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Erin Myszkowski  
*University of Central Florida*



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MEDICAL SCHOOL PREREQUISITE COURSES  
COMPLETED AT TWO-YEAR COLLEGES  
BY MEDICAL SCHOOL MATRICULANTS:  
AN ANALYSIS AT THE  
UNIVERSITY OF CENTRAL FLORIDA

by

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B.S. University of Wisconsin-Madison, 2001

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A dissertation submitted in fulfillment of the requirements  
for the degree of Doctor of Education  
in the Department of Educational and Human Sciences  
Higher Education & Policy Studies  
in the College of Education  
at the University of Central Florida  
Orlando, Florida

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Major Professor: Dr. Rosa Cintrón

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## ABSTRACT

Many medical school admissions personnel and pre-health advisors advise premedical students not to take the medical school prerequisite courses at two-year colleges because they believe the courses are less academically rigorous than the same courses at four-year institutions (Losada, 2009; Marie, 2009; Thurlow, 2008, 2009a, 2009b). According to this belief, premedical students who complete the medical school prerequisite courses at a two-year college could be at a disadvantage in regard to medical school admission compared to those students who complete the medical school prerequisite courses at a four-year institution. In an effort to analyze these perceptions, this study examined factors pertaining to the enrollment of premedical students in the medical school prerequisite courses at two-year colleges.

This research study examined the enrollment statuses and grades of matriculants to medical school from the University of Central Florida between 2007 and 2011. Specifically, the type of student enrollment of the matriculants who completed any of the medical school prerequisite courses at a two-year college was examined, and both their type of institutional enrollment and grades in the organic chemistry courses were also examined. The results indicated that there were significant differences in types of student enrollment in most medical school prerequisite courses at two-year colleges, and based on these differences, the researcher identified whether completing certain prerequisite courses as certain types of enrollment were either “more acceptable” or “less acceptable” for premedical students. In addition, the results indicated that there were not significant differences in organic chemistry grades based on the type of institution where the courses

were taken. Based on these results, the researcher could not categorize the courses at either type of institution as “more rigorous” or “less rigorous” than the other, but the researcher also recommends that these results should be perceived cautiously until additional, more in-depth research can be conducted on this topic. Finally, recommendations and implications for premedical students, pre-health advisors, medical school admissions personnel, two-year colleges, and four-year institutions were discussed.

To my father and mother, Rodger and Shirley,  
and my sister and brother, Renée and Evan,  
and my family, friends, teachers, and coaches  
from Peshtigo, Wisconsin,  
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the values of hard work, discipline, and perseverance.

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## CHAPTER 1 INTRODUCTION

### Background

Applicants to medical school are often advised by medical school admissions personnel and pre-health advisors to avoid taking the medical school prerequisite courses (i.e., two courses in biology, two courses in general chemistry, two courses in organic chemistry, two courses in physics, and various courses in mathematics) at two-year colleges such as community colleges or junior colleges (Losada, 2009; Marie, 2009; Thurlow, 2008, 2009a, 2009b). Some medical school admissions personnel have expressed the belief that the medical school prerequisite courses taught at two-year colleges are less academically rigorous than the same courses taught at four-year colleges or universities (Baffi-Dugan, 2008; Losada, 2009; Marie, 2009; Medical School Admission Requirements [MSAR], 2011; Thurlow, 2008, 2009a, 2009b; see Appendix A for each medical school's policy or preference). In contrast, other medical school admissions personnel have indicated that the medical school prerequisite courses taught at two-year colleges are comparable in academic rigor to the same medical school prerequisite courses taught at four-year colleges or universities (Baffi-Dugan, 2008; MSAR, 2011; University of Washington Pre-Health Advising, 2011; see Appendix A for each medical school's policy or preference). These conflicting perspectives raise an important question about whether taking the medical school prerequisite courses at a two-year college will disadvantage students who do so by making them less competitive for admission to medical school as compared to their premedical peers who take the

prerequisite courses at a four-year college or university (Losada, 2009; Thurlow 2008, 2009a, 2009b).

The level of academic rigor of courses has often been assessed by examining the institution where the courses were taken (Julian, 2005). In other words, an institution's level of "institutional selectivity" can serve as a proxy for an assessment of an institution's academic quality or rigor of courses. For example, if a student earned an "A" grade in a course at a local community college, and another student earned an "A" grade in the same course at Harvard, many would agree that there was a higher level of academic rigor in the course at Harvard than at the local community college because the institutional selectivity of Harvard is greater than the institutional selectivity of the local community college. Most often, medical school applicants will take the medical school prerequisite courses at either a two-year college or a four-year institution, and even though it is likely that there are variable levels of academic rigor within each type of institution, the stereotype seems to exist that courses taken at two-year colleges are less academically rigorous than courses taken at four-year institutions (Thurlow, 2008, 2009b).

The question about the type of institution, two-year or four-year, where an applicant should take the medical school prerequisite courses because of the perceived level of academic rigor at each is an area of much debate for premedical students and pre-health advisors. Common resources that provide information about medical school prerequisite courses are the *Medical School Admission Requirements* (MSAR), the *Premedical Advisor's Reference Manual* (PARM), and each medical school's website.

Among these resources, there is no consensus about the type of institution that premedical students should choose for prerequisite coursework in order to be most competitive for admission to medical school. The variability in their recommendations forces premedical students and pre-health advisors to face difficult questions regarding whether it is best for each student to take the medical school prerequisite courses at a two-year college or a four-year institution based on each student's life circumstances.

Premedical students complete medical school prerequisite courses at two-year colleges for many different reasons. For example, many students who take the medical school prerequisite courses at two-year colleges could be categorized as transfer, transient, accelerated/dual enrollment, or post-baccalaureate students. Although many medical schools disparage medical school prerequisite courses taken at two-year colleges (Baffi-Dugan, 2008; Losada, 2009; Marie, 2009; MSAR, 2011; Thurlow, 2008, 2009a, 2009b; see Appendix A for each medical school's policy or preference), the rationales for why premedical students take the prerequisite course(s) at a two-year college often differ. Medical schools likely hold different perceptions of the types of applicants and their rationales for taking courses at two-year colleges; a likelihood exists that both positive and negative perceptions exist among the schools.

Additionally, a growing number of students, including premedical students, can be categorized as transfer students, or students who choose to begin their higher education at a two-year college (The Chronicle of Higher Education, 2010). These students transfer to a four-year institution at the end of two years, or after they have earned their Associate of Arts (AA) degree, to continue their education towards earning a

bachelor's degree. Because growth in two-year college enrollment has also increased at a faster pace than four-year institution enrollment (The Chronicle of Higher Education, 2010), it is inevitable that medical schools will receive more applications than before from applicants who took courses and/or earned an AA degree at a two-year college. Pre-health advisors (who primarily advise only at four-year institutions, and not at two-year colleges) are likely to find that they are advising a larger population than before of premedical students who began their higher education at a two-year college and earned an AA degree before transferring to a four-year institution.

Regarding two-year colleges, some states in the U.S., including Florida, have larger numbers of students attending two-year colleges than others. As of Fall of 2010, there were 28 Florida state and community colleges that comprise the Florida College System, previously known as the Florida Community College System. Of the 907,753 students enrolled in the Florida College System (annual, unduplicated), 333,272 students were AA degree-seeking (Florida Department of Education, 2011a). Data from Fall of 2009 indicated that only California, with 1,629,609 students enrolled in two-year, public institutions, had more students in these similar institutions than Florida (The Chronicle of Higher Education, 2011). According to the Chronicle of Higher Education (2011), other states with large numbers of students in two-year, public institutions as of Fall of 2009 were Texas (662,634), Illinois (383,960), New York (317,112), Michigan (254,782), and Ohio (196,676). Because of the large number of students enrolled in Florida state and community colleges compared to other states, one could infer that there is a greater

chance that students in Florida who plan to apply to medical school could take some of the medical school prerequisites at a two-year college.

Although Florida had a large number of students enrolled in two-year colleges, Florida also had lower medical school matriculation rates than states with similar numbers of applicants. Table 1 shows the top seven states by number of applicants and matriculants to medical school in 2010 and 2011.

Table 1

*Number of Applicants and Matriculants to Medical Schools by State, 2010 & 2011*

State	Applicants		Matriculants		% Matriculated	
	2010 <sup>a</sup>	2011 <sup>c</sup>	2010 <sup>b</sup>	2011 <sup>d</sup>	2010	2011
California	4,972	5,185	2,154	2,258	43.3	43.5
Texas	3,427	3,163	1,481	1,554	43.2	49.1
New York	2,983	3,147	1,335	1,425	44.7	45.3
Florida	2,334	2,492	915	999	39.2	40.1
Illinois	1,863	1,994	898	931	48.2	46.7
Michigan	1,629	1,721	667	741	40.9	43.1
Ohio	1,561	1,533	721	751	46.2	49.0
All States	42,742	43,919	18,665	19,230	43.7	43.8

<sup>a</sup>Adapted from “Table 10: Applicants to U.S. Medical Schools by Hispanic or Latino Ethnicity, Non-Hispanic or Latino Race, and State of Legal Residence, 2010” by Association of American Medical Colleges, 2010d. Copyright 2009 by the Association of American Medical Colleges.

<sup>b</sup>Adapted from “Table 11: Matriculants to U.S. Medical Schools by Hispanic or Latino Ethnicity, Non-Hispanic or Latino Race, and State of Legal Residence, 2010” by Association of American Medical Colleges, 2010e. Copyright 2009 by the Association of American Medical Colleges.

<sup>c</sup>Adapted from “Table 10: Applicants to U.S. Medical Schools by Hispanic or Latino Ethnicity, Non-Hispanic or Latino Race, and State of Legal Residence, 2011,” by Association of American Medical Colleges, 2011p. Copyright 2011 by the Association of American Medical Colleges.

<sup>d</sup>Adapted from “Table 11: Matriculants to U.S. Medical Schools by Hispanic or Latino Ethnicity, Non-Hispanic or Latino Race, and State of Legal Residence, 2011,” by Association of American Medical Colleges, 2011q. Copyright 2011 by the Association of American Medical Colleges.

Compared to the top seven states, Florida had the lowest medical school matriculation rate in 2010 (39.2%) and in 2011 (40.1%). Therefore, the state of Florida not only had a very large number of students enrolled in public, two-year institutions, but also had a lower than average percentage of applicants matriculating to medical school. From these statistics, one could infer that premedical students in Florida could have the factors of type and/or quality of degree-granting institution where they took the prerequisite courses negatively affecting their chances of admission to medical school.

#### Role of Institutional Selectivity in Medical School Admissions

To assess the academic rigor of the institution where premedical students completed the medical school prerequisite courses, a factor often taken into consideration was an institution's level of selectiveness of students, or "institutional selectivity" (Basco, Way, Gilbert, & Hudson, 2002; Blue, Gilbert, Elam, & Basco, Jr., 2000; Clapp & Reid, 1976; Huff & Fang, 1999; Julian, 2005; Kleshinski, Khuder, Shapiro, & Gold, 2009; Mitchell, 1990; Mitchell, Haynes, & Koenig, 1994; Veloski, Callahan, Xu, Hojat, & Nash, 2000). According to Julian (2005), institutional selectivity was "commonly considered an indicator of selectivity of an undergraduate institution and serves as a proxy for academic quality" (p. 912). Additionally, "institutional selectivity data are used to help control for differences in grading stringency across undergraduate institutions" (Blue et al., 2000, p. S31). In this respect, medical school admissions personnel may use measures of institutional selectivity to help them assess differences in academic quality or rigor across types of institutions.

Medical school admissions personnel may use indices of institutional selectivity to assess the quality or rigor of colleges and universities. For example, some common indices include *Peterson's Four-Year Colleges Entrance Difficulty Index* (Peterson's, 2011), *Barron's Profiles of American Colleges Admissions Selector Rating* (Barron's Educational Services, 2011), or the Higher Education Research Index (HERI), also known as the "Astin Index" (Blue et al., 2000; Kleshinski et al., 2009). Measures of a college or university on an institutional selectivity index can range from "most competitive" to "not competitive," for example. Medical school applicants who took courses at and/or graduated from an institution with a high measure on an institutional selectivity index may be perceived to have higher academic quality. Similarly, applicants who are perceived to have high academic quality could have an advantage in medical school admissions over applicants who are perceived to have low academic quality because they took courses at an institution with a low measure on an institutional selectivity index.

A common way to assess institutional selectivity is to examine a college or university's entrance requirements. Most two-year community and junior colleges do not have entrance requirements, but instead have an "open door" policy for individuals who are over the age of 18 and have graduated from high school or obtained a GED (Sallie Mae, 2011). In addition, two-year community and junior colleges are not ranked by any of the major institutional selectivity indices such as *Peterson's*, *Barron's*, or the Astin Index; these indices only rank four-year institutions. If two-year colleges were ranked by institutional selectivity indices, they would likely be ranked as "not competitive" because



of their “open door” policies. Therefore, if a medical school used institutional selectivity as a proxy for academic quality, and the institutional selectivity of two-year community and junior colleges was very low, students who attended and/or took their medical school prerequisite courses at a two-year college could also be perceived to have low academic quality.

### Two-Year College Coursework and Medical School Admissions

The numbers of applicants and matriculants to medical school who attended two-year community colleges in the past have been very low. In one of the only studies found on this topic, Thurlow (2009a) found that only 2.1% of all medical school *applicants* between 2004 and 2007 had earned an AA degree at a community college and only 8.1% had taken any courses at a community college. Thurlow (2009a) also found that only 1.3% of all of the medical school *matriculants* between 2004 and 2007 had earned an AA degree at a community college and 7.1% had taken any courses at a community college. Additionally, the matriculation rates of applicants with an AA degree (29.0%) were substantially lower than matriculation rates of all applicants (46.7%) from 2004 to 2007, and of applicants with some community college courses but without an AA degree (41.9%; Thurlow, 2009a). Thurlow’s statistics on applicant and matriculant statuses to medical school for community college-involved students, both AA degree-earners and those who took courses but did not earn an AA degree, are included in Table 2.

Table 2 shows that very low percentages of medical school applicants and matriculants either earned an AA degree or took some community college courses.

Thurlow (2009a) concluded that “applicants who received an associate’s degree (AA) have substantially lower success rates in being admitted to medical schools, than either those who were casual enrollers in a community college [i.e., students who took some community college courses but did not earn an AA degree] or those that took no CC [community college] courses” (p. 53).

Table 2

*Applicants and Matriculants to Medical School with an AA Degree or Community College Courses, 2004-2007*

Degree or Courses	Applicants		Matriculants		% Matriculated
	#	%	#	%	
AA Degree	3,084	2.1	893	1.3	29.0
Some CC Courses (non-AA)	12,057	8.1	4,928	7.1	40.9
No CC Courses	133,998	89.8	63,749	91.6	47.6
All Degree Types	149,139	100.0	69,570	100.0	46.6

*Note.* Adapted from “Applicants to US Allopathic Medical Schools Who Take Courses at Community Colleges: How Do They Fare?” by D. Thurlow, 2009a, *The Advisor*, 29(2), 46-53.

### Statement of the Problem

Students can attend two-year colleges for many reasons, including “some economic, some academic, and some cultural” (Cohen & Brawer, 2003, 2008; Stanford School of Medicine, 2011; Vaughan, 1995). More specifically, students can attend community colleges to save money on tuition, complete the basic general education requirements, have time to define a major, have an opportunity to boost their GPA, and

save money by living at home, just to name a few (Kulla, 2009; National Center for Education Statistics, 2003; Provasnik & Planty, 2008; Thurlow, 2009b). Regardless of the reason to attend a two-year college, many academically qualified students choose to attend a two-year college instead of a four-year college or university to begin their college education.

Many resources about preparation for medical school recommend beginning the process during the freshman year of college (Divita, 2010; MSAR, 2011), but it has been recognized that “the guidance and resources available to students regarding a premedical path at most community colleges typically lag behind those found at four-year colleges” (Stanford School of Medicine, 2011, para. 4). The lag in guidance and resources at two-year colleges may be due to most pre-health advisors being employed at four-year institutions, not at two-year colleges. Regardless, the lack of information on the premedical preparation process at two-year colleges would seem to account for some of the difficulties encountered by premedical students who start at two-year colleges.

In addition, as previously stated, the medical school prerequisite courses at two-year colleges are viewed by many medical school admissions personnel as being less academically rigorous than the prerequisite courses at four-year colleges or universities (Baffi-Dugan, 2008; Losada, 2009; Marie, 2009; MSAR, 2011; Thurlow, 2008, 2009a, 2009b; see Appendix A for each medical school’s policy or preference). Losada (2009) stated that the “conventional belief among many prehealth students is that prerequisite classes taken at community colleges will be disparaged by admissions committees and could lead to the rejection of the applicant” (para. 1). Many medical school applicants

who completed courses at two-year colleges fear they will be “judged to be less well prepared for the highly science-based curricula at medical school” (Thurlow, 2009b, p. 35). In addition, “there is considerable skepticism among some medical schools as to the value of CC [community college] courses” (Thurlow, 2009a, p. 53). Because academics play such a large role in medical school success, a medical school’s perception of premedical students at two-year community colleges being not as academically qualified as their peers attending four-year institutions can likely hinder their chances of admission.

Many involved in medical school admissions believe that academic quality and rigor of the prerequisite courses is a key factor. Losada (2009) shared the words of Ms. Judy Colwell, a former Assistant Director of Medical School Admissions at Stanford University, as well as a medical school admissions consultant with more than 19 years of experience as a premedical advisor, who stated that “particularly when looking at science prerequisite classes, medical schools want to make sure that an applicant can perform at a rigorous level. Rigor of the courses is very important and reputation of the school is important too” (para. 5). Similarly, according to Thurlow (2009b), the unwillingness of some medical schools to accept two-year college courses as fulfilling their prerequisite requirements “may be based on specific experiences where some community college courses, especially science courses, have been found to be less rigorous than their counterparts at four-year institutions” (p. 35). Additionally, Colwell advises that both traditional and non-traditional premedical students take their prerequisites “at the most rigorous four-year institution that time and money will allow” (Losada, 2009, para. 15).

Colwell's advice regarding taking the medical school prerequisites specifically at rigorous *four-year* institutions excludes community colleges or junior colleges from the discussion because of their status as *two-year* institutions. Based on this information, premedical students who complete the prerequisite courses at two-year colleges seem to be academically putting themselves at a disadvantage in the medical school admissions process.

Conversely, others involved in medical school admissions believe that the type and/or quality of the institution are less important factors in the admission process. Dr. Amerish Bera, Clinical Professor of Medicine and former Associate Dean of Admissions at the University of California-Davis School of Medicine, "advises that students take prerequisite coursework at the institution they will feel most supported, can build confidence, and have the best opportunity to learn the material" (Losada, 2009, para. 13). Additionally, "whereas it is certain that some community college courses are not as rigorous as those at some four-year institutions, the perception that *all* community college courses are not as demanding seems to be an unjustified generalization" (Thurlow, 2009b, p. 36). Dr. Bera believes that performing well in classes, regardless of the type of institution at which courses are taken, and having a high score on the Medical College Admission Test (MCAT), are of more importance than whether a science course is taken at a two-year college or a four-year institution. He believes that "in the end, the MCAT becomes the great equalizer," (Losada, 2009, para. 12) and "it is most important to have a good GPA that aligns with strong MCAT scores" (Losada, 2009, para. 14). Similarly, in a study by Mitchell (1987), 40% of admission officers reported they "altered their

consideration of MCAT data for applicants at unfamiliar institutions” and “they looked for a correspondence between MCAT scores and GPAs to help them interpret grade data from unfamiliar schools” (p. 876). By believing that the combination of MCAT score and a good GPA are better indicators of future academic performance in medical school, Dr. Bera opens the door for students to take the medical school prerequisite courses at either type of institution—two-year college or four-year institution.

The debate about the type and/or quality of institution where premedical students should take the medical school prerequisite courses has been a question that many pre-health advisors encounter almost daily when advising premedical students. According to Losada (2009), “it is clear that among the advising sources noted there is no clear agreement on the assessment of community college science prerequisites in medical school admissions... even the experts are divided in their advice” (para. 16). Although admission to medical school is multi-faceted, studying this facet of the medical school preparation and admission process can better inform premedical students and allow pre-health advisors to better advise current and future premedical students about how this factor plays a role in their competitiveness for admission to medical school.

### Purpose of the Study

Due to the variability of recommendations from medical school admissions personnel regarding the type and/or quality of institution at which to take the medical school prerequisite courses, it is difficult for premedical students and pre-health advisors to gauge the level of significance that this admissions factor plays in the overall medical

school admissions process. Assessing the level of significance becomes additionally difficult because many medical school applicants apply to a plethora of medical schools. Of the many different medical schools, it is likely that some will be more accepting of and some more discouraging of medical school prerequisite courses taken at a two-year college. Due to the medical schools' different policies and preferences on this topic, unless premedical students complete all prerequisite courses at a four-year university, it is especially difficult for premedical students and pre-health advisors to construct an academic plan that satisfies the policies and preferences of each school.

The main purpose of this study is to further inform premedical students and pre-health advisors about the significance of type and/or quality of institution in medical school admissions. Additionally, the results of this study may also be of interest to medical schools and two-year and four-year higher education institutions. To arrive at the results, this study will examine the differences amongst medical school matriculants from the University of Central Florida (UCF) who completed medical school prerequisite courses at a two-year college. More specifically, this study will examine premedical students' types of enrollment and performances in the medical school prerequisite courses at a two-year college. Overall, the intent of this study is to assess the significance of the different types of student enrollment in two-year colleges and the combination of type of institution and grades in medical school prerequisite courses.

### Significance of the Study

From the information and statistics presented in this study thus far, several inferences can be made from the perspective of medical school admissions personnel.

1. Many two-year colleges, because of their low (or lack of) institutional selectivity, are perceived to be of low academic quality.
2. Because the medical school admissions process is very competitive, a medical school applicant who has taken some or all of the medical school prerequisite courses at a two-year college can run the risk of having this coursework perceived to be of low academic quality.
3. Having coursework perceived to be of low academic quality can make a medical school applicant less competitive for admission than an applicant who took the medical school prerequisite courses at a four-year institution or at an institution perceived to be of high academic quality.

This study has the potential to be significant by adding to the understanding of the role that the type and/or quality of an institution plays in the process of medical school admissions and to further explore how the factors of type of student enrollment in two-year colleges and academic rigor of the type of an institution impacts medical school admissions outcomes.

### Conceptual Framework

Robert Sternberg's Theory of Successful Intelligence (1997, 1999), also known as the Triarchic Theory of Successful Intelligence, has been applied to prior admission-



prediction studies (Sternberg, The Rainbow Project Collaborators, & The University of Michigan Business School Project Collaborators, 2004). Furthermore, Sternberg's theory of successful intelligence has been previously proposed as a theory to guide medical school admissions (Sternberg, 2008). Therefore, even though other theories of multiple types of intelligences exist (e.g., Thurstone, 1938; Gardner, 1983; 1999; Guilford, 1982), Sternberg's theory of successful intelligence was deemed by the researcher to be the most applicable to the study of medical school admission in this study.

Sternberg's theory of successful intelligence has suggested that people are intelligent in a broad variety of ways, but intelligence is often only evaluated through a narrow lens. Over the years, many different definitions of intelligence have been proposed (e.g., Thurstone, 1921; Sternberg & Detterman, 1986), but the conventional notion of intelligence has been "built around a loosely consensual definition of intelligence in terms of generalized adaption to the environment" (Sternberg, 2003, p. 139). Some intelligence theorists extended this definition by believing that a "general ability", or general factor of intelligence, often referred to as *g*, was at the core of all adaptive behavior (Brand, 1996; Jensen, 1998; Sternberg & Grigorenko, 2002). Today, many intelligence theories further extend the concept of general intelligence and focus more upon specific mental abilities housed within the general factor of intelligence (e.g., Carroll, 1993; Gustafsson, 1994; Horn, 1994). Similar to many of today's common intelligence theories, Sternberg's theory of successful intelligence is comprised of three mental abilities: analytical, creative, and practical.

While some theories of intelligence indicate that intelligence can be assessed broadly and with conventional tests, “lay conceptions of intelligence are quite a bit broader than the ones of psychologists who believe in *g*” (Sternberg, 2003, p. 140). Sternberg and colleagues (Sternberg, 1985; Sternberg, Conway, Ketron, & Bernstein, 1981) discovered that even lay persons had a more holistic view of intelligence that consisted of practical problem-solving, verbal, and social-competence abilities (Sternberg, 2003). Of these three abilities, only the first of the three—practical problem-solving—was measured by current conventional tests. Similarly, Sternberg’s theory of successful intelligence indicated that of his three identified types of intelligence (analytical, creative, and practical), only analytical abilities were often measured through conventional tests of intellectual or academic skills (Sternberg, 2003, 2005). Sternberg argued that intelligence should not just be defined “in a classical sense (memory and analytical abilities), but also in the broader sense of taking into account the individual’s creative and practical abilities” (Sternberg, 2003, p. 142). According to Sternberg, intelligence should not be assessed so narrowly, but intelligence should instead be assessed more holistically and broadly.

By definition, successful intelligence is:

1) the ability to achieve one’s goals in life, given one’s sociocultural context; 2) by capitalizing on strengths and correcting or compensating for weaknesses; 3) in order to adapt to, shape, and select environments; and 4) through a combination of analytical, creative, and practical abilities (Sternberg, 2008, p. S105).

To ease in the understanding of this theory, the sections of the theory, along with important concepts/tenets of each section, are illustrated in Table 3, with examination of each of the four sections of the theory of successful intelligence to follow.

Table 3

*Important Concepts from Robert Sternberg's Theory of Successful Intelligence*

General Concept	Detailed Concept
Ability to achieve personal life goals, given one's sociocultural context	<ul style="list-style-type: none"> <li>● "Intelligence" is different to each individual depending on their sociocultural context</li> <li>● Formulating a meaningful and coherent set of goals and having the skills and dispositions to reach those goals</li> </ul>
Capitalizing on strengths and correcting or compensating for weaknesses	<ul style="list-style-type: none"> <li>● People achieve success in many different ways, even within a given occupation</li> <li>● Intelligent people are aware of their strengths and weaknesses and find ways to work effectively within their given abilities</li> </ul>
Adapting to, shaping, and selecting environments	<ul style="list-style-type: none"> <li>● Intelligence is broader than adaptation, but also includes modifying the environment to suit oneself (shaping), and sometimes finding a new environment that is a better match to one's skills, values, and desires (selection)</li> </ul>
Combination of analytical, creative, and practical abilities	<ul style="list-style-type: none"> <li>● The three abilities are distinct, but can be dependent on each other</li> <li>● While all three abilities are needed to be successfully intelligent, one need not be strong in all three all of the time; most tasks can be successfully completed in a number of ways by balancing the three abilities</li> </ul>

The first section of the theory of successful intelligence—the ability to achieve one's goal in life, given one's sociocultural context—"recognize[d] that 'intelligence' means a somewhat different thing to each individual" (Sternberg, 2005, p. 189). In

essence, “intelligence involves formulating a meaningful and coherent set of goals, and having the skills and dispositions to reach those goals” (Sternberg, 2005, p. 189). While different people formulate different goals, according to this section of the theory of successful intelligence, intelligent individuals obtain the skills, abilities, and experiences to position themselves to achieve their goals. To the contrary, unintelligent individuals may set goals without acquiring the skills, abilities, or experiences to achieve their goals. Additionally, an evaluation of intelligence “should not focus on what goal was chosen but rather on whether the individual has chosen a worthwhile set of goals and shown the skills and dispositions needed to achieve them” (Sternberg, 2005, p. 189). Therefore, intelligent individuals set realistic, attainable goals for themselves, while unintelligent and unrealistic individuals will not.

The second section of the theory of successful intelligence—addressing capitalizing on strengths and correcting or compensating for weaknesses—recognized that “people achieve success, even within a given occupation, in many different ways” (Sternberg, 2003, p. 142). Stated differently, “there is no single way to succeed in a job that works for everyone” (Sternberg, 2005, p. 190). People who are good at what they do, or are successfully intelligent, are aware of their strengths and weaknesses and find ways to work effectively within their given abilities. For example, good students discover study techniques that help them learn best. Therefore, they arrange their studying so they can capitalize on their studying-related strengths and either compensate for or correct their studying-related weaknesses (Sternberg, 2005). Some students may study best in groups and others may study best alone; some may learn better visually and others may learn

better verbally. Not all studying techniques work for every student, so students must find the appropriate balance of studying techniques that work best for them to learn most effectively.

The third section of successful intelligence theory, which references the ability to adapt to, shape, and select environments, recognized that “intelligence broadly defined refers to more than just ‘adapting to the environment,’ which is the mainstay of conventional definitions of intelligence” (Sternberg, 2005, p. 190). Instead, “intelligence involves not only modifying oneself to suit the environment (adaptation), but also modifying the environment to suit oneself (shaping) and sometimes finding a new environment that is a better match to one’s skills, values, and desires (selection)” (Sternberg, 2003, p. 142). When a person enters a new environment, that person often hopes to be able to not only adapt to that environment, but also shape the environment to improve upon its initial state. Sometimes, people can fail at adapting to or shaping an environment. In such instances, the appropriate next step is often to select a different environment (Sternberg, 2005). To be successfully intelligent, people need to recognize when they are or are not adapting and shaping their environments; if they are not, then they need to be able to recognize the need to select a new environment.

The fourth section of the theory of successful intelligence, which addresses a combination of analytical, creative, and practical abilities, recognizes that the success of an individual “depends on the individual’s ability to capitalize on analytical, creative, and/or practical strengths and to correct or compensate for these weaknesses” (Sternberg, 2003, p. 142). While all three abilities—analytical, creative, and practical—are needed to

be successfully intelligent, one need not be strong in all three all of the time; most tasks can be successfully completed in a number of ways by balancing the three abilities. For example,

analytical thinking is invoked when components are applied to fairly familiar kinds of problems abstracted from everyday life. Creative thinking is invoked when the components are applied to relatively novel kinds of tasks or situations. Practical thinking is invoked when the components are applied to experience to adapt to, shape, and select environments. One needs creative skills and dispositions to generate ideas, analytical skills and dispositions to decide if they are good ideas, and practical skills and dispositions to implement one's ideas and to convince others of their worth. (Sternberg, 2003, p. 143)

Each of the three abilities is distinctly different from each other and can be measured in different ways. Data suggest that "within a variety of populations, analytical, creative, and practical abilities are relatively distinct" (Sternberg, 2003, p. 145). Although it is possible for the abilities to be dependent on others, one "would be well-advised not to conclude that high levels of traditional [analytical] intelligence imply high levels of creative or practical intelligence, or vice versa" (Sternberg, 2003, p. 145). Additionally, each of the three abilities can be assessed in distinct ways. For example, analytical abilities and memory can be measured by assessing one's abilities to recall and recognize information, as well as to compare, contrast, evaluate, critique, and judge (Sternberg, 2005, p. 190); skills can be measured by traditional tests (Sternberg, 2003, p. 142). Creative abilities are measured by, for example, "having people write and tell short

stories, by having them do captions for cartoons, and by having them use computer software to design a variety of products, such as greeting cards and a company logo” (Sternberg, 2003, p. 145). Finally, practical abilities are measured by, for example, “solving everyday problems presented by means of films and an office-based situational-judgment inventory and a college student situational-judgment inventory” (Sternberg, 2003, p. 145). Therefore, although traditional tests of intelligence often measure analytical ability, both creative and practical abilities are less often measured by traditional tests (Sternberg, 2003; 2005).

Sternberg’s theory of successful intelligence can be broadly applied to medical school admissions as well. According to Sternberg (2008), “we use tests that we know are only modestly to moderately predictive of success in medical school and that measure content that covers only a small fraction of the skills necessary for success as a medical professional” (p. S105). Similarly, traditional methods of teaching and assessment in colleges and universities often only benefit a small number of students with certain ability-based styles. The traditional teaching and assessment almost never benefit the larger body of students who likely have the abilities to be successful, but whose ability-based styles do not correspond with the teaching and learning valued by their college or university. “To rectify this situation, one must value other ability-based styles then change teaching and assessment so that these other ability patterns can lead to success in school” (Sternberg, 2008, p. S105). The theory of successful intelligence helps to identify the broader abilities in which students can possess intelligence, with the additional goal of identifying how these broader abilities can be better assessed.



In addition to identifying the broader abilities in which students can possess intelligence, Sternberg hopes the theory of successful intelligence can assist in improving upon current predictive assessments, such as the Scholastic Aptitude Test (SAT) or MCAT, regarding success in college or medical school, respectively. Although both the SAT and MCAT were designed to assess students' readiness for college and medical school, respectively, (AAMC, 2011j; College Board, 2011a), "as is always the case for a single test or type of test, there is room for improvement" (Sternberg, 2008, p. S105). The theory of successful intelligence suggested "that broadening the range of skills tested to go beyond analytical skills to include practical and creative skills as well might significantly enhance the prediction of college performance beyond current levels" (Sternberg, 2008, p. S105). Additionally, "the theory does not suggest *replacing* but, rather, *augmenting* the SAT, the MCAT, or similar measures in the university admissions process" (Sternberg, 2008, p. S105). Lastly, "the theory of successful intelligence provides one basis for improving prediction and, possibly, for establishing greater equity and diversity" (Sternberg, 2008, p. S105). Therefore, similar to the concept of holistic review in relation to medical school admissions, the theory of successful intelligence indicated that assessing students and their abilities more broadly or holistically will improve prediction and promote greater diversity.

Although the conceptual framework will not be directly addressed in the research questions, a thorough discussion of how the theory of successful intelligence relates to the results of the data analysis and the concept of holistic review is included in Chapter 5.

### Research Questions

Specifically, this study will answer the following research questions:

1. Is there a difference in types of student enrollment in the medical school prerequisite courses at two-year colleges amongst medical school matriculants from the University of Central Florida?
2. What differences, if any, exist in Organic Chemistry I and II grades earned at any two-year college versus any four-year institution by medical school matriculants from the University of Central Florida?

### Definition of Terms

The following definitions were offered to clarify terms used in the proposed study:

*Accelerated/dual enrollment student:* For purposes of this study, an accelerated/dual enrollment student is a student who completed college level courses at a two-year college while in high school and prior to enrolling at UCF.

*Allopathic medical schools:* Also referred to in this study as “medical schools,” these medical schools grant a Doctor of Medicine (M.D.) degree. Medical schools that grant a Doctor of Osteopathic Medicine (D.O.) degree are not included in this study.

*American Medical Association (AMA):* Since 1847, the mission of the American Medical Association (AMA) has been to promote the art and science of medicine and the betterment of public health. Today, their core strategy used to carry out this mission is to help doctors help patients. The AMA unites physicians nationwide to work on the most

important professional and public health issues (American Medical Association [AMA], 2011a).

*American Medical College Application Service (AMCAS):* A non-profit, centralized application processing service that is only available to medical school applicants to the first-year entering classes at participating U.S. allopathic medical schools. Most allopathic medical schools use AMCAS as the primary application method (Association of American Medical Colleges [AAMC], 2011a, 2011f).

*Applicant:* A student who applied to medical school.

*Association of American Medical Colleges (AAMC):* Founded in 1876, the Association of American Medical Colleges (AAMC) is a not-for-profit association representing all 135 accredited U.S. allopathic medical schools as well as other institutions and organizations. In sum, AAMC represents 128,000 medical school faculty members, 75,000 medical students, and 110,000 resident physicians. “The AAMC serves and leads the academic medicine community to improve the health of all” (AAMC, 2011b, para. 1).

*Attributes:* Also known in other literature as noncognitive variables, qualitative variables, or personal qualities, this category of the Experiences-Attributes-Metrics (E-A-M) model includes the applicant’s skills and abilities at time of entry to medical school, personal and professional characteristics, and demographic factors. Examples of *skills and abilities* include active listening, problem solving, written and oral communication, critical thinking, and being multilingual. Examples of *personal and professional characteristics* include resilience, integrity, adaptability, persistence, motivation, intellectual curiosity, and empathy. Examples of

*demographic factors* include socioeconomic status, parental education levels, geography, being a first generation college student, race, ethnicity, and gender.

(Addams, Bletzinger, Sondheimer, White, & Johnson, 2010a, p. 22)

*Community colleges:* Also referred to as two-year colleges, and referred to in the past as junior colleges, community colleges are primarily two-year, public institutions in higher education. Many students enrolled at community colleges pursue an Associate of Arts (AA) degree, and after earning an AA degree, many community college students will transfer to a four-year, bachelor's degree-granting institution. "The mission of the community college is to provide education for individuals, many of whom are adults, in its service region" (American Association of Community Colleges [AACCC], 2011, para. 1).

*Experiences:* This category of the E-A-M model

encompasses the path the applicant has taken to get to where he or she is.

Examples of experiences could include being the primary care-giver of an ill family member, distance traveled, educational background, employment history, research experience, or experience in a health care setting. (Addams et al., 2010a, p. 22)

*Four-year institutions:* Refers to institutions of higher education that grant bachelor's (BS or BA) degrees and often graduate degrees as well. Time-to-degree of bachelor's degree attainment typically takes four years, but can often take a longer period of time or occasionally a shorter period of time depending on a variety of factors such as a student's progression through the courses required within a selected major.

*Holistic review:* A technique utilized in medical school admissions designed by the AAMC with the goal of assisting medical schools in enhancing student body diversity as a means of achieving the mission-based excellence they seek. Within holistic review, student body diversity is broadly framed as experiences, attributes, and metrics (AAMC, 2011i). In practice, holistic review is a “flexible, highly individualized process in which balanced consideration is given to the multiple ways in which applicants may prepare for and demonstrate suitability as medical students and future physicians” (Addams et al., 2010a, p. 17).

*Institutional selectivity:* “Commonly considered an indicator of selectivity of an undergraduate institution and serves as a proxy for academic quality” (Julian, 2005, p. 912). Additionally, “institutional selectivity data are used to help control for differences in grading stringency across undergraduate institutions” (Blue et al., 2000, p. S31).

*Junior colleges:* This term was commonly used in the past to refer to two-year or community colleges. See definitions of two-year colleges and community colleges for more information.

*Matriculant:* A student who applied to, gained acceptance to, and has entered a medical school to pursue an M.D. degree.

*Medical College Admission Test (MCAT):* “A standardized, multiple-choice examination designed to assess the examinee's problem solving, critical thinking, writing skills, and knowledge of science concepts and principles prerequisite to the study of medicine” (AAMC, 2011j, para. 1). The MCAT is taken by students around the time they plan to apply to medical school. The current MCAT includes sections in Biological Sciences

(BS), Physical Sciences (PS), and Verbal Reasoning (VR), as well as a Writing Sample (WS). Each of the BS, PS, and VR sections is scored 1-15 (lowest-highest); the WS is scored J-T (lowest-highest). An MCAT Total score is the sum of the BS, PS, and VR scores.

