12-2015

Predicting Desired Outcomes from Applicants' Medical School Admission Data

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A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Education in Educational Leadership

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December 2015

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Keywords: admissions, applicant, medical school, USMLE®, MCAT®

ABSTRACT

Predicting Desired Outcomes from Applicants' Medical School Admission Data

by

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Medical schools in the United States serve to train the next generation of physicians, admitting students who will continue to advance each school's mission. Admission committees are tasked with identifying those candidates who will be successful academically and who promote the objectives of the school with respect to mission. The Quillen College of Medicine at East Tennessee State University in northeast Tennessee seeks to attract and retain physicians with an interest in rural and primary care medicine. A total of 630 students were included in this study representing classes from 2001 to 2011. This study examined admissions data including MCAT scores, undergraduate GPAs, admission interview scores, and admission committee rating scores along with USMLE Step 1 scores to determine if there is any correlation of these variables with graduates selecting a primary care career or a rural practice location.

With respect to data available at admission, only MCAT scores were shown to have a significant correlation to specialty choice. None of the admission data significantly correlated with practice location. USMLE Step 1 scores had a weak negative relationship with specialty choice and a negligible relationship with practice location.

This study provides the admission committee information that these variables are insufficient by themselves to predict whether a medical student applicant will select a primary care specialty or practice in a rural location. Other data, perhaps even subjective data, would need to be analyzed to predict how well the admissions committee is addressing the college's mission with its selection of medical students.

DEDICATION

This work is dedicated to two of my professors and mentors who convinced me to pursue this endeavor. I learned much from them and appreciate the wisdom and guidance they provided me as I began this educational journey. Thank you to Dr. Russell F. West and Dr. Leo M. Harvill for all of the students you helped through the years. I will forever be grateful.

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CHAPTER 1

INTRODUCTION

Medical education is a long and arduous process that requires years of preparation and dedicated studies for those seeking a career as a physician. The desire to become a physician is rooted in many different perspectives, almost exclusive to each individual. Some have grown up with parents or other family members practicing medicine. Others have encountered a health problem of their own, spurring their interest in learning the profession. Still many others find medicine as their calling through happenstance. Whether the initial interest lies in science or the art of medicine, it is true that all successful applicants to medical school must have a considerable background both in science and the humanities. Well-rounded physicians often have the best outcomes and are sought after by patients.

The medical schools in the United States serve to train the next generation of physicians, promote advances in medical care, and conduct research that is intertwined with patient care and education. Each medical school has its own mission, focusing on the needs of its patient population locally, and the impact it has on a region or national level. Some schools have dedicated their curricular emphasis to training physician scientists – those who will continue a career in academic medicine and research. Other schools are focused on educating physicians to meet the specific needs of a patient population. Many schools are located in geographically diverse areas that create a challenge for providing care in rural and underserved populations.

With each school's mission being unique, the admissions committees for each school operate somewhat differently (Arnold, Coe, & Pepper, 1984). It has been demonstrated that a medical school's mission and structure significantly impact student specialty choices (Bland, Meurer, & Maldonado, 1995). Therefore, schools want to attract the best and brightest students who fit with their missions. Admissions committees use many factors in their review of candidates including grades, test scores, interviews, extracurricular activities, personal interests, background, and other types of performance evaluations. With considering a mixture of both quantitative and qualitative data, the admissions process is time consuming and not necessarily an exact science.

Admission committee members often serve for several consecutive years, seeing the trends in applications, understanding the strengths of applicants, and knowing which specific students thrive in school after matriculating. Admission office staff members often share anecdotes with prospective candidates, explaining types of qualities the committee wants to see in an applicant, and providing guidance on whether a school is the right fit for an individual.

Committees face difficult decisions to determine whether an applicant is the right fit for its class. Keeping the school's mission centered in the process guides the committee members to review the materials in a framework that facilitates the process. For example, if a school's foundation is the development of physician scientists, committee members will explore the potential for scientific inquiry and skills with applicants. If a school's mission involves promoting the practice of primary care and rural medicine, indicators for those types of choices for an applicant won't necessarily be the same as the physician scientist.

Candidates apply to most medical schools using a central, online application process provided by the Association of American Medical Colleges (AAMC). This system is called the American Medical College Application Service (AMCAS) (“AMCAS For Applicants - Applicants - Students,” 2014). However, schools in Texas use a different system named the Texas Medical & Dental Schools Application Service (“Texas Medical & Dental Schools Application Service,” 2014). In either case, the application allows a candidate to provide demographic information, academic transcripts, letters of recommendations, test scores, and essays. The committee evaluates academic performance of each candidate by reviewing the grade point average (GPA) and specific course of study outlined on a transcript. Additionally the AAMC provides a single national admissions exam for medical schools, the Medical College Admissions Test® (MCAT®) (“Medical College Admission Test (MCAT) - Applicants - Students,” 2014).

Quantitatively, students can be compared only two ways, GPA and MCAT scores. To assist with review both of the figures are broken down into components. The current MCAT has three numerical scores that are combined into a composite score. The three scores represent performance in each of the following areas: verbal reasoning, biological sciences, and physical sciences (“Medical College Admission Test (MCAT) - Applicants - Students,” 2014). Each GPA is also broken down into separate components to facilitate the review process. The GPA is automatically reported by AMCAS by a separate score totaling all biology, chemistry, physics, and math courses, another score for all the remaining courses, and lastly a total GPA (AMCAS for applicants - applicants - students, 2014).

When students matriculate at a medical school, the typical 4-year curriculum involves the 2 years of basic science course work followed by 2 years of clinical education in various practice locations. Student progress is monitored based on performance in classroom courses and clinical courses called clerkships. Graded examinations, subjective evaluation by faculty, and performance data are used to compile the formative and summative assessments for students. At the conclusion of the basic science course materials students take the first step of a three-part examination that leads to licensure in the United States.

The United States Medical Licensing Exam® (USMLE®) is a series of examinations sponsored by the Federation of State Medical Boards and the National Board of Medical Examiners that determine if an individual meets the minimum qualifications to be licensed for independent practice (United States Medical Licensing Exam, 2015). USMLE Step 1 is a comprehensive examination of basic science material and its application to the practice of medicine. USMLE Step 2 is a two-part examination that focuses on the clinical sciences and practice of medicine. One part, Clinical Knowledge (CK), evaluates abilities, skills, and knowledge related to clinical science and the practice of medicine. The second part, Clinical Skills (CS), is a performance exam where student interact with standardized patients demonstrating interviewing skills, physical examination skills, and ability to synthesize clinical information. USMLE Step 3 is a 2-day examination that is designed to evaluate the individual's ability to practice medicine independently. Medical students typically take USMLE Step 1 after they complete the first 2 years of the curriculum. Medical students sit for USMLE Step 2 CK and Step 2 CS somewhere in the beginning of their fourth year of medical school. USMLE Step 3 is taken after graduation.

Both USMLE Step 1 and Step 2 CK have numerical scores that are provided for each examinee. Medical schools often use these scores to determine how well both individual students and classes as a whole are performing in medical school. They are outcome measures that schools use to assess the appropriateness of their curricula. Much like the MCAT, the USMLE is one of the few quantitative data that can be compared across all medical students and schools.

After graduating from medical school new physicians must continue with their specialty training in a residency program. After completing this training program physicians are eligible to sit for specialty specific board certification examinations. Additionally, physicians are then selecting a location for their practice, often in the same geographic area where they completed residency training.

There are select programs at both the state and federal level for recruiting physicians to underserved areas. Those areas are often rural in nature. The National Health Service Corps provides the opportunity for loan repayment for those who enter underserved areas (National Health Service Corps, 2014). There are specific guidelines used by the National Health Service Corps that the US Department Health and Human Services Health Resources and Services Administration (HRSA) has defined as a health professions shortage area (U S Department of Health and Human Services Health Resources and Services Administration, 2014a). Additionally, HRSA also defines areas of medically underserved areas or populations (U S Department of Health and Human Services Health Resources and Services Administration, 2014b).

Statement of the Problem

The challenge for admissions committees is how to determine whether certain qualities in an individual or select quantitative data correlate to success in medical school and to specific career path selection or practice location for physicians. As specialty selection is influenced by a medical student's experiences and values (Clinite et al., 2013), the question of what data committee members should pay close attention to at their institution must be considered. The purpose of this study is to provide admissions committee members with guidance on how well they are selecting candidates that meet the mission of the school.

The Quillen College of Medicine at East Tennessee State University in northeast Tennessee prides itself in serving the southern Appalachian region by producing physicians who predominantly chose to practice primary care or in a rural setting. Its mission statement demonstrates its dedication to the "…improvement of health care in Northeast Tennessee and the surrounding Appalachian Region" (James H. Quillen College of Medicine, n.d.). Having a strong primary care workforce is associated with better population health with lower costs (Carek et al., 2012). Students from this school are more likely to pursue a career in primary care compared to national averages (Chen, Fordyce, Andes, & Hart, 2010). The admissions committee reviews over 2000 applications each year for a class of 72 students. Select members of the committee initially screen applications, inviting those most competitive to submit supplemental application material including additional short answer essays. Applicants who are not considered competitive are no longer considered for admission.

Each candidate's application is screened a second time, with those most competitive being invited to the campus for face-to-face interviews with two individual committee members. Those members enter comments into the AMCAS system along with a private 25-point score that is used for review later. After a group of 30 to 40 candidates have been interviewed, the committee spends a significant amount of time holistically reviewing the entire application package for each person. Four different committee members who did not participate in the interview of a candidate are randomly selected to completely review the file and provide a ranking.

Prior to an admissions committee meeting, all files are reviewed and rated. The final rating scale is a 9-point scale, which provides for a composite 36 points possible when all four reviewers' scores are combined. These composite scores reflect the committee's thoughts on the candidate's suitability for admission including academic performance, maturity, fit with the school's mission, and other unique qualities that would enhance the diversity and experience of the entering class. The committee is provided a roster of all interviewed candidates for the cycle along with their committee rating score. Admission actions are determined based on candidates' committee rating scores at each meeting.

The admissions committee is charged with selecting those individuals for the class based on their ability to succeed while meeting the mission of the school. As USMLE scores are the only quantitative values that all medical students have in common, it is often used as one of the main objective measurements of success in medical school. Students who graduate from medical school then spend a minimum of 3 years and can spend up to 12 years of additional clinical training in residency and fellowship programs depending on specialty choice. Only after this training are individuals ready for independent practice and are licensed to do so. Thus, the outcome measures of career choice and practice location are often not reviewed by the admissions committee to determine if its selection process is meeting the mission of the school.

Anecdotal statements and not systematic review are the most often relied upon data for the committee to determine how well its process works. In order for the committee to have a solid understanding of how well its matriculants are succeeding in school and how well they are representing the school's mission, a quantitative study of admissions data compared to USMLE scores, career choice, and practice location must be completed.

Additionally, there is debate as to whether the HRSA definitions of health professions shortage area and medically underserved areas or populations are fair measures for determining rural location. The US Census Bureau has a strict definition of rural that may or may not overlap Health Resources Services Administration (HRSA) defined shortage areas (Hart, Larson, & Lishner, 2005). Members of an admissions committee must be cognizant of the limitations created by definitions for underserved and rural when reviewing whether committee work is congruent with the school's mission.

