

Challenging Traditional Premedical Requirements as Predictors of Success in Medical School: The Mount Sinai School of Medicine Humanities and Medicine Program

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Abstract

Purpose

Students compete aggressively as they prepare for the MCAT and fulfill traditional premedical requirements that have uncertain educational value for medical and scientific careers and limit the scope of their liberal arts and biomedical education. This study assessed the medical school performance of humanities and social science majors who omitted organic chemistry, physics, and calculus, and did not take the MCAT.

Method

The authors compared and contrasted the academic outcomes of 85 Humanities and Medicine Program (HuMed) students at Mount Sinai School

of Medicine with those of their 606 traditionally prepared classmates for the 2004–2009 graduating classes. The authors analyzed basic science knowledge, clerkship performance, humanism, leadership, community service, research fellowships, distinctions, and honors.

Results

There were no statistically significant differences between the groups in clerkship honors other than psychiatry (HuMed students outperformed their peers, $P < .0001$) or in commencement distinctions or honors. Although HuMed students were significantly more likely to secure a scholarly-year mentored project

($P = .001$), there was no difference in graduating with distinction in research ($P = .281$). HuMed students were more likely to have lower United States Medical Licensing Examination Step 1 scores (221 ± 20 versus 227 ± 19 , $P = .0039$) and to take a nonscholarly leave of absence ($P = .0001$). There was a trend among HuMed students toward residencies in primary care and psychiatry and away from surgical subspecialties and anesthesiology.

Conclusions

Students without the traditional premedical preparation performed at a level equivalent to their premedical classmates.

The American Medical Association began its efforts to standardize medical education in the second half of the 19th century. By 1904, it created the Council on Medical Education, and shortly thereafter it engaged the Carnegie Foundation in an attempt to survey every medical school in the United States.¹ The man who led that survey, Abraham Flexner,² included among his recommendations undergraduate premedical (premed) requirements for admission to medical school. By 1930, the

premed science requirements were clearly established: two semesters each of general chemistry, physics, and biology, and one semester of organic chemistry. Despite early and continuous opposition to these narrow requirements, they remain essentially unchanged 80 years later.³

The most thoughtful and comprehensive opposition began in 1981. The Association of American Medical Colleges assembled the panel on the General Professional Education of the Physician and College Preparation for Medicine (GPEP)—a group of college presidents, medical school deans, department chairs, professors of science and liberal arts, and practitioners⁴—to assess prevalent medical education policies and the nature of premedical undergraduate preparation.

The resulting 1984 report, *Physicians for the Twenty-First Century*,⁴ recommended broadening the baccalaureate preparation for medicine and modifying medical school admission requirements. In GPEP's view, college students' premature tendency to shape their education to meet the narrow objective of medical school

admission resulted in an unbalanced college experience that excluded the possibility of a broad liberal arts education. GPEP was the first group to formally acknowledge the existence of this "premed syndrome" and predicted that these tendencies would be further reinforced if medical school admissions policies continued to emphasize high MCAT scores and exceptional grade achievement. GPEP argued that all physicians should not only acquire and sustain clinical expertise, skills, and knowledge, but also hone and apply humanistic values and attitudes common to a profession dedicated to caring and healing.

Opposition to traditional premed requirements continues to be voiced by a variety of leaders in medical education.^{5–8} According to Gross and colleagues,⁹ critics of premed requirements fall into three categories: those who would eliminate all requirements,¹⁰ those who advocate for continuously updating the premed science curriculum,^{5–7} and those who believe that the premed curriculum must be broadened to reflect a richer liberal arts education.^{5,6,8}

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Despite general agreement that many premed requirements are of limited educational value for the practicing physician or active scientist and that a broad liberal arts education provides direct benefits to practitioners and their patients, little progress has been made toward a fundamental reappraisal. In 2009, over 80% of matriculating applicants entered medical school with majors other than the humanities or social sciences.¹¹ The belief that the premed science background (including one year each of organic chemistry, physics, and calculus) is the best form of student preparation for medical school persists, and admissions committees' reliance on exceptional MCAT scores prevails.

