Predictors of Academic Success in Health Professions Programs

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Health professions academic programs are unique in that a paucity of clinical training sites requires programs to limit the number of admitted students. The selection of students is typically accomplished through the use of rigorous admissions criteria. In this paper, we explore the relationship between entry-level college students' academic preparedness (based on University admission criteria) and persistence in health professions academic programs (as measured by admission to a health professions program). Student data spanning ten years details the academic profile of entry-level freshmen and transfer students with a declared interest in one of five entry-level academic programs at a public, regional university in the Midwestern United States. We find that students who are more prepared for college-level coursework are significantly more likely to be admitted into a health professions program than their under-prepared counterparts. Prepared students are also more likely than their under-prepared counterparts to persist in the major.

INTRODUCTION AND LITERATURE REVIEW

The United States is currently experiencing rapid growth in healthcare industries, indicating an increased need for skilled and trained health professionals. The total number of job openings for nurses (due to both an increased demand for nursing care and an aging nurse workforce) will exceed 1 million by 2022 (Rosseter, 2014). Bureau of Labor Statistics (2015) estimates suggest that, while the nursing profession will exhibit the highest levels of growth, all areas of healthcare will experience growth. For example, the demand for medical and clinical laboratory technologists and technicians, radiologic technologists, and respiratory therapists are expected to increase by 16%, 9%, and 12%, respectively, over the next seven years.

The task of educating the next generation of health professionals is entrusted to colleges and universities. As the demand for healthcare professionals grows, academic institutions face several challenges to address this growth. One challenge is the need to balance increased student enrollments with an obligation to maintain a high quality of didactic and experiential instruction. Hiring and retaining experienced clinical faculty, in particular, is a significant problem for colleges and universities. A recent

survey of nursing baccalaureate schools, for example, reported that the two most common barriers to increased program enrollment were insufficient faculty (59 percent of respondents) and insufficient clinical sites (62 percent of respondents) (Fang, Li, & Bednash, 2013). These rate limiting factors can, in turn, be linked to budget constraints, aging faculty, and job competition (Rosseter, 2015). Unfortunately, these constraints are not limited to nursing programs. For example, 5 out of 8 medical laboratory technology students and 1 to 3 medical laboratory science students have been unable to graduate on time (Health Force Minnesota, n.d.). Within these fields, program closure, improving economic conditions that encourage faculty retirement, and a paucity of clinical training sites all limit the number of graduates (Scott, 2015).

The lack of clinical/experiential training sites is a related, and especially problematic, challenge for health professions programs. Since a substantial proportion of degree requirements (which, for some programs, can be as much as 50 percent of the requirements for a bachelor degree) must be completed at an experiential site, and since clinical sites face space and workload constraints (i.e., patient care duties take precedence over training students), there is a limit on the number of students who can gain access to these sites. The lack of experiential sites is fundamentally tied to a paucity of clinical faculty, as many clinical faculty members split their time between instructional activities (which may be academic or experiential) and clinical practice.

These challenges force academic programs to limit the number of students who can enter into a health professions program since these programs cannot offer a degree without ensuring that students can complete the degree. Programs often use selective admissions processes as a means of ensuring that the number of students admitted matches the number of available clinical (or experiential) training opportunities (Fang, Li, & Bednash, 2013). The more limited the number of experiential sites, the more selective the admissions process becomes, and the more otherwise qualified applicants are denied admission to a professional program. In their 2012-2013 annual report (which included responses from approximately 1200 programs), the American Association of Colleges of Nursing found that, of the 370,574 baccalaureate nursing applications received, 121,329 qualified applicants had to be turned away from programs (Fang, Li, & Bednash, 2013).

Once accepted into the professional program, the objective is to provide students with the knowledge, skills, and abilities necessary to be eligible to practice in that profession. The majority of these professions require students to pass licensure and/or certification exams before they are eligible to practice. For example, nursing students prepare for the National Council Licensure Examination (NCLEX), and pharmacy students prepare for the North American Pharmacist Licensure Examination (NAPLEX). Passing the exam not only requires that students adequately learn the majority of the content in the professional program, but also have the test-taking skills necessary to pass a high-stakes, standardized exam. Working backward, admissions committees may give more weight in their admissions processes to criteria that reflect academic preparedness and/or more well-developed test-taking skills, as it facilitates program retention, matriculation, and seamless entry into professional practice.