Research Questions

Several scores in the admissions process may have a correlation to a student's choice to practice either primary care or in a rural location. Primarily this study is designed to determine whether there is a difference in the MCAT scores, undergraduate GPAs, interview scores, and committee ratings between two sets of comparable outcome choices, specialty choice and practice location. Additionally, a review is made of USMLE Step 1 scores to determine if there is any correlation between performance in medical school and specialty choice or practice location. Specialty choice is categorized as either primary care or nonprimary care. Primary care includes family medicine, general internal medicine, geriatrics, general pediatrics, and obstetrics and gynecology. Practice location is defined either rural or nonrural based on the criteria set by the Rural/Urban Commuting-Area taxonomy (Hart et al., 2005) ("UW RHRC Rural Urban Commuting Area Codes - RUCA," n.d.).

Research Question 1.

Is there a significant difference in MCAT scores, undergraduate GPAs, interview scores, or committee rating scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty?

Research Question 2.

Is there a significant difference in MCAT scores, undergraduate GPAs, interview scores, or committee rating scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location?

Research Question 3.

Is there a significant relationship between medical school graduates' choice of specialty (primary care or nonprimary care) and USMLE scores?

Research Question 4.

Is there a significant relationship between medical school graduates' choice of practice location (rural or nonrural) and USMLE scores?

Research Question 5.

How well does a linear combination of medical school admission criteria (MCAT scores, undergraduate GPAs, interview scores, and committee rating scores) predict students' USMLE scores?

Significance of the Study

The results of this study may provide the admissions committee with a sound understanding of where its graduates are practicing and in which specialty. Results will also provide the committee with outcome data to evaluate whether the mission of the school is being fulfilled.

Because each school has a unique student applicant pool and separate mission, the wider implications of this study are somewhat limited. Several other studies at other institutions have been able to demonstrate correlations and predictive factors related to choosing a primary care specialty or practicing in a rural location. While those results may or may not be generalized to other institutions, the underlying culture and impact a school has on its region tend to limit the ability to directly apply results from other schools.

As the nation braces for a shortage in physicians in the near future, it is vital that medical schools are aware of the limitations and challenges that lay ahead in providing the physician workforce. With the United States facing a predicted shortage of 90,000 physicians by 2020, remaining true to mission is important in the admissions process (Kirch, 2013). Mitka (2010) notes that because of the inherent workforce limitations from the medical school structure there continue to be ongoing concerns about physician shortages especially in rural areas. Increases in primary care graduates from medical school because of the HMO movement of the 1980s and 1990s are now in decline (Colwill, 2003; Jeffe, Whelan, & Andriole, 2010). In light of the current predicted shortage of physicians in the United States, the public will likely see an even greater demand for primary physicians because of the increased number of insured individuals because of the Affordable Care Act (Jeffe et al., 2010).

Definitions of Terms

The following terms are defined for use in this study:

1. Allopathic medical school – a medical school granting the Doctor of Medicine (MD) degree.
2. Association of American Medical Colleges (AAMC) – a non-profit organization representing all United States and Canadian allopathic medical schools.
3. Medical College Admissions Test (MCAT) – the entrance exam for candidates seeking admission to allopathic medical schools in the United States and Canada, sponsored by the AAMC.
4. Primary care physician – physicians practicing in one of the following general specialties: family medicine, general internal medicine, geriatrics, general pediatrics, obstetrics and gynecology.

5. United States Medical Licensing Exam (USMLE) – a three-step exam required for licensure in the United States sponsored by the National Board of Medical Examiners and the Federation of State Medical Boards.

Limitations and Delimitations

This study is limited by the assumption that the data provided are accurately recorded and that subjects are practicing in the area reported to the medical school. It is assumed that the methodology appropriately addresses each research question. Additionally, it is assumed that the statistical analyses performed were appropriate and capable of detecting differences in the variables. Also, this study is limited by the usefulness of the results to the admissions committee. Additionally, this study is limited by the lack of a consistent and standard definition of what constitutes a rural area by different government agencies and researchers.

This study is delimited to medical school graduates from the allopathic Quillen College of Medicine at East Tennessee State University in northeast Tennessee who have completed residency training and are in practice. Any graduates without data for the study variables were excluded from the study. The results may be applicable only to the admissions committee at the school of study and not generalizable to other medical schools.

Overview of the Study

With the pressure of meeting the challenge of educating enough physicians to meet the needs of the region, the admissions committee of the Quillen College of

Medicine is committed to selecting those candidates who meet its mission. The purpose of this study is to review select admissions criteria and one performance measure from medical school to determine how those data correlate with a graduate's choice of primary care or nonprimary care specialty and practice in a rural or nonrural setting. Chapter 1 provides introductory material about the study including how the admissions committee functions. Chapter 2 provides an overview of the literature as it relates to admission data at medical schools and predicting outcomes. Chapter 3 contains the methodology of the study. Chapter 4 provides the results of the analyses. Chapter 5 summarizes the results providing conclusions, implications, and possibilities for future research.

CHAPTER 2

LITERATURE REVIEW

History of Medical Education

Teaching the profession of medicine has an extensive history long associated with higher education. In Europe medicine became a part of the university system during the 12^{th} and 13^{th} centuries (Magee, 2004). Medical training in the United States evolved differently than in Europe. There was no formal medical training in the American colonies until the University of Pennsylvania Medical School was founded in 1765 (Cannom, 1969). Colonists therefore trained in Europe with Edinburgh being the most sought after school (Moll, 1968). At the time of the Revolutionary war it is estimated that there were 3,500 physicians for the 3 million colonists, with only 400 having MD degrees. Of those, only 51 had graduated from an American medical school (Cannom, 1969).

In May 1765 Dr. John Morgan's appointment at the College of Philadelphia is now recognized as the beginning of medical education in America (Moll, 1968). Despite the fact that medical education was tied to the College of Philadelphia, there was very little oversight and control over curriculum and training. In fact, the first known legislation to control the practice of physicians was passed in Virginia in 1639 and was related to the charging of excess fees, not education (Cannom, 1969). The first action regarding the governing of medical practice was in 1806 in New York where physicians were authorized to form local societies with license granting authority (Cannom, 1969).

By 1800 three other medical schools had been formed, Harvard, Dartmouth, and King's College in New York (Cannom, 1969). Throughout the 1800s medical education remained unstandardized. There were three ways to become a practicing physician. One was the apprenticeship method that provided hands on instruction by a physician. Physicians also owned their own schools, charging students to attend lectures to learn the practice of medicine. Also, there was a hybrid system combining the aspects of the apprenticeship and lecture models housed in universities (Beck, 2004).

In the early 1800s before the Civil War era, because the United States was in a state of great expansion and exploration westward in addition to massive immigration, most states had relaxed or abandoned physician licensing requirements in order to meet the great demand for physicians (Moll, 1968). At the beginning of the Civil War 85 proprietary medical schools were in existence. Because the education was not always readily accessible, many medical students went to Paris for training (Cannom, 1969). After the Civil War, many American physicians trained in Germany (Cannom, 1969). Students often selected training in Germany because of the scientific foundation of the curriculum (Cooke, Irby, Sullivan, & Ludmerer, 2006). Toward the end of the 1800s proprietary schools in the United States had grown to over 160 in number (Hildebrandt, 2010). For those proprietary medical schools often the most important criterion for admission was having adequate financial resources to pay the tuition bills (Chambers, Cohen, & Girotti, 2011).

For Tennesseans the first medical school did not open until 1846 (Corgan, 2006). Better scientific understanding and research were leading to longer training times. Advances in clinical science and laboratory investigations revealed that many of the mainstay treatments of the 1800s were in fact not helpful, often times harmful (Beck, 2004). Between 1885 and 1899 the curriculum for the Doctor of Medicine had increased by two fold both in time and content (King, 1983).

Regulation of Medical Education

The public was beginning to recognize the importance of regulating medical education. By 1900 most states and territories had reinstated licensing control over physicians. Additionally 26 states required examinations for those graduating from medical school (Moll, 1968). The American Medical Association (AMA) was a leader in the establishment of standards for medical schools (Beck, 2004). In 1904, the AMA formed the Council on Medical Education that outlined a major restructuring of medical schools to include 2 years of laboratory training followed by 2 years of clinical training.

In addition to the AMA other organizations were beginning to assert influence in medical education. The Association of American Medical Colleges (AAMC) was formed in 1876 (Barzansky, 2010). The AAMC still functions today as the organization representing all schools in the United States that grant the Doctor of Medicine degree. There were 133 medical schools in 1910 with highly variable entrance requirements. Early members of the AAMC sought to standardize admissions standards across these schools.

Outside of the AMA and the AAMC there was public interest being voiced in having a comprehensive review of medical education mainly because of the perceived poor scientific training of physicians (Hellmann, 2010). In 1908 the Carnegie Foundation asked Abraham Flexner, an educator and nonphysician, to review the status of medical education in the United States and Canada. The idea was that by brining to light the conditions in medical schools public support for reform would be assured (Kanter, Groce, Littleton, & Gunderman, 2010).

The Flexner Report

The Abraham Flexner report of 1910 is widely recognized as a turning point in the history of medical education. The study was designed to define the relationship between a professional field of study and those degrees obtained through university. The report indicated that the US needed fewer physicians and better-trained physicians. Flexner stated that medical schools should each be part of a university.

As Moll (1968) noted one of the most remarkable points to consider from the changes spurred by the Flexner Report was that the process "was not accomplished through governmental action" but rather was the result of physicians working to make the changes voluntarily (p. 179). Many of the criteria Flexner used in his analysis had been developed by the AAMC (Barzansky, 2010). The Flexner Report illuminated the significant educational shortfall and variability in medical education (Barzansky, 2010). In 1912 a group of state medical boards created a group called the Federation of State Medical Boards whose members voluntarily adhered to the standards and structure developed by both the AMA and AAMC (Beck, 2004).

Flexner regarded Johns Hopkins as the ideal model for medical education (Cooke et al., 2006). The first president of Johns Hopkins, Daniel Gilman, is credited with introducing ideas he had learned in Europe in establishing the university hospital and its medical school (Weatherall, 2006). William Osler, often thought of as the father of modern medicine, advocated that physicians should care more about the person than the pathology and devised a system of clerkships at Johns Hopkins involving the students in teaching at the bedside (Dornan, 2005).

By 1922 the number of US medical schools had dropped to 81 (Mitka, 2010). With the Flexner push to return medical school to the universities, students matriculating were often from upper socioeconomic class and were white males. The many schools that closed because of the Flexner Report were often ones training underrepresented minorities and women (Mitka, 2010).

Kushner (2008) provides a perspective, framing the importance of understanding the history of medical education and the changes brought about by the Flexner report noting, "if a history of medicine uninformed by biomedical knowledge is untenable, then medical research uninformed by historical context is incomplete" (p. 711). Central to Flexner's ideals was his concept of medical education as a public good (Humphrey, Levinson, & Smith, 2010). That can be seen in subsequent public commitment to the funding of graduate medical education with the establishment of Medicare in 1965 (Ward & Mainiero, 2013).

