of multiple variables in the admissions process in order to select the students with the best chance of success in a combined-degree medical program and the best chance of success at becoming a competent physician after graduation.

Physician Shortages: Importance of Retaining Medical Students

Attend any admissions conference in the United States, and you will find numerous sessions on how to improve the retention of undergraduate students. Universities work hard to not only admit and enroll students who can fulfill the mission of their institutions, but they also work hard to make sure those students are retained. Campuses are implementing early warning systems and advising strategies to identify struggling students, and providing academic resources to assist students in becoming academically successful, all in hopes of improving retention and graduation rates.

In a medical school environment, retaining students through graduation supports institutional mission but also guarantees that more physicians are entering the health care workforce. Over the next ten years, the U.S. will face significant physician shortages (AAMC, 2012; Cooper, Stoflet, & Wartman, 2003; Cooper, 2007; Gallegos, 2014; Jolly, Erikson, & Garrison, 2013; Rosenblatt, 2010; Snyderman, 2011). Medical schools need to consider ways in which they might graduate more physicians. While a solution to the physician shortage for some schools may include expanding the class size to graduate more physicians, the answer for other programs may be to graduate more of the students who gain admission in the first place. At a time when physician shortages are looming, retaining the students who are admitted becomes increasingly important.

According to several reports from the Association of American Medical Colleges (AAMC), by 2025 the supply of physicians will be significantly outpaced by the demand for physicians (AAMC, 2012; Gallegos, 2014). This dilemma has been created by an aging population, increased access to health care through health care reform, and general population growth, all of which will create a shortage of approximately 124,000

physicians by 2025 (Dill & Salsberg, 2008). According to the U.S. Department of Health and Human Services, the number of physicians in practice will only increase by seven percent over the next ten years (AAMC, 2012). This slight increase will not be enough to accommodate the increase in population, the increase in older Americans or the increase in the number of Americans who have gained access to healthcare.

Shortages will exist in almost all specialties, however the greatest shortages will occur in areas such as family medicine, surgery and other medical specialties (AAMC, 2012; Gallegos, 2014; Sklar, 2013). In addition, rural communities will experience a drastic decline in healthcare providers, in communities where providers are already scarce (Rosenblatt, 2010). As the single provider for medical training, medical schools have a responsibility to the communities in which they teach, as well as the greater communities regionally and nationally, to increase the number of physicians being trained and put into practice. In many cases, this will include improving the retention of students who enter medical schools, specifically improving the retention of those students who enter medical education through a more non-traditional path, such as a combined degree program. The overall purpose of this study was to specifically address this issue of retention in a combined-degree medical program, and how incoming student experiences, attributes and metrics may or may not predict success.

History of Combined-Degree Medical Programs

In other parts of the world, students interested in and qualified for specific professional paths are often guided towards those paths beginning in and extending from high school or secondary school. In the United States, most students, regardless of professional interest, will pursue four years of undergraduate education followed by

graduate or professional education when necessary. In this model, students interested in medicine pursue medical education in a segmented way, consisting of undergraduate pre-medical education, medical school with curriculum in the basic medical sciences and clinical experiences and, finally, graduate medical education. In a combined-degree medical program, the curriculum is integrated rather than segmented. Students are able to complete the same number of required baccalaureate courses and the required medical school coursework as students pursuing a traditional path to medicine, but are able to pursue both curricular experiences in a less segmented way.

The original goals of combined-degree programs were many. Whether developing six-, seven-, or eight-year combined-degree programs, the goals for developing such programs included recruiting highly talented high school or early college students; recruiting students who demonstrate the maturity and initiative to begin a career in medicine at a younger age; preparing physicians to meet the needs of a state or region; offering a curriculum developed within the liberal arts; increasing the declining pool of medical school applicants; increasing the number of high achieving students from disadvantaged or under-represented backgrounds entering the profession of medicine; and developing a path to medicine that would decrease the time to graduation and the total cost to students who are interested in becoming physicians (Cosgrove, et al., 2007; Drees, et al., 2007; Eaglen, et al, 2012; Olson, 1992).

Although Johns Hopkins University initiated a combined-degree program in 1957, Northwestern University Medical School and Boston University School of Medicine are credited with the first combined-degree programs that began in 1961 (Eaglen, et al., 2012). A recent study on current combined-degree programs identified “81 distinct

programs, available at 57 medical schools" (Eaglen, et al., 2012, p. 1600). To identify these programs, combined-degree programs have been defined as those programs that integrate the undergraduate and medical education, with the undergraduate and medical faculty working together to develop a curriculum that includes the requirements for a baccalaureate degree and the full spectrum of the medical school curriculum (Eaglen, et al., 2012; Olson, 1992). In addition, combined-degree programs admit students who are graduating from high school or who have completed the first one to two years of college, offer clinical or other medical experiences early in the undergraduate curriculum, and offer a guaranteed or likely admission to medical school based on academic performance in the undergraduate curriculum (Eaglen, et al., 2012; Olson, 1992).

Most combined-degree medical programs, while admitting students younger than their traditional counterparts, continue to use traditional methods for making admissions decisions. Because prospective students are younger, and MCAT scores may not be available, combined-degree programs rely on other forms of standardized testing such as the ACT or SAT. Combined-degree programs use other admissions tools that reflect what is used by traditional medical programs, such as grade point average, specifically looking at performance in math and science coursework, as well as other tools such as essays, reporting of co-curricular activities and health experiences, references and, when applicable, interviews (Eaglen, et al., 2012). Many combined-degree programs use these multiple components of the admissions application to determine which students will be admitted to their programs, but do not necessarily know which of these components predict success. This study evaluates those pieces of the admissions application, along with individual incoming student experiences, attributes and metrics, to see if there is a

predictive relationship between the experiences, attributes and metrics used in holistic admissions and success in the combined-degree medical program at UMKC.

Holistic Admissions

Holistic admissions is implemented at many colleges and universities across the country, and is a means by which an admissions officer or committee can consider multiple factors when deciding whom to admit. In holistic admissions, equal consideration is given to a variety of factors reviewed in an application and no one component of that application guarantees the admission of a student. "An institution should use a range of criteria in its selection process…includ[ing] intellectual curiosity and accomplishment, extraordinary talent, leadership, service to others, motivation, tenacity and demonstrated ability to overcome hardship" (Laird, 2005, p. 20). Ultimately, the institution should consider what characteristics it hopes to see in its students and graduates, identify those traits that contribute to success, and evaluate those characteristics and traits in the admissions process.

One of the primary goals of holistic admissions, at least for medical schools, is to admit a diverse class who will graduate to become competent physicians who meet the healthcare needs of our country. Holistic admissions is a way to achieve diversity by linking the admissions process with institutional mission and goals. Admissions policies should be linked directly to mission statement, and policy itself should extend directly from the mission statement and statement of purpose (Laird, 2005). If achieving diversity is a goal of admissions practices, then diversity should be identified as an institutional goal in order to link mission and policy.

In medicine, diversity is a compelling interest and "an argument can be made to support the fact that diversity in medicine serves a compelling individual, institutional, economic, and societal interests" (Cantwell, Canche, Milem, & Sutton, 2010, p. 5). At UMKC, the goal of holistic admissions is to admit students who are likely to succeed, as well as who represent a diversity of backgrounds. In order to understand holistic admissions as it is implemented in medical schools today, it is important to understand how we got here and how our history dictates what can and cannot be used when making an admissions decision to achieve diversity.

Although this study focuses on the experiences, attributes and metrics evaluated in holistic admissions, and their relationship to student retention and academic performance in medical school, a secondary goal of this study was to evaluate outcomes from implementing holistic admissions. As previously mentioned, a goal of holistic admissions at UMKC is to increase diversity in the medical school. The role that diversity plays in admissions decisions is complicated, as diversity in medical school is a compelling interest but cannot be the only interest when making admissions decisions. When implementing holistic admissions policies, it is necessary to understand the history of the use of race in admissions decisions and how to now implement attributes of diversity into current holistic admissions practices.

History and relevant legal decisions. In the late 1970's, a critical case in the role of affirmative action policies in college and university admissions was heard before the United States Supreme Court. Allan P. Bakke, a Caucasian applicant to medical school at the University of California – Davis, had been denied admission twice to the UC-Davis medical school. The argument presented to the Supreme Court was that Bakke

had been denied due to his race, or rather, due to a quota system in place that held a certain number of seats in the class for minority students. As a part of the Supreme Court ruling, it was ordered that Allan Bakke be admitted to the UC-Davis medical school "because a rigid ethnic quota was found to have kept him out" (Alleyne, 1981, p. 290). Although this was a part of the decision, it was not the only part of the decision decided by the Court that day. In the Bakke ruling, the Court also determined it acceptable for race and ethnicity to play a role in college admissions decisions so long as strict quota systems were not in place (Alleyne, 1981; Bloom, 2004; Eckes, 2004; Goldstein, 2003; Synnott, 2004). In its decision, the Court "placed a judicial stamp of approval on a relatively broad use of racial preferences by institutions of higher education" (Bloom, 2004, p. 460), but did not concretely identify how and when race and ethnicity may be used in decisions.

The only clear outcome of Bakke was that racial quotas in college and university admissions were no longer allowed, however many unanswered questions remained and many universities continued to implement admissions practices that provided the same results without the specific use of a defined quota. For example, in defending the decision in Bakke, the Court used the Harvard admissions process for undergraduate admissions as an example of a university that used race when making decisions, without specifying a quota, as a means to achieve a goal of attaining diversity (Alleyne, 1981; Bloom, 2004). The Court used Harvard as an example because it did not set specific quotas or caps for minority students, whereas UC-Davis specifically advertised that it held sixteen seats for incoming minority students. In a post-Bakke world in college admissions, admissions officers were only prohibited from setting a quota but were not

prohibited from using race and ethnicity as a factor in making admissions decisions. Admissions officers were not prohibited from creating multiple applicant pools, for example a pool where students were admitted based on academic numbers alone versus a pool of candidates who were considered diverse, so long as "the numbers involved are not predetermined, fixed, and…exclusionary" (Alleyne, 1981, p. 294). The bottom line after Bakke was that quotas were unacceptable, but the undefined use of race and ethnicity in college admissions decisions remained an acceptable part of the process.

Although Bakke terminated the use of a quota system, it did not provide any guidance to the use of race and ethnicity in admissions decisions and therefore left the door open for future lawsuits against college and universities who utilized affirmative action programs. In 1992, in Hopwood v. Texas, four Caucasian applicants to the University of Texas Law School sued the university after they had been rejected to law school, even though they had higher grades and test scores than some admitted applicants. The case brought to light the affirmative action policies of UT-Austin, and the case challenged UT-Austin's practice of color-coding the applications by race and ethnicity, assigning an admissions subcommittee of minority committee members to consider the applications of minorities separate from non-minorities, the lower academic standards set forth for minority applicants and the implementation of waiting lists that were divided by race and ethnicity (Synnott, 2004). The Fifth Circuit court immediately ruled against UT-Austin, stating that the university could not employ policies that discriminated against non-minority students for the purpose of increasing the enrollment of minority students. The biggest issue with Bakke, leading to the policies criticized in Hopwood, was that admissions officers believed it was still acceptable to have a quota

system so long as it was concealed within policies not defined by quotas (Alleyne, 1981; Synnott, 2004).

Twenty-five years after the Bakke decision, the use of race and ethnicity in college admissions was again a controversial topic in the Supreme Court, when two cases were brought against the University of Michigan. In the first case, Grutter v. Bollinger, Barbara Grutter was denied to the law school even though she felt she presented a strong academic record and diverse life experiences (Synnott, 2004). In the second case, Gratz v. Bollinger, Jennifer Gratz was denied undergraduate admission even though she had demonstrated a strong academic performance during high school. In both cases, the complainants believed that they were denied admission due to racial preferences in the admissions process that allowed for the admission of minority students who were less qualified.

In the Grutter case, the law school admissions policy "articulated a commitment to achieving a diverse student body to enhance the education offered" (Goldstein, 2003, p. 917). The law school, in its admissions practices, recognized diversity as an important part of building the law school class, but took into account multiple factors when making admissions decisions including test scores, grades and other information related to undergraduate performance, letters of recommendation, and essays. Race was also a part of the review process, as it was a goal of the law school to achieve a "critical mass of underrepresented minorities without identifying any prescribed number" (Goldstein, 2003, p. 917). The law school's admissions policies did not use a quota system, but rather used race as a plus factor when making admissions decisions. When making

admissions decisions, race was one of many factors considered, which was deemed acceptable by the Court.

In the Gratz case, on the other hand, it was discovered that the undergraduate admissions process awarded points to applicants from specific minority groups. Jennifer Gratz "believed that she was rejected because of a university policy that awarded 20 points out of 150 points to African Americans, Hispanics and Native Americans" (Synnott, 2004, p. 480), and that these students benefited from formalized racial preference in the admissions process. In Gratz, the Court upheld the complaint and ruled that the undergraduate process of awarding extra points to minority applicants was an unequal process. "The Court found that, even if diversity was a compelling interest, a conclusion Grutter imposed, a twenty percent bump based on race was not narrowly tailored" (Goldstein, 2003, p. 899). Ultimately, the law school policy was considered acceptable because it was flexible and race was one of many factors to be considered when making an admissions decision, whereas the undergraduate policy formalized racial preference by giving an automatic increase in application score to minority students.

The cases of Grutter and Gratz helped to more specifically define how race can be used when making admissions decisions at both the undergraduate and graduate or professional level. By allowing admissions committees to consider race and ethnicity on an individual basis, this prevented consideration of race in order to achieve a "proportionate representation, because no slots were reserved to particular racial minorities and no one was excluded on account of their race" (Synnott, 2004, p. 483). Race can be considered as a plus factor, one of many factors, but cannot be the only point

of consideration when making a decision about who to admit and cannot be tied to a rigid quota or point system.

In 2008, the Supreme Court was confronted again with the use of affirmative action in admissions decisions, when Abigail Fisher challenged the use of race in admissions policies at the University of Texas – Austin. Fisher argued that UT-Austin's current policies, to admit the top ten percent of all Texas high school graduates and to utilize a holistic review process for all other applicants, was discriminatory based on race (College Board, 2013). In Fisher, the Supreme Court reaffirmed its opinions from Grutter and Gratz by claiming "institutions of higher education may still pursue their mission-based, compelling interest in promoting the educational benefits of diversity through admissions and other programs that consider race or ethnicity and use holistic review in a manner that is narrowly tailored to achieve that interest" (College Board, 7, 2013).

Recently the Supreme Court was challenged to determine whether or not a state could ban the use of race in admissions at all of its universities, a case that did not require the court to take a position on the use of race in admissions at an institution in a state where affirmative action in admissions is legal (Schmidt, 2014). In 2006, the state of Michigan adopted a voter-approved ban on the use of race in college admissions decisions. This ban was challenged in the Supreme Court, only for the Court to uphold the ban in Michigan finding that the Court has no authority to overturn this policy approved by voters (Schmidt, 2014). This particular case did not challenge the use of race in admissions decisions in states where it is legal, but rather upheld a state's right to ban the use of race in college admissions if it so chooses.

After the decisions of Grutter and Gratz, the Association of American Medical Colleges (AAMC) developed policies and procedures for medical schools in states where race was an acceptable factor to be used in admissions decisions, states such as Missouri. When developing these policies, the AAMC used the rationale from the Grutter decision, that

> "a diverse student body creates a range of educational benefits, including a richer classroom environment and improved understanding among the races, all of which better prepares students for an increasingly diverse workplace and society" (Goldstein, 2003, p. 918).

These policies became the guidelines that medical schools like UMKC have used to narrowly tailor the use of race in admissions decisions to reaffirm institutional goals of achieving diversity in the class. The implementation of a holistic admissions process has allowed medical school admissions committees to use race as a factor in individual admissions decisions, so long as that factor is not given top priority, while also considering many other components of the application. These cases, and other recent decisions of the Supreme Court, paved the way for holistic admissions as it is practiced in medical schools today.

For the UMKC combined-degree medical program, holistic admissions is practiced in the way the AAMC intended, with diversity factors such as race, gender or geographic origin taken into consideration as only one of many factors used when making admissions decisions. These factors are used in an effort to achieve diversity in the class and, ultimately, to meet the diverse needs of the state, but are not the only factors used to make admissions decisions.

Association of American Medical Colleges (AAMC) and holistic admissions in medical schools. The Association of American Medical Colleges (AAMC) encourages medical schools to implement and integrate the holistic review of applications into admissions processes, to the extent that they have created guidelines, manuals and workshops to assist medical schools in better implementing and integrating holistic processes and policies into the admissions decisions that are made. For the AAMC and medical school holistic admissions, holistic admissions is defined 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. Under a holistic review framework, candidates are evaluated by criteria that are institution-specific, broad-based, and mission-driven and that are applied equitably across the entire candidate pool" (AAMC, 2010, p. ix).

Holistic review of applications requires that admissions committees review applicants across a number of experiences, attributes and metrics and not make decisions based solely on one or two characteristics. Integrating this process into medical school admissions decisions is an important part of developing "admissions policies and procedures that are well-designed, grounded, consistent, and documented" (AAMC, 2010, p. 5). While it is necessary to review the experiences, attributes and metrics for each applicant, it is also necessary to develop a process by which those experiences, attributes and metrics have been defined by the admissions committee and applied consistently to each applicant.

While a goal of holistic admissions is to achieve greater diversity in a class, the ultimate goal of this process is to admit students who demonstrate the academic potential to succeed in medical school while also demonstrating other attributes that are important for the practice of medicine. The review of such characteristics must be integrated throughout the entire admissions process, including screening, interviewing and the final selection of candidates (AAMC, 2010), and must be consistently and fairly applied to all applicants in each stage of the process.

In holistic admissions, there is no one process that will work for every medical school. Each medical school needs to make decisions about the holistic admissions practices utilized, based on the school's mission and goals for its students and graduates. Holistic admissions strengthens the admissions process by asking the admissions committee "to consider and make informed decisions about the many and diverse ways an applicant might prepare for medical school and contribute to the learning and health care environments in the context of institutional mission and goals" (AAMC, 2010, p. 9). If a school's mission, for example, is to graduate physicians who will practice in the state and meet the healthcare needs of the state, then the admissions committee should identify those characteristics of applicants who are more likely to meet this goal. Furthermore, when identifying these characteristics, medical schools should look specifically at the experiences, attributes and metrics they want to be represented in the class who will ultimately carry out the mission of the school.

In the end, a holistic admissions process must incorporate four core principles (AAMC, 2013):

1. Selection criteria are defined broadly, and are clearly linked to a medical school's mission and goals,
2. Admissions committee members consider individually for each applicant how he or she may contribute to the educational environment, healthcare community and eventual practice of medicine,
3. Race and ethnicity may be used as factors, but only when they align with medical school mission and only in a broader sense of applicant review of experiences, attributes and metrics, and
4. A balance of these experiences, attributes and metrics must be the foundation of admissions decisions at all stages of the process, including screening, interviewing and final selection of candidates for admission to medical school.

Holistic admissions at UMKC has been implemented using these four core principles as the foundation for selecting students for admission to the combined-degree medical program.

