



Illustration by Erica Aitken.

Competencies as the basis for reformed premedical education

The case for an unrestricted liberal arts collegiate education

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One hundred years ago Abraham Flexner changed the paradigm by which physicians are trained in this country.^{1,2} Among his many contributions was the principle that successful performance in universal, standardized, and demanding premedical basic science courses be required of undergraduates applying for admission to U.S. medical schools. By 1930 these requirements were fully entrenched, requiring two semesters each of chemistry, biology, and physics, and one semester of organic chemistry. Eighty years later, despite continued and mounting opposition, these premed requirements continue to be enforced.

Calls for change of this status quo have persisted and, in recent years, intensified.^{3–8} While the displeasure is uniform, the ways in which baccalaureate preparation for medical school and medical school admissions policies might be amended reflect differing and sometimes even opposing perspectives. Most representative of this polarity are two major advocacy statements: on the one hand the 2009 report of the AAMC-HHMI Committee, “Scientific Foundations for Future Physicians,”⁹ and on the other the now decades old but still pertinent “Physicians for the Twenty-First Century” report of the AAMC Project Panel on General Professional Education of the Physician and College Preparation for Medicine (GPEP) which appeared in the early 1980s.¹⁰ Both the AAMC-HHMI and GPEP expert panels were commissioned to examine, among other elements of medical education, the aims and content of the premedical curriculum. Their vastly different conclusions are emblematic of the major themes that characterize diverging objectives of premedical education reforms.

The case for *SCIENCE* competencies: The HHMI-AAMC Report

The AAMC and HHMI convened a diverse group of scientists, physicians, and science educators drawn from small colleges, large universities, and medical schools to address the following paradox: while the scientific knowledge essential for acquiring and successfully applying the skills necessary for the expert practice of clinical medicine has changed “dramatically,” the medical prerequisites and admission requirements have remained “essentially unchanged.” The group was asked to address the inherent tension between “teaching scientific facts” and “preparing physicians to actually use scientific knowledge.” It set out to identify “the most important scientific competencies in the natural sciences required of students graduating from college prior to matriculating into medical school.”^{9ExecSum}

In keeping with the National Academies’ BIO 2010 conclusions that premedical course requirements and the MCAT content constrain undergraduate science education,¹¹ the HHMI/AAMC group defined eleven knowledge principles and eight scientific competencies that reflect acquisition and effective application of those principles. Proficiency in each determines readiness for medical school admission.

In the view of the committee, the shift from testing facts to achieving competencies will allow greater flexibility for collegiate faculty and curriculum planners to exploit the talents and resources of their institutions when revising course content. Ultimately, such changes will help to engage and personalize the curricula of their science/premedicine students and their science faculties.

The report acknowledged that these recommendations were a “first step” in a continuing “conversation” about the appropriate skills, knowledge, values, and attitudes future physicians should possess. In this regard the AAMC has also convened a separate panel to examine the behavioral and *social science* (our emphasis) competencies for future physicians, which will be released at a later date.