A potentially confounding issue is student interest and/or motivation (Hidi & Harackiewicz, 2000). Some students are academically prepared for college-level coursework, including high stakes exams, but through a lack of interest or effort (i.e., changing career aspirations, burnout, etc.) do not perform well in college, whether are pre-professional or (if admitted) in a professional program (Gagné & Deci, 2005; Vanthournout, Donche, Gijbels, & Van Petegem, 2011; Vanthournout, Gijbels, Coertjens, Donche, & Petegem, 2012). Similarly, students who are underprepared for college-level work may be able to remediate their deficiencies, but simply choose not to pursue a major in health professions simply because their interests and energies lie elsewhere. In these cases, failure to progress through a health professions program may be an indicator of success for a subset of non-admitted students.

These issues pose an interesting policy question. When comparing the entry-level academic profiles of students who have successfully navigated the selective admission processes of academic health professions programs, are there indicators or markers within students' academic profiles suggesting that students do, or do not, have the ability to overcome academic hardships that occur prior to admission? As a corollary, can this question be answered empirically, while compensating for the fact that certain

students do not persist based on a lack of interest and/or motivation in a healthcare career, rather than academic readiness for a career in a health profession?

This paper undertakes a descriptive, retrospective empirical analysis to explore the relationship between entry-level college students' academic preparedness and persistence in (as measured by successful admission to) a health professions academic program. Student data spanning ten years details the academic profile of entry-level freshmen and transfer students with declared interest in one of five entry-level academic programs in a health professions college housed in a regional, public university in the Midwestern U.S. Considered cumulatively, this empirical analysis provides important inferences about i) what types of students – regarding initial academic preparation - are being selected into health professions programs; and ii) how those students compare to the general population of students.

METHODOLGY

Study Setting

The *[institution name omitted to preserve anonymity]* offers entry-level (pre-professional) programs in pharmacy, nursing, medical laboratory science, radiologic sciences, and respiratory care, all of which utilize a competitive selective admission process. All five programs offer both pre-professional preparation for the degree, as well as professional (academic and experiential) coursework. Pre-professional pharmacy coursework may be complete in two or three years and must be satisfied before applying to the professional program. Students admitted to the professional program on a competitive basis and must meet all program admission requirements. The undergraduate nursing program consists of three tracks. The pre-licensure baccalaureate program is a four-year program consisting of one year of pre-nursing coursework and three years of professional nursing courses. Students must meet admission requirements to apply to the program. Two other tracks, one for currently registered licensed practical nurses, and one for registered nurses who do not hold a bachelor degree, allow these working clinicians to finish their undergraduate nursing degree. Three undergraduate programs in the allied health sciences are offered, all of which lead to a Bachelor of Science degree: medical laboratory science, radiologic sciences, and respiratory care. The pre-professional medical laboratory science coursework is three years in length, followed by an 11 to 12-month professional clinical experience/internship within one of the institution's affiliated hospital programs. The pre-radiologic sciences coursework is two or more years in length, followed by a two-year full-time professional internship with one of the institution's affiliated hospital schools of radiologic technology. The pre-professional respiratory care coursework is approximately two years in length, followed by a 15-month professional internship at a single hospital program in respiratory therapy. Applicants are eligible to apply to any of the three allied health programs once they have met all of the aforementioned academic requirements.

Hypothesis Development and Statistical Methods

This analysis utilizes a descriptive, retrospective study design using data drawn from a single academic institution. Hence, this analysis can be considered as a pilot study. Given the wide array of health professions majors, as well as the myriad admissions criteria and student characteristics that facilitate academic success, an emphasis is placed on parsimony. We utilize an empirical methodology that places no prior expectations on the relationship between academic preparedness and successful admission to a health professions program. Similarly, no prior expectations are developed concerning the effects of motivation and interest in offsetting or moderating a student's level of academic preparedness. The analysis focuses on describing trends inherent in the data and use simple hypothesis tests to evaluate significant differences in those trends. In all cases, a null hypothesis of "ignorance," or no statistical relationship between academic preparedness and either admission into a professional program or persistence towards a major, is utilized.