The Experiences-Attributes-Metrics model. The UMKC combined-degree medical program, in implementing holistic admissions, uses the Experiences-Attributes-Metrics (EAM) model developed by the AAMC. The EAM model was developed based on a model that understood diversity to be an important resource in the workplace and that diversity plays an integral role in the success of an organization (Loden & Rosenor, 1990). In this model, primary and secondary dimensions of diversity were identified, with primary dimensions identified as "those immutable human differences that are inborn and/or that exert an important impact on our early socialization and ongoing impact throughout our lives" (Loden & Rosenor, 1990, p. 18). Primary dimensions

included such characteristics as age, gender, ethnicity and race, and tend to have play a significant role in who we become. Primary dimensions are those dimensions that influence how we define ourselves and the world around us.

Secondary dimensions, on the other hand, are those dimensions that may change throughout our lives as we have new experiences. Secondary dimensions may include such things as educational background, geographic location, income or religious beliefs, and while these dimensions may influence who we are, "their presence or absence does not usually change our fundamental core identity" (Loden & Rosenor, 1990, p. 20). These dimensions may influence how we see ourselves, but how we see ourselves may change as these secondary dimensions change. The way in which the primary and secondary dimensions interact with one another is what makes each individual unique, and why an admissions committee may want to evaluate a candidate on more than just metrics when making admissions decisions.

On the basis of Loden & Rosenor's model of primary and secondary dimensions, the AAMC developed the Experiences-Attributes-Metrics (EAM) model to provide guidance to medical schools on how to incorporate the experiences, attributes and metrics of an individual candidate into the admissions decision made about that candidate. The experiences of a candidate include the story of the candidate and how he or she got to the point of application, and may include such things as educational background, experiences in co-curricular or health care settings, or family settings. The attributes of a candidate include the non-academic abilities of a candidate such as problem-solving skills, interpersonal communication skills and critical-thinking skills; demographic characteristics such as ethnicity, gender, parental level of education, or geographic origin;

and other personal characteristics, such as an applicant's resiliency, motivation for medicine or empathy. Finally, the metrics of a candidate include the academic components of the application such as grade point average and standardized test score (AAMC, 2010).

It is important, when considering the experiences, attributes and metrics of a candidate, to identify those experiences, attributes and metrics that are important to an individual medical school and to identify those that may predict success, as defined by that medical school. The UMKC combined-degree medical program has identified those experiences, attributes and metrics that support the admission of students who will meet the mission and vision of the school, to meet the diverse needs of the state. The purpose of this study was to evaluate how those experiences, attributes and metrics may or may not predict success in the UMKC combined-degree medical program.

Relationship between holistic admissions and retention. At UMKC, the ultimate goal of holistic admissions is to give "balanced consideration to the multiple ways in which applicants may prepare for and demonstrate suitability as medical students and physicians" (AAMC, 2010, 13). Ultimately, medical schools want to admit students who can manage the academic course load, be retained from year to year, and graduate as competent physicians. While an additional goal of holistic admissions at UMKC is to increase diversity, as defined across a number of spectrums and perspectives, diversity has little meaning if a medical school is not retaining the students it admits.

The reality is that there is only one path to becoming a physician – a student must be admitted to medical school. The criteria that a medical school establishes for admission ultimately "determines the type of people who will study and then practice

medicine" (AAMC, 2013, p. v). In a holistic admissions process, one cannot implement an effective process without also evaluating the outcomes of using those identified experiences, attributes and metrics to make admissions decisions. Schools must define what success means – retention, graduation, clinical performance – and must evaluate "whether integrating mission-driven, holistic admissions and related diversity interests help achieve that success" (AAMC, 2013, p. vi). Holistic admissions has no meaning unless it is a foundation for informing which students will be successful and which students will not be successful, which is the fundamental purpose of this study: to identify those experiences, attributes and metrics that may or may not predict success in UMKC combined-degree medical program.

Evaluating Cognitive Measures in Admissions

At UMKC, and other selective programs, when considering applicants for admission to college, admissions officers consider a number of factors when deciding whom to admit. Depending on the school and the admissions policies, some factors may carry more weight than others. In most cases, however, the goal of college admissions policies are to identify those students who will demonstrate academic success as evidenced by persistence and graduation (Sedlacek, 2004; Zwick, 2002). The use of different variables in the admissions process assist colleges in achieving these goals of individual student success only if those variables have an ability to predict that success (Sawyer, 2010). If a number of criteria are used to select students, specifically at more selective institutions, then those criteria should be evaluated for their predictive ability of individual student success.

Many institutions of higher education review academic components when deciding whom to admit, mostly reviewing standardized test scores and high school GPA and viewing them "to serve a useful role in the admissions process" (Linn, 2005, 144). Even in a holistic admissions process, cognitive measures, sometimes referred to as metrics, are used as a part of the decision making process and an applicant is expected to achieve a certain level of performance on those cognitive measures if admission is to be granted. For incoming undergraduate students, and students entering combined-degree programs, the common metrics evaluated are performance on the ACT or SAT and high school GPA. The UMKC combined-degree medical program is no exception, reviewing both standardized test scores and high school GPA as part of its review process.

Many studies have attempted to verify whether or not standardized test scores, high school GPA or a combination of the two are predictors of academic performance in the first year of college and beyond (Camara, 2005; Kobrin, et al., 2008; Linn, 2005; Mattern & Patterson, 2009; Mattern, et al., 2013; Radunzel & Noble, 2012; Sawyer, 2010; Sawyer, 2007; Schmitt, et al., 2011; Thomas, Kuncel, & Crede, 2007; Zwick, 2002). Many of these studies do support the notion that these academic metrics do predict success, as defined by performance after the first year of college.

Standardized test score. In a 2009 study looking at whether or not the SAT predicts retention of first-year students, Mattern and Patterson found that the SAT does predict retention while also predicting retention at a higher rate for those with stronger performance on the SAT (Mattern & Patterson, 2009.) In this study, "results indicate the SAT predicts second-year retention, with 95.5 percent of high performers returning but

only 63.8 percent of low performers" (Mattern & Patterson, 2009, p. 1). This study revealed similar results when looking at retention based on high school GPA.

A 2010 study, focusing on the predictive ability of the ACT rather than the SAT, reviewed data from 192 colleges and universities who use the ACT when making admissions decisions (Sawyer, 2010). This study found that, while ACT score and high school GPA together are better predictors of first-year GPA, the ACT score is more predictive than high school GPA when only looking at institutions or programs with high selectivity and high expectations of academic performance (Sawyer, 2010). These findings are in alignment with the findings of other studies looking at the predictive ability of standardized test score, and may suggest that standardized test score may have a positive predictive relationship with success in a combined-degree medical program.

Standardized test score and high school GPA. A 2012 study on the ability of the ACT and high school grade point average to predict long-term success as defined by progress toward degree, degree completion and grade point average at time of degree completion, found that a combination of ACT score and high school GPA were predictive of long-term success in college (Radunzel & Noble, 2012). This study looked at approximately 190,000 ACT test takers who entered colleges and universities between 2000 and 2006, and found that ACT score and high school GPA together were incrementally more predictive of long-term college success than ACT or high school GPA alone and that using both metrics together "was generally more beneficial for improving prediction accuracy and success rates over those based on single-predictor models" (Radunzel & Noble, 2012, p. 41).

Standardized test scores alone do account for some performance in the first year of college, primarily because they are designed to be direct measures of cognitive ability, whereas high school grades are a measure of cognitive ability and other significant academic behaviors such as ability to manage time, participation in coursework and attendance in classes (Sawyer, 2010). Because of this, it is no surprise that performance in the first year has a higher correlation with both test score and high school GPA. It is also no surprise that institutions of higher education consider these metrics when making admissions decision as the goal is to "admit students who have a reasonable chance of progressing towards and completing a degree" (Radunzel & Noble, 2012, p. 40). Just as with standardized test score, one could expect that the review of both standardized test score and high school GPA will positively predict success in a combined-degree medical program.

Although standardized test score and high school GPA have been proven to be effective predictors of success in college, with success being defined multiple ways, it is important to consider that these cognitive variables may become incrementally more predictive of student success in college when combined with other, non-cognitive attributes evaluated in the admissions process. "Academic success also depends on non-cognitive variables, such as motivation and social connectedness; behavioral variables, such as time spent working on a job; and on variables, such as high school GPA, that incorporate both cognitive and non-cognitive characteristics" (Sawyer, 2007, p. 261). The use of non-cognitive variables in the admissions process, and their ability to predict student success while in college, is another necessary piece of the puzzle for admissions officers hoping to achieve the goal of admitting students who have the greatest chance of

achieving success. The UMKC combined-degree medical program evaluates non-cognitive variables, in addition to standardized test score and high school GPA, in order to identify those applicants who have the greatest chance of not only succeeding academically in medical school, but also practicing medicine in a clinically competent and compassionate way.

Evaluating Non-Cognitive Measures in Admissions

When evaluating applicants for admission to college, it is important to consider the evaluation of non-cognitive attributes and the role they may play in determining which students should be admitted and which students, ultimately, might be successful. "We need to decide whether we think the purpose of an admissions process – not just the purpose of standardized tests in an admission process but the purpose of the entire process itself – is to reward students for their work up to the point they file their college applications, or whether it is to select students who will do their best at a particular college or university in the future…" (Laird, 2005, p. 15). The evaluation of non-cognitive variables, in addition to the review of cognitive variables, may lead us down a path of better predicting which students will be successful.

Even though cognitive variables have historically been given more consideration when making admissions decisions (Thomas, et al, 2007), the use of non-cognitive attributes in the evaluation of applicants can contribute to predicting the future success of students as well as achieving an institutional goal such as increased diversity (Sedlacek, 2004). "If different groups have different experiences and different ways of presenting their attributes and abilities, it is unlikely we could develop a single measure, test item, etc. that could be equally valid for all" (Sedlacek, 2004, p. 4). The use of non-cognitive

variables is, therefore, directly linked to holistic admissions policies that are driven by institutional missions that include diversity as a foundation for educational experiences.

The goal of an admission process should not be to reward students for who they have been and what they have accomplished, but should be to select those students whose accomplishments will continue and thrive at a specific educational institution in a specific educational environment. Admissions officers who subscribe to the National Association for College Admissions Counseling *Statement of Principles of Good Practice* have an ethical responsibility to consider more than just test scores as the single admissions factor but to rather consider test scores in relationship to other student characteristics and attributes. Admissions officers have a responsibility to consider students as individuals, for their individual contributions to our schools, and to review each applicant completely while considering both cognitive and non-cognitive attributes and achievements (Laird, 2005). This is the goal of reviewing non-cognitive attributes and experiences, in addition to cognitive metrics – to review individual students and their demonstrated potential for success.

In order to better understand the role of non-cognitive attributes in the college admissions process, it is necessary to evaluate these attributes as they relate to outcome measures in college (Camara, 2005). Non-cognitive attributes generally refer to a wide range of attributes, such as motivation, personality, background characteristics and experiences, demographic characteristics, and involvement in non-academic experiences, and these attributes and accomplishments "can all influence the probability of admissions above and beyond high school grades and test scores" (Linn, 2005, p. 151). A student's academic and non-academic accomplishments may provide critical information about

how a student may perform in the future because "there is consistency in one's behaviors, attitudes, and values" (Camara, 2005, p. 89). The accomplishments a student achieves while in high school, both academic and non-academic, may provide insight into what a student may be capable of achieving while in college. At UMKC, how a student performed in high school, and the accomplishments he/she achieved, may predict his/her performance in a combined-degree medical program, a program that demands consistency in behavior, attitude and performance in order to succeed.

Sedlacek, in his research on non-cognitive variables in the admissions process, defines non-cognitive variables as those "relating to adjustment, motivation and student perceptions, rather than relying solely on the traditional verbal and quantitative areas typically measured by standardized tests" (Sedlacek, 2004, p. 7). He argues that the intention of evaluating non-cognitive variables in the admissions process is not to replace the common use of cognitive variables, such as standardized test score and high school GPA, but to supplement those variables with others that would expand our view of an applicant. As do others who support the review of multiple measures in making admissions decisions, Sedlacek also promotes the idea that the goal of the admissions process is to identify those attributes that might predict long-term outcomes such as college GPA beyond the first year, retention and graduation (2004). By implementing an admissions model that incorporates multiple attributes, both cognitive and non-cognitive, we may be able to "interpret assessment results of both present and future student success" (Sedlacek, 2004, p. 10). As discussed in most of the non-cognitive literature, the goal of evaluating a variety of attributes is to improve our ability to predict which students will be successful once admitted.

No institution sets out to admit students who will not be successful, and although colleges and universities don't expect to find the perfect solution to predicting student success, they do expect to develop admissions procedures that take into account all of the possible variables that may better predict success. Although non-cognitive variables are taken into consideration when making admissions decisions for UMKC's combined-degree program, it is unknown whether these variables predict success in this particular program. Considering high school background, such as high school type or strength of high school curriculum, may or may not prove predictive. Additionally, components of the application process, such as the interview process or involvement in high school activities, may or may not provide insight into whether or not a student succeeds. Finally, diversity characteristics, such as race, gender, geographic origin or socioeconomic background, may be beneficial for increasing the diversity of the class, but may or may not have any value in predicting which students are successful.

High school curriculum. Currently, in the UMKC combined-degree admissions process, rigor of the high school curriculum is evaluated when making admissions decisions. Admissions committee members consider completion of a rigorous high school curriculum to be a benefit to students entering this program, and have an expectation that students have taken the most rigorous curriculum available in high school. The committee does not consider type of high school, public or private, when making decisions, but does have an expectation that a student would have taken advanced level coursework, if available.

Research on the coursework completed in high school is mixed as to whether or not certain types of courses will predict success or persistence in college. Some studies

suggest that the strength of the high school curriculum, particularly enrollment in Advanced Placement coursework, predicts success in college (Dougherty, Mellor, & Jian, 2005; Horn & Kojaku, 2001). A student's performance in high school, specifically performance on standardized exams and in high school coursework, has shown to have a positive relationship to first-year performance in college and college persistence. While this academic readiness is linked to persistence in college, a way for a school to increase a student's college readiness is "to increase their participation in Advanced Placement courses and exams, as students who take and pass AP exams have demonstrated the ability to do college-level work prior to leaving high schools (Dougherty, et al., 2005, p. 2).

Others would argue that enrollment in AP courses may be predictive of college success (Dodd, Fitzpatrick, De Ayala, & Jennings, 2002; Klopfenstein & Thomas, 2009), but that performance in AP coursework may not consistently predict performance in the first year of college or college persistence (Klopfenstein & Thomas, 2009). Klopfenstein & Thomas argue, rather, that it is completion and performance in other rigorous high school courses, such as math and science, which have a stronger relationship with college success and persistence. "It would be more efficient for postsecondary institutions to focus on the years of high school science and math studied as math and science experience consistently emerge as strong predictors of college success" (Klopfenstein & Thomas, 2009, 888).

Horn and Kojaku also support the notion that a rigorous high school curriculum plays an important role in persistence, finding that the number of students who persisted from the first to the second year at the institution at which they originally enrolled, or the

number of students who persisted when transferring from one institution to another, was positively related to the rigor of the student's high school curriculum (2001). The literature, however, is inconclusive in how rigorous curriculum is defined.

For the UMKC combined-degree medical program, the admissions committee currently evaluates the rigor of the high school curriculum as defined by enrollment in math and science courses and completion of Advanced Placement, International Baccalaureate, college dual-enrollment or other honors-level courses. It is unclear if enrollment in these courses while in high school will provide any insight into whether or not a student succeeds in the combined-degree program, but it is important to identify whether or not a predictive relationship exists between persistence in the program and rigor of high school coursework.

Components of the application process. When applying to a selective academic or professional program, such as the combined-degree medical program at UMKC, students are required to submit multiple application components. Students are often asked to submit academic information, such as test scores and transcripts, but are also asked to submit additional materials such as personal statements, résumés and references. In addition, if selected, many students participate in a "personal interview during which an attempt is made to assess each candidate's interpersonal skills, motivation, and problem exploration" (Eva, Reiter, Rosenfeld, & Norman, 2004, p. S40). In cases of holistic review, all of these components are reviewed when making decisions about who to admit.

Interviews. In almost all medical schools located in the United States, the interview is a required part of the application process for students being seriously

considered for admission (Albanese, Snow, Skochelak, Huggett, Farrell, 2003). In many ways, the interview is used as a way to evaluate the non-cognitive abilities of applicants to medical school that traditional admissions metrics, such as grade point average and standardized test score, can't measure. The medical profession, including medical schools and the Association of American Medical Colleges, have a continued interest in defining professionalism and other attributes beyond academic knowledge to include "attitudes and behaviors related to patient care, particularly…altruism, communication skills, compassion, empathy, and integrity as characteristics to enter the medical profession" (Etienne and Julian, 2005, p. 219). The goal of the interview process is to measure such attributes and a candidate's ability to further develop these attributes as a medical professional.

For admission to the UMKC combined-degree medical program, interviews are a significant portion of the final decision that is made regarding whom to admit. Interviews are used as a way to learn more about a student, and his/her motivation for medicine, past experiences, self-insight, and other skills such as time management, stress management and study habits (Albanese, et al., 2003; Camara, 2005; Eva, et al., 2004; Eva, Rosenfeld, Reiter & Norman, 2004). Interviews allow an admissions committee to evaluate a student on other factors that may not be gathered from the paper components of the application.

In an evaluation of the literature on standard interviews, a one-on-one interview, Ferguson, James and Madeley found that, in some cases, the "interview added little to the selection process" (2002, p. 955) while in other cases the results of the interview related to student's "preclinical success, withdrawal, and drop out rates, and overall rating

of…potential competency as doctors" (2002, p. 956). In the standard interview process formerly utilized at UMKC, candidates interviewed individually with multiple interviewers and discussed a variety of topics. In this interview process, the interviews are unstructured and bias often enters the evaluation process for each interviewer.

In 2013, the combined-degree medical program at UMKC began utilizing a multiple-mini interview (MMI) process, a structured process with predetermined questions and guidance on evaluation. The MMI is designed to give candidates multiple, shorter interviews that assess a candidate on a different attribute within each different interview station. This process has been implemented with a goal of providing an interview experience that is "more reliable, valid, and less likely to result in gender and/or racial bias" (Latif, 2005, p. 724), while also measuring non-cognitive traits such as self-insight, interpersonal and communication skills, and ethical judgment, which "are better discriminators between good and bad clinical performance in medicine" (Latif, 2005, p. 723).

The goal of the interview process is to identify those candidates who can succeed academically while also further developing non-cognitive abilities that are important for successful clinical performance. "Clinical decision making requires an understanding not only of the nature of the disease, but also of its implications on the unique sensibilities of the patient in question" (Eva, et al., 2009, p. 774), and the MMI is an interview tool that has demonstrated predictive ability of future clinical performance (Eva, et al., 2009).