As a result of the Flexner Report proprietary medical schools that were largely serving the interests of the physician owners closed (Moll, 1968). Medical education had become structured in the framework of scientific rigor and was associated with universities. The AMA and the AAMC continued to provide guidance and structure in the continued evolution of medical education. The AAMC especially focused on medical school structure, introducing standards for admission including the first Medical College Admissions Test (MCAT) (McGaghie, 2002).

Medical College Admissions Test History

The MCAT was first administered in 1962 with four components: science achievement, general information, quantitative ability, and verbal ability (Callahan, Hojat, Veloski, Erdmann, & Gonnella, 2010). A new MCAT was administered between 1978 and 1991 with science problem solving, quantitative skills, and reading skills. The latest version of MCAT in use since 1991 includes four sections: biological sciences, physical sciences, verbal reasoning, and a writing sample (Callahan et al., 2010). In 2008 the AAMC established a 22-member advisory group known as the MR5 Committee, working toward a redesign of the MCAT for use by 2015 (Mann, 2011). The purpose of the redesign is to balance testing in the natural and behavioral sciences (Gabbe & Franks, 2011).

As medical schools and academic medical centers have evolved, Halperin (2011) noted, "the modern medical school attempts to serve both missions: service to the public, and cultivation of the public mind" (p. 10). Schools decide how best to serve their communities and advance the science and education of medicine. Many schools focus on producing graduates who will be the next generation of physician scientists. Other schools are better equipped to provide health services for the underserved. Primary care providers are often needed in geographically isolated and rural areas.

The mission of a medical school must be reflected in the charge of an admissions committee. If the school is focused on graduating primary care physicians, that must be considered in the admissions process of the school. In fact, "Admissions Committees are probably the biggest single determinant of the output of generalists" (Rabinowitz, 1999, p. S39).

Researchers have provided admissions committees with analyses on predicting success in medical school and how candidates for admission might have the same values that would help the school meet its mission. Kanter (2008) stated, "an admission decision requires the synthesis of many different kinds of information (often measured in different ways, and sometimes not measureable)" (p. 623). The admissions committee of the Quillen College of Medicine at East Tennessee State University prides itself on selecting students who opt for a career in primary care and for those who choose to practice in rural areas.

Admissions Variables and Specialty Choice

The literature related to primary care and rural medicine career selection is not easily compared study by study due to the variances in size, scope, and inherent methodology flaws. A nonstatistical meta-analysis by Bland et al. (1995) revealed that public medical schools were consistently more likely than private medical schools to graduate students going into a primary care specialty. Yet, it is difficult for a public school to provide better focus on how best to select for those candidates who are more likely to enter a primary care career. Several factors have been identified that influence medical students' choice of specialty including attitudes, intellectual ability, sex, race, science aptitude, clinical experiences, and personality (Chen et al., 2010; Fadem, Nicolich, Simring, Dauber, & Bullock, 1984).

As has been noted, the only data that all candidates have in common are MCAT scores and GPAs. Many researchers have been able to demonstrate differences between primary care physicians and other physicians in their MCAT scores and science GPAs.

However, many have argued those differences are small and are not easily applied in the admissions process. Rabinowitz (1999) stated, “there is no increase in attrition for students with credentials in the lower part of [the range of scores for matriculants]” (p. S41).

Early survey work indicates that some medical schools during the 1970s and 1980s were moving away from GPA and MCAT as the most important criteria for admission (Arnold et al., 1984). At the University of Missouri-Columbia in the late 1970s researchers determined that because of the low correlation of GPA with clinical success their admissions committee would be better served to find well-rounded candidates meeting both academic criteria and select personal traits (Murden, Galloway, Reid, & Colwill, 1977). While the admissions committee members placed great importance on personal traits, the study revealed that most of them agreed that they placed greater emphasis on the GPA (Murden et al., 1978).

While personal traits are important in a holistic admissions process, selection committees strive to ensure that candidates fit the school’s culture and are capable of handling the academic rigor. Thus, GPA and MCAT are often used in the admissions process to establish a threshold (Albanese, Snow, Skochelak, Huggett, & Farrell, 2003).

Dartmouth medical students in the early 1980s were studied to determined how useful the MCAT and undergraduate GPA were with the admissions committee selection of the class. Hall and Bailey (1992) found that their admissions committee’s use of MCAT, GPA, and the perceived academic caliber of the undergraduate school were good predictors of success in the first year of medical school. A study at McMaster University found undergraduate GPAs had the best predictive ability for performance in its medical school (Kulatunga-Moruzi & Norman, 2002).

Performance in medical school is often equated to how well a student does on the United States Medical Licensing Exam (USMLE) Step 1, which is usually written after completion of the basic science course work. Early studies of the MCAT with the version introduced in 1977 demonstrated that MCAT scores were able to predict performance on a part of medical licensing exam series at the time, National Board of Medical Examiners Part I examination, a precursor to the USMLE (Jones & Thomae-Forgues, 1984). The USMLE Steps 1, 2, and 3 became the only license examination series accepted for MD graduates in 1994 (Swanson, Case, Melnick, & Volle, 1992).

MCAT and USMLE Predicting Success

Several studies have been able to correlate MCAT performance to the USMLE. For example, Julian (2005) determined that the MCAT positively correlated with moderately high validity coefficients with USMLE Steps 1 and 2. The MCAT also positively correlated very well with USMLE Step 3, even with greater accuracy than GPA from the first year of medical school. Julian noted this is likely because of the commonality of multiple-choice, high stakes examinations. A meta-analysis by Donnon, Paolucci, and Violato (2007) demonstrated small to medium positive correlations of the MCAT with both medical school performance and USMLE. Albanese et al.'s 2003 work is also prolific in this area noting, "MCAT scores correlate fairly strongly with United States Medical Licensure Examination (USMLE) Step 1 scores" (p. 316). At Jefferson Medical College a historical review of all MCAT versions indicated that scores are moderately positively correlated with the USMLE (Callahan et al., 2010). Research also showed that first time failure of USMLE Step 1 is highly positively correlated with undergraduate GPA, medical school GPA, and MCAT (Albanese, Farrell, & Dottl, 2005b).

Research has also revealed that sets of MCAT scores, using averages of multiple attempts, also had predictive value of performance in medical school (Hojat, Veloski, & Zeleznik, 1985). Students with the same average MCAT score, determined by averaging all attempts by a student, have been shown to perform the same on USMLE Step 1 regardless of the number of MCAT attempts (Zhao, Oppler, Dunleavy, & Kroopnick, 2010). Furthermore, the writing sample has been shown to have little predictive value in medical school performance or USMLE (Donnon et al., 2007; Gilbert, Basco, Blue, & O'Sullivan, 2002).

Because MCAT scores have been shown to predict success in medical school, it appears logical that admissions committees should establish baseline or minimum MCAT scores to ensure student selected for admission will be successful. However, studies have not identified a single statistical approach to set a threshold cut score for the MCAT (Albanese et al., 2005a). When using MCAT and GPA only as a threshold, former AAMC president Jordan Cohen stated that admissions committees might actually find other information in the application process that outweighs any concern with MCAT and GPA (Albanese et al., 2005b).

Also, there is concern about the use of MCAT thresholds in the admissions process because of the *Gratz v. Bollinger* Supreme Court decision that ruled against using a point system for undergraduate admissions (Albanese, Farrell, & Dottl, 2005a). At the

University of Wisconsin Medical School in Madison, Albanese et al. (2005a) published a study demonstrating that despite the *Gratz v. Bollinger* decision, a school could apply rational and defensible thresholds for MCAT and undergraduate GPAs.

While a published academic exercise provides the foundation for an approach to setting thresholds, it precludes admissions committees from the holistic review of applicants. MCAT scores and undergraduate GPAs are so ingrained in thoughts about performance that the *US News and World Report* use them in its annual ranking system for medical schools (Albanese et al., 2003).

Some schools have decided that other important factors should be heavily weighted in the admissions process, not just MCAT and GPA. A study at the Mount Sinai School of Medicine compared a cohort of medical students whose undergraduate course of study did not include organic chemistry, physics, and, calculus, and who did not take the MCAT with a cohort of traditionally prepared medical students. The researchers determined that while the humanities prepared students scored slightly lower on the USMLE Step 1 licensing exam, they performed at a level equal to their classmates in school (Muller & Kase, 2010). In a study of medical students at the University of Kentucky Elam (1993) found that while basic science principles may be more familiar to students with a strong undergraduate science background, those nonscience majors with "compensatory skills such as reading and analytical abilities" likewise performed well in their coursework (p. 229). The performance in both the classroom and clinical settings did not appear to be influenced by a student's premedical curriculum. Suggestions have been made that medical schools should adopt an MCAT-blind admissions policy where committee members are not provided with actual MCAT results of candidates, only that they have met a certain threshold set that predicts a likelihood of success (Smith, 2011).

Many researchers have also worked to determine if there are correlations between MCAT, USMLE performance, and GPA with those students who are either coming from disadvantaged backgrounds or who are more likely to pursue a career in primary care. For schools that focus on producing graduates likely to practice in an underserved area, identifying those individuals is important. For example, underrepresented minority students are more likely to practice in medically underserved areas when compared to white and Asian physicians (Barnhart, Shekelle, & Lewis, 1996). Underrepresented minority applicants to medical schools also have lower GPAs and MCAT scores on average (Reede, 1999). In fact, a study at the University of Michigan demonstrated that MCAT did not predict performance for underrepresented minority students in medical school (White, Dey, & Fantone, 2009). Additionally, MCAT science scores are lower for rural applicants than nonrural (Basco Jr., Gilbert, & Blue, 2002). Thus, creating MCAT thresholds has the potential for excluding applicants of interest.

In the 1980s Linzer et al. (1994) noted a few studies had determined that primary care students had lower test scores and science GPAs, but the authors questioned whether this association would continue into the 1990s. In an earlier version of the MCAT Kassebaum, Szenas, and Schuchert (1996) found that students with higher MCAT Chemistry section scores were less likely to choose a primary care specialty. The University of Missouri-Columbia School of Medicine has been able to show that an admissions committee can maintain competitive criteria for selection while not jeopardizing the ability to admit those students more likely to enter rural practice (Longo, Gorman, & Ge, 2005).

Other objective data have not been proven to be predictive in performance. No studies have been able demonstrate significant difference in USMLE performance based on undergraduate major (Kleshinski, Khuder, Shapiro, & Gold, 2009). Wiley and Koenig (1996) concluded that MCAT scores had slightly higher positive correlation to medical school GPA than undergraduate grades.

In addition to MCAT and GPA admissions committees use the interview process to gain insight into a candidate's ability to succeed in school and how well he or she fits with the school's mission. Studies have shown that information elicited during the interview can be related to students' performance in the clinical years of medical school training (Albanese et al., 2003). Meredith, Dunlap, and Baker (1982) demonstrated that narrative interview comments during the admissions interview best predicted students' performance on clinical clerkships in medical school at the University of Arizona in the early 1980s. However, interviews introduce a highly subjective factor into the admissions process of medical school. Further attempts have been made to correlate interview scores with later performance in medical school. Basco et al. (2008) demonstrated a "small but statistically significant" positive correlation between the interview and a prototype of the USME Step 2 Clinical Skills exam (p. 158). He notes however that the small positive correlation is of little use to admissions committees.