Table 1 HHMI: Scientific Foundations for Future Physicians Eight Expectations of Entering Medical Students			
1. Apply quantitative reasoning and appropriate mathematics to describe and explain phenomena in the natural world.		5. Demonstrate knowledge of how biomolecules contribute to the structure and function of cells.	
<ul style="list-style-type: none"> Interpret data sets and communicate those interpretations using visual and other tools Demonstrate quantitative numeracy and facility with the language of mathematics Make statistical inferences from data sets 	<ul style="list-style-type: none"> Apply algorithmic approaches and principles of logic (including the distinction between cause/ effect and association) to problem solving Extract relevant information from large data sets 	<ul style="list-style-type: none"> Structure, biosynthesis, and degradation of biological macromolecules Principles of chemical thermodynamics and kinetics that drive biological processes in the context of space (i.e., compartmentation) and time: enzyme-catalyzed reactions and metabolic pathways, regulation, integration, and the chemical logic of sequential reaction steps 	<ul style="list-style-type: none"> Biochemical processes that carry out transfer of biological information from DNA, and how these processes are regulated Principles of genetics and epigenetics to explain heritable traits in a variety of organisms
2. Demonstrate understanding of the process of scientific inquiry, and explain how scientific knowledge is discovered and validated.		6. Apply understanding of the principles of how molecular and cell assemblies, organs, and organisms develop structure and carry out function.	
<ul style="list-style-type: none"> Develop observational and interpretive skills through hands-on laboratory or field experiences Demonstrate the ability to measure with precision, accuracy, and safety Operate basic laboratory instrumentation for scientific measurement 	<ul style="list-style-type: none"> Articulate (in guided inquiry or in project-based research) scientific questions and hypotheses, design experiments, acquire data, perform data analysis, and present results Demonstrate the ability to search effectively, to evaluate critically, and to communicate and analyze the scientific literature 	<ul style="list-style-type: none"> General components of prokaryotic and eukaryotic cells, such as molecular, microscopic, macroscopic, and three-dimensional structure, to explain how different components contribute to cellular and organismal function How cell-cell junctions and the extracellular matrix interact to form tissues with specialized functions 	<ul style="list-style-type: none"> Mechanisms governing cell division and development of the embryos Principles of biomechanics and explain structural and functional properties of tissues and organisms
3. Demonstrate knowledge of basic physical principles and their application to the understanding of living systems.		7. How organisms sense and control their internal environment and how they respond to external change. Explain:	
<ul style="list-style-type: none"> Mechanics as applied to human and diagnostic systems Electricity and magnetism (e.g., charge, current flow, resistance, capacitance, electrical potential, and magnetic fields) Wave generation and propagation to the production and transmission of radiation 	<ul style="list-style-type: none"> Thermodynamics and fluid motion Quantum mechanics, such as atomic and molecular energy levels, spin, and ionizing radiation Systems behavior, including input-output relationships and positive and negative feedback 	<ul style="list-style-type: none"> Maintenance of homeostasis in living organisms by using principles of mass transport, heat transfer, energy balance, and feedback and control systems Physical and chemical mechanisms used for transduction and information processing in the sensing and integration of internal and environmental signals 	<ul style="list-style-type: none"> How living organisms use internal and external defense and avoidance mechanisms to protect themselves from threats, spanning the spectrum from behavioral to structural and immunologic responses
4. Demonstrate knowledge of basic principles of chemistry and some of their applications to the understanding of living systems.		8. Demonstrate an understanding of how the organizing principle of evolution by natural selection explains the diversity of life on earth. How:	
<ul style="list-style-type: none"> Atomic structure Molecular structure Molecular interaction Thermodynamic criteria for spontaneity of physical processes and chemical actions and the relationship of thermodynamics to chemical equilibrium 	<ul style="list-style-type: none"> Principles of chemical reactivity to explain chemical kinetics and derive possible reaction mechanisms Chemistry of carbon containing compounds relevant to their behavior in an aqueous environment 	<ul style="list-style-type: none"> Genomic variability and mutation contribute to the success of populations 	<ul style="list-style-type: none"> Evolutionary mechanisms contribute to change in gene frequencies in populations and to reproductive isolation
Source: Reference 9.			

The case for *ATTITUDES AND VALUES* competencies: The GPEP Report

Assembled three decades ago, the GPEP committee included college presidents, medical school deans, chairmen, professors, practitioners, and nonmedical members. Its charge was an ambitious, all-encompassing review of the entire landscape of American medical education: collegiate, medical school, graduate medical education, and faculty development. In particular, the panel was commissioned to assess the adequacy of medical education and admissions policies and the nature of premedical undergraduate preparation to “meet the challenges of medical care in the twenty-first century.”^{10pxiii}

The report’s recommendations reflected the panel’s perception of a widening disconnect between (1) increasing medical specialization fueled by the accelerating expansion of medical science, technology, and information services, and (2) the individual patient’s—indeed the general public’s—concerns about quality and access to health care.

With respect to premedical education, their major recommendations were as follows:

- Broaden the baccalaureate preparation in the social sciences and the humanities.
- Modify medical school admissions requirements to accommodate broader and more diverse baccalaureate preparation.
 - Require an undergraduate scholarly endeavor.
 - Final admissions decisions should incorporate an applicant’s ability “to learn independently, acquire critical analytical skills, [and] develop the values and attitudes essential for members of a caring profession.”^{10p9}



In the panel’s view, the tendency of college students to shape their education prematurely towards the narrow objective of admission to medical school generates an unbalanced college experience resulting in exclusion of a broad liberal arts education. The panel predicted a further reinforcement of these adverse tendencies if medical school admissions policies continued to emphasize high MCAT scores and exceptional science grade point averages. The fundamental position underlying the panel’s conclusion was the conviction that all physicians, regardless of specialty, should not only acquire and sustain clinical expertise, skills, and knowledge, but also retain, hone, and apply humanistic values and attitudes nurtured and expanded in college and inherent to a profession dedicated to caring and healing.^{10pp18–19} In support of this conclusion, the panel recommended that evidence of strong rhetorical skills be included in medical school admissions criteria and given greater weight in their selection processes. These skills were defined as cogent, effective writing demonstrating originality, thorough research, sound analysis, and persuasive argument that was developed and sharpened in a variety of liberal arts disciplines.