*Medical School Admission Requirements (MSAR):* “Published annually by the AAMC, the MSAR is the only medical school application guide authorized by medical schools themselves. This comprehensive resource will tell you about each school’s focus, mission, and curriculum, as well as its entrance requirements and selection factors” (MSAR, 2011, p. 1).

*Medical school admissions personnel:* Consists of both medical school admissions officers and medical school admissions committee members. Medical school admissions officers work primarily in a medical school admissions office under titles such as Director of Admissions. Medical school admissions committee members can include medical school faculty members who not only assist in interviewing and making admissions decisions, but can also teach at the medical school and/or practice medicine.

*Medical school prerequisite courses:* The common courses required for admission by most all medical schools. The common prerequisite courses often include: two courses in biology (Biology I and II), two courses in general chemistry (General Chemistry I and II), two courses in organic chemistry (Organic Chemistry I and II), two courses in physics (Physics I and II), and various courses in mathematics (College Algebra, Pre-Calculus, Trigonometry, and Calculus I). Each medical school decides their specific prerequisite courses though, so prerequisite courses for admission can vary by each medical school.

*Metrics:* This category of the E-A-M model “includes the academic/quantitative components of the applicant’s portfolio, most notably GPA and MCAT scores” (Addams et al., 2010a, p. 22).

*Post-baccalaureate student:* For purposes of this study, a post-baccalaureate student is a student who completed courses at a two-year college after earning a baccalaureate degree.

*Pre-health:* A term commonly used to describe either a student who has an interest in pursuing admission to a health profession such as medicine, dentistry, pharmacy, etc., or an advisor at a college or university who provides advising to students interested in the health professions.

*Premedical:* A term commonly used to describe a student who is pursuing admission to medical school.

*Premedical Advisor’s Reference Manual (PARM):* A printed resource for pre-health advisors that addresses “issues and questions of concern to advisors that may not be answered on the school’s website or in the Medical School Admissions Requirement book” (National Association of Advisors for the Health Professions [NAAHP], 2011, para. 1). The PARM includes information on each medical school such as “the admissions process, the competitive applicant, the interview, communication with students, special features, and citizenship/residency” (NAAHP, 2011, para. 2).

*Transfer student:* For purposes of this study, a transfer student is one who completed courses at a two-year college as part of an AA degree or who completed a substantial

number of courses after graduating from high school at an institution other than UCF prior to enrolling at UCF.

*Transient student:* For purposes of this study, a transient student is one who completed a course or courses at a two-year college while taking courses at UCF during the same semester, or while taking courses at UCF in both the previous and subsequent semesters.

*Two-year colleges:* Institutions of higher education that grant an associate's (AA or AS) degree. An associate's degree is often completed within two years. Common examples of two-year colleges are community colleges, or as referred to in the past, junior colleges. After earning an AA degree, many students at two-year colleges will transfer to a four-year, bachelor's degree-granting institution.

*U.S. medical schools:* In the context of this study, U.S. medical schools will describe only allopathic (M.D.-granting) medical schools, as opposed to osteopathic (D.O.-granting) medical schools. Additionally, this study only examined medical schools in the United States, not medical schools in Canada.

### Context

The University of Central Florida (UCF) is a large, metropolitan university located in Orlando, Florida. The University of Central Florida officially began as Florida Technological University (FTU) in 1963; the first classes at FTU were offered in 1968. In 1978, the name of the university was changed to the University of Central Florida by an action of the Florida Legislature. Today, UCF is one of Florida's eleven public universities and has Carnegie Classifications of RU/VH (Research Universities [very



high research activity]), CompDoc/NMedVet (Comprehensive doctoral [no medical/veterinary]), HU (High undergraduate), and MFT4/S/HTI (Medium full-time four-year, selective, high transfer-in). As of Fall of 2010, UCF offered 91 bachelor's, 92 master's, three specialist, 29 doctoral, and one professional degree, and had a student enrollment of 56,337 (UCF Office of Institutional Knowledge Management, 2010c). Of the 56,337 students enrolled at UCF, 47,652 were undergraduate students, 8,585 were graduate students, and 100 were medical students (UCF Office of Institutional Knowledge Management, 2010b).

#### Transfer Students to the University of Central Florida

According to the University of Central Florida (UCF) College Portrait of Undergraduate Education (2010-2011), 12,049 new students enrolled in UCF in Fall of 2010. Of the 12,049 newly enrolled students, 5,896 were transfer students and 6,153 were new freshmen (UCF Office of Institutional Knowledge Management, 2010a). These numbers indicate that 48.9% (5,896) of the new students who enrolled at UCF in Fall of 2010 were transfer students, which many would consider to be a fairly large percentage. Furthermore, UCF was recognized by the College Board in a July 2011 report titled "Improving Student Transfer from Community Colleges to Four-Year Institutions—The Perspective of Leaders from Baccalaureate-Granting Institutions" as one of twelve four-year institutions in the nation that is "known for their commitment to transfer students" (College Board, 2011b, p. D).

The high number of transfer students to UCF is due in part to its consortium agreement with four central Florida area community/state colleges called “DirectConnect to UCF,” or simply DirectConnect. The four community/state colleges in the DirectConnect agreement are Brevard Community College, Lake-Sumter Community College, Seminole State College (previously known as Seminole Community College), and Valencia College (previously known as Valencia Community College). As a part of the consortium agreement, community/state college students who graduate with an Associate of Arts (AA) degree or select Associate of Science (AS) degrees from one of the four DirectConnect colleges are guaranteed admission to UCF as a transfer student (UCF Regional Campuses, 2011). As a result the DirectConnect to UCF agreement, UCF receives many transfer students who enroll after taking approximately two years to complete their associate’s degree at their community/state college.

Of these transfer students enrolling in UCF in Fall of 2010, approximately 70% came from the four central Florida area community/state colleges that are part of the DirectConnect agreement (Reiss & Archer, 2011). The vast majority of these transfer students likely took two years to earn their AA degree at their community/state college and subsequently transferred to UCF. Of the remaining 30% of the transfer students, it is likely that many came from other community/state colleges around Florida.

Furthermore, community college students transferring to UCF are projected to continue to rise. In 2005, a total of 11,332 community college transfer students enrolled at UCF, or 32.9% of all newly enrolled undergraduate students in 2005. In 2010, a total of 14,479 community/state college transfer students enrolled at UCF, or 34.3% of all

newly enrolled undergraduate students in 2010. By 2015, this figure is expected to rise to 18,355 community/state college transfer students, or 40.5% of all projected-to-be enrolled undergraduate students at UCF in 2015 (Reiss & Archer, 2011).

### Current State of Community/State Colleges in Florida

In the last few years, many of Florida's community colleges have gone through a transition. In 1998, access to a baccalaureate degree was identified as a "significant problem" in Florida by the State Board of Community Colleges, the Postsecondary Education Planning Commission (PEPC), and the Senate Education Committee (Florida Department of Education, 2008). In addition, the Pappas Consulting Group (2007) emphasized the importance of establishing additional access points to baccalaureate degree education. As a result, obtaining a baccalaureate degree through a community college became recognized as a feasible solution (Florida Department of Education, 2008). The following year, the Florida Legislature authorized community colleges to seek approval to grant baccalaureate degrees that were in high demand, such as nursing, education, and computer technology (Florida Department of Education, 2008, 2011a). As community colleges in Florida applied for and were granted approval to offer four-year degrees, the names of these institutions began to change.

Starting in 2008, many community colleges in Florida began to change their names to reflect their new function of granting a small number of baccalaureate degrees. To reflect this evolution in the system as a whole, the Florida Legislature approved the name change of the Florida Community College System to the Florida College System.

At the same time, several Florida community colleges dropped the word “community” from their names and simply retained the word “college,” or changed the word “community” to “state” (Florida Department of Education, 2011a). By 2011, of the 28 institutions in the Florida College System, nine were community colleges, eight were considered colleges, and eleven were considered state colleges (The Florida College System, 2011). While many of the Florida community colleges began to offer a small number of baccalaureate degrees, the core mission of their institutions stayed the same (Florida Department of Education, 2011a).

Although many of the institutions in Florida previously known as community colleges are no longer referred to as community colleges, but rather colleges or state colleges, many of their goals and segments of their mission remain in line with those of a community college. For example, goals of the Florida College System include a drive to “ensure open-door access and student success” and “maintain a low tuition policy that supports open-door access” (Florida Department of Education, 2011a, p. 10). In addition, segments of the mission of the Florida College System include “providing lower level undergraduate instruction and awarding associate degrees” and “preparing students directly for careers requiring less than baccalaureate degrees” (Florida Department of Education, 2011a, p. 11). These stated goals and segments of the mission are similar to those of community colleges around the country. Therefore, while many of the Florida community colleges are now considered colleges or state colleges, for the purpose of this study, medical school prerequisite courses taken at Florida colleges or state colleges will

be held in a similar perspective to those taken at two-year community colleges because the missions and goals of these Florida institutions have not drastically changed.

### Limitations and Delimitations

#### Limitations

A few key limitations of this study are acknowledged.

1. Only matriculants to medical school from UCF who used the UCF Pre-Health Profession Advisement Office's (PHPAO) Composite Evaluation Letter (CEL) service were included in this study. While the vast majority of matriculants to medical school from UCF used this service, a number of matriculants from UCF did not use this service and therefore were not included in this study.
2. Due to restrictions on access to data on medical school applicants and matriculants, the researcher was not allowed access to data on students from UCF who only *applied* to medical school, but were not admitted. Instead, only matriculants, or students who *applied* and *matriculated* to medical school, were included in this study. These data restrictions prevented the researcher from examining the differences or relationships amongst medical school *applicants* and *matriculants* from UCF.
3. The recent transition of many Florida two-year community colleges into baccalaureate-granting state colleges and colleges can cause controversy in studying students who attended two-year colleges in Florida and matriculated

to medical school. Disagreement among scholars may exist regarding the researcher's categorization of all community colleges, state colleges, and colleges in the Florida College System as two-year colleges from the perspectives of medical school admissions personnel.

### Delimitations

Some delimitations are also acknowledged in this study.

1. The researcher chose only to study students from UCF who matriculated to medical schools in the most recent five years (2007 to 2011).
2. The researcher chose only to study medical school matriculants' academic performances in Organic Chemistry I and II at two-year colleges, not performances in the other medical school prerequisite courses at two-year colleges.
3. Only students from UCF who matriculated to U.S. allopathic medical schools were included in this study. Many additional premedical students from UCF matriculated to M.D.-granting Caribbean medical schools and U.S. osteopathic medical schools, but they were not included in this study.

### Organization of the Study

Chapter 1 provided pertinent background information and statistics that are necessary to understand the issues in this study, along with the statement of the problem, purpose of the study, and specific research questions that will be examined. Chapter 2

provides a more detailed review of the literature including current resources available to premedical students and pre-health advisors, an analysis of the different types of premedical student enrollment in two-year colleges, information regarding the competitiveness of the medical school admission process, and a thorough review of the AAMC's E-A-M model and concept of holistic review. Finally, Chapter 3 specifies the design of the study, instrumentation used to collect data, statistical procedures, variables, the data collection plan, and a more in-depth discussion of the research questions that are examined.

## CHAPTER 2 REVIEW OF THE LITERATURE

### Introduction

Chapter 2 contains a detailed review of the literature surrounding the topics of medical school admissions and applicants who completed prerequisite courses at two-year colleges. This chapter will begin with a review of the current available resources that discuss medical school admissions and two-year college coursework followed by a discussion of the different types of student enrollment in two-year colleges. The medical school admission process itself, along with the competitiveness of the admission process, will be discussed next. The chapter concludes with a very thorough review of the factors included in the AAMC's E-A-M (Experiences-Attributes-Metrics) model and the AAMC's concept of holistic review in medical school admission.

### Premedical Resources

Three common resources that discussed medical school prerequisite courses include the *Premedical Advisor's Reference Manual* (PARM), the *Medical School Admission Requirements* (MSAR), and each medical school's website. These resources not only listed the specific medical school prerequisite courses required by each medical school, but also provided additional information about the prerequisite courses, such as the type and/or quality of institution where each medical school preferred or required their applicants to take the prerequisite courses. Although each medical school's specific policies or preferences regarding the type and/or quality of institution preferred are



included in Appendix A (if such information was disclosed), this section will further examine the information provided by each of the three resources.

### Premedical Advisor's Reference Manual (PARM)

The *Premedical Advisor's Reference Manual* (PARM), a leading publication from the National Association of Advisors for the Health Professions (NAAHP), was a resource specifically for pre-health advisors and addressed “issues and questions of concern to advisors that may not be answered on the [medical] school’s website or in the Medical School Admission Requirements” (NAAHP, 2011, para. 1). In the description of each medical school included in the *PARM*, information was provided in six main sections, including “the admissions process, the competitive applicant, the interview, communication with students, special features, and citizenship/residency” (NAAHP, 2011, para. 2). In “the competitive applicant” section, information regarding the type of institution and/or academic rigor of coursework was often included. Although the policies and preferences of the medical schools around this topic tended to vary, the *PARM* provided evidence that many of the medical schools discourage applicants from taking the prerequisite courses at two-year colleges.

The policies and preferences stated by medical schools in the *PARM* regarding taking medical school prerequisite courses at two-year colleges were highly variable. Within the *PARM* (Baffi-Dugan, 2008), some medical schools indicated a requirement or strong preference that applicants take the prerequisite courses only at four-year institutions. For example, a medical school in the southwest U.S. stated that “in general,

required courses should have been taken at a four-year institution” (p. 24), and a medical school in the northeast U.S. stated that it “strongly recommend[s] that students take the premedical courses at a four year institution, not at a community college” (p. 100). Other medical schools were less critical of applicants taking prerequisite science courses at two-year colleges. For instance, a medical school in the southeast U.S. stated that “courses taken at junior or community college are not judged differently than any other course” (p. 98), and a medical school in the midwest U.S. stated that “there is equal weight given for... junior college courses... if they are documented on the official transcript” (p. 114). Still, other medical schools in the *PARM* did not state a preference, but commented on the academic rigor of the institution where they believe applicants should take the medical school prerequisite courses. For example, a medical school in the south central U.S. stated that “students should be advised to take the most rigorous courses available” (p. 88), and a medical school in the north central U.S. stated that “all prerequisites should be taken for a grade (not pass/fail) in the most rigorous setting possible. Students should have reasonable explanations for taking... courses at less competitive institutions” (p. 128). Therefore, because the policies and preferences of medical schools regarding two-year college coursework tends to vary by school, and because medical school applicants often apply to a wide range of medical schools, it seems likely that applicants who complete prerequisite courses at a two-year college will be at a disadvantage at at least some of the medical schools to which they apply.

Thurlow (2009b) categorized medical schools’ policies and preferences regarding taking the prerequisite courses at two-year colleges that were listed in the *PARM*. Table 4

indicates Thurlow’s general classifications of these policies or preferences. Thurlow (2009b) classified 36% of the medical schools in the *PARM* as “discouraging or highly discouraging” students from taking medical school prerequisites at community or junior college and 18% as “accepting or conditionally accepting” community or junior college courses towards the medical school prerequisite courses. The remaining 46% of the medical schools in the *PARM* made no mention of a policy or preference regarding prerequisite courses.

Table 4

*General Classifications of Medical Schools’ Policies or Preferences for Applicants Taking Prerequisite Courses at Two-Year Colleges as Listed in the PARM*

Thurlow’s Classifications	% of Medical Schools in the PARM
“Discourage or Highly Discourage”	36.0
“Accept or Conditionally Accept”	18.0
No Mention of a Policy or Preference	46.0

*Note.* Adapted from “Pilot Study to Begin to Identify How to Keep Community College Students in the Pipeline to Medicine: A Detailed Description,” by D. Thurlow, 2009b, *The Advisor*, 29(1), 33-41.

Although many medical schools explicitly stated their policy or preference for the type of institution where they recommend their applicants take the prerequisite courses, it must be noted that many medical schools do not seem to acknowledge such a policy or preference either in-writing or even on their website. Of the medical schools that do not state their policy or preference, it is possible that many more could discourage applicants from taking the medical school prerequisite courses at community or junior college. Regardless, this lessened level of acceptance for medical school prerequisite courses

taken at community or junior college among an explicitly identified 36% of U.S. medical schools could be a significant barrier for many premedical students who plan to complete many or all of the prerequisite courses at a two-year college.

### Medical School Admission Requirements (MSAR)

The *Medical School Admission Requirements* (MSAR) is an annual publication of the Association of American Medical Colleges and is regarded as the most authoritative guide to U.S. and Canadian medical schools (MSAR, 2010, 2011). The chapters in the *MSAR* explain the medical school admissions process and include topics such as exploring medicine as a career, preparation for medical school, the MCAT exam, application to medical school, as well as special topics such as diversity in medicine, data on medical school applicants and acceptees, and financing options for medical education. Overall, the *MSAR* is an extremely comprehensive guide to medical school admissions for both medical school applicants and pre-health advisors.

The most recent version of the *MSAR* (2011) includes both an online and a print-version components. The *MSAR* printed guidebook includes profiles and information on each U.S. and Canadian medical school; the online version includes comprehensive listings and data on each U.S. and Canadian medical school, such as matriculants' demographics, specialty choice, and selection factors. One key piece of information listed on the selection factors page includes each medical school's answer to the question: "Is community college coursework accepted in fulfillment of prerequisites?" Table 5 shows the percentage of how each U.S. medical school answered this question by percentage.

The *MSAR* indicated that while 52.6% of medical schools answered affirmatively to accepting community college coursework in fulfillment of medical school prerequisite courses, 33.1% of medical schools indicated that community college coursework may be accepted “on a case-by-case basis” and 3.0% of medical schools answered “no” to accepting community college coursework. Of the 33.1% of medical schools that indicated acceptance of community college coursework “on a case-by-case” basis, the possibility still exists that some of these schools would not accept community college coursework towards the medical school prerequisite courses. Therefore, according to the *MSAR* (2011), chances of admission for medical school applicants who completed prerequisite courses at community colleges can be hindered at up to 36.1% of these institutions (33.1% “on a case-by-case basis” and 3.0% “no”).

Table 5

*U.S. Medical Schools’ Answers to the Question: “Is Community College Coursework Accepted in Fulfillment of Prerequisites?” as Listed in the MSAR, 2011*

Medical Schools’ Answers	% of Medical Schools in the MSAR
Yes	52.6
On a Case-by-Case Basis	33.1
No	3.0
No Answer	11.3

*Note.* From *Medical School Admission Requirements (MSAR)*, 2011, Washington, DC: Association of American Medical Colleges.

## Medical School Websites

Each medical school's respective website is a common source of information for anyone searching for information about the given institution. Although each medical school's website differs, there are many similar elements within each website. For example, many medical school websites contained links including a general "about us," admissions, academics, research, patient care, community, and others. Due to the similarities in many medical school websites, much of their more detailed information is located on similarly-named pages.

The search for information on each medical school's website regarding respective policies or preferences on the type and/or quality of institution where applicants should take prerequisite courses was completed in a careful, deliberate fashion. After accessing each medical school's website, the admissions page was often the first page searched for this information. Within the admissions pages, the next areas searched varied; however, the information on a policy or preference for quality and/or type of institution was generally found on pages addressing prospective applicants, admissions processes, selection criteria, or frequently asked questions (FAQ). While the search for this information was completed diligently, the possibility was acknowledged that the researcher may not have located the information she sought, even if the information was in fact located on the website. Therefore, while Appendix A details the findings from the websites on these policies or preferences, the researcher may have categorized a medical school website as having "no comment" even if the website did indeed contain the information.

Overall, of all of the medical school websites searched, only 19.5% of the websites featured any comments regarding a policy or preference for the type of institution where applicants should take the prerequisite courses. Table 6 classifies the comments from the medical school websites into the same general categories as Thurlow (2009b), plus the addition of a category called “Accept, but Discourage.” Results indicated that the majority of medical schools (80.5%) did not state their policy or preference on their websites for the type and/or quality of institution where premedical students should take the medical school prerequisites. Of the 19.5% of medical schools that did state their policy or preference on their websites, the medical schools were equally divided between “discourage or highly discourage” (9.0%) and “accept or conditionally accept” (9.0%). Only two medical schools, or 1.5% of all medical schools, stated on their websites that although they did accept coursework taken at a two-year college, they prefer that the medical school prerequisite courses be taken at a four-year university, hence being classified as “accept, but discourage.” Because the majority of medical schools did not state their policy or preference for the type and/or quality of institution where applicants should take the prerequisite courses on their websites, it is difficult for premedical students and pre-health advisors to gauge the competitiveness for admission of potential applicants who have taken a substantial number of medical school prerequisite courses at a two-year college.

Table 6

*General Classifications of Medical Schools' Policies or Preferences for Applicants Taking Prerequisite Courses at Two-Year Colleges as Listed on Medical School Websites (N=132)*

Classifications	% of Medical Schools from Medical School Websites
“Discourage or Highly Discourage”	9.0
“Accept or Conditionally Accept”	9.0
“Accept, but Discourage”	1.5
No Mention of a Policy or Preference	80.5

Table 7 summarizes the policies and preferences of medical schools from the three common premedical resources—*PARM*, *MSAR*, and medical schools' websites—regarding the type and/or quality of institution where medical school applicants should take the medical school prerequisite courses. The results indicated that there is notable variability in the policies or preferences for type and/or quality of institution where premedical students should take the prerequisite courses by each of the common sources of information for premedical students and pre-health advisors. For example, 18.0% of medical schools in the *PARM*, 9.0% of the medical schools' websites, and 52.6% of medical schools in the *MSAR* indicated that they “accept or conditionally accept” medical school prerequisite courses taken at two-year colleges. Therefore, although it is inevitable that many premedical students take the medical school prerequisite courses at two-year colleges for a variety of reasons, it is difficult to assess how taking these courses at two-year colleges affect their competitiveness for admission to medical school.



Table 7

*General Classifications of Medical Schools' Policies or Preferences for Applicants Taking Prerequisite Courses at Two-Year Colleges as Listed in PARM, Medical School Websites, and MSAR*

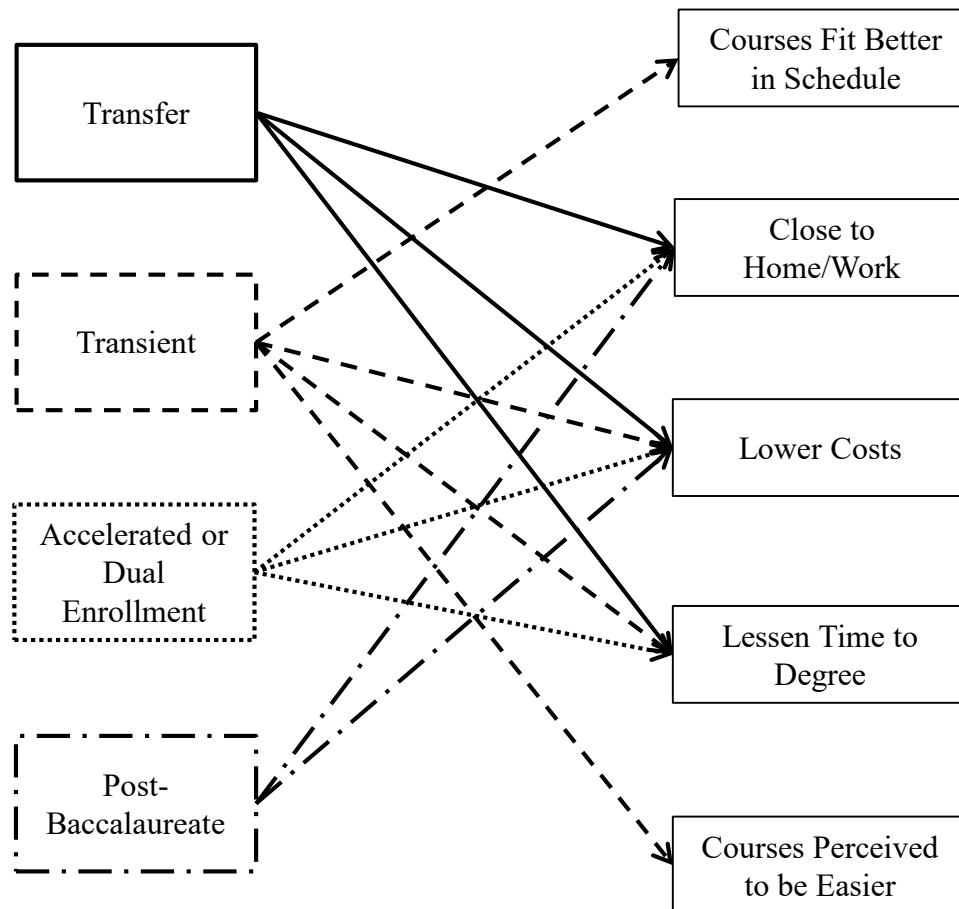
Classifications	% PARM	% Websites	% MSAR
“Discourage or Highly Discourage” / No	36.0	9.0	3.0
“Accept or Conditionally Accept” / Yes	18.0	9.0	52.6
“Accept, but Discourage” / On a Case-by-Case Basis	—	1.5	33.1
No Mention of a Policy or Preference / No Answer	46.0	80.5	11.3

*Note.* From *Medical School Admission Requirements (MSAR)*, 2011, Washington, DC: Association of American Medical Colleges; and “Pilot Study to Begin to Identify How to Keep Community College Students in the Pipeline to Medicine: A Detailed Description,” by D. Thurlow, 2009b, *The Advisor*, 29(1), 33-41.

### Types of Premedical Student Enrollment in Courses at Two-Year Colleges

The types of enrollment of premedical students who complete courses at two-year colleges often differ from each other, along with their rationales for doing so.

Additionally, based on each type of student enrollment and their rationale for why they took the medical school prerequisites at a two-year college, each medical school’s perspective of these rationales could differ. The premedical students in this study were categorized according to each of these types of student enrollment. These different types of premedical students and their different rationales for taking the medical school prerequisite courses at two-year colleges are discussed in greater depth in the subsequent sections. Similarities in rationales are presented graphically in Figure 1; this diagram will be referenced in the discussion for each student type.



*Figure 1.* Relationships between types of enrollment premedical students who complete prerequisite coursework at two-year institutions and rationales.

The types of student enrollment are located in the boxes on the left and rationales are located in the boxes of the right. Multiple arrows pointing to a box at the right indicates that this rationale is utilized by multiple student types.

### Transfer Student: From Two-Year College to Four-Year Institution

Some premedical students began their college education at a two-year college with the intent to earn their AA degree and then transfer to a four-year institution. Often, these premedical students completed some or all of the medical school prerequisite courses at a two-year college while they earned their AA degree. This type of student, formally defined as a student who has attended another college or university, is referred to as a transfer student (Lawson State Community College, n.d.; Mississippi Valley State University, 2011).

Some of the common rationales for why transfer students complete medical school prerequisite courses at two-year colleges are provided in Figure 1. These rationales included a desire to lessen time-to-degree upon transfer to a four-year institution, as well as to lower their costs due to lower course costs at two-year institutions compared to four-year counterparts. Additionally, transfer students can sometimes lower their costs even more by attending college close to home and living at home with family.

Depending on a transfer student's chosen major, advisement could have been provided for them to complete certain medical school prerequisite courses at the two-year college in order to remain on track to complete the academic requirements for their major upon transfer to the four-year institution. Although many transfer students may believe that taking medical school prerequisites courses at a two-year college is a beneficial action due to the reduction in time-to-degree and lowering of overall costs, they could be simultaneously hindering their competitiveness for admission to medical school if any of

the medical schools to which they subsequently apply state that they discourage or do not accept medical school prerequisite courses from two-year colleges.

#### Transient Student: From Four-Year Institution to Two-Year College

Many premedical students began their college education at a four-year institution with the intent to earn their bachelor's degree at the four-year institution. Sometimes, while taking courses at their four-year institution, these premedical students completed a small number of courses at a local two-year college. The student then sent a transcript of courses taken at the two-year college to their four-year institution to have these courses applied to their bachelor's degree course requirements. This type of student, formally defined as a student who wishes to attend an institution other than their home institution for one term, was referred to as a transient student (Articulation and General Studies Committee, 1997; Lawson State Community College, n.d.).

Some of the common rationales for why transient students complete medical school prerequisite courses at two-year colleges are provided in Figure 1. Using the information presented in this figure as a guide, the following were some common scenarios and rationales for taking medical school prerequisite courses as a transient student at a two-year college:

1. A premedical student was moving back to his or her family's home during the summer, where the closest institution was a two-year college. Therefore, taking the course during the summer at the two-year college helped lessen time-to-degree.

2. A premedical student wanted to take a course at their four-year institution, but the day and/or time the course was offered at the four-year institution did not fit in to their schedule of other courses, or conflicted with their work schedule or other necessary obligations. Therefore, they took the course that fits better in their schedule at a nearby two-year college.
3. A premedical student received little or no any financial assistance for college and was struggling to pay for courses and other bills. The student knew that the medical school prerequisite courses at a nearby two-year college were less expensive than the same courses at their four-year institution. Therefore, they took the course(s) at the nearby two-year community college because they were more affordable.
4. A premedical student heard from other students that a certain prerequisite course was very difficult at their four-year institution and many students received poor grades in the course. Therefore, instead of taking the course at the four-year institution, they took the course at a nearby two-year college where they perceived the course to easier and their grade in the course would not lower their GPA.

Although each of these scenarios can occur for premedical students, medical schools could perceive the rationales for some of these scenarios more positively or negatively than other rationales.

## Accelerated Student: From High School & Two-Year College to Four-Year Institution

Some premedical students were very academically advanced in high school and therefore pursued options that allowed them to earn college credit while still enrolled in high school. The two most common acceleration mechanisms included credit by exam and dual enrollment (Florida Department of Education, 2010). To earn credit by exam, “students typically enroll in advance coursework then pass an associated standardized exam” (Florida Department of Education, 2010, para. 1) such as Advanced Placement (AP) or International Baccalaureate (IB; Waits, Setzer, & Lewis, 2005). Similarly, dual enrollment programs allowed high school students to complete college courses while still enrolled in high school (Florida Department of Education, 2010; Kleiner & Lewis, 2005). By receiving credit by exam or being dually-enrolled in both high school and college, these students often accumulated a larger number of college credits prior to entering college than many of their peers. Therefore, when these students began college, they were referred to as accelerated students. An accelerated student is formally defined as a student enrolled in high school and college courses simultaneously while in high school (dual enrollment), and therefore enters college in an accelerated fashion with numerous college courses completed (Articulation and General Studies Committee, 1997; Florida Department of Education, n.d.).

Dual enrollment of academically advanced high school students in colleges was a common practice in the U.S. (Kleiner & Lewis, 2005), but it is not always possible for students to be dually enrolled in both high school and a *four-year* institution because of the lack of proximity of many four-year institutions to a student’s high school. Instead,

chances were greater for students in high schools in many parts of the U.S. to be located in closer proximity to a two-year community college than a four-year institution. More often, accelerated students were therefore dually enrolled in both high school and a two-year community college rather than high school and a four-year institution.

Some of the common rationales for why accelerated students complete medical school prerequisite courses at two-year colleges are provided in Figure 1. Many of these rationales were similar to those of transfer and transient students. By completing college courses at a two-year college while enrolled in high school, accelerated students hoped to lessen their time-to-degree. Additionally, accelerated students hoped to lower their costs because the costs of two-year college courses were generally less expensive compared to courses at four-year institutions. For some students, course costs can be waived completely if formally taken through dual enrollment (Florida Department of Education, n.d.). While lessening their time-to-degree and reducing educational expenses were seemingly positive choices for accelerated students, the effects of taking the prerequisite courses at a two-year college can sometimes lead to more negative than positive perceptions in terms of competitiveness for eventual medical school admission and their own academic development.

#### Post-Baccalaureate Student: From Four-Year Institution Graduate to Two-Year College

Some premedical students had not considered a career in medicine during their initial undergraduate years. For students who chose a career that more closely matched to their non-medically-related interests while earning their bachelor's degree, they often

chose a major that did not include many science courses because a firm knowledge of the sciences was unnecessary at the time for their career choice. Sometimes, after these students graduated with their bachelor's degree and worked for a number of years, an event or realization occurred in their lives that made them feel the need to pursue a career in medicine. Often, these students chose to return to college and enroll in the medical school prerequisite courses required for application to medical school.

Because these premedical students had already earned a bachelor's degree, many were not seeking to earn a second bachelor's degree prior to beginning medical school. Instead, they planned to complete only the science courses that were required for preparation and application to medical school. These students are often referred to as post-baccalaureate premedical students. The University of Washington (2011) formally defined a post-baccalaureate student as "a student [who] has already earned a baccalaureate degree from a regionally accredited college or university and is returning to college to complete additional undergraduate coursework," and sometimes "completing coursework required for application to graduate school or a professional program such as medical school" (para. 1).

Some post-baccalaureate premedical students continued to continue their employment while completing the medical school prerequisite courses. Because of this choice to continue their employment, they were sometimes limited to where they could take the medical school prerequisite courses. Therefore, due to the location of either their employer or their home, the only option for post-baccalaureate students to complete the medical school prerequisite courses was a two-year college.



Some of the common rationales for why post-baccalaureate students complete medical school prerequisite courses at two-year colleges are provided in Figure 1. These rationales were often similar to the rationales of transfer, transient, and accelerated students. Similar to accelerated students, the chances were greater for post-baccalaureate premedical students in many parts of the U.S. to be located in closer proximity to a two-year community college than a four-year institution. Additionally, similar to transfer, transient, and accelerated students, post-baccalaureate premedical students were often attracted to the lower tuition of courses at two-year colleges when compared to four-year institutions. Many post-baccalaureate premedical students believed that completing the medical school prerequisite courses at a lesser expense at a two-year college close to home and work positively influenced their preparation for admission to medical school. Instead, post-baccalaureate students run the risk of medical schools holding a negative perception of the prerequisite courses at two-year colleges because of the perceived lack of academic rigor.

#### Competitiveness of Medical School Admission

Admission to medical school has been very competitive for premedical students. Data from the Association of American Medical Colleges (AAMC) showed that only 45.2% of allopathic medical school applicants actually gained acceptance to medical school between 2008 and 2010, with 56,255 acceptees out of 124,503 applicants (AAMC, 2010g). Table 8 displays the top five medical schools in the U.S. that received the highest number of applications in 2010. George Washington School of Medicine and Health

Sciences received the highest number of applicants (14,008) who ultimately competed for only 177 first-year medical school seats at the school, yielding a 1.3% matriculation rate (AAMC, 2010b).

Table 8

*U.S. Medical School Applications by Schools with Most Applications, 2010*

Medical Schools	City, State	Applications	# Matriculants	% Matriculated
George Washington University School of Medicine and Health Sciences	Washington, DC	14,008	177	1.3
Drexel University College of Medicine	Philadelphia, PA	12,584	260	2.1
Georgetown University School of Medicine	Washington, DC	11,549	196	1.7
New York Medical College	Valhalla, NY	11,344	194	1.7
Boston University School of Medicine	Boston, MA	11,230	178	1.6

*Note.* Adapted from “Table 1: U.S. Medical School Applications and Matriculants by School, State of Legal Residence, and Sex, 2010,” by the Association of American Medical Colleges, 2010b. Copyright 2009 by the Association of American Medical Colleges.

On the other end of application spectrum, Table 9 shows the top five medical schools in the U.S. that received the fewest number of applications in 2010. For example, the University of Mississippi School of Medicine only admitted applicants from the state of Mississippi. This arrangement contributed to it receiving the fewest number of applicants to a U.S. medical school in 2010 with 310 applicants for 135 first-year medical school seats, or a 43.5% matriculation rate (AAMC, 2010b).

Table 9

*U.S. Medical School Applications by Schools with Fewest Applications, 2010*

Medical Schools	City, State	Applications	# Matriculants	% Matriculated
University of Mississippi School of Medicine	Jackson, MS	310	135	43.6
University of North Dakota School of Medicine and Health Sciences	Grand Forks, ND	318	62	19.5
Sanford School of Medicine The University of South Dakota	Vermillion, SD	455	54	11.9
University of New Mexico School of Medicine	Albuquerque, NM	688	94	13.7
Louisiana State University School of Medicine in Shreveport	Shreveport, LA	727	118	16.2

*Note.* Adapted from “Table 1: U.S. Medical School Applications and Matriculants by School, State of Legal Residence, and Sex, 2010,” by the Association of American Medical Colleges, 2010b. Copyright 2009 by the Association of American Medical Colleges.

An additional statistic of interest involved the number of applications per student. In 2010, a total of 42,742 applicants to U.S. allopathic medical schools submitted 580,304 applications, for an average of 13.6 individual medical school applications per applicant (AAMC, 2010b). Data on application and matriculation rates illustrated that medical school admission is not guaranteed; often only a small percentage of applicants gain admission.

To be competitive for admission to medical school, most premedical students gained a variety of experiences, possessed specific attributes, and earned high metrics such as GPA and MCAT scores. Table 10 shows the mean GPA and MCAT scores of applicants and matriculants to medical school in 2010. The AAMC (2010f) reported that the mean total GPA of matriculants to U.S. medical schools was 3.67 and the mean science GPA was 3.61. Furthermore, the AAMC indicated that the total MCAT mean score of matriculants to U.S. medical schools in 2010 was 31.1 out of a highest possible total score of 45. The mean section scores for these same matriculants, each out of a maximum of 15 points and summing to the total MCAT score when combined, were 10.8 in Biological Sciences (BS), 10.4 in Physical Sciences (PS), and 9.9 in Verbal Reasoning (VR).

The AAMC (2010f) also provided the corresponding mean GPA and MCAT scores of *applicants*, also located in Table 10. These figures included a mean total GPA of 3.53, a mean science GPA of 3.43, and a total MCAT mean score of 28.3. The differences in GPAs and MCAT scores between matriculants and applicants were 0.14 for total GPA, 0.18 for science GPA, and 2.8 for total MCAT score. These differences in metrics were very small, providing evidence that medical school admissions personnel evaluated and considered factors beyond metrics when making admission decisions.

Table 10

*GPAs and MCAT Scores for Applicants and Matriculants to U.S. Medical Schools, 2010*

Metrics	Applicants		Matriculants	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Total GPA	3.5	0.3	3.7	0.3
Science GPA	3.4	0.4	3.7	0.3
Total MCAT	28.3	5.5	31.1	4.1
MCAT Verbal Reasoning (VR)	9.1	2.1	9.9	1.7
MCAT Physical Sciences (PS)	9.4	2.3	10.4	1.9
MCAT Biological Sciences (BS)	9.8	2.1	10.8	1.7

*Note.* Adapted from “Table 17: MCAT Scores and GPAs for Applicants and Matriculants to U.S. Medical Schools, 1999-2010,” by the Association of American Medical Colleges, 2010f. Copyright 2009 by the Association of American Medical Colleges.