Ultimately, "there is evidence that interview ratings are predictive of subjective clinical assessments, and low interview assessments are predictive of failure or withdrawal from medical school" (Albanese, et al., 2003, p. 315). The goal of the

structured multiple-mini interview process for the UMKC combined-degree medical program is to identify those students who will be successful in medical school and who demonstrate those non-cognitive traits desired for medical students and physicians. The literature would support the idea that a structured interview process may predict success in medical school, and is an important consideration for this study.

Involvement in high school. In addition to academic information and interviews, additional information may be reviewed by admissions committees for selective programs. This additional information can include the review of extracurricular activities, leadership positions held, honors and awards earned and other items that might relate to involvement in high school. The UMKC combined-degree medical program is looking for well-rounded students, and believes that involvement in high school is a way to evaluate a student's other interests outside of medicine.

Additionally, involvement in high school may be an indicator of other traits such as teamwork, time management, leadership, self-awareness, self-confidence and ability to work in different, non-academic situations (Broh, 2002; Hansen, Larson, & Dworkin, 2003; Lipscomb, 2007; Lleras, 2008). "Early opportunities and experiences often shape later life chances and successes" (Lleras, 2008, 899), and involvement in different high school activities leads students to learn and develop different kinds of attitudes, behaviors and skills (Broh, 2002; Hansen, et al., 2003; Lleras, 2008).

It is also possible that involvement in high school extracurricular activities has an influence on student persistence and success in college (Lipscomb, 2007; Lleras, 2008; Marsh and Kleitman, 2002). In addition to high school academic performance, earning honors in high school, and performance on standardized tests such as the ACT or SAT, a

student's involvement in high school activities increased the ability to predict success in college (Camara, 2005).

In looking at student data from the National Educational Longitudinal Study (NELS), Lleras found that leadership in high school and participation in extracurricular activities were "positively and significantly related to educational attainment" (2008, p. 890). In another study using NELS data, Lipscomb found that participating in high school activities, including clubs and sports, "is associated with a 1.5 to 2 percent improvement in test scores and a 5 percent improvement in Bachelor's degree attainment expectations" (Lipscomb, 2007, p. 472).

Marsh and Kleitman considered the influence of structured versus non-structured extracurricular activities, and in-school versus out-of-school extracurricular activities, and found that that structured activities, whether in-school or out-of-school, were "positively associated with…higher educational aspirations" (Marsh and Kleitman, 2002, p. 485). Specifically looking at in-school structured activities, students who had higher participation in such activities often had higher aspirations for both educational and occupational goals (Marsh and Kleitman, 2002). When looking at these students two years after high school graduation, greater involvement with in-school structured activities were "also associated with higher levels of university enrollment, months in university, higher educational aspirations, higher levels of education achieved, and higher occupational aspirations" (Marsh and Kleitman, 2002, p. 489).

When considering this variable in the current study, as it relates to persistence in a combined-degree medical program, involvement and leadership in high school may contribute to a student's success in a combined-degree medical program.

Demographic characteristics. A goal of using holistic admissions for medical school admissions is to increase the diversity of the incoming class, the school and the medical profession. For the UMKC combined-degree program, diversity is defined broadly to include race and ethnicity, gender, geographic origin, socioeconomic status and other characteristics or experiences that might contribute to the diversity of the school and profession. These student characteristics are not evaluated directly in the admissions process, meaning there is no specific part of the process that takes into account specific diversity attributes. Consideration is broadly given, however, to how a student might contribute to the diversity of the class across multiple dimensions and that contribution may be considered when making admissions decisions.

For the purposes of the current study, diversity attributes were evaluated in terms of their relationship to retention in or withdrawal from the UMKC combined-degree medical program. Even if the consideration of diversity attributes remain an important part of the admissions process, it is necessary to understand which students may or may not face difficulty given his/her background or experiences.

Race and ethnicity. For the purposes of this study, and other studies looking at race and ethnicity as they relate to performance in college (ACT, 2013; Fletcher & Tienda, 2010; Kao & Thompson, 2003; Lorah & Ndum, 2013; Lleras, 2008; Mattern & Patterson, 2009; Reason, 2009), minority students are defined as those students from African-American, Hispanic and Native American backgrounds. Even though the number of minority students interested in careers in science, technology, engineering and math is significantly lower than their nonminority counterparts (ACT, 2013), it is

necessary for medical schools to enroll a larger number of students from diverse backgrounds in order to meet the diverse needs of the healthcare population.

Though the achievement gap between minority and nonminority students has decreased in recent years, significant gaps still exist and continue to expand as students progress through their academic careers (Adelman, 2006; Fletcher & Tienda, 2010; Kao & Thompson, 2003; Lorah & Ndum, 2013). This achievement gap is important to understand as it relates to persistence in higher education, especially as the demographics of students entering higher education are expected to change over the next several years.

The achievement gap and persistence of students through college have been shown to vary among students from different ethnic groups. "Racial gaps in academic achievement and graduation rates persist" (Fletcher & Tienda, 2010, p. 145), as students from white or Asian backgrounds tend to persist in college at higher rates than minority students (Mattern & Patterson, 2009; Reason, 2009). Fletcher & Tienda found "substantial racial/ethnic differences in grade point average and college persistence" (2010, p. 146), including lower college GPAs for students from black or Hispanic backgrounds as compared to their white peers.

A 2013 ACT study found achievement gaps in the four benchmarks measured by the ACT – biology, English composition, college algebra and social sciences – among students from minority groups in that these students performed at a lower level in these college courses than did their white counterparts (Lorah & Ndum, 2013). In addition, even though high school grades and standardized test scores would predict otherwise, students from minority groups earn lower college grade point averages than students from other racial and ethnic groups (Lorah & Ndum, 2013). ACT has also noted gaps for

racial and ethnic groups in "college enrollment, retention, and students' chances of earning a first-year GPA of 3.0 or higher" (Lorah & Ndum, 2013).

Even though the number of white students enrolled in college represents a declining portion of overall enrollment, and the number of minority students represents an increasing portion of overall enrollment, white students still persist in college at higher rates than minority students (Postsecondary Education Opportunity, 2010). Although several studies note achievement gaps among different ethnic groups, some of these same studies also note that these racial gaps may be attributed more to gaps in socioeconomic status rather than attributed to race alone (Kao & Thompson, 2003; Lorah & Ndum, 2013; Reason, 2009).

While socioeconomic status will be discussed in another section as a variable to consider, it will be important for the current study to evaluate race alone as a predictor for persistence in the combined-degree program, as well as to evaluate race in combination with other variables. Although several studies identify an achievement gap between students from various racial and ethnic groups as it relates to persistence in college, it was important to see if that held true in the combined-degree program at UMKC.

Gender. Over the past several years, the number of women enrolled in college has surpassed the number of men enrolled in college, with an increase in female college student enrollment to approximately 55 percent of enrolled students (Postsecondary Education Opportunity, 2010). This increase in female enrollment has also been the trend in the UMKC combined-degree program, with more women applying to and enrolling in the program each year.

When looking at persistence in college, women outperform men by persisting beyond the first year at a rate of approximately 74 percent versus 66 percent for men (Postsecondary Education Opportunity, 2010). Lleras, in a 2008 study looking at noncognitive factors as they relate to educational aspirations and attainment, found that men reported significantly lower levels of educational attainment than their female counterparts. In addition, a 2005 study looking at performance in an engineering program found that women outperformed men when looking at GPA in the engineering program, with females earning higher grade point averages than males (French, Immekus, & Oakes, 2005).

Although these studies have identified a gender gap, with females outperforming males, other research would indicate that there is no significant difference in performance among males and females (Mattern & Patterson, 2009). Studies have, however, found gender to be a predictor of college persistence and performance when combined with other incoming student characteristics such as race and ethnicity and socioeconomic status (Mattern & Patterson, 2009; Reason, 2009). Again, this study investigated gender as a single variable for predictive ability on success in the UMKC combined-degree program, while also looking at its relationship to success when combined with other incoming student characteristics.

Geographic origin. For the purposes of this study, geographic origin was defined by a student's state of residence and students are classified as in-state, regional and out-of-state. In-state students are further defined by whether or not a student comes from an urban or non-urban (rural) area. For medical schools, recruiting, admitting and retaining students from rural backgrounds has a profound influence on future physician practice

patterns, as students from rural areas who graduate from medical school are more likely to practice in a rural area (Willoughby, Arnold, & Calkins, 1981). The expected physician shortages also have a greater influence on those from rural backgrounds, as twenty percent of Americans live in rural or underserved areas with a shortage of health professionals (AAMC, 2010).

The transition from high school in a rural community to college in a larger city may not be the easiest transition to navigate. For some rural students, leaving a small town for a bigger, college town may be exciting, but for many this transition is filled with anxiety (Schultz, 2004). Rural students may feel a contradiction of emotions, feeling isolated, overwhelmed and disconnected while also experiencing pleasure, pride and a sense of accomplishment (Schultz, 2004), all of which may contribute to how the student performs in college.

Although there has been an increase in educational attainment for students from rural areas, a gap in attainment still exists between rural and non-rural students with those from rural areas less likely to attend college or earn college degrees (Byun, Meece, & Irvin, 2010; Gibbs, 2003; Provansik, et al., 2007). Hu, in a study using National Education Longitudinal Study data, documented that rural students have aspirations for high school or community college, but have lower educational aspirations for enrolling at a four-year college and earning a baccalaureate degree or higher, as compared to their nonrural counterparts (2003). However, this gap in educational aspirations and attainment has been attributed to "higher rates of poverty, poorer schooling conditions, lower parental and teacher expectations, and lower school achievement (Byun, et al., 2010, p. 9).

Byun, et al., in a study using National Education Longitudinal Study data, found that students from rural areas were 36.2 percent less likely than students from non-rural areas to pursue higher education, however this finding was heavily influenced by additional variables such as parent educational attainment and socioeconomic status (2010). In addition, the authors found that students from rural backgrounds are less likely to obtain a bachelor's degree, however this finding was also influenced by socioeconomic status and other variables (Byun, et al., 2010). Ultimately, the study demonstrated that when other variables are accounted for, there are little differences in educational aspirations and educational attainment between rural and nonrural students, and that the differences in aspirations and attainment among rural and nonrural students is "largely due to pre-existing differences in the socioeconomic and demographic backgrounds between rural and nonrural youth" (Byun, et al., 2010, p. 20). Other studies have also indicated that there is no difference between the educational aspirations of students from rural communities, versus those from nonrural communities, when other variables are accounted for (Edington & Kohler, 1987; Howley, 2006).

In an older study specifically looking at urban and rural students who entered the UMKC combined-medical degree program, the authors found no statistically significant differences in academic performance between students from urban areas versus students from rural areas (Willoughby, et al., 1981). This study specifically looked at performance as defined by grade point average, scores on yearly examinations, performance clinically and program status of the student two years after entering the combined-degree program, and found no statistically significant differences between students from different geographic areas.

The purposes of the current study were to evaluate incoming student characteristics, including geographic origin of the student, and whether or not they would predict persistence in the combined-degree program. The current study is evaluating both rural and urban origin for Missouri residents, in addition to origin as an in-state, regional or out-of-state students, as defined by the UMKC School of Medicine.

Socioeconomic background. Although previous research has identified gaps in persistence or educational attainment based upon race and ethnicity, gender or geographic origin, several of these studies have identified socioeconomic status as a bigger influence than these other demographic characteristics (Kao & Thompson, 2003; Lleras, 2008; Lorah & Ndum, 2013; Mattern & Patterson, 2009; Reason, 2009). For the purposes of this study, parental educational attainment or parental occupation are used as a proxy for socioeconomic status as this study did not have access to socioeconomic data. Other studies define socioeconomic status by parental educational attainment and parental income (Lotkowski, Robbins, & Noeth, 2004; Walpole, 2003), however this study does not have access to family income information.

In the literature, socioeconomic status has been linked to persistence or success in college, specifically that students from lower socioeconomic backgrounds are less likely to persist in college (Lleras, 2008; Lotkowski, et al., 2004; Mattern and Patterson, 2009; Reason, 2009; Walpole, 2003). Not only are students from lower socioeconomic backgrounds less likely to persist through the first year of college, they are also "less likely to persist to a bachelor's degree or to have graduate degree aspirations" (Walpole, 2003, p. 48), and their aspirations specifically for pursuing advanced degrees in medicine or law are much lower than those of their higher socioeconomic peers (Walpole, 2003).

Walpole's study looked at students nine years after graduation, and beyond, confirming that students from lower socioeconomic backgrounds had lower educational aspirations at the time of entering college, they also experienced "lower levels of income, graduate school attendance, and educational attainment that their peers from high SES backgrounds" (Walpole, 2003, p. 56).

Other studies reinforce the idea that socioeconomic status may predict who succeeds in college (Lleras, 2008; Lotkowski, et al., 2004; Mattern and Patterson, 2009; Reason, 2009), confirming that students from higher socioeconomic backgrounds were more likely to persist in college even after controlling for other background variables such as academic performance in high school, race and gender (Lotkowski, et al., 2004; Mattern and Patterson, 2009; Reason, 2009). In a 2004, ACT research report, Lotkowski, Robbins and Noeth found that socioeconomic status alone moderately predicted college GPA, and when combined with ACT scores and high school grade point average accounted for "26% of the variability of college GPA across all students" (2004, p. 9). Lleras found that those from higher socioeconomic backgrounds were "significantly more likely to complete higher levels of schooling" (2008, p. 895), and other studies support the theory that students from higher socioeconomic backgrounds were more likely to persist and graduate from college (Mattern and Patterson, 2009; Reason, 2009).

For the current study, when looking at socioeconomic status as defined by parent educational attainment, students from lower socioeconomic backgrounds may find more difficulty persisting in the combined-degree medical program, as supported by previous research.

Summary

This chapter reviewed the relevant literature as it relates to combined-degree medical programs, holistic admissions practices in medical schools, and the use of both cognitive and non-cognitive factors when making admissions decisions and predicting student success. This chapter provided the foundation for the importance of the current study, and how better understanding whether or not incoming student experiences, attributes and metrics, both cognitive and non-cognitive, can predict which students will be successful in a combined-degree medical program and becoming a physician.

The next chapter will outline the statistical analysis to be used to determine whether or not any of the variables discussed in the current chapter are predictive of student retention in the combined-degree medical program at UMKC. The literature reviewed indicates that variables such as test score, high school grade point average, gender, status as an underrepresented minority, and parent level of education are predictive of a student's performance and retention during the first two years of college. The following chapter will provide an outline of analysis to be used to determine whether or not these previous findings hold true for the UMKC School of Medicine.

Chapter Three: Research Methods

This chapter outlines the research methods used in this study, including an overview of the research purpose, the research questions, data collection and data analysis.

Research Purpose

The purpose of this study was to identify which experiences, attributes and metrics of an incoming student, if any, predict a student's chances of successfully completing the first two years of the combined degree medical program at the University of Missouri-Kansas City. The purpose was to evaluate incoming student experiences, attributes and metrics, both those currently evaluated in the admissions process, such as standardized test scores, high school GPA and a student's investigation of the healthcare profession, and those not evaluated, such as gender, parent level of education, race and ethnicity, and geographic origin.

The study looked at differences in GPA in the first two years of the program and retention status among different groups of students. The data were evaluated for differences among all students admitted between 2005 and 2013, students admitted pre-holistic admissions between 2005 and 2009 and students admitted post-holistic admissions between 2010 and 2013. Statistics to determine differences in pre-holistic versus post-holistic admissions were calculated when appropriate. For the pre-holistic admissions years, the independent variables include standardized test score, high school GPA, race and ethnicity, gender and geographic origin. For the post-holistic admissions years, the independent variables included standardized test score, high school GPA, rigor of the high school curriculum, race and ethnicity, gender, parent level of education,

geographic origin, admission type, and application materials such as essay, involvement in high school activities, involvement in health-related activities, references and interviews. The dependent variables for both groups include year 1 GPA, year 2 GPA and status in the program, which is defined as a student demonstrating success in the program, entering the Alternate Program, or withdrawing or being dismissed from the program.

Data were analyzed using SPSS, including descriptive statistics, correlations, comparison of means through t-test and ANOVA, linear regression and multinomial logistic regression.

Data Sources

The data for this study is quantitative, and came from the University of Missouri-Kansas City School of Medicine Office of Admissions and the Office of Medical Education and Research. The data was compiled from multiple sources, including Office of Admissions databases, Office of Medical Education and Research databases, as well as two other university systems, PeopleSoft and ImageNow. As the Assistant Dean of Admissions and Recruitment at the UMKC School of Medicine, the author of this study has authorized access to the data.

The following demographic data was obtained from the admissions application of each student, from Office of Admissions databases: race/ethnicity; gender; geographic origin; parent level of education; and parent occupation. The following student data was obtained from the Office of Admissions, from the individual student applications and/or by reviewing additional application materials available in Office of Admissions databases, PeopleSoft and/or ImageNow: standardized test scores (ACT or SAT); high

school grade point average; involvement in high school activities; involvement in health care experiences; results from the interview process; and admission type (provisional or full admission). The following student data was obtained from the Office of Admissions database, ImageNow, through the review of individual student transcripts: participation in Advanced Placement, International Baccalaureate, college dual-enrollment or honors coursework. The following student data was obtained from the Office of Medical Education and Research: Year 1 grade point average, Year 2 grade point average, current status in the School of Medicine (routine promotion, entered Alternate Program, withdrew or dismissed from School of Medicine).

Sample

The sample consists of students who entered the University of Missouri-Kansas City School of Medicine combined-degree medical program between the fall 2005 and fall 2013 semesters. This provided data for approximately 960 students. The data were evaluated in three groups: All students admitted between 2005 and 2013 (N = 962), students admitted pre-holistic admissions between 2005 and 2009 (N = 529), and students admitted post-holistic admissions between 2010 and 2013 (N = 433).

Procedure

A proposal for this study was presented to and approved by the faculty dissertation members at the University of Kansas. In addition, an application for human subjects approval is being presented to the Social Sciences Institutional Review Board at the University of Missouri-Kansas City. This study is also supported by the UMKC School of Medicine Office of Medical Education and Research and the UMKC School of Medicine Office of Student Affairs.

UMKC student ID numbers are the initial individual student identifier that allowed the researcher to collect accurate data on each individual student. Since data are being collected from multiple sources, School of Medicine databases as well as university databases, the UMKC student identification number was the common identifier between all databases. Once all of the data were collected from the various data sources, the UMKC student identification number was dropped from the data set so that data was no longer linked to an individual student.

Research Questions

The fundamental goal of this study was to identify those incoming student experiences, attributes and metrics that predict the retention of combined-degree medical students. This goal leads to the following research question:

- What incoming student experiences, attributes and metrics predict whether or not a student will demonstrate success, enter the Alternate Program, or encounter dismissal or withdrawal from medical school?

Though this is the primary question guiding the study, there are additional, more focused questions that assist with answering this question.

Additional questions guiding the study. The following questions were the guide for data collection and data analysis:

1. What is the relationship between the following student admissions application metrics and experiences and retention?
    a. Standardized test scores;
    b. High school core GPA;

c. Overall rigor of high school curriculum, including AP, IB, dual-enrollment or honors courses completed in high school;
d. Involvement in high school activities and leadership;
e. Investigation of the medical profession while in high school;
f. References;
g. Interview results;
h. Admission status (e.g. full admission v. provisional admission).