Although medical education leaders have acknowledged that the GPEP recommendations are appealing, to the best of our knowledge no definitive studies have been undertaken to examine how well students might perform if they were admitted to medical school with a broad liberal arts education rather than having fulfilled the traditional premed requirements.

For more than 20 years, the Mount Sinai School of Medicine of New York University (Mount Sinai) has welcomed humanities and social science majors who specifically omitted certain standard premed requirements and did not take the MCAT.¹² We present here a representative six-year retrospective observational study comparing the medical school performance outcomes of these humanities and social sciences majors with those of their classmates who pursued traditional premed education to determine whether premed requirements predict success in medical school.

The Humanities and Medicine Program at Mount Sinai

The Humanities and Medicine Program (HuMed) was established at Mount Sinai School of Medicine in 1987. It offers qualified sophomores and juniors majoring in humanities or the social sciences guaranteed admission to our medical school on successful completion of a baccalaureate degree. Admission decisions are based on high school and college transcripts, two personal essays, three letters of recommendation, SAT scores (minimum verbal score of 650, or ACT equivalent), and two interviews at Mount Sinai.

Once accepted, students must maintain a minimum GPA of 3.5. They forego organic chemistry, physics, calculus, and the MCAT, but they must achieve a minimum grade of B in biology and general chemistry (two semesters each).

After completing their junior year, students are required to spend an eight-week summer term at Mount Sinai. The summer experience includes clinical service rotations in all specialties, seminars in medical topics (e.g., bioethics, health policy, palliative care), and an abbreviated course in the "Principles of Organic Chemistry and Physics Related to Medicine" (six credit-hours for organic chemistry, two credit-hours for physics). This course covers basic principles and complies with the requirement that all graduates of medical schools chartered by the University of the State of New York must have passed courses in these subjects before receiving the MD degree. Students complete weekly examinations, which are graded pass/fail.

On completing their undergraduate degree, accepted students are encouraged to take a year off before matriculating.

During the summer before they matriculate, students may attend an optional Summer Enrichment Program (SEP) that attempts to acclimate incoming HuMed students to the medical school curriculum and environment. Approximately 75% of the matriculating HuMed cohort participate each year. The SEP curriculum includes overviews of biochemistry, anatomy, embryology, cell physiology, and histology. Examinations are self-assessments and are reviewed in class. Students do not receive grades.

Method

We reviewed academic outcomes data for the graduating classes of 2004–2009. We chose this period because starting in 2004 the proportion of HuMed students increased with each matriculating class. In addition, by 2004 a comprehensive and validated Medical Student Performance Evaluation (MSPE) grid was introduced that identifies and quantifies all aspects of student achievement.¹³ Using students' MSPE grids, we compared academic data that reflected science knowledge base, clinical performance, leadership and community service, humanism and professionalism,

research/scholarship, and residency career choice.

In total, we reviewed academic outcomes data for the 691 students who graduated in the classes of 2004–2009. Of these students, 85 (12.3%) were HuMed. The proportion of HuMed students in each class ranges from 8.3% (9/108) in the class of 2004 to 16.4% (20/122) in the class of 2009. In the analysis of scholarly concentrations and distinction in research, we included the members of the class of 2010 who were undertaking their scholarly year in 2009.

IRB approval was not requested because this study fell under the general exemption from our institutional review board for educational outcomes data.

Tracking cohorts

Because students may apply in their sophomore or junior year of college, may take a year off before matriculating, and may add a scholarly fifth year during medical school, it is impossible to follow an intact cohort from application through matriculation and commencement. For example, approximately 25% of the students in every Mount Sinai medical school class, including many HuMed students, spend a scholarly year doing research and join a different graduating class.

Statistical analysis

We conducted cross-tabulations and ANOVA comparing HuMed students with non-HuMed students across various database variables. All significance was tested at the 95% level of confidence. The data analysis was generated using SAS software (Version 9.1, SAS System for Windows, 2002–2003, SAS Institute Inc., Cary, North Carolina).