Regarding extracurricular experiences recommended for medical school, the *Medical School Admission Requirements* (MSAR) published annually by the AAMC, served as a good resource for information regarding admission to medical school. The MSAR cited the percentage of accepted applicants to each medical school who had community service/volunteer work, medically-related work, and research. Table 11 identifies the percentage of accepted applicants to the 2009 and 2010 entering classes and with such experiences.

For accepted applicants to the 2009 entering classes of all U.S. medical schools, the MSAR (2010) cited that 81% of accepted applicants completed community service/volunteer work in a medical/clinical setting, 76% of accepted applicants reported research/lab experience, and 67% of accepted applicants experienced community

services/volunteer work in non-medical/non-clinical settings. Additionally, for accepted applicants to the 2010 entering classes, the *MSAR* (2011) found that 82% of accepted applicants completed community service/volunteer work in a medical/clinical setting, 77% of accepted applicants reported research/lab experience, and 68% of accepted applicants experienced community services/volunteer work in non-medical/non-clinical settings, all of which represented a 1% increase in all experience areas. Both the AAMC statistics and *MSAR* provided evidence that high GPAs, high MCAT scores, and a variety of extracurricular experiences were needed to be competitive for admission to medical schools.

Table 11

*Percentages of Entering Classes at All U.S. Medical Schools with Experiences as Listed in the MSAR, 2010 and 2011*

Experiences	% in 2009 Entering Classes	% in 2010 Entering Classes
Community Service/Volunteer – Medical/Clinical	81	82
Community Service/Volunteer – not Medical/Clinical	67	68
Research/Lab	76	77

*Note.* From *Medical School Admission Requirements (MSAR)*, 2010, Washington, DC: Association of American Medical Colleges; and *Medical School Admission Requirements (MSAR)*, 2011, Washington, DC: Association of American Medical Colleges.

The *MSAR* copyrighted in 2011 included statistics on the 2010 medical school entering classes of students, and the *MSAR* copyrighted in 2010 included statistics on the 2009 medical school entering classes of students.

In regard to attributes of applicants to medical school, admissions personnel strived to assess applicants for a variety of desirable attributes and characteristics. These attributes included characteristics such as “altruism, motivation for medicine, dedication,

and intellectual curiosity” (AMA, 2010, p. 2). The tools and modalities used to assess these attributes and characteristics included conducting interviews, reading letters of evaluation, evaluating premedical coursework, and examining extracurricular activities and written statements (AMA, 2010). Both the AMA and the AAMC recognized that admissions personnel are not currently as advanced in their abilities to assess applicants’ characteristics as they are in their abilities to assess applicants’ metrics, but both associations are dedicated to improving these attribute assessment abilities. As a result, the AMA had called for “apportion[ing] more weight in admissions decisions to characteristics of applicants that predict success in the interpersonal domains of medicine”, and a goal of the AAMC was “to improve the selection process to create a diverse, capable, and caring physician workforce for the 21<sup>st</sup> century” (AMA, 2010, p. 2).

### Medical School Admissions Process

The process of granting admission to medical school has been multi-faceted and diverse, and can differ for each medical school. The AAMC’s *Handbook for Admissions Officers* (2011h) states that the admissions process to medical school consists of “all procedures related to the recruitment, application, review, interview, selection, and matriculation of students” (p. 18). The admissions process section of the *Handbook for Admissions Officers* delineated the stage of receiving “applications and evaluating applicants” to include the sub-stages of “determination of recipients of secondary application materials, letters of evaluation/recommendation, screening applicants for interviews, the interview process, [and] committee deliberations and decisions” (AAMC,

2011h, pp. 18-22). Completion of these processes and stages requires medical school admissions personnel to evaluate medical school applicants both “on paper” and “in-person”. Both the on-paper and in-person evaluation processes are further examined in subsequent sections.

### “On-Paper” Evaluation

Evaluation of a medical school applicant on-paper included reviewing and evaluating all of the written materials the applicant has submitted to the medical school. Once applications were received by the medical schools, the on-paper evaluation processes described in the AAMC’s *Handbook for Admissions Officers* (2011h) included: “determination of recipients of secondary application materials, letters of evaluation/recommendation, [and] screening of applicants for interviews” (p. 5). In both the “determination of recipients of secondary application materials” and “letters of evaluation/recommendation” processes, medical schools were encouraged to publish their policies so they were clear to all applicants. During the “screening of applicants for interviews” process, admissions personnel were encouraged to “set guidelines for evaluating application files that can be consistently and fairly applied to all candidates” (AAMC, 2011h, p. 20). In addition, during the same “screening of applicants for interviews” process described in the *Handbook*, it was acknowledged that some medical schools only used metrics, such as GPAs and MCAT scores, as thresholds to determine which applicants received further consideration (AAMC, 2011h, p. 20). To the contrary, the AAMC stated “it is well known that virtually every medical school admissions



committee takes criteria beyond MCAT scores and GPAs into account when selecting students” (Addams et al., 2010a, p. 22). Despite this seemingly conflicting information, it has been highly recommended that medical schools incorporate a holistic review of applicants’ metrics, attributes, and experiences during this stage in the admissions process (AAMC, 2011h).

Medical schools that incorporated a holistic review of applicants “on-paper” often assessed applicants by criteria and modalities such as the following:

- undergraduate GPA
- GPA in biology, chemistry, physics, and mathematics courses (i.e., Science GPA or BCPM GPA)
- non-science GPA
- MCAT scores
- quality of degree granting institution (i.e., institutional selectivity)
- breadth and difficulty of undergraduate coursework (i.e., academic rigor)
- letters of evaluation/recommendation from (but not limited to) physicians, faculty members, premedical committees, community leaders, research sponsors, or employers
- involvement in and quality of physician shadowing and/or health related work experience
- involvement in non-health related extracurricular activities during undergraduate and graduate education such as volunteerism, community service, and leadership
- involvement in and quality of undergraduate research experience
- involvement in and quality of academic programs at the graduate or postgraduate levels
- personal comments on the American Medical College Application Service (AMCAS) application or supplemental forms

- status with regard to demographic factors such as age, gender, and racial-ethnic background
- distance traveled (i.e., challenges and hardships overcome)
- socioeconomic background
- state of legal residence
- other criteria (Creighton University School of Medicine, 2011; Louisiana State University Health Sciences Center School of Medicine at New Orleans, 2011; MSAR, 2010, 2011; Mitchell, 1987, 1990; Mitchell et al., 1994; Washington University School of Medicine in St. Louis, 2011).

#### “In-Person” Evaluation

The in-person portion of the evaluation process has been reserved for only the best medical school applicants that are able to progress past the on-paper portion of the evaluation. Medical schools evaluate applicants in-person through a face-to-face interview; hence the “the interview process” was the next stage in the admission process listed in the *Handbook for Admissions Officers* (AAMC, 2011h, pp. 20-21) after the “screening of applicants for interviews” stage. The *Handbook* identified two main goals for medical school admissions personnel when interviewing medical school applicants: “they hope to confirm initial impressions of the applicant and identify personal attributes that should impact the selection process but are not easily recognized in the written application” (AAMC, 2011h, p. 20).

According to the *Handbook* (AAMC, 2011h), the in-person interview serves several purposes, including being able “to evaluate an applicant’s personal attributes and readiness to enter medical school, to afford the applicant the opportunity the acquire

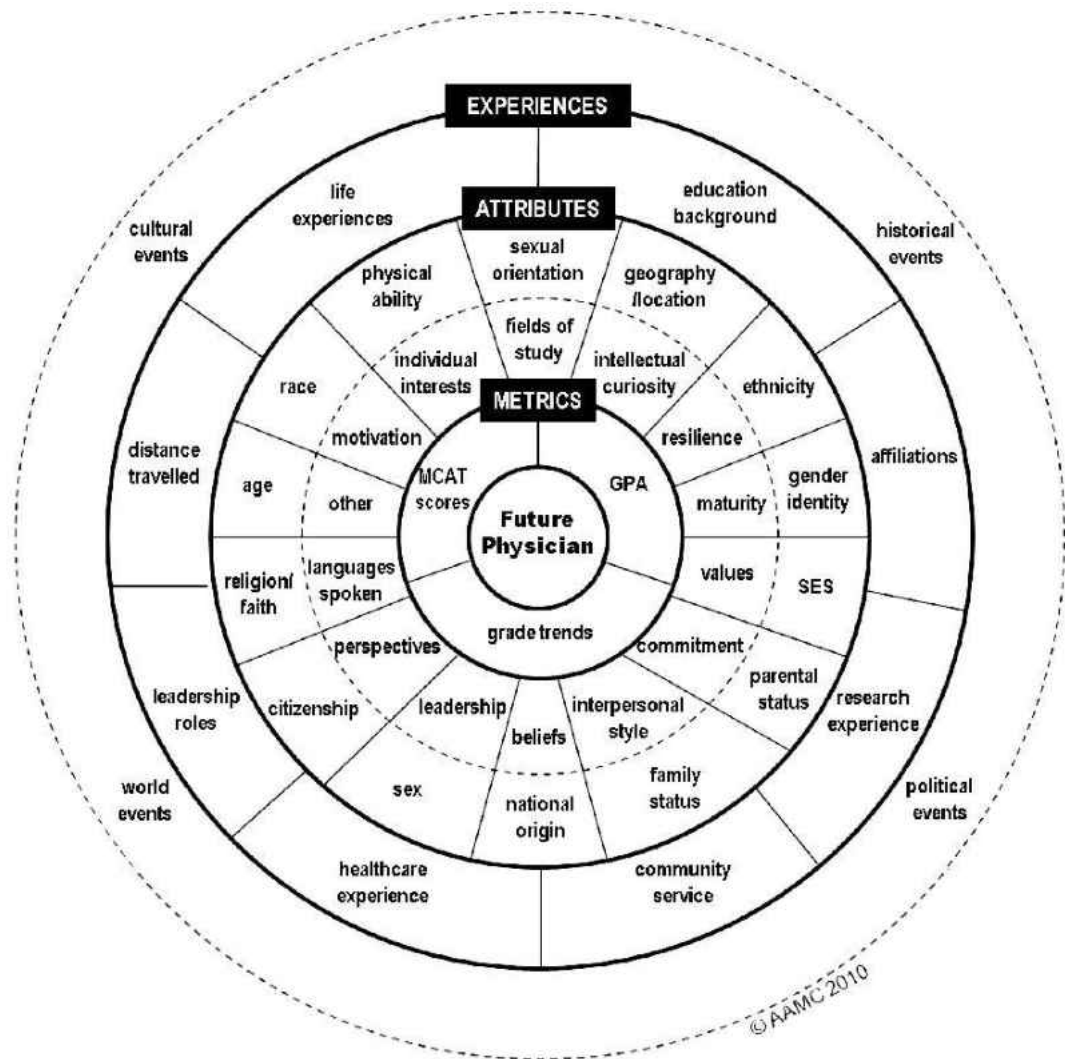
information about the medical school, [and] to recruit applicants to the medical school” (p. 20). Although some applicant attributes were recognized and evaluated during the “on-paper portion of the evaluation process, the in-person interview allowed the medical school to further assess an applicant’s attributes, such as: personality; general functioning and capabilities; verbal communication skills; ability to establish rapport; motivation for the study of medicine; compassion and empathy; maturity; integrity; initiative and productivity; and emotional stability, to name a few (University of Nebraska College of Medicine, 2011; Washington University School of Medicine in St. Louis, 2011). Although assessing applicants’ attributes was an important component of the admissions process, according to the admissions process section of the *Handbook* (AAMC, 2011h), medical schools found the most value in utilizing both on-paper and in-person screening tools to evaluate applicants according to their experiences, attributes, and metrics.

### E-A-M Model

In 2010, in an effort to formalize medical school admission criteria, the AAMC created the E-A-M (Experiences-Attributes-Metrics) model (see Figure 2). The purpose of the creation of the E-A-M model was for “medical schools to develop admission criteria that are clearly linked to institutional priorities and promote medical student diversity as a means of realizing those priorities” (Addams et al., 2010a, p. 21). The E-A-M model has been often referenced in relation to the concept of holistic review. Holistic review was a “flexible, highly individualized process in which balanced consideration is given to the multiple ways in which applicants may prepare for and demonstrate

suitability as medical students and future physicians” (Addams et al., 2010a, p. 17).

Within holistic review, admissions committees worked to identify a balance of applicants’ experiences, attributes, and metrics (E-A-M) that were used to screen, interview, and select applicants with the intent to create diversity amongst the matriculants to the medical school class (Addams et al., 2010a, p. 21).



*Note.* From “Launching of the Holistic Review Admissions Workshop: Roadmap to Excellence Through Diversity,” by A. N. Addams, S. E. White, and G. H. Young, 2010b, slide 43. Copyright 2010 by the Association of American Medical Colleges. Permission requested. Adapted from *Workforce America! Managing Employee Diversity as a Vital Resource* (p. 20), by M. Loden and J. B. Rosener, 1991, Homewood, IL: Business One Irwin.

*Figure 2.* Experiences-Attributes-Metrics (E-A-M) model.

According to the *Roadmap to Diversity: Integrating Holistic Review Practices into Medical School Admission Processes* (Addams et al., 2010a), the definitions of experiences, attributes, and metrics were:

*Experiences:* This category encompasses the path the applicant has taken to get to where he or she is. Examples of experiences could include being the primary caregiver of an ill family member, distance traveled, educational background, employment history, research experience, or experience in a health care setting (p. 22).

*Attributes:* This category includes the applicant's skills and abilities at time of entry to medical school, personal and professional characteristics, and demographic factors. Examples of *skills and abilities* include active listening, problem solving, written and oral communication, critical thinking, and being multilingual. Examples of *personal and professional characteristics* include resilience, integrity, adaptability, persistence, motivation, intellectual curiosity, and empathy. Examples of *demographic factors* include socioeconomic status, parental education levels, geography, being a first generation college student, race, ethnicity, and gender (p. 22).

*Metrics:* This category includes the academic/quantitative components of the applicant's portfolio, most notably GPA and MCAT scores (p. 22).

Each of the factors within the experiences, attributes, and metrics categories are further examined in relation to medical school admissions in the subsequent sections.

## Experiences

According to the *MSAR* (2011), “Your experiences convey a lot about your interests, your capabilities, and your knowledge. As a result, medical schools take a hard look at what you’ve done—and where you’ve been—up to this stage in your life” (p. 40). An applicant’s experiences help medical schools gauge their likeliness of success in their medical school and also gauge the degree to which they can be supportive of a medical school’s mission. Additionally, extracurricular activities are assessed by medical schools not only for their relationship to medical or clinical work, but also for the level of commitment an applicant made to their experiences. Admissions personnel evaluated medical school applicants’ experiences by length of time invested, depth of the experience, and lessons learned in relation to the particular activity (*MSAR*, 2011). The experiences category in the E-A-M model consisted of educational background, affiliations, research experience, community service, healthcare experience, leadership roles, distance traveled, and life experiences. Each of these factors is discussed more in-depth in the following sections.

### Educational Background

Of all of the factors included in the experiences, attributes, and metrics categories, the current study will focus most upon students’ educational backgrounds. A student’s educational background further consists of many factors, including their level of educational attainment. A student’s level of educational attainment has been divided into both “between-college effects” and “within-college effects.” Additionally, students’

educational backgrounds differed greatly and most factors within a student's educational background play a role in shaping the type of student and person they have become. The concept of educational attainment within the context of educational background will be discussed next.

Pascarella and Terenzini (2005) defined educational attainment as "the number of years of schooling completed or degrees earned" (p. 373), and examined educational attainment by researching both between-college effects and within-college effects. Between-college effects included factors such as institution type (two-year college versus four-year institution) and institutional quality (highly selective to not selective); within-college effects included factors such as academic performance, academic major, programmatic interventions, interactions with faculty members, interactions with peers, and general academic and social engagement. Between-college effects will be examined first, followed by within-college effects.

#### Educational Attainment: Between-College Effects

The educational attainment of different types of students varied distinctly by type of institution. To examine these differences, Pascarella and Terenzini (2005) summarized evidence from previous studies on educational attainment in a category called between-college effects. Between-college effects explored "whether discernable differences in student development or the outcomes of college are attributable to the characteristics of the particular institution attended (institutional type, student body selectivity, size, financial resources, and so on)" (p. 9). In the following paragraphs, the between-college



effects of institution type and institutional quality and their relationship to educational attainment are explored.

### Institution Type

Conflicting evidence on educational attainment of students who attended two-year versus four-year institutions suggested that two-year community colleges can both *divert* and *democratize* educational opportunities (Pascarella & Terenzini, 2005). For example, in diverting educational opportunities, researchers have indicated that beginning the pursuit of a bachelor's degree at a two-year institution such as a community college reduced the chances of ultimately earning a bachelor's degree by 15% to 20% (Pascarella & Terenzini, 1991). This evidence supported Clark's (1960) "cooling out" theory which noted that community college attendance reduced a student's chance of ultimately attaining a bachelor's degree. In contrast, in democratizing educational opportunities, Surette (1997) found that "one cannot reject the hypothesis that a year of two-year college credits and a year of four-year credits raise equally the probability of subsequently attending a four-year college" (p. 18), [and] possession of an associate degree raised the probability of subsequent four-year attendance even further" (Pascarella & Terenzini, 2005, p. 376). Additionally, according to Swanson (2002), if a comparison was made between students who started college at a two-year community college versus students who never enrolled into a postsecondary institution, the comparison would likely suggest that students who began postsecondary careers at a two-year community college actually "warmed up" their educational attainment rather than cooling it off (Pascarella &

Terenzini, 2005, p. 381). Therefore, conflicting evidence stated that attendance at a two-year community college both “cooled out” and “warmed up” educational attainment.

Other studies on educational attainment of students who started at a two-year community college versus a four-year institution yielded negative net effects. For example, Whitaker and Pascarella (1994) found that initial enrollment in a two-year institution yielded a statistically significant, negative effect on educational attainment measured 14 years after high school graduation. Ganderton and Santos (1995) estimated that enrollment in a two-year institution and then transferring (versus initially enrolling at a four-year institution) decreased the adjusted probability of graduating with a bachelor’s degree within a six-year period. Lavin and Crook (1990) estimated that students who initially enrolled in a community college were 19% less likely to complete a bachelor’s degree than similar students who enrolled in a four-year institution. Finally, Pascarella, Edison, Nora, Hagedorn, and Terenzini (1998) found that students who enrolled in a community college with plans to complete a bachelor’s degree were, after two years of college, 20% to 30% more likely than their four-year counterparts to have reduced their degree aspirations below a bachelor’s degree. These studies were consistent in pointing to some degree of disadvantage for students who began their postsecondary education at a two-year community college.

Another deciding factor in students’ educational attainment was if a bachelor’s degree-seeking student who started his or her education by attending a two-year community college *actually transferred* to a four-year institution. Once a two-year community college student transferred to the four-year institution, the student’s chances

of ultimately earning a bachelor's degree were about the same as a student who started at a four-year institution—76% versus 78%, respectively (Cuccaro-Alamin, 1997; Pascarella & Terenzini, 2005). Therefore, a key to increasing bachelor's degree attainment of students who started at a two-year community college was to ensure that they make the transfer to the four-year institution.

The time-to-degree also differed between students who began their college education at a two-year community college or at a four-year institution. Within five years of beginning college, 57% of students who began college at a four-year institution earned a bachelor's degree, while only 8% of students who began college at a two-year institution earned a bachelor's degree (Pascarella & Terenzini, 2005). “Baccalaureate degree recipients who begin at a two-year institution are more than twice as likely as their four-year peers to take more than six years to complete a degree” (Pascarella & Terenzini, 2005, p. 376). Similarly, Lavin and Crook (1990) found that time-to-degree increased by about four-fifths of a year for students with initial enrollment at a community college as compared to those in four-year enrollment. Although the time-to-degree of bachelor's degree-seeking students who began at a two-year community college may be longer than their peers who started at a four-year institution, as stated previously, the ultimate goal of attaining a bachelor's degree was about the same after the community college student made the transfer to the four-year institution—76% versus 78%, respectively (Cuccaro-Alamin, 1997; Pascarella & Terenzini, 2005). Therefore, the end result of bachelor's degree attainment was somewhat similar for students who started at a two-year college versus students who started at a four-year institution, but the

time taken to earn the bachelor's degree was longer for students who started at two-year colleges.

Overall, Pascarella and Terenzini ultimately supported Clark's "cooling out" theory in regards to the conflicting evidence of the cooling out or warming up effect of two-year community college attendance on students' educational attainment. Pascarella and Terenzini (2005) concluded from the evidence that "students seeking a bachelor's degree who begin their college careers at a two-year public institution continue to be at a disadvantage in reaching their education goals compared with similar students entering a four-year college or university" (p. 381). While many of the studies on enrollment at two-year community colleges versus four-year institutions produced conflicting results, Pascarella and Terenzini used the evidence on "whether [two-year community college] students in fact transfer to a four-year institution" and "the greater amount of time needed to complete a baccalaureate degree program" as key factors in reaching their conclusion. The inconsistent results provided just cause for future research on these populations, however. Furthermore, the whole of these results provided evidence that the type of institution (two-year versus four-year) a student attended can have a significant influence on their educational background.

### Institutional Quality

Other evidence of between-college effects on the educational attainment of students was more consistent. For example, when evaluating the relationship between students' educational attainment and institutional quality, evidence consistently pointed

to higher probabilities of degree completion as institutional selectivity rose (Pascarella & Terenzini, 2005). According to Julian (2005), institutional selectivity was “commonly considered an indicator of selectivity of an undergraduate institution and serves as a proxy for academic quality” (p. 912). Many different indices exist to attempt to assess an institution’s selectivity, such as *Peterson’s Four-Year Colleges Entrance Difficulty Index* (Peterson’s, 2011), which coded college and university entrance selectivity as most difficult, very difficult, moderately difficult, minimally difficult, and noncompetitive (Kleshinski, Khuder, Shapiro, & Gold, 2009); *Barron’s Profiles of American Colleges Admissions Selector Ratings* (Barron’s Educational Services, 2011), which categorizes institutions by most competitive, highly competitive+, highly competitive, very competitive+, very competitive, competitive, less competitive, and not competitive (Blue et al., 2000); and the “Astin Index” (sometimes referred to as the HERI index) which is comprised of “the average combined SAT score for all individuals admitted to a particular institution” (Blue et al., 2000; Julian, 2005). Medical school applicants who took courses at and graduated from an institution with a high measure on an institutional selectivity index were also perceived to have higher academic quality. Students who were perceived to have high academic quality usually had an advantage in medical school admissions over students who were perceived to have low academic quality.

Most two-year community and junior colleges do not have entrance requirements, but instead have an “open door” policy for individuals who are over the age of 18 and graduate from high school or obtain a GED (Sallie Mae, 2011). In addition, two-year community and junior colleges are not ranked by *Peterson’s*, *Barron’s*, nor are they part

of the Astin Index. If these two-year colleges were ranked by these indexes, they would likely be ranked as being “not competitive” because of their “open door” policy. If using institutional selectivity as a proxy for academic quality, and the institutional selectivity of two-year community and junior colleges was very low, one could infer that students who attended a two-year college could also be perceived to have low academic quality.

#### Educational Attainment: Within-College Effects

Different students within the same institution often have different experiences. Pascarella and Terenzini (2005) studied educational attainment within institutions by examining within-college effects. Within-college effects explored “different subenvironments or experiences inside the institution (for example, resident arrangement, academic major, quality of instruction, peer group involvement, extracurricular activities, interaction with faculty) that may have influences on student change or development” (Pascarella & Terenzini, 2005, p. 9). In the following sections, the within-college effects of academic performance, academic major, programmatic interventions, interactions with faculty members, interactions with peers, and general academic and social engagement and their relationship to educational attainment are explored.

#### Academic Performance

One factor in educational attainment was academic performance, or grades. Grades were often a combination of “a student’s previous academic achievement, general intellectual capacities and skills, academic skills (such as computer literacy and study and

time management skills), and personal traits (such as motivation, self-discipline, and perseverance)” (Pascarella & Terenzini, 2005, p. 396). Even given their multifaceted nature, “college grades may be the single best predictors of student persistence, degree completion, and graduate school enrollment” (Pascarella & Terenzini, 2005, p. 396). While grades were an important piece of educational attainment and a student’s educational background, they are discussed more in-depth in the *Metrics* section of this chapter.

#### Academic Major

A student’s academic major was another factor in educational attainment.

Pascarella and Terenzini (2005) found that

with few exceptions (Astin & Astin, 1993, is one), the largest cluster of studies finds that, net of other factors, students majoring in the sciences, mathematics, and engineering (SME) and/or business or health-related professions are more likely to persist and earn bachelor’s degrees than their peers with majors in the social sciences, humanities, or education (p. 424).

Additionally, fields that usually required attending graduate or professional school, such as medical school, had a strong positive relationship to educational attainment (Pascarella & Terenzini, 2005, p. 425). Therefore, a student’s major often had an influence on their level of educational attainment and their subsequent educational background.

### Programmatic Interventions

Another factor in educational attainment involved programmatic interventions. Some programmatic interventions discussed in Pascarella and Terenzini (2005) included instruction in academic skills (such as Supplemental Instruction [SI]); advising and counseling programs; and undergraduate research programs. The aim of programmatic interventions was to increase student retention and degree completion. Often, students who take advantage of such programmatic interventions benefit both academically and socially. Undergraduate research experience is discussed more in-depth later in the *Experiences* section of this chapter.

### Interaction with Faculty Members

Interaction with faculty members was another factor in educational attainment. Research from previous studies indicated that “student contact with faculty members outside the classroom appears consistently to promote student persistence, educational aspirations, and degree completion” (Pascarella & Terenzini, 2005, p. 417). Most studies indicated that interaction with faculty members was positively related to educational persistence. Astin (1993) found significant positive correlations between student-faculty interaction and *every* academic attainment outcome including college GPA, degree attainment, graduating with honors, and enrollment in graduate or professional school. Therefore, students’ educational backgrounds were usually strengthened if they found a way to interact with faculty members outside of class.



### Interaction with Peers

Interaction with peers, or other college students, was also named as another important factor for students' educational attainment. Astin (1993) asserted that "the student's peer group is the single most potent source of influence on growth and development during the undergraduate years" (p. 398). Therefore, one way for students to increase their chances of persistence and degree completion is to make friends and network with their fellow students.

### General Academic and Social Engagement

Lastly, general academic and social engagement was factor in educational attainment. Tinto's (1975, 1987, 1993) theory of student departure was the most widely used theory that guided research on the persistence of college students in relation to their academic and social engagement in their college or university (Pascarella & Terenzini, 2005). Pascarella and Terenzini (2005), Astin (1993), and Braxton, Sullivan, and Johnson (1997) all agreed that critical factors in students' persistence decisions included their level of involvement and integration in any of the components of an institution's academic and social systems. Hence, as students became more involved in or integrated into their institution's academic and social systems, the greater their chances were of persisting and completing their degrees.

## Affiliations

Another factor in the *Experiences* section of the E-A-M model considered in medical school admission involves affiliations. Some medical schools offer affiliation programs with undergraduate and graduate institutions around the country. Premedical students who participated in these programs often have a direct, guaranteed path from their undergraduate or graduate programs to a particular medical school as long as they perform to the specifications listed by the program. Two common types of affiliations between undergraduate and graduate institutions and medical schools include combined undergraduate/M.D. programs and post-baccalaureate premedical programs. Each program is discussed more in-depth in the following sections.

### Combined undergraduate/M.D. programs

Approximately one quarter of U.S. medical schools offer combined undergraduate/M.D. programs for graduating high school students. The length of these programs range from six to nine years. Depending on the program, the first two to four years of the curriculum consists of undergraduate courses, including the medical school prerequisite courses. The remaining years of the program are then dedicated to completing the medical school curriculum. Students who graduate from these programs often earn both a bachelor's degree from the undergraduate institution and an M.D. degree from the medical school (MSAR, 2011).

The purposes of combined undergraduate/M.D. programs vary by institution, but include the following items:

- to permit highly qualified students to plan and complete a broad liberal arts education before initiating their medical studies
- to attract highly capable students to a sponsoring medical school
- to enhance diversity in the educational environment
- to reduce the total number of years required to complete the M.D. degree
- to educate physicians likely to practice in particular geographic areas or to work with medically underserved populations
- to reduce the costs of a medical education
- to prepare physician-scientists and future leaders in health policy (MSAR, 2011, p. 73).

Only highly qualified, mature high school students committed to a future in medicine are typically admitted to combined undergraduate/M.D. programs. Premedical students who are chosen for these programs often also had their undergraduate extracurricular experiences shaped for a career in medicine.

#### Post-baccalaureate premedical programs

Many undergraduate and graduate institutions also offer post-baccalaureate premedical programs “to assist individuals to pursue a medical career after they have already received a bachelor’s degree” (AAMC, 2011m). The foci of the various post-baccalaureate premedical programs differed with programs specifically geared towards an assortment of student types, including: career-changers (individuals who completed a bachelor’s degree, but had not yet completed the medical school prerequisite courses required for application to medical school); academic record-enhancers (individuals who

completed the required medical school prerequisite courses, but needed to improve their GPA to increase their competitiveness for medical school); and groups underrepresented in medicine, or economically or educationally disadvantaged students (AAMC, 2011m). Some of the post-baccalaureate premedical programs have affiliation agreements with specific medical schools. Therefore, if students enrolled in these affiliation-based programs complete the program requirements to the listed specifications, they can be granted a seat in the entering class of the affiliated medical school.

### Research Experience

Another factor in the *Experiences* section of the E-A-M model is research experience. According to the *MSAR* (2010), 76% of all applicants to U.S. medical schools in 2009 reported research/lab experience. Furthermore, 77% of accepted applicants in 2010 reported research/lab experience (see Table 11), an increase of approximately 10% since 2002 (MSAR, 2011, p. 63). As evidenced by these high percentages, research experience was a factor in medical school admissions that was not only strongly considered, but also increasingly attained by accepted applicants.

Like other experiences, research experience is not often a requirement for medical school, but it often strengthens a premedical student's application for medical school. Participation in research often enhances students' understanding of the topics covered in college coursework. Conducting research also typically involves "understanding more about the process of posing questions" and "investigating [these questions] can enhance [a premedical student's] learning experience, and help [them] develop skills that will be

of benefit to [them] in [their] work as a physician” (Indiana University-Bloomington, 2011, para. 1). Additionally, many medical schools believe that it is important for premedical students to “understand such concepts as the scientific method, statistical significance, and the experimental process so that [they] are capable of critically reviewing research reports in the professional literature and using relevant and valid results in [their] practice” (Baffi-Dugan & Cannon, 2009, p. 45), so experience in research teaches and brings exposure to these concepts. Although research experience greatly differs by student, many medical schools seem to believe that research exposure and experience enhance many of the skills required to become a future physician.

Another reason research experience is noted as a valuable experience for admission to medical school is because physicians must participate in life-long learning. According to the *MSAR* (2011), “Medical schools encourage... research work by premedical students. Activities such as [research work] demonstrate in-depth scholarly exploration and the presence of lifelong learning skills that are essential to a career in medicine” (p. 11). Furthermore, many physicians find it necessary to “read medical journal articles and assess their findings, and evaluate the validity of new research studies on disease and treatments” (Indiana University-Bloomington, 2011, para. 4). Having a strong familiarity with the process of conducting scientific research helps physicians evaluate the validity of research studies. Research experience also helps physicians to think scientifically (Indiana University-Bloomington, 2011). By having experience in research, medical school applicants provide evidence of their intellectual curiosity and

desire for knowledge—both of which are positive traits of physicians—to medical school admissions personnel.

### Community Service

Another factor in the *Experiences* section of the E-A-M model is community service. Community service, in relation to medical school admission, has been defined as “activities where the applicant has helped others by providing support or assistance, apart from their simply seeking exposure to the medical profession” (Elam et al., 2002, p. S23). Because the factor of healthcare experience was examined in a preceding section, it was assumed that the definition of community service in this section would refer to non-medical/non-clinical community service.

Community service experience was reported by a majority of applicants and accepted applicants to medical school. According to the *MSAR* (2011), 65% of all applicants to U.S. medical schools in 2010 reported non-medical/non-clinical community service. Furthermore, 68% of accepted applicants in 2010 reported non-medical/non-clinical community service (see Table 11), an increase of approximately 5% since 2002 (MSAR, 2011, p. 63). As evidenced by the percentage of all applicants and accepted applicants who completed community service, community service was deemed to be a factor in medical school admissions that is not only strongly considered, but is also increasingly attained by accepted applicants.

According to the Massachusetts Institute of Technology (MIT) Career Development Center (2011), “community service is a critical aspect of applying to

medical school” (para. 1). Medical school admissions personnel often look for applicants who “are humanistic in nature, who care genuinely about others, and who have shown evidence of this interest through volunteer or community service activities” (para. 1). The MIT Career Development Center also stressed to premedical students that “it is important that [they] select a community service project that [they] genuinely care about and will have a commitment toward” and “participation in volunteer work... provides some evidence of [their] personal qualities such as integrity, breadth of interest, human relations skills, and motivation towards medicine” (para. 2).

To further the aforementioned notions regarding the usefulness of community service, “admissions committees rely on community service experience information in selecting applicants who may have altruistic inclinations” (Elam et al., 2002, p. S23). In striving to select applicants who can potentially become competent and caring physicians, medical school admissions personnel frequently consider evidence of applicants’ humanitarianism and altruism. Often, these characteristics are assessed through medical school applicants’ participation in community service activities (Elam et al., 2002). Many medical school admission personnel believe that applicants who exhibit significant community service experiences will also exhibit humanitarian concern for the patients and the public upon becoming a physician.

### Healthcare Experience

Another factor in the *Experiences* section of the E-A-M model is an applicant’s previous healthcare experience. Healthcare experience includes any experiences—paid or

volunteer—in a health, medical, or clinical setting. According to the *MSAR* (2011), 78% of all applicants to U.S. medical schools in 2010 reported medical/clinical community service/volunteer clinical experience. Furthermore, 82% of accepted applicants in 2010 reported medical/clinical community service/volunteer clinical experience (see Table 11), an increase of approximately 9% since 2002 (*MSAR*, 2011, p. 63). As evidenced by the percentage of all applicants and accepted applicants who had medical/clinical healthcare experience, healthcare experience was a factor in medical school admissions that was not only strongly considered, but has been increasingly attained by accepted applicants.

Healthcare experience includes “anything that can give you insight into the health fields” (University of Oregon Academic Advising, 2011, para. 2). Some sources have suggested that the best healthcare experiences provide premedical students with “direct contact with ill people, giving [them] more insight into just how difficult it is to work with the sick” (University of Oregon Academic Advising, 2011, para. 2). The University of Oregon provided a sample of recommendations from other colleges and universities regarding gaining healthcare experience. For example, “patient contact is necessary if a student is to be competitive...it is both useful and important that a student understand the medical profession from first-hand experiences...it is important for students to gain medically related experience preferably involving patient contact...there is no specific requirement for health-related experience, nor is one preferred, but the committee would question an applicant who had no exposure to the field” (University of Oregon Academic Advising, 2011, para. 3). Therefore, although patient care experience within healthcare was not deemed an explicit requirement for admission to medical school, gaining this



type of experience can be very helpful for not only testing one's interest in the medical profession, but to also provide evidence of one's care for others in a medical setting.

Another type of healthcare experience brought forth involved physician shadowing. "Shadowing is an opportunity for prospective physicians to witness firsthand what they are getting into" (University of Washington School of Medicine, 2011b, para. 2). Although shadowing physicians does not constitute direct patient care experience, it still serves as very helpful healthcare experience for medical school applicants. "By observing physicians at work, applicants can see how physicians deliver bad news or deal with difficult patients. Applicants will also develop a more realistic understanding of what medicine can and can't do" (University of Washington School of Medicine, 2011b, para. 2). Many medical schools want to verify that their applicants made an informed decision about pursuing a career as a physician, so shadowing physicians not only helps applicants "test drive" the profession, but also helps medical schools know that applicants have observed the profession firsthand and are still committed to the career.

### Leadership Roles

Another factor in the *Experiences* section of the E-A-M model accounts for an applicant's previous leadership roles. Leadership has been defined as "a position of responsibility for others, with a purpose to guide or direct others" (University of Utah School of Medicine, 2011, para. 9). According to the University of Utah School of Medicine (2011), "Dedication, determination, ability to make decisions and a willingness to contribute to the welfare of others are indicators of one's ability to succeed in

medicine” (para. 9). Additionally, leadership can be demonstrated in a variety of ways, including but not limited to “positions in employment, church, community and school organizations including coaching, tutoring, and mentoring” (University of Utah School of Medicine, 2011, para. 9). Therefore, leadership experience is not limited to academic pursuits, but can be assessed very broadly and in numerous environments.

Physicians are leaders in their work environments. Other healthcare professionals often surrounding physicians on a daily basis include nurses, physician assistants, medical technologists or technicians, health service administrators, and many others. These health professionals often look to the physician for direction and leadership regarding patient care. Additionally, leadership skills are essential within the physician profession. For example, less-experienced physicians such as physician interns, residents, or fellows are often supervised and trained by more experienced attending physicians who have completed a medical residency. As physicians ascend through the levels of graduate medical education, they are often required to help train those physicians seeking education and training in medical specialties. Therefore, medical schools often seek students who exhibit leadership skills, as they inevitably become obligatory in a career as a physician.

### Distance Traveled

Another factor in the *Experiences* section of the E-A-M model is distance traveled. Distance traveled has been defined as any obstacle or hardship medical school applicants have overcome to get to their current point in their education (MSAR, 2011).

Many medical school admissions personnel place significance on these types of experiences. Medical schools “view life challenges [applicants] faced and conquered as admirable experience—and indicative of some very positive traits” (MSAR, 2011, p. 40). Though some medical school applicants view their “distance traveled” as an inhibiting factor towards their competitiveness for admission to medical school, many medical school admissions personnel actually view each applicant as an individual with his or her own unique challenges and hardships. By overcoming these challenges and hardships, medical school applicants exhibit some very desirable attributes from the perspective of medical school admissions personnel and therefore can use these triumphs to their advantage in the medical school admissions process.

