Questioning the Premedical Paradigm

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Between 1893, with the opening of the Johns Hopkins Medical School, and 1905, with the actions of the inaugural conference of the Council on Medical Education (CME), there was a remarkable coalescing of interests in the United States around a single national standard for both medical education and premedical education. This coalescence is reflected in the premedical admission requirements of the medical schools we have been following. In 1893, all the schools except Johns Hopkins had required only a high school diploma and examinations in a range of subjects. In 1905, Johns Hopkins and Harvard both required a bachelor’s degree. While Hopkins required undergraduate courses in chemistry, biology, and physics, Harvard required only an undergraduate course in chemistry, though recommending courses in the other sciences. The Universities of Michigan and California required two years of college, with courses in the three natural sciences. Columbia deferred to the requirements set by the State Regents, which specified one year of college and examination in a range of subjects that included chemistry, biology, and physics.

The work of the American Academy of Medicine (AAM), the Association of American Medical Colleges (AAMC), and the American Medical Association (AMA) had been effective in creating a coalition to argue and lobby for the application of these standards nationally. By 1905 they had been successful in getting several states to pass laws that limited the granting of a medical license to graduates of medical schools that adhered to the standard of medical education and premedical education promulgated by these organizations. As has been noted, New York and Michigan were among the states that had passed such laws. California passed a law in 1901 that was to have a direct influence on the founding of the Stanford University Medical School in 1908.

The Founding of a New Medical School in California and the Closing of an Old One, 1901–1908

In 1873 there were two principal medical schools in San Francisco. That year the Toland Medical College had transferred its assets to the recently created University
of California, leaving the Medical College of the Pacific as the principal private medical school.

The Medical College of the Pacific had been founded in 1858 by Dr. Elias Cooper as the first medical school on the Pacific Coast. Between 1873 and 1900, the school was reasonably successful, changing its name to the Cooper Medical College in honor of its founder. With a substantial endowment donated by Dr. Levi Cooper Lane, a successful surgeon and the nephew of the founder, the college had acquired a medical school building and a successful hospital. As the benefactor of the school and as the leader of its faculty, Dr. Lane had kept abreast of the movement to elevate and standardize medical and premedical education. In the 1890s he had extended the school’s curriculum to four years and established the requirement of a high school diploma for admission, largely in response to the standards published by the AAMC. As Dr. John Wilson explained in his history of the Stanford Medical School:

With respect to the critical issue of admission standards, which ultimately determine the quality of the profession, the Faculty was well aware that Presidents Eliot of Harvard, Gilman of Hopkins and Jordan of Stanford all advised that a bachelor’s degree or its equivalent should ultimately be required for entrance to medical school. Nevertheless, the Faculty was unprepared to take such a step. Like other free-standing proprietary schools, Cooper College depended upon tuition for its support. High standards for admission would have resulted in a disastrous reduction in the student body and in tuition income. It was growing increasingly clear to the Directors and Faculty of the College that only financial underwriting by a parent body such as a university could provide for the higher admission standard called for by the presidential triumvirate.

However, the faculty of Cooper Medical College faced a problem. In making the initial financial bequest that permitted the college to acquire the building for its school and the affiliated hospital, Dr. Lane had stipulated, “This College shall never be affiliated with, or become the department of any other educational institution, but shall remain an independent school in which Medicine and its Kindred Sciences shall be taught.” While the financial viability of the college depended on affiliating with a university in order to be able to raise its admission standards to meet the evolving AAMC requirements, Dr. Lane’s bequest prohibited such an affiliation.

On February 27, 1901, the California legislature passed a law titled, “An act for the regulation of the practice of medicine and surgery in the State of California, and for the appointment of a board of medical examiners in the matter of said regulation.” The efforts of the AAM, the AAMC, and the National Conference of State
Medical Examination and Licensing Boards described in the previous chapter had come to fruition in California. The state had created a board of medical examiners and delegated to the Medical Society of the State California (the state affiliate of the AMA) the authority to name a majority of the board’s members. The law specified that in order to be eligible for a license to practice medicine in California a physician must possess “a diploma issued by some legally chartered medical school, the requirements of which medical school shall have been at the time of granting such diploma, in no particular less than those prescribed by the Association of American Medical Colleges for that year.”