2. What is the relationship between the following individual student attributes and retention?
    a. Race/ethnicity;
    b. Gender;
    c. Geographic origin, including state residency and rural versus urban status;
    d. Parent level of education.

These questions were designed to address the fundamental issue—to identify those experiences, attributes and metrics that have a predictive relationship with student success and retention in an accelerated combined-degree program.

Additional research question. A secondary goal of this study was to identify any differences in retention, student academic performance, or diversity outcomes for students admitted pre-holistic admissions (2005 – 2009) or post-holistic admissions (2010 – 2013), leading to the following research question:

- Are there any differences in outcomes for students admitted between 2010 and 2013, after current holistic admissions practices were implemented?

Although not the primary focus of this study, this study was interested in whether or not retention has improved and diversity has increased since the implementation of holistic admissions in its current format in 2010.

Variables

For the purposes of this study, the dependent variables used to assess retention included:

1. Year 1 GPA – continuous variable;
2. Year 2 GPA – continuous variable;
3. Student successfully completed the first or second year of the program;
4. Student entered the Alternate Program;
5. Student withdrew or was dismissed from the program.

For certain analysis, dependent variables three through five were redefined in the following ways:

- Successful (1) v. Non-successful (0), with successful defined as retained in the program without entering the Alternate Program and not successful being defined as withdrawal/dismissal from the combined-degree medical program.
- Successful (1) v. Alternate Program (0), with successful defined as retained in the program without entering the Alternate Program and Alternate Program being defined as entering the Alternate Program.

For other analysis, dependent variables three through five were redefined as:

- Withdrawal or Dismissal (0),
- Entered the Alternate Program (1),
- Successful (2).

The independent variables, those variables that the study evaluated for a relationship to the dependent variables outlined above, include:

1. Standardized test score – continuous variable.
    a. When a student applies for admission to the combined-degree program at the UMKCSchool of Medicine, he/she is required to take a standardized test, either the ACT or SAT. The ACT is comprised of four sections, English, Reading, Math and Science, and also includes an optional writing exam. The SAT is comprised of three sections: Math, Critical Reading and Writing. For the purposes of this study, the writing section is not evaluated because it is not required to be submitted with the admissions application. A composite score is calculated for both exams, with the highest possible score on the ACT a 36 and the highest possible score on the Critical Reading and Math sections of the SAT a 1600. For data analysis, SAT score was converted to an ACT equivalent score using the ACT-SAT concordance table provided by ACT and the College Board, so that all standardized test scores were on the same scale (ACT, 2013).
2. Core high school GPA – continuous variable:
    a. The core high school grade point average is calculated at the point of application to the university by the UMKC Office of Admissions. As a requirement of the university, a student is required to complete seventeen core requirements in English, science, mathematics, social science, fine arts and foreign language. A grade point average in these courses is calculated (4.0 scale) and provided to the School of Medicine. This is the

grade point average used in the admissions process, and is the grade point average that will be used in this study.

3. Essay – coded 1, 2, 3, or 4:
    a. In the application review process, essays are scored on a 1 – 4 scale, with 4 being a high score and 1 being a low score. Scores are assessed based on content of the essay, grammar, spelling and effectiveness of written communication.
4. Rigor of high school curriculum – coded 1, 2, 3, 4, or 5:
    a. In the application review process, rigor of the high school curriculum is scored on a scale of 1 to 5, with a score of 5 indicating a more rigorous high school curriculum. A more rigorous curriculum is defined by the number of Advanced Placement, International Baccalaureate, dual-enrollment or honors-level courses a student enrolled in throughout high school, based on the types of courses available at an individual high school.
5. Involvement in co-curricular activities – coded 1, 2, 3, or 4:
    a. In the application review process, involvement in co-curricular activities are scored on a 1 – 4 scale, with 4 being a high score and 1 being a low score. Scores are assessed based on level and duration of involvement and demonstrated leadership.
6. Investigation of the health care profession – coded 1, 2, 3, or 4:
    a. In the application review process, involvement in health related activities are scored on a 1 – 4 scale, with 4 being a high score and 1 being a low

score. Scores are assessed based on level and duration of involvement and demonstrated commitment to health care. Scores are assessed with the knowledge that access to health care experiences will vary by student.

7. References – coded 1, 2, 3, or 4:
    a. In the application review process, references are scored on a 1 – 4 scale, with 4 being a high score and 1 being a low score. Scores are assessed based on the scores and comments provided by each individual providing a reference.
8. Interview results – continuous variable.
    a. Interviewers were asked to score a candidate on a scale of 0 – 35, with 35 being the highest score possible. Interviewers were asked to rate each candidate on seven attributes, with each attribute worth a maximum of five points to result in a total score out of 35.
9. Admission Type – coded into two categories, provisional (0) and full (1).
    a. Students invited to interview are required to complete a chemistry assessment on the day of the interview. Students offered admission who achieve a passing score on this assessment (40 or higher out of 60) are offered full admission. Students offered admission who do not achieve a passing score (39 or lower out of 60) are offered provisional admission. Students offered provisional admission must take a chemistry course (lecture and lab) the summer prior to matriculation and meet minimum academic standards in this course to enter the School of Medicine.

10. Race/ethnicity – coded into two categories, non-minority (0) and underrepresented minority (1).
    a. When completing the application for admission, students are asked to identify their racial or ethnic group and may self-identify one or more racial or ethnic categories. Although race or ethnicity was originally coded into the categories of White, Asian, Asian-Underrepresented, African-American, Hispanic, Native Hawaiian or Pacific Islander, American Indian, or Not Specified, the racial/ethnic categories were collapsed into students under-represented in medicine (African-American, Hispanic, Native Hawaiian or Pacific Islander, Asian Under-Represented, American Indian) and students not under-represented in medicine (White, Asian, Not Specified).
11. Gender – coded into two categories, male (0) and female (1).
12. Geographic origin – coded into three categories, in-state (1), regional (2) and out-of-state (3). In-state students are further classified into two categories, urban (1) and rural (2).
13. Parent level of education – coded into the following categories:
    a. At least one parent earned a post-graduate degree in medicine: 1
    b. At least one parent earned a post-graduate degree in another field: 2
    c. At least one parent earned a baccalaureate degree: 3
    d. Both parents earned no more than a high school diploma: 4

This study did not have access to family financial information, financial aid information or other sources traditionally used to measure socioeconomic status. Therefore, this

study looked at parent level of education as a proxy for socioeconomic status. For certain analysis, parent level of education was collapsed into two groups: (1) at least one parent earned a baccalaureate degree and both parents earned no more than a high school diploma, and (2) at least one parent earned a post-graduate degree in medicine and at least one parent earned a post-graduate degree in another field.

Data Analysis

The following sections outline the descriptive statistics collected for the sample, as well as the statistical analysis used to answer the research questions in this study.

Descriptive statistics. Descriptive statistics, including means, standard deviations and frequencies, were run to gain a better understanding of incoming students as they enter the combined-degree medical program, as well as these students as they progress through the program. To better understand incoming students, means and standard deviations were run on the following variables:

- Standardized test score;
- High school GPA.

This study also provides an overview of the following as it relates to incoming student data, and assesses the data for all students admitted between 2005 and 2013, students admitted pre-holistic admissions (2005 – 2009) and post-holistic admissions (2010 – 2013):

- Frequency (percentage) of students who are underrepresented minority students v. non-minority students;
- Frequency (percentage) of men v. women;

- Frequency (percentage) of students from in-state, regional and out-of-state, including frequency (percentage) of in-state students from rural backgrounds v. non-rural backgrounds;
- Frequency (percentage) of students whose parents have achieved graduate level degrees or higher, baccalaureate degrees or less than a baccalaureate degree.

This study also provides descriptive statistics of students once they have completed a portion of the program, including:

- Frequency (percentage) of students who continued in the combined-degree medical program;
- Frequency (percentage) of students who withdrew or were dismissed from the combined-degree medical program;
- Frequency (percentage) of students who entered the Alternate Program.

Variables that predict academic performance in medical school. Once the descriptive statistics were collected, the next step was to look at the relationship between each of the individual independent variables and academic performance in medical school as defined by year 1 GPA and year 2 GPA. The independent variables of standardized test score, high school grade point average, and interview scores were analyzed for a relationship with year 1 GPA and year 2 GPA. A correlation between each independent variable and dependent variable was collected.

For students admitted post-holistic admissions, the additional independent variables of essay, rigor of high school curriculum, high school activities, health experience, references, and admission type were analyzed for a relationship with year 1

and year 2 GPA. A t-test or ANOVA between each independent variable and dependent variable was run to determine if there were any significant differences between the grade point averages among these variables.

In addition to variables considered in the admissions process, demographic variables were also analyzed for their relationship with academic performance as defined by year 1 and year 2 GPA. Race/ethnicity, gender, geographic origin, and parent level of education were analyzed for a relationship with year 1 GPA and year 2 GPA. Again, a t-test or ANOVA was run to determine whether or not a relationship exists between demographic variables and grade point average.

Once it was determined which independent variables had statistically significant relationships with the dependent variables, regression was run. For the dependent variables, year 1 and year 2 GPA, linear regression was run for the independent variables that were shown to be the most statistically significant.

Variables that predict student success in medical school. For this data analysis, this study looked at whether or not there is a relationship between incoming student experiences, attributes and metrics and a student's success in the combined-degree medical program at UMKC. Student success was defined as successful, entering the Alternate Program, or dismissed or withdrawn from the program.

The independent variables of standardized test score, high school grade point average and interview scores were analyzed for a relationship with dependent variables of successful versus not successful and successful versus entering the alternate program. The independent variables of essay, rigor of high school curriculum, high school activities, health experience, references, admission type, race/ethnicity, gender,

geographic origin, and socioeconomic status as defined by parent level of education was analyzed for a relationship with the dependent variables of successful versus not successful and successful versus entering the Alternate Program. A chi-square was run between each independent variable and status in the program.

All independent variables were analyzed for a relationship with the dependent variable of status in the program. This analysis provides for the determination of whether or not the independent variables predict if a student ends up in a certain "group" (e.g. successful, enters Alternate Program, withdraws or is dismissed). For the dependent variable of status in the program, multinomial logistic regression was run for those independent variables that were shown to be the most statistically significant. The goal of each statistical analysis was to determine which variables predicted the possible outcomes being evaluated.

Summary

This chapter provided additional information regarding the data to be used in the study, the independent and dependent variables to be evaluated, the sources from which data was collected and the methods by which data was analyzed. The goal of these methods was to determine which independent variables, if any, have predictive value.

Chapter Four: Results

The primary purpose of this study was to evaluate which, if any, incoming student experiences, attributes and metrics can predict success in a combined-degree medical program. This study also aimed to identify differences in outcomes pre-holistic versus post-holistic admissions. This study focused on incoming student data from a single institution, the University of Missouri—Kansas City School of Medicine. The study focused on identifying specific student experiences, attributes and metrics that may contribute to a student demonstrating success, entering the Alternate Program, or encountering dismissal or withdrawal from school in the combined-degree medical program at UMKC. A number of incoming student experiences, attributes and metrics were evaluated in this study to determine which independent variables had a predictive relationship with the dependent variables. The first section of this chapter presents the descriptive statistics for each variable, while the second section answers the research questions through the presentation of correlations, comparison of means, Chi-square analysis, and linear and logistic regression analysis.

Descriptive Statistics

Descriptive statistics were run on the following variables: standardized test score, high school GPA, race and ethnicity, gender, geographic origin, parent level of education, and status in the program.

Demographics. The study sample includes students admitted to the University of Missouri-Kansas City School of Medicine combined-degree program between the fall 2005 and fall 2013, for a total of 962 students. For some of the statistical analysis, the sample sizes may vary due to missing data. Of the total sample, as shown in Table 1,

56.2% (541) were admitted from in-state, 18.9% (182) were admitted from the regional states (Arkansas, Illinois, Kansas, Nebraska and Oklahoma) and 24.5% (239) were admitted from out-of-state.

Students from the state of Missouri who are admitted to the School of Medicine are identified as urban or rural based on the county associated with the permanent address listed in the application for admission. The School of Medicine uses the county classification developed by the Missouri Department of Health and Senior Services, which defines urban counties as "those with a population density over 150 people per square mile, plus any county that contains at least part of the central city of a census-defined Metropolitan Statistical Area" (Van Dyne, et al., 2013, 8). Based on this classification, there are 14 counties in the state of Missouri that have been designated as urban and 101 counties designated as rural. Table 1 displays that 79.9% (432) of in-state students were admitted from urban areas, while 20.1% (109) were admitted from rural areas.

For students admitted pre-holistic admissions, 54.3% (287) were admitted from in-state (with 78.5% (226) admitted from urban areas and 21.5% (62) admitted from rural areas), 12.7% (67) were admitted from regional states and 32.9% (174) were admitted from out-of-state. For students admitted post-holistic admissions, 58.4% (253) were admitted from in-state (with 81.4% (206) admitted from urban areas and 18.6% (47) admitted from rural areas), 26.6% (115) admitted from regional states and 15.0% (65) admitted from out-of-state. Table 1 presents the percentages and frequencies for geographic origin for each individual matriculating class, all students admitted between

2005 and 2013, as well as for students admitted pre-holistic admissions and post-holistic admissions.

TABLE 1: Percentages and Frequencies for Geographic Location

Matriculating Year	In-State	Urban	Rural	Regional	Out-of-State
2005	59.4 (60)	76.7 (46)	23.3 (14)	NA*	40.6 (41)
2006	50.5 (48)	77.1 (37)	22.9 (11)	NA*	49.5 (47)
2007	56.5 (70)	80.0 (56)	20.0 (14)	14.5 (18)	29.0 (36)
2008	50.0 (50)	84.0 (42)	16.0 (8)	25.0 (25)	25.0 (25)
2009	54.1 (59)	75.0 (45)	25.0 (15)	22.0 (24)	22.9 (25)
2010	60.2 (59)	74.6 (44)	25.4 (15)	21.4 (21)	18.4 (18)
2011	54.9 (62)	74.2 (46)	25.8 (16)	25.7 (29)	19.5 (22)
2012	57.3 (63)	88.9 (56)	11.1 (7)	27.3 (30)	15.5 (17)
2013	61.6 (69)	87.0 (60)	13.0 (9)	31.3 (35)	7.1 (8)
All Years	56.2 (541)	79.9 (432)	20.1 (109)	18.9 (182)	24.5 (239)
Pre-Holistic Admissions 2005-2009	54.3 (287)	78.5 (226)	21.5 (62)	12.7 (67)	32.9 (174)
Post-Holistic Admissions 2010-2013	58.4 (253)	81.4 (206)	18.6 (47)	26.6 (115)	15.0 (65)

*The regional category did not exist prior to 2007.

Table 2 displays the descriptive statistics calculated for gender, with 43.9% (422) of all students admitted between 2005 and 2013 male and 56.1% (540) female. There was very little change in these percentages for the pre-holistic and post-holistic admissions years, with the percentages of males 44.2% (234) and 43.4% (188), respectively, and the percentages of females 55.8% (295) and 56.6% (245), respectively.

TABLE 2: Percentages and Frequencies for Gender

Matriculating Year	Male	Female
2005	45.5 (46)	54.5 (55)
2006	37.9 (36)	62.1 (59)
2007	53.2 (66)	46.8 (58)
2008	40.0 (40)	60.0 (60)
2009	42.2 (46)	57.8 (63)
2010	39.8 (39)	60.2 (59)
2011	46.0 (52)	54.0 (61)
2012	46.4 (51)	53.6 (59)
2013	41.1 (46)	58.9 (66)
All Years	43.9 (422)	56.1 (540)
Pre-Holistic Admissions 2005-2009	44.2 (234)	55.8 (295)
Post-Holistic Admissions 2010-2013	43.4 (188)	56.6 (245)

In addition, descriptive statistics were computed for race and ethnicity. The results from descriptive statistics displayed in Table 3 identified 15.7% (152) of all students admitted between 2005 and 2013 were from groups under-represented in medicine. 12.3% (65) of students admitted pre-holistic admissions were admitted from groups under-represented in medicine, whereas 20.1% (87) of students admitted post-holistic admissions were from groups under-represented in medicine. To determine whether or not the increase in admission of students under-represented in medicine post-holistic admissions was statistically significant, a chi-square test was computed. The test revealed that the increase post-holistic admissions was statistically significant, with $x(1) = 10.903$, $p = .001$.

TABLE 3: Percentages and Frequencies for Race and Ethnicity

Matriculating Year	Under-Represented in Medicine (URM)	Not Under-Represented in Medicine (Non-URM)
2005	11.9 (12)	88.1 (89)
2006	6.4 (6)	93.6 (89)
2007	13.7 (17)	86.3 (107)
2008	16.0 (16)	84.0 (84)
2009	12.8 (14)	87.2 (95)
2010	14.2 (14)	85.8 (84)
2011	21.2 (24)	78.8 (89)
2012	17.3 (19)	82.7 (91)
2013	26.8 (30)	73.2 (82)
All Years	15.7 (152)	84.3 (810)
Pre-Holistic Admissions 2005-2009	12.3 (65)	87.7 (464)
Post-Holistic Admissions 2010-2013	20.1 (87)	79.9 (346)

Descriptive statistics were also calculated for parent level of education. Parent level of education was re-coded in the following way: At least one parent earned a post-graduate degree in medicine; At least one parent earned a post-graduate degree in another field; At least one parent earned a baccalaureate degree; both parents earned no more than a high school diploma. Because these data were not consistently collected pre-holistic

admissions, the results presented in Table 4 are for the students admitted post-holistic admissions only. For students admitted between 2010 and 2013, 35.3% (153) had at least one parent who earned a post-graduate degree in medicine, 39.0% (169) had at least one parent who earned a post-graduate degree in another field, 21.2 % (92) had at least one parent who earned a baccalaureate degree and 4.4% (19) had two parents who earned no more than a high school diploma.

TABLE 4: Percentages and Frequencies for Parent Level of Education

Matriculating Year	At Least One Parent with Post-Grad Degree in Medicine	At Least One Parent with Post-Grad Degree	At Least One Parent with Baccalaureate Degree	Both Parents with High School Diploma
2005	NA	NA	NA	NA
2006	NA	NA	NA	NA
2007	NA	NA	NA	NA
2008	NA	NA	NA	NA
2009	NA	NA	NA	NA
2010	37.8 (37)	36.7 (36)	21.4 (21)	3.1 (3)
2011	38.9 (44)	38.9 (44)	19.5 (22)	2.7 (3)
2012	34.5 (38)	40.0 (44)	20.9 (23)	4.5 (5)
2013	30.4 (34)	40.2 (45)	22.3 (25)	7.1 (8)
All Years	NA	NA	NA	NA
Pre-Holistic Admissions 2005-2009	NA	NA	NA	NA
Post-Holistic Admissions 2010-2013	35.3 (153)	39.0 (169)	21.2 (92)	4.4 (19)

When a student applies for admission to the School of Medicine, he/she is required to take a standardized test, either the ACT or SAT. To better understand the students admitted between 2005 and 2013, means and standard deviations were calculated for the ACT score (or its equivalent). If applicants took both the ACT and SAT, or if the applicant took an exam multiple times, the highest test score was used in the data analysis. The average standardized test score for all students admitted to the School of Medicine was 30.02 (SD = 2.62), with a minimum score of 22 and a maximum

score of 36. As presented in Table 5, there was very little change in mean standardized test score pre- or post-holistic admissions.