Garcia, Nation, and Parker (2004) discussed how medical schools took “distance traveled” into account to recruit a diverse medical school class. Many medical school applicants had not had “optimal access to educational opportunities”, and therefore had certain characteristics that must “merit careful attention” (Garcia, Nation, & Parker, 2004, p. 247). According to Garcia, Nation, and Parker (2004), the “distance traveled” factor of certain medical school applicants consisted of the following characteristics:

- *Parental Income, Education, and Occupation:* The lack of role models in the applicant’s home and family, or the possibility that they may be the first in their family to achieve a college or professional degree may limit their contact with people who can help them navigate the challenges of higher education.
- *Precollege Education:* The quality of teachers, curriculum, and available resources varies tremendously across high school districts and is closely tied to educational outcomes.
- *Hours Worked While Attending College:* Applicants who made a significant commitment to a part-time job during their undergraduate years to support themselves or their families cannot be expected to have participated in

extracurricular activities to the same degree as those applicants without similar obligations.

- *Cultural Barriers:* Expected educational outcomes vary among racial and ethnic groups. The applicant may have been subject to an environment in which high levels of educational achievement were neither expected nor valued.
- *Geographic Location or Neighborhood Where Applicant Was Raised:* The location in which a student was raised and attended schools directly affects the number and quality of his or her educational opportunities.
- *Prior Experience with Prejudice:* Underperformance on standardized tests based on stereotype threat is a frequent outcome for students whose abilities have been persistently questioned or challenged by the society at large.
- *Special Family Obligations and Other Circumstances:* Minority students from poor families are frequently asked to contribute to the finances of their household or obliged to provide supervision and assistance to siblings or disabled relatives. (pp. 247-248)

By including the recognition of the “distance traveled” factor in medical school admissions, medical school admissions personnel assure applicants that admission is not solely based on metrics but personal experiences as well.

### Life Experiences

A final factor in the *Experiences* section of the E-A-M model is life experiences. The path to medical school is not always direct for many students. Many premedical students who applied to and matriculated to medical school did not always know that they wanted to become a physician. Therefore, some premedical students graduated with an undergraduate degree in a completely unrelated field to health care and worked in that field for years before they discovered a calling towards a career in medicine. Other

premedical students earned a master's or doctoral degree prior to applying for admission to medical school.

Additionally, daily life itself continues during students' medical school preparation and application processes. Some premedical students become sidetracked for a time from their goal of gaining admission to medical school for instances such as the birth of a child, the death of a loved one, a divorce, or other emotional or financial stressors. Further, other premedical students purposefully incorporate substantial life experiences as a part of their preparation for medical school, such as study abroad experiences, medical mission trips, or other experiences known to broaden an applicant's worldview. The quality and quantity of life experiences encountered by medical school applicants are endless, and these experiences were often beneficial to applicants' growth and development both as a person and hopefully as a future physician.

#### Attributes

Academic and experiential accomplishments alone were not deemed sufficient enough to gain entry to medical school. Although intellectual capacity is an essential skill for a physician, certain other attributes were also equally important. Applicant attributes included "those that portend the ability to develop and maintain effective relationships with patients, work collaboratively with other team members, act ethically and compassionately, and in many other ways master the 'art' of medicine" (MSAR, 2011, p. 11). Additionally, "medical schools will analyze a broad range of attributes, including

those related to the applicant's skills and abilities, personal and professional characteristics, and demographic factors" (MSAR, 2011, p. 41).

Aside from these general qualities, medical schools also give weight to specific attributes in alignment with their missions. The attributes category in the E-A-M model consists of demographic factors such as sexual orientation, geography/location, ethnicity, gender identity, socioeconomic status (SES), parental status, family status, national origin, sex, citizenship, religion/faith, age, race, and physical ability. In addition, other skills, abilities, personal and professional characteristics such as fields of study, intellectual curiosity, resilience, maturity, values, commitment, interpersonal style, beliefs, leadership, perspectives, languages spoken, other, motivation, and individual interests are included as well. Because of their similarities, some attributes may be grouped together and discussed in the same section. Each attribute is discussed more in the proceeding sections.

### Demographic Factors

Although demographic factors are taken into consideration in the admission process for medical school, they must only be considered within current legal guidelines. Many medical schools have an equal opportunity statement posted on their respective websites that references their nondiscrimination policy on the basis of many demographic factors. For example, Dartmouth Medical School (2011) stated that they were committed to the principle of equal opportunity for all its students, faculty, employees, and applicants for admission and employment. For that reason

Dartmouth does not discriminate on the basis of race, color, religion, sex, age, sexual orientation, gender identity or expression, national origin, disability, military or veteran status in access to its programs and activities, and in conditions of admission and employment (para. 3).

Therefore, although medical school admissions personnel consider many demographic factors in their holistic review of applicants in order to admit a diverse medical school class, they take care to not discriminate against applicants based on these demographic factors.

Fully exploring and analyzing the extent to which each of these demographic factors is considered in the medical school admissions process was beyond the scope of this research. Certain key court cases such as *Regents of the University of California v. Bakke* (1978), *Hopwood v. Texas* (1996), *Johnson v. University of Georgia* (2001), *Gratz v. Bollinger* (1995), and *Grutter v. Bollinger* (1996), for example, can provide an overview of court decisions regarding challenges to affirmative action policies used in college and university admissions (National Conference of State Legislatures, 2011). Other articles by Bollinger (2003) and Steinecke, Beaudreau, Bletzing, and Terrell (2007) can be referenced as they discuss the importance of recognizing demographic factors and elaborate upon some of the challenges regarding consideration of certain demographic factors in admission to colleges and universities. The review of demographic factors in admissions contained in the subsequent sections is intended to serve as a brief overview of each demographic factor and the potential role each plays in medical school admissions.

## Sexual orientation & gender identity

Two factors in the *Attributes* section of the E-A-M model are sexual orientation and gender identity. Sexual orientation has been defined as the gender to which one is attracted (Gender Equity Resource Center, 2011). Four main types of sexual orientation exist: heterosexual, homosexual, bisexual, and asexual (TeensHealth from Nemours, 2011). Both homosexual and bisexual were indicated as the sexual orientations of the minority of medical students. Often, students who identified as being in the minority in regards to sexual orientation were referred to as gay, lesbian, or bisexual students.

Gender identity is often conflated with sexual orientation, but they ultimately are different components of sexuality. Gender identity has been defined as a sense of gender, including refusing to label oneself with a gender (Gender Equity Resource Center, 2011). In other words, gender identity is not always consistent with one's genitals (AMA, 2011d). Those who have a gender identity that is different from the social expectations for their genitals are sometimes referred to as transgender. The common types of gender identity include: man, woman, and human (AMA, 2011d). Often, students who identified as being in the minority in regards to sexual orientation or gender identity were referred to as GLBT (gay, lesbian, bisexual, or transgender) students in medical school literature and policies.

Both the AAMC and the AMA recognize the importance of nondiscrimination on the basis of sexual orientation and gender identity. The AMA's "Policy Regarding Sexual Orientation" includes an extensive list of physician-centered and patient-centered policies about the rights of patients and nondiscrimination by physicians (AMA, 2011b). In



addition, the AAMC has worked to address the needs of GLBT medical school students and patients by providing recommendations for GLBT programs and activities. In an AAMC document titled “Institutional Programs and Educational Activities to Address the Needs of GLBT Students and Patients,” the AAMC emphasized the importance of educating medical students and faculty in areas of professional obligations, medical school curricula, competencies, learning environments, and effective practices in working with GLBT medical school students and patients (AAMC, 2007).

#### Geography/Location

Another factor in the *Attributes* section of the E-A-M model includes the geography or location where a medical school applicant resides, also known by the phrase “residency.” As a general rule, many public medical schools indicated a preference for applicants who have residency in their state, while many private medical schools did not indicate a preference for residents from certain states (Princeton University Health Professions Advising, 2011). Because public medical schools are state-supported institutions, they often have a responsibility to ensure that a large majority of each matriculating class is composed of residents of that state (UCF College of Medicine, 2011). For example, medical school applicants who were residents of Florida were preferred in admission by public medical schools in Florida, and medical school applicants who were residents of Wisconsin were preferred in admission by public medical schools in Wisconsin. Therefore, AAMC statistics illustrated that matriculants to

public medical schools have often largely consisted of residents of the same state where the medical school was located (AAMC, 2010b).

#### Race & ethnicity

Two additional factors in the *Attributes* section of the E-A-M model are an applicant's race and ethnicity. Race has been defined as a "social category based on similar physical appearance," and ethnicity has been defined as a "social category based on shared culture or cultural heritage" (Heurtin-Roberts, 2004, slide 13). Although race and ethnicity are categorically different, due to their similarities, research and literature on race and ethnicity in medical school admissions often appeared together.

Since 2002, following U.S. federal guidelines, the AMCAS has asked medical school applicants who are U.S. citizens or permanent residents to self-identify using two separate questions, one pertaining to "ethnicity" and one pertaining to "race" (AAMC, 2010d; 2010e). The question on the AMCAS about ethnicity has asked applicants to self-identify as "Spanish/Hispanic/Latino/Latina" or "Not Spanish/Hispanic/Latino/Latina". The question about race asked applicants to self-identify using non-Hispanic or Latino race categories, and applicants were able to "check all that apply" (AAMC, 2010d, 2010e). Table 12 identifies the number and percentage of applicants and matriculants to medical schools in 2010 by race/ethnicity.

Table 12

*Number and Percentage of Applicants and Matriculants to Medical School by Race and Ethnicity, 2010*

Race/Ethnicity	Applicants <sup>a</sup>		Matriculants <sup>b</sup>	
	#	%	#	%
Hispanic or Latino				
Mexican American	734	1.7	390	2.1
Puerto Rican	722	1.7	377	2.0
Cuban	265	0.6	112	0.6
Other Hispanic or Latino	1,402	3.3	595	3.2
Multiple Hispanic	148	0.4	65	0.4
Non-Hispanic or Latino				
Black or African American	3,062	7.2	1,174	6.3
Asian	8,685	20.3	3,812	20.4
American Indian or Alaska Native	114	0.3	51	0.3
Native Hawaiian or Pacific Islander	86	0.2	25	0.1
White	23,392	54.7	10,665	57.1
Other Race	9	—	3	—
No Race Response	1,275	3.0	611	3.3
More than One Race	1,142	2.7	514	2.8
Foreign	1,706	4.0	281	1.5
<b>Total</b>	<b>42,742</b>		<b>18,665</b>	

<sup>a</sup>Adapted from “Table 10: Applicants to U.S. Medical Schools by Hispanic or Latino Ethnicity, Non-Hispanic or Latino Race, and State of Legal Residence, 2010,” by the Association of American Medical Colleges, 2010d. Copyright 2009 by the Association of American Medical Colleges.

<sup>b</sup>Adapted from “Table 11: Matriculants to U.S. Medical Schools by Hispanic or Latino Ethnicity, Non-Hispanic or Latino Race, and State of Legal Residence, 2010,” by the Association of American Medical Colleges, 2010e. Copyright 2009 by the Association of American Medical Colleges.

*Note.* Percentages are rounded to the nearest hundredth and may not add up to 100 percent.

The statistics shown in Table 12 by race and ethnicity indicated that white students constituted the majority of applicants (54.7%) and matriculants (57.1%) to medical school. All applicants and matriculants combined in 2010 that were considered minorities, or URMs, accounted for 45.3% of all applicants and only 42.9% of all matriculants. When accounting for individual sub-categories of races and ethnicities, these numbers of applicants and matriculants were even smaller.

Many involved in healthcare believe that the race and ethnicity of applicants should be considered in medical school admissions. In 2001, a study by the Institute of Medicine asserted that adding diversity to the health professions was both “the right thing to do and the smart thing to do” (Smedley, Stith, Colburn, & Evans, 2001). The rationale for identifying an increase in diversity as the “right thing to do” was for the benefit of social justice. Regarding social justice, a report by the Sullivan Commission on Diversity in the Healthcare Workforce (2004) identified that 25% of the U.S. population was made up of African Americans, Hispanics, and American Indians, but those same races/ethnicities made up only 6% of practicing physicians. In addition, the former president of the AAMC, Dr. Jordan Cohen, M.D., outlined four essential reasons why diversifying the health professions was the “smart thing to do”:

1. High quality medical education is further enhanced by adequate representation among students and faculty of the diversity of the U.S. society.
2. Increasing workforce diversity will improve access to care for underserved populations.

3. Increasing the diversity of the research workforce can accelerate advances in medical and public health research.
4. Diversity among managers of health care organizations makes good business sense. (Cohen, 2003; Ross, 2009).

With medical school admissions being the initial access point to medical education and becoming a physician, it is likely that much of the responsibility for creating a more diverse population of physicians is in the hands of medical school admissions personnel.

Many governing bodies, including the AMA, have also acknowledged the responsibility of medical school admissions personnel to attempt to eliminate racial and ethnic disparities in health care (AMA, 2011c, 2011e). One of the recommendations to address these disparities was to “increase the proportion of underrepresented U.S. racial and ethnic minorities among health professionals” (AMA, 2011c, para. 5). Medical school admissions personnel have therefore been tasked with finding ways to admit more racially and ethnically diverse classes to medical school.

#### Socioeconomic status (SES)

Another factor in the *Attributes* section of the E-A-M model is an applicant’s socioeconomic status (SES). Social scientists have long agreed that socioeconomic status is comprised of three main elements: parental income, education, and occupation (Grbic, Garrison, & Jolly, 2010). Statistics from the AAMC on all matriculants to U.S. medical schools between 2003 and 2006 indicated that only 15% were classified as having a low socioeconomic status, while 26.7% and 58.3% of matriculants were classified as having

middle and high socioeconomic statuses, respectively (Brewer & Grbic, 2010). Additionally, evidence has suggested that medical students from low socioeconomic statuses are more likely to practice medicine in low socioeconomic areas and are more likely to practice family medicine (Collier, 2010). Evidence has also suggested that “health is unevenly distributed across socioeconomic status” and “persons of lower income, education, and occupation status experience worse health and die earlier than do their better-off counterparts” (Fiscella & Williams, 2004, p. 1139). With health disparities across socioeconomic statuses as well as an impending shortage of primary care and family physicians predicted to occur in the near future (Champlin, 2006; Lloyd, 2009), it seems that medical schools can make a positive contribution to health care by focusing on admission of students from low socioeconomic backgrounds.

#### Parental status & family status

Two more factors in the *Attributes* section of the E-A-M model are an applicant’s parental status and family status. To explore the factor of parental status, the researcher examined both parental income and parental education. When examining medical school students by parental income, a consistent trend between 1987 and 2005 appeared such that there were many more students in medical school whose parents’ income was in the upper quintile of income for all U.S. households than were students in medical school whose parents’ income was in the lowest quintile of income for all U.S. households (Jolly, 2008). “The percentage of students from the highest quintile has never been less than 48.1% or more than 56.9%. The fraction of students from the lowest quintile has

never been greater than 5.5%” (Jolly, 2008, para. 8). Additionally, more than three quarters of medical students came from families with income levels in the top two quintiles (Jolly, 2008). These statistics suggest that a medical school applicant has a better chance at admission to medical school if his or her parents’ income level was high.

In examining parental education in relation to medical school admission, similar trends existed. While approximately one-half of medical students’ fathers were shown to hold a graduate degree (including professional degrees), only 12% of the weighted sample of men in the U.S. population in general held this credential (Grbic et al., 2010). This statistic was similar for women; approximately one third of medical students’ mothers were shown to hold a graduate degree, but only roughly 10% of U.S. women in the weighted general population sample did so (Grbic et al., 2010). Moreover, differences in parental education existed among racial ethnic groups. Educational profiles differed greatly along racial and ethnic lines; parental education among African Americans and Hispanic/Latinos was shown to be at significantly lower levels than those among Asians and whites (Grbic et al., 2010). An additional study indicated that parental income was correlated to MCAT scores for both majority and minority medical school students (Fadem, Schuchman, & Simring, 1995). Therefore, trends related to parental status as measured by parental income and parental education indicated that students of parents with high levels of both income and education have historically had greater success in gaining admission to medical school.

The family status of medical students also played a role in the level of support a medical student felt and the decisions made during medical school. Due to the academic

rigor of medical school, it was assumed that a medical student ideally had a solid family support system to help them cope with any struggles, academic or otherwise, that occurred during medical school. This level of support from family was evidenced in the Medical School Graduation Questionnaire, which indicated that 32.3% of student respondents listed “family expectations” as having a “strong influence” or a “moderate influence” in helping them choose their medical specialty (AAMC, 2011, p. 31).

Although no literature or particular research was located addressing the specific role of family status (sans parental status) in the medical school admissions process, the presence and influence of family was assumed to play a role in the level of support students felt during medical school, and was found to have an effect on decisions that medical students made regarding their specialty as a future physician.

#### Citizenship & national origin

Two factors in the *Attributes* section of the E-A-M model include an applicant’s citizenship status and national origin. When seeking admission to a U.S. medical school, an applicant’s citizenship and national origin often play a very large role. If an applicant is not a U.S. citizen, a major factor in how their application is evaluated is based on whether they are categorized as a permanent resident or possess a “green card.” A “green card holder (permanent resident) is someone who has been granted authorization to live and work in the United States on a permanent basis” (U.S. Citizenship and Immigration Services, 2011, para. 4). If a non-U.S. citizen student is not a permanent resident, or does not hold a green card, then the student is considered an international student. Non-U.S.



citizen permanent resident students and international students are viewed differently in the medical school admissions process.

Although gaining admission to medical school is competitive for every applicant, differences in competitiveness are dramatic based on citizenship status. According to an article from the National Association of Advisors for the Health Professions (NAAHP), when applying to U.S. medical schools, non-U.S. citizen permanent residents (green card holders) are generally treated the same as U.S. citizens. In most cases, permanent residents can qualify as legal residents of a state and are therefore afforded the same preferences that may be given to state residents at public and some private medical schools. Those not having a green card (i.e., international students) have a more serious problem, since not all medical schools will consider international applicants (2008, para. 1).

According to the AAMC (2011n), 19,230 students matriculated to U.S. medical schools in 2011, and of that number, only 155 matriculants were foreign or international students. This small number of foreign matriculants signifies some of the difficulties international students encounter when attempting to gain admission to U.S. medical schools.

For international students who apply to U.S. medical schools, they face the dual issue of a limited number of medical schools willing to accept them, coupled with being limited financially. Many U.S. medical schools that accept applications from international students

require that each such admitted student places in escrow the equivalent of one to four years' tuition and fees (~U.S. \$40,000 – U.S. \$200,000). Unless an international student's family can supply the necessary funds, depositing this amount of money in an escrow account is a nearly impossible task (Miller & Huff, 2004, para. 3).

Therefore, international medical school applicants are at a severe disadvantage for admission to U.S. medical schools compared to U.S. citizen applicants because of the limited available seats and the financial stipulations placed upon foreign students.

#### Sex

Another factor in the *Attributes* section of the E-A-M model is an applicant's sex. The application and matriculation rates of men and women to medical school over the past few years have been fairly stable and balanced. Table 13 illustrates the number and percentages of applicants and matriculants to medical school by sex from 2009 through 2011. Approximately 47% of applicants and matriculants to medical school were women, and approximately 53% of applicants and matriculants to medical school were men over the past three years. These figures indicate a degree of equality in applications and matriculations to medical school by sex.

Table 13

*Number and Percentages of Applicants and Matriculants to Medical Schools by Sex, 2009-2011*

Group	2009		2010		2011	
	#	%	#	%	#	%
<b>Applicants</b>						
Women	20,252	47.9	20,207	47.3	20,780	47.3
Men	22,013	52.1	22,533	52.7	23,135	52.7
Total	42,286	100.0	42,741	100.0	43,919	100
<b>Matriculants</b>						
Women	8,817	47.9	8,756	46.9	9,037	47.0
Men	9,573	52.1	9,909	53.1	10,193	53.0
Total	18,390	100.0	18,665	100.0	19,230	100.0

*Note.* Adapted from “Table 7: Applicants, First-Time Applicants, Acceptees, and Matriculants to U.S. Medical Schools by Sex, 2000-2011,” by the Association of American Medical Colleges, 2011o. Copyright 2011 by the Association of American Medical Colleges.

### Religion/Faith

Another factor in the *Attributes* section of the E-A-M model is an applicant’s religion or faith. Many institutions of higher education were founded on the beliefs of Catholicism, Judaism, Mormonism, and other faiths (Brubacher & Rudy, 1999).

Although the foundations of most medical schools are not rooted in religion, some medical schools are known to have a stronger link to religion than others.

No medical school limits admission of students based on religion, but some are more accommodating to students of certain religious backgrounds. For example, Loma Linda University School of Medicine admitted its first class of students in 1909 with a focus on “educating medical missionaries who could work in Seventh-day Adventist hospitals nationally and worldwide” (Evans, 2009, para. 3). In addition, Mount Sinai School of Medicine and Albert Einstein College of Medicine were founded in the Jewish faith, and New York Medical College “has been associated with the Catholic Archdiocese of New York for the past 30 years” (Evans, 2009, para. 17). While each of these institutions have had or still have an affiliation with a certain faith, each of their student bodies are extremely diverse and include students from all religious, racial, and ethnic groups. Although the medical schools with religious affiliations do not actively pursue or discriminate against applicants of certain religions, they make students aware of their accommodations, programs, and even aspects of their curricula that support a specific set of religious values (Evans, 2009).

## Age

Another factor in the *Attributes* section of the E-A-M model is an applicant’s age. Some medical school applicants fear that they will be discriminated against or are at a disadvantage in admission if they do not apply to or enter medical school soon after

completing their bachelor's degree. Many medical schools assure applicants that this fear is not valid.

For example, the website for Harvard Medical School (2010) provides a question-and-answer section that includes the question, "Do you have an age limit for applicants?" The response stated, "No. HMS complies with Federal and State Law prohibiting discrimination against any applicant or enrolled student on the basis of race, color, religion, sex, sexual preference, age, or handicap" (para. 7). The website for the Texas Tech University Health Sciences Center School of Medicine (2011b) contained a similar question with a response of, "There is no age limitation for applying to medical school. The average age of our classes is typically around 24. Many people attend medical school who already had a career in something else" (para. 1). In addition, AAMC (2010c) statistics indicated that many students in medical school were not in their early 20s, but that 25% of applicants at anticipated matriculation to medical school were 25 years of age or older. Therefore, although age is considered in application to medical school, it is not a factor upon which applicants can be discriminated against or held at a disadvantage.

#### Physical ability

Another factor in the *Attributes* section of the E-A-M model is an applicant's physical ability. The "Americans with Disabilities Act (ADA) has afforded new rights and protections to persons with disabilities and heightened public awareness of the needs of this population" (AAMC, 2011g, para. 1). The purpose of the ADA in admissions is to "provide opportunities for persons with disabilities to compete with other applicants on

the basis of their ability. Schools must judge persons on the basis of their ability to complete the educational program rather than on their status as disabled persons” (AAMC, 2011g, para. 2).

Medical school applicants with physical disabilities must be able to meet the technical standards and/or essential requirements set forth by the medical school within reasonable accommodations. For example, Florida Atlantic University Charles E. Schmidt College of Medicine (2011b) stated that “individuals with disabilities (as defined by Section 504 of the Rehabilitation Act and the Americans with Disabilities Act) may be qualified to study medicine with the use of reasonable accommodation” (para. 10). Similarly, the University of Maryland School of Medicine (2011b) stated that “state and federal law require that the University of Maryland School of Medicine provide reasonable accommodations for applicants with disabilities. In the context of the School of Medicine’s curriculum, some disabilities cannot be accommodated, while others can be accommodated” (para. 15). According to the AAMC, “persons seeking admission must be able to perform the ‘essential functions’ or meet the ‘essential eligibility requirements’ of the program once they have been provided with any needed accommodation or modification” (AAMC, 2011g, para. 2). Therefore, while some requests for accommodations are honored, others may not. Each medical school decides whether the request for accommodations is feasible and reasonable.

Medical school applicants have the right to not disclose their disability in the admissions process. The AAMC stated that “preadmission inquiry as to whether a person is disabled is not permitted, but a school may seek as much information as is needed to

make a determination that an individual can perform the ‘essential functions’ or meet the ‘essential eligibility requirements’ of the educational program (AAMC, 2011g, para. 2).

Similarly, the University of Maryland School of Medicine (2011b) stated that

an applicant is not disqualified from consideration due to a disability. Applicants are not required to disclose the nature of a disability to the Committee on Admissions. Applicants with questions about the School’s Essential Requirements for Admission, Academic Advancement and Graduation in relation to their disability are encouraged to discuss the issue of accommodation with the Committee on Admissions prior to the interview process (para. 16).

Therefore, although medical schools have a right to ask applicants about their abilities to perform the technical standards and/or meet the essential functions required to by the school, applicants are not required to disclose the nature of their disability.

#### Skills, Abilities, and Personal and Professional Characteristics

Assessing medical school applicants’ skills, abilities, and personal and professional characteristics is an important component of the medical school admissions process. “Medical educators (and the public) agree that being a ‘good doctor’ is more than academic achievement and other measures of intellectual ability” (American Medical Association, Council on Medical Education, 2010, p. 18). Additionally, “many of these educators have called for a more ‘holistic assessment’ of medical school applicants that would include personal qualities such as altruism, motivation, dedication and intellectual curiosity” (American Medical Association, Council on Medical

Education, 2010, p. 18). Although many involved in medical school admissions are in agreement that it is imperative to evaluate an applicant's skills, abilities, and personal and professional characteristics, it has also been recognized that there is not a national, standardized way to assess these personal qualities.

In an attempt to create a standardized way to assess these qualities, the AAMC recently established the Innovation Lab Working Group (ILWG) and charged the group with the task of investigating ways to measure personal characteristics in the admissions process (Michener, Gabbe, Friedlander, Davis, Koenig, & Terregino, 2010). Based on their research, the ILWG recommended that

- information on applicants' personal competencies should be collected in a nationally-standardized manner;
- this information should be gathered from multiple sources using multiple measures in order to get a more complete picture of applicants' characteristics; and
- the resulting information should be provided to committees in time for initial screening (Michener et al., 2010).

Due to the recency of the recommendations by the ILWG, the AAMC was still taking the recommendations into consideration and possibly working with constituent groups, such as the AMA, to further examine the possibility of implementing assessments to measure these personal characteristics. Regardless, the ILWG recommendations on assessing medical school applicants' personal qualities are different than the manner in which these qualities were previously assessed.

Currently, most medical schools use the medical school interview to assess applicants' skills, abilities, and personal and professional characteristics. According to



Dunleavy and Whittaker (2011), data indicated that personal characteristics of applicants are evaluated almost exclusively via interview, due to difficulties in assessing these qualities through other methods elsewhere in the admissions process. Regardless, data “suggest that admissions committees’ value information on personal characteristics and may use the interview to supplement academic data gathered from other parts of the application” (Dunleavy & Whittaker, 2011, para. 11). Therefore, while medical school interviews are currently used by admissions personnel to assess personal qualities, current efforts by the ILWG, AAMC, and AMA may change how these qualities are assessed in the future.

The skills, abilities, and personal and professional characteristics listed as a part of the E-A-M model do not serve as a comprehensive list of all qualities evaluated in applicants. Although this listing is thorough, other sources have acknowledged that there are other skills, abilities, and personal and professional characteristics that have also been evaluated by medical school admissions personnel. For example, listings of such qualities were found from: AAMC 2008 Survey of Academic Affairs Officers and Admissions Officers (American Medical Association, Council on Medical Education, 2010, p. 6), Dunleavy and Whittaker’s (2011) Table 1: Percentage of Responding Admissions Officers Who Ask Questions About Personal Characteristics during the Admissions Interview (p. 2), and the six entry-level competencies identified by the Innovation Lab Working Group (AAMC, 2010a; Koenig et al., 2010, p. 4; Michener et al., 2010, slide 32). The authors of the E-A-M model, in essence, also acknowledged the existence of

other skills, abilities, and personal and professional characteristics within the *Attributes* section by their inclusion of a factor deemed “Other.”

#### Fields of study

A factor in the *Attributes* section of the E-A-M model is an applicant’s field of study, or undergraduate major. According to the *MSAR* (2011), “unbeknownst to many college students, there is no such thing as the ‘best’ major for those bound to medical school. In fact, no medical school requires a specific major of its applicants” (p. 10). Table 14 illustrates the undergraduate majors of accepted applicants to medical schools between 2008 and 2010. Of the types of majors chosen by accepted applicants to medical school, Biological Sciences was the most frequently selected major. It should be noted that approximately 50% of all accepted applicants in each year majored in an area other than Biological Sciences. While some students may have believed it is best to major in the Biological Sciences because of the curriculum overlap with medical school prerequisite courses, both the information on choosing a major in the *MSAR* (2011) and the statistics in Table 14 indicated that students who applied medical school were free to choose any major in any discipline.

Table 14

*Percentages of Accepted Applicants to Medical School by Undergraduate Major, 2008-2010*

Undergraduate Major	% 2008	% 2009	% 2010
Biological Sciences	51.0	49.5	50.9
Humanities	6.0	6.0	6.0
Math and Statistics	1.0	1.0	1.0
Other	15.3	16.4	16.6
Physical Sciences	12.4	12.8	11.9
Social Sciences	12.3	12.4	12.1
Specialized Health Sciences	3.0	3.0	3.0

*Note.* From *Medical School Admission Requirements (MSAR)*, 2011, Washington, DC: Association of American Medical Colleges.

Premedical students who chose a non-science, liberal arts, or humanities-focused major have been reassured that they do not disadvantage themselves when pursuing admissions to medical school (Brieger, 1999; Koenig, 1992; MSAR, 2011; Rifkin, Smith, Stimmel, Stagnaro-Green, & Kase, 2000). In 1984, an AAMC report of the Panel on the General Professional Education of the Physician recommended that “students preparing for medical school should strive for a curriculum that provides a broad study in both the sciences and the humanities and that required courses should be kept to a minimum” (Rifkin et al., 2000, p. S124). Although all medical schools require specific science-focused prerequisite courses, students who chose majors that do not require these prerequisite courses as a part of the major curriculum take these courses as electives and still met the medical school prerequisite requirements. Many studies confirmed that

“there is no significant difference in overall medical school performance between students who were science majors and those who were not” (Brieger, 1999, p. 1220).

Medical school applicants should therefore not feel restricted in choosing a science major because of the perception that they will appear less competitive for admission to medical school.

Several studies compared undergraduate performances of medical students with different undergraduate majors. The results have shown that undergraduate science majors and non-science majors have achieved equivalent undergraduate grade-point averages and MCAT scores, and perform similarly in medical school (Dornbush, Singer, Brownstein, & Richman, 1987; Koenig, 1992; Yens & Stimmell, 1982; Zeleznik, Hojat, & Veloski, 1983). Regarding MCAT scores, the total median MCAT scores for biology majors, social science majors, and humanities majors were 28.1, 28.5, and 29.1, respectively (MSAR, 2011, p. 10). Therefore, there was little difference in MCAT scores of students in these distinct undergraduate majors.

Additionally, a study by Koenig (1992) found that even in medical school, performances of students with undergraduate science majors and non-science majors were very similar. The only statistically significant difference found was on the National Board of Medical Examiners (NBME) Part I examination (now called the United States Medical Licensing Exam [USMLE]), which was taken after the first two years of medical school. Koenig found that on the NBME Part I examination, students with undergraduate non-science-focused majors (“broadly prepared” students) scored higher on the clinically-oriented Behavioral Sciences section, but students with undergraduate science-

focused majors scored higher on the basic science-oriented Physiology, Biochemistry, and Pharmacology sections (Koenig, 1992, p. 194). Koenig (1992) also studied Part II (typically taken during the fourth year of medical school) and Part III (typically taken at the end of the first year of residency) of the NBME exam (now USMLE Part II and Part III) for medical students, and mean performances by medical students with undergraduate science majors and non-science majors were equivalent. These results indicated that after a period of time in medical school, the performance gap lessened for students with undergraduate science-focused majors and non-science-focused majors.

#### Intellectual curiosity

Another factor in the *Attributes* section of the E-A-M model was an applicant's level of intellectual curiosity. The University of Minnesota Medical School listed intellectual curiosity as an essential personal characteristic necessary for a "dedication to lifelong learning" (University of Minnesota Medical School, 2011). In addition, Abraham Flexner, who in 1910 was one of the greatest reformers of medical education of our time, placed the intellectual curiosity of physicians at the heart of medicine. Flexner's vision of medical education involved the "development of an intellectual curiosity and fueled the change from an empiric, trade school model to a genuinely scientific approach as physicians realized they needed to think critically about the biological systems they were tampering with in treating patients" (Curry & Montgomery, 2010, p. 284). Intellectual curiosity in the early days of Flexner's vision seemed to be characterized by concepts such as the desire to question what appeared to be known, to go beyond the limits of the

task at hand, to think “outside of the box,” and to have a genuine curiosity about learning. Just as in Flexner’s vision, assessing intellectual curiosity in future physicians is equally important in present day. Medical school admissions personnel today strive to seek out students who possess an intellectual curiosity and have a motivation to want to learn more.

### Resilience

Another factor in the *Attributes* section of the E-A-M model is an applicant’s resilience. The AAMC’s Innovation Lab Working Group (ILWG) included the factor of resilience in their list of the six entry-level competencies required for successful performance in medical school. The ILWG defined resilience (along with adaptability) as, “Resilience and Adaptability: Demonstrates tolerance of stressful or changing environments or situations and adapts effectively to them; is persistent, even under difficult situations; recovers from setbacks” (AAMC, 2010a, para. 5). In addition, the University of Minnesota Medical School (2011) identified “psychological resilience as demonstrated through emotional stability, skills to cope with stress, an ability to deal with sacrifice and hardship, maturity, good judgment, and an ability to defer gratification” as an “essential” personal characteristic necessary for a “dedication to lifelong learning” (para. 5).

A sense of resilience has also been studied in medical students and physicians. In particular, resiliency was studied when examining areas for decreasing burnout in medical students and physicians. According to Santen, Holt, Kemp, and Hemphill (2010),

when the student's reservoir of resiliency is depleted, it can lead to burnout.

Positive inputs into the resiliency reserve are psychosocial support, mentorship, intellectual stimulation, and social/health-promoting activities. One method of bolstering reserves is to help in the development of self-esteem and competency through focusing on student strengths. In addition our study, among others, shows that by increasing perceived control, burnout may be reduced (p. 762).

Therefore, both medical students and practicing physicians would be well served with high levels of resilience to prevent burnout and to increase medical school/medical career satisfaction.

## Maturity

Another factor in the *Attributes* section of the E-A-M model is an applicant's maturity. Maturity was listed as the third highest personal characteristic (of fifty-one total characteristics) asked about at admission interviews by admission officers. In total, 92% of admission officers indicated that they ask questions to assess an interviewee's level of personal maturity (Dunleavy & Whittaker, 2011). In addition, medical schools such as Harvard Medical School (2011) and New York Medical College School of Medicine (2011) stated on their websites, respectively, that they "seek students of integrity and maturity" and seek future physicians who have the "emotional maturity to complete medical school and practice medicine independently." Carrothers, Gregory, and Gallagher (2000) also considered maturity as a component of "emotional intelligence"

and studied how emotional intelligence (and therefore maturity) can be better measured in medical school admission.

Maturity of medical school applicants and matriculants often gained greater consideration if an applicant was accelerated in their undergraduate studies and therefore entered medical school at a young age, or if an applicant had applied to an accelerated medical school program (e.g., a three-year curriculum instead of a four-year curriculum) and would therefore be practicing medicine at a young age. For example, Lake Erie College of Osteopathic Medicine (LECOM) is an osteopathic medical school that offers an accelerated, three-year curriculum for medical students. When evaluating medical students who expressed an interest in the three-year curriculum, LECOM stated that they sought, amongst other qualities, “evidence of emotional maturity as demonstrated by a willingness and ability to succeed in complex and rigorous coursework” (Bell, Ferretti, & Ortoski, 2007, p. 896). Additionally, some medical schools considered the admission of superior applicants who had not earned a bachelor’s degree prior to medical school matriculation. Texas Tech University Health Sciences Center School of Medicine (2011a) stated that “students without a baccalaureate degree must also exhibit definite evidence of experience and maturity” (para. 1). These examples especially indicated the importance of maturity for applicants who matriculate into medical school early or who enter an accelerated medical school program.



## Values

Another factor in the *Attributes* section of the E-A-M model is an applicant's values. Values have been defined as "the principles which influence the most important aspects of [one's] life. They affect [one's] actions, attitudes, and behaviors" (AAMC, 2005a, p. 8). Examples of physician values included the following items.

- *Altruism*: A physician is obligated to attend to the best interest of patients, rather than self-interest.
- *Accountability*: Physicians are accountable to their patients, to society on issues of public health, and to their profession.
- *Excellence*: Physicians are obligated to make a commitment to life-long learning.
- *Duty*: A physician should be available and responsive when "on call," accepting a commitment to service within the profession and the community.
- *Honor and integrity*: Physicians should be committed to being fair, truthful and straightforward in their interactions with patients and the profession.
- *Respect for others*: A physician should demonstrate respect for patients and their families, other physicians and team members, medical students, residents and fellows (University of Washington School of Medicine, 1998b).

Most patients expect their physicians to adhere to the values stated in this list, in addition others.

Many professional associations, including those of physicians, often have an oath to attempt to ensure that those who were members of their association "behave according to certain 'professed' values and virtues" (Kopelman, 1999, p. 1307). As a profession, physicians have a Hippocratic Oath which includes the values and virtues by which they must abide as a physician (Markakis, Beckman, Suchman, & Frankel, 2000).

Additionally, medical students are expected to learn, at the least, the professional behaviors that are expected of a physician, and at best, the values and virtues of a

humanistic physician (Kopelman, 1999). Even during medical residency training, “the process of socialization and the various ways trainees (i.e., medical residents) learn and internalize professional and humanistic values, attitudes, and behaviors... are critically important in training physicians” (Markakis et al., 2000, p. 141). Medical school applicants who already possess many of the values that are sought by patients and taught to future physicians have a head start in regard to learning the professionalism, values, and virtues of the medical profession.

### Commitment

Another factor in the *Attributes* section of the E-A-M model is an applicant’s commitment. Commitment of medical school applicants was examined in two ways: commitment to medical education, training, and a career in medicine; and commitment to serving others as a physician. First, medical students must make a commitment to the length of time needed to complete medical school and residency. Depending on the medical specialty chosen, the combination of completing medical school and residency training ranges from approximately seven years to eleven years of education after earning a bachelor’s degree. Therefore, the long length of training to become a physician infers that medical school applicants must make a commitment to medical education and training.

Medical school applicants must also possess a commitment to a future career in medicine. To provide evidence of a commitment to a career in medicine, applicants engage in either a high quantity or high quality of health-related experiences during

preparation for medical school. These health-related experiences provide medical school admissions personnel with evidence of an applicant's dedication and commitment towards pursuing a career in medicine.