In 1901 the AAMC published the following statement of its requirements for admission to a medical school: “Each college holding membership in this Association shall require of each student, before admission to its course of study, an examination, the minimum of which shall be as follows . . .” The statement then went on to list the specific content expected in English, arithmetic, algebra, physics, and Latin. (There was no mention of chemistry or biology.) The statement also indicated that, in lieu of the examination, member colleges “are at liberty to recognize the official certificates of reputable literary and scientific colleges, academies, high schools, and normal schools.”

Dr. Lane was fully aware of the direction the AAMC was taking in defining premedical requirements. He had changed the medical school curriculum and the admission requirements at Cooper Medical College to conform to the 1901 standard, but he realized that the college would have substantial difficulty maintaining these requirements over time while also remaining financially viable. Wilson’s history of the Stanford Medical School reports, “In January 1902, during the last weeks of a terminal illness characterized chiefly by progressive exhaustion and anxiety, Dr. Lane decided to revoke the pledge. By this time he had accepted the view that medical schools in the United States were destined to be integral parts of universities.”

He also urged the remaining directors of the medical school to consider affiliating with Stanford University, which had been founded a decade earlier by the railroad magnate Leland Stanford.

In September 1902, Clarence John Blake, an eminent ear surgeon from the Harvard Medical School, wrote to David Starr Jordan, president of Stanford, encouraging him to consider establishing a medical school through an affiliation with Cooper Medical College. In the letter Blake first argues the general point that a medical school should be part of a university: “The day of the private venture in medical education in this country is fast drawing to a close and the main outlook for the advance of medical education is the medical school, not chartered to members of the medical profession nor established as the adjunct to a hospital, but cre-
ated as an integral part of the university system.”9 Blake then goes on to point out, “An examination of the plant of the Cooper Medical College shows it to be available for the purpose of a university hospital,” and he encourages Jordan to take advantage of “the wealth of clinical material within your reach” by merging with Cooper.

In the years immediately following Dr. Lane’s death, there appear to have been few serious discussions between the leaders of the Cooper Medical College and President Jordan of Stanford regarding a possible merger. The leaders of Cooper worked to establish a medical library in memory of Dr. Lane and continued to run the medical school in a manner that largely followed the requirements laid down by the AAMC. Then, on April 18, 1906, San Francisco experienced a major earthquake and fire that destroyed much of the city. While the school’s Lane Hospital was not severely damaged, the school nonetheless experienced a major disruption: “The net result was marked temporary loss of patient income which, in addition to costly building repairs, put a serious strain on the budget of the College. It was of special significance that the disaster occurred at a time when income from student fees was declining and annual budget shortfalls were beginning to occur. These circumstances heightened the interest of the Directors in a liaison with Stanford.”10

Dr. C. N. Ellinwood was at that time president of Cooper Medical College. Faced with the financial disruptions of the earthquake on top of the pressures of adhering to the AAMC’s standards as was required by law, Ellinwood approached Stanford about a possible merger. He appointed a committee of Cooper faculty to carry out these discussions. On August 1, 1906, the Stanford University trustees also appointed a committee to negotiate with Cooper about a possible merger. That committee reported back to the trustees on November 1, recommending that Stanford “maintain a department of medicine on a basis of scholarship and efficiency equal to that of the very best medical schools in the country.”11

Stanford University had first opened in the fall of 1891. Its First Annual Register for the 1891/92 school year states, “Students intending to enter on the study of medicine, will take Physiology and Histology as a major subject, with collateral work in Chemistry, Botany, and other sciences.”12 By the 1894/95 school year, that statement had been expanded to read: “Students intending to enter on the study of medicine, are advised to take Physiology and Histology as a major subject, with Chemistry, Physics, Comparative Anatomy of the Vertebrates, and Hygiene among the collateral subjects. Such a course gives that foundation both in scientific knowledge and in skill in experimental Physiology, and in Histological and Anatomical technique, which will make it possible to accomplish the medical course of the best medical schools in a much shorter time and with much greater advantage.”13
Recall that, as described in the previous chapter, President Jordan had addressed the AAM in 1891, arguing in support of the requirement of a bachelor’s degree as a prerequisite for admission to medical school. Even before Stanford was to establish its medical school, Jordan had introduced to Stanford an undergraduate premedical major modeled closely on the premedical major created by Daniel Coit Gilman at Johns Hopkins.