GPEP also suggested that “medical school admissions committees’ practice of recommending additional courses beyond those required for admission should cease” and that “some institutions may wish to experiment by not recommending any specific course requirements.”^{10p20}

In conclusion, both HHMI and GPEP, albeit with very different approaches and reasoning, seek to distinguish and nurture the self-initiating, self-directed, independent student from the equally intelligent, well prepared, but passive recipient of current knowledge.

Table 2 General Professional Education of the Physician and College Preparation for Medicine in the Twenty-First Century Recommendations: Baccalaureate Education	
1. Broaden preparation of every student	“...to achieve an education that encompasses broad study in the natural and social sciences and in the humanities.” First to publicly define and decry existence of “a Premed Syndrome.”
2. Modify admissions	“Medical school admissions committees’ practice of recommending additional courses beyond those required for admission should cease. Some institutions may wish to experiment by not recommending any specific course requirements.”
3. Requiring scholarly endeavor	“College faculties should make the pursuit of scholarly endeavor and the development of effective writing skills” a requirement.
4. Making selection decisions	“Medical school admissions committees should make final decisions using criteria that appraise students’ abilities to learn independently, to acquire critical analytic skills, to develop attitudes essential for members of a caring profession and to contribute to the society of which they are a part.”
Source: Reference 10.	

Efforts to meld these principles are ongoing. For example, the Accreditation Council for Graduate Medical Education (ACGME) introduced the “General Competencies” for graduate medical education in 1999.¹² This broad set of general skills and attitudes (including competence in patient care, medical knowledge, and interpersonal and communication skills, among others) was meant to serve as a framework for resident training and development. To sustain ACGME accreditation, each training program, regardless of specialty, is now responsible for documenting its trainees’ performance and progress within each competency element.

In 1998 the AAMC, with broad input from national leaders in medical education, published the “Learning Objectives for Medical Student Education” as part of its Medical School Objectives Project (MSOP).¹³ This aimed to define the essential attributes physicians need to fulfill their “duty to society” (including requiring physicians to be altruistic, knowledgeable, skillful, and dutiful).¹³

Two elements of the proposals by GPEP, ACGME, and the AAMC (MSOP) are strikingly similar: the inextricable connection between competency in communication skills and effective patient care, and the fact that altruism and accountability (performing in a “dutiful” manner) are essential elements inherent to the behavioral attributes we call “professionalism.”

How will medical schools respond?

While both the HHMI and GPEP positions are appealing, it seems that meaningful reform can only be achieved by a combination of (1) individual colleges developing competency based curricula, (2) the AAMC altering the MCAT to assess the acquisition of competencies, and (3) medical schools modifying the philosophies governing their admissions criteria. That degree of change is daunting on many levels, not the least of which is medical schools’ apparent collective reluctance to fix something they believe isn’t broken.

What is missing is formal, persuasive evidence defining how well students perform if admitted to medical school with radically different post-Flexnerian baccalaureate backgrounds, foregoing the MCAT and allowing them to undertake a diverse and flexible array of undergraduate coursework.

The Humanities and Medicine Program at Mount Sinai School of Medicine

In partial answer to this challenge, a recent detailed report of the Mount Sinai School of Medicine Humanities in Medicine (HuMed) Program is worthy of consideration.¹⁴ The HuMed Program, founded in the late 1980s, sought to embody the essence of the GPEP principles. A portion of the medical school entering class applicants who were exclusively liberal arts majors were exempted from all the standard premed curriculum courses and omitted the MCAT examination. In this day of evidence-based decision making, it must be noted that this major decision was based on expert opinion alone.