The data used in this study included all undergraduate students admitted fall 2006 through fall 2016 semesters, who at some point declared a pre-professional program in one of the institution's five entry-level health professions programs. This provides sufficient time to evaluate whether students were

successful (or on a trajectory to be successful), or unsuccessful, in gaining admission to their professional program of choice. All data and methods of analysis were approved by the institution's Institutional Review Board.

The institution's Office of Institutional Research provided student-specific information over a variety of different admission characteristics, preparedness for college-level coursework, and whether the student was accepted into a health professions program. Data include; high school grade point average, entrance exam scores (ACT composite and various domain-specific scores), and credits transferred from various institutions as appropriate. Academic progress, specifically persistence in a health professions major (progressing as a pre-professional student and/or successfully navigating the selective admission process to their professional program of choice) was also recorded. Many of these variables are discrete; for example, one is accepted or not accepted into a professional program. These variables were coded and analyzed as observed.

For continuous variables, there is considerable variation in the information expressed in the variable; for example, a high school grade point average of 3.20 may express something different in a student's academic preparedness for college-level coursework if they attended a very small, rural high school versus a large, urban high school. Additionally, the institution often uses discrete cutoff points in continuous admission metrics as measured of academic preparedness; for example, at *[institution name omitted to preserve anonymity]*, ACT scores below 21 often signal that a student is at risk of not being ready for college-level coursework. Given the study's emphasis on parsimony (and to ensure more consistent interpretation of student data), a decision was made to transform all continuous variables into discrete variables. ACT scores were disaggregated into three categories: those without an ACT score, those scoring 20 or lower, and those scoring above 20. High school grade point averages were divided into four categories: those not reporting a grade point average (usually, but not exclusively, transfer students), those whose grade point average was less than 3.00; those whose grade point average was between 3.00 and 3.50, those whose grade point average was above a 3.50. *[Institution name omitted to preserve anonymity]* utilizes two supplemental tests to gauge math readiness for college algebra and pre-calculus, respectively. This information was broken into three categories for each student: no score/did not take the exam in question, test scores indicating the student was not ready for the mathematics course in question, and an exam score indicating mathematics readiness.

Students often transfer coursework to *[institution name omitted to preserve anonymity]* which is required for admission to one of the professional health programs. A decision was made to examine transfer coursework in four courses commonly required by the majority of the institution's health professions admissions processes: Public Speaking (COMM 110), Anatomy and Physiology I (BIOL 220), Introductory Statistics (STAT 330), and Introductory Composition II (ENGL 120). For students with transfer credits in key, pre-professional coursework, binary variables were created identifying those students who transferred in credits for a given course with a grade of B or higher. Grades of B or higher were used as a cutoff since most required pre-professional course grades should be B or higher to count positively in the application process. Students earning grades lower than a B are often advised to repeat the course at NDSU. As a result of these discretizations, all hypothesis tests are conducted using chi-square tests of homogeneity and employ a 5 percent level of significance.

The study's objectives were examined using a two-step empirical methodology. First, descriptive statistics (more specifically, contingency tables) were used to examine the academic preparedness of students for college-level coursework (as measured by overall readiness as well as readiness for math and English coursework at the time students entered college) who were ultimately admitted into a health professions program. Chi-square tests of homogeneity were used to determine whether the proportions of admitted students who were underprepared at the start of their college careers were statistically similar to those admitted students who were initially prepared for college-level coursework. The examination provides insight into whether admissions criteria disproportionally screen out students who were initially underprepared for college-level coursework.

Next, descriptive statistics (contingency tables) are used to examine the initial academic preparedness (again, as measured by overall readiness as well as readiness for math and English coursework at the time

students entered the institution) of all students who declared an intent to pursue a health professions major during the evaluation period. To account for interest and motivation in a health career students are disaggregated both by admission to a health profession, and whether they declared an intent to pursue a health professions major when they initially enrolled in courses at the institution. By disaggregating professional program admission decisions based on a student's initial, intended career path, it is possible to control for whether students gradually developed an interest in a health career, versus those who consistently displayed an interest in a career. Students not admitted into a professional health program represent those who ultimately choose a different career path. Chi-square tests of homogeneity were used to evaluate whether significant differences in academic preparedness exist between those students who were, and were not, ultimately admitted into a health professions program and those who did, and did not, initially declare a health-related major. The empirical analysis cumulatively provides important inferences about i) what types of students – regarding initial academic preparation - were selected into health professions programs, and ii) how those students compared to the general population of students. Lastly, all statistical analyses employ 5 percent significance levels and were conducted using IBM Statistics, Version 24.