Some studies have shown that other factors in both the admissions process and those inherent to the culture of the school influence career selection and practice location.

Basco, Buchbinder, Duggan, and Wilson (1998) demonstrated that public medical schools and those schools with recruitment activities highlighting primary care were more likely to admit students interested in primary care and rural medicine. Students who state an intent to practice family medicine immediately after admission to medical school is an important predictor of those students going on to practice in a rural setting (Rabinowitz, Diamond, Markham, & Paynter, 2001). In a study of eight Canadian medical schools, matriculating with intent to practice family medicine was the most important predictor of selecting primary care (Scott et al., 2011). Rabinowitz and colleagues (2012) also demonstrated there was a significant positive correlation between entering students' career plans and their eventual likelihood of practicing in a rural location.

Predictors of Rural Practice

Certain characteristics have been identified that predict a student's desire to practice rural family medicine including small hometown, spouse from rural area, and education conducted in a rural area (Avery Jr. et al., 2012). A study at the University of Buffalo revealed that students who graduated from rural high schools were more than twice as likely to select a career in family medicine compared to those from nonrural high schools (Pretorius, Milling, & McGuigan, 2008). Physicians who attended a rural high school or self-reported as growing up in a rural area were more likely to practice in a rural area (Owen, Conaway, Bailey, & Hayden, 2007). Medical students and their spouses with a rural background are more likely to have intent to practice in a rural setting (Royston, Mathieson, Leafman, & Ojan-Sheehan, 2012).

Applicants from rural areas are more likely to choose a career in primary care than those with urban backgrounds (Kassebaum et al., 1996). Students from rural areas are also more likely to practice in rural areas (Pretorius et al., 2008). Bland and his colleagues (1995) have noted

> several student characteristics are associated with the choice of a primary care career: being female, being older, being married, having a broad undergraduate background, having non-physician parents, having relatively low income expectations, being interested in diverse patients and health problems, and having less interest in prestige, high technology, and surgery. (p. 636)

The admissions process additionally can influence selection of those interested in rural medicine for those medical schools that have preferences for rural backgrounds in the admission process. Those schools are also likely to be ones with greater faculty numbers in primary care and curricula that reinforces primary care (Bland et al., 1995). Personality may also influence career selection by medical students. In an Australian study Jones et al. (2013) determined that while personality could not fully explain attitude toward rural practice, individuals are likely better suited to rural practice because of personality.

Some schools by their nature may have an advantage for recruiting primary care physicians. A medical school's culture and attitude towards primary care play a role in influencing students' career selections (Erikson, Danish, Jones, Sandberg, & Carle, 2013; Whitcomb, Cullen, Hart, Lishner, & Rosenblatt, 1992). Additionally, the proportion of faculty in family medicine is a stronger predictor than family medicine faculty to student ratios (Bland et al., 1995). Observing or shadowing as a premedical student in an urban hospital is inversely related to selecting a career in family medicine (Avery Jr. et al., 2012). Linzer et al. (1994) suggested that in order to produce more primary care physicians greater care must be made to encourage those with an interest in primary care to pursue a career in medicine.

Students often have preconceived ideas when applying to medical school. Students planning careers in general pediatrics, surgical subspecialties, and obstetrics-gynecology are shown to be only half as likely to enter a rural practice than those selecting family medicine as a career (Rabinowitz et al., 2012). Students choosing nonprimary care and subspecialties are more motivated by higher income, greater flexibility with family time, and opportunities for research (Hays, 1993). A study of 11 medical schools' classes from 1983 to 2003 revealed the importance of financial compensation was inversely related to an interest in primary care (Clinite et al., 2013). Some students desiring a nonprimary care specialty actually make that decision prior to matriculation at medical school. Johnson et al. (2012) recently noted in a study that students opting for a career in orthopaedic surgery often made the decision before medical school.

The influence of a rural background on practice location is not limited to those in the United States. Studying the effects of rural versus urban backgrounds of medical school candidates at University of Alberta, researchers noted that being female, having lived in a rural location, and the influence of community are associated with selecting a career in family medicine (Gill, McLeod, Duerksen, & Szafran, 2012). Studies of students in Australian medical schools show that students who lived in rural areas and those exposed to rural medicine during their training are more likely to select rural practice as a career choice (Henry, Edwards, & Crotty, 2009; Stagg, Greenhill, & Worley, 2009). A model developed by researchers in Australia and New Zealand demonstrated that the strongest predictors of rural practice are student interest, having lived in a rural area, and having a non-practice requirement scholarship (Jones, Humphreys, & Prideaux, 2009; Walker, Dewitt, Pallant, & Cunningham, 2012). Yet, another study performed at a Canadian medical school demonstrated that those attending rural high schools and those with rural backgrounds are more likely to be practicing in a rural location after training (Tate & Aoki, 2012).

Some have suggested that medical schools work closely with their undergraduate admissions offices to recruit academically strong high school students in hopes of retaining them through undergraduate education and then on to medical school. Elam Johnson, and Rosenbaum, (1997) have demonstrated that students who study in the same institution undergraduate through medical school are more likely to remain in the state to practice.

Medical educators and administrators have the greatest impact on the supply and retention of rural primary care physicians (Rabinowitz et al., 2001). Schools and residency training programs have developed strategies for promoting primary care and rural medicine once students begin school. Rosenblatt found a small number of medical schools are responsible for producing the majority of graduates who go on to practice in a rural setting (Rosenblatt, Whitcomb, Cullen, Lishner, & Hart, 1992). Curricular elements shown to increase the likelihood of selecting a primary care specialty are required family medicine clerkships and longitudinal primary care experiences (Bland et al., 1995). At the Universities of Alberta and Calgary faculty determined that physicians with urban backgrounds were not as well prepared for certain aspects pertaining to rural practice. They suggested that increasing exposure to rural culture might improve recruiting and retaining rural physicians (Szafran, Crutcher, Woloschuk, Myhre, & Konkin, 2013). Family medicine residency graduates who completed rural health programs are more likely to practice in a rural area (Acosta, 2000). This supports the concept that specialized curricula and exposure to rural medicine does impact choices that students make.

In a retrospective study reviewing 25 years of data support for rural programs or tracks within medical schools to increase graduates from those programs correlates strongly with those entering family medicine as a career and practicing in rural locations (Rabinowitz, Diamond, Markham, & Santana, 2013). Jefferson Medical College's Physician Shortage Area Program has demonstrated a direct impact on the rural workforce indicating that medical schools' efforts can positively impact the workforce shortage of physicians in rural areas (Rabinowitz, 1993; Rabinowitz, Diamond, Markham, & Hazelwood, 1999). Unfortunately, rural track family medicine residency programs structured to encourage rural practice are unlikely able to meet the supply of physicians needed for rural locations in the US (Rosenthal, 2000).

Many medical schools have employed strategies to retain and recruit rural practice physicians because of workforce needs in their states (Geyman, Hart, Norris, Coombs, & Lishner, 2000). It is known that primary care physicians outnumber specialists in those practicing in rural areas (Acosta, 2000). In terms of rural practice and primary care career selection it has been proposed that schools with rural as a component of its mission profile applicants and admit students with goals congruent with the mission (Geyman et al., 2000). Family medicine residency programs located at small community-based hospitals are the ideal locations for training those interested in rural practice (Ross, 2013). This is supported by Acosta (2000) who reported that, “family physicians are three times as likely as general internists, and five times as likely as general internists or general pediatricians, to practice in nonmetropolitan areas” (p. 254).

Institutions that have implemented policies to promote primary care career selection have seen success in increasing the number of graduates in those areas. Several studies have shown that a school’s greatest influence may actually be a result of culture and mission. Both GPA and MCAT have been shown to have positive correlation to both performance in medical school and to career selection. Because identifying predictors of success at one medical school may not be easily translated to another medical school, it is important that a review of the specific admission data and outcome data be completed (Zeleznik, Hojat, & Veloski, 1987).

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

This is an ex post facto study using data from the Quillen College of Medicine at East Tennessee State University. Every applicant to the medical school completes an AMCAS application. For those who were deemed most competitive the final step in the application process is an interview. The admissions committee members then complete a final review and ranking of the file. Each month the committee completes a cycle of interviews and final reviews. Candidates are then accepted, placed on a hold list, or are terminated from further consideration.

In the late spring of each year each expected matriculant college has a formal student record created containing data from the AMCAS application including undergraduate GPA and MCAT scores. Additionally, the college's admissions committee members' numeric interview rating scores and final composite review scores are also retained in the AMCAS system. Those data are automatically entered into the university's student record system Banner Unified Digital Campus. During the student's tenure at the college, when individual USMLE scores are received, they too are maintained in Banner.

Research Design

This research study was designed to determine whether there is a difference in the MCAT scores, undergraduate GPAs, interview scores, and committee ratings between two sets of comparable outcome choices, specialty choice and practice location. Additionally, a review was made of USMLE Step 1 scores to determine if there is any correlation between performance in medical school and specialty choice or practice location.

Specialty choice for this study was categorized as either primary care or nonprimary care. Primary care is defined to include family medicine, general internal medicine, geriatrics, general pediatrics, and obstetrics and gynecology. Practice location was defined as either rural or nonrural, based on the criteria defined by Rural/Urban Commuting-Area taxonomy (Hart et al., 2005; "UW RHRC Rural Urban Commuting Area Codes - RUCA," n.d.).

Research Questions and Null Hypotheses

The following research questions and null hypotheses were developed for this study.

Research Question 1.

Is there a significant difference in MCAT scores, undergraduate GPAs, interview scores, or committee rating scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty?

> H_o1_1: There is no significant difference in MCAT scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty.

H_o1_2: There is no significant difference in undergraduate GPAs between medical school students who select a primary care specialty and those who select a nonprimary care specialty.

H_o1_3: There is no significant difference in interview scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty.

H_o1_4: There is no significant difference in committee rating scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty.

Research Question 2.

Is there a significant difference in MCAT scores, undergraduate GPAs, interview scores, or committee rating scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location?

H_o2_1: There is no significant difference in MCAT scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.

H_o2_2: There is no significant difference in undergraduate GPAs between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.

H_o2_3: There is no significant difference in interview scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.

H_o2_4: There is no significant difference in committee rating scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.

Research Question 3.

Is there a significant relationship between medical school graduates' choice of specialty (primary care or nonprimary care) and USMLE scores?

$H_0$3: There is not a significant relationship between medical school graduates' choice of specialty (primary care or nonprimary care) and their USMLE scores.

Research Question 4.

Is there a significant relationship between medical school graduates' choice of practice location (rural or nonrural) and USMLE scores?

$H_0$4: There is not a significant relationship between medical school graduates' choice of practice location (rural or nonrural) and USMLE scores.

Research Question 5.