TABLE 5: Means and Standard Deviations for Standardized Test Score

Matriculating Year	Mean Test Score	Standard Deviation	Minimum Score	Maximum Score
2005	29.38	2.61	23	35
2006	29.96	2.43	24	35
2007	29.53	2.62	22	35
2008	30.20	2.66	23	36
2009	30.69	2.45	23	35
2010	30.55	2.53	24	35
2011	30.18	2.87	22	35
2012	30.50	2.64	23	35
2013	30.06	2.69	23	35
All Years	30.02	2.62	22	36
Pre-Holistic Admissions 2005-2009	29.79	2.53	22	36
Post-Holistic Admissions 2010-2013	30.31	2.69	22	35

In addition to standardized test score, students are also required to submit high school transcripts so that a high school GPA can be calculated. At the time of admission, the GPA is calculated based on the 17 core requirements of the university:

- Four units of English,
- Four units of Math (Algebra I or higher),
- Three units of science, including one unit of Biology and one unit of Chemistry,
- Three units of social science,
- Two units of a single foreign language, and
- One unit of Fine Arts.

The UMKC Office of Admissions calculates a GPA in these courses on a 4.0 scale. For students admitted between 2005 and 2013, the average high school GPA was 3.80 (SD = .232), with a minimum grade point average of 2.57 and a maximum of 4.0. Table 6 also displays the mean high school GPA for pre- and post-holistic admissions, revealing no significant difference.

TABLE 6: Means and Standard Deviations for High School GPA

Matriculating Year	Mean High School GPA	Standard Deviation	Minimum GPA	Maximum GPA
2005	3.82	.252	2.88	4.00
2006	3.81	.203	3.15	4.00
2007	3.76	.287	2.57	4.00
2008	3.80	.221	3.17	4.00
2009	3.78	.241	3.00	4.00
2010	3.85	.173	3.31	4.00
2011	3.81	.230	3.04	4.00
2012	3.80	.225	3.13	4.00
2013	3.78	.220	3.00	4.00
All Years	3.80	.232	2.57	4.00
Pre-Holistic Admissions 2005-2009	3.79	.245	2.57	4.00
Post-Holistic Admissions 2010-2013	3.81	.215	3.00	4.00

Finally, status in the program was also examined to see the frequency of students demonstrating success in the program, entering the Alternate Program or leaving the program. Withdrawal/Dismissal was coded as 0, entering the Alternate Program was coded as 1 and success in the program was coded as 2. Table 7 displays the percentages and frequencies for all students admitted, students admitted pre-holistic admissions and students admitted post-holistic admissions. For all students admitted between 2005 and 2009, 73.7% (709) have been successful in the program without entering the Alternate Program or leaving the program. 10.7% (103) have entered the Alternate Program, and 15.6% (150) have either withdrawn from the program or been dismissed from the program.

For students admitted pre-holistic admissions, 69.8% (369) have demonstrated success in the program, 11.7% (62) entered the Alternate Program and 18.5% (98) withdrew or were dismissed. For students admitted post-holistic admissions, 78.5% (340) have experienced success in the program, 9.5% (41) have entered the Alternate Program and 12.0% (52) have withdrawn or been dismissed. To determine whether or

not there was a statistically significant increase in the number of students who demonstrated success post-holistic admissions, a chi-square analysis was completed revealing that students who entered the program post-holistic admissions were more likely to experience success, with $x(2) = 10.095$, $p = .006$.

TABLE 7: Percentages and Frequencies for Status in the Program

Matriculating Year	Successful	Alternate Program	Withdrawal/Dismissed
2005	86.1 (87)	NA	13.9 (14)
2006	73.7 (70)	5.3 (5)	21.1 (20)
2007	50.8 (63)	19.4 (24)	29.8 (37)
2008	63.0 (63)	20.0 (20)	17.0 (17)
2009	78.9 (86)	11.9 (13)	9.2 (10)
2010	85.7 (84)	1.0 (1)	13.3 (13)
2011	66.4 (75)	14.2 (16)	19.5 (22)
2012	75.5 (83)	14.5 (16)	10.0 (11)
2013	87.5 (98)	7.1 (8)	5.4 (6)
All Years	73.7 (709)	10.7 (103)	15.6 (150)
Pre-Holistic Admissions 2005-2009	69.8 (369)	11.7 (62)	18.5 (98)
Post-Holistic Admissions 2010-2013	78.5 (340)	9.5 (41)	12.0 (52)

Variables That Predict Academic Performance in Medical School

The goal of this study was to identify those incoming student experiences, attributes and metrics that may determine a student's success and academic performance in the combined-degree medical program at UMKC. For the following analysis, the variable used to evaluate academic performance was medical school GPA, specifically the GPA earned at the end of the first and second years of the six-year combined-degree program. This analysis utilized correlations, t-tests, ANOVA and linear regression to determine whether or not incoming student experiences, attributes and metrics have any relationship with medical school GPA.

Admission variables and year 1 and year 2 GPA. The following analysis looks specifically at variables used in the admissions process, including standardized test score

and high school GPA, and a student's academic performance in medical school as measured by year 1 and year 2 GPA.

Standardized test score. For all students entering the program between 2005 and 2013, there was a statistically significant relationship between standardized test score and year 1 GPA, with r (944) = .270, p = .0001. There was also a statistically significant relationship between standardized test score and year 2 GPA, with r (701) = .217, p = .0001. In both cases, although statistically significant, the correlations represent a weak association between the variables.

For students admitted pre-holistic admissions, there was a statistically significant relationship between standardized test score and year 1 GPA, with r (518) = .184, p = .0001, however there was a weak association between the variables. There was also a statistically significant relationship between standardized test score and year 2 GPA, with r (198) = .286, p = .000, however this correlation was also weak.

For students admitted post-holistic admissions, there was a statistically significant relationship between standardized test score and year 1 GPA, with r (424) = .372, p = .000, representing a moderate association between the variables. There was also a correlation between standardized test score and year 2 GPA, with r (501) = .185, p = .000, however this correlation was weaker. Table 8 presents the correlations between standardized test score and medical school GPA.

TABLE 8: Correlations for Standardized Test Score & Year 1 and Year 2 GPA

	Mean	r	Sig.
All Years			
Year 1 GPA	3.61	.270	.000*
Year 2 GPA	3.36	.217	.000*
ACT Score	30.02		
Pre-Holistic Admissions			
Year 1 GPA	3.61	.184	.000*
Year 2 GPA	3.33	.185	.000*
ACT Score	29.79		
Post-Holistic Admissions			
Year 1 GPA	3.61	.372	.000*
Year 2 GPA	3.43	.286	.000*
ACT Score	30.31		

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

High school GPA. In addition to standardized test score, correlations were also calculated for high school GPA and medical school GPA, with results presented in Table 9. For all students entering the program between 2005 and 2013, there was a statistically significant relationship between high school GPA and year 1 GPA, with $r (914) = .333$, $p = .000$, and between high school GPA and year 2 GPA, with $r (674) = .219$, $p = .000$. In both cases, although statistically significant, the correlations represent a weak association between the variables.

For students entering the program pre-holistic admissions, there was a statistically significant relationship between high school GPA and year 1 GPA, with $r (488) = .378$, $p = .0001$, representing a moderate association between the variables. There was also a statistically significant relationship between high school GPA and year 2 GPA, with $r (474) = .221$, $p = .0001$, however the correlation is weak.

For students entering the program post-holistic admissions, there was also a statistically significant relationship between high school GPA and year 1 GPA, with $r (424) = .279$, $p = .000$, and between high school GPA and year 2 GPA, with $r (198) = .185$, $p = .009$. In both cases, however the correlations were weak.

TABLE 9: Correlations for High School GPA & Year 1 and Year 2 GPA

	Mean	R	Sig.
All Years			
Year 1 GPA	3.61	.333	.000*
Year 2 GPA	3.36	.219	.000*
High School GPA	3.80		
Pre-Holistic Admissions			
Year 1 GPA	3.61	.378	.000*
Year 2 GPA	3.33	.221	.000*
High School GPA	3.79		
Post-Holistic Admissions			
Year 1 GPA	3.61	.279	.000*
Year 2 GPA	3.43	.185	.009**
High School GPA	3.81		

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Predicting GPA with all admissions variables. Linear regression was performed to determine if any of the variables currently used in the admissions process are predictive of year 1 or year 2 GPA. These variables include standardized test score, high school GPA, rigor of high school curriculum, essay, involvement in high school activities, health-related experiences, references, interviews and admission type.

For all students, ACT score and high school GPA together account for 16.0% of the variance in year 1 GPA ($p = .000$). ACT score and high school GPA together account for less of the variance in year 2 GPA, accounting for only 8.3% ($p = .000$). For students admitted pre-holistic admissions, ACT score and high school GPA together account for 15.8% of the variance in year 1 GPA ($p = .000$), however only account for 7.3% of the variance in year 2 GPA ($p = .000$).

For students admitted post-holistic admissions, ACT score and high school GPA together account for 19.1% of the variance in year 1 GPA ($p = .000$), and 10.5% of the variance in year 2 GPA ($p = .000$). Other independent variables, such as rigor of the high school curriculum, essay, involvement in high school activities and experiences in health care, were all statistically significant in predicting both year 1 and year 2 GPA, however

they independently accounted for very little of the variance in GPA. All admissions variables taken together accounted for 20.6% (p = .000) and 14.6% (p = .000) of the variance in year 1 and year 2 GPA, respectively.

Additionally, students admitted post-holistic admissions are offered either full admission or provisional admission. Provisional admission is offered to students who did not pass a chemistry assessment completed during the admissions process. These students must take a chemistry course the summer prior to matriculation and meet minimum academic standards in this course in order to enter the School of Medicine. When evaluating admission type, full admission was coded as 1 and provisional admission was coded as 0.

Tables 10 and 11 reveal that the admission type of a student was statistically significant in predicting both year 1 and year 2 GPA. Admit type accounted for 14.1% (p = .000) of the variance in year 1 GPA, and 7.1% (p = .000) of the variance in year 2 GPA. The Beta weights obtained indicate that a negative relationship exists between admit type and year 1 and year 2 GPA, with students offered provisional admission earning lower year 1 GPAs (B = -.323, p = .000) and lower year 2 GPAs (B = -.246, p = .000). More specifically, students who were admitted provisionally will earn a year 1 GPA that is .323 grade points lower than students offered full admission and a year 2 GPA that is .246 grade points lower.

Across almost all statistics presented in Tables 10 and 11, high school GPA was the strongest predictor of both year 1 and year 2 GPA. For year 1 GPA, high school GPA obtained the largest Beta weight for all years (B = .504, p = .000), pre-holistic admissions (B = .535, p = .000) and post-holistic admissions, (B = .461, p = .000). Similar results

were found for year 2 GPA, with high school GPA again obtaining the largest Beta weight for all years (B = .437, p = .000), pre-holistic admissions (B = .447, p = .000) and post-holistic admissions (B = .351, p < .01). These results indicate that high school GPA made the largest contribution to a student's GPA at both the end of year 1 and the end of year 2.

TABLE 10: Linear Regression and Admissions Predictors of Year 1 GPA

	R	R^2	B	Sig.
All Years				
ACT Score	.270	.073	.036	.000*
High School GPA	.333	.111	.504	.000*
ACT/HS GPA	.400	.160		.000*
Pre-HA (2005 – 2009)				
ACT Score	.184	.034	.025	.000*
High School GPA	.378	.143	.535	.000*
ACT/HS GPA	.397	.158		.000*
Post-HA (2010 – 2013)				
ACT Score	.372	.138	.049	.000*
High School GPA	.279	.078	.461	.000*
ACT/HS GPA	.437	.191		.000*
Curriculum	.171	.029	.091	.000*
Essay	.105	.011	.073	.030**
HS Activities	.125	.016	.072	.010**
Health Experience	.125	.016	.060	.010**
References	.119	.014	.068	.014**
Interviews	.046	.002	.004	.989
Non-Cog Only	.217	.047		.055
All Admissions Variables	.453	.208		.000*
Admit Type (Full v. Provisional)	.375	.141	-.323	.000*

*Statistically significant at the .000 level.
**Statistically significant, p < .05.

TABLE 11: Linear Regression and Admissions Predictors of Year 2 GPA

	R	R^2	B	Sig.
All Years				
ACT Score	.217	.047	.039	.000*
High School GPA	.219	.048	.437	.000*
ACT/HS GPA	.289	.083		.000*
Pre-HA (2005 – 2009)				
ACT Score	.185	.034	.035	.000*
High School GPA	.221	.049	.447	.000*
ACT/HS GPA	.270	.073		.000*
Post-HA (2010 – 2013)				
ACT Score	.286	.082	.042	.000*
High School GPA	.185	.034	.351	.009**
ACT/HS GPA	.325	.105		.000*
Curriculum	.063	.004	.037	.378
Essay	.009	.000	-.007	.900
HS Activities	.041	.002	.025	.569
Health Experience	.129	.017	-.072	.068
References	.193	.037	.130	.006**
Interviews	.044	.002	.004	.757
Non-Cog Only	.244	.059		.042**
All Admissions Variables	.382	.146		.000*
Admit Type (Full v. Provisional)	.267	.071	-.246	.000*

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Demographic variables and year 1 and year 2 GPA. In addition to analyzing the relationship between variables used in the admissions process and medical school GPA, this study also analyzed the relationship between demographic variables, such as gender or parent level of education, and medical school GPA. Tests for comparisons of means and linear regression analysis were conducted on the following variables: gender, race and ethnicity, parent level of education and geographic origin. The goal of this analysis was to determine whether or not there was a statistically significant relationship between these independent variables and medical school GPA.

Gender. When evaluating gender, males were coded as 0 and females were coded as 1. An independent-samples t-test was calculated to see if there were any significant

differences between males and females in year 1 GPA and year 2 GPA, and the results are presented in Table 12.

For all students and for students admitted post-holistic admissions, the mean year 1 GPA for males was significantly higher for males than for females, yet there was no statistically significant difference in year 2 GPA between males and females. For students admitted pre-holistic admissions, there was no statistically significant difference in year 1 or year 2 GPA between males and females.

TABLE 12: T-Test for Males and Females & Year 1 GPA and Year 2 GPA

	Males	Females	SD	T-Test	Sig.
Year 1 GPA					
All Years	3.65	3.59	.332 (Male) .368 (Female)	2.789	.023**
Pre-HA	3.63	3.61	.357 (Male) .349 (Female)	.888	.767
Post-HA	3.68	3.57	.298 (Male) .390 (Female)	3.180	.0001*
Year 2 GPA					
All Years	3.37	3.35	.458 (Male) .472 (Female)	.616	.541
Pre-HA	3.34	3.33	.478 (Male) .500 (Female)	.089	.487
Post-HA	3.46	3.40	.393 (Male) .390 (Female)	1.171	.623

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Status as an underrepresented minority. When evaluating status as a student underrepresented in medicine, non-minority students were coded as 0 and under-represented minority students were coded as 1. Students who self-identified as African American, Hispanic, Asian Underrepresented, Native Hawaiian or Pacific Islander, or American Indian were coded as 1, as students underrepresented in medicine.

For all students, as well as for students admitted pre-holistic or post-holistic admissions, there was no statistically significant difference in year 1 and year 2 GPA for

students who are underrepresented in medicine as compared to students who are not underrepresented in medicine, as seen in Table 13.

TABLE 13: T-Test for Underrepresented Minorities and Non-Minorities & Year 1 GPA and Year 2 GPA

	URM	Non-URM	SD	T-Test	Sig.
Year 1 GPA					
All Years	3.49	3.64	.381 (URM) .344 (Non-URM)	4.667	.072
Pre-HA	3.46	3.64	.372 (URM) .345 (Non-URM)	3.719	.198
Post-HA	3.51	3.64	.388 (URM) .344 (Non-URM)	2.951	.250
Year 2 GPA					
All Years	3.23	3.38	.542 (URM) .449 (Non-URM)	2.905	.927
Pre-HA	3.15	3.36	.612 (URM) .465 (Non-URM)	3.122	.593
Post-HA	3.38	3.44	.350 (URM) .399 (Non-URM)	.833	.302

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Geographic origin for in-state, regional and out-of-state students. In evaluating differences in mean year 1 GPA for all students admitted between 2005 and 2013, among different residency groups there was a statistically significant difference as determined by one-way ANOVA ($F(2,943) = 5.043$, $p = .007$). A Tukey post-hoc test revealed that year 1 GPA was statistically significantly lower for in-state students in comparison to regional students ($p = .005$). There was no statistically significant difference in year 1 GPA between in-state and out-of-state students ($p = .452$) or regional and out-of-state students ($p = .291$).

In evaluating differences in mean year 2 GPA among different residency groups, there was a statistically significant difference between groups as determined by one-way ANOVA, $F(2, 700) = 3.135$, $p = .044$. However, additional post-hoc testing, through a Tukey post-hoc test, revealed that there were no statistically significant differences between groups.

In evaluating differences in mean year 1 GPA among different residency groups for students admitted pre-holistic admissions, there was no statistically significant difference between groups as determined by one-way ANOVA, $F(2, 517) = 2.895$, $p = .056$. There was also no statistically significant difference between groups in year 2 GPA, with $F(2, 500) = 2.311$, $p = .100$.

For students admitted post-holistic admissions, there was a statistically significant difference in year 1 GPA between different residency groups, with $F(2, 423) = 4.479$, $p = .012$. A Tukey post-hoc test further revealed that year 1 GPA was statistically significantly lower for in-state students in comparison to out-of-state students ($p = .043$). There was no statistically significant difference in year 1 GPA between in-state and regional students ($p = .052$) or regional and out-of-state students ($p = .891$). In evaluating differences in mean year 2 GPA among different residency groups, there was no statistically significant difference between groups, with $F(2, 197) = .803$, $p = .449$. Table 14 presents the ANOVA for students admitted between 2005 and 2013, as well as for students admitted both pre- and post-holistic admissions.

TABLE 14: ANOVA for Residency & Year 1 GPA and Year 2 GPA

	In-State	Regional	Out-of-State	SD	F	Sig.
Year 1 GPA						
All Years	3.58	3.67	3.62	.367 (In-state) .289 (Regional) .378 (OOS)	5.043	.007**
Pre-HA	3.60	3.68	3.59	.364 (In-state) .283 (Regional) .377 (OOS)	2.895	.056
Post-HA	3.57	3.66	3.69	.372 (In-state) .295 (Regional) .375 (OOS)	4.479	.012**
Year 2 GPA						
All Years	3.34	3.44	3.32	.483 (In-state) .436 (Regional) .446 (OOS)	3.135	.044**
Pre-HA	3.32	3.42	3.29	.515 (In-state) .447 (Regional) .464 (OOS)	2.311	.100
Post-HA	3.40	3.48	3.42	.391 (In-state) .410 (Regional) .368 (OOS)	.803	.449

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Geographic origin for in-state students, rural v. urban. In addition to evaluating geographic origin by residency, geographic information as a rural student or urban student was evaluated for in-state students, with urban coded as 1 and rural coded as 2. As displayed in Table 15, there was no statistically significant difference in year 1 and year 2 GPA for students admitted from urban or rural backgrounds. There were no differences for all students admitted between 2005 and 2013, or for students admitted pre- and post-holistic admissions.