RESULTS

A full set of data were available for 6,839 undergraduate students who declared a pre-professional major. Table 1 contains cross-tabulations analyzing the outcome of these students' admissions processes and various student characteristics. For simplicity, Table 1 categorizes students based on whether or not they were ultimately admitted into one of the institution's five professional programs. A full disaggregation of acceptances into specific professional programs is contained in the paper's Appendix A. Those results largely mimic the results in Table 1, and thus are not discussed in this section.

TABLE 1
ALL STUDENT WHO DECARED A PRE-PROFESSIONAL MAJOR

Panel A: Success by Transfer Credits in English 120

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No Transfer Credit for English 120	3415	1268	4683
Transfer Credit for English 120	1253	903	2156
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel B: Success by Transfer Credits in Statistics 330

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No Transfer Credit for Statistics 330	4433	1964	6397
Transfer Credit for Statistics 330	235	207	442
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel C: Success by Transfer Credits in Comm. 110

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No Transfer Credit for Communications 110	3463	1329	4792
Transfer Credit for Communications 110	1205	842	2047
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel D: Success by Transfer Credits in Biology 220

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No Transfer Credit for Biology 220	4089	1518	5607
No Transfer Credit for Biology 220	579	653	1232
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel E: Success by Composite ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No ACT Score	639	325	964
ACT Composite Score under 21	1148	243	1391
ACT Composite Score 21 or Higher	2881	1603	4484
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel F: Success by English ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No ACT Score	637	325	962
ACT English Score under 21	1484	363	1847
ACT English Score 21 or Higher	2547	1483	4030
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel G: Success by Math ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No ACT Score	637	325	962
ACT Math Score under 21	1206	260	1466
ACT Math Score 21 or Higher	2825	1586	4411
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel H: Success by Scientific Reasoning ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No ACT Score	639	325	964
ACT SR Score under 21	958	206	1164
ACT SR Score 21 or Higher	3071	1640	4711
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel I: Success by High School GPA

High School GPA	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No GPA	575	402	977
GPA Less than 3.00	795	83	878
GPA between 3.00 and 3.50	1430	313	1743
GPA Above 3.50	1868	1373	3241
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel J: Success by Algebra Readiness Test Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No Test Score	3831	1886	5717
Not Algebra Ready	174	54	228
Algebra Ready	663	231	894
Total	4668	2171	6839
Chi-Square Probability			<0.001

Panel K: Success by Pre-Calculus Readiness Test Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into a Professional Program	Total
No Test Score	3863	1894	5757
Not Pre-Calculus Ready	25	10	35
Pre-Calculus Ready	780	267	1047
Total	4668	2171	6839
Chi-Square Probability			<0.001

For all students entering the program with transfer work, Introductory Composition II and Public Speaking were the most readily available courses at institutions of higher education. The relationship between Introductory Composition II and admission to a health professions program was significant ($p < .001$), as was the relationship between Public Speaking and admittance to a health professions program ($p < .001$). Students who transferred in credit for Introductory Composition II were nearly three times more likely to gain admission into a professional program than students who did not transfer in credit for this course. Students who transferred in credit for public speaking were nearly four times more likely to gain admission into a professional program than students who did not transfer credit for this course. Similarly, students, who transferred credit for Anatomy and Physiology I were more likely to be admitted into a professional program, as were students who transferred credit for Introductory Statistics. Results across all four transfer courses considered were consistent, which leads us to believe that students who transfer in with credit with a grade of B or better in specific foundational courses and who declare a health professions major initially are more likely to gain admittance to a professional program than those who do not declare a health professions major until later in their academic career.

The relationship between composite ACT scores and admittance to a professional program was also significant ($p < .001$). Students who obtained an ACT composite score of 21 or higher were more likely to be admitted to the program compared to students with ACT composite scores under 21. Similar trends were observed by ACT content specific scores in English, mathematics, and scientific reasoning. Additionally, the relationship between high school grade point averages and admittance was significant ($p < .001$). Students with high school grade point averages of 3.50 and higher were more likely to gain admittance, whereas, students with a high school grade point averages below 3.00 were less likely to gain admittance. Lastly, students whose test scores indicated a readiness for college-level algebra and calculus, respectively, were more likely to be admitted into a professional program than students who were not math-ready ($p < .001$).