Applicants to the HuMed program are college sophomores (and rarely juniors). Therefore admission decisions are based on high school and initial college freshman and partial sophomore grades and SAT scores. As important, however, are two personal essays, three letters of recommendation, and a listing of extracurricular (school and community) activities. Approximately fifteen percent of the applicant pool is invited for personal interviews at Mount Sinai.

The assessment process therefore involves two major elements.

1. In addition to excellent GPA performance, high SAT scores are admittedly crucial. Although the stipulated minimum score for each element is 650, in recent years the pool of applicants chosen for interview generally exceed 750 on average and those chosen for final admission to the program score over 750.

2. In the personal essays, interviews, and extracurricular evidence of personal interests and involvement, we seek evidence of rhetorical “skills defined by cogent, effective writing displaying originality, thorough research, sound analysis, and persuasive argument developed and sharpened” in a variety of activities. In the interviews we seek cogent, lucid, thoughtful responses—evidence of “competency in communication” to challenging questions.¹⁰ Finally personal activities should demonstrate depth of involvement and conclusive impact on some aspect of human welfare.

Accordingly, the HuMed selection process seeks to distinguish the self-initiating, self-directed, and independent

student from the equally intelligent, well prepared, but passive recipient of current knowledge.

Once accepted, students must maintain a college GPA of 3.5. Although they forego the full traditional requirements and MCAT, they are required to take and achieve a minimum grade of B in biology and general chemistry (two semesters each).

After completing their junior year in college, students are required to spend an eight-week summer term at Mount Sinai. This 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). Students complete weekly examinations that are graded pass/fail.

During the summer prior to matriculation, HuMed students may attend an optional Summer Enrichment Program (SEP) that serves to acclimate incoming HuMed students to the medical school curriculum and environment. Approximately seventy-five percent of the matriculating HuMed cohort participates each year. The SEP curriculum includes overviews of biochemistry, anatomy, embryology, cell biology, and histology. Examinations are the self-assessment type and are reviewed in class. Students do not receive grades.

The first-year medical school curriculum is not altered to accommodate the HuMed students.

Aims of the HuMed program

This new program sought to encourage a group of applicants with an interest in the humanistic elements of medicine to consider pursuing a career in the profession. At a minimum, the program would result in a more diverse and enriched pool of potential applicants. Mount Sinai believed that these policies would eliminate the initial reluctance of these applicants to pursue medicine, typically based on an uncertain interest in science, concern over their ability to meet the high scholastic expectations of medical school admissions committees, and/or their unwillingness to divert the time and effort required to meet standard medical school requirements.

The keen awareness premed students have of the competitive nature of the admissions process and the need for outstanding performance in science GPA and MCAT scores might induce them to cram for grades without appreciation of the science being studied. As a result, their retention of the information might only be transitory. Educators have turned “what should be a comprehensive meritocracy into a narrow minded and mean spirited ‘testocracy.’”¹⁵

This narrow focus fosters other negative results:

- Cultivation of true scientific curiosity is diminished as the satisfactions of scientific discovery are lost.
- The process of assessing student performance by “objective” validating memorized current knowledge ignores the fact that science is not static.

- 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 filter through which medical school admission committees select applicants.^{6,7}

But more important than simply enriching the applicant pool, HuMed was founded on the principle that a broad liberal arts education might supply the values, skills, and attitudes GPEP espoused. As such, a liberal arts education might enhance student appreciation and understanding of the range of characteristics describing the human condition, the context in which dysfunction, disability, and disease intrudes and distorts. It was felt that this benefit might be accrued from three elements of a challenging liberal arts background: amplification, self-discovery, and the development of professionalism.

- *Amplification*—Fiction at its best can depict in several hours of reading and reflection more about the nature of the human condition (that brew of joy, sadness, fright, relief, bewilderment, confusion, and pain) than the untutored, intuitive observations derived through the single, often imperfect lens of a maturing adolescent. Reading the best fiction as part of a colloquium led by an experienced preceptor/facilitator in a small group of able, interactive classmates identifies and amplifies elements that may be ephemeral in life, often unseen or unremarked. Focused insight through reading, discussion, and interpretation replaces and completes the surmised and the unexperienced. It gives meaning to a life-altering event and the needs of the individual(s) involved.