Lastly, medical school applicants possess a commitment to serve others if/when they become a physician. Many medical schools emphasize the need for this type of commitment on their websites, such as “a commitment to improving the human condition” (University of Minnesota Medical School, 2011), “a commitment to lifelong learning” (Dartmouth Medical School, 2011), “commitment to public service” (Rosalind Franklin University of Medicine and Science, 2011), “a commitment of service to others” (The Florida State University College of Medicine, 2011), and “a commitment to the community” (University of Utah School of Medicine, 2011). Evidence of this type of commitment on an application appears to serve the applicant well in his or her quest for admission.

#### Interpersonal style

Another factor in the *Attributes* section of the E-A-M model is an applicant's interpersonal style or interpersonal skills. The AAMC's Innovation Lab Working Group (ILWG) included the factor of interpersonal skills in their list of the six entry-level competencies required for successful performance in medical school. The ILWG defined interpersonal skills (along with social and teamwork skills) as, “Social, Interpersonal, and Teamwork Skills: Demonstrates an awareness of others' needs, goals, feelings, and the ways that social and behavioral cues affect peoples' interactions and behaviors; adjusts

behaviors appropriately in response to these cues; treats others with respect and demonstrates a respect for diverse populations” (AAMC, 2010a, para. 5). In addition, the University of Minnesota Medical School (2011) identified “outstanding interpersonal skills” as an “essential” personal characteristic necessary for a success in medical school.

Many medical schools included interpersonal skills in the description of technical standards required for completion of a medical degree. In 1979, the AAMC Executive Council approved the recommendations of the AAMC Special Advisory Panel on Technical Standards for Medical School Admission (Harvard Medical School, 2008). These technical standards are posted on many medical schools’ websites and include a listing of abilities and skills medical students must possess to be admitted to medical school and complete a medical degree; these abilities and skills include those that are observational, communicational, motor, intellectual-conceptual (integrative and quantitative), behavioral, and social. Interpersonal skills were listed in the description of the “behavioral and social attributes” of the technical standards. The inclusion of interpersonal skills in the technical standards of medical school admission implied that a basic level of interpersonal skills is essential to become a physician. Applicants and medical students with more honed levels interpersonal skills are likely to hold an advantage over those who have weaker interpersonal skills.

Lastly, interpersonal skills are assessed when medical students take the USMLE (United States Medical Licensing Exam) Step 2 Clinical Skills. The USMLE Step 2 Clinical Skills exam is often taken during the fourth year of medical school and consists of three subcomponents: Integrated Clinical Encounter, Communication and

Interpersonal Skills, and Spoken English Proficiency (United States Medical Licensing Exam [USMLE], 2011). The subcomponent of Communication and Interpersonal Skills consists of questioning skills; information-sharing skills; professional manner and rapport; providing opportunity for the patient to express feelings/concern; and encouraging additional questions or discussion (USMLE, 2011). Each of the three subcomponents of the Step 2 Clinical Skills must be passed in a single administration for a medical student to pass the Step 2 Clinical Skills exam. Therefore, because medical students are formally assessed on their communication and interpersonal skills during medical school, possessing strong interpersonal skills is imperative to becoming a physician.

## Beliefs

Another factor in the *Attributes* section of the E-A-M model is an applicant's beliefs. Much of the literature about beliefs and medicine revolved around cultural or religious beliefs. In the AAMC Position Statement titled "The Medical Home," one of the topics covered included a physician's respect for a patient's cultural and religious beliefs (AAMC, 2008). Similarly, "patients bring cultural, religious and ideological beliefs with them as they enter into a relationship with the physician. Occasionally, these beliefs may challenge or conflict with what the physician believes to be good medical care" (University of Washington School of Medicine, 1998a, para. 1). For a physician, understanding and respecting the patient's cultural and religious beliefs is a key to establishing and maintaining a patient-physician relationship.

The concept of cultural competence underlies a physician's understanding of his or her patient's cultural and religious beliefs. "Cultural competence in health care combines the tenets of patient/family-centered care with an understanding of the social and cultural influences that affect the quality of medical services and treatment" (AAMC, 2005b, p. 1). In 2000, the Liaison Committee on Medical Education (LCME) introduced cultural competence as a standard in medical education. The LCME identified the standard of cultural competence as:

The faculty and students must demonstrate an understanding of the manner in which people in diverse cultures and belief systems perceive health and illness and respond to various symptoms, diseases, and treatments. Medical students should learn to recognize and appropriately address gender and cultural biases in health care delivery, while considering first the health of the patient (AAMC, 2005b, p. 1).

With the U.S. population becoming increasingly more diverse, coupled with the strong evidence of racial and ethnic disparities in health care, it has been increasingly important for medical students to learn cultural competency in health care so they are able to treat their future patients in a culturally competent manner.

## Leadership

Another factor in the *Attributes* section of the E-A-M model is leadership. Leadership has been defined as "a position of responsibility for others, with a purpose to guide or direct others" (University of Utah School of Medicine, 2011, para. 9).

Individuals with characteristics such as dedication, determination, ability to make decisions, and a willingness to contribute to the welfare of others have readily accepted positions of leadership (University of Utah School of Medicine, 2011). Leadership was also listed as the ninth highest personal characteristic (of fifty-one total characteristics) asked about at admission interviews by admission officers; 80% of admission officers indicated that they ask questions to assess an interviewee's leadership quality (Dunleavy & Whittaker, 2011).

Leadership and teamwork were also identified as one of the nine content areas of UME-21 (Undergraduate Medical Education for the 21<sup>st</sup> Century). The UME-21 project was a \$7.6 million national demonstration project developed by the Health Resources and Services Administration (Rabionwitz et al., 2001). The UME-21 project funded 18 public and private U.S. medical schools for a three-year period (1998 through 2001) with a goal to implement innovative educational strategies. The UME-21 project was “designed to develop innovative curricula that addressed the training necessary for medical students to gain skills required to provide high-quality, accessible, and affordable care in the modern healthcare environment” (O’Connell & Pascoe, 2004, p. S51). As a result of the project, curricular changes were recommended in nine content areas, one of which was leadership (Rabionwitz et al., 2001). The identification of leadership as one of the nine content areas emphasized the integral essence of leadership in medical education.

## Perspectives

Another factor in the *Attributes* section of the E-A-M model is an applicant's perspective. Medical schools strive to create a "learning environment [for medical students] that embraces diversity of perspectives" (University of Rochester Medical Center, 2010, para. 3). To create this learning environment, medical schools sought to admit students who hold diverse perspectives.

An applicant's perspective was often a product of their background and included their opinions. An applicant's background, which Merriam-Webster (2011) has defined as consisting of experiences, knowledge, and education, in combination with their opinions, often shapes their perspectives. Medical school applicants come from a wide variety of backgrounds; some examples of diverse personal backgrounds include: previous healthcare experience; knowledge of a particular culture, religion, socioeconomic status, or sexual orientation; or education in the arts, politics, law, or public health. Based on each applicant's background, they often hold certain opinions about a myriad of topics including healthcare. The perspectives, backgrounds, and opinions of medical school applicants when they matriculate to a medical school are as endless as they are diverse. Medical school admissions personnel value these perspectives because they are often representative of the patients in need of healthcare.

## Languages spoken

Another factor in the *Attributes* section of the E-A-M model is the languages spoken by the applicant, or an applicant's multilingual abilities. Although the vast



majority of the U.S. population speaks English at home (80.3%), the percentage of the U.S. population who does not speak English at home has steadily risen over the past three decades (Shin & Kominski, 2010). Of the percent of the U.S. population who spoke a language other than English at home, 62.3% spoke Spanish or Spanish Creole, 18.6% spoke Other Indo-European languages, 15.0% spoke Asian and Pacific Island languages, and 4.1% spoke a language other than classified previously (Shin & Kominski, 2010). Shin and Kominski (2010) also noted that of the percent of the U.S. population who did not speak English at home, many of them were bilingual or multilingual and had the ability to speak English. Although a total of 75.7% indicated they spoke English “very well” (55.9%) or “well” (19.8%), 24.3% indicated they spoke English “not well” (16.3%) or “not at all” (8.1%). Because the language abilities of the U.S. population have been shifting over time, and more people are speaking languages other than English, it appears beneficial for medical school applicants, medical students, and physicians to be able to speak a language other than English as well in order to best communicate and care for these non-primary English speakers.

The rise over time in the percentage of the U.S. population who speak a language other than English at home has prompted more multicultural and multilingual resources for patients in health care. Many medical schools stated that they considered multilingual proficiency when reviewing criteria of medical school applicants (e.g., Baylor College of Medicine, 2011a; Texas A&M Health Science Center College of Medicine, 2011), and some medical schools also looked for evidence of multilingual service in an applicant’s previous experiences (e.g., University of Colorado School of Medicine, 2011). In

addition, the U.S. Department of Health and Human Services published an online “Multicultural Resources for Health Information” webpage in 2007. This webpage included categories of linked resources including: Cultural Competency; Dictionaries, Glossaries, and Online Translation Tools; Health Resources in Multiple Languages; Interpreting in Health Care; and Multicultural Research, amongst other categories (U.S. Department of Health and Human Services, 2011). Overall, much more attention has recently been brought to the language abilities of patients and how health care professionals have responded.

### Motivation

Another factor in the *Attributes* section of the E-A-M model is an applicant’s motivation for a career in medicine. Several psychological theories have discussed the concept of motivation. Many of those theories have two basic constructs in common: the commitment to an objective, known as intention, and the willingness to invest effort towards its achievement, known as volition (Archer, 1994; Garcia, McCann, Turner, & Roska, 1998; Perrot, Deloney, Hastings, Savell, & Savidge, 2001; Reed, 2007). To meet the qualifications and be competitive for admission to medical school, medical school applicants exhibit a strong commitment to their goal of admission and are willing to invest much effort towards accomplishing their goal. Due to the competitiveness of gaining admission, medical school applicants must exhibit a strong motivation to make themselves viable for admission to medical school.

Many medical schools have also stated that they seek students with a high motivation for a medical career. For example, Baylor College of Medicine (2011b) stated that an essential quality of a physician was a “strong motivation for a career in medicine,” and the Albany Medical College (2011) and the Rosalind Franklin University of Medicine and Health Science (2011) also cited motivation as an important selection criteria. Motivation for a medical career was also listed as the top ranked personal characteristic (of fifty-one total characteristics) about which admissions officers ask prospective students at admission interviews. In total, 98% of admission officers indicated that they ask questions to assess an interviewee’s motivation for a medical career (Dunleavy & Whittaker, 2011). Overall, due to the competitiveness of medical school admission, applicants have been shown to both exhibit behaviors and engage in experiences that portray their motivation for a career in medicine.

#### Individual interests

Another factor in the *Attributes* section of the E-A-M model is an applicant’s individual interests. Individual interests include passions, hobbies, and/or activities that are unrelated to a career in medicine, but highlight personal enjoyment and gratification. Individual interests, in relation to the medical school application process, also allow applicants to showcase their own uniqueness in comparison to other applicants.

Individual interests of applicants have been exhibited in many different ways. Some medical school applicants showcase their individual interests through education, such as their choice of a major or minor. For example, a medical school applicant with a

passion for the arts can exhibit this passion by choosing a major or minor in an art-related area such as art, music, or theatre. Medical school applicants also exhibit individual interests through experiences. For example, in the same case of the applicant who has a passion for the arts, he or she may have played an instrument in a band, sung in a choir, or simply enjoyed painting during free time. Regardless of the type of interest, many medical schools were interested in premedical students' passions and hobbies outside of their medical school preparation. Medical school applicants' individual interests provided medical school admissions personnel with additional information about the applicant's identity as a unique person.

#### Other

In addition to the attributes listed in the *Attributes* section of the E-A-M model, there likely are "other" factors that are also considered by medical school admissions personnel. For example, one demographic factor that could be considered that is not listed in the E-A-M model is military or veteran status. In addition, factors that could be included in the skills, abilities, and personal and professional characteristics list but are not included are endless. Examples of such factors could include: reliability, dependability, desire to learn, compassion, empathy, professionalism, adaptability, or critical thinking (AAMC, 2010a; Dunleavy & Whittaker, 2011). While the list of attributes in the E-A-M model is very thorough, the creators of the E-A-M model seemed to acknowledge that their list is not comprehensive by their inclusion of "other" as a factor.

## Metrics

Medical school admissions personnel need to determine if applicants have the knowledge and academic skills needed to successfully complete medical school. To a large extent, medical school admissions personnel review an applicant's metrics, or GPAs and MCAT scores, to answer those questions (MSAR, 2011). An applicant's academic record and MCAT scores provide objective information about his or her knowledge and ability compared to other applicants (MSAR, 2011). The metrics category in the E-A-M model consists of GPA, MCAT scores, and grade trends. Each factor is discussed more in-depth in the proceeding sections.

### GPA

One factor in the *Metrics* section of the E-A-M model is an applicant's GPA, or grade point average. A GPA is "a measure of a student's academic achievement at a college or university, which is calculated by dividing the total number of grade points received by the total number attempted" (AAMC, 2011e, p. 3). An applicant's GPA serves as a key part of an applicant's academic history throughout his or her college career. An applicant's "academic history helps admission committees establish whether study skills, persistence, courses of study, and grades predict success in medical school" (MSAR, 2011, p. 41). From an applicant's college transcript, in addition to their GPA, medical school admissions personnel considered:

- grades earned in each course and laboratory;
- number of credit hours carried in each academic period;

- distribution of coursework among the biological, physical, and social sciences and humanities;
- need for remediation of unsatisfactory academic work;
- number of incomplete grades and course withdrawals; and
- number of years taken to complete the degree program (MSAR, 2011, p. 41).

Although an applicant GPA plays a key part in the evaluation of academic history, medical school admissions personnel examine transcripts not just for GPA, but also for these additional factors, in order to gain a better picture of the applicant's overall academic history.

Medical schools examine an applicant's GPA by reviewing their undergraduate science GPA (consisting of biology, chemistry, physics, and mathematics courses), undergraduate non-science GPA, and undergraduate total GPA. Table 15 shows the science GPA, non-science GPA, and total GPA for all applicants and matriculants to medical school in 2010. As indicated, the mean GPAs of applicants were lower than the mean GPAs of matriculants in each area (science GPA, non-science GPA, and total GPA). The largest difference in GPA between applicants and matriculants was in science GPA, where matriculants' mean science GPA (3.61) was 0.18 points higher than applicants' mean science GPA (3.43). The second largest difference was in total GPA, where matriculants' mean total GPA (3.67) was 0.14 points higher than applicants' mean total GPA (3.53). The least amount of difference was in the non-science GPAs, where matriculants' mean non-science GPA (3.75) was only 0.10 points higher than applicants' mean non-science GPA (3.65). Overall, medical school applicants' high science, non-

science, and total GPAs (all above 3.6) provided evidence that these students could handle the academic rigors of the prerequisite courses.

Table 15

*Science, Non-Science, and Total GPAs of Applicants and Matriculants to Medical School, 2010*

Applicant Status	Science GPA		Non-Science GPA		Total GPA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Applicants	3.43	0.43	3.65	0.30	3.53	0.34
Matriculants	3.61	0.32	3.75	0.24	3.67	0.26

*Note.* Adapted from “Table 17: MCAT Scores and GPAs for Applicants and Matriculants to U.S. Medical Schools, 1999-2010,” by the Association of American Medical Colleges, 2010f. Copyright 2009 by the Association of American Medical Colleges.

Many studies have indicated that science GPA and/or total GPA, along with MCAT scores, have been predictors of success in medical school. Numerous scholars have consistently indicated that Medical College Admission Test (MCAT) scores and undergraduate grade point averages (GPAs) are the most important indicators of students’ future academic performance (Donnon, Paolucci & Violato, 2007; Huff & Fang, 1999; Julian, 2005; Koenig, Sireci, & Wiley, 1998; Koenig & Wiley, 1997; Kuncel & Hezlett, 2007; Mitchell, 1990; Mitchell et al., 1994; Swanson, Case, Koenig, & Killian, 1996; Veloski et al., 2000; Wiley & Koenig, 1996; Zeleznik, Hojat, & Veloski, 1987). Furthermore, “research has indicated that these factors, most notably the MCAT scores and undergraduate GPA, are reliable in helping to predict medical school performance” (Blue et al., 2000, p. S31). In other words, many researchers agreed that undergraduate

GPA and MCAT scores provide predictive validity for making decisions about medical school admission.

Success in medical school is often measured by performance in basic science courses, performance in clinical science courses, and scores on NBME Parts I, II, and III examinations (now the USMLE Parts I, II, and III). GPAs of applicants were one of the main factors found to be useful for “predicting basic science grades, clinical science grades, NBME Parts I, II, and III scores, and academic difficulty” in medical school (Mitchell, 1990, p. 155). Specifically, “MCAT science scores and undergraduate science GPAs have been associated with preclinical [or basic science] academic performance, and verbal scores on the MCAT and non-science GPA have been more closely associated with performance in the clinical years” of medical school (Veloski et al., 2000, p. S28). Mitchell (1990) noted though that “academic data should be supplemented with demographic and other nonacademic data at all points. Consistencies and disparities in the information provided by multiple types of data provide a more complete picture of the applicant” (p. 155). Therefore, even though science GPAs and total GPAs, often along with MCAT scores, have indicated reliability in helping to predict performance in medical school, they should be used in conjunction with other non-metric variables.

### MCAT Scores

Another factor in the *Metrics* section of the E-A-M model is an applicant’s MCAT scores. The MCAT, or Medical College Admission Test, is



a standardized, multiple-choice examination designed to assess problem solving, critical thinking, and writing skills in addition to the examinee's knowledge of science concepts and principles prerequisite to the study of medicine. Scores are reported in each of the following areas: Verbal Reasoning, Physical Sciences, Writing Sample, and Biological Sciences. Medical college admission committees consider MCAT scores as part of their admission decision process (AAMC, 2011e, p. 3).

Because there can be a significant differences in grading scales and standards from college to college, the standardized MCAT scores help medical school admissions personnel evaluate all applicants on the same scale (MSAR, 2011). The *MSAR* (2011) even stated that “the ability of admissions officers to predict who will be successful in their programs increases by as much as 50% (gauging by first- and second-year medical school grades) when they look at MCAT scores in conjunction with undergraduate GPAs as opposed to grades alone” (p. 41). In addition, similar to measures of institutional selectivity, MCAT scores are a measure which standardize comparisons of applicants, and are applicable to everyone since all applicants to medical school take the MCAT.

Medical schools examined applicants’ total MCAT score, along with scores on the MCAT sections of Biological Sciences (BS), Physical Sciences (PS), Verbal Reasoning (VR), and the Writing Sample (WS). Scores on each of the BS, PS, and VR sections can range from 0 to 15 (lowest to highest) and scores on the WS can range from J to T (lowest to highest). The MCAT Total score is the sum of the three section (BS, PS, and VR) scores. Therefore, the highest total MCAT score is a 45.

Table 16 shows the MCAT BS, PS, VR, WS, and Total scores for all applicants and matriculants to medical school in 2010. As expected, the mean MCAT scores of applicants to medical school were lower than the mean MCAT scores of matriculants to medical school in each section (BS, PS, VR, WS, and Total). Of the MCAT section scores, the difference between applicants and matriculants in both mean BS score and mean PS score was 1.0. The difference between the applicants and matriculants in mean VR scores was 0.8, less than the differences between the mean BS and PS mean scores of applicants and matriculants. Due to the differences in the MCAT section scores, the sum of the section scores, or the mean of the MCAT Total score, was also higher for matriculants ( $M = 31.1$ ) than for applicants ( $M = 28.3$ ).

Table 16

*MCAT Scores (Biological, Physical, Verbal, Writing, and Total) of Applicants and Matriculants to Medical School, 2010*

Status	Biological		Physical		Verbal		Writing	Total	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	Median	<i>M</i>	<i>SD</i>
Applicants	9.8	2.1	9.4	2.3	9.1	2.1	P	28.3	5.5
Matriculants	10.8	1.7	10.4	1.9	9.9	1.7	Q	31.1	4.1

*Note.* Adapted from “Table 17: MCAT Scores and GPAs for Applicants and Matriculants to U.S. Medical Schools, 1999-2010,” by the Association of American Medical Colleges, 2010f. Copyright 2009 by the Association of American Medical Colleges.

Similar to the previous section on GPAs, the value of MCAT scores and GPAs in predicting students’ performances in medical school have been well established. As stated previously, MCAT scores and GPAs were recognized as important indicators of

future academic performance (Donnon et al., 2007; Huff & Fang, 1999; Julian, 2005; Koenig et al., 1998; Koenig & Wiley, 1997; Kuncel & Hezlett, 2007; Mitchell, 1990; Mitchell et al., 1994; Swanson et al., 1996; Veloski et al., 2000; Wiley & Koenig, 1996; Zeleznik et al., 1987), and reliably predicted performance in medical school (Blue et al., 2000). In addition, statistics from the AAMC also indicated that MCAT scores and GPAs of applicants predicted medical students' time to graduation, scores on USMLE exams, and likelihood of experiencing academic difficulty or distinction. Regarding the relationship between MCAT scores, GPAs, and four-year graduation rates from medical school, 86% of medical students who entered medical school between 2003 and 2005 graduated from medical school in four years; additionally students with higher MCAT scores and higher GPAs were associated with higher four-year graduate rates (AAMC, 2011r).

Addressing the relationship between MCAT scores, GPAs, and USMLE outcomes, 95% of medical students who entered medical school between 2003 and 2005 passed the USMLE Step 1 Exam on the first attempt, but statistics indicated that students with lower MCAT scores and GPAs had lower pass rates on their first attempt (AAMC, 2011r). For example, among all students with MCAT scores at 26 and below, and among all students with GPAs at 3.19 and below, both had average pass rates on the USMLE Step 1 below 90% (AAMC, 2011r).

Finally, regarding the relationship between MCAT scores, GPAs, and withdrawal or dismissal from medical school for academic reasons, data from students who entered medical school between 2003 and 2005 indicated that although only 1.4% of students

withdrew or were dismissed from school for academic reasons, students with lower MCAT scores and GPAs were still indicated to be more likely to have higher levels of academic withdrawal or dismissal (AAMC, 2011r). Overall, each of these statistics indicated that students who matriculated to medical school with higher MCAT scores and GPAs were often associated with positive outcomes in medical school, and students who matriculated to medical school with lower MCAT scores and GPAs were still successful in medical school the vast majority of the time, but were more at-risk for negative outcomes.

### Grade Trends

Another factor in the *Metrics* section of the E-A-M model is an applicant's grade trends. According to the University of Wisconsin-Madison Institute for Biology Education (2011), upward grade trends are positive when preparing for medical school. In addition, the Texas Tech University Health Science Center School of Medicine (2011b) listed an upward grade trend as a positive factor that is considered if an applicant's overall GPA is not within the normal range of competitive GPAs for admission. Lastly, the Michigan State University College of Human Medicine (2011b) stated that when reviewing applicants' science and non-science grades for admission, they take note of several grade factors, including trends in grades.

Some medical school applicants do not have consistently high grades or a high GPA throughout their college careers. For these applicants, an upward trend in grades toward the end of their undergraduate careers, or a trend of solid grades in science

courses, are especially helpful for their chances of admission. Above all, applicants want medical school admissions personnel to know that at the time of their application, they are an academically strong student even if they had some academic difficulties in their past.

### Holistic Review

In the early 2000s, partly due to the U.S. Supreme court rulings in the University of Michigan cases in 2003 (i.e., *Grutter v. Bollinger*, and *Gratz v. Bollinger*), it became more apparent than before that certain populations were experiencing disparities in health care, and these same populations were underrepresented in careers in medicine (AAMC, 2011c). As a result, the AAMC began to undertake initiatives aimed at increasing diversity among medical students. While the AMCAS did not need to be modified to recognize diversity amongst medical school applicants, the AAMC instead looked at the medical schools themselves and their own applicant evaluation and review processes. The AAMC began to promote holistic review within the medical school admissions process, but realized that they needed to play a large role in helping medical schools initiate these holistic review practices.

In 2010, in an effort to help to increase diversity (in a broad sense) among medical students and physicians, the AAMC launched the Holistic Review Project. Holistic review was defined as “a flexible, highly-individualized process by which balanced consideration is given to the multiple ways in which applicants may prepare for and demonstrate suitability as medical students and future physicians” (Addams et al.,

2010a, p. 5). According to Dr. Darrell G. Kirch, M.D., President and CEO of the AAMC, since the establishment of the Holistic Review Project, “medical schools are increasingly taking a holistic approach to admissions decisions by evaluating candidates’ experiences and personal attributes in addition to their academic credentials and metrics such as the MCAT” (MSAR, 2011, p. 1). Dr. Kirch also noted though that the previous “admissions process [was] in no way ‘broken.’ However, its emphasis on cognitive factors—standardized test scores and grades—may work against students whose superlative personal attributes... remain ‘hidden’” (Kirch, 2010, para. 3). To help bring these personal attributes and other applicant experiences to the forefront, holistic review in admissions was set into place to provide medical school admissions personnel with a more complete, well-rounded picture of applicants.

The purpose of the AAMC’s Holistic Review Project is to “assist medical schools in establishing and implementing institution-specific, student diversity-related policies, processes, and practices that will advance their institutional mission and core educational goals in support of shaping the future physician workforce” (AAMC, 2011d, 2011k). The core principles considered in holistic review include:

1. Selection criteria are broad-based, clearly link to school-specific mission and goals, and promote diversity as an essential element to achieving institutional excellence.
2. A balance of Experiences, Attributes, and Metrics (E-A-M) is used to assess applicants with the intent of creating a richly diverse interview and selection pool and student body; applied equitably across the entire candidate pool; and

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

3. Admissions staff and committee members give individualized consideration to how each applicant may contribute to the medical school learning environment and practice medicine, weighing and balancing the range of criteria needed in class to achieve the outcomes desired by the school.
4. Race and ethnicity may be considered as factors when making admission-related decisions only when aligned with mission-related educational interests and goals associated with student diversity; and when considered as a broader mix of factors, which may include personal attributes, experiential factors, demographics, or other considerations (AAMC, 2011d).

Additionally, within the context of holistic review, diversity was broadly defined as:

- not an end goal, but a means to achieving an institution’s core educational goals and mission;
- a multidimensional concept, which may include dimensions of experiences and attributes, such as distance travelled, race, educational background, languages spoken, resilience, SES [socioeconomic status], sexual orientation, and many others; and
- an inherently institution-specific, mission-driven concept, not “one-size fits all” (AAMC, 2011d).

Since the AAMC has been assisting medical schools in practicing holistic review in admissions, evidence exists as to how admissions personnel have incorporated holistic review. The AAMC (2010r) surveyed medical school admissions officers about the importance of the different application data in deciding which applicants to interview and

which applicants to admit. The rating scale that admissions officers used ranged from 5 for “extremely important” to 1 for “not important.” For each of the 23 different variables, Table 17 shows how the medical school admissions officers ranked the importance of the application factors in their holistic review of applicants’ qualifications for both interview invitations and offers of acceptance.

The data in Table 17 indicated that some of the application factors that were used to invite an applicant for an interview were ranked differently than those used to offer an applicant acceptance. For example, while Science GPA, Total GPA, Total MCAT scores, and letters of recommendation were the top four application factors considered to invite applicants for an interview, the application factors of interview recommendation, letters of recommendation, Science GPA, medical community service, and Total GPA were considered most important to offer applicants acceptances after they have interviewed. Also, data about applicants’ experiences and attributes were given more consideration when determining which interviewees to offer acceptances, or when the numbers of applicants under consideration were smaller than the initial screen (AAMC, 2011r). Therefore, it appeared that admissions officers considered an applicant’s metrics (i.e., GPAs and MCAT scores) more when they decided who to invite for an interview, and they seemed to use more experiential data and attribute data when they decided who was the best fit with their school’s mission and goals, and hence, whom to offer acceptances.



Table 17

*Application Data Rated as Important to Admission Committees' Decisions Regarding Which Applicants to Interview and Accept (N = 113)*

Application Factor	Invite Interviewees	Application Factor	Offer Acceptances
--	--	Interview recommendation	4.5
GPA: Science	3.7	Letters of recommendation	3.8
GPA: Total	3.6	GPA: Science	3.7
MCAT scores: Total	3.5	Community service: Medical	3.6
Letters of recommendation	3.4	GPA: Total	3.6
Community service: Medical	3.3	MCAT scores: Total	3.4
Personal statements	3.2	Personal statements	3.4
Medical/Clinical work experience	3.2	Medical/Clinical work experience	3.4
Community service: Non-medical	3.1	Community service: Non-medical	3.3
Leadership experience	3.0	Leadership experience	3.2
Completion of premedical requirements	3.0	Completion of premedical requirements	3.1
State residency	2.8	Experience with underserved populations	3.0
Experience with underserved populations	2.7	State residency	2.8
U.S. citizenship/permanent residency	2.7	Research experience: Medical/clinical	2.7
GPA: Non-science	2.6	U.S. citizenship/permanent residency	2.7
Research experience: Medical/clinical	2.5	GPA: Non-science	2.6
SES	2.1	SES	2.1
Race/ethnicity	2.0	Race/ethnicity	2.1
Rural background	1.9	Rural background	2.1
Completion of challenging non-science courses	1.9	Completion of challenging non-science courses	2.1
Selectivity of undergraduate institution	1.8	Selectivity of undergraduate institution	1.9
Urban background	1.5	Urban background	1.5
Gender	1.2	Gender	1.3

Note. Survey questions: *How important were the following data in selecting the applicants who were invited to interview? How important were the following data in selecting the interviewees who were accepted?*

Rating Scale: 5 = Extremely important, 4 = Very important, 3 = Important, 2 = Somewhat important, 1 = Not important  
 Red = Metric data, Blue = Experiential data, Green = Attribute data, Purple = Combination of multiple types of data

Sources: "Medical School Admissions: More Than Grades and Test Scores," from *Analysis in Brief*, 11(6), by D. Dunleavy, H. Sondheimer, L. Castillo-Page, and R. B. Bletzinger, 2011; and "Using MCAT Data in Medical Student Selection," by the Association of American Medical Colleges, 2011r.

Overall, the AAMC’s Holistic Review Project was designed to teach medical school admissions personnel how to functionally consider and balance multiple factors—specifically, applicants’ experiences, attributes, and metrics—in the medical school admissions process. By expanding the selection factors that were evaluated, and learning how to appropriately apply holistic review principles, the hope was that medical schools would achieve greater student diversity. Research has shown that “a diverse student body will produce doctors that are better equipped to treat the nation’s increasingly diverse patient population” (Fuchs, 2009, para. 4).

### Summary

The review of the literature detailed the important components and concepts involved in medical school admissions. Specifically, the medical school admissions process itself and the competitiveness of the medical school admissions process were described, along with the E-A-M model, which classified a multitude of medical school admission factors into the experiences, attributes, or metrics categories. Furthermore, four different types of premedical students who take courses at two-year colleges were described and discussed, and the resources that help to guide premedical students and pre-health advisors about each medical school’s policy or preference regarding completion of medical school prerequisite courses at two-year colleges was also included in this chapter. Lastly, the concept of holistic review was described as the concept which should now guide evaluation of applicants in the medical school admissions process.

## **CHAPTER 3 METHODOLOGY**

### Introduction

This chapter describes the methodology used to conduct the research for this study. In addition to providing the rationale for the design of the study, the population of the study and the instrumentation used to collect data were also described. Next, the research questions along with the statistical procedures and analysis were discussed. Lastly, the authorization from the Institutional Review Board (IRB) was included and the data collection plan was described.

### Design of the Study

The medical school prerequisite courses required by most every medical school in the U.S. include a minimum of two courses in biology (e.g., Biology I and II), two courses in general chemistry (e.g., General Chemistry I and II), two courses in organic chemistry (e.g., Organic Chemistry I and II), two courses in physics (e.g., Physics I and II), and various courses in mathematics (e.g., College Algebra, Pre-Calculus, Trigonometry, and Calculus I). While many premedical students completed some or all of these twelve prerequisite courses at a four-year institution, many also completed these courses at a two-year college. Because some medical schools have stated that they discourage applicants from taking the prerequisite courses at two-year colleges, medical school applicants who chose to take courses at two-year colleges, regardless of their rationale for doing so, could be at a disadvantage in seeking admission to medical school.

Although there are many resources (i.e., *PARM*, *MSAR*, medical school websites) that describe the medical schools' preferences for the type and/or quality of institution where their applicants should take the prerequisite courses, there seemed to be inconsistency on this topic amongst these resources (see Table 7). For example, for any given medical school, the *PARM* may state a certain preference, but the *MSAR* and/or the medical school's website may not mention that same preference. These inconsistencies in preferences and policies across resources cause difficulties for medical school applicants and pre-health advisors in attaining the correct information on this topic for each medical school.

Additionally, many of the resources were not very detailed on the topic of taking prerequisite courses at two-year colleges. The lack of detail made it difficult for premedical applicants and pre-health advisors to evaluate whether some medical schools were more accepting of prerequisite courses taken at a two-year college by certain types of students but not for others. For example, a medical school that accepts prerequisite courses at two-year colleges may be more accepting if a transfer or accelerated/dual enrollment student completed some of the medical school prerequisite courses at a two-year college, but may be less accepting if a transient student or a post-baccalaureate student completed some of the medical school prerequisite courses at a two-year college. Regardless, without additional details from the medical schools on their preferences or policies for types of student enrollment at two-year colleges, medical school applicants and pre-health advisors are not given clear answers about the impact of these factors on medical school admission.

In an effort to add to the understanding of completing medical school prerequisite courses at two-year colleges, the researcher focused on two aspects of course completion at two-year colleges: types of student enrollment and grades in organic chemistry. The different types of student enrollment at two-year colleges include transfer, transient, accelerated/dual enrollment, and post-baccalaureate. Previous analyses of all undergraduate students from UCF have indicated that large numbers of students completed courses at two-year colleges (Reiss & Archer, 2011). This study examined the different types of student enrollment of medical school matriculants from UCF who completed any of the twelve medical school prerequisite courses at two-year colleges.

This research also focused on grades in Organic Chemistry I and II and type of institutional enrollment of medical school matriculants from UCF. The researcher chose to focus on grades in only the Organic Chemistry I and II courses because organic chemistry has historically become one of the most scrutinized of the medical school prerequisite courses. According to Brieger (1999), “by the 1920s, organic chemistry began to take shape as one of the defining premedical sciences. By the 1950s, organic chemistry grades took on mythical properties” in the eyes of medical school applicants and medical school admissions personnel (p. 1218). The way that organic chemistry has been studied and learned was comparable to developing skills of “mastering scientific facts and learning a new language. Similar skills were needed by the medical student; hence the grade in organic chemistry became one of the key predictors of success in mastering medical sciences” (Brieger, 1999, p. 1219). Additionally, Brieger (1999) stated that the chemistry department in many colleges and universities was notorious for tough

grading policies, so this too helped the organic chemistry grades take on legendary proportions. Therefore, of all of the medical school prerequisite courses, the researcher specifically focused on grades in Organic Chemistry I and II in the current study because of the historically perceived importance of the organic chemistry courses in medical school admissions and the parallels drawn between learning organic chemistry and learning medical sciences.

Overall, this research examined the differences in enrollment at two-year colleges amongst medical school matriculants from UCF. A quantitative research methodology used two main sources of data: the UCF Pre-Health Professions Advisement Office's (PHPAO) listing of medical school matriculants from UCF, and student educational records. Both the PHPAO listing of medical school matriculants and student educational records were pre-existing sources of student data, so no surveys or other instrumentation were required. The researcher was granted access to both sources of data (see Appendix B & C), and in conducting her data collection and analyses, she took precautions to ensure that she was compliant with all Family Educational Rights and Privacy Act (FERPA) and Institutional Review Board (IRB) guidelines regarding student records.

### Population

The population of this study consisted of medical school matriculants from UCF who were admitted to U.S. medical schools' entering classes between 2007 and 2011. The UCF Pre-Health Professions Advisement Office (PHPAO) office produced a Composite Evaluation Letter (CEL) for the vast majority, but not all, of medical school

matriculants from UCF between 2007 and 2011. Of the students that received the CEL, many informed the PHPAO of the medical school where they eventually matriculated. The PHPAO maintained a listing of these students/medical school matriculants from UCF, and these students gave the PHPAO office permission to publish their names and the name of the medical school where they matriculated. Subsequently, the director of the PHPAO allowed the researcher to use the list of matriculants for this study (see Appendix C).

Typically, students apply to medical school during the summer between their junior and senior years in college. Furthermore, in order to be eligible to receive a CEL from the PHPAO, UCF students must have completed a minimum of 30 credit hours in residence at UCF. Therefore, while most students were around the ages of 21 or 22 when applying to medical school, even if a student entered college at a very young age, they must have still taken a minimum of two years to complete the medical school prerequisite courses, and completed at least one year at UCF prior to being eligible for a CEL from the PHPAO. In line with common application trends and due to PHPAO requirements for a CEL, all students who received a CEL from the PHPAO and were included in this study were over the age of 18.

### Instrumentation

To collect data on the medical school matriculants from UCF who were part of U.S. medical school entering classes between 2007 and 2011, two sources of data were

utilized: the PHPAO list of medical school matriculants from UCF and student educational records. These two sources are described at further length.

### Matriculation Lists

The PHPAO matriculation lists were used to identify the students from UCF who matriculated to U.S. medical schools. To compile the list, the PHPAO was informed of the medical schools to which UCF students matriculated by the students themselves. The PHPAO had a relationship with the vast majority of medical school matriculants from UCF as a result of producing a Composite Evaluation Letter (CEL) for the students as a supplement to their application materials. The PHPAO received permission from the students to publish their names along with the name of the medical school to which they matriculated, and the director of the PHPAO subsequently gave the researcher permission to use the list of matriculants for the current study (see Appendix C). Because not all medical school matriculants from UCF utilized the PHPAO CEL, not all matriculants to medical school from UCF between 2007 and 2011 were included in this study.

### Student Educational Records

Student educational records of UCF students were used to collect data about the medical school matriculants from UCF. To acquire access to UCF student educational records, UCF employees whose positions require this access must have completed specific, mandatory trainings such as Student Records FERPA training through the UCF Registrar's Office. As a current pre-health advisor at UCF, completion of these trainings



not only allowed the researcher and other UCF academic advisors to access UCF student educational records, but also assured that the researcher utilized the records within FERPA guidelines. In regards to using student educational records for this study, the researcher received approval for the use of these student educational records from the UCF Registrar (see Appendix B).

The specific student educational records that were utilized in this study included grades and academic transcripts. Only the grades and academic transcripts of medical school matriculants from UCF between the years 2007 and 2011 identified from the PHPAO matriculation lists were utilized though; educational records of other UCF students were not required for this study. Therefore, the student educational records from only a specific population of students were used in this research.

## Statistical Procedures

### Variables

A number of dependent and independent variables were used to test the research questions in this study. The proceeding sections address the details of these variables.