Table 2 disaggregates the results in Table 1 but also accounts for students who initially declared an intent to pursue a health professions degree, versus some other major at the institution. As in Table 1, students who transferred credit for Introductory Composition II (Panel A), Introductory Statistics (Panel B), Public Speaking (Panel C), and Anatomy and Physiology I (Panel D), all were significantly and disproportionately more likely to be admitted into a professional program ($p < .001$). However, these results also indicate that students who initially declared an intent to pursue a health professions major were the ones disproportionately more likely to be admitted into the professional program. Indeed, of those students who did not initially declare a health-related major, and were accepted into a health-related professional program, the propensity to transfer in credit in four key, pre-professional courses was relatively similar to those students who were not admitted.

TABLE 2
ALL STUDENT WHO DECARED A PRE-PROFESSIONAL MAJOR, BY ADMISSIONS OUTCOME

Panel A: Success by Transfer Credits in English 120

Transfer Credit	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No Transfer Credit for English 120	985	2430	330	938	4683
Transfer Credit for English 120	280	973	139	764	2156
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel B: Success by Transfer Credits in Statistics 330

Transfer Credit	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No Transfer Credit for Statistics 330	1214	3219	443	1521	6397
Transfer Credit for Statistics 330	51	184	26	181	442
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel C: Success by Transfer Credits in Comm. 110

Transfer Credit	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No Transfer Credit for Communications 110	993	2470	355	974	4792
Transfer Credit for Communications 110	272	933	114	728	2047
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel D: Success by Transfer Credits in Biology 220

Transfer Credit	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No Transfer Credit for Biology 220	1145	2944	376	1142	5607
Transfer Credit for Biology 220	120	459	93	560	1232
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel E: Success by Composite ACT Score

Test Score	Not Accepted Into a Professional Program, Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No ACT Score	117	522	33	292	964
ACT Composite Score under 21	293	855	48	195	1391
ACT Composite Score 21 or Higher	855	2026	388	1215	4484
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel F: Success by English ACT Score

Test Score	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No ACT Score	117	520	33	292	962
ACT English Score under 21	426	1058	82	281	1847
ACT English Score 21 or Higher	722	1825	354	1129	4030
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel G: Success by Math ACT Score

Test Score	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No ACT Score	117	520	33	292	962
ACT Math Score under 21	306	900	52	208	1466
ACT Math Score 21 or Higher	842	1983	384	1202	4411
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel H: Success by Scientific Reasoning ACT Score

Test Score	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No ACT Score	117	522	33	292	964
ACT SR Score under 21	254	704	42	164	1164
ACT SR Score 21 or Higher	894	2177	394	1246	4711
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel I: Success by High School GPA

Test Score	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No GPA	117	458	37	365	977
GPA Less than 3.00	253	542	23	60	878
GPA between 3.00 and 3.50	362	1068	69	244	1743
GPA Above 3.50	533	1335	340	1033	3241
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel J: Success by Algebra Readiness Test Score

Test Score	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No Test Score	1012	2819	392	1494	5717
Not Algebra Ready	59	115	15	39	228
Algebra Ready	194	469	62	169	894
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panel K: Success by Pre-Calculus Readiness Test Score

Test Score	Not Accepted Into a Professional Program and Did Not Initially Declare a Major	Not Accepted Into a Professional Program and Initially Declared a Major	Accepted Into a Professional Program and Did Not Initially Declare a Major	Accepted Into a Professional Program and Initially Declared a Major	Total
No Test Score	1025	2838	393	1501	5757
Not Pre-Calculus Ready	7	18	5	5	35
Pre-Calculus Ready	233	547	71	196	1047
Total	1265	3403	469	1702	6839
Chi-Square Probability					<0.001

Panels E through H in Table 2 disaggregate students based on admission and initial major interest, and performance on the ACT exam. Panel I presents a similar disaggregation by high school grade point averages, and Panels J and K assess math readiness at the time students entered college. As in Table 1, students who were admitted to a health professions program were significantly and disproportionately more likely to perform better on the ACT (both overall and by section), as well as have earned higher grades in high school ($p < .001$). However, these panels also suggest that students who did not initially declare a health-related major, but were ultimately accepted into a health professions program, were more likely than those who were not admitted to having higher ACT scores (again, both overall and by section) and higher high school grade point averages. For students who completed the math placement exams, students who were accepted into a health professions program, regardless of whether they initially declared an interest in a health major upon entering college, displayed greater mathematics readiness (whether algebra or pre-calculus readiness) than non-accepted students.