How well does a linear combination of medical school admission criteria (MCAT scores, undergraduate GPAs, interview scores, and committee rating scores) predict students' USMLE scores?

$H_0$5: There is not a significant relationship between medical school admission criteria and students' USMLE scores.

Instrumentation

The data used in this study included the highest recorded MCAT score, total undergraduate GPA, interview score, committee rating score, USMLE Step 1 scores, specialty choice, and zip code of practice location. Each MCAT score has three numerical scores with a range of 0 to 15 that are also combined into a composite score ranging from 0 to 45. The three scores represent performance in each of the following areas: verbal reasoning, biological sciences, and physical sciences with the highest score of 15 possible for each section ("Medical College Admission Test (MCAT) - Applicants - Students," 2014).

The USMLE scores are reported in a range from 1 to 300. The USMLE reports that difficulty across years is accommodated by the staff using statistical procedures, allowing comparison of scores across years ("USMLE Score Interpretation Guidelines," n.d.).

The total undergraduate GPA provided by AMCAS is reported on a 0.00 to 4.00 scale with 4.00 being the highest score. Applicants who attend a school that uses a different GPA scale have a new 4.00 scale GPA calculated and reported by AMCAS ("AMCAS For Applicants - Applicants - Students," 2014). The zip code data for practice location were cross referenced with the Rural/Urban Commuting-Area taxonomy to determine if the practice location is rural or nonrural (Hart et al., 2005; "UW RHRC Rural Urban Commuting Area Codes - RUCA," n.d.).

Data Collection

The Institutional Review Board at East Tennessee State University approved this study. The data for the study were obtained from the college's Admissions and Records Office staff who extracted and redacted the information from the Banner database. The data included graduates starting with the class of 2001. Because students who graduate from medical school continue with residency training for a minimum of 3 more years, the data are from students who graduated at least 3 years ago. Recent graduates' data were not reviewed, as those individuals have not yet have completed residency training and chosen a location for practice. Because rural practice is considered an outcome of interest, it is important to include only those who have completed training. Thus, the population of this study was 11 graduating classes from the Quillen College of Medicine at East Tennessee State University from 2001 to 2011. The number of students included in the study was 630.

Data Analysis

All data analyses were completed using IBM SPSS Statistics 21. For Research Question 1, a point-biserial correlation t analysis was completed comparing the means of MCAT scores, undergraduate GPA, interview score, and committee rating score with primary care and nonprimary care specialty choices. For Research Question 2, a point-biserial correlation t analysis was completed comparing means of MCAT scores, undergraduate GPA, interview score, and committee rating score with rural and nonrural practice location. Point-biserial correlation was used because rural and nonrural practice locations are dichotomous. All data were analyzed at the .05 level of significance.

To determine compare medical school performance with specialty choice and practice location USMLE scores were used. For Research Question 3 a point-biserial correlation analysis was completed comparing the mean USMLE scores with primary care and nonprimary care specialty choice. For Research Question 4 a point-biserial correlation analysis was completed comparing USMLE scores with rural and nonrural practice location. Point-biserial correlation was used because rural and nonrural practice locations are dichotomous. For Research Question 5 a multiple regression analysis was conducted to evaluate how well the admissions criteria predicted USMLE Step 1 scores. All data were analyzed at the .05 level of significance.

Chapter Summary

This was study is an ex post facto study of data from the Quillen College of Medicine at East Tennessee State University. The study was designed to use data from the admissions process and medical school performance using USMLE scores as a proxy to determine if there were any relationship between these data and selection of a primary care specialty and a rural practice location. As the college's mission focuses on primary care and rural physicians, the study provided insight into the performance of the admissions committee in meeting its objectives.

CHAPTER 4

RESULTS

Demographics

The population of this study was 11 graduating classes from the Quillen College of Medicine at East Tennessee State University from 2001 through 2011. The number of students included in the study was 463. Students without recorded values in the database were excluded from analysis. Table 1 includes characteristics of the study population. MCAT scores ranged from 19 to 39 with a mean of 27.95 (*SD* = 2.96). Undergraduate GPAs ranged from 2.39 to 4.00 with a mean of 3.62 (*SD* = .30). Interview scores recorded for the applicants ranged from 31 to 50 with a mean of 42.9 (*SD* = 4.10). Committee member rating scores ranged from 22 to 36 with a mean of 30.6 (*SD* = 2.11). Performance measures from medical school included USMLE Step 1. The range of Step 1 scores were from 146 to 267 with a mean of 217 (*SD* = 21.77). Because career specialty and location of practice are categorical and dichotomous, a point-biserial correlation coefficient was used for the analysis in Research Questions 1, 2, 3, and 4.

Table 1

Specialty and Locations of the Study Population

	N	%
Primary Care Specialty	197	49.6
Nonprimary Care Specialty	200	50.4
Rural Practice Location	28	7.0
Nonrural Practice Location	371	93.0

Analysis of Research Questions

The following five research questions and 11 null hypotheses were tested.

Research Question 1.

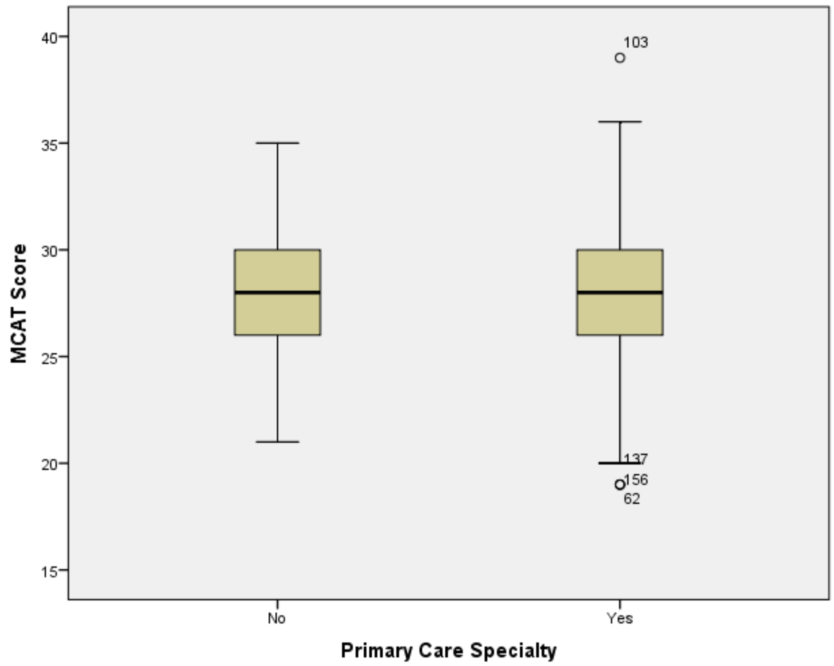
Is there a significant relationship in MCAT scores, undergraduate GPAs, interview scores, or committee rating scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty?

> H_o1_1: There is not a significant relationship in MCAT scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty.
>
> H_o1_2: There is not a significant relationship in undergraduate GPAs between medical school students who select a primary care specialty and those who select a nonprimary care specialty.

H_o1_3: There is not a significant relationship in interview scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty.

H_o1_4: There is not a significant relationship in committee rating scores between medical school students who select a primary care specialty and those who select a nonprimary care specialty.

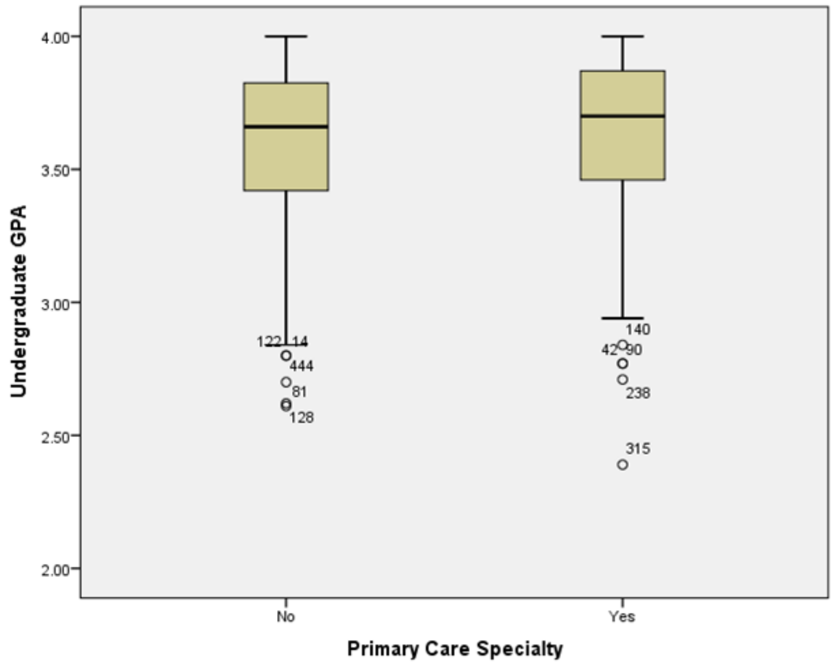
A correlation coefficient was computed to determine if a relationship exists between medical students' career specialty choice (primary care or nonprimary care) and their MCAT scores. The results of the correlational analysis revealed a weak negative relationship between MCAT scores and career specialty choice and a statistically significant correlation [r_{pb} = -.10, p = .028]. Therefore, H_o1_1 was rejected. Medical students selecting a primary care residency had a mean MCAT score of 27.71 (N = 196, *SD* = 3.08), and those selecting a nonprimary care residency had a mean MCAT score of 28.29 (N = 200, *SD* = 2.83). Figure 1 shows a box plot comparing the MCAT scores for those who selected a primary care specialty versus a nonprimary care specialty.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 1. MCAT scores for specialty choice, primary care and nonprimary care

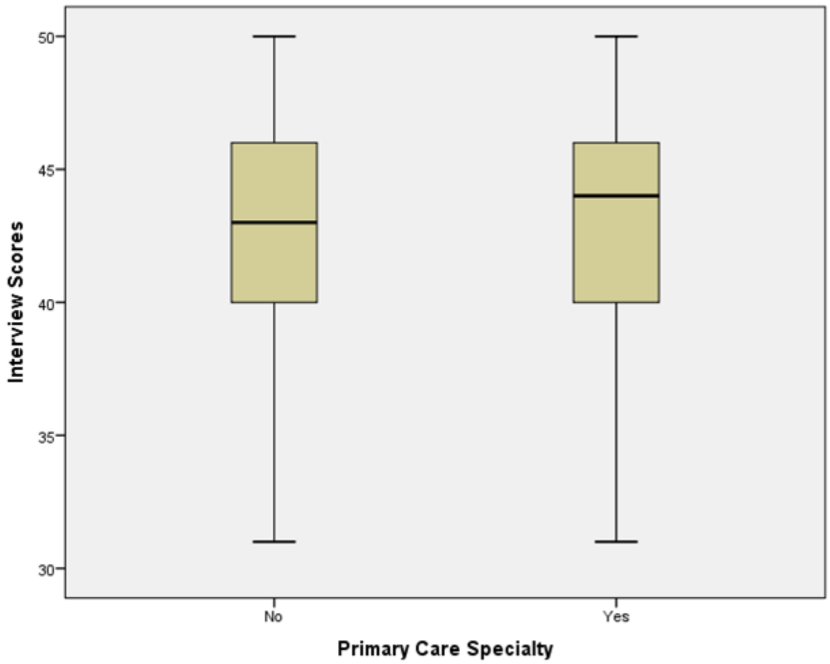
A correlation coefficient was computed to determine if a relationship exists between medical students' career specialty choice (primary care or nonprimary care) and their undergraduate GPAs. The results of the correlational analysis revealed a weak positive relationship between undergraduate GPA and career specialty choice without a statistically significant correlation [r_{pb} = .05, p = .307]. Therefore, H_o1_2 was retained. Medical students selecting a primary care residency had a mean undergraduate GPA of 3.63 (N = 197, *SD* = .30), and those selecting a nonprimary care residency had a mean undergraduate GPA of 3.60 (N = 199, *SD* = .30). Figure 2 shows a box plot comparing the undergraduate GPAs for those who selected a primary care specialty versus a nonprimary care specialty.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 2. Undergraduate GPAs for specialty choice, primary care and nonprimary care