### Dependent Variable

One dependent variable was utilized in this study. The dependent variable was grades in Organic Chemistry I and II (i.e., A [4.0], A- [3.75], B+ [3.25], B [3.0], B- [2.75], C+ [2.25], and C [2.0]). Many medical schools require students to earn a grade of C or above in each prerequisite course, so the only grades examined in this study

included A, A-, B+, B, B-, C+, and C. As previously stated, many medical school admissions personnel believe that the academic rigor of prerequisite courses at two-year colleges is less than that of four-year institutions. Therefore, in theory, one could argue that if courses such as Organic Chemistry I and II were less academically rigorous at two-year colleges, students who completed the courses at two-year colleges should have earned higher grades in the courses than their four-year institution peers. The researcher therefore assessed the differences in grades in Organic Chemistry I and II (i.e., grades of A through C) based on the type of institution where the courses were completed.

#### Independent Variables

The independent variables in this study included type of student enrollment at two-year colleges and type of institution where medical school matriculants completed the medical school prerequisite courses. The types of student enrollment in the twelve medical school prerequisite courses were of interest because many medical schools promote enrollment in medical school prerequisite courses at four-year institutions, but discourage enrollment at two-year colleges. Many UCF premedical students enrolled in two-year colleges as either transfer, transient, accelerated/dual enrollment, or post-baccalaureate students though. The researcher assessed these differences in types of enrollment in the medical school prerequisite courses at two-year colleges amongst medical school matriculants from UCF.

The researcher categorized the types of institutions in this study as either a two-year college or a four-year institution. Due to the large numbers of UCF students who

completed courses at a two-year college (Reiss & Archer, 2011), the researcher assumed that many medical school matriculants from UCF completed many of the medical school prerequisite courses at two-year colleges as well. Additionally, as previously stated, many medical school admissions personnel believe that the academic rigor of courses such as Organic Chemistry I and II is less at a two-year college than a four-year institution. Based on that belief, one could argue that students who completed Organic Chemistry I and II at a two-year college should have earned a higher grade than students who completed the courses at a four-year institution. Therefore, the researcher assessed the differences between type of institution (i.e., two-year college or four-year institution) where Organic Chemistry I and II were completed based on grades in Organic Chemistry I and II.

### Research Questions

#### Research Question 1

*Is there a difference in types of student enrollment in the medical school prerequisite courses at two-year colleges amongst medical school matriculants from the University of Central Florida?*

The first research question was addressed by collecting data from the PHPAO matriculation lists and from student educational records. UCF medical school matriculants were identified from the PHPAO lists of medical school matriculants between 2007 and 2011. The names of the medical school matriculants on the PHPAO lists were used to locate their student educational records. From the student educational records of the medical school matriculants, the UCF academic advisor who collected the data on the researcher's behalf was able to view where each student took each of the

twelve medical school prerequisite courses. Based on the researcher's guidelines, the data collector categorized the type of student enrollment in each medical school prerequisite course as either transfer, transient, accelerated/dual enrollment, post-baccalaureate, or four-year. To categorize each of these matriculants by type of student enrollment for purposes of this study, the data collector used the following guidelines for students who completed courses at any two-year colleges:

*Transfer Student:* A student who completed courses at a two-year college as part of an AA degree or who completed a substantial number of courses *after* graduating from high school at an institution other than UCF and prior to enrolling at UCF.

*Transient Student:* A student who completed a course or courses at a two-year college while taking courses at UCF during the same semester, or while taking courses at UCF both the semester before and/or the semester after.

*Accelerated/Dual Enrollment Student:* A student who completed college-level courses at a two-year college while in high school and prior to enrolling at UCF.

*Post-baccalaureate Student:* A student who completed courses at a two-year college *after* earning a bachelor's degree.

## Research Question 2

*What differences, if any, exist in Organic Chemistry I and II grades earned at any two-year college versus any four-year institution by medical school matriculants from the University of Central Florida?*

The second research question was also addressed by collecting data from the PHPAO matriculation lists and from student educational records. The UCF advisor who

collected the data on the researcher's behalf used student educational records to view the type of institution where the medical school matriculants from UCF took Organic Chemistry I and II and categorized the institutions as either two-year colleges or four-year institutions. Many of the community colleges in Florida recently changed their names to "state colleges" or just "colleges." Because the missions and goals of these colleges have not drastically changed from when they were considered community colleges (Florida Department of Education, 2011a), the medical school prerequisite courses taken at Florida colleges or state colleges were held in a similar perspective to medical school prerequisite courses taken at two-year community colleges. Therefore, both colleges and state colleges in Florida that were previously known as two-year community colleges were categorized as two-year colleges in this study.

The UCF advisor who collected the data also used student educational records to view medical school matriculants' grades in Organic Chemistry I and II. Matriculants' grades were entered as either 4.0 (A), 3.75 (A-), 3.25 (B+), 3.0 (B), 2.75 (B-), 2.25 (C+), or 2.0 (C). Many medical schools do not accept a grade below a C to fulfill the academic requirements of the medical school prerequisite courses. Therefore, if a grade below a C was earned in Organic Chemistry I or II, medical school matriculants from UCF retook the courses until they earned a grade of C or above. In these rare instances, the grades of each attempt were averaged into one grade.

## Statistical Analysis

The analytical methods that were used in this study included chi-square goodness-of-fit tests, Mann-Whitney U tests, and descriptive statistics. The data were analyzed using SPSS. This section further describes how these analytical methods were utilized with respect to each research question.

Research Question 1, which addressed differences in types of student enrollment in the twelve medical school prerequisite courses at two-year colleges amongst medical school matriculants from UCF, was analyzed by twelve chi-square goodness-of-fit tests, one test for each medical school prerequisite course. This statistical analysis is recommended when using nominal data and assessing the differences amongst a single categorical variable; in this case, types of student enrollment. Additionally, the chi-square goodness-of-fit is “used to determine whether the observed proportions in two or more categories or a categorical variable differ from what we would expect *a priori*” (Lomax, 2007, p. 152). Because the researcher attempted to assess the differences in observed frequency between four categories of type of enrollment at two-year colleges (transfer, transient, accelerated/dual enrollment, and post-baccalaureate), the chi-square goodness-of-fit was chosen as the appropriate analytical method.

Research Question 2, which addressed the differences in grades in Organic Chemistry I and II of medical school matriculants by type of institution was analyzed by two Mann-Whitney U tests, one for Organic Chemistry I and one for Organic Chemistry II. A Mann-Whitney U test is recommended when using ordinal data to assess the difference between two independent groups. Because the researcher attempted to assess

the difference between type of institution—two-year college or four-year institution—where an applicant took Organic Chemistry I and II and their grades, which are in the form of ordinal data, a Mann-Whitney U test was chosen as the appropriate analytical method.

Descriptive statistics were also utilized to showcase information about the percentages of students who completed each of the medical school prerequisite courses at a two-year college and percentages of each of the types of enrollment of students who completed the prerequisite courses at a two-year college.

#### Authorization to Conduct Study

Before beginning data collection, the researcher submitted the study to UCF's Institutional Review Board (IRB) and sought approval for conducting research on human subjects. Although student information was included within the data set, the data collector redacted all personally identifiable information from the data set prior to sending it to the researcher. No surveys or other instrumentation were provided to students for data collection purposes. Therefore, the current study only involved the use of a data set with no personally identifiable student information. Upon review by IRB, the researcher's study was approved as exempt research. The letter specifying this classification is located in Appendix E.

## Originality Score

The UCF College of Graduate Studies requires the submission of each dissertation or thesis to Turnitin.com to test for originality. The major professor of the researcher defined an acceptable originality score to be between zero and ten percent. The initial submission of this document yielded a score of 26%. With the removal of bibliographic and quoted material, the score was reduced to 9%, which is within the acceptable range. The researcher's graduate advisor approved the document as original work.

## Data Collection Plan

Data from medical school matriculants from UCF who used the PHPAO CEL and gave their permission for their names to be included on the matriculant lists between 2007 and 2011 were collected for this study. Because both the PHPAO lists of medical school matriculants and UCF student educational records were pre-existing sources of data, the collection of data was conducted shortly after IRB approval. The data collection methods for the PHPAO matriculation lists and the UCF student educational records are described below.

## Matriculation Lists

The PHPAO housed the lists of medical school matriculants from UCF who used the CEL between 2007 and 2011. The director of the PHPAO received student permission to publish their names on these lists and subsequently allowed the researcher



to use the lists of medical school matriculants from UCF for the current study (see Appendix C). To protect student confidentiality and prevent researcher bias, the PHPAO matriculation lists were sent to another UCF academic advisor who used the lists to produce the data set, and then redacted UCF student/matriculant names prior to sending the data set to the researcher.

### Student Educational Records

By completing specific trainings on FERPA and student records by the UCF Registrar's Office, academic advisors at UCF have access and the ability to view a student's unofficial transcript. A student's unofficial transcript contains student educational records such as their first name, middle name, last name, grades in courses, institutions where courses were completed, and many other sources of student information. To protect student confidentiality, and to remove the possibility for researcher bias, the researcher arranged to have another UCF academic advisor who can also access UCF students' unofficial transcripts cross-reference and produce the data set on the researcher's behalf. Prior to beginning these data collection methods, the researcher received permission from the UCF Registrar to utilize student educational records and collect data in this manner (see Appendix B).

Special care was taken to ensure that the identity of the medical school matriculants from the PHPAO lists were cross-referenced to match the identity of exact same student in UCF's educational records. To ensure that the identities of the medical school matriculant and of the student in UCF's educational records were matched

correctly, the UCF advisor who collected the data cross-referenced on the variables of first name, middle name, and last name. In any cases of matriculants with the same first name, middle name, and last name as other students at UCF who appeared in the student educational records search, the degree award date was used as a secondary variable to identify the appropriate student. If for any reason the identity of a matriculant from the PHPAO lists could not be matched to the identity of a student in UCF's educational records, the matriculant from the PHPAO list was removed from the population of students to be studied.

After the data set was produced, the UCF advisor who collected the data then redacted the names of the matriculants and assigned them each a letter in place of their name, such as Student A, Student B, Student C, etc. After all of the names were redacted, the data collector emailed the completed, student identity-free data set to the researcher. Therefore, the researcher was blind to the actual identities of the students in the data set. This blind data set both protected student confidentiality and removed any possibility for researcher bias.

The data set was kept on a password-protected computer at UCF that only the researcher could access. The researcher ensured that the data set compiled by the data collector, and the names of medical school matriculants on the PHPAO lists, were deleted from the data collector's records once the final data set was sent to the researcher. By the precautions set forth in this data collection plan, the researcher protected both the confidentiality and security of the students' records.

## CHAPTER 4 DATA ANALYSIS AND FINDINGS

Many medical school admissions personnel via the *Medical School Admission Requirements* (MSAR), *Premedical Advisor's Reference Manual* (PARM), and their medical school websites have discouraged premedical students from taking the medical school prerequisite courses at two-year colleges. While a number of medical schools “discourage” this practice, very few do not actually accept prerequisite courses completed at two-year colleges (see Table 7 and Appendix A). Therefore, because very few medical schools are either strictly opposed to or do not explicitly accept the prerequisites from a two-year college, many premedical students at the University of Central Florida and other institutions often choose to complete these courses at a two-year college as either a transfer, transient, accelerated/dual enrollment, or post-baccalaureate student.

Over time, very few, if any, studies have been conducted on either the type of student enrollment or type of institutional enrollment of medical school applicants or matriculants in medical school prerequisite courses. As referenced previously in this manuscript, one of the few studies to approach this topic was conducted by Thurlow. According to Thurlow's (2009a) research, the percentages of applicants and matriculants to medical school who either earned an AA degree or completed some community colleges courses were very low. Of all matriculants to M.D.-granting medical schools in the U.S. between 2004 and 2007, only 1.3% earned an AA degree, and only 7.1% were non-AA students but completed some community college coursework (see Table 2).

Unlike Thurlow’s (2009a) research, the current study only examined matriculants to medical school, not applicants. However, when a similar analysis to Thurlow’s was conducted on matriculants to medical school from UCF between 2007 and 2011, the percentages were much higher. Of the matriculants to medical school from UCF between 2007 and 2011, 12.5% earned an AA degree and 36.4% completed some community college courses, while 51.1% completed no community college courses, compared to 1.3%, 7.1%, and 91.6% in Thurlow’s national study. Table 18 presents the comparison of associated counts and percentages from this analysis and Thurlow’s analysis.

Table 18

*Comparison of Matriculants to Medical School: UCF Data & National Data*

Degree or Courses	UCF (2007-2011)		National (2004-2007)	
	#	%	#	%
AA Degree	22	12.5	893	1.3
Some CC Courses (non-AA)	64	36.4	4,928	7.1
No CC Courses	90	51.1	63,749	91.6
<b>All Degree Types</b>	<b>176</b>	<b>100.0</b>	<b>69,570</b>	<b>100.0</b>

*Note.* National Data adapted from “Applicants to US Allopathic Medical Schools Who Take Courses at Community Colleges: How Do They Fare?” by D. Thurlow, 2009a, *The Advisor*, 29(2), 46-53.

The analyses in the current study focused not only on the type of institution where medical school matriculants from UCF completed the medical school prerequisite courses, but also focused on their specific type of enrollment—transfer, transient, accelerated/dual enrollment, or post-baccalaureate—in the prerequisite courses.

Additional analyses also focused on students' grades in two specific prerequisite courses, Organic Chemistry I and II.

This chapter presents the results of statistical analyses performed on the two previously stated research questions along with some additional descriptive statistics of interest. The analyses for this study were conducted on a total of 176 students from UCF who matriculated to a U.S. M.D.-granting medical school between 2007 and 2011. Both the chi-square goodness-of-fit and Mann-Whitney inferential tests were conducted in this study at the  $\alpha = .05$  level of significance. All data were analyzed using SPSS.

#### Research Question 1

Is there a difference in types of student enrollment in the medical school prerequisite courses at two-year colleges amongst medical school matriculants from the University of Central Florida?

Twelve different medical school prerequisite courses were selected for analysis of this question. The rationale for this analysis was to determine whether all types of two-year college enrollments are essentially created equal. In other words, out of the sub-population of students who took these courses at a two-year college instead of a four-year institution, the goal was to determine whether all did so in a similar capacity (e.g., as a transfer, transient, accelerated/dual enrollment, or post-baccalaureate student) or whether some types of enrollments were more prevalent than others. Chi-square goodness-of-fit tests were selected to run these analyses, as the question involved a single nominal independent variable (student enrollment type) that was measured in frequency.

Statistical assumptions were tested prior to analysis. The main assumption to be tested with respect to this test was that all expected cell counts were at least five or greater. Each of the four categories were assumed to hold an equal likelihood, so any course in which fewer than 20 students had enrolled in a two-year college could not be analyzed using the chi-square test; with four groups, 20 was the minimum number of available observations so that cell counts could equal a minimum of five. For these cases, inferential results were not obtained, but frequencies were provided.

In cases where inferential results using the chi-square test were obtained, and the test was significant, a discussion of standardized residuals followed. Residuals represent differences between observed values based on the data that was collected and the expected values—in this case, the total number of observations divided by four, representing the four groups. Standardized residuals are the actual residual values divided by the square root of the expected value; this calculation standardizes the residual value so that all can be interpreted uniformly regardless of the size of samples involved. Cells with standardized residuals smaller than -2 and larger than 2 are typically considered influentially different than the expected norm. In other words, negative standardized residuals mean the observed value was smaller than the expected; positive standardized residuals represent the opposite case. Each of the twelve medical school prerequisite courses was analyzed with results presented in the following sections.

## Biology Prerequisite Courses

### Biology I

Table 19 presents the analysis regarding the difference between types of student enrollment in Biology I at two-year colleges. Of the 176 matriculants to medical school in this study, 26 (14.8%) completed Biology I at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 26.31, p < .001$ , between two-year student types in Biology I. The largest proportion of students consisted of transfers (65.4%), and only one student appeared in the transient and post-baccalaureate groups, respectively (3.8% each). Likewise, a greater proportion of students than expected were transfers ( $SR = 4.1$ ) and smaller proportions of students than expected were transient or post-baccalaureate ( $SR = -2.2$ , each). The accelerated student proportion was on-target with the expected value ( $SR = 0.2$ ).

Table 19

*Chi-Square Goodness-of-Fit Test for Two-Year Student Type, Biology I (N = 26)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	17	1	7	1
% of Total	65.4	3.8	26.9	3.8
Std. Res	4.1	-2.2	0.2	-2.2

*Note.*  $\chi^2(3) = 26.31, p < .001$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.

## Biology II

Table 20 presents the analysis regarding the difference between types of student enrollment in Biology II at two-year colleges. Of the 176 matriculants to medical school in this study, 24 (13.6%) completed Biology II at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 14.67, p = .002$ , between two-year student types in Biology II. The largest proportion of students consisted of transfers (58.3%). Likewise, a greater proportion of students than expected were transfers ( $SR = 3.3$ ); among all other groups, observed proportions were on par with expected proportions.

Table 20

*Chi-Square Goodness-of-Fit Test for Two-Year Student Type, Biology II (N = 24)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	14	4	4	2
% of Total	58.3	16.7	16.7	8.3
Std. Res	3.3	-0.8	-0.8	-1.6

*Note.*  $\chi^2(3) = 14.67, p = .002$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.



## Chemistry Prerequisite Courses

### Chemistry I

Table 21 presents the analysis regarding the difference between types of student enrollment in Chemistry I at two-year colleges. Of the 176 matriculants to medical school in this study, 27 (15.3%) completed Chemistry I at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 22.33, p < .001$ , between two-year student types in Chemistry I. The largest proportion of students consisted of transfers (63.0%). Likewise, a greater proportion of students than expected were transfers ( $SR = 3.9$ ); among all other groups, observed proportions were on par with expected proportions.

Table 21

*Chi-Square Goodness-of-Fit Test for Two-Year Student Type, Chemistry I (N = 27)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	17	2	6	2
% of Total	63.0	7.4	22.2	7.4
Std. Res	3.9	-1.8	-0.3	-1.8

*Note.*  $\chi^2(3) = 22.33, p < .001$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.

## Chemistry II

Table 22 presents the analysis regarding the difference between types of student enrollment in Chemistry II at two-year colleges. Of the 176 matriculants to medical school in this study, 31 (17.6%) completed Chemistry II at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 22.03, p < .001$ , between two-year student types in Chemistry II. The largest proportion of students was transfers (61.3%). Likewise, a greater proportion of students than expected were transfers ( $SR = 4.0$ ); among all other groups, observed proportions were on par with expected proportions.

Table 22

*Chi-Square Goodness-of-Fit Test for Two-Year Student Type, Chemistry II (N = 31)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	19	5	4	3
% of Total	61.3	16.1	12.9	9.7
Std. Res	4.0	-1.0	-1.4	-1.7

*Note.*  $\chi^2(3) = 22.03, p < .001$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.

## Organic Chemistry I

Table 23 presents the frequency of the types of student enrollment in Organic Chemistry I at two-year colleges. Of the 176 matriculants to medical school in this study, only 11 (6.3%) completed Organic Chemistry I at a two-year college. As previously stated, the main assumption to be tested with respect to this analysis is that all expected cell counts are at least five or greater. Because each of the four categories were assumed to be equally likely, any course in which fewer than 20 students had enrolled in a two-year college could not be analyzed using the chi-square test. Therefore, with a sub-population size of 11, results for Organic Chemistry I could not be analyzed with chi-square due to failure to meet this assumption, but frequencies are provided. Of the 11 matriculants who completed Organic Chemistry I at a two-year college, transfer students had the largest proportion of students (63.6%) and no students were post-baccalaureate. Transient and accelerated student proportions were even (18.2% each).

Table 23

*Frequencies for Two-Year Student Type, Organic Chemistry I (N = 11)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	7	2	2	0
% of Total	63.6	18.2	18.2	0.0

*Note.* Post-Bacc = post-baccalaureate.

## Organic Chemistry II

Table 24 presents the frequency of the types of student enrollment in Organic Chemistry II at two-year colleges. Of the 176 matriculants to medical school in this study, only 12 (6.8%) completed Organic Chemistry II at a two-year college. As in the case presented with Organic Chemistry I, any course in which fewer than 20 students were enrolled could not be analyzed using a chi-square test. Therefore, with a sub-population size of 12, results for Organic Chemistry II could not be analyzed with chi-square due to failure to meet this assumption, but frequencies are provided. Of the 12 matriculants who completed Organic Chemistry II at a two-year college, transfer students had the largest proportion of students (50.0%), and the remaining students were transient (33.3%) and accelerated (16.7%). No students were post-baccalaureate.

Table 24

*Frequencies for Two-Year Student Type, Organic Chemistry II (N = 12)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	6	4	2	0
% of Total	50.0	33.3	16.7	0.0

*Note.* Post-Bacc = post-baccalaureate.

## Physics Prerequisite Courses

### Physics I

Table 25 presents the frequency of the types of student enrollment in Physics I at two-year colleges. Of the 176 matriculants to medical school in this study, only 17 (9.7%) completed Physics I at a two-year college. As in the case presented with Organic Chemistry I and II, any course in which fewer than 20 students were enrolled could not be analyzed using a chi-square test. Therefore, with a sub-population size of 17, results for Physics I could not be analyzed with chi-square due to failure to meet this assumption, but frequencies are provided. Of the 17 matriculants who completed Physics I at a two-year college, transfer students had the largest proportion of students (64.7%); the remaining students were transient (23.5%) and accelerated (11.8%). No students were post-baccalaureate.

Table 25

*Frequencies for Two-Year Student Type, Physics I (N = 17)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	11	4	2	0
% of Total	64.7	23.5	11.8	0.0

*Note.* Post-Bacc = post-baccalaureate.

## Physics II

Table 26 presents the frequency of the types of student enrollment in Physics II at two-year colleges. Of the 176 matriculants to medical school in this study, only 16 (9.1%) completed Physics II at a two-year college. Similar to the case with Organic Chemistry I, II, and Physics I, any course in which fewer than 20 students were enrolled could not be analyzed using a chi-square test. Therefore, with a sub-population size of 16, results for Physics II could not be analyzed with chi-square due to failure to meet this assumption, but frequencies are provided. Of the 16 matriculants who completed Physics II at a two-year college, transfer students had the largest proportion of students (43.8%), closely followed by transient students (37.5%). The remaining students were accelerated (12.5%) and post-baccalaureate (6.3%).

Table 26

*Frequencies for Two-Year Student Type, Physics II (N = 16)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	7	6	2	1
% of Total	43.8	37.5	12.5	6.3

*Note.* Post-Bacc = post-baccalaureate.

## Mathematics Prerequisite Courses

### College Algebra

Table 27 presents the analysis regarding the difference between types of student enrollment in College Algebra at two-year colleges. Of the 176 matriculants to medical school in the study, 38 (21.6%) completed College Algebra at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 38.84, p < .001$ , between two-year student types in College Algebra. The largest proportion of students consisted of those who were accelerated (55.3%); no students were transient nor post-baccalaureate. Likewise, there were more transfer students ( $SR = 2.4$ ) and accelerated ( $SR = 3.7$ ) students than expected.

Table 27

*Chi-Square Goodness-of-Fit for Two-Year Student Type, College Algebra (N = 38)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	17	0	21	0
% of Total	44.7	0.0	55.3	0.0
Std. Res	2.4	-3.1	3.7	-3.1

*Note.*  $\chi^2(3) = 38.84, p < .001$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.

## Pre-Calculus

Table 28 presents the analysis regarding the difference between types of student enrollment in Pre-Calculus at two-year colleges. Of the 176 matriculants to medical school in this study, 22 (12.5%) completed Pre-Calculus at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 22.36, p < .001$ , between two-year student types in Pre-Calculus. The largest proportion of students consisted of those who were accelerated (54.5%); no students were transient nor post-baccalaureate. Likewise, there were more accelerated students ( $SR = 2.8$ ) than expected; standardized residuals indicate that transfer students ( $SR = 1.9$ ) were in line with expected values.

Table 28

*Chi-Square Goodness-of-Fit Test for Two-Year Student Type, Pre-Calculus (N = 22)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	10	0	12	0
% of Total	45.5	0.0	54.5	0.0
Std. Res	1.9	-2.3	2.8	-2.3

*Note.*  $\chi^2(3) = 22.36, p < .001$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.



## Trigonometry

Table 29 represents the analysis regarding the difference between types of student enrollment in Trigonometry at two-year colleges. Of the 176 matriculants to medical school in this study, 34 (19.3%) completed Trigonometry at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 23.18, p < .001$ , between two-year student types in Trigonometry. There were fairly even proportions of transfer (44.1%) and accelerated (47.1%) students. Additionally, one student (2.9%) was transient and two students were post-baccalaureate (5.9%). Likewise, there were more students than expected that were transfers ( $SR = 2.2$ ) or accelerated ( $SR = 2.6$ ); fewer students than expected were transient ( $SR = -2.6$ ) or post-baccalaureate ( $SR = -2.2$ ).

Table 29

*Chi-Square Goodness-of-Fit Test for Two-Year Student Type, Trigonometry (N = 34)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	15	1	16	2
% of Total	44.1	2.9	47.1	5.9
Std. Res	2.2	-2.6	2.6	-2.2

*Note.*  $\chi^2(3) = 23.18, p < .001$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.

## Calculus

Table 30 presents the analysis regarding the difference between types of student enrollment in Calculus at two-year colleges. Of the 176 matriculants to medical school in this study, 25 (14.2%) completed Calculus at a two-year college. The analysis indicated that there was a significant difference,  $\chi^2(3) = 14.84, p = .002$ , between two-year student types in Calculus. The largest proportion of students consisted of transfers (56.0%); the second-largest proportion of students represented those who were transient (24.0%). Likewise, a greater proportion of students than expected were transfers ( $SR = 3.1$ ) and a smaller proportion of students than expected were post-baccalaureate ( $SR = -2.1$ ). However, transient ( $SR = -0.1$ ) and accelerated ( $SR = -0.9$ ) were on target with their expected values.

Table 30

*Chi-Square Goodness-of-Fit Test for Two-Year Student Type, Calculus (N = 25)*

Value	Transfer	Transient	Accelerated	Post-Bacc
<i>n</i>	14	6	4	1
% of Total	56.0	24.0	16.0	4.0
Std. Res	3.1	-0.1	-0.9	-2.1

*Note.*  $\chi^2(3) = 14.84, p = .002$ . Std. Res = standardized residual. Post-Bacc = post-baccalaureate.

## Research Question 2

What differences, if any, exist in Organic Chemistry I and II grades earned at any two-year college versus any four-year institution by medical school matriculants from the University of Central Florida?

Two separate Mann-Whitney tests, one for Organic Chemistry I grades and the other for Organic Chemistry II grades, were run to address this research question. The ordinal dependent variable was grade earned in Organic Chemistry I or II, converted into a corresponding number on a four-point scale. The dichotomous independent variable addressed whether the course had been taken at a two-year college or four-year institution.

The nonparametric Mann-Whitney test, determining differences in mean ranks of course grade, was selected instead of the parametric independent *t*-test based on three main factors. First, very few observations (between 10% and 12%, approximately) yielded a plus-or-minus letter grade, which meant that nearly all of the observations fell into the discrete, not continuous, categories of A, B, or C. Second, visual examination of histograms showed an unmistakable left-hand skew due to the large number of A-level grades. Finally, the percentages of two-year and four-year students were extremely unbalanced; only 6%-7% of the populations consisted of two-year students. For these reasons, it was decided that a more conservative comparison could be made with an approach that emphasized rankings over means and did not require proof of a normally-distributed distribution. In the following sections, the analysis of medical school matriculants' Organic Chemistry I and II grades by type of institution was presented.

## Organic Chemistry I

Table 31 presents the analysis regarding the difference in grades in Organic Chemistry I by type of institution. Of the 176 matriculants to medical school in this study, only 11 (6.3%) completed Organic Chemistry I at a two-year college, and 165 (93.7%) completed Organic Chemistry I at a four-year institution. The Mann-Whitney test,  $Z = -0.85$ ,  $p = .40$ , indicated that there was no significant difference in mean ranks of Organic Chemistry I grades between those who took the course at a four-year institution and those who took the course at a two-year college. The mean rank of the two-year college-based scores ( $M_r = 77.27$ ) was lower than was the mean rank of the four-year institution-based scores ( $M_r = 89.25$ ), which suggests that those at the four-year institutions performed better in this course than did those at the two-year colleges. However, again, this difference was not statistically significant in nature.

Table 31

*Mann-Whitney Results for Organic Chemistry I Grade by Institution Type (N = 176)*

Institution Type	<i>n</i>	<i>M Rank</i>
Four-Year	165	89.25
Two-Year	11	77.27

*Note.*  $Z = -0.85$ ,  $p = .40$ .

## Organic Chemistry II

Table 32 presents the analysis regarding the difference in grades in Organic Chemistry II by type of institution. Of the 176 matriculants to medical school in this study, only 12 (6.8%) completed Organic Chemistry II at a two-year college, and 164 (93.2%) completed Organic Chemistry II at a four-year institution. The Mann-Whitney test,  $Z = -0.98$ ,  $p = .33$ , indicated that there was no significant difference in mean ranks of Organic Chemistry II grades between those who took the course at a four-year institution and those who took the course at a two-year college. The mean rank of the two-year college-based scores ( $M_r = 101.29$ ) was higher than was the mean rank of the four-year institution-based scores ( $M_r = 87.56$ ), which suggests that those at the two-year colleges performed better in this course than did those at the four-year institutions. However, again, this difference was not statistically significant in nature.

Table 32

*Mann-Whitney Results for Organic Chemistry II Grade by Institution Type (N = 176)*

Institution Type	<i>n</i>	<i>M</i> Rank
Four-Year	164	87.56
Two-Year	12	101.29

*Note.*  $Z = -0.98$ ,  $p = .33$ .

### Additional Statistics of Interest

In addition to the analyses run for the two research questions, some additional statistics of interest were obtained to help clarify the types of enrollment of the 176

matriculants to medical school between 2007 and 2011 from UCF. The researcher hoped that these additional statistics will create a better understanding of the types of enrollment of this population of students. Table 33 represents the numbers and percentages of all matriculants who completed a medical school prerequisite course at a two-year college. This table allows for easier comparison of enrollment between the twelve different prerequisite courses.

Table 33

*Two-Year College Enrollment by Course (N = 176)*

Course	#	%
Biology I	26	14.8
Biology II	24	13.6
Chemistry I	27	15.3
Chemistry II	31	17.6
Organic Chemistry I	11	6.3
Organic Chemistry II	12	6.8
Physics I	17	9.7
Physics II	16	9.1
College Algebra	38	21.6
Pre-Calculus	22	12.5
Trigonometry	34	19.3
Calculus	25	14.2

## **CHAPTER 5**

### **DISCUSSION, CONCLUSION, AND RECOMMENDATIONS**

In this chapter, the results of the research questions along with summaries of their findings are discussed. In addition, the most significant of the findings of the study are introduced. To conclude, implications for practice and policy and implications for future research are presented.

#### Discussion

##### Research Question 1

Is there a difference in types of student enrollment in the medical school prerequisite courses at two-year colleges amongst medical school matriculants from the University of Central Florida?

Research Question 1 examined the types of student enrollment—transfer, transient, accelerated/dual enrollment, and post-baccalaureate—completed at two-year colleges by the matriculants to medical school in the current study. This question analyzed premedical student enrollment in medical school prerequisite courses at two-year colleges in a more in-depth fashion than has been utilized in the past. While Thurlow (2009a) examined the numbers and percentages of medical school applicants and matriculants who completed an AA degree or some courses at community colleges (see Table 2), this study further examined each student’s type of enrollment at a two-year college.

The researcher believed that the type of two-year college enrollment in the prerequisite courses was important because anecdotal evidence from medical school



admissions personnel and pre-health advisors portrayed diverse perceptions of the different types of enrollment. For example, some medical school admissions personnel and pre-health advisors believe that it is more acceptable to complete prerequisite courses at a two-year college as a transfer or accelerated student, but not as acceptable to complete the courses at a two-year college as a transient or post-baccalaureate student. It is the perception of the researcher that medical school admissions personnel and pre-health advisors believe that these perceived levels of acceptability based on type of enrollment and type of institution are correlated to perceived chances of admission to medical school. Therefore, this research question analyzed the data regarding the differences in types of enrollment at two-year colleges and attempted to provide statistical evidence to further enhance the validity and understanding of these perceptions about acceptability.

The terms “more acceptable” and “less acceptable” were used to describe the results of the chi-square goodness-of-fit tests. Based on the assumptions of medical school admissions personnel and pre-health advisors, courses completed by matriculants that were statistically significant and with standardized residuals greater than what were expected for their type of enrollment were categorized as “more acceptable” to complete at a two-year college with respect to that type of enrollment. Similarly, courses that were either not significant or significant but with standardized residuals either on-target with the expected value or by a smaller proportion of students than was expected were categorized as “less acceptable” to complete at a two-year college. Figure 3 illustrates the relationships between the results of the chi-square tests and levels of acceptability.

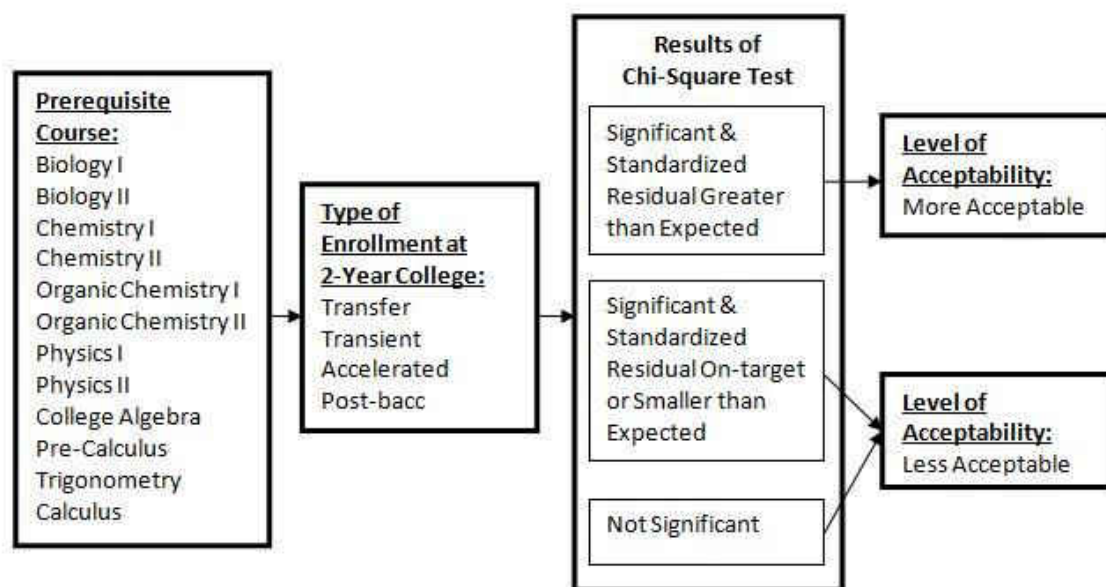


Figure 3. Relationships between results of chi-square tests and levels of acceptability.

As depicted in Figure 3, a prerequisite course completed at a two-year college as a certain type of enrollment that was found to be statistically significant and with a standardized residual *greater than expected* indicated that there was a statistically significant difference in the proportions of students with different types of enrollment in a course (significant difference), and that there was a greater proportion of students than expected with a certain type of enrollment (greater than expected standardized residual). The researcher categorized these instances as “more acceptable” because if students in this category matriculated to medical school at greater proportions than expected, then it seemed more acceptable for the pre-health advisors to suggest that other premedical students follow these same paths to medical school in the future.

A prerequisite course completed at a two-year college as a certain type of enrollment that was found to be statistically significant and with a standardized residual *on-target with or smaller than expected* indicated that there was a statistically significant difference in proportions of students with different types of enrollment in a course (significant difference), and proportions of students that were either on-target with or smaller than the expected proportions of students with certain types of enrollment (on-target or smaller than expected standardized residual). The researcher categorized these instances as “less acceptable” because if students in this category matriculated to medical school either on-target with or at smaller proportions than expected, then it seemed less acceptable for pre-health advisors to suggest that other premedical students follow these same paths to medical school in the future.

A prerequisite course completed at a two-year college as a certain type of enrollment in this study that was found to be not statistically significant indicated that the assumption of a minimum number of students completing the course at a two-year college was not met. The researcher categorized these instances as “less acceptable” because the number of students in this category who matriculated to medical school was very low, and it seemed less acceptable for pre-health advisors to suggest that other premedical students follow these same paths to medical school in the future.

The results of the chi-square goodness-of-fit tests on each of the medical school prerequisite courses are discussed in the following sections. Because the results of the chi-square tests were disclosed in Chapter 4, the researcher chose to illustrate those

results in Figure 4 before the individual prerequisite course discussion of the results in hopes that Figure 4 could act as a visual guide for the reader during the discussion.

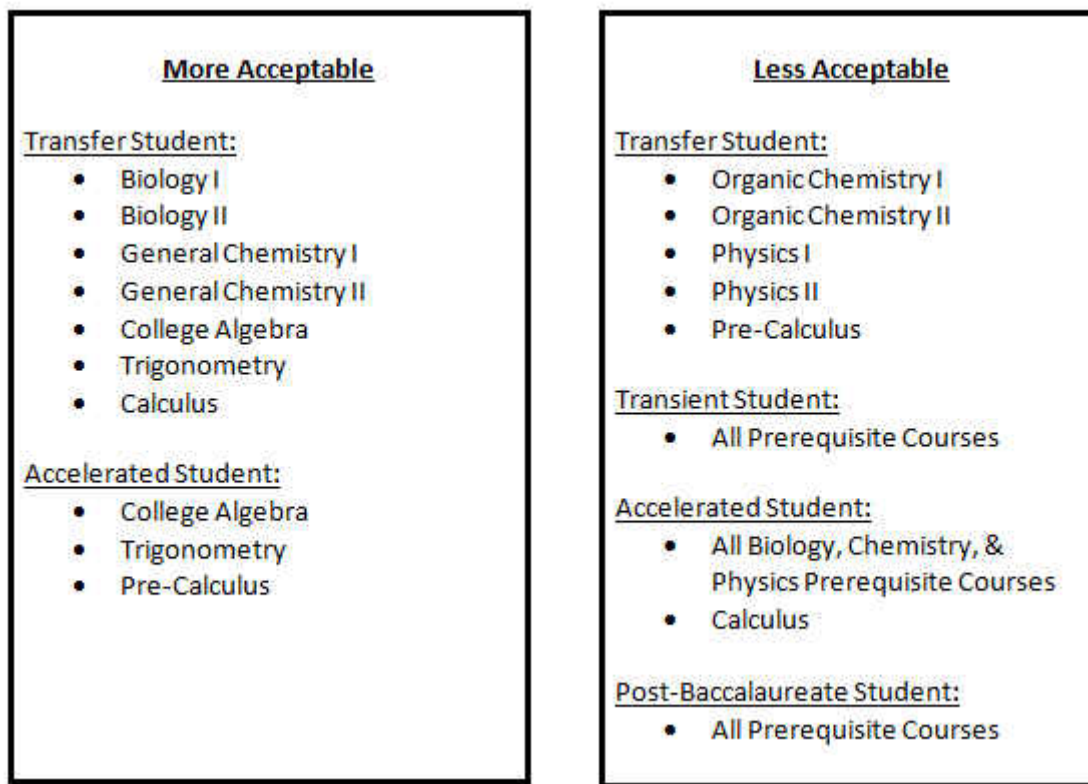


Figure 4. Summary of results of chi-square tests on medical school prerequisite courses.