DISCUSSION AND CONCLUSION

Health professions programs face binding constraints, including the availability of clinical training sites and experienced clinical faculty to train students. As student demand for clinical training increases (which, in itself stems from the growing need for clinicians and the availability of well-paying jobs after graduation), these constraints require health professions programs to alter their admissions practices and to become more selective in admitting students. Of crucial interest are the characteristics of students who are most likely to be accepted into health professions programs, and by extension, how prospective applications can best position themselves to gain entry into those programs. The results of this analysis suggest that students who are successfully admitted into health professions programs have higher grade point averages in high school, higher ACT scores, and enter the institution with transfer college credits in important pre-professional courses (many taken during their high school studies). Overall, the results suggest that the increase in selectivity appears to be based, at least as a general rule, on higher academic achievements that occur *before* one studies at the current institution. That is, admission processes tend to select those with the highest academic potential and screen out those whose initial scholastic achievements are lower or achieved later in one's college career.

It is also important to note several caveats to this conclusion. First, it is important to be intentional as to how one measures academic achievements earned prior to college. Our results in Table 2 suggest that, while earning college credit in high school certainly positions a student to be successful in gaining admission to a health professions program (and to persist in the major), students who have comparable ACT scores and high school grade point averages, but who do not have transfer credit, are also as likely

to be accepted into a health professions program. This is especially evident when comparing the credentials of those students who did, and did not, initially declare a health professions major, yet were ultimately accepted into a professional program. Those who did not initially declare a major were less likely to transfer in credits that counted towards admission to their professional program, yet (because of their scholastic acumen) were still just as likely to be admitted.

A second caveat is that students who are academically prepared for college-level work can, through exploration of other majors, ultimately be successful in pursuing a healthcare career, even if they initially pursue another major on campus. Thus, conducting admissions to professional health programs after one or more years of college (rather than at the time of admission to the institution in general) appears to strengthen the depth and diversity of the applicant pools. Given the lack of experiential sites and clinical faculty, adding depth and diversity to applicant pools creates both opportunities and challenges, as discussed in the paper's introduction.

A final caveat is that the interpretations of the results in Tables 1 and 2 were framed based on likelihoods and/or student averages, in terms of those factors that lead to successful admission into a professional health program. Examining Tables 1 and 2 it is *possible*, as evidenced by the numbers in these tables, that some students who entered college with less academic preparation for college-level work, were able to remediate those deficiencies and be accepted into a professional program. However, the small frequency of students in these categories suggests that, while *possible*, it is not the *norm*.

The results contained in Tables 1 and 2 also provide several policy recommendations. One potential drawback to the results contained in Tables 1 and 2 is that the training involved in becoming a health profession is based on both academic acumen and the ability to model the professional and ethical standards inherent in the discipline. If professional programs are more likely to admit students based on academic acumen, then programs must do one of two things to ensure that their graduates are prepared for professional practice. One course of action is to place greater curricular emphasis on professionalism and professional development. This approach naturally assumes that students with academic acumen have the ability and the motivation to model professional behaviors. The other approach is to revisit admission criteria and processes to ensure that adequate weight in the admissions process is allocated to professionalism and professional development.

A second policy implication associated with the results contained in Tables 1 and 2 is that admissions processes may be biased against those who take much longer to develop a track record of academic success. Affected groups may include non-traditional aged students, students with adequate academic skills but an exceptional ability to model professional behaviors or those students whose work ethic and maturity develop after they graduate from high school. If the number of applicants is large relative to the number of seats in the professional program, a specific professional program may not be negatively impacted by this drawback. However, the profession as a whole may find it advantageous to promote opportunities for these individuals to receive training and ultimately enter a health profession, as these individuals may bring a unique and valuable contribution to the profession.