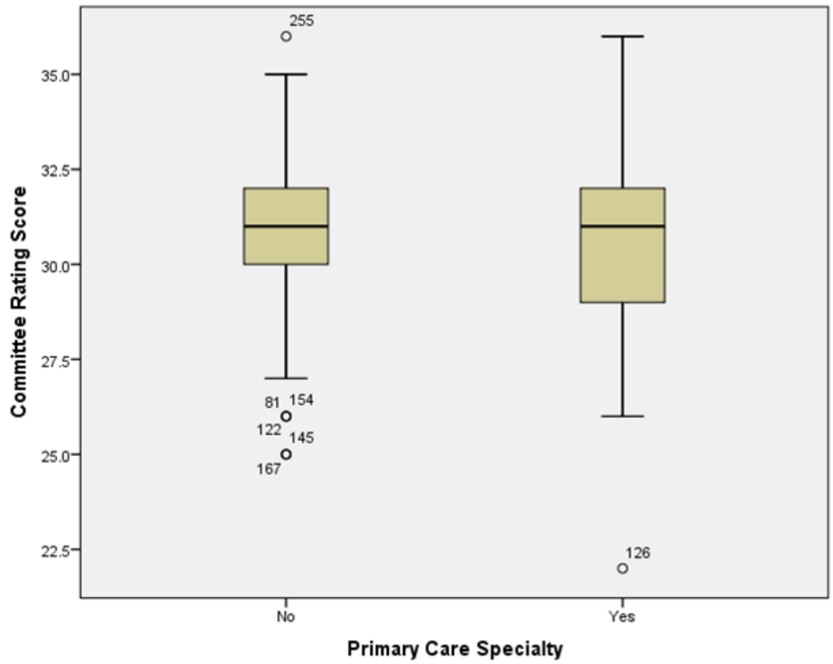
A correlation coefficient was computed to determine if a relationship exists between medical students' career specialty choice (primary care or nonprimary care) and their interview scores. The results of the correlational analysis revealed a weak positive relationship between interview score and career specialty choice without a statistically significant correlation [r_{pb} = .02, p = .647]. Therefore, H_o1_3 was retained. Medical students selecting a primary care residency had a mean interview score of 42.84 (N = 180, *SD* = 4.14), and those selecting a nonprimary care residency had a mean interview score of 42.64 (N = 180, *SD* = 4.14). Figure 3 shows a box plot comparing the interview scores for those who selected a primary care specialty versus a nonprimary care specialty.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 3. Interview scores for specialty choice, primary care and nonprimary care

A correlation coefficient was computed to determine if a relationship exists between medical students' career specialty choice (primary care or nonprimary care) and their committee rating scores. The results of the correlational analysis revealed a weak negative relationship between committee score and career specialty choice without a statistically significant correlation [r_{pb} = -.02, p = .672]. Therefore, H_o1_4 was retained. Medical students selecting a primary care residency had a mean committee rating score of 30.68 (N = 185, *SD* = 2.17), and those selecting a nonprimary care residency had a mean committee rating score of 30.77 (N = 188, *SD* = 2.18). Figure 4 shows a box plot comparing the interview scores for those who selected a primary care specialty versus a nonprimary care specialty.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 4. Committee rating scores for specialty choice, primary care and nonprimary care

The correlations for each independent variable are shown in Table 2.

Table 2

Correlations Among Admissions Data with Career Specialty Choice

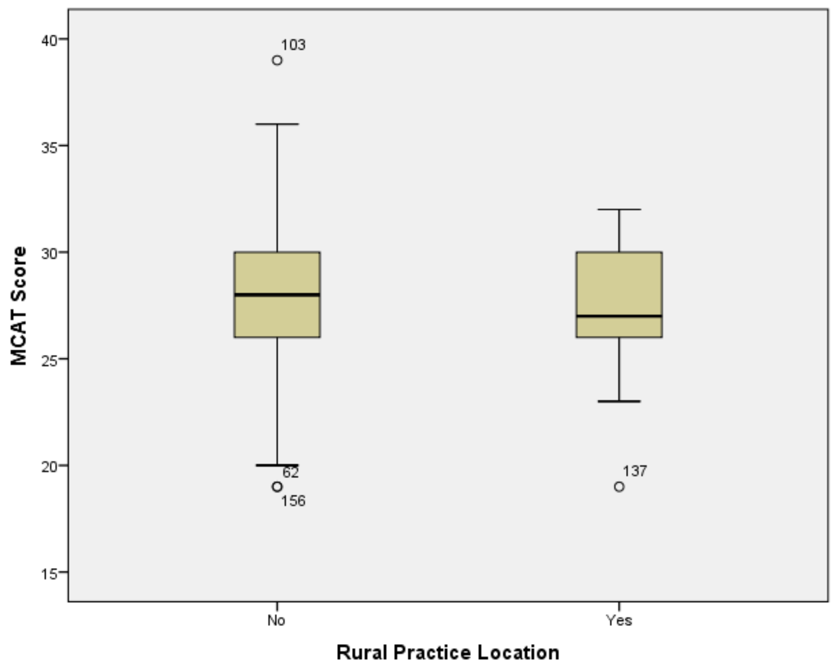
	r_{pb}	p	r^2
MCAT Score	-.098	.028	.010
Undergraduate GPA	.052	.307	.003
Interview Scores	.024	.647	.001
Committee Rating Scores	-.022	.672	<.001

Research Question 2.

Is there a significant relationship in MCAT scores, undergraduate GPAs, interview scores, or committee rating scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location?

> H_o2_1: There is no significant relationship in MCAT scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.
>
> H_o2_2: There is no significant relationship in undergraduate GPAs between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.
>
> H_o2_3: There is no significant relationship in interview scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.
>
> H_o2_4: There is no significant relationship in committee rating scores between medical school graduates who choose to practice in a rural location and those who choose to practice in a nonrural location.

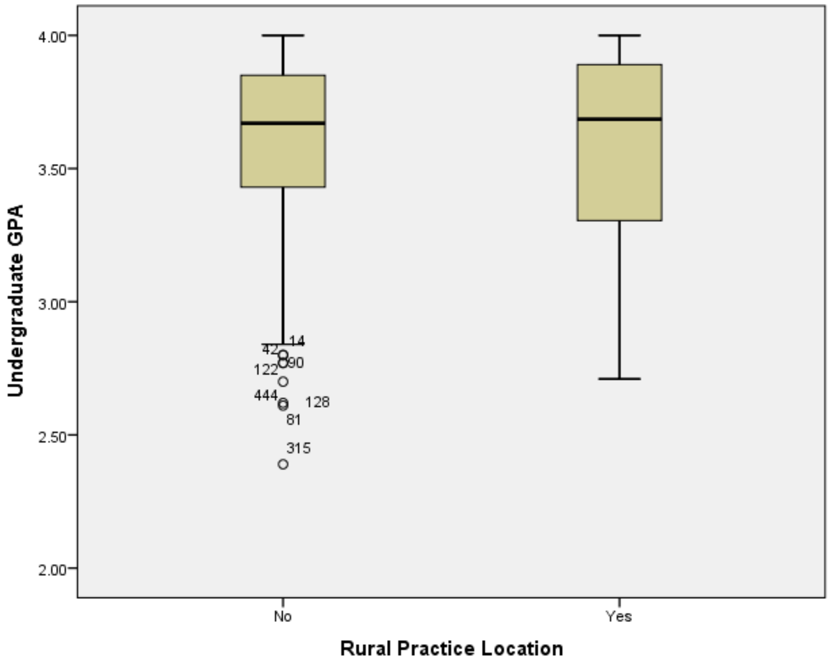
A correlation coefficient was computed to determine if a relationship exists between medical students' practice location (rural or nonrural) and MCAT scores. The results of the correlational analysis revealed a weak negative relationship between MCAT score and practice location without a statistically significant correlation [r_{pb} = -.05, p = .311]. Therefore, H_o2_1 was retained. Medical students practicing in a rural location had a mean MCAT score of 27.46 (N = 28, *SD* = 2.9), and those selecting a nonrural practice location had a mean MCAT score of 28.05 (N = 370, *SD* = 2.97). Figure 5 shows a box plot comparing the MCAT scores for those practicing in a rural location versus a nonrural location.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 5. MCAT scores for practice location, rural and nonrural

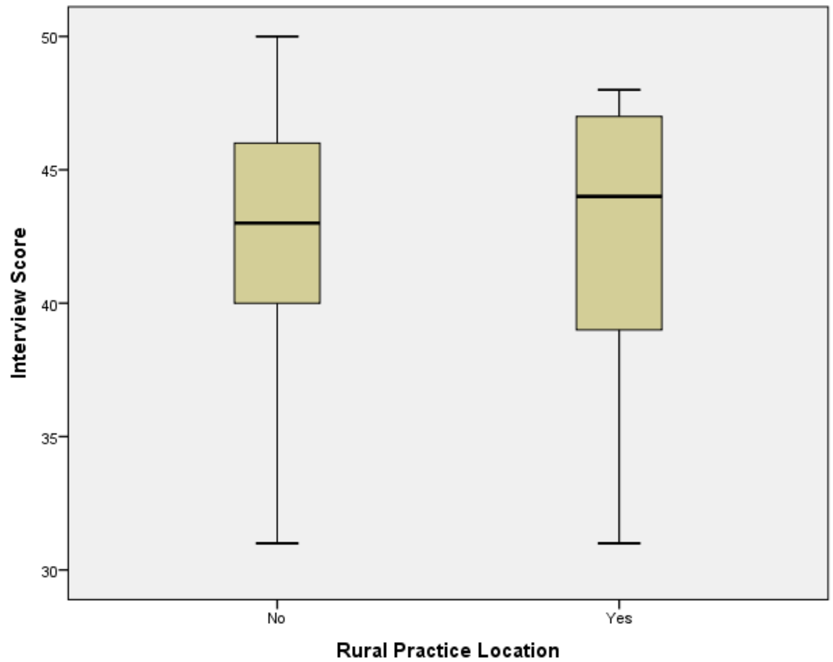
A correlation coefficient was computed to determine if a relationship exists between medical students' practice location (rural or nonrural) and undergraduate GPA. The results of the correlational analysis revealed a weak negative relationship between undergraduate GPA and practice location without a statistically significant correlation [r_{pb} = -.001, p = .982]. Therefore, H_o2_2 was retained. Medical students practicing in a rural location had a mean undergraduate GPA of 3.61 (N = 28, *SD* = .33), and those selecting a nonrural practice location had a mean undergraduate GPA of 3.61 (N = 369, *SD* = .30). Figure 6 shows a box plot comparing the undergraduate GPAs for those practicing in a rural location versus a nonrural location.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 6. Undergraduate GPAs for practice location, rural and nonrural