Results

To evaluate academic achievement in medical school, we compared data for the 691 students who graduated in the classes of 2004–2009. We identified no statistically significant differences between the 85 HuMed and 606 non-HuMed students for the academic outcomes listed below (Table 1):

- United States Medical Licensing Examination (USMLE) Step 1 failures
- Exceptional performance on the Comprehensive Clinical Assessment

Table 1

Academic Outcomes of HuMed Students Compared With Those of Non-HuMed Students at the Mount Sinai School of Medicine for the Classes of 2004–2009*

Academic outcome	HuMed students (n = 85)	Non-HuMed students (n = 606)	P value
Ranked in top quartile based on ratio score	31%	26%	.3295
MSPE final performance rating			
Outstanding	35%	26%	.0696
Excellent	33%	26%	.1731
Very good	22%	25%	.5579
Good	9%	23%	.0046
Alpha Omega Alpha status = yes	22%	16%	.1102
Received MSPE points			
School leadership award	99%	92%	.0195
Community service	91%	83%	.0646
Took nonscholarly LOA[†]	11%	3%	.001
Received Gold Humanism Honor Society award	25%	20%	.3170
Received honors grade in clerkship			
Psychiatry	46%	23%	<.0001
Obstetrics–gynecology	33%	26%	.1597
Anesthesiology	41%	34%	.1932
Surgery	34%	27%	.1970
Neurology	38%	32%	.2853
Junior pediatrics	34%	29%	.3056
Family medicine	29%	25%	.3918
Junior medicine	28%	27%	.8596
COMPASS II score[‡]			.1471
0	68%	77%	
2	14%	13%	
4	18%	10%	
USMLE Step I score	221 ± 20	227 ± 19	.0039
USMLE Step I failure	4%	2%	.4760
Serious academic difficulty[§]	2.4%	2.3%	1.000

* Non-HuMed students complete traditional premed requirements prior to medical school admission; HuMed students are humanities and social sciences majors who do not. MSPE indicates Medical Student Performance Evaluation; USMLE, United States Medical Licensing Examination.

[†] Nonscholarly LOA indicates a leave of absence related to academic, personal, or psychiatric difficulties.

[‡] COMPASS II is a standardized, patient-based clinical exam given at the end of third year of medical school.

[§] Serious academic difficulty indicates a student who has three course failures or two failures and two marginal grades during the first or second year of medical school.

- (COMPASS II) at the end of the third year
- Honors grades in clerkships (except psychiatry, in which significantly more HuMed students received honors grades)
- School leadership MSPE points
- Gold Humanism Honor Society awards
- Rank in the top 25% of the class

- Outstanding or excellent MSPE final descriptors
 - Alpha Omega Alpha designation
- We identified statistically significant differences in the following outcomes:
- HuMed students had lower USMLE Step 1 scores.

- HuMed students earned a higher number of community service MSPE points.
- HuMed students were more likely to require a nonscholarly leave of absence for academic or personal reasons.

We reviewed research or scholarly project performance data for this same cohort and identified the following differences between HuMed and non-HuMed students:

- HuMed students were significantly more likely than non-HuMed students to dedicate a year to scholarly research (28.2% or 24/85 versus 14.1% or 86/606, $P = .001$) and to be awarded a Doris Duke Clinical Research Fellowship (10.6% or 9/85 versus 3% or 18/606, $P = .001$).
- HuMed students were more likely than non-HuMed students (11.8% or 10/85 versus 8.3% or 50/606, $P = .281$) to graduate with distinction in research (named as first author on a peer-reviewed publication), but the trend was not significant.

In evaluating residency choices, we identified a trend among HuMed students versus non-HuMed students toward residency choices in primary care (49.4% or 42/85 versus 39% or 237/606) and psychiatry (14% or 12/85 versus 5.6% or 34/606) and away from surgical subspecialties (7% or 6/85 versus 13% or 80/606) and anesthesiology (5.8% or 5/85 versus 9% or 55/606) (Figure 1). We attempted to compare the quality of residency programs matched by students in the two groups but found the task impossible. With few exceptions, Mount Sinai graduates match at hospitals that are either based in or very close affiliates of academic health centers, making it very difficult to define the quality of or distinguish among the residency placements.