While the current analysis provides some interesting empirical insights, it also exhibits several limitations. Perhaps most importantly, the analysis draws upon data from only one institution, which recruits its professional students primarily from the institution's student body. Other institutions may serve fundamentally different student populations (with a fundamentally different mix of academic readiness for college), or draw applicants to the professional program from a variety of other institutions, and may experience different trends than reported in this manuscript. Second, the current analysis is descriptive in nature. It does not attempt to identify the underlying causal mechanism by which students achieve (or do not achieve) early academic success and are admitted (or not admitted) into health professions programs. Lastly, the current study is limited in that it does not collect and analyze a full complement of factors that lead to successful admission to a health professions program. For example, students who achieve early academic success may differ from other students in their intrinsic and/or extrinsic motivation (Gagné & Deci, 2005; Vanthournout, Donche, Gijbels, & Van Petegem, 2011; Vanthournout, Gijbels, Coertjens, Donche, & Petegem, 2012). Future studies that can collect data on a

broader and deeper set of student-specific characteristics may uncover additional, and more insightful, conclusions than provided in this manuscript.

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APPENDIX

ALL STUDENTS WHO DECLARED A PRE-PROFESSIONAL MAJOR IN THE COLLEGE OF HEALTH PROFESSIONS BY MAJOR AT ADMISSION

Panel A: Success by Transfer Credits in English 120

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No Transfer Credit for English 120	3415	587	430	56	41	154	4683
Transfer Credit for English 120	1253	510	257	33	32	71	2156
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel B: Success by Transfer Credits in Statistics 330

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No Transfer Credit for Statistics 330	4433	984	626	80	69	205	6397
Transfer Credit for Statistics 330	235	113	61	9	4	20	442
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel C: Success by Transfer Credits in Communications 110

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No Transfer Credit for Communications 110	3463	604	460	57	54	154	4792
Transfer Credit for Communications 110	1205	493	227	32	19	71	2047
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel D: Success by Transfer Credits in Biology 220

Transfer Credit	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No Transfer Credit for Biology 220	4089	653	549	72	59	185	5607
Transfer Credit for Biology 220	579	444	138	17	14	40	1232
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel E: Success by Composite ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No ACT Score	639	202	80	19	12	12	964
ACT Composite Score under 21	1148	169	13	7	15	39	1391
ACT Composite Score 21 or Higher	2881	726	594	63	46	174	4484
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel F: Success by English ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No ACT Score	637	202	80	19	12	12	962
ACT English Score under 21	1484	233	36	15	22	57	1847
ACT English Score 21 or Higher	2547	662	571	55	39	156	4030
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel G: Success by Math ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No ACT Score	637	202	80	19	12	12	962
ACT Math Score under 21	1206	197	10	7	12	34	1466
ACT Math Score 21 or Higher	2825	698	597	63	49	179	4411
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel H: Success by Scientific Reasoning ACT Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No ACT Score	639	202	80	19	12	12	964
ACT SR Score under 21	958	135	13	8	17	33	1164
ACT SR Score 21 or Higher	3071	760	594	62	44	180	4711
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel I: Success by High School GPA

High School GPA	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No GPA	575	261	98	18	11	14	977
GPA Less than 3.00	795	60	3	3	8	9	878
GPA between 3.00 and 3.50	1430	175	52	10	19	57	1743
GPA Above 3.50	1868	601	534	58	35	145	3241
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel J: Success by Algebra Readiness Test Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No Test Score	3831	947	594	80	65	200	5717
Not Algebra Ready	174	35	9	2	2	6	228
Algebra Ready	663	115	84	7	6	19	894
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							<0.001

Panel K: Success by Pre-Calculus Readiness Test Score

Test Score	Not Successfully Admitted Into a Professional Program	Successfully Admitted Into the BSN Program	Successfully Admitted Into the Doctor of Pharmacy Program	Successfully Admitted Into the MLS Program	Successfully Admitted Into the RT Program	Successfully Admitted Into the RS Program	Total
No Test Score	3863	951	597	80	65	201	5757
Not Pre-Calculus Ready	25	6	4	0	0	0	35
Pre-Calculus Ready	780	140	86	9	8	24	1047
Total	4668	1097	687	89	73	225	6839
Chi-Square Probability							0.004