A series of detailed negotiations took place, and on September 14, 1907, President Jordan reported to the trustees, “I have reached the conclusion that it is wise for Stanford University to accept the offer recently made by the Cooper Medical College.” Jordan went on to say, “The degree of MD should not be granted in less than seven years from the date of matriculation in the freshman class.”

The recommended premedical major at Stanford as described in the bulletin for 1907–08 is essentially the same as that published in 1894–95. Thus it was clear that, should Stanford establish a medical school, it would include admissions requirements that were essentially the same of those at Johns Hopkins. This is precisely what happened. The Stanford trustees approved Jordan’s recommendation, and in 1908 the Stanford Medical School accepted its first class. As reported by President Jordan in his Annual Report for 1908, and as stated in the University’s bulletin for the 1908–1909 school year, “Three years of collegiate work in Stanford University, or its equivalent as accepted by the Committee on Advanced Standing, will be required for admission to the course in Medicine. This preparatory course must include one year of Physics with laboratory work, one year of Chemistry with laboratory work, one year of Physiology or Biology with laboratory work, and French or German (such a reading knowledge as shall be acceptable to the Department of Medicine).”

The legal requirement facing Cooper Medical College as a result of the state law passed in 1901, coupled with the devastation of the 1906 San Francisco earthquake, apparently placed an insurmountable burden on the leaders of the college. With David Starr Jordan as its president, Stanford University was to replace Cooper with its own medical school. In doing so, Stanford closely followed the example set by President Gilman of Johns Hopkins and acted in full support of and compliance with the national standards described in 1905 by the CME.

The CME Standards and the Flexner Report, 1905–1910

The CME and the AAMC worked in close collaboration to support the extension of the standards identified in 1905. When Arthur Bevan retired from the CME in 1928, he described the activities of the CME after 1905 in a speech to the AMA’s An-
nual Congress on Medical Education, Medical Licensure, and Hospitals: “As the Council continued to study the problem, it soon became evident that the most important piece of work to be done by the Council was to make a personal inspection of the more than 160 schools; to ascertain the character of their plants, of their work and of their faculties, and in general their fitness to teach medicine; and to mark them as one might in giving a civil service examination.”

As described by Dr. Bevan, members of the CME personally visited each of the schools in the country, grading them on such factors as the curriculum, physical plant, laboratory facilities, hospital facilities, and policies regarding admission requirements. Schools were graded on a 100–point scale and, based on this grading, divided into three groups:

- Class A—schools scoring above 70 points, labeled as “acceptable”
- Class B—schools scoring from 50 to 70 points, labeled as “doubtful”
- Class C—schools scoring below 50 points, labeled as “nonacceptable”

These inspections, completed in 1907, yielded the following results:

- 82 (51%) were rated as Class A
- 46 (29%) were rated as Class B
- 32 (20%) were rated as Class C

Many of the schools in the lower category were schools of homeopathic medicine or “eclectic” medicine that did not adhere to the scientific standards promulgated by the CME and the AAMC. “It early became apparent,” said Bevan in his 1928 address, “that as soon as the one-year, and then the two-year university requirement of physics, chemistry and biology was generally adopted, homeopathy and eclecticism would die for lack of students, and this proved to be the case.”