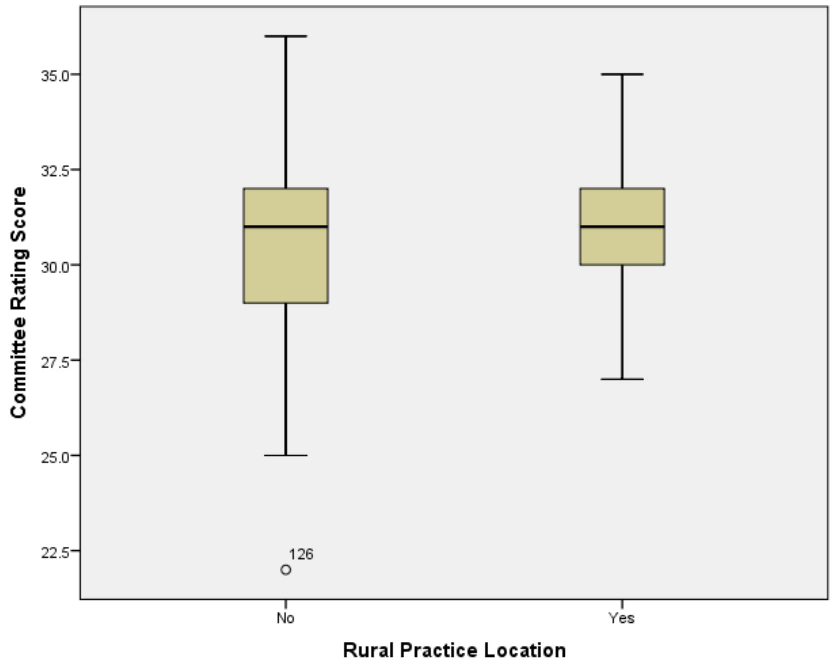
A correlation coefficient was computed to determine if a relationship exists between medical students' practice location (rural or nonrural) and interview scores. The results of the correlational analysis revealed a weak positive relationship between interview score and practice location without a statistically significant correlation [r_{pb} = .003, p = .960]. Therefore, H_o2_3 was retained. Medical students practicing in a rural location had a mean interview score of 42.76 (N = 25, *SD* = 4.51), and those selecting a nonrural practice location had a mean interview score of 42.72 (N = 336, *SD* = 4.20). Figure 7 shows a box plot comparing the interview scores for those practicing in a rural location versus a nonrural location.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 7. Interview scores for practice location, rural and nonrural

A correlation coefficient was computed to determine if a relationship exists between medical students' practice location (rural or nonrural) and committee rating score. The results of the correlational analysis revealed a weak positive relationship between committee rating score and practice location without a statistically significant correlation [r_{pb} = .006, p = .903]. Therefore, H_o2_4 was retained. Medical students practicing in a rural location had a mean committee rating score of 30.77 (N = 26, *SD* = 1.75), and those selecting a nonrural practice location had a mean committee rating score of 30.72 (N = 348, *SD* = 2.20). Figure 8 shows a box plot comparing the committee rating scores for those practicing in a rural location versus a nonrural location.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 8. Committee rating scores for practice location, rural and nonrural

The correlations for each independent variable are shown in Table 3.

Table 3

Correlations Among Admissions Data with Practice Location

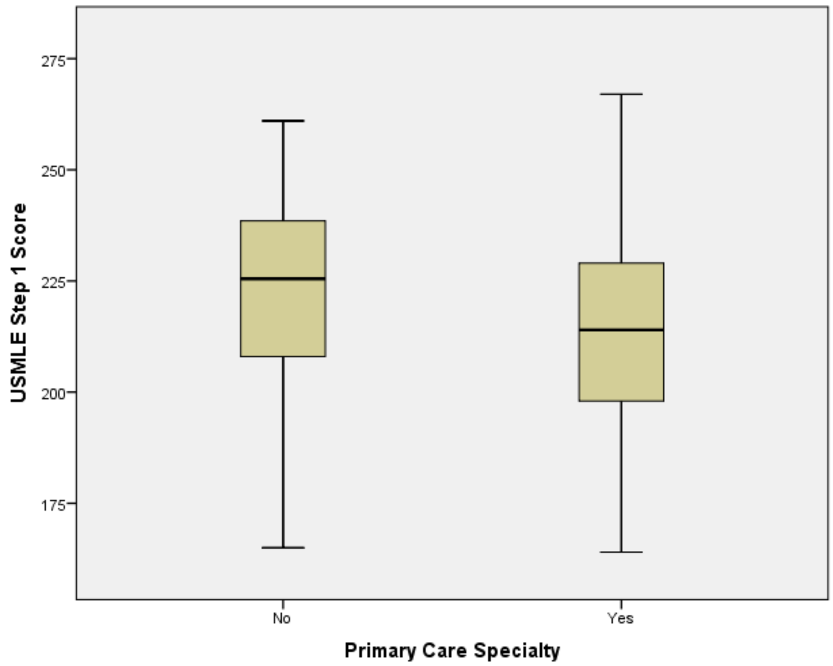
	r_{pb}	p	r^2
MCAT Score	-.051	.311	.003
Undergraduate GPA	-.001	.982	<.001
Interview Scores	.003	.960	<.001
Committee Rating Scores	.006	.903	<.001

Research Question 3.

Is there a significant relationship between medical school graduates' choice of specialty (primary care or nonprimary care) and USMLE Step 1 scores?

$H_0$3: There is not a significant relationship between medical school graduates' choice of specialty (primary care or nonprimary care) and USMLE Step 1 scores.

A correlation coefficient was computed to determine if a relationship exists between medical students' career specialty choice (primary care or nonprimary care) and USMLE Step 1 scores. The results of the correlational analysis revealed a weak negative relationship between USMLE Step 1 score and career specialty choice and a statistically significant correlation [$r_{pb} = -.21$, $p = .001$, $r^2 = .058$]. Therefore, H_o3 was rejected. Medical students selecting a primary care residency had a mean USMLE Step 1 score of 212.85 (N = 197, *SD* = 20.93), and those who selected a nonprimary care specialty had a mean USMLE Step 1 score of 223.01 (N = 200, *SD* = 20.07). Figure 9 shows a box plot comparing the USMLE Step 1 scores for those who selected a primary care specialty versus a nonprimary care specialty.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

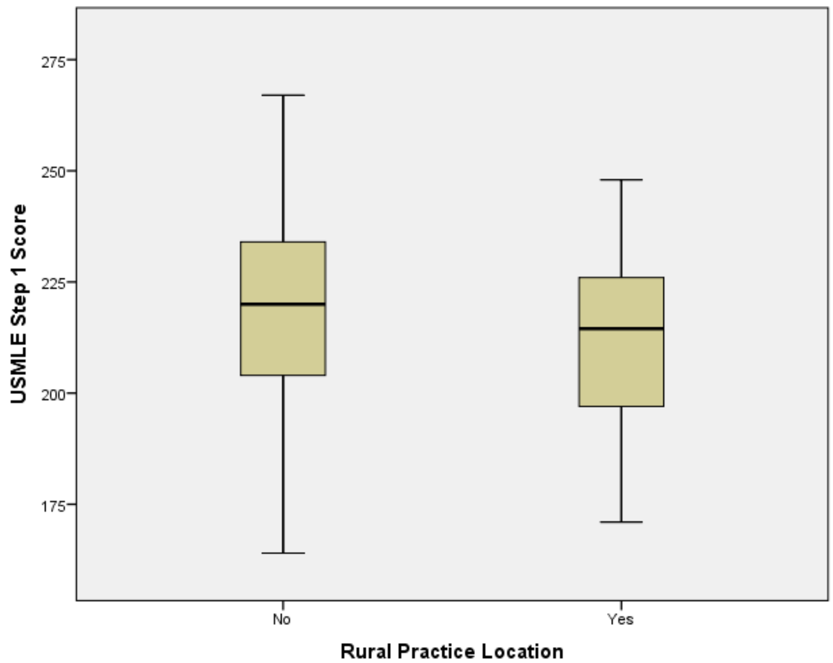
Figure 9. USMLE Step 1 scores for specialty choice, primary care and nonprimary care

Research Question 4.

Is there a significant relationship between medical school graduates' choice of practice location (rural or nonrural) and USMLE scores?

> $H_0 4$: There is not a significant relationship between medical school graduates' choice of practice location (rural or nonrural) and USMLE scores.

A correlation coefficient was computed to determine if a relationship exists between medical students' practice location (rural or nonrural) and their USMLE Step 1 score. The results of the correlational analysis revealed a weak negative relationship between USMLE Step 1 score and practice location without a statistically significant correlation [r_{pb} = -.09, p = .076, r^2 = .008]. Therefore, $H_o 4$ was retained. Medical students practicing in a rural location had a mean USMLE Step 1 score of 211.14 (N = 28, *SD* = 19.54), while those who selected a nonrural location had a mean USMLE Step 1 score of 218.46 (N = 371, *SD* = 21.09). Figure 10 shows a box plot comparing the USMLE Step 1 scores for those practicing in a rural location versus a nonrural location.



Note: outliers > 1.5 but < 3 interquartile ranges (IQRs)

Figure 10. USMLE Step 1 score for practice location, rural and nonrural

Research Question 5.

To what extent does a linear combination of medical school admission criteria (MCAT scores, undergraduate GPAs, interview scores, and committee rating scores) predict students' USMLE scores?

$H_0$5: There is no significant relationship between a linear combination of the predictor variables (MCAT score, undergraduate GPA, interview score, and committee rating score) and the criterion variable USMLE score.

A multiple regression analysis was conducted to evaluate how well the admissions criteria predicted USMLE Step 1 scores. The predictors were MCAT score, undergraduate GPA, interview score, and committee rating score. The linear combination of admissions criteria was significantly related to USMLE Step 1 score, $F(4, 411) = 32.00$, $p < .001$. Therefore, $H_0 5$ was rejected. The multiple correlation coefficient was .49, indicating that approximately 24% of the variance of the USMLE Step 1 score can be accounted for by the linear combination of admissions criteria.

Table 4 shows indices to indicate the relative strength of each individual admission criterion. Two of the admissions criteria, MCAT score and undergraduate GPA, were statistically significant.