TABLE 15: T-Test for Geographic Origin (Rural and Urban for In-State Residents) & Year 1 GPA and Year 2 GPA

	Rural	Urban	SD	T-Test	Sig.
Year 1 GPA					
All Years	3.56	3.59	.365 (Rural) .369 (Urban)	.755	.657
Pre-HA	3.56	3.60	.332 (Rural) .373 (Urban)	.551	.746
Post-HA	3.54	3.58	.410 (Rural) .364 (Urban)	.574	.302
Year 2 GPA					
All Years	3.32	3.34	.453 (Rural) .491 (Urban)	.423	.570
Pre-HA	3.29	3.32	.457 (Rural) .520 (Urban)	.404	.418
Post-HA	3.38	3.41	.448 (Rural) .374 (Urban)	.298	.607

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Parent level of education. Within this data set, parent level of education data were only available for students admitted post-holistic admissions between 2010 and 2013. When evaluating this variable, parent level of education was re-coded in the following way: At least one parent earned a post-graduate degree in medicine was coded as 1; At least one parent earned a post-graduate degree in another field was coded as 2; At least one parent earned a baccalaureate degree was coded as 3; Both parents earned no more than a high school diploma was coded as 4.

In evaluating differences in mean year 1 GPA among different groups, there was a statistically significant difference between groups as determined by one-way ANOVA ($F(3,422) = 3.912$, $p = .009$). A Tukey post-hoc test revealed that year 1 GPA was statistically significantly lower for students who had at least one parent who earned a baccalaureate degree in comparison to students who had at least one parent who earned a post-graduate degree ($p = .035$). There was no statistically significant difference in year 1 GPA between other groups.

In evaluating differences in mean year 2 GPA among different groups, there was no statistically significant difference between groups, with $F(3, 196) = 2.640$, $p = .051$. Therefore, additional post-hoc testing was not necessary. Table 16 presents the ANOVA results for socioeconomic status as defined by parent level of education and medical school GPA.

TABLE 16: ANOVA for Parent Level of Education & Year 1 GPA and Year 2 GPA

	Post-Grad Medicine (1)	Post-Grad (2)	Bacc (3)	High School (4)	SD	F	Sig.
Year 1 GPA	3.64	3.65	3.52	3.45	.331 (1) .340 (2) .403 (3) .388 (4)	3.912	.009**
Year 2 GPA	3.46	3.48	3.28	3.26	.396 (1) .361 (2) .418 (3) .342 (4)	2.640	.051

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Predicting GPA with all demographic variables. Linear regression was also performed to determine if the demographic variables were predictive of year 1 or year 2 GPA, with results displayed in Tables 17 and 18. When evaluating these variables for all years, gender and status as an underrepresented minority had statistically significant relationships but accounted for very little of the variance in year 1 GPA, accounting for only .8% ($p < .01$) and 2.3% ($p = .000$) respectively. For students admitted pre-holistic admissions, only status as an underrepresented minority was statistically significant but also accounted for very little of the variance at 2.6 % ($p = .000$). When evaluating the post-holistic variables, gender, status as an underrepresented minority, geographic origin and parent level of education were all statistically significant but, again, accounted for very little of the variance in year 1 GPA. In all cases, as displayed in Table 17, the Beta

weights obtained indicate that status as an underrepresented minority had the strongest, negative relationship with year 1 GPA.

Fewer demographic variables had statistically significant relationships with year 2 GPA, with only status as an underrepresented minority being statistically significant for all years and students admitted pre-holistic admissions, and parent level of education being statistically significant for post-holistic admissions. In each case, however, these variables individually accounted for less than 4% of the variance in year 2 GPA.

TABLE 17: Linear Regression and Demographic Predictors of Year 1 GPA

	R	R^2	B	Sig.
All Years				
Gender	.090	.008	-.064	.005*
Underrepresented Minority Status	.150	.023	-.146	.000*
Geographic Origin	.062	.004	.028	.056
Pre-HA (2005 – 2009)				
Gender	.039	.002	-.028	.375
Underrepresented Minority Status	.161	.026	-.173	.000*
Geographic Origin	.006	.000	.003	.893
Post-HA (2010 – 2013)				
Gender	.153	.023	-.110	.002*
Underrepresented Minority Status	.142	.020	-.126	.003*
Geographic Origin	.138	.019	-.059	.004*
Parent Level of Education	.161	.026	.133	.001*

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

TABLE 18: Linear Regression and Demographic Predictors of Year 2 GPA

	R	R^2	B	Sig.
All Years				
Gender	.023	.001	-.022	.538
Underrepresented Minority Status	.109	.012	-.146	.004*
Geographic Origin	.003	.000	.002	.944
Pre-HA (2005 – 2009)				
Gender	.004	.000	-.004	.929
Underrepresented Minority Status	.138	.019	-.204	.002*
Geographic Origin	.004	.000	-.003	.922
Post-HA (2010 – 2013)				
Gender	.083	.007	-.065	.243
Underrepresented Minority Status	.059	.003	-.061	.406
Geographic Origin	.046	.002	.023	.518
Parent Level of Education	.196	.038	.185	.005*

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Variables that Predict Student Success in Medical School

In addition to evaluating the relationship between incoming student experiences, attributes and metrics and academic performance as measured by medical school GPA, this study determined whether or not there is a relationship between incoming student experiences, attributes and metrics and a student's status in the combined-degree medical program at UMKC. For the following analysis, a student's status was defined as successful, entering the Alternate Program, or dismissed or withdrawn from the program. The following analysis looks at both admission and demographic variables, and utilizes the chi-square test for independence and multinomial logistic regression to determine whether or not a relationship exists between these variables and status in the program.

Admissions variables and status in the program. Multinomial logistic regression was performed to determine if the predictor variables of standardized test score, high school GPA, rigor of high school curriculum, essay, involvement in high school activities, health-related experiences, references and admit type were predictive of a student demonstrating success, entering the Alternate Program, or withdrawing or being dismissed from the program. For all students and students admitted pre-holistic admissions, only standardized test score and high school GPA were available for analysis as the other variables were introduced post-holistic admissions.

Admissions variables and withdrawal or dismissal from the program. Table 20 displays the results for all students, students admitted pre-holistic admissions and students admitted post-holistic admissions for students who withdraw or are dismissed from the program. For each group, similar results indicate the lower the ACT score, the more likely a student is to withdraw or be dismissed from the program. For all students,

the odds of a student with a higher ACT score demonstrating success are approximately 20% greater than students with lower ACT scores ($e^{.179} = 1.196$, $p < .01$). For students admitted pre-holistic admissions, the odds of a student with a higher ACT score demonstrating success are approximately 14% greater than a student with lower ACT scores ($e^{.133} = 1.142$, $p < .01$). The results from the post-holistic data analysis demonstrate almost identical results to the analysis for all students, in which a student with a higher ACT score demonstrating success is approximately 20% greater than a student with a lower ACT score ($e^{.177} = 1.194$, $p < .01$). The implication from each set of analysis is that students with higher ACT scores are less likely to withdraw or be dismissed from the combined-degree program at UMKC.

In addition, those students with lower high school grade point averages are more likely to withdraw or be dismissed from the program. For all students, students admitted pre-holistic admissions and students admitted post-holistic admissions, those students who demonstrate a higher high school GPA are four to four and a half times more likely to demonstrate success in the program than students with a lower high school grade point average. For students who demonstrated a higher high school grade point average, those admitted between 2005 and 2013 were 4.497 times more likely to demonstrate success ($p < .01$); those students admitted pre-holistic admissions were 3.999 times more likely to demonstrate success ($p < .01$); and those students admitted post-holistic admissions are 4.557 times more likely to demonstrate success ($p < .05$). In each case, the logistic regression analysis indicates that a student with a higher high school GPA is less likely to withdraw or be dismissed from the program.

For students admitted post-holistic admissions, additional independent variables increased a student's odds of demonstrating success in the program. The odds of a student with a more rigorous high school curriculum demonstrating success in the program is approximately 92% greater than the odds of a student with a weaker high school curriculum ($e^{.651} = 1.917$, $p < .01$). Furthermore, the odds of a student with stronger reference letters demonstrating success in the program is approximately 63% greater than the odds of a student with less supportive references ($e^{.490} = .1.633$, $p < .05$). Of the additional variables considered in the holistic admissions process, only rigor of the high school curriculum and more supportive reference letters increased a student's odds of demonstrating success in the program versus withdrawing or being dismissed.

The final analysis of admissions variables includes an analysis of admit type, provisional versus full admission, which was only collected for students admitted post-holistic admissions. As presented in Table 19, there is a statistically significant relationship between admit type and whether or not a student withdraws or is dismissed from the program, with $x(1) = 26.731$, $p = .000$. Of students admitted provisionally, 30% will withdraw or be dismissed versus 9% of students who are not admitted provisionally.

TABLE 19: Chi-Square for Admit Type and Status in the Program

	Pearson Chi-Square	Df	Sig.	Cramer's V
Succ v. Not	26.731	1	.000*	.261
Succ v. Alt Prog.	11.704	1	.001	.175

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

The logistic regression analysis presented in Table 20 reveals that being offered provisional admission increases the odds of a student withdrawing or being dismissed. A student who was fully admitted to the program is 3.178 times more likely to demonstrate success in the program ($p < .05$) than a student who was admitted provisionally.

TABLE 20: Multinomial Logistic Regression: Admissions Variables and Withdrawal or Dismissal from the Program

	B	SE	OR (95% CI)
All Years			
ACT Score	.179*	.036	1.196 (1.114 – 1.285)
High School GPA	1.503*	.374	4.497 (2.161 – 9.359)
Pre-Holistic Admissions			
ACT Score	.133*	.048	1.142 (1.039 – 1.255)
High School GPA	1.386*	.466	3.999 (1.606 – 9.961
Post-Holistic Admissions			
ACT Score	.177*	.061	1.194 (1.059 – 1.346)
High School GPA	1.517**	.700	4.557 (1.155 – 17.986)
Curriculum	.651*	.245	1.917 (1.186 – 3.099)
Essay	-.199	.346	.819 (.416 – 1.613)
HS Activities	-.182	.303	.834 (.461 – 1.508)
Health Experience	.391	.254	1.478 (.898 – 2.431)
References	.490**	.247	1.633 (1.007 – 2.649)
Admit Type (Full v. Provisional)	1.156*	.352	3.178 (1.595 – 6.329)

*Statistically significant, $p < .01$.
**Statistically significant, $p < .05$.

Admissions variables and the alternate program. Table 21 displays the results for all students, students admitted pre-holistic admissions and students admitted post-holistic admissions for students who demonstrate success versus enter the Alternate Program. The results indicate that, for all students admitted between 2005 and 2013, students admitted pre-holistic admissions and students admitted post-holistic admissions, the lower the ACT score the more likely a student is to enter the Alternate Program. For all students, the odds of a student with a higher ACT score demonstrating success versus entering the Alternate Program are approximately 13% greater than for students with lower test scores ($e^{.120} = 1.128$, $p < .01$). For students admitted pre-holistic admissions the odds are approximately 8% greater ($e^{.076} = 1.079$, $p < .01$), and for students admitted post-holistic admissions the odds are approximately 26% greater ($e^{.231} = 1.260$, $p < .01$) that a student with a higher test score will demonstrate success versus enter the Alternate Program. Ultimately, the logistic regression analysis indicates that students with higher ACT scores are less likely to enter the Alternate Program.

Additionally, for all analysis, the lower the high school GPA the more likely a student is to enter the Alternate Program. For all students, a student with a higher high school GPA is 4.192 times more likely to demonstrate success versus entering the Alternate Program ($p < .01$). Likewise, a student with a higher high school GPA who was admitted pre-holistic admissions is 4.345 times more likely to demonstrate success ($p < .01$), and students admitted post-holistic admissions with a higher high school grade point average are 5.177 times more likely to demonstrate success versus enter the Alternate Program ($p < .01$). Therefore, a student with a higher high school GPA is less likely to enter the Alternate Program than a student with a lower high school GPA. .

Interestingly enough, the only additional variable considered in the post-holistic admissions process that demonstrates a relationship with entering the Alternate Program is admission type (provisional v. full admission). Students who are offered full admission are 4.597 times more likely to demonstrate success versus enter the Alternate Program than a student who is offered provisional admission ($p < .01$).

TABLE 21: Multinomial Logistic Regression: Admissions Variables and Entering the Alternate Program

	B	SE	OR (95% CI)
All Years			
ACT Score	.120*	.041	1.128 (1.040 – 1.222)
High School GPA	1.433*	.420	4.192 (1.841 – 9.545)
Pre-Holistic Admissions			
ACT Score	.076*	.056	1.079 (.968 – 1.204)
High School GPA	1.469*	.521	4.345 (1.564 – 12.073)
Post-Holistic Admissions			
ACT Score	.231*	.057	1.260 (1.127 – 1.409)
High School GPA	1.644*	.631	5.177 (1.502 – 17.840)
Curriculum	.451	.316	1.569 (.844 – 2.918)
Essay	-.503	.428	.605 (.262 – 1.398)
HS Activities	-.542	.374	.582 (.280 – 1.210)
Health Experience	-.082	.314	.921 (.497 – 1.706)
References	-.150	.296	.861 (.482 – 1.538)
Admit Type (Full v. Provisional)	1.525*	.313	4.597 (2.488 – 8.494)

*Statistically significant, $p < .01$.
**Statistically significant, $p < .05$.

Demographic variables and status in the program. Chi-square analysis and multinomial logistic regression were run for status in the program against the following variables: gender, race/ethnicity, geographic origin, and parent level of education. The chi-square test was run for all students admitted 2005 – 2013, and the results are presented in Tables 22 through 26. The results revealed that there was no statistically significant relationship between any of the independent variables – race, gender, geographic origin and parent level of education – and whether or not a student enters the Alternate Program. There were, however, statistically significant relationships between all independent variables and whether or not a student withdraws or is dismissed from the program.

Gender. Results in Table 22 indicate that there is a statistically significant relationship between gender and whether or not a student withdraws or is dismissed from the program, with $x(1) = 4.748$, $p = .029$. In fact, women are more likely than men to withdraw or be dismissed with 20% of women leaving the program in comparison to 14% of men.

TABLE 22: Chi-Square for Gender and Status in the Program

	Pearson Chi-Square	df	Sig.	Cramer's V
Succ v. Not	4.748	1	.029**	.074
Succ v. Alt Prog.	3.284	1	.070	

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Race/ethnicity. Race/ethnicity was evaluated through the student's status as an underrepresented minority or non-minority. Results displayed in Table 23 indicate that there is a statistically significant relationship between status as an underrepresented minority and whether or not a student withdraws or is dismissed from the program, with $x(1) = 6.149$, $p = .013$. Underrepresented minority students are more likely to withdraw

or be dismissed, with 25% of underrepresented minority students withdrawing or being dismissed from the program versus only 16% of their non-minority counterparts.

TABLE 23: Chi-Square for Underrepresented Minority Status & Status in the Program

	Pearson Chi-Square	df	Sig.	Cramer's V
Succ v. Not	6.149	1	.013**	.085
Succ v. Alt Prog.	2.139	1	.144	

*Statistically significant at the .000 level.
**Statistically significant, p < .05.

Geographic origin. Geographic origin was evaluated based on both residency (in-state, regional and out-of-state) and status as a rural or urban student for in-state students. As outlined in Table 24, there is a statistically significant relationship between residency and whether or not a student withdraws or is dismissed from the program, with $x(2) = 19.739$, $p = .000$. 22% of in-state students withdraw or are dismissed from the program, versus 9% of regional students and 14% of out-of-state students.

Although there were statistically significant differences in status by residency, there was no statistically significant relationship between geographic origin (rural or urban) among in-state students and whether or not a student was successful, entered the Alternate Program or withdrew or was dismissed from the program.

TABLE 24: Chi-Square for Residency and Status in the Program

	Pearson Chi-Square	Df	Sig.	Cramer's V
Succ v. Not	19.739	2	.000*	.152
Succ v. Alt Prog.	.072	2	.964	

*Statistically significant at the .000 level.
**Statistically significant, p < .05.

TABLE 25: Chi-Square for Geographic Origin (Rural/Urban) and Status in the Program

	Pearson Chi-Square	Df	Sig.	Cramer's V
Succ v. Not	2.372	1	.124	
Succ v. Alt Prog.	.766	1	.381	

*Statistically significant at the .000 level.
**Statistically significant, p < .05.

Parent level of education. As displayed in Table 26, there is a statistically significant relationship between parent level of education and whether or not a student withdraws or is dismissed from the program, with $x(3) = 19.641$, $p = .000$. By far, the level of education obtained by one or both parents demonstrates the largest gap in percent of students who are successful, with 64% of students whose parents have not earned graduate degrees withdrawing or being dismissed from the program in comparison to 19% of students who have at least one parent with a graduate degree.

TABLE 26: Chi-Square for Parent Level of Education & Status in the Program

	Pearson Chi-Square	df	Sig.	Cramer's V
Succ v. Not	19.641	3	.000*	.224
Succ v. Alt Prog.	2.715	3	.438	

*Statistically significant at the .000 level.
**Statistically significant, $p < .05$.

Demographic variables and withdrawal or dismissal from the program. Through a multinomial logistic regression analysis, all demographic variables were evaluated for their relationship with a student withdrawing or being dismissed from the program. The results displayed in Table 27 indicate that, for all years, women are more likely to withdraw or be dismissed than men, which is in alignment with the results from the chi-square analysis. The odds of a male demonstrating success are about 67% that of a female ($e^{-.402} = .669$, $p < .01$). Women admitted post-holistic admissions are also more likely to withdraw or be dismissed. A male student admitted post-holistic admissions is 3.274 times more likely to demonstrate success in the program than a female ($p < .01$).

For all students, underrepresented minority students are more likely to withdraw or be dismissed, with the odds of an underrepresented minority demonstrating success is about 58% that of a non-minority ($e^{-.553} = .575$, $p < .05$). Underrepresented minority students admitted pre-holistic admissions are also more likely to withdraw or be

dismissed from the program, with the odds of an underrepresented minority student demonstrating success about 40% that of a non-minority student ($e^{-.927} = .396$, $p < .01$). These results also support the chi-square analysis that found a statistically significant relationship between status as an underrepresented minority and whether or not a student withdraws or is dismissed from the program.