### Biology Prerequisite Courses

#### Biology I

The data on matriculants who completed Biology I at a two-year college indicated that a greater proportion of students than expected were transfer students. Of the 176 medical school matriculants in the study, 26 (14.8%) completed Biology I at a two-year college. Of those 26 matriculants, 17 (9.7%) were transfer students, one (0.6%) was a

transient student, seven (4.0%) were accelerated students, and one (0.6%) was a post-baccalaureate student. The accelerated matriculants were on-target with the expected number of students, while the singular transient and post-baccalaureate matriculants represented a smaller proportion than expected. Therefore, Biology I seemed to be a course that was more acceptable to complete at a two-year college as a transfer student, but less acceptable to complete at a two-year college as either an accelerated, transient, or post-baccalaureate student.

## Biology II

The data on matriculants who completed Biology II at a two-year college indicated that a greater proportion of students than expected were transfer students. Of the 176 medical school matriculants in the study, 24 (13.6%) completed Biology II at a two-year college. Of those 24 matriculants, 14 (8.0%) were transfer students, four (2.3%) were transient students, four (2.3%) were accelerated students, and two (1.1%) were post-baccalaureate students. The numbers of transient, accelerated, and post-baccalaureate matriculants were on par with the expected number of students. Therefore, similar to Biology I, Biology II seemed to be a course that was more acceptable to complete at a two-year college as a transfer student, but less acceptable to complete at a two-year college as either an accelerated, transient, or post-baccalaureate student.

## Chemistry Prerequisite Courses

### General Chemistry I

The data on matriculants who completed General Chemistry I at a two-year college indicated that a greater proportion of students than expected were transfer students. Of the 176 medical school matriculants in the study, 27 (15.3%) completed General Chemistry I at a two-year college. Of those 27 matriculants, 17 (9.7%) were transfer students, two (1.1%) were transient students, six (3.4%) were accelerated students, and two (1.1%) were post-baccalaureate students. The numbers of transient, accelerated, and post-baccalaureate matriculants were on par with the expected number of students. Therefore, General Chemistry I seemed to be a course that was more acceptable to complete at a two-year college as a transfer student, but less acceptable to complete at a two-year college as either an accelerated, transient, or post-baccalaureate student.

### General Chemistry II

The data on matriculants who completed General Chemistry II at a two-year college indicated that a greater proportion of students than expected were transfer students. Of the 176 medical school matriculants in the study, 31 (17.6%) completed General Chemistry II at a two-year college. Of those 31 matriculants, 19 (10.8%) were transfer students, five (2.8%) were transient students, four (2.3%) were accelerated students, and three (1.7%) were post-baccalaureate students. The numbers of transient, accelerated, and post-baccalaureate matriculants were on par with the expected number of students. Therefore, similar to General Chemistry I, General Chemistry II seemed to be a

course that was more acceptable to complete at a two-year college as a transfer student, but less acceptable to complete at a two-year college as either an accelerated, transient, or post-baccalaureate student.

### Organic Chemistry I

The data on matriculants who completed Organic Chemistry I at a two-year college indicated that because too few matriculants (11, 6.3%) completed Organic Chemistry I at a two-year college, the chi-square test could not be run, and therefore no determination of expected proportions could be made. Of those 11 matriculants, only seven (3.8%) were transfer students, two (1.1%) were transient students, two (1.1%) were accelerated students, and none (0%) were post-baccalaureate students. These low numbers of matriculants who completed Organic Chemistry I at a two-year college seemed to suggest that it was less acceptable to complete Organic Chemistry I at a two-year college regardless of the type of enrollment.

### Organic Chemistry II

The data on matriculants who completed Organic Chemistry II at a two-year college indicated that because too few matriculants (12, 6.8%) completed Organic Chemistry II at a two-year college, the chi-square test could not be run, and therefore no determination of expected proportions could be made. Of those 12 matriculants, only six (3.4%) were transfer students, four (2.3%) were transient students, two (1.1%) were accelerated students, and none were post-baccalaureate students. Similar to Organic

Chemistry I, these low numbers of matriculants who completed Organic Chemistry II at a two-year college seemed to suggest that it was less acceptable to complete Organic Chemistry II at a two-year college regardless of the type of enrollment.

### Physics Prerequisite Courses

#### Physics I

The data on matriculants who completed Physics I at a two-year college indicated that because too few matriculants (17, 9.7%) completed Physics I at a two-year college, the chi-square test could not be run, and therefore no determination of expected proportions could be made. Of those 17 matriculants, 11 (6.3%) were transfer students, four (2.3%) were transient students, two (1.1%) were accelerated students, and none were post-baccalaureate students. These low numbers of matriculants who completed Physics I at a two-year college seemed to suggest that it was less acceptable to complete Physics I at a two-year college regardless of the type of enrollment.

#### Physics II

The data on matriculants who completed Physics II at a two-year college indicated that because too few matriculants (16, 9.1%) completed Physics II at a two-year college, the chi-square test could not be run, and therefore no determination of expected proportions could be made. Of those 16 matriculants, only seven (4.0%) were transfer students, six (3.4%) were transient students, two (1.1%) were accelerated students, and one (0.6%) was a post-baccalaureate student. These low numbers of matriculants who



completed Physics II at a two-year college seemed to suggest that it was less acceptable to complete Physics II at a two-year college regardless of the type of enrollment.

### Mathematics Prerequisite Courses

#### College Algebra

The data on matriculants who completed College Algebra at a two-year college indicated that a greater proportion of students than expected were transfer students and accelerated students. Of the 176 medical school matriculants in the study, 38 (21.6%) completed College Algebra at a two-year college. Of those 38 matriculants, 17 (9.7%) were transfer students, 21 (11.9%) were accelerated students, and none were transient or post-baccalaureate students. The numbers of transient and post-baccalaureate matriculants comprised a smaller proportion of students than expected. Therefore, College Algebra seemed to be a course that was more acceptable to complete at a two-year college as either a transfer or accelerated student, but less acceptable to complete at a two-year college as either a transient or post-baccalaureate student.

#### Pre-Calculus

The data on matriculants who completed Pre-Calculus at a two-year college indicated that a greater proportion of students than expected were accelerated students. Of the 176 medical school matriculants in the study, 22 (12.5%) completed Pre-Calculus at a two-year college. Of those 22 matriculants, 10 (5.7%) were transfer students, 12 (6.8%) were accelerated students, and none were transient or post-baccalaureate students.

The numbers of transfer matriculants were on target with the expected number of students, while the transient and post-baccalaureate matriculants comprised a smaller proportion of students than expected. Therefore, Pre-Calculus seemed to be a course that was more acceptable to complete at a two-year college as an accelerated student, but less acceptable to complete at a two-year college as either a transfer, transient, or post-baccalaureate student.

### Trigonometry

The data on matriculants who completed Trigonometry at a two-year college indicated that a greater proportion of students than expected were transfer students and accelerated students. Of the 176 medical school matriculants in the study, 34 (19.3%) completed Trigonometry at a two-year college. Of those 34 matriculants, 15 (8.5%) were transfer students, one (0.6%) was a transient student, 16 (9.1%) were accelerated students, and two (1.1%) were post-baccalaureate students. The numbers of transient and post-baccalaureate matriculants comprised a smaller proportion of students than expected. Therefore, similar to College Algebra, Trigonometry seemed to be a course that was more acceptable to complete at a two-year college as a transfer or accelerated student, but less acceptable to complete at a two-year college as either a transient or post-baccalaureate student.

## Calculus

The data on matriculants who completed Calculus at a two-year college indicated that a greater proportion of students than expected were transfer students. Of the 176 medical school matriculants in the study, 25 (14.2%) completed Calculus at a two-year college. Of those 25 matriculants, 14 (8.0%) were transfer students, six (3.4%) were transient students, four (2.3%) were accelerated students, and one (0.6%) was a post-baccalaureate student. The numbers of transient and accelerated matriculants were on par with the expected number of students, while the number of post-baccalaureate matriculants was lower than expected. Therefore, Calculus seemed to be a course that was more acceptable to complete at a two-year college as a transfer student, but less acceptable to complete at a two-year college as either an accelerated, transient, or post-baccalaureate student.

## Research Question 2

What differences, if any, exist in Organic Chemistry I and II grades earned at any two-year college versus any four-year institution by medical school matriculants from the University of Central Florida?

Research Question 2 examined matriculants' grades in the organic chemistry courses, ranging from A to C, as well as the type of institution at which they completed the organic chemistry courses, either two-year or four-year. Previous literature cited the importance of institutional selectivity, or quality of the institution, in the medical school admissions process (Basco et al., 2002; Blue et al., 2000; Clapp & Reid, 1976; Huff & Fang, 1999; Julian, 2005; Kleshinski et al., 2009; Mitchell, 1990; Mitchell et al., 1994;

Veloski et al., 2000). Just as the level of institutional selectivity is an evaluation of the difficulty of admission to an institution, the level of academic rigor is an evaluation of the difficulty of courses at an institution. Therefore, the researcher assumed that parallels could be drawn between the academic rigor of courses at an institution and the institution's level of selectivity.

To review, many medical school admissions personnel believe that the academic rigor of courses at two-year colleges is less than the academic rigor of courses at four-year institutions (Baffi-Dugan, 2008; Losada, 2009; Marie, 2009; MSAR, 2011; Thurlow, 2008, 2009a, 2009b; see Appendix A for each medical school's policy or preference). Based on this perception, it was assumed that students who completed the prerequisite courses at a two-year college should earn higher grades in those courses than students who completed the same courses at a four-year institution. Based on this assumption, this research question attempted to assess the level of academic rigor at an institution according to students' grades in the organic chemistry courses.

The terms "more rigorous" and "less rigorous" were intended to describe the results of the Mann-Whitney tests. If the Mann-Whitney test was significant, then the type of institution with the lower mean rank of grades would be categorized as the more rigorous type of institution, and the type of institution with the higher mean rank of grades would be categorized as the less rigorous type of institution because of the assumptions that higher overall grades indicate a lack of academic rigor, and lower overall grades indicate the presence of academic rigor. For example, if the mean rank of grades in a course at a two-year college was higher than the mean rank of grades in the

same course at a four-year institution, then the course at the four-year institution would be categorized as having more academic rigor because of its lower mean rank, and the course at the two-year college would be categorized as having less academic rigor because of its higher mean rank. Stated simply, a lower mean rank implied more academic rigor, and a higher mean rank implied less academic rigor. Based on these assumptions, if a statistically significant difference existed among organic chemistry grades between those matriculants who completed the courses at either a two-year college or a four-year institution, then the level of rigor of the courses at each institution would be categorized as “more rigorous” or “less rigorous” than the other. Figure 5 illustrates the relationships between the results of the Mann-Whitney tests and levels of academic rigor.

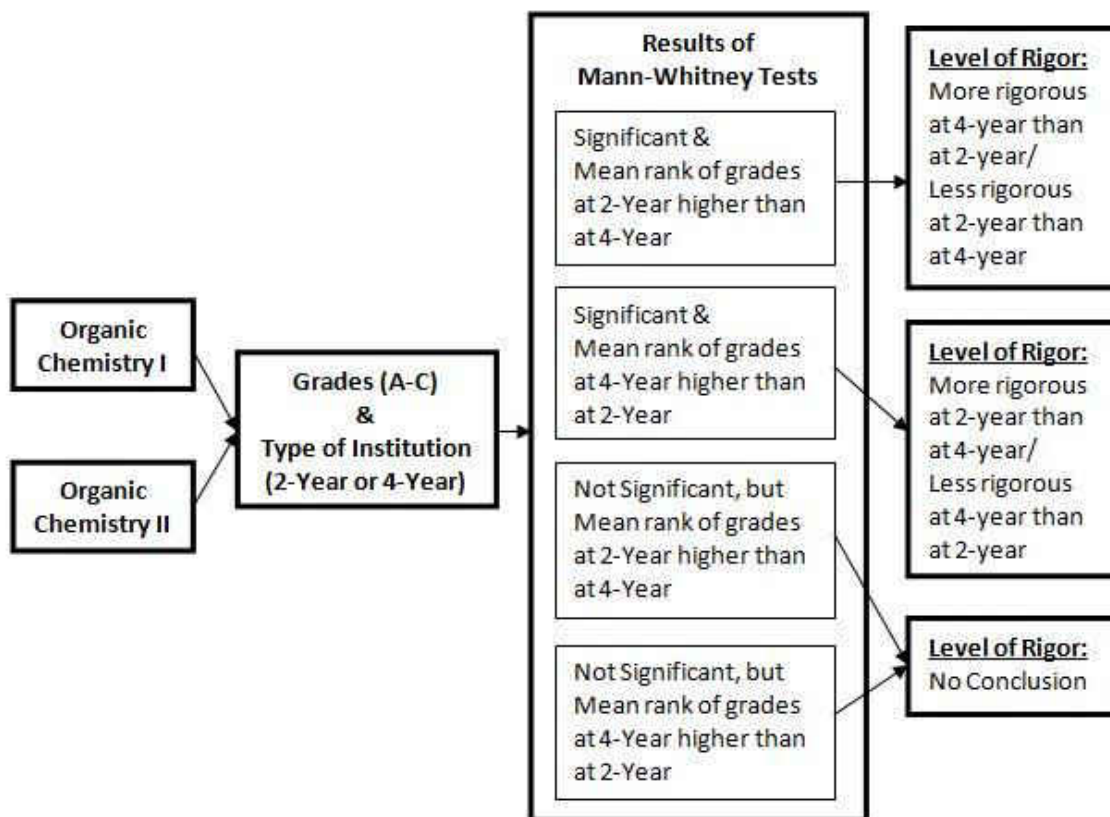


Figure 5. Relationships between results of Mann-Whitney tests and levels of rigor.

As depicted in Figure 5, an organic chemistry course with a statistically significant Mann-Whitney test result and with a higher mean rank of grades at two-year colleges would be categorized as being less rigorous at a two-year college than at a four-year institution. In other words, an organic chemistry course in this instance would also be categorized as being more rigorous at a four-year institution than at a two-year college. Consequently, higher overall grades (higher mean ranks) at the two-year colleges would imply less academic rigor in the course at a two-year college.

An organic chemistry course with a statistically significant Mann-Whitney test result and with a higher mean rank of grades at a four-year institution would be

categorized as being more rigorous at a two-year college than at a four-year institution. In other words, an organic chemistry course in this instance would also be categorized as being less rigorous at a four-year institution than at a two-year college. Consequently, higher overall grades (higher mean ranks) at the four-year institutions would imply less academic rigor in the course at a four-year institution.

Organic chemistry courses without a statistically significant Mann-Whitney test result were not able to be categorized for level of rigor regardless of the mean rank of the grades in the course. Even if the mean ranks of the grades indicated a difference, because the test was not significant, a conclusion about the differences in the levels of rigor of the courses at the different types of institutions could not be drawn.

The results of the Mann-Whitney tests on the Organic Chemistry I and II courses are discussed in the following sections. Because the results of the Mann-Whitney tests were disclosed in Chapter 4, the researcher chose to illustrate a summary of those results in Figure 6 before the discussion of the results in hopes that Figure 6 could act as a visual guide for the reader during the discussion.

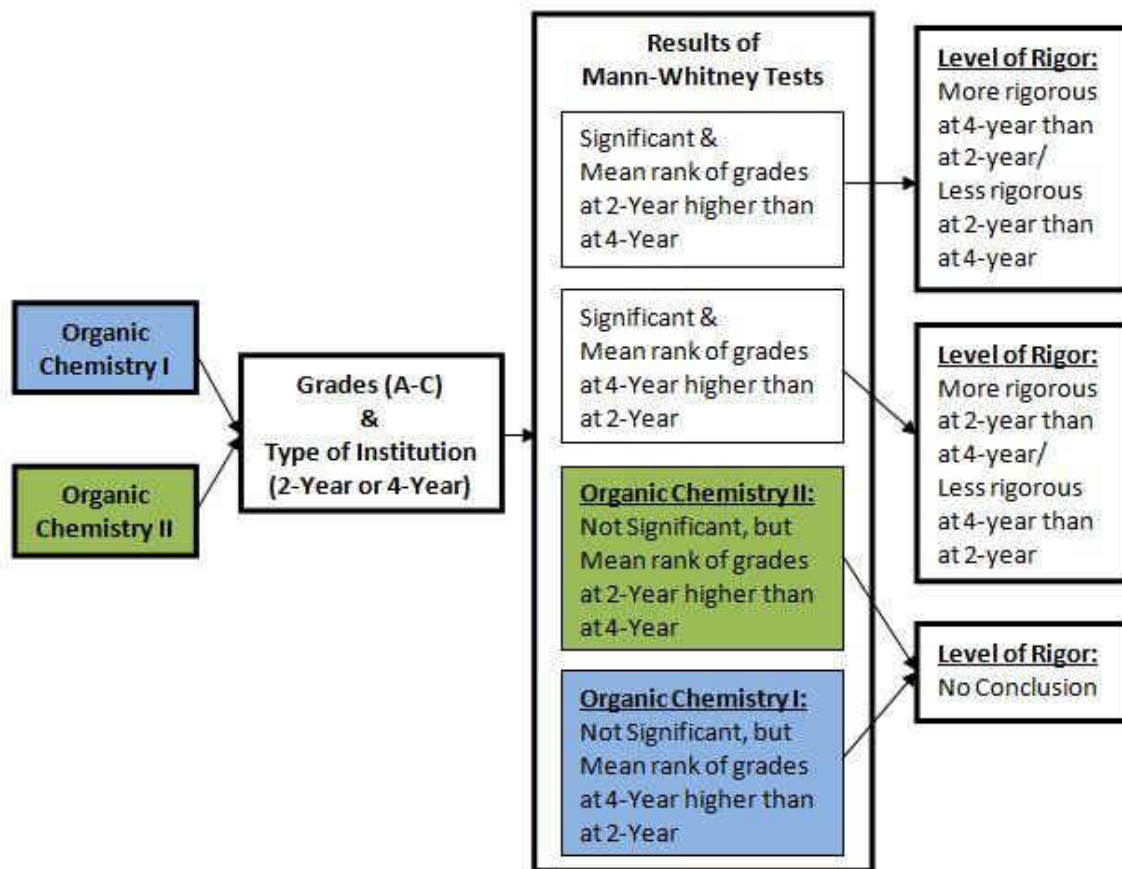


Figure 6. Summary of results of Mann-Whitney tests on organic chemistry courses.

### Organic Chemistry I

There was no significant difference in grades of matriculants who completed Organic Chemistry I at a two-year college versus a four-year institution. Of the 176 matriculants to medical school in this study, only 11 (6.3%) completed Organic Chemistry I at a two-year college, and 165 (93.7%) completed Organic Chemistry I at a four-year institution. The mean rank of matriculants' grades at four-year institutions was higher than the mean rank at the two-year colleges, which suggested that students who



completed Organic Chemistry I at a four-year institution performed better than did those at a two-year college, and that the course may be more rigorous at a two-year college than at a four-year institution. However, the differences were not statistically significant. Therefore, from the results of this analysis, the researcher could not conclude that the rigor of courses at one type of institution was more or less academically rigorous than at the other.

### Organic Chemistry II

Similar to the results of Organic Chemistry I, there was no significant difference in grades of matriculants who completed Organic Chemistry II at a two-year college versus a four-year institution. Of the 176 matriculants to medical school in this study, only 12 (6.8%) completed Organic Chemistry II at a two-year college, and 164 (93.2%) completed Organic Chemistry II at a four-year institution. Different from the results of Organic Chemistry I, the mean rank of matriculants' grades at two-year colleges was higher than the mean rank at four-year institutions. This result suggested that students who completed Organic Chemistry II at a two-year college performed better than did those at a four-year institution, and that the course may be more rigorous at the four-year institution than at a two-year college. However, again, the differences were not statistically significant. Therefore, from the results of this analysis, the researcher could not conclude that the rigor of courses at one type of institution was more or less academically rigorous than at the other.

### Significant Findings

The results of this study were important not only because of what was found to be statistically significant, but also because of what was not found to be statistically significant. Prior to the current study, scant research was conducted that examined the anecdotal information that many pre-health advisors and medical school admissions personnel have shared with premedical students regarding the preferred type of student enrollment or institutional enrollment in the medical school prerequisite courses. This study attempted to empirically analyze some of this anecdotal information by examining the type of student enrollment in a more in-depth fashion than has been utilized in the past, and being one of the first studies of this nature to attempt to analyze the academic rigor of courses at a type of institution in this manner.

In Research Question 1, matriculants' types of student enrollment in each medical school prerequisite course was examined. While some courses were found to be "more acceptable" to complete at two-year colleges as different types of enrollments (e.g., transfer, transient, accelerated/dual enrollment, or post-baccalaureate), other courses were found to be "less acceptable." A summary of the results of this analysis were presented in Figure 3.

The levels of acceptability, categorized as "more acceptable" or "less acceptable," of completing the medical school prerequisite courses at two-year colleges varied by type of student enrollment and by course. The results indicated that it was more acceptable to complete the biology, general chemistry, and most of the mathematics courses as a transfer student, with the exception of Pre-Calculus. Most mathematics courses were also

considered more acceptable to complete as an accelerated student, with the exception of Calculus. In addition, the results indicated that it was less acceptable to complete any of the medical school prerequisite courses as a transient or a post-baccalaureate student. The completion of the organic chemistry and physics courses, as well as Pre-Calculus, was also considered less acceptable academic approaches as a transfer student. The same held true in completing all of the biology, chemistry and physics courses, as well as Calculus, as an accelerated student.

Furthermore, the very small percentages of total matriculants who completed the organic chemistry and physics courses at a two-year college should be noted. Fewer than 10% of the total matriculants completed the physics courses at a two-year college (Physics I = 9.7%; Physics 2 = 9.1%), and less than seven percent of total matriculants completed organic chemistry courses at a two-year college (Organic Chemistry I = 6.3%; Organic Chemistry II = 6.8%). Because the numbers of matriculants who completed these courses at two-year colleges were so small, the chi-square tests could not be run, and no determination of expected proportions could be made. Therefore, proportions related to their acceptability could not be found, and they were categorized as “less acceptable” to complete at a two-year college.

In Research Question 2, the rigor of courses was examined according to matriculants' grades in Organic Chemistry I and II and the type of institution where they completed these courses. If the presence of a significant difference of the grades at each type of institution existed, then the level of rigor at one type of institution could be categorized as “more rigorous” or “less rigorous” than at the other type of institution.

According to the results, no significant difference was found between matriculants' grades at the two-year colleges and four-year institutions for either Organic Chemistry I or Organic Chemistry II. Therefore, neither institution could be considered to provide a more or less rigorous version of the courses. However, although not at a significant level, the results also suggested that students who completed Organic Chemistry I at a four-year institution performed better than did those at a two-year college, and students who completed Organic Chemistry II at a two-year college performed better than did those at a four-year institution. These contradicting results could further suggest the lack of difference in the level of rigor of courses at either type of institution.

The very small percentages of total matriculants who completed the organic chemistry courses at a two-year college (Organic Chemistry I = 6.3%; Organic Chemistry II = 6.8%) compared to a four-year institution (Organic Chemistry I = 93.7%; Organic Chemistry II = 93.2%) should also be noted. The mean ranks produced in Research Question 2, especially due to the comparison of a large group (four-year institutions) and a small group (two-year colleges) for both Organic Chemistry I and II, may be skewed due to the disproportionate group sizes. Therefore, the researcher believes that the results of this analysis should be perceived cautiously until future research can be conducted to reaffirm (or contradict) the results.

#### Implications for Practice and Policy

Upon examination of the matriculants to medical school in this study, along with the levels of institutions they attended, their types of enrollment at two-year colleges, and

their grades in organic chemistry courses, several recommendations were identified for practice and policy. Recommendations were identified for three sets of stakeholders in this study: premedical students and pre-health advisors, medical school admissions personnel, and two-year and four-year higher education institutions. Implications for practice and policy were examined according to the results of each research question.

### Research Question 1

Research Question 1 examined the types of student enrollment—transfer, transient, accelerated/dual enrollment, and post-baccalaureate—in medical school prerequisite courses at two-year colleges by the matriculants to medical school in this study. Based on the results of this analysis, recommendations for practice and policy for premedical students, pre-health advisors, medical school admissions personnel, and two-year and four-year higher education institutions are presented in the following sections.

#### Premedical Students and Pre-Health Advisors

Premedical students often rely upon pre-health advisors for advisement on how to best prepare themselves for admission to medical school. When questions from premedical students about the type of institution where it is most acceptable to complete the medical school prerequisite courses arise, many pre-health advisors feel challenged when attempting to answer these questions. Although the most conservative strategy is to complete all of the medical school prerequisite courses at a four-year institution, this ideal scenario is not possible for all premedical students. Due to a wide variety of factors,

premedical students often complete medical school prerequisite courses at two-year colleges; depending on a student's academic situation, enrollment types at these institutions differ. For premedical students who choose to complete some or all of the medical school prerequisite courses at two-year colleges, pre-health advisors should be prepared to discuss with and inform these students about the levels of acceptability of completing the different prerequisite courses under different enrollment types. Based on the data analysis in the current study, Table 34 serves as a practical guide for pre-health advisors to inform premedical students about the acceptability of completing the different medical school prerequisite courses at two-year colleges as different types of enrollments.

Table 34

*Pre-Health Advisor's Guide to Acceptability of Medical School Prerequisite Courses at a Two-Year College According to Type of Student Enrollment*

Prerequisite	Transfer	Transient	Accelerated	Post-Bacc
Biology I	<b>More</b>	Less	Less	Less
Biology II	<b>More</b>	Less	Less	Less
General Chemistry I	<b>More</b>	Less	Less	Less
General Chemistry II	<b>More</b>	Less	Less	Less
Organic Chemistry I	Less	Less	Less	Less
Organic Chemistry II	Less	Less	Less	Less
Physics I	Less	Less	Less	Less
Physics II	Less	Less	Less	Less
College Algebra	<b>More</b>	Less	<b>More</b>	Less
Pre-Calculus	Less	Less	<b>More</b>	Less
Trigonometry	<b>More</b>	Less	<b>More</b>	Less
Calculus	<b>More</b>	Less	Less	Less

*Note.* More = more acceptable. Less = less acceptable.

The knowledge gained from the data analysis in Research Question 1 seemed to align with some of the anecdotal information that pre-health advisors and medical school admissions personnel have historically shared with premedical students. The researcher previously stated that some medical school admissions personnel and pre-health advisors

believe that it is more acceptable to complete prerequisite courses at a two-year college as a transfer student or as an accelerated student, but not as acceptable to complete the courses at a two-year college as a transient or post-baccalaureate student. As evidenced in Table 34, the results of this study somewhat affirm this perception, especially in regard to lesser acceptability of completing the medical school prerequisite courses at a two-year college as a transient or post-baccalaureate student.

The results of Research Question 1 also provided information that can inform policy for pre-health advisors. As a policy, the results of Research Question 1 inform pre-health advisors that they should not make “blanket” statements to all premedical students about the disadvantage at which they place themselves by completing medical school prerequisite courses at a two-year college. Instead, when pre-health advisors advise premedical students who plan to complete or have previously completed prerequisite courses at a two-year college, they should inquire further to (a) identify each student’s type of enrollment at the two-year college, (b) provide the student detailed information about level of acceptability for their type of enrollment in each prerequisite course, and (c) help the student devise a plan to continue their academic preparation for medical school on the most beneficial path for their individual set of circumstances. The results of this analysis prove that premedical students who complete certain medical school prerequisite courses at a two-year college are not necessarily at a disadvantage when seeking admission to medical school, and as a matter of policy, pre-health advisors should help convey this information to premedical students.



### Medical School Admissions Personnel

Medical school admissions personnel provide information to premedical students about the experiences, attributes, and metrics that they seek for admission to their medical school. In addition to learning this information directly from medical school admissions personnel themselves, premedical students and pre-health advisors often consult various resources such as the *MSAR*, *PARM*, and each medical school's website for this information. In regards to policies or preferences on type or quality of institution where premedical students should complete the medical school prerequisite courses, the level of transparency of medical schools tends to vary across these resources.

Additionally, although the majority of medical schools were consistent in their policies or preferences on this topic across these resources, some inconsistencies still existed.

Therefore, as a matter of practice, medical schools should provide more transparency and do their best to provide consistency across the resources regarding their policies or preferences on the type or quality of institution where their applicants should complete the prerequisite courses.

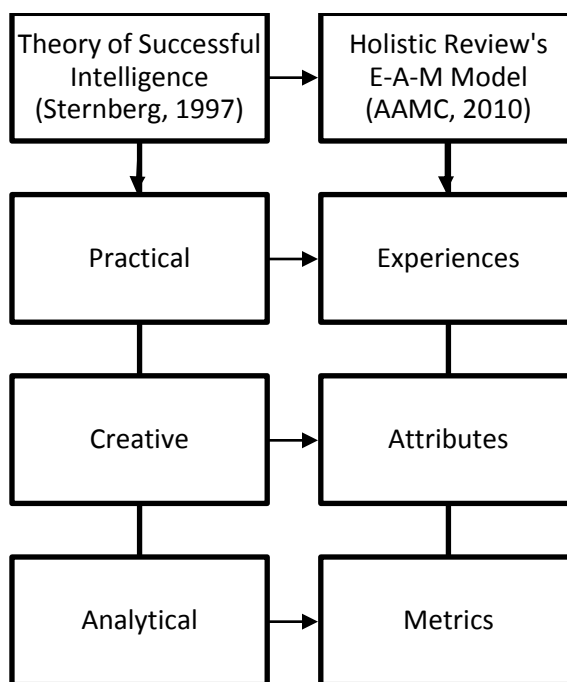
Furthermore, it would be most helpful if medical schools provided more detail about their policies and preferences on type or quality of institution where premedical students should take prerequisite courses. For example, beyond stating whether they accept, accept but discourage, discourage or highly discourage, or do not accept prerequisite courses at two-year colleges, medical schools could further specify the *type of student enrollment* (if any) in *which* prerequisite courses (if any) that their medical school would deem acceptable to complete at a two-year college for admission to their

school. For example, a medical school could state that they deem it acceptable for their applicants to complete the mathematics courses at a two-year college as an accelerated or transfer student, but not complete these courses as a transient or post-baccalaureate student. This level of detailed information would leave few questions regarding the acceptability of these courses for their applicants and for pre-health advisors.

The recent practice of holistic review by most medical school admissions personnel seems to be advantageous to premedical students who completed medical school prerequisite courses at two-year colleges. As previously stated, admissions personnel use holistic review to receive a more complete, well-rounded picture of their applicants. In contrast, admissions personnel who do not utilize holistic review may assess applicants more narrowly and according to only a few factors such as GPAs, test scores, and type or quality of undergraduate institution. By providing greater focus on an applicant's overall qualifications, such as their experiences, attributes, and metrics, admissions personnel seem to lessen the amount of weight that a select few factors may have in their evaluation of applicants, instead more evenly distributing the weight amongst a wide variety of factors. Therefore, the perceived disadvantage of medical school applicants who completed prerequisite courses at a two-year college should be lessened under the practice of holistic review because type of institution is only one factor amongst many factors that are reviewed and evaluated.

While the practice of holistic review seems to be the driving force behind the broadening of criteria that are reviewed in admissions processes in order to admit a more diverse class, the researcher believes that the concept of holistic review can be originally

traced to Sternberg's theory of successful intelligence (1997, 1999). The main tenets of the theory of successful intelligence and holistic review are very similar in that they both aspire to broaden the review of students for the purpose of creating greater equity and diversity. For example, Robert Sternberg (2008) stated that the theory of successful intelligence suggests "broadening the range of skills tested to go beyond analytical skills to include practical and creative skills as well might significantly enhance the prediction of college performance beyond current levels" (p. S105). Furthermore, Dr. Darrell G. Kirch, M.D., President and CEO of the AAMC (MSAR, 2011), stated that "medical schools are increasingly taking a holistic approach to admissions decisions by evaluating candidates' experiences and personal attributes in addition to their academic credentials and metrics" (p. 1). Based on these statements, it seems that the "analytical skills" referred to in the theory of successful intelligence are held in similar regard to the "metrics" referred to in the E-A-M model component of holistic review, as are the "practical and creative skills" and the "experiences and personal attributes" in the theory of successful intelligence and the E-A-M model component of holistic review, respectively. Figure 7 graphically depicts the researcher's perception of the relationship between these similar components.



*Figure 7.* Similarities between the theory of successful intelligence and holistic review’s E-A-M model.

It does appear that the practice of holistic review by medical school admissions personnel should help to “level the playing field” for premedical students who complete the prerequisite courses at a two-year college. Additionally, because the researcher believes that the groundwork for the practice of holistic review may have originated from theory of successful intelligence, it ultimately appears that theory may have informed the practice, and the theory may have been the catalyst for greater equity in admissions for these premedical students. Therefore, by this logic, the theory of successful intelligence played in integral role in initiating the broadening of review of applicants, and should also help to lessen the perceived disadvantage of applicants who complete medical school prerequisite courses at two-year colleges.

## Two-Year Colleges and Four-Year Institutions

Both two-year colleges and four-year institutions provide challenges for premedical students who begin their higher education at two-year colleges and ultimately hope to gain admission to medical school. As previously stated, statistics show that two-year college enrollment has increased at a faster pace than four-year university enrollment in recent years (The Chronicle of Higher Education, 2010). As a result, it seems inevitable that medical schools will receive more applications than before from applicants who took courses and/or earned an AA degree at a two-year college. Furthermore, it has been previously recognized that “the guidance and resources available to students regarding a premedical path at most community colleges typically lag behind those found at four-year colleges” (Stanford School of Medicine, 2011, para. 4). Due to these trends, as well as the significance of the results found in this study regarding the medical school prerequisite courses, the researcher believes that it would be helpful for more two-year colleges to begin to employ pre-health advisors for their premedical students. If possible, it would also be helpful for the pre-health advisors at four-year institutions located in close proximity to two-year colleges to strive to maintain open communication and share information and updates with advisors who work with pre-health students at two-year colleges, and vice versa.

In addition, those faculty and administrators at four-year institutions, two-year colleges, and on statewide articulation coordinating committees who develop transfer and articulation agreements between institutions should be aware of the effects of these agreements on premedical students. Transfer and articulation agreements between

institutions are intended to benefit students by easing their transfer and transition from one institution to another. Nevertheless, due to the perception of the lack of academic rigor in prerequisite courses at two-year colleges by many medical school admissions personnel, premedical students who abide by these agreements between two-year colleges and four-year institutions can sometimes hinder their chances of admission to medical school if they plan to complete certain prerequisite courses at a two-year college. Therefore, the researcher recommends that faculty and administrators who develop transfer and articulation agreements between two-year colleges and four-year institutions make special note of agreements that include medical school prerequisite courses. Additionally, recognition should somehow be provided to this perception held by many medical schools and possibly held by other graduate and professional school programs as well.

## Research Question 2

Research Question 2 examined the level of academic rigor of courses according to matriculants' grades in Organic Chemistry I and II and the type of institution at which they completed these courses. Based on the results of this analysis, recommendations for practice and policy for premedical students, pre-health advisors, medical school admissions personnel, and two-year and four-year higher education institutions are presented in the following sections.

## Premedical Students and Pre-Health Advisors

Premedical students sometimes ask pre-health advisors the question, “How negatively will it affect my chances of admission to medical school if I take the organic chemistry courses at a two-year college?” This is a challenging question for pre-health advisors to answer, often requiring a multi-faceted response, and likely prompting many additional questions about that student’s previous metrics, experiences, attributes, and life circumstances. Previous literature such as that of Breiger (1999) has informed pre-health advisors and premedical students about the importance of organic chemistry courses in the medical school admissions process. Additionally, pre-health advisors often provide anecdotal information to premedical students about avoiding the completion of prerequisite courses at two-year colleges if possible, especially the organic chemistry courses, based on resources available about medical school policies and preferences. In an effort to provide data to support or refute these notions, the purpose of Research Question 2 was to examine matriculants’ grades in the organic chemistry courses to determine if there was actually a significant difference in grades between two-year colleges and four-year institutions.

The perception held by many involved in medical school admissions is that prerequisite courses at two-year colleges are less academically rigorous than the same courses at four-year institutions (Baffi-Dugan, 2008; Losada, 2009; Marie, 2009; MSAR, 2011; Thurlow, 2008, 2009a, 2009b; see Appendix A for each medical school’s policy or preference); therefore, this assumption is that students’ grades in those courses at two-year colleges should be higher on average than their grades at four-year institutions. In

contrast to this assumption, the results of this analysis indicated that there was no significant difference in students' grades in either of the organic chemistry courses based on whether they took the course at a two-year college or a four-year institution. In other words, the analysis indicated that the organic chemistry courses taken at a two-year college were not less rigorous than the organic chemistry courses taken at a four-year institution. Due to the small number of students in this study who completed the organic chemistry courses at two-year colleges, and very disproportionate population sizes used to obtain the results, however, the researcher is cautious about generalizing these results to other populations.

If pre-health advisors were to implement these results into practice and policy, the results of both Research Questions 1 and 2 can be used to make some general recommendations to premedical students regarding the organic chemistry courses. First, for premedical students enrolled at a two-year college (i.e., transfer students) who have *not yet taken* the organic chemistry courses at a two-year college but plan to do so, the researcher believes that pre-health advisors should recommend not completing the organic chemistry courses at a two-year college, even though the results of Research Question 2 indicated that neither institution could be considered to provide a more or less rigorous version of the course. Due to the very disproportionate population sizes that produced the results of Research Question 2, the researcher believes that the results on the organic chemistry courses found in Research Question 1 (i.e., it is less acceptable to complete the organic chemistry courses at a two-year college as a transfer student) may be currently more reliable than the results of Research Question 2. Therefore, the



researcher believes that until more research can be conducted to support or refute the results found in Research Question 2, the more conservative recommendation for these premedical students is to err on the side of caution and complete the organic chemistry courses at a four-year institution.