Discussion

Throughout the 20th century, medical educators and leaders have bemoaned the fact that premed requirements have strayed from their intended purpose: to provide aspiring physicians with a broad-based education that will better prepare them to be independent and creative

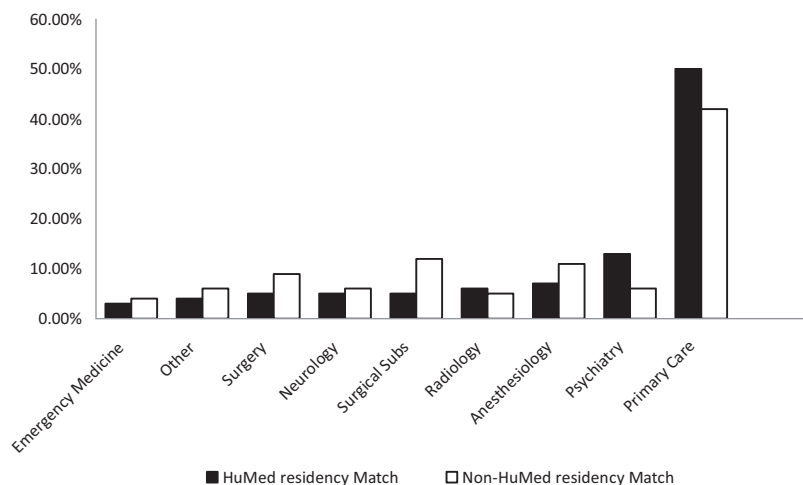


Figure 1 Residency specialty Match distribution for the Mount Sinai students in the classes of 2003–2009 matching in residencies during the study period. Of the 691 students, 85 were HuMed students and 606 were non-HuMed students. HuMed and non-HuMed students for graduating classes 2003–2009. Primary care includes internal medicine, family medicine, pediatrics, obstetrics–gynecology, and medicine–pediatrics.

thinkers.^{6,8} Lewis Thomas,¹⁰ in the 1970s, was perhaps the most radical voice:

I have a suggestion, requiring for its implementation the following announcement from the deans of all the medical schools: henceforth, any applicant who is self-labeled as a “premed,” distinguishable by his course selection from his classmates, will have his dossier placed in a third stack of three. Membership in a “premedical society” will, by itself, be grounds for rejection. Any college possessing something called a “premedical curriculum,” or maintaining offices for people called “premedical advisors,” will be excluded from recognition by the medical schools.

The “standard” prerequisites for admission to medical school constitute a major investment of credit hours and commonly involve large assemblies of students passively receiving didactic instruction. Furthermore, students’ keen awareness of the competitive nature of the admission process and the need for outstanding performance in science GPA and on the MCAT induces them to cram for grades without appreciating the science being studied, and their retention of the information is only to be transient. Educators have turned “what should have been a comprehensive meritocracy into narrow-minded and mean-spirited ‘testocracy.’”¹⁴

We believe this narrow focus fosters other negative results. First, the cultivation of true scientific curiosity is diminished as the satisfactions of scientific discovery are lost. Second, the

process of assessing students’ performance by “objective” tests that validate largely memorized current knowledge denies the fact that science is not static. Third, science is not presented as the portal of entry through which the wonders of biomedicine can be engaged; rather, it is distorted into a set of obstacles to be surmounted and functions solely as a filtration mechanism (“weeding out,”^{6,7} “separating the wheat from the chaff”⁹) by which medical school admissions committees select applicants.

Our data, collected over the course of six years, confirm earlier findings on the HuMed program¹² and provide further evidence that a significant reduction in standard premed requirements does not limit students’ ability to assimilate the basic science knowledge necessary for promotion to the clinical clerkship years. Nor does it limit their success in the clinical years in clerkships, electives, clinical skills exams, research endeavors, or residency selection.

Therefore, HuMed students have not missed some essential preparatory ingredient by acquiring an extensive liberal arts college education at the expense of the traditional premed science requirements and the MCAT. Rather, they may experience some gains from the diverse, enriching, collegiate liberal arts education that the GPEP report and others anticipated. We postulate that these gains may include:

- enhanced communication skills and a more humanistic approach to the patient, as evidenced by HuMed students’ better performance in psychiatry;
- a greater interest in pursuing broader medical school experiences, as evidenced by HuMed students’ greater participation in scholarship and research; and
- a heightened interest in fields that provide greater interpersonal connections between patient and physician, as evidenced by HuMed students’ trend toward residencies in primary care and psychiatry.