Like the chi-square analysis, the multinomial logistic regression model also found that in-state students admitted between 2005 and 2013 are more likely to withdraw or be dismissed from the program. A regional or out-of-state student is 1.731 times more likely to demonstrate success in the program than an in-state student ($p < .01$).

For students admitted post-holistic admissions, parent level of education remained an indicator of which students would withdraw, reflecting the results found in the chi-square analysis. Students with at least one parent who has earned a graduate degree are 2.928 times more likely to demonstrate success in the program than students whose parents have not earned graduate degrees ($p < .01$). With 64% of students whose parents have not earned graduate degrees withdrawing or being dismissed from the program, these students are less likely to demonstrate success.

TABLE 27: Multinomial Logistic Regression: Demographic Variables and Withdrawal or Dismissal from the Program

	B	SE	OR (95% CI)
All Years			
Gender	-.402*	.185	.669 (.465 - .962)
URM Status	-.553**	.225	.575 (.370 - .894)
Residency	.549**	.246	1.731 (1.069 – 2.803)
Pre-Holistic Admissions			
Gender	-.213	.231	.808 (.514 – 1.272)
URM Status	-.927*	.309	.396 (.216 - .725)
Residency	.474	.285	1.606 (.919 – 2.807)
Post-Holistic Admissions			
Gender	1.186*	.393	3.274 (1.517 – 7.068)
URM Status	.174	.402	1.190 (.541 – 2.615)
Residency	-.678	.558	.507 (.170 – 1.515)
Parent Level of Education	1.074*	.307	2.928 (1.604 – 6.329)

*Statistically significant, $p < .01$.
**Statistically significant, $p < .05$.

Demographic variables and entering the alternate program. Multinomial logistic regression was also used to evaluate the relationship between all demographic variables and their relationship with a student entering the Alternate Program. The results displayed in Table 28 indicate that there is only a relationship between status as an underrepresented minority student and entering the Alternate Program for those students admitted pre-holistic admissions. Underrepresented minority students admitted pre-holistic admissions were more likely to enter the Alternate Program, with the odds of an underrepresented minority student demonstrating success about 47% that of a non-minority student. No other variables appear to predict whether or not a student will enter the Alternate Program.

TABLE 28: Multinomial Logistic Regression: Demographic Variables and Entering the Alternate Program

	B	SE	OR (95% CI)
All Years			
Gender	-.393	.218	.675 (.441 – 1.034)
URM Status	-.395	.272	.674 (.395 – 1.147)
Residency	.074	.278	1.077 (.624 – 1.858)
Pre-Holistic Admissions			
Gender	.072	.275	1.075 (.627 – 1.843)
URM Status	-.754**	.378	.471 (.224 - .987)
Residency	-.136	.335	.873 (.452 – 1.685)
Post-Holistic Admissions			
Gender	.458	.482	1.580 (.614 – 4.067)
URM Status	-.170	.495	.844 (.320 – 2.226)
Residency	.405	.751	1.500 (.344 – 6.537)
Parent Level of Education	.097	.386	1.102 (.517 – 2.348)

*Statistically significant, $p < .01$.
**Statistically significant, $p < .05$.

Summary

This chapter described the statistical analysis used in this study, including descriptive statistics, correlations, comparison of means through t-test and ANOVA, linear regression and multinomial logistic regression. The goal of this analysis was to determine if there are any incoming student experiences, attributes and metrics that might predict academic performance and student retention in the combined-degree medical program at the University of Missouri – Kansas City. A secondary goal of this study was to identify if there were any statistically significant differences among students admitted pre-holistic admissions versus post-holistic admissions.

From the descriptive statistics and the chi-square analysis, the increase in students underrepresented in medicine, from 12.3% pre-holistic admissions to 20.1% post-holistic admissions, was a statistically significant increase. Additionally, the differences in the percentages of students who demonstrated success pre-holistic admissions (69.8%) in comparison to post-holistic admissions (78.5%) was also statistically significant. In addition, though the data demonstrates statistically significant differences in success for

underrepresented minority students admitted pre-holistic admissions, there were no significant differences in whether or not an underrepresented minority student left the program or entered the Alternate Program post-holistic admissions. Therefore, an additional outcome of holistic admissions has been that underrepresented minority students are just as likely as their non-minority counterparts to demonstrate success in the program.

Students enter the program with an average ACT score of 30. This study found there to be a statistically significant relationship between ACT score and academic performance as measured by year 1 and year 2 GPA. In addition, students with higher ACT scores were less likely to enter the Alternate Program or withdraw or be dismissed from the program

The average high school GPA for students entering the program is a 3.80. Similar to ACT score, a statistically significant relationship exists between high school GPA and year 1 and year 2 GPA. Overall, students with a higher high school GPA are also less likely to withdraw or be dismissed from the program and were less likely to enter the Alternate Program.

The analysis of other experiences, attributes and metrics evaluated in the post-holistic admissions process revealed that all admissions factors together account for approximately 21% of the variance in year 1 GPA and 15% of the variance in year 2 GPA. Many of the non-cognitive admissions factors, such as rigor of high school curriculum, essay, involvement in high school activities, health experiences or references, account for very little of the variance in medical school GPA, with ACT score and high school GPA accounting for a larger percentage of the variance. The logistic regression

analysis, however, found that, in addition to a higher ACT score and higher high school GPA, a more rigorous high school curriculum and stronger reference letters increased a student's odds of demonstrating success in the program.

When looking at other incoming student attributes, such as gender, status as an underrepresented minority student, geographic location, parent level of education, and admit type (full admission versus provisional admission), each of these variables demonstrated different relationships with medical school GPA and status in the program.

When evaluating gender, the analysis indicated that males demonstrated higher mean GPAs than females, and were also less likely to withdraw or be dismissed from the program. Status as an underrepresented minority had no relationship with year 1 or year 2 GPA, but for all students admitted between 2005 and 2013 was predictive of whether or not a student withdrew or was dismissed from the program with 25% of underrepresented minority students leaving the program. The analysis of geographic origin indicated that in-state students exhibit a lower year 1 GPA than regional or out-of-state students, and these students are more likely to withdraw or be dismissed with 22% of in-state students leaving the program in comparison to 9% of regional students and 14% of out-of-state students. Likewise, students whose parents have not earned graduate degrees demonstrated a lower year 1 GPA than students whose parents have earned graduate degrees. Even more concerning is the percentage of students whose parents have not earned graduate degrees who leave the program (64%) versus those students with at least one parent with a graduate degree (19%). Finally, admit type was evaluated to determine whether or not a relationship existed between full admission or provisional admission and GPA or status in the program. The mean year 1 GPA for students granted full admission

was significantly higher than for students granted provisional admission. Additionally, students admitted provisionally are more likely to withdraw or be dismissed with 30% of students who are admitted provisionally leaving the program.

Chapter five will provide further interpretation of the results and their relationship to the research question and to the previous literature reviewed. In addition, chapter five will outline limitations of the study, implications for future policy, and recommendations for future research.

Chapter Five: Discussion

The previous chapters have provided an introduction and background of the problem and research questions, an overview of the literature related to holistic admissions and student retention in college, an outline of the methods used in this study, and a presentation of the results of statistical analyses. This chapter provides an interpretation of the results outlined in chapter four and additional discussion of the data analysis as it relates to the research questions and to the literature reviewed in chapter two. In addition, this chapter outlines limitations of the study, implications for future research, and how the results of the study may influence policy at the UMKC School of Medicine. Finally, this chapter provides a final summary of the study.

Summary of Research Purpose and Questions

The University of Missouri – Kansas City offers a combined baccalaureate-medical degree program that allows a student to complete both the baccalaureate degree and medical degree in six years, as opposed to the more traditional route of completing four years of undergraduate education followed by four years of medical school. The primary purpose of this study was to examine the relationship between incoming student experiences, attributes and metrics and their relationship to academic performance and student retention in medical school. A secondary purpose was to determine whether or not there were any differences among student outcomes for students admitted pre-holistic admissions versus post-holistic admissions.

This study sought to determine whether or not factors measured in the admissions process, such as standardized test score, high school GPA, rigor of the high school curriculum, involvement in high school activities and leadership, investigation of the

medical profession while in high school, references and admit status (full admission versus provisional admission), have a predictive relationship with academic performance and/or student retention. In addition, this study evaluated the relationship between factors not currently assessed in the admissions process and student academic performance and retention. These factors include experiences, attributes and metrics considered crucial in a holistic admissions process, such as race and ethnicity, gender, geographic origin and parent level of education.

The study looked at these experiences, attributes and metrics for all students who entered the UMKC School of Medicine combined-degree program between 2005 and 2013, however also focused on differences between groups of students admitted pre-holistic admissions (2005 through 2009) and post-holistic admissions (2010 through 2013) to see if there were any significant differences in academic performance and student retention after the current holistic admissions practices were implemented.

This study provides a descriptive summary of the students who have entered the UMKC School of Medicine between 2005 and 2013, including a breakdown by gender, race and ethnicity, geographic origin and parent level of education. In addition, this study identifies how medical school GPA or student retention may or may not be influenced by these demographic variables. This study also evaluates how other experiences, attributes and metrics evaluated in the admissions process predict medical school GPA and student retention.

Key Findings

The following section will identify key findings as they relate to the relationship between admissions variables and academic performance and success, demographic

variables and academic performance and success, and differences in academic performance and success post-holistic admissions. The data analysis identified a relationship between some of the independent variables and year 1 GPA, year 2 GPA and status in the program, which is defined as demonstrating success, entering the Alternate Program, or withdrawing or being dismissed from the program. In addition, the study revealed some differences between pre-holistic and post-holistic admissions. The following sections will describe in greater detail these key findings.

Admissions variables: Predicting academic performance and success. The results of this study indicate that there is a relationship between several variables used in the admissions process and academic performance and success in medical school. High school GPA and standardized test score demonstrated a significant, positive relationship with both year 1 and year 2 GPA, as well as with whether or not a student demonstrated success in the program. Additional admissions variables evaluated post-holistic admissions, such as rigor of high school curriculum and admission status (full admission versus provisional admission), also demonstrated a significant, positive relationship with medical school GPA and status in the program.

Standardized test score and high school GPA. The data analysis suggests that standardized test score and high school GPA are both positively predictive of medical school GPA in a combined-degree program. This conclusion is consistent with research on the relationship between test score, high school GPA and first year GPA of traditional college students, which finds that both test score and high school GPA are predictive of academic performance in the first year of college (Camara, 2005; Kobrin, et al., 2008; Linn, 2005; Mattern & Patterson, 2009; Mattern, et al., 2013; Radunzel & Noble, 2012;

Sawyer, 2010; Sawyer, 2007; Schmidt, et al., 2011; Thomas, et al., 2007; Zwick, 2002). For this study, high school GPA and standardized test score are both independently correlated with year 1 GPA and year 2 GPA. However, similar to other research findings (Radunzel & Noble, 2012; Sawyer, 2010), high school GPA and standardized test score combined are a better predictor of medical school GPA than each variable alone.

Moreover, test score and high school GPA had a significant, positive relationship with a student's status in the program. The results of almost all analysis indicated that a student with a higher ACT score was less likely to enter the Alternate Program or withdraw or be dismissed from the program. These findings align with the results of other studies (Mattern & Patterson, 2009; Sawyer, 2010) that found that students with higher standardized test scores demonstrate higher retention rates than those with lower test scores.

Additionally, a student with a higher high school grade point average is less likely to withdraw or be dismissed. A student with a higher high school GPA is also less likely to enter the Alternate Program. High school GPA was even more significant for students admitted post-holistic admissions, with students who demonstrated a higher high school GPA over four times more likely to demonstrate success.

Researchers who investigated the predictive ability of both standardized test scores and high school GPA found that the combination of the two were more predictive of long-term success (Radunzel & Noble, 2012; Sawyer, 2010). The findings of the current study support the notion that standardized test score and high school GPA combined are more predictive of whether or not a student is successful in the combined-degree program at UMKC than these items alone, with higher performance on each of

these variables increasing the odds of success in the program. That being said, this study identified high school GPA as the stronger predictor of the two variables. While previous studies (Mattern & Patterson, 2009; Sawyer, 2010) indicate that test score is more predictive of academic performance and retention, this study found that high school GPA is more predictive of academic performance and student success than standardized test score.

The results of this analysis are useful because they further support the notion that academic performance in high school remains a good predictor of whether or not a student will demonstrate success in a combined-degree medical program. This analysis supports the continual consideration of these metrics throughout the admissions process and when making admissions decisions.

Rigor of the high school curriculum. In addition to standardized test score and high school GPA demonstrating a relationship with medical school GPA and status in the program, an additional variable evaluated post-holistic admissions also positively influences a student's status in medical school. The rigor of a student's high school curriculum, while only accounting for 3% of the variance in medical school GPA, displayed a positive, significant relationship with whether or not a student is successful in the program. Although the literature is inconsistent in how rigorous coursework is defined, this study defined rigorous coursework as completing Advanced Placement, International Baccalaureate, honors courses or courses through dual-enrollment at a college or university. Students identified as completing a more rigorous high school curriculum demonstrated enrollment in several of these courses during each year of high school. Students with a more rigorous high school curriculum were less likely to

withdraw or be dismissed from the program than a student with a weaker high school curriculum. The results of this study are consistent with the results of other studies that found, while a stronger high school curriculum may not consistently predict academic performance in college, completion of such courses does have a relationship with persistence (Dodd, et al., 2002; Horn & Kojaku, 2001; Klopfenstein & Thomas, 2009). Students in the combined-degree program at UMKC who demonstrated a more rigorous curriculum in high school are more likely to demonstrate success in the program.

Admission type. At the UMKC School of Medicine, students are offered either provisional or full admission due to performance on a chemistry assessment completed at the time of interview. Performance on this exam is not used to make admissions decisions, but is rather used to determine the type of admission offered if the student is selected for admission. If offered provisional admission, a student is required to take an introductory chemistry course the summer prior to matriculation. Due to limited data, admission type was evaluated for students admitted post-holistic admissions only.

Due to admission status as an institution specific variable there is little external research evaluating a student's admission type on their academic performance or retention, however this study found a relationship to exist. The results from this study indicate that students who are offered provisional admission demonstrate a lower medical school GPA at the end of the first year than students offered full admission, and these students are more likely to enter the Alternate Program or withdraw or be dismissed from the program. In fact, admission type accounts for approximately 14% of the variance in year 1 GPA, and 30% of students admitted provisionally will withdraw or be dismissed versus only 9% of students who are fully admitted. Furthermore, a student who was fully

admitted to the program is three times more likely to demonstrate success in the program than a student who was admitted provisionally and four and a half times more likely to not enter the Alternate Program. These results support the notion that students with weaker performance on the chemistry assessment, regardless of the requirement for provisional students to complete a chemistry course the summer prior to matriculation, are more likely to enter the Alternate Program, withdraw or be dismissed once they enter the program.

Although academic metrics used in the admissions process held up as good predictors of academic performance in a combined-degree medical program, a further review of the results as they relate to non-cognitive experiences and individual student attributes is important to determine what, if any, additional experiences or attributes are predictive of student performance and retention.

Demographic variables: Predicting academic performance and success. The results of this study indicate that there is a relationship between several demographic variables and academic performance and success in medical school. Although the relationships varied, the variables of gender, status as an under-represented minority, geographic origin and socioeconomic status as defined by parent level of education all had some relationship with year 1 or year 2 GPA, status in the program, or both.

Gender. There has been a shift in the gender ratio in higher education, with more women than men enrolled in colleges and universities (Postsecondary Education Opportunity, 2010). This shift also holds true in the UMKC combined-degree program, with females representing approximately 56% of students enrolled between 2005 and 2013.

Results of the analysis in this study indicate that gender does play a role in academic performance and student retention in the combined-degree medical program at UMKC. The results of the current study reveal that mean year 1 GPA was statistically significantly higher for all males admitted between 2005 and 2013, as well as for all males admitted post-holistic admissions. In addition, the results indicate that females are more likely to withdraw or be dismissed from the program, with 20% of women leaving versus 14% of men. These results are contradictory to other studies that have determined that females academically outperform men and persist beyond the first year of college at a rate higher than their male counterparts (French, et al., 2005; Lleras, 2008; Postsecondary Education Opportunity, 2010), as males in the UMKC program academically outperform females and are more likely to demonstrate success

Status as an underrepresented minority student. One of several goals of holistic admissions at medical schools is to increase diversity in a medical school class, including diversity as defined by race or ethnicity. It is believed that a diverse student body contributes to an improved understanding of others in workplace or community interactions, and that these contributions can positively influence medical education (AAMC, 2010; Goldstein, 2003). After the implementation of holistic admissions practices in 2010, student diversity (as evaluated by race and ethnicity) at the UMKC School of Medicine significantly increased from 12.3% to 20.1% of students admitted from groups underrepresented in medicine. Although a goal of holistic admissions is to increase diversity in the medical school class, an additional goal is to admit students with a variety of characteristics who demonstrate the academic ability to perform well and graduate from medical school.

For all students admitted to the School of Medicine, there were no significant differences in medical school GPA between underrepresented minority students and their non-minority counterparts. While the analysis revealed that status as an underrepresented minority had a statistically significant negative relationship with medical school GPA, it only accounted for a very small percentage (approximately 2%) of the variance in year 1 GPA. Although other research on college students would indicate significantly lower academic performance for underrepresented students as measured by first-year GPA (Fletcher & Tienda, 2010; Kao & Thompson, 2003; Lorah & Ndum, 2013. Schneider, et al., 2006), this finding did not hold true for students in the combined-degree medical program at UMKC.

Although race and ethnicity demonstrated a weak correlation with academic performance for students underrepresented in medicine, a relationship did exist between race and ethnicity and whether or not a student withdrew or was dismissed from the program. Underrepresented minority students admitted between 2005 and 2013 were more likely to withdraw or be dismissed from the program than their non-minority counterparts, with 25% of underrepresented minority students leaving the program versus 16% of non-minority students. These results are consistent with other studies that have revealed a lower persistence rate for underrepresented students (Fletcher & Tienda, 2010; Mattern & Patterson, 2009; Postsecondary Education Opportunity, 2010; Reason, 2009). Although the results are consistent with previous studies in terms of persistence of underrepresented minority students, it is surprising that these students leave at higher rates even though they do not demonstrate any significant difference in medical school

GPA. These results may indicate that other factors besides academic performance in the first two years may lead to dismissal or withdrawal of underrepresented students.

Although underrepresented minority students admitted between 2005 and 2013 and minority students admitted pre-holistic admissions were more likely to withdraw or be dismissed, these differences did not exist for underrepresented minority students admitted post-holistic admissions. After the implementation of holistic admissions, no statistically significant differences exist in academic performance or status in the program for underrepresented minority students versus their non-minority counterparts. This is an important finding and will be discussed further in the discussion section of this chapter.

Geographic origin. As a public institution, the majority of students (56.2%) admitted to the UMKC School of Medicine are from the state of Missouri. Students admitted from the state of Missouri often achieve a comparable level of academic performance in high school as their regional and out-of-state counterparts, however regional and out-of-state students find more of a challenge to gain admission due to the large number of applicants for limited positions in the class. This study revealed differences in year 1 GPA between in-state students and regional or out-of-state students, with regional and out-of-state students demonstrating a higher mean GPA at the end of the first year. In addition, a relationship exists between a student's residency category and whether or not they withdraw or are dismissed from the program, with in-state students more likely to withdraw.