- *Self-discovery*—Not only does a liberal arts education prepare the student for what to look for in others, it also informs the sensitized and guided student of his or her own diverse reactions and sensitivities. It induces and expands personal scrutiny of one’s own preferences, prejudices, miscalculations, and ignorance. Under the best circumstances it expands the individual’s sense of self: what talents and resources one possesses and which need development, strengthening, and correction, all in preparation for a career dedicated to healing others.

- *Professionalism*—A liberal arts collegiate education, so often undertaken in a small-group faculty-facilitated format, reinforces awareness of the importance and benefits of productive interaction with others. These benefits are twofold. The best students will endeavor to hone the skills that maximize effective written and oral communication: conciseness, cogency, lucidity, and fluency. They discover and emulate those virtues in their most effective classmates, and they develop a personal style of interactive conduct of their own that leads to more successful subsequent interactions. Moreover the benefit of interdependence induces positive socializing behavior, personal control, ethical interactions, civility, and courtesy.

These are the essential elements of all human interactions, be they with patients or peers. Over time, students successful

in these encounters appreciate language and the methodologies and the targets of precise communication. They become as aware of the needs of others as they are of their own. In sum, the defining philosophy of HuMed posits that the result of such an education will be a receptive, interactive, communicative, and sensitive prospective medical professional.

Outcomes

The HuMed Program has been in place for over twenty years. A recent report in *Academic Medicine* reviewed outcome data for six graduating classes.¹⁴ The report compares medical school performance outcomes of undergraduate humanities and social science majors who specifically omitted all standard premed requirements and the MCAT with classmates who pursued the traditional premed science-based preparation. Using a Medical Student Performance Evaluation (MSPE) grid, the report compares academic data reflecting basic science knowledge, clinical performance, leadership, community service, humanism and professionalism, and research/scholarship of the two groups of students. No statistically significant differences were identified between HuMed and non-HuMed students for the following academic outcomes:

- USMLE Step 1 failures
- Exceptional performance on the end of third-year Comprehensive Clinical Assessment

- Honors grades in clerkship (except Psychiatry, where significantly more HuMed students received honors grades)
- School leadership
- Gold Humanism Honor Society awards
- Rank in the top twenty-five percent of the class
- Nomination to AΩA

HuMed students were significantly more likely (thirty-two percent versus twelve percent) to do a scholarly year dedicated to research and be awarded Doris Duke Clinical Research Fellowships (twelve percent versus three percent). There was a nonsignificant trend among the HuMed students (eleven percent versus seven percent) to graduate with Distinction in Research (first-author peer-reviewed publication). Notably, HuMed students were also more likely to require nonscholarly leaves of absence, typically for academic or personal difficulties.

Finally, although difficult to quantify, a trend was identified among HuMed students versus non-HuMed students towards residency choices in Primary Care (fifty percent versus forty-two percent) and Psychiatry (thirteen percent versus six percent), and away from surgical subspecialties (five percent versus twelve percent) and Anesthesiology (seven percent versus eleven percent).

The results provide evidence that for these HuMed students a significant reduction of standard premed requirements did not result in a limited ability to assimilate the basic science knowledge necessary for promotion to the clinical clerkship years, nor did it limit success in the clinical years either in clerkships, electives, clinical skills exams, research endeavors, or residency selection.

Discussion

The HuMed Program at Mount Sinai School of Medicine was designed to encourage application from students who were interested in the altruistic and humanistic elements of a medical career but were deterred by the rigid academic requirements.

Directly or indirectly, intentionally or not, the traditional requirements appear to be very effective barriers that limit the diversity of applicant premed preparation. Humanities and social science majors matriculating in U.S. medical schools in 2010 comprised less than eighteen percent of the total.¹⁶

We believe however, these prerequisites need not be a barrier to dual-major collegiate education, provided the medical school has known policies that welcome, not exclude, such applicants. This has certainly been the case at Mount Sinai, where from the first entering classes in 1968 and thereafter the school has welcomed dual majors.¹⁷ In 2009, the proportion of these dual majors among the entering class was twenty-five percent, excluding the HuMed students, and almost half (forty-three percent) when HuMed was included. These nontraditional students had pursued a wide range of liberal



arts majors—music, history, theology, economics, and fine arts, among others. The number one student in the class of 2010 was a Religious Studies major, one of the top graduates in 2009 (AQA and currently a PGY2 in Medicine at Mount Sinai) a Dramatic Arts major, and the number one graduate in the class of 2008 a Music major. Finally, a member of the class of 2014 spent his entire collegiate career in the extremely competitive combined Columbia-Juilliard Performing Arts program studying and performing as a cellist.