The success of the HuMed program over the years has broadened the criteria for admission to Mount Sinai for the entire applicant pool by encouraging our admissions committee to look favorably on humanities and social science majors. Whereas the national proportion of humanities and social sciences majors matriculating in 2009 was less than 18%,¹¹ the proportion of these majors among the Mount Sinai class was 25% without the HuMed students (43% when they were included).

The HuMed group does have lower USMLE Step 1 scores, which may reflect their nonscience background and the challenges of adjusting to multiple-choice examinations. The difference seems unlikely to affect their clinical skills or to keep them from securing high-quality residency training positions.

More troubling is the HuMed group’s significantly higher rate of nonscholarly leave of absence. This may indicate that a very small number of students struggle academically and require leave before returning to school, or are unsure of their career choice and find their uncertainty compounded by the demanding medical school curriculum. Mount Sinai addresses these concerns in a variety of ways. First, admissions standards attempt to identify students with very high academic potential. Second, students who attend the optional SEP learn studying and test-taking skills for the sciences. Third, prospective students are strongly encouraged to take at least one year off before matriculating, which allows them ample time to reflect on their career choice.

Summer-term organic chemistry and physics

Originally, the inclusion of an introductory course in organic chemistry and physics during the mandatory summer term was necessary to comply with New York State requirements. Like the SEP, this program may provide HuMed students with some valuable preparation for medical school coursework. We acknowledge that these disciplines have educational value for future physicians and scientists, but we contend that admissions committees pay them too much attention and that far too much time is devoted to them in the undergraduate premed curriculum. That time could otherwise be spent providing a broader liberal arts education and enhancing the science curriculum to better meet the needs of this century's revolutions in biomedicine, technology, and health policy.^{6,7}

Limitations

Our study has several limitations. First, the HuMed program exists only at Mount Sinai, and we do not know whether our results can be generalized to other schools, regions, and curricula.

Second, we were unable to control for undergraduate GPA between the HuMed and non-HuMed groups. Once students are accepted into the HuMed program, typically in their sophomore year, they are required to maintain a minimum GPA of only 3.5. This minimum standard allows them the freedom to explore more academically challenging courses and relieves them of the burden of having their GPA define their academic success. It is unlikely that they will work as hard as their premed peers at attaining the highest possible GPA. In addition, it is unlikely that a student's isolated freshman GPA can be reliably used to compare academic ability between these groups.

Third, it is difficult to track a distinct cohort of students through the entirety of their medical education. It is not unusual for students to defer matriculation for one or two years, and, once matriculated, students sometimes take a leave of absence for personal reasons. It is common for students to add a year devoted to scholarly work or research to the traditional four years of medical school. When such students reenter medical school, they join a different graduating class. Sometimes, the

curriculum they experience with their new class is distinctly different than that received by their original class. Although the overwhelming majority of students in our study followed a traditional four-year path, the slight variations in class composition may have had unpredictable effects on academic outcomes for either the HuMed or traditional cohort.

Finally, our study does not address whether there are substantive differences in career choice and professional performance between the HuMed cohort and their premed peers. Which students choose more academically oriented careers? Which group is more likely to incorporate community or social service in their work? Which group has higher patient satisfaction ratings? We are attempting to answer these questions through ongoing surveys of Mount Sinai alumni.

Conclusions

The HuMed program at Mount Sinai was designed to determine the extent to which the MCAT and traditional premed courses in organic chemistry, physics, and calculus are necessary for successful completion of a medical school curriculum. It was also designed to encourage students interested in the humanistic elements of medicine to seriously consider pursuing a medical career. Many of these students are initially reluctant to pursue medicine because they are uncertain about their interest in science, they are concerned about their ability to meet the high scholastic expectations of admissions committees,¹⁵ or they are unwilling to divert the time and effort required to meet standard medical school admission requirements.