However, when looking at Missouri residents only, there were no differences in medical school GPA or in student retention for students from urban or rural backgrounds. While several studies looking at undergraduate students indicate that rural students

demonstrate lower college attendance rates, lower academic performance and lower degree completion rates than their non-rural counterparts (Byun, et al., 2010; Gibbs, 2003; Hu, 2003; Provansik, et al., 2007), these findings did not hold true in the current study. There are studies that support the current findings and found no differences in rural student educational performance or aspirations (Edington & Kohler, 1987; Howley, 2006), including a 1981 study that looked at differences in rural and urban students who entered the combined-degree program at UMKC (Willoughby). Based on the current study, it remains true that there are no differences in academic performance among urban and rural students in the program at UMKC.

Parent level of education. Parent level of education was only evaluated for students admitted post-holistic admissions. It served as a proxy for socioeconomic status as this study did not have access to student financial information. The analysis revealed that 74.3% of students admitted had at least one parent with a graduate degree, and that these students demonstrated a higher GPA after the first year of medical school. In addition, parent level of education appears to predict whether or not a student will withdraw or be dismissed from the program, with 64% of students whose parents did not have advanced degrees leaving the program versus 19% of students whose parents did have graduate degrees.

Socioeconomic status has been linked to academic performance or retention, specifically that students from lower socioeconomic backgrounds demonstrate a lower college GPA and are less likely to persist (Lleras, 2008; Lotkowski, et al., 2004; Mattern and Patterson, 2009; Reason, 2009, Walpole, 2003). These findings from previous studies were supported by the current study, revealing that students whose parents had

less education did, in fact, demonstrate a lower medical school GPA and were more likely to withdraw or be dismissed from the program.

Differences in pre-holistic versus post-holistic admissions. A secondary goal of this study was to identify any differences in predicting outcomes between those students admitted pre-holistic admissions (2005 through 2009) and those students admitted post-holistic admissions (2010 through 2013). The goals of holistic admissions, as implemented at the UMKC School of Medicine since 2010, are to increase diversity in the incoming class and to improve the retention of students. Both of these goals appear to have been accomplished with the implementation of holistic admissions.

As mentioned previously, one goal of holistic admissions is to increase diversity in medical school in order to serve the interests of the medical school mission, community, profession of health care and society (Cantwell, et al., 2010). Additionally, other authors have noted the importance of diversity in medical education and in preparing students to enter a diverse workforce working with a diverse patient population (AAMC, 2010; Goldstein, 2003); Loden & Rosenor, 1991). The results of this study indicate that holistic admissions policies have led to an increase in enrollment of students underrepresented in medicine, and that these increases have been statistically significant.

A second goal of holistic admissions is to admit students who demonstrate characteristics associated with academic success in medical school (AAMC, 2010; AAMC, 2013). Descriptive statistics were examined to see the frequency of students who demonstrated success in the program, entered the Alternate Program, or left the program either by dismissal or withdrawal. In reviewing the data for the pre-holistic admissions years versus the post-holistic admissions years, fewer students left the

program or entered the Alternate Program during the post-holistic years. During the pre-holistic years, 69.8% (369) of students were successful whereas 78.5% (340) of students were successful during the post-holistic years. In addition, since the implementation of holistic admissions, more students have been retained in the program with 88% of students demonstrating success or entering the Alternate Program. These differences in retention rates were found to be statistically significant. Although there may be other factors contributing to these results, it appears that holistic admissions may play some role in increased diversity and increased retention.

Another important finding when comparing pre-holistic versus post-holistic admissions outcomes are the differences in academic performance and student success among underrepresented minority students. Underrepresented minority students admitted post-holistic admissions demonstrated no differences in medical school GPA and no differences in likelihood of demonstrating success, whereas minority students admitted pre-holistic admissions were more likely to withdraw, be dismissed or enter the Alternate Program. Again, this will be discussed further in the Discussion section of this chapter.

Other findings. An interesting finding, as it relates to post-holistic admissions analysis, is the lack of influence that the additional, individual post-holistic application components had on a student's medical school GPA or status in the program. Several studies have supported the notion that a review of non-cognitive traits will increase diversity and improve student retention (Camara, 2005; Laird, 2005; Linn, 2005; Sedlacek, 2004). This study supports the notion that a holistic admissions process, which includes the review of non-cognitive traits, has significantly increased the number of

underrepresented minority students enrolled, has increased retention and has increased the retention of underrepresented minority students.

However, an evaluation of individual application components reveals that these additional components do not have a strong relationship with outcomes such as medical school GPA or status in the program. For example, studies would support the notion that involvement in high school activities would influence student persistence (Camara, 2005; Lipscomb, 2007; Lleras, 2008; Marsh and Kleitman, 2002), however this study did not support this finding. The additional application components—essay, involvement in high school activities, and experiences in health care—are statistically significant, however account for very little of the variance in year 1 or year 2 GPA. Only a more rigorous high school curriculum and more supportive reference letters increase the odds of a student demonstrating success. All admissions variables together account for 21% of the variance in year 1 GPA, however individual components such as essay or high school activities, each account for less than two percent of the variance.

Likewise, standard interviews were not statistically significant and had no relationship with medical school GPA or status in the program. The literature on the influence of standard interviews on academic performance and student persistence is contradictory, with some cases showing little influence and some cases demonstrating a relationship with success and retention (Ferguson, et al., 2002). This study aligns with the notion that there is no relationship between standard interviews and academic performance and student retention.

As evidenced by this study, academic components considered in the admissions process and demographic variables not considered in the admissions process have the

ability to predict academic performance and status in the program, whereas the individual application components do not account for much in terms of medical school GPA and status in the program. This study has demonstrated, however, that the holistic admissions process has resulted in significant improvements in retention and diversity.

Discussion and Challenges

One of the most significant findings of this study is the fact that holistic admissions in its current format is significantly related to the number of students retained in the program and the number of students admitted from underrepresented backgrounds. In addition to the increase in the percentage of students being retained in the program, there are no statistically significant differences between underrepresented minority students and their non-minority counterparts after the implementation of holistic admissions. These post-holistic admissions outcomes do support the use of holistic admissions practices, however do not negate the finding for all students admitted between 2005 and 2013, where underrepresented minority students are more likely to leave the program even though there is no statistically significant difference in medical school GPA.

In thinking about the differences for underrepresented minority students admitted 2005 through 2013, a post-study evaluation of differences in standardized test score, high school GPA and rigor of high school curriculum among students from underrepresented backgrounds was conducted to see if an assumption based on previous research held true – that these students were more likely to enter college with lower academic performance in high school, and were therefore more likely to withdraw or be dismissed. Students from underrepresented minority backgrounds were more likely to enter the program with

significantly lower standardized test scores, 28 versus 30, and a lower high school GPA, 3.70 versus 3.82, ($p = .000$).

Additionally, as it relates to the rigor of the high school curriculum, the post-study evaluation found no correlation between status as an underrepresented minority student and rigor of the high school curriculum. Research does support the notion that attending a private or more affluent high school that offers a more rigorous curriculum may result in better performance in college (Evans and Schwab, 1995; Pike and Saupe, 2002; Sander, 2000), however it may be the economic composition of the high school that is the important variable (Camara, 2005; Niu and Tienda, 2013) with students who attend more affluent high schools having a greater chance of persisting in college. These students are "more likely to graduate on time or persist in their pursuit of a degree…compared with students who attended average high schools" (Niu and Tienda, 2013, p. 52). Currently, the UMKC combined-degree program does not consider attendance at a private or more affluent high school as a factor when making admission decisions, mostly because of the assumption that private or affluent high schools offer little racial, ethnic or socioeconomic diversity and that students who attend such high schools have advantages that other students may not have.

If, generally speaking, high school academic performance is lower for under-represented minority students, and students with lower high school academic performance are more likely to withdraw or be dismissed from the program, then one may assume that underrepresented minority students are more likely to withdraw or be dismissed. This assumption would be supported by other research that recognizes an achievement gap among students from black or Hispanic backgrounds in comparison to

their white or Asian peers (Fletcher & Tienda, 2010; Lorah & Ndum; Mattern & Patterson, 2009; Reason, 2009). These studies support the notion that underrepresented minority students demonstrate lower performance in high school, lower academic performance in college and lower rates of persistence. This study may support these findings for all students admitted and students admitted pre-holistic admissions, however it did not support previous research for students admitted post-holistic admissions as underrepresented minority students are just as likely to perform well academically and persist. In general, this study did not focus on other factors that may influence the persistence of underrepresented minority students and it did not focus on the challenges related to recruiting and retaining underrepresented minority students.

Although there appears to be no differences in status in the combined-degree program at UMKC for underrepresented minority students versus their non-minority counterparts admitted post-holistic admissions, a real challenge still exists in recruiting minority students to medical school. Approximately 15% of students admitted to a traditional medical school are underrepresented minority students, out of approximately 20,000 applicants offered admission to medical school in the United States (AAMC, 2012; Figueroa, 2014). A recent study looking at the challenges of recruiting underrepresented minority students identified multiple barriers to entering medical school for students underrepresented in medicine, including a focus on standardized test scores for admission; science preparation of underrepresented minority students; challenges in communication skills, mentorship and peer support; financial and economic standing of disadvantaged students; study skills to handle the rigors of medical school; and/or a lack of understanding about attending college or medical school (Figueroa, 2014). This

analysis should lead to the conclusion that underrepresented minority students may need additional supports when entering medical school, especially a combined-degree medical program directly out of high school, rather than focusing on the fact that these students may enter medical school with lower scores.

Additionally, the importance of diversity in medical education has been supported throughout this study (AAMC, 2010; AAMC, 2013; Cantwell, et al., 2010, College Board, 2013; Goldstein, 2003; Loden & Rosenor, 1991). Recognizing that a diverse environment in medical school leads to an increased ability to work with colleagues and patients from diverse backgrounds, "diversity and inclusion are powerful tools for enhancing the medical education environment and ultimately the overall health of the nation" (AAMC, 2012, p. 10). That being said, simply recognizing the importance of diversity in the incoming class is quite different than embracing diversity as a core value of the institution. Although holistic admissions policies and practices embrace the concept of diversity, and attempt to admit a diverse class across a number of diversity characteristics, institutional climate and culture may or may not reflect diversity as a core value and perceptions of this climate and culture may vary from student to student (AAMC, 2012). "Therefore, identification of the strengths and weaknesses of an institution as it relates to diversity, as well as the beliefs and perspectives of those within the institution, are critical first steps in creating diverse and inclusive environments" (AAMC, 2012, p. 9).

It is an accomplishment to have achieved greater levels of diversity after the implementation of holistic admissions, but the challenges of recruiting and retaining students from diverse backgrounds do not disappear because more students from diverse

backgrounds are admitted and retained. In fact, one might argue that it becomes necessary to integrate ways of achieving and supporting a diverse medical student body, beyond the point of admission, in order to retain and graduate more minority physicians.

Implications of the Study

The impetus for this study stems from a lack of research on incoming student experiences, attributes and metrics and their relationship with performance in a combined-degree medical program. While research exists for traditional undergraduate students and predictors of academic performance and student retention, little exists on the relationship of these predictors and students who enter combined-degree medical programs. This study identified which of those predictors of academic performance and student retention, which broadly apply to undergraduate students, also apply to students in a combined-degree medical program.

Additionally, the Association of American Medical Colleges has encouraged medical schools to utilize holistic admissions practices in order to align admissions decisions with institutional mission, increase diversity in the medical school class and select the students who are most likely to succeed and become physicians. Increasing the diversity of the medical school class, and retaining more students who enter combined-degree programs, influences the number of physicians in practice in a time when physician shortages are imminent. For a combined-degree program like the one at the University of Missouri—Kansas City, graduating a larger number of the students it admits will ultimately place more students in practice in areas of shortage.

In order to retain and graduate a larger number of the students the school admits, this study looked at the classes admitted between 2005 and 2013 to determine if there are

any experiences, attributes and metrics of an incoming student that might predict retention. The implications from the previously mentioned findings are numerous, and may apply specifically to UMKC or more broadly to other medical school programs.

First, an admissions committee that utilizes a holistic review process when making decisions, in order to consider all of the experiences, attributes and metrics a student might contribute to the medical community, reviews both cognitive and non-cognitive variables when making admissions decisions. As it relates to the variables considered in the admissions process for a combined-degree program that admits students directly out of high school, this study found that the academic factors of standardized test score, high school GPA and rigor of the high school curriculum increase the odds of a student demonstrating success in the program, leading to the conclusion that these metrics remain important when making admission decisions.

Additionally, the chemistry assessment administered at UMKC to determine admission type is not currently used when making admissions decisions. The exam results are used once decisions are made to determine the type of admission a student may be offered, provisional or full. This study demonstrated that 30% of students admitted provisionally are likely to withdraw or be dismissed, and students fully admitted to the program are more likely to demonstrate success in the program. These results would support the use of the chemistry assessment scores as a part of the holistic process when making admission decisions, and not just as a tool to determine admission type.

When reviewing the demographic variables that influence academic performance and status in a combined-degree medical program, the results for all students admitted between 2005 and 2013 indicate that several demographic variables predict medical

school GPA and status in the program. Women are more likely to display lower mean GPAs and are more likely to withdraw or be dismissed; underrepresented minority students are more likely to withdraw or be dismissed; students from lower socioeconomic backgrounds demonstrate lower GPAs and are more likely to withdraw or be dismissed; and in-state students exhibit lower GPAs and are more likely to withdraw or be dismissed.

Although the results may not be surprising given pre-existing research, these results should not alter the way in which demographic variables are considered in the admissions process. These results do not suggest admitting fewer women, fewer underrepresented minority students, fewer students from lower socioeconomic backgrounds or fewer in-state students. Rather, these results indicate that there may be other factors that influence the outcomes for these students and other steps should be taken to evaluate how to further assist these groups of students once they are enrolled.

As will be discussed in the limitations section, this study did not look at environmental factors related to student persistence or factors related to support for students in certain groups. Next steps at the UMKC School of Medicine may include an assessment of institutional climate and culture as a way to identify barriers, as well as areas of support, for students from backgrounds with lower performance and higher odds of leaving the program.

While this study did identify those experiences, attributes and metrics that predict academic performance and status in the UMKC program, this study also revealed the significance of holistic admissions as an effective admissions process for medical students. For this medical school, holistic admissions has achieved its goal of increasing

diversity in the class and increasing the number of students who are retained each year. By reviewing candidates across a number of experiences, attributes and metrics, rather than making admissions decisions based solely on metrics, the UMKC School of Medicine has seen significant outcomes as they relate to retention and the enrollment of students underrepresented in medicine. Students are retained at a higher level, with almost ninety percent of students retained since the implementation of holistic admissions, versus 81% retained pre-holistic admissions. In addition, the percentage of students underrepresented in medicine has increased from approximately twelve percent to twenty percent, representing a class of diverse experiences and backgrounds. Furthermore, underrepresented minority students who have been admitted post-holistic admissions are just as likely to demonstrate success. These results support the original intent of holistic admissions, and the continued use of holistic admissions practices when making admissions decisions.

The results as they relate to the implementation of holistic admissions may apply more broadly as well, by supporting the notion that holistic admissions models intend to align admission practices with institutional mission, while also supporting outcomes and goals (AAMC, 2013), such as achieving diversity and increasing retention. This study supports the mission-driven identification of experiences, attributes and metrics to be reviewed in a holistic admissions process, reviewing those experiences, attributes and metrics in every step of that process, and relying on other factors besides metrics alone to make admissions decisions and increase diversity in medical schools.

Limitations and Future Studies

The goal of this study was to evaluate incoming student experiences, attributes and metrics and whether or not they predict academic performance or student retention in the combined-degree medical program at the UMKC School of Medicine. A number of limitations exist and should be taken into consideration when reviewing the results and planning future studies.

First, this study is limited due to a lack of evaluation of the role of student environment, both pre-college and current, in a student's academic performance and retention. Additionally, this study did not consider student experiences in the program, such as student-faculty relationships or academic and other advising, and their relationship to academic performance or retention. Future studies may want to evaluate student experience and environment and their role in performance and retention.

Secondly, although an increase in enrollment of students underrepresented in medicine and an increase in the number of students retained has materialized since the implementation of holistic admissions policies, it is unknown the true effect of these policies and what other factors may influence these increases. Additional studies may need to further evaluate the role holistic admissions plays in increased diversity and improved retention, and how institutional culture and climate influence the retention of students from diverse backgrounds.

An additional limitation of this study was the size of the sample. Holistic admissions has only been implemented in its current form since 2010, limiting the number of students used in the post-holistic admissions data analysis. In addition, there was limited data available for students admitted pre-holistic admissions. Future studies

should be conducted several years from now when the sample size will be larger, more students have had the opportunity to persist and graduate, and holistic admissions policies have been implemented over a longer period of time.

In addition, though the current analysis would indicate that a standard interview process is not predictive of academic performance or success in medical school, the School of Medicine has implemented a new interview process. This new process is a multiple-mini interview, a process by which the candidate rotates through ten interviews, or stations, and will discuss a different case, question or scenario within each station. The goal of each station is to evaluate a candidate on one attribute, as opposed to attempting evaluation of multiple attributes in a short period of time. As the interview is conducted, interviewers take notes regarding applicant responses and score those responses on a 10-point scale. The overall interview score and final comments are used by the Council on Selection in the final selection process. Future studies should evaluate the results of performance on the MMI and student performance in clinical experiences and on clinical exams, and should look at the value of the MMI in predicting student success and academic performance.

Finally, a limitation of this study is that it was conducted at one institution, using data from a unique medical education program. Although other combined-degree medical programs exist, none are structured or implemented in the same way as the program at UMKC. This may limit the results of this study being applied to other institutions, other medical schools or other combined-degree programs, and may not be looked at as descriptive of all students in medical education programs.

Conclusion

This study identified those experiences, attributes and metrics that influence academic performance and student retention in a combined-degree medical program. Although this study identified several demographic variables that predict these outcomes, it would be inappropriate to use these variables to make admissions decisions. Rather, it would be more appropriate to further research these groups with poorer performance in an attempt to identify common themes or issues related to poorer academic performance and decreased success in the program.

This study also identified several academic components that demonstrate strong, predictive relationships with academic performance and status in the program. Reviewing academic performance in high school through standardized test score, high school GPA and rigor of high school curriculum remains an important part of the admissions process, and remains predictive of how a student will perform in the combined-degree program at UMKC. That being said, although specific non-cognitive components of the application process did not demonstrate strong, predictive relationships with academic performance or status in the program, the concept of holistic admissions as a whole was proven to be effective in achieving its goals of increasing student diversity in the class and increasing student retention. If for no other reason than to admit more students from diverse backgrounds and to admit students who are more likely to be successful, holistic admissions should remain a common practice at this medical school. While the practice may continue to be refined, it has proven to have a statistically significant influence on important outcomes for the school.

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