This story does not always apply. Many students accepted to Mount Sinai via the HuMed program decide to pursue other, nonmedical careers. Case in point: one accepted HuMed student continued his interest in creative writing and is now a *New York Times* best-selling novelist!

As an experiment in educational philosophy defining the ingredients necessary for a career in medicine, the HuMed program clarifies the extent to which traditional courses in organic chemistry, physics, and mathematics are necessary for successful completion of a medical school curriculum. For example, we compared the USMLE Step 1 scores, Step 1 failure rates, and serious academic difficulty (defined as three course failures or two course failures and two marginal grades in the first or second year of medical school) for the HuMed and non-HuMed cohorts. These outcomes were respectively, Step 1 scores 221 versus 227, Step 1 failure four percent versus two percent, and serious academic difficulty 2.4 percent versus 2.3 percent. Only the Step 1 score difference was statistically significant.

More troubling is the higher rate for HuMed students of nonscholarly leave of absence (eleven percent versus three percent, $P=.001$).¹⁴ This may indicate that a very small number of students are troubled as they struggle academically with unfamiliar material (but do not fail) and require a pause before returning to school. Still others find they are unsure of their career choice. Mount Sinai addresses these concerns in a variety of ways: admission standards attempt to identify students with very high academic potential and intellectual “flexibility,” students who attend SEP learn studying and test-taking skills for the sciences, prospective students are strongly encouraged to take at least one year off before matriculating. We believe this does allow ample time for most to reflect on their career choice. Happily, HuMed students in this category return to school and graduate at a rate no different from their non-HuMed classmates.

HuMed outcomes suggest that no essential preparatory ingredient was missing by having had an extensive liberal arts college education at the expense of the traditional requirements and outstanding performance on MCATs. It is clear that a significant reduction of the traditional requirements did not result in either significant failure or significant inability to assimilate and apply the predoctoral basic science material in years 1 and 2, nor did it limit success in the clinical years either in clerkships or clinical skills exams. The HuMed students did not significantly fail the challenges of the basic sciences. In



addition, they have performed as well, and in some instances better, than their premed classmates in the clinical years.

The success of HuMed over the years has had an unanticipated but gratifying impact on our medical school community. It has broadened the spectrum of criteria for admission for the entire pool of applicants. In addition, it has encouraged initiation and expansion of required and elective humanism in medicine courses within the medical school curriculum.

Finally and yet to be determined is whether the expanded liberal arts background obtained in a variety of experiences such as electives, community service, additional degrees, and personal avocations will lead these HuMed students to pursue successful, fruitful lifetime careers in the profession. Can follow-up ever accurately measure fulfillment and satisfaction? Will burn-out frequencies or incidents of unprofessional behavior be reduced?

Alas, incidents of immoral behavior occur in all elements of society. Those of us in medicine—as practitioners, educators, or investigators—are painfully aware of the egregious examples of criminality, addiction, mendacity, abuse, plagiarism, and bribery that have tarnished our profession. We have assumed, and continue to rely on, our ability to identify and weed out those with such tendencies as they emerge, however subtly, during the challenging and stressful years of medical school and residency training. Clearly, this process is an imperfect and deficient filter.

We invite the *Pharos* readership to suggest applicable measures we might employ to judge the long-term impact, if any, of the HuMed program on these students.

What can be said with certainty, however, is that such a



change in requirements does not adversely influence successful performance in a demanding and highly competitive medical school environment.

Summary

As the HHMI-AAMC declared, their report should be taken as a “first step in a continuing conversation about the appropriate skills and knowledge,” and, echoing the ACGME and GPEP, “values and attitudes that future physicians should possess.”^{9pExecSum} As a new formulation evolves, the pre-medical curriculum must foster “scholastic vigor, analytic thinking, quantitative assessment and analysis of complex systems.”^{9pExecSum} Based on the Mount Sinai experience, these qualities are not engendered solely nor confined to engagement in natural sciences. Students involved in a variety of baccalaureate liberal arts endeavors appear to acquire similar intellectual competencies. Furthermore, when performed successfully in challenging collegiate environments, a thorough liberal arts education may yield precisely the same values, attitudes, and behavioral characteristics all agree are essential to the medical profession and preparing physicians for the twenty-first century.

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