Acceptance into the HuMed program allows such students time to pursue a diverse liberal arts education and engage in a broad variety of challenging curricular and extracurricular experiences. In our experience, the benefits accrued by liberalizing undergraduate premedical education so that students may focus on the humanities and social sciences are significant.¹⁶ Similarly structured programs could allow, or even require, students to pursue statistics, genetics, biochemistry, and molecular biology to

develop "a more molecularly oriented and scientifically sophisticated knowledge base."⁶

Recent calls to rethink collegiate premed requirements have suggested enhancing undergraduate science preparation while incorporating more of the liberal arts, allowing students to "explore and stretch academically and intellectually ... and prepare for citizenship in society."^{6,8} The common theme is the need to remove content that is "irrelevant to medical practitioners, researchers, and administrators" and that serves only as a mechanism for weeding out students in a "trial by fire."^{6,8}

As the successful academic outcomes of students from the HuMed program illustrate, it is clear that relieving students of the burdens of traditional premed requirements in college will provide them the opportunity to pursue multiple and more diverse paths to success in medical school.¹⁶

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Teaching and Learning Moments

Monkey See, Monkey Don't

On my very first trip to the OR, I passed out. As a 12-year-old, I was overwhelmed by the open cholecystectomy. The attending surgeon was wise enough to recognize my symptoms and hurriedly had the circulator nurse take me outside. I spent the rest of the day with a pathologist grossing in surgical specimens. The juxtaposition of the living person in the OR with the dead tissue on a disposable specimen tray affected me deeply. The surgeon directly cared for his patient; the interventions guided by his hands healed. The experience, which I perceived as the dichotomy between purely therapeutic medicine and diagnostic medicine, convinced me to become a surgeon.

Johnny was one of my first complicated patients during my pediatric surgery rotation. A Wilms tumor protruded from his left kidney. On rounds, the surgical team and I discussed what we saw in the films and the more esoteric points of pediatric solid tumors. The attending outlined various concerns he had with Johnny's management and follow-up. I wasn't really paying attention to what was said. My primary concerns were staying awake and not looking stupid. After all, the patient didn't appear to be too sick, and, in a few hours, I'd be in the OR.

The surgical details of the case were complicated. The attending complimented my understanding of vascular anatomy and oncology. The movements of my hands with the weight of instruments began to feel

natural. At hour nine, I started to sweat. Suddenly, I was 12 years old again. I had to leave the case. As quickly as possible, I removed my gown and gloves and ran for the cafeteria. After a healthy dose of sugary soda, I returned to the OR and delivered the tumor through Johnny's abdomen.

Congratulations were given all around; the case was successful. My personal pride in finishing despite a bout of hypoglycemia was palpable. To be the first assistant on a Wilms tumor case with a world-renowned pediatric surgeon was no small accomplishment to me. I had removed Johnny's cancer with my own two hands, and my own sense of future seemed without bounds. The shock was equally palpable when the attending later told me that I'd never be a good surgeon.

My disinterest in patient management and follow-up that morning had not escaped notice. I was told that surgeons manage patients, not procedures. While I clearly loved the technical aspects of surgery, I didn't love managing the nonoperative care of surgery patients. I was crushed by the negative weight of my attending's comments. It was the most disappointing day of my life. My own considerable estimation of my surgical dexterity was destroyed with his next comment, "I could train a monkey with the hand skills."

Several weeks later, I saw Johnny in the pediatric hematology–oncology clinic for a follow-up appointment. I entered the clinic room and was struck

by the two-year-old blowing spit bubbles. At that moment, Johnny became a person and not just a specimen to be manipulated and processed. He was a little boy, and, most important, he was my patient. None of what I saw that day in clinic was familiar from my early morning visits to his room in the children's hospital.

The attending was right. My interest in management, follow-up, and outpatient clinic never did surpass the appeal of the OR. The ability to diagnose and heal patients, and not only aptitude for procedures, makes a surgeon. That day in the clinic, I recognized the truth in the previously disappointing negative comments from the attending. My concern should have been our patient, Johnny. A mastery of the molecular biology of tumors, venous drainages, and surgical approaches is not what defines the physician. These things are underpinning components; they are not the patient.

Instead of disappointment, the surgeon's comments gave me a reason to explore other areas of medicine. I was dangerously close to becoming a well-trained monkey with occasional spells of hypoglycemia. The truth, while disappointing, was liberating. In the end, I decided to become something other than a surgeon.

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