Secondly, for premedical students enrolled at two-year colleges who have *already taken* the organic chemistry courses at a two-year college (i.e., transfer students), the researcher believes that pre-health advisors should recommend not retaking the organic chemistry courses at a four-year institution. Instead, advisors should recommend that premedical students continue to excel in additional upper-division science coursework at the four-year institution to prove to medical school admissions personnel that they are capable of consistently handling a high level of academic rigor in their courses.

Additionally, similar to the recommendations from Dr. Amerish Bera (Losada, 2009), the researcher believes that premedical students can confirm their mastery of the organic chemistry concepts with a strong score on the Biological Sciences portion of the MCAT, as this portion contains organic chemistry topics. Lastly, reaffirming the results of Research Question 2 through more in-depth analyses on different populations can hopefully benefit these premedical students in the future.

The final recommendation applies to premedical students who are in high school but enrolled in the medical school prerequisite courses through dual-enrollment at a two-year college (i.e., accelerated students), are enrolled at four-year institutions but are considering taking the organic chemistry courses at a two-year college (i.e., transient students), or have already earned a bachelor's degree but are completing the medical

school prerequisite courses at a two-year college (i.e., post-baccalaureate students). Regarding these students, the researcher believes that pre-health advisors should recommend not completing the organic chemistry courses at a two-year college, even though the results of Research Question 2 indicated that neither institution could be considered to provide a more or less rigorous version of the course. The rationale for this recommendation is similar to that for transfer students who have not yet completed the organic chemistry courses at a two-year college. Due to the very disproportionate population sizes that produced the results of Research Question 2, the researcher believes that the results on the organic chemistry courses found in Research Question 1 (i.e., it is less acceptable to complete the organic chemistry courses at a two-year college as a transfer student) may be currently more reliable than the results of Research Question 2. Therefore, the researcher believes that until more research can be conducted to support or refute the results found in Research Question 2, the more conservative recommendation for these premedical students is to err on the side of caution and complete the organic chemistry courses at a four-year institution.

#### Medical School Admissions Personnel

While the results of this study indicated that there was not a significant difference in students' grades in either of the organic chemistry courses at either type of institution, the researcher is cautious of these results because of the very disproportionate population sizes of matriculants that produced these results. Although the results should be the basis for providing recommendations, the researcher's cautiousness of the generalization of the

results due to the disproportionate population sizes makes it difficult to provide recommendations based on these results. Therefore, in the next paragraph, although the researcher discusses implications and provides recommendations for medical school admissions personnel based upon the results that were found in Research Question 2, it should be recognized, however, that these recommendations may not be generalizable beyond the population studied and that the researcher recommends future research on this topic to support or refute the results that were found.

Because the analysis in this study produced results which indicated that there was *not* a significant difference in students' grades in the organic chemistry courses at two-year colleges and four-year institutions, then medical school admissions personnel could assume that the level of rigor in courses at one type of institution was not more or less academically rigorous than the other. Furthermore, because the levels of academic rigor of courses at the types of institutions were not perceived to be significantly different, then medical school admissions personnel should not discourage premedical students from taking prerequisite courses at a two-year college, and instead hold similar perceptions of the levels of academic rigor of prerequisite courses from both types of institutions. In other words, according to the results of Research Question 2, premedical students should not be at a disadvantage in the admissions process for taking prerequisite courses at a two-year college based on the perception of differences in academic rigor.

As previously stated, the researcher believes there are parallels between academic rigor and institutional selectivity. While level of academic rigor is an evaluation of the difficulty of courses at an institution, the level of institutional selectivity is an evaluation

of the difficulty of admission to an institution. Similarly, while the selectivity of an institution, which can “serve as a proxy for academic quality,” (Julian, 2005, p. 912) is often a factor considered in the holistic review of applicants to medical school, it is only one factor amongst many. For example, Table 17 lists multiple admissions factors as rated by level of importance by 113 medical school admissions officers regarding which applicants to interview and accept. The factor of “selectivity of an institution” was ranked 21st out of the 23 ranked factors. This low ranking provides some insight into the level of importance of this factor compared to other factors according to medical school admissions officers.

Even though the results of Research Question 2 did not indicate that there was a significant difference in academic rigor of the organic chemistry courses at two-year colleges and four-year institutions, if a difference did exist, Table 17 seems to signify that this factor is not one of the most substantial in evaluation of applicants. Based on this information, it would appear that medical school admissions personnel may not be as concerned about selectivity of an institution, or possibly the type or quality of an institution where an applicant takes the prerequisite courses, as some of them may seem to be based on the information in the *PARM*, *MSAR*, and their websites. While it is certain that regional and individual differences exist amongst medical school admissions officers’ ratings of these admissions factors, the fact that the information in Table 17 is derived from a survey of admissions officers from the vast majority of medical schools ( $N = 113$ ) in the nation makes this resource fairly indicative of the national perspective on this topic. Therefore, the results about the type or quality of institution from Research

Questions 1 and 2 may hold more weight than was indicated by Table 17 for some medical school admissions personnel, but other medical school admissions personnel may be less concerned with this factor. Still, due to the high level of competitiveness in the medical school admissions process, even admissions factors that seemingly hold less weight than others can be the difference between gaining or not gaining admission.

### Two-Year Colleges and Four-Year Institutions

In Florida in the late 1960s, those in higher education public institutions “voiced concerns about the difficulties encountered in assigning course credits to students transferring from lower-division colleges to the upper-division of universities, or to students changing institutions prior to degree completion” (Florida Department of Education, 2011b, p. 3). As a result, a statewide common course numbering system was established in order to ensure that particular courses taken at two-year colleges were deemed equivalent to their counterpart courses at four-year institutions. For example, in Florida, “equivalent courses at different institutions are identified by the same prefixes and same last three digits of the course number and are guaranteed to be transferable between participating institutions that offer the course” (University of Central Florida, 2012, p. 411). Therefore, “transfer of any successfully completed course from one participating institution to another is guaranteed in cases where the course to be transferred is equivalent to one offered by the receiving institution” (University of Central Florida, 2012, p. 411). Even though these courses are deemed equivalent for purposes of transferring from one institution to the next, they are often not deemed

equivalent in regards to academic rigor according to many medical school admissions personnel. In other words, courses at most public institutions in Florida with the same course prefix and same last three digits are deemed to be equivalent for purposes of transferring from one participating institution to the next, but are often not deemed to be equivalent in level of academic rigor if taken at two different types of institutions – a two-year college and a four-year institution. This “equivalent, but not equivalent” notion can be confusing for many premedical students who begin their higher education at a two-year college and intend to complete their education at a four-year institution.

Furthermore, not only are certain courses in Florida deemed to be equivalent to each other due to the statewide common course number system, but curriculum alignment efforts are also utilized to try to ensure that the content of the courses at different institutions are equivalent. Curriculum alignment focuses on “adjusting curricula at both course and program levels to ensure that content, depth of coverage, objectives, and outcomes for a given course are consistent from one institution to another, and that each course and program properly prepares students for success in subsequent courses and programs” (University of Central Florida, 2011a, para. 1). Additionally, specific efforts at UCF have been made to ensure alignment of curriculum in the disciplines of biology, chemistry, physics, and mathematics (University of Central Florida, 2011b), which happen to comprise the disciplines of the medical school prerequisite courses. Again, although efforts are being made to attempt to make these courses from two-year colleges equivalent to their counterpart courses at four-year institutions, many medical schools

still seem to hold the “equivalent, but not equivalent” perspective which can be confusing for many premedical students who begin their higher education at a two-year college.

Through the collective efforts of the statewide common course numbering system and curriculum alignment, two-year colleges and four-year institutions in Florida are attempting to ensure that courses at different institutions are equivalent to each other. Although these equivalency efforts exist, many medical schools do not always perceive science courses at a two-year college to be equivalent in level of academic rigor to the same courses at a four-year institution (Baffi-Dugan, 2008; Losada, 2009; Marie, 2009; MSAR, 2011; Thurlow, 2008, 2009a, 2009b; see Appendix A for each medical school’s policy or preference). The results of Research Question 2 alluded to the notion that the differences in academic rigor of organic chemistry courses at the two types of institutions may be less than many medical school admissions personnel perceive. As previously noted though, due to the small number of premedical students who completed the organic chemistry courses at two-year colleges in this study, the results may not be generalizable beyond the population studied, and the researcher recommends to interpret the results cautiously until additional, more in-depth research can be conducted. Regardless, in order to address the “equivalent, but not equivalent” notion about the medical school prerequisite courses at two-year colleges and four-year institutions, the researcher recommends that faculty and administrators at four-year institutions, two-year colleges, and on curriculum alignment committees and statewide articulation coordinating committees make special note of agreements that include medical school prerequisite courses. Taking this action will help provide recognition to this perception held by many

medical schools and possibly held by other graduate and professional school programs as well.

### Implications for Future Research

The findings in this study expand upon the previous research and literature on two-year college courses and medical school admissions. However, due to limitations on accessibility of certain data and the scope of this research, the researcher recognized certain aspects of this study that could have been expanded upon further. These limitations on data and scope, along with the results obtained from the study, led to several possibilities for a more in-depth analysis of aspects of two-year college enrollment and the medical school admissions process.

First, as recognized in the limitations of this study, only matriculants to medical school from UCF were included and analyzed in this study. The researcher believes that the inclusion of *applicants* to medical schools in addition to *matriculants* could have allowed additional research questions to be posed and deeper levels of analysis to occur, and suggests that future research on this topic should include both applicants and matriculants. Furthermore, the inclusion of applicants in addition to matriculants would increase the overall number of premedical students to be studied; these larger numbers could potentially lead to greater generalizability of results. Lastly, the researcher suggests studying a broader population of premedical students in the future. The premedical students in this study graduated from only one institution—a large, public, metropolitan institution in Florida which has very strong articulation agreements with numerous local



two-year colleges. While it can be argued that this institution was an optimal choice for such a study, additional value and insight can potentially be obtained by studying this topic at a statewide or national level.

Second, as recognized in the delimitations of this study, matriculants to medical school from UCF within only the most recent five years, 2007 to 2011, were included in this study. Due to the large student enrollment of UCF, this time frame allowed the researcher to study a large number of matriculants to medical school compared to the number of matriculants to medical school at a majority of colleges and universities around the nation during that same time frame. However, an even larger population could have been studied if the researcher had chosen to increase the range of years. Future researchers could choose to study a wider range of years, therefore increasing the size of the population in their study.

Additionally, the statistics generated from this study, addressing students from the years 2007 to 2011, were compared to those of Thurlow's study (2009a), which addressed students from the years 2004 to 2007. Along with studying two different time frames, there were also differences in the state of the U.S. economy between the two time periods. Many would agree that the U.S. economy was more prosperous during the time frame of Thurlow's study (2009a) from 2004 to 2007 than during the time frame of this study from 2007 to 2011. Literature exists that discusses how enrollments in two-year community colleges rise during times of economic downturn and financial crisis (Associated Press, 2008; Higa, 2012), and due to this trend, the researcher's comparison of statistics from the two studies (see Table 2 and Table 18) may provide evidence of

differences in the populations studied because of differences in the state of the U.S. economy. Although it was not possible for the researcher to control for factors such as the state of the U.S. economy when making comparisons of these statistics, future researchers of this topic may want to control for such factors if they choose to make comparisons of trends from different time frames.

Third, in Research Question 2, of the twelve medical school prerequisite courses, only the organic chemistry courses were examined, while in Research Question 1, all twelve medical school prerequisite courses were examined. Only the organic chemistry courses were chosen to be analyzed for their academic rigor in Research Question 2 because of previous literature, such as that of Breiger (1999), which exclaimed the heightened importance of and additional scrutiny placed upon grades in organic chemistry courses by medical school admissions personnel. While the results of the analysis of premedical students' grades in only the organic chemistry courses did provide some insight, additional analyses of each of the medical school prerequisite courses could have provided different weight to the overall results found in Research Question 2. Therefore, future research should analyze all twelve of the medical school prerequisite courses, instead of only a select few, in order to provide a broader scope of reliability to the results.

Fourth, in the analysis of Research Question 2, the researcher utilized a very narrow definition of academic rigor. In this study, the researcher defined academic rigor solely according to students' grades because grades were an easily quantifiable variable. Although assessment (measured by grades) can play a role in academic rigor, most

definitions of academic rigor are typically broader and include more than just grades. For example, one definition stated that “academic rigor is determined not just by what is taught, but how it is taught and how it is assessed” (Hechinger Institute on Education and the Media, 2009, p. 3). Said similarly, academic rigor has been said to consist of the three main components of “content, pedagogy, and assessments” (p. 3). Therefore, although rigor may be difficult to analyze solely quantitatively, future research on academic rigor should strive to define and assess academic rigor more holistically than just by grades as in this study.

Additionally, comparing the academic rigor (grades) of a course being taught at numerous institutions presents inherent challenges. A common challenge is the reliability of grades in a course not only taught by multiple faculty members at the same institution, but also taught by multiple faculty members at different institutions. In an article by Jaschik (2009), Kay McClenney, director of the Community College Survey of Student Engagement at the University of Texas at Austin, was quoted as saying, “notoriously, grades are unreliable, and they include measures of just about everything—attendance, class participation, involvement in group discussions or campus events, and faculty bias—as well, hopefully, as some aspects of student learning.” Furthermore, McClenney noted that she did not “know anyone who believes that an A in English 301 means the same thing in my class as in the class down the hall, much less in the class across the country” (para. 17). Similarly, professors at the same institution or different institutions may teach the curriculum differently or assign grades differently based upon their own particular knowledge and expertise, the different populations of students in their

classrooms, different grade expectations, and different grading scales. Therefore, attempting to draw comparisons in grades across multiple institutions, both two-year and four-year, presents significant challenges and warrants the need for future research.

Lastly, this study did not address the important aspects of race or ethnicity amongst two-year community college students and medical school admissions. Many articles and resources that discussed the topic of student enrollment in two-year community colleges and medical school admissions also discussed the importance of racial and ethnic diversity in medicine. For example, according to Thurlow (2008), “the minority population at community colleges is a key component of any plan to enrich the pipeline to medicine with applicants from groups who are underrepresented in medicine” (p. 24). In addition, the AAMC’s publication, *Roadmap to Diversity: Integrating Holistic Review Practices into Medical School Admissions Processes* (Addams et al., 2010a), explained the importance of “incorporating race and/or ethnicity as part of a holistic process, where multiple individual factors may be considered” (p. 6) and addressed the need for a more diverse physician workforce. Although this researcher chose not to make the factors of race and ethnicity major foci in this study, these factors are relevant to this topic and should be integrated into future research.

### Conclusion

Medical school admissions personnel have different perceptions and policies regarding the levels of acceptance or discouragement of premedical students taking medical school prerequisite courses at two-year colleges. These different perceptions and

policies make it difficult for premedical students and pre-health advisors to navigate the significance of this factor in each medical school's admission process, especially within the practice of holistic review. As a result, the researcher conducted this study to provide more statistical evidence about how these various policies and preferences affect premedical students.

This study provided an in-depth analysis of one sub-factor amongst many factors assessed by medical school admissions personnel in their admissions processes. Within the context of holistic review, the type or quality of institution where a premedical student takes the prerequisite courses is a sub-factor within the larger factor of their educational background, educational background is a factor within the larger category of experiences, experiences is a category within the E-A-M (Experiences-Attributes-Metrics) model, and the E-A-M model is a key component of the concept of holistic review. While the sub-factor of type or quality of institution may be a less significant factor in medical school admissions in some parts of the country, this sub-factor is a common topic of discussion amongst premedical students, pre-health advisors, and medical school admissions personnel in Florida, which has a very large population of students in two-year community colleges (Florida Department of Education, 2011a). Due to the practice of holistic review, medical school admissions personnel place more focus on an applicant's overall qualifications, such as their experiences, attributes, and metrics, which seems to lessen the amount of weight placed on a select few factors or sub-factors. Therefore, the perceived disadvantage of medical school applicants who completed prerequisite courses at a two-year college should be lessened under the practice of

holistic review, as type or quality of institution is only one sub-factor amongst many that are reviewed and evaluated holistically.

The results of the study brought new insights into type of student enrollment and academic rigor of medical school prerequisite courses at two-year colleges. The analyses indicated that it was more acceptable for premedical students to take certain prerequisite courses at a two-year college as certain types of enrollment, and less acceptable for others (see Figure 4 and Table 34). Furthermore, the analyses indicated that no significant difference was found between matriculants' grades at the two-year colleges and four-year institutions for either Organic Chemistry I or Organic Chemistry II. Therefore, neither type of institution could be considered to provide a more or less rigorous version of the courses. However, the researcher strongly recommends that the results of this analysis should be perceived cautiously until additional, more in-depth research can be conducted to reaffirm (or contradict) these results. Overall, this study expanded upon the previous research on the factors of institutional and student enrollment in medical school admissions, and also provided some empirical evidence to help support the anecdotal information on this topic that pre-health advisors and medical school admissions personnel share with premedical students.

**APPENDIX A**  
**COMMENTS ON THE TYPE OR QUALITY OF INSTITUTION WHERE**  
**STUDENTS SHOULD TAKE MEDICAL SCHOOL PREREQUISITE COURSES:**  
**MEDICAL SCHOOL WEBSITES AND**  
**THE MEDICAL SCHOOL ADMISSION REQUIREMENTS (MSAR)**

Comments on the Type or Quality of Institution Where Students Should Take Medical School Prerequisite Courses: Medical School Websites and the Medical School Admission Requirements (MSAR)

<b>Medical School</b>	<b>State</b>	<b>Medical School Websites</b>	<b>Medical School Admission Requirements (2011):</b> Answers to the Question: <i>Is Community College Coursework Accepted in Fulfillment of Prerequisites?</i>
University of Alabama School of Medicine	AL	No comment	On a case-by-case basis
University of South Alabama College of Medicine	AL	“The [Admission] Committee may also consider the college attended, recognizing that academic standards vary from school to school” (University of South Alabama College of Medicine, 2009).	No answer
University of Arizona College of Medicine	AZ	“Community college coursework is accepted” (University of Arizona College of Medicine, 2011).	Yes
University of Arkansas for Medical Sciences College of Medicine	AR	No comment	Yes
Keck School of Medicine of the University of Southern California	CA	No comment	Yes
Loma Linda University School of Medicine	CA	No comment	On a case-by-case basis
Stanford University School of Medicine	CA	No comment	On a case-by-case basis
University of California-Davis School of Medicine	CA	No comment	Yes
University of California-Irvine School of Medicine	CA	“Candidates for admission may submit community college credit only to the extent granted on transfer to a four-year college or university” (University of California-Irvine School of Medicine, 2011).	Yes
University of California-Los Angeles David Geffen School of Medicine	CA	No comment	No answer
University of California-San	CA	No comment	Yes



Diego School of Medicine			
University of California-San Francisco School of Medicine	CA	No comment	Yes
University of Colorado School of Medicine	CO	No comment	Yes
University of Connecticut School of Medicine	CT	No comment	No answer
Yale University School of Medicine	CT	No comment	On a case-by-case basis
George Washington University School of Medicine and Health Sciences	DC	“The Committee on Admissions does accept coursework taken at a community college; however, it is preferable to have all of the pre-medical coursework taken at a four year college or university” (George Washington School of Health Sciences, 2011).	Yes
Georgetown University School of Medicine	DC	No comment	On a case-by-case basis
Howard University College of Medicine	DC	No comment	On a case-by-case basis
Florida Atlantic University Charles E. Schmidt College of Medicine	FL	“Preference will be given to applicants who have done the majority of their preparation at the senior college level” (Florida Atlantic University Charles E. Schmidt College of Medicine, 2011a).	No answer
Florida International University Herbert Wertheim College of Medicine	FL	“Can prerequisite lower division courses be taken at community colleges? Yes. However, additional upper level science courses are encouraged in preparation for the MCAT and success for medical school” (Florida International University Herbert Wertheim College of Medicine, 2011).	Yes
Florida State University College of Medicine	FL	“Courses taken... at a four-year institution are considered to be more academically competitive” (The Florida State University College of Medicine, 2011).	Yes
University of Central Florida College of Medicine	FL	No comment	On a case-by-case basis
University of Florida College of Medicine	FL	“Q: Can I take the prerequisite courses at my local community/junior college? A: In order to create the most academically competitive application you should take all prerequisite courses at the most competitive bachelor degree granting institution where you can gain entrance. You should take your prerequisite courses from your degree	No answer

		granting institution” (University of Florida College of Medicine, 2011).	
University of Miami Miller School of Medicine	FL	<p>“Can I take all of my premed courses at a junior college near my home? Most admissions committees feel that there are differences between junior college courses and senior college courses. Whether this view is justified or not, you should contact medical schools in which you are interested to see how they view coursework taken at the junior college level. The Miller School of Medicine will accept junior college courses but much prefers that the premed courses be taken at the senior college level. Perhaps a more important question to ask yourself is how these courses are going to prepare you to take the MCAT and to survive in medical school” (University of Miami Miller School of Medicine, 2011a), and</p> <p>“It is expected that the major portion of required science courses will be taken at the senior college level. An application that presents only a junior college academic record will not be considered” (University of Miami Miller School of Medicine, 2011b).</p>	On a case-by-case basis
University of South Florida College of Medicine	FL	<p>“Can I take all of my premed courses at a junior college? In order to create the most academically competitive application you should take all prerequisite courses at the most competitive bachelor degree granting institution where you can gain entrance. You should take your pre-requisite courses from your degree granting institution. However, if you started your academic career at a junior college those courses are acceptable for completion of the pre-requisites. In this case you are encouraged to take additional science courses at a bachelor degree granting institution” (University of South Florida College of Medicine, 2011).</p>	Yes
Emory University School of Medicine	GA	No comment	Yes
Medical College of Georgia at Georgia Health Sciences University	GA	No comment	On a case-by-case basis
Mercer University School of Medicine	GA	No comment	No answer
Morehouse School of Medicine	GA	No comment	On a case-by-case basis

University of Hawaii John A. Burns School of Medicine	HI	No comment	Yes
Chicago Medical School at Rosalind Franklin University of Medicine and Science	IL	No comment	No answer
Loyola University Chicago Stritch School of Medicine	IL	No comment	Yes
Northwestern University The Feinberg School of Medicine	IL	No comment	On a case-by-case basis
Rush Medical College of Rush University Medical Center	IL	No comment	Yes
Southern Illinois University School of Medicine	IL	No comment	Yes
University of Chicago Division of the Biological Sciences The Pritzker School of Medicine	IL	No comment	On a case-by-case basis
University of Illinois at Chicago College of Medicine	IL	No comment	Yes
Indiana University School of Medicine	IN	No comment	On a case-by-case basis
University of Iowa Roy J. and Lucille A. Carver College of Medicine	IA	No comment	Yes
University of Kansas School of Medicine	KS	No comment	Yes
University of Kentucky College of Medicine	KY	No comment	Yes
University of Louisville School of Medicine	KY	No comment	On a case-by-case basis
Louisiana State University School of Medicine in New Orleans	LA	No comment	Yes
Louisiana State University School of Medicine in Shreveport	LA	“It is expected that the major portion of required science courses will be taken at the senior college level. An application that presents only a junior college record will not be accepted” (Louisiana State	Yes

		University Health Shreveport, 2011).	
Tulane University School of Medicine	LA	No comment	Yes
Johns Hopkins University School of Medicine	MD	No comment	No
Uniformed Services University of the Health Sciences F. Edward Hebert School of Medicine	MD	No comment	Yes
University of Maryland School of Medicine	MD	“Will the University of Maryland School of Medicine accept pre-medical coursework completed at a community college? Courses taken at the community college level will satisfy our pre-requisites. However, the Committee does prefer that the bulk of courses be taken at a four year college or university” (University of Maryland School of Medicine, 2011a).	Yes
Boston University School of Medicine	MA	“We generally prefer that applicants take these courses at 4-year undergraduate institution... This applies also to... community college... courses as well” (Boston University School of Medicine, 2011).	On a case-by-case basis
Harvard Medical School	MA	No comment	Yes
Tufts University School of Medicine	MA	No comment	Yes
University of Massachusetts Medical School	MA	No comment	On a case-by-case basis
Michigan State University College of Human Medicine	MI	“Community college courses are acceptable if the course(s) is accepted by an accredited four-year US or Canadian undergraduate institution as transfer credit” (Michigan State University College of Human Medicine, 2011a).	Yes
Oakland University William Beaumont School of Medicine	MI	“Will OUWB accept community college classes for prerequisite coursework? Yes, the OUWB School of Medicine will accept prerequisite coursework taken at a community college. However, students are encouraged to take additional upper level science courses at a four-year institution in preparation for MCAT and medical school coursework” (Oakland University William Beaumont School of Medicine, 2011).	Yes

University of Michigan Medical School	MI	No comment	Yes
Wayne State University School of Medicine	MI	No comment	No answer
Mayo Medical School	MN	No comment	No answer
University of Minnesota Medical School	MN	No comment	Yes
University of Mississippi School of Medicine	MS	“For applicants who have a baccalaureate degree, there is no limit to the number of hours one can acquire from a community college to satisfy prerequisite coursework” (University of Mississippi Medical Center, 2011).	Yes
Saint Louis University School of Medicine	MO	No comment	On a case-by-case basis
University of Missouri-Columbia School of Medicine	MO	No comment	Yes
University of Missouri-Kansas City School of Medicine	MO	No comment	No answer
Washington University in St. Louis School of Medicine	MO	No comment	Yes
Creighton University School of Medicine	NE	No comment	On a case-by-case basis
University of Nebraska College of Medicine	NE	No comment	Yes
University of Nevada School of Medicine	NV	No comment	No
Dartmouth Medical School	NH	No comment	Yes
Cooper Medical School at Rowan University	NJ	No comment	No
University of Medicine and Dentistry of New Jersey – New Jersey Medical School	NJ	No comment	On a case-by-case basis
University of Medicine and Dentistry of New Jersey, Robert Wood Johnson Medical School	NJ	No comment	Yes
University of New Mexico	NM	No comment	Yes

School of Medicine			
Albany Medical College	NY	No comment	On a case-by-case basis
Albert Einstein College of Medicine of Yeshiva University	NY	No comment	Yes
Columbia University College of Physicians and Surgeons	NY	No comment	On a case-by-case basis
Hofstra North Shore – LIJ School of Medicine	NY	“Specifically, the Committee will consider, among other criteria:… Rigor of undergraduate study, including the university and academic major…” (Hofstra North Shore – LIJ School of Medicine, 2011).	On a case-by-case basis
Mount Sinai School of Medicine of New York University	NY	"Q: Can I take my courses at a community college, or must I take them at a four-year college or university? A: We have no requirement, however, the Admissions Committee considers not only what courses the applicant takes, but where the courses are taken" (Mount Sinai School of Medicine, 2011).	Yes
New York Medical College	NY	No comment	Yes
New York University School of Medicine	NY	No comment	On a case-by-case basis
State University of New York Downstate Medical Center College of Medicine	NY	“Admissions preference is also given to applicants who have completed prerequisite courses in four year colleges/universities” (SUNY Downstate Medical Center, 2011).	On a case-by-case basis
State University of New York Upstate Medical University	NY	No comment	On a case-by-case basis
The School of Medicine at Stony Brook University Medical Center	NY	No comment	On a case-by-case basis
University at Buffalo State University of New York School of Medicine and Biomedical Sciences	NY	No comment	On a case-by-case basis
University of Rochester School of Medicine and Dentistry	NY	No comment	On a case-by-case basis
Weill Cornell Medical College	NY	“Can I take my prerequisite courses at a Community College? It is not recommended” (Weill Cornell Medical College, 2011).	Yes
Duke University School of Medicine	NC	No comment	Yes

The Brody School of Medicine at East Carolina University	NC	“If you have...taken some of your prerequisites at a community college, we will accept these as long as your degree-granting college or university lists these courses on your official transcript” (East Carolina University Brody School of Medicine, 2011).	On a case-by-case basis
University of North Carolina at Chapel Hill School of Medicine	NC	“The opportunity to attend a highly selective college or university is not available to all students. Excellence, regardless of the setting, will be considered favorably” (University of North Carolina School of Medicine, 2011).	No answer
Wake Forest University School of Medicine	NC	“Prerequisite course work from community colleges is strongly discouraged because of the difficulty in adequately assessing the quality of that preparation. If a prerequisite course is completed at a community college, student must take subsequent courses in that discipline at a four-year college or university in the United States or Canada” (Wake Forest University School of Medicine, 2011).	On a case-by-case basis
University of North Dakota School of Medicine and Health Sciences	ND	No comment	Yes
Case Western Reserve University School of Medicine	OH	“If all science pre-requisites were taken at community college, we strongly recommend that you take at least one year of upper-level sciences from an accredited four-year degree granting university within the United States or Canada. If a few science pre-requisite courses were taken at a community college, we will evaluate on a case-by-case basis” (Case Western Reserve University School of Medicine, 2011).	On a case-by-case basis
Northeast Ohio Medical University	OH	No comment	Yes
Ohio State University College of Medicine	OH	No comment	On a case-by-case basis
The University of Toledo College of Medicine	OH	No comment	Yes
University of Cincinnati College of Medicine	OH	No comment	Yes
Wright State University Boonshoft School of Medicine	OH	No comment	Yes
The University of Oklahoma	OK	No comment	Yes

College of Medicine			
Oregon Health and Science University School of Medicine	OR	No comment	Yes
Drexel University College of Medicine	PA	No comment	On a case-by-case basis
Jefferson Medical College of Thomas Jefferson University	PA	No comment	On a case-by-case basis
Pennsylvania State Milton S. Hershey Medical Center College of Medicine	PA	No comment	On a case-by-case basis
Raymond and Ruth Perelman School of Medicine at the University of Pennsylvania	PA	No comment	On a case-by-case basis
Temple University School of Medicine	PA	No comment	On a case-by-case basis
The Commonwealth Medical College	PA	No comment	On a case-by-case basis
University of Pittsburgh School of Medicine	PA	No comment	No answer
Ponce School of Medicine	PR	No comment	No
Universidad Central Del Caribe School of Medicine	PR	No comment	Yes
University of Puerto Rico School of Medicine	PR	No comment	Yes
The Warren Alpert Medical School of Brown University	RI	No comment	On a case-by-case basis
Medical University of South Carolina College of Medicine	SC	No comment	No answer
University of South Carolina School of Medicine	SC	"Do you accept prerequisite courses taken at a community/junior college? Yes we do" (University of South Carolina School of Medicine, 2011).	Yes
Sanford School of Medicine The University of South Dakota	SD	No comment	On a case-by-case basis
East Tennessee State University James H. Quillen College of	TN	No comment	Yes



Medicine			
Meharry Medical College	TN	No comment	Yes
University of Tennessee Health Science Center College of Medicine	TN	No comment	Yes
Vanderbilt University School of Medicine	TN	No comment	On a case-by-case basis
Baylor College of Medicine	TX	No comment	On a case-by-case basis
Texas A&M Health Science Center College of Medicine	TX	No comment	Yes
Texas Tech University Health Sciences Center Paul L. Foster School of Medicine	TX	No comment	Yes
Texas Tech University Health Sciences Center School of Medicine	TX	No comment	On a case-by-case basis
The University of Texas Medical School at San Antonio	TX	No comment	No answer
University of Texas Medical Branch School of Medicine	TX	No comment	Yes
University of Texas Medical School at Houston	TX	No comment	No answer
University of Texas Southwestern Medical Center at Dallas Southwestern Medical School	TX	No comment	Yes
University of Utah School of Medicine	UT	No comment	Yes
University of Vermont College of Medicine	VT	No comment	Yes
Eastern Virginia Medical School	VA	No comment	Yes
University of Virginia School of Medicine	VA	No comment	Yes
Virginia Commonwealth	VA	No comment	Yes

University School of Medicine			
University of Washington School of Medicine	WA	“Are prerequisite courses taken at a community college accepted? You may take the prerequisite courses at any accredited university or community college of your choice” (University of Washington School of Medicine, 2011a).	Yes
Marshall University Joan. C. Edwards School of Medicine	WV	No comment	Yes
West Virginia University School of Medicine	WV	No comment	On a case-by-case basis
Medical College of Wisconsin	WI	No comment	Yes
University of Wisconsin School of Medicine and Public Health	WI	No comment	Yes

**APPENDIX B**  
**PERMISSION LETTER FROM UCF REGISTRAR**

**Erin Myszkowski**

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**From:** Brian Boyd  
**Sent:** Wednesday, April 04, 2012 12:32 PM  
**To:** Erin Myszkowski  
**Cc:** Paul Viau  
**Subject:** Accessing student records

Hi Erin,

Following up from our meeting on Monday and after reviewing the information regarding the research topic, you should be O.K. to proceed with your research based on the following assumptions and understandings:

1. The research methodology meets with IRB standards and approval.
2. Access to and review of those student records is limited to personnel who already have this level of security. I understand from our meeting, that your methodology involves another advisor in your office to pull these records where you will be the individual receiving and reviewing them with emplids, SSNs, names redacted, and any other personally identifiable data (directory or non-directory) is redacted.
3. I understand that any presentation of the data and results will be in more of an aggregate or summative form where specific student records are not being viewed by persons other than yourself and the advisor assisting you.
4. The student record data used for this project will only be used for this project and when the raw data is no longer needed, they should be returned to the Registrar's Office or destroyed with a confirmation.
5. There will not be any redisclosure of any portion of the records to any other third party that are pulled for this purpose.

Let me know if you have any questions.

Brian C. Boyd  
University Registrar  
University of Central Florida

V: 407-823-3016  
F: 407-823-5625  
Email: [brian.boyd@ucf.edu](mailto:brian.boyd@ucf.edu)

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**APPENDIX C**  
**PERMISSION LETTER FROM PHPAO DIRECTOR**

## **Erin Myszkowski**

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**From:** Genaro Lopez  
**Sent:** Tuesday, January 31, 2012 1:10 PM  
**To:** Erin Myszkowski  
**Subject:** RE: Assistance with my Dissertation Research  
**Attachments:** PHPAO Accept List 2009 - Allopathic ONLY [1].doc; PHPAO Accept List 2010 - Allopathic ONLY [1].doc; PHPAO Acceptance List 2011 FINAL [1].doc

Attached please find the names of the UCF student applicants to Allopathic (MD) medical school, who used the services of our office's Composite Evaluation Letter (CEL) services and were admitted to the national entering classes of 2009, 2010, and 2011. These students gave our office approval to publish their names and those of their accepting institution, and these lists were posted on the glass case outside our PHPAO. UCF applicants who opted not to use our CEL packet service and thus applied independently, are NOT included in these lists. Unfortunately, the names of those UCF applicants who used our CEL services and for various reasons did not gain admission, can not be released to outside parties in order to protect the confidentiality of their files. I hope that the attached is of value to you. Good luck!

Genaro A. Lopez, Ph.D., DIM  
Director, Pre-Health Professions Advisement Office  
Professor of Physiology  
Burnett School of Biomedical Sciences  
College of Medicine  
University of Central Florida

## **Erin Myszkowski**

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**From:** Genaro Lopez  
**Sent:** Thursday, February 02, 2012 3:18 PM  
**To:** Erin Myszkowski  
**Subject:** PHPAO UCF Accept Lists for 2007 and 2008 Allopathic ONLY applicants

Erin,

Attached are the 2007 and 2008 Acceptance Lists for UCF Allopathic applicants who used our office's Composite Evaluation Letter application service. Have a good day!

Genaro

**APPENDIX D**  
**REQUEST FOR USE OF E-A-M MODEL FIGURE**

**Erin Myszkowski**

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**From:** Henry Sondheimer <hsondheimer@aamc.org>  
**Sent:** Tuesday, November 29, 2011 1:57 PM  
**To:** Erin Myszkowski  
**Cc:** S. Elizabeth White; Amy Addams; Hope Gray; Lily May Johnson; Robert Sabalis; Geoffrey Young  
**Subject:** RE: Permission to use E-A-M model graphic in my dissertation

Erin,

I will take this up with the Holistic Review Project Team at our next upcoming meeting on Friday the 2<sup>nd</sup>. Thank you for writing.

Dr. Sondheimer

**Henry M. Sondheimer, M.D.**  
**Senior Director**  
**Medical Education Projects**

**Association of American Medical Colleges**  
2450 N Street, N.W., Washington, D.C. 20037-1127  
**T** (202) 828-0684 **E** [hsondheimer@aamc.org](mailto:hsondheimer@aamc.org)  
[www.aamc.org](http://www.aamc.org)

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**From:** Erin Myszkowski [<mailto:ErinM@ucf.edu>]  
**Sent:** Thursday, November 24, 2011 5:22 PM  
**To:** Henry Sondheimer  
**Subject:** Permission to use E-A-M model graphic in my dissertation

Dr. Sondheimer,

I am a doctoral student at the University of Central Florida in the Educational Leadership - Higher Education and Policy Studies Track program. I am also a Pre-Health Advisor at the University of Central Florida. Because you are the Staff Contact listed on the AAMC website for Holistic Review, I figured you would be the person to which I should make my request.

I am currently in the process of writing my dissertation, and I would like to request permission to use an image used in an AAMC powerpoint in my dissertation. The image in particular is of the E-A-M model, and it is used on slide 43 of this powerpoint presentation titled "Launch of the Holistic Review Admissions Workshop": [https://www.aamc.org/download/161972/data/holistic\\_review\\_2010\\_annual\\_mtg.pdf](https://www.aamc.org/download/161972/data/holistic_review_2010_annual_mtg.pdf). The cropped version of the E-A-M model that I would specifically like to use is attached.

If there is someone else I should be in contact with regarding this request, please let me know and I will follow up with them promptly.

Please let me know if you have any questions about my request. I appreciate your consideration. I hope to hear from you soon.



**APPENDIX E**  
**INSTITUTIONAL REVIEW BOARD APPROVAL**



University of Central Florida Institutional Review Board  
 Office of Research & Commercialization  
 12201 Research Parkway, Suite 501  
 Orlando, Florida 32826-3246  
 Telephone: 407-823-2901 or 407-882-2276  
 www.research.ucf.edu/compliance/irb.html

**Approval of Exempt Human Research**

From: **UCF Institutional Review Board #1  
 FWA00000351, IRB00001138**  
 To: **Erin Myszkowski**  
 Date: **April 30, 2012**

Dear Researcher:

On 04/30/2012, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review: Exempt Determination  
 Project Title: AN ANALYSIS OF MEDICAL SCHOOL PREREQUISITE COURSES COMPLETED AT TWO-YEAR COLLEGES BY MEDICAL SCHOOL MATRICULANTS FROM THE UNIVERSITY OF CENTRAL FLORIDA  
 Investigator: Erin Myszkowski  
 IRB Number: SBE-12-08402  
 Funding Agency:  
 Grant Title:  
 Research ID: N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 04/30/2012 09:48:05 AM EDT

IRB Coordinator

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