Table 4

The Bivariate and Partial Correlations of the Admissions Criteria with USMLE Step 1 Score

Criteria	Correlation between each criterion and Step 1	Correlation between each criterion and Step 1 controlling for all other criteria
MCAT Score	.399*	.398*
Undergraduate GPA	.238*	.290*
Interview Scores	-.084	-.120
Committee Rating Scores	.172	.400

*p ≤ .01

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this research study was to determine whether there is a difference in the MCAT scores, undergraduate GPAs, interview scores, and committee ratings between two sets of comparable outcome choices, specialty choice, and practice location. Additionally, a review was made of USMLE Step 1 scores to determine if there was a correlation between performance in medical school and specialty choice or practice location.

Specialty choice for this study was categorized as either primary care or nonprimary care. Primary care is defined to include family medicine, general internal medicine, geriatrics, general pediatrics, and obstetrics and gynecology. Practice location was defined as either rural or nonrural, based on the criteria defined by Rural/Urban Commuting-Area taxonomy.

Findings

For Research Question 1 analyzing the relationship between admissions factors including MCAT scores, undergraduate GPAs, interview scores, and committee rating scores and the selection of a primary care specialty provided little insight into how well these data were related to specialty choice. Only the MCAT score was shown to have a statistically significant correlation to specialty choice. Those with a higher MCAT score were more likely to select a nonprimary care specialty. However, the power of this relationship was determined to be weak [$r_{pb} = -.10$, $p = .028$].

This finding is similar to those from Kassebaum et al. (1996) who found that students with higher MCAT scores in the chemistry section were less likely to choose a primary care specialty. However, the MCAT version in the Kassebaum study was an earlier version than the one included in this study.

Remarkably, the other admissions factors did not have a statistically significant relationship to specialty choice. Whereas undergraduate GPA and MCAT both have been shown to predict success in medical school (Donnon et al., 2007; Hall & Bailey, 1992; Kulatunga-Moruzi & Norman, 2002), only MCAT had a weak relationship in this study. Additionally, the committee rating scores and interview scores did not predict whether a student would select a primary care residency or not.

Studies have shown that often other factors are associated with choosing primary care including having lived in a rural area (Avery et al., 2012; Bland et al., 1995; Owen et al., 2007; Pretorius et al., 2008; Royston et al., 2012). Because of the rural location of East Tennessee State University with a candidate pool reflecting geographic diversity, one might expect to see committee scores reflect the findings in these previous studies. However, the data do not support such conclusions.

It is difficult to determine from the current data set how well the admissions committee selects individuals who may have an interest in primary care. Because the college of medicine includes rural and primary care as a foundation to its mission, it may be that candidates are self-selecting for the school based on this fact. The candidate pool for the college is likely not representative of other schools' applicant pools that have previously been studied.

For Research Question 2 the study results do not show any significant difference in MCAT scores, undergraduate GPAs, interview scores, or committee rating scores in students who select a rural practice location over a nonrural location. These results may not be significant because of the limited number of graduates in the study population who are actively practicing in a rural location (N = 28) compared to nonrural (N = 370) for the MCAT analysis. Additionally, because of the study design the results only reflect a snapshot in time, where the graduates are currently practicing and not where they have practiced previously or where they may practice in the future.

Similar to these admissions data and specialty choice, the literature related to rural practice selection demonstrates many other factors that tend to predict rural practice including rural background, early identification of family medicine interest, rural high school, and being older (Avery et al., 2012; Bland et al., 1995; Owen et al., 2007; Pretorius et al., 2008; Rabinowitz, Diamond, Markham, & Santana, 2012; Royston et al., 2012).

Research Question 3 provided an examination of whether there was a significant relationship between specialty choice of primary care or nonprimary care and USMLE Step 1 scores. The results show there is a statistically significant relationship, albeit a weak relationship [$r^2 = .058$]. Students selecting a career in primary care had a lower USMLE score on average compared to those choosing a nonprimary care specialty. This is supported by national data that show that overall more competitive specialties have higher USMLE scores (“Charting Outcomes in the Match,” n.d.). The most competitive specialties are nonprimary care (“Charting Outcomes in the Match,” n.d.).

Research Question 4 addressed practice location where USMLE scores did not have a significant relationship to selecting rural versus nonrural practice locations. Similarly to admissions data not correlating to practice location, USMLE scores may not be able to discriminate in such a small population. Also, because East Tennessee State University is known for its primary care and rural medicine mission, it may attract stronger students who wish to practice in a rural location and thus would have higher USMLE scores.

Because USMLE scores are used as a benchmark of success in medical school (Albanese et al., 2005a), it is reasonable that the admissions committee would seek to determine how well the combination of admissions factors including MCAT, undergraduate GPA, interview scores, and committee rating scores would predict USMLE Step 1 scores. With Research Question 5 the multiple regression analysis revealed that there was a statistical significance accounted for by the linear combination of those factors. The partial correlations that were significant included MCAT score and undergraduate GPA. Interview scores and committee rating scores did not show correlations that were significant.

Interestingly, in terms of being able to predict USMLE performance only the objective admissions data were significant. The scores given by the admissions committee, which would be considered largely subjective, did not have a strong correlation. This suggests that the admissions committee members do a good job at synthesizing objective and subjective data but are not able to quantify their impression into a scale that is predictive of either success in medical school as represented by USMLE scores or for selecting a career in primary care or a rural location.

The data and research questions analyzed in this study suggest that the admissions committee decisions cannot be used to determine whether the school is meeting its mission of primary care and rural medicine. It is appropriate to think of the representative work of the committee work being distilled into creating a threshold where accepted candidates can be assured of being capable of demonstrating success in medical school. Being able to quantify that success by correlating the scores created by the committee members is not possible in the current system.

Implications for Practice

Using the findings of this study, the admissions committee members can begin to address how they might continue their current practices or modify the process to better select candidates who meet the school's mission. As a result of the present study, it is recommended that the committee members should pay significant attention to the use of committee rating scores. Using a single score to predict primary care selection or preference for rural practice is impractical. Often it would seem that committee members may score individuals higher based on their prediction of the candidate wanting to practice primary care or rural medicine. Having grown up in rural setting or entering medical school with an intent to practice family medicine have both been shown in previous studies to predict selecting a primary care specialty or practicing in a rural setting (Bland et al., 1995; Kassebaum et al., 1996; Pretorius et al., 2008). However, the data in this study show that the committee scores, while certainly incorporating whether a candidate growing up in a rural setting or having a strong desire to pursue primary care, are not reasonable scores for predicting desired outcomes.

Another implication is that committee members must balance that MCAT scores do predict success in medical school and on USMLE Step 1 along with how MCAT scores are weakly correlated with whether an individual would select a primary care specialty. If previous research (Donnon et al., 2007; Hall & Bailey, 1992; Kulatunga-Moruzi & Norman, 2002) and the present study are used as a basis for promoting primary care, then it seems reasonable that individuals with lower MCAT scores would be more likely to pursue a career in primary care. However, because MCAT scores predict success in medical school, the question is how low of a score will committee members be able to accept and still have applicants who can succeed in medical school. The implication is that using select score ranges may increase the proportion of those selecting primary care, but are those individuals selecting primary care because they truly want to or is it because primary care specialties are their only option because of not being as competitive for other specialties? Such determinations cannot be made with this study alone.

Thus, when applying a quantitative framework for reviewing admissions, limitations exist on whether students are preselected for primary care, their decisions are influenced by the faculty, staff, and curriculum, and whether they select primary care over another specialty because they are able to, not because they have no other options. It may be intuitive that these limitations are not absolute in isolation. It is likely that all play an important part of the decision process of students as they consider specialty choice.

An additional implication is that this study should not be used to reflect on how well the admissions committee is doing with respect to placing individuals in rural locations. While rural practice is not limited to primary care, similar reflections above specialty choice can also transfer to thoughts about graduates' desires to practice in rural areas. This study does not provide enough insight as to whether the admissions committee is meeting this part of its mission based on these quantitative data. With so few graduates included in the present study practicing in a rural setting, there are insufficient numbers to provide any answers on correlation. The application of this fact to committee operations must include an understanding of the limits of these quantitative data. In fact, previous studies indicated that several factors might influence the decision to practice in a rural location, none of which are carefully annotated in any individual committee member's interview scores or committee rating scores. Those factors include graduating from a rural high school, growing up in a rural location, or having exposure to a rural track within medical school (Acosta, 2000; Bland et al., 1995; Rabinowitz et al., 2001).

Because of the unique study population, these implications cannot be easily applied across institutions. Because each medical school is unique, it is difficult to determine how students' backgrounds, MCAT scores, and undergraduate GPAs might predict success in medical school or determine how well those individual schools are meeting their mission. The admissions committee at East Tennessee State University operates under its own set of guidelines, endorsed by the membership of the committee. It would be difficult to find a way to translate interview scores or committee rating scores from one institution to another for a combined study.

Recommendations for Future Research

Looking to the future, there are several different needs for research both at East Tennessee State University and across the nation. First and perhaps most obviously is that the MCAT structure completely changed in 2015. Not only is the content drastically different, but also the scoring rubric leads to a different scale and mean. While researchers could convert scores from one scale to another, it would not necessarily be appropriate to compare in this way, as the content is vastly different. It could be beneficial to the admissions committee is to conduct a study similar to this one but using the new MCAT scores to see if greater specificity exists in correlating to the new scoring scale.

At a national level new studies should be conducted to determine how well the new MCAT correlates to objective outcomes – success in medical school, medical school GPA, USMLE scores, and special selection. The intent of the new MCAT is to provide a better tool for differentiating candidates (Gabbe & Franks, 2011), and medical schools across the country are eager to see how this new exam helps.

This study was limited in its ability to be used to measure how well the admissions committee at East Tennessee State University is fulfilling its mission, further studies that might be of greater help are likely to be qualitative in design. It may be the interview scores and committee rating scores do not have great inter-rater reliability. Even if support existed to show this is true, it is likely that qualitative designs would give a more detailed perspective on the work of the committee. As noted in Chapter 1, much of the committee's work is heavily dependent on human one-on-one interaction through the interview process and subsequent committee deliberation. A qualitative study that could provide themes to reflect upon might give the committee the feedback and confidence it needs in continuing to do its work.

This study was designed to see how well the admissions committee is meeting its mission by reviewing data to analyze correlations and predictive values; it was not intended for the study to provide comment on whether the committee was admitting students who would not be successful in medical school. Students with lower MCAT scores seem to have a greater chance of selecting a primary care specialty. It seems reasonable that occasionally the committee will admit a student with a much lower MCAT score if other factors such as undergraduate GPA seem to support his or her ability to succeed in medical school.

With this acceptance comes the greater risk of admitting an individual who is not able to succeed in medical school academically. Therefore, another area for future study is to retrospectively review aggregate data from individual students who have had significant academic difficulty in medical school to see what if any trends could be identified in the admission data including MCAT, undergraduate GPA, interview score, and committee rating score.

Another useful study would be to review the trends of the admissions committee data over time. This study was confined to an 11-year time period with the data analyzed as one block. However, it is reasonable to assume that demographics of applications may have changed over time. Additionally, the committee membership changes as new members rotate on as others rotate off the committee over a period of time. Thus, analyzing trends year by year may provide the committee with additional insight.

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