The CME had evidence of the shortcomings of many of the medical schools in the country, yet did not yet have a public forum or base of public support broad enough to translate those findings into new public policy. Bevan explained in 1928,

As the work of the Council developed, it occurred to some of the members of the Council that, if we could obtain the publication and approval of our work by the Carnegie Foundation for the Advancement of Teaching, it would assist materially in securing the results we were attempting to bring about. With this in mind we approached President Henry S. Pritchett of the Carnegie Foundation, presented to him the evidence we had accumulated and asked him to make it the subject of a special report on medical education by the Carnegie Foundation. He enthusiastically agreed to this proposition.
The Carnegie Foundation for the Advancement of Teaching (Carnegie Foundation) was founded in 1905, the same year the CME held its inaugural conference. Henry Pritchett, its first president, was an astronomer who, like many of the leaders in medical education, had studied in Germany. Like those leaders, he became enamored of the German model of science and science education—thus his enthusiasm for accepting the CME’s proposal to repeat their study. In his history of U.S. medical education, Kenneth Ludmerer describes the relationship between CME and the Carnegie Foundation:

Since it seemed politically imprudent for a medical organization to be so publicly critical of medical schools, the council invited the Carnegie Foundation for the Advancement of Teaching to conduct a similar study, and Henry Pritchett, the president of the Carnegie Foundation, readily accepted the invitation. Records of both the council and the Carnegie Foundation indicate how closely the two cooperated in performing the survey. As a political stratagem, however, it was decided not to make public the council’s role in organizing the study. . . . Thus, the report could be publicly perceived as the independent judgment of an outside agency.20

Pritchett attended the 1908 meeting of the CME to discuss further the idea of the Carnegie Foundation’s picking up where the CME had left off. The minutes of that meeting reflect the understanding between Pritchett and Bevan, and between the Carnegie Foundation and the CME: “[Pritchett] agreed with the opinion previously expressed by the members of the Council that while the Foundation would be guided very largely by the Council’s investigation, to avoid the usual claims of partiality no more mention should be made in the report of the Council than any other source of information. The report would therefore be, and have the weight of an independent report of a disinterested body, which would then be published far and wide. It would do much to develop public opinion.”21

Pritchett selected Abraham Flexner to conduct the study for the Carnegie Foundation. Flexner had graduated from Johns Hopkins in 1886, earning his bachelor’s degree in only two years by passing out of some required courses and double-booking his academic schedule. As he described in his autobiography, he had to enlist the personal intervention of President Gilman to permit him to take make-up exams when he found that the double-booked courses had scheduled their final exams at the same time.22

After receiving his degree from Johns Hopkins, Flexner moved to Louisville, Kentucky, and at the age of nineteen became a high school teacher. He eventually started his own private high school, which enjoyed considerable success. After nearly
twenty years as a high school teacher, now married and with a young child, Flexner spent an evening sitting with his wife, thinking about their future. When his wife asked him, “What would you do if you had never married?” Flexner replied, “I should quit school teaching and go to Europe.” “Then that is what we will do,” his wife replied, and their life took an entirely different turn. In 1905 they closed down the school and pooled their savings, a sum that would allow him to spend a year taking graduate courses in psychology and philosophy at Harvard and then a year touring Europe, engaged in an independent study of the European educational system.

Flexner returned from Europe in 1907. His savings largely exhausted, he began looking for work. He consulted with Ira Remsen, Daniel Coit Gilman’s successor as president of Johns Hopkins University. Gilman had left Johns Hopkins in 1902 to become, at the request of Andrew Carnegie, the first president of the Carnegie Institution of Washington (currently the Carnegie Institution for Science). Flexner requested from Remsen a letter of introduction to Henry Pritchett, the former president of M.I.T., whom Andrew Carnegie had asked to become the president of the recently established Carnegie Foundation for the Advancement of Teaching. Pritchett offered Flexner the position as lead researcher on the study of U.S. medical schools.

According to Ludmerer, “It is well known how little Flexner knew about medicine as he began the project in December 1908.” In Flexner’s own words describing his initial response to Pritchett’s offer, “As our family resources had been depleted during the preceding three years I was, I confess, prepared to do almost anything of a scholarly nature. . . . I called his attention to the fact that I was not a medical man and had never had my foot inside a medical school.” Pritchett offered Flexner the job nevertheless.

In preparing for the study, Flexner read extensively and traveled to Chicago “for two reasons: first, to confer on the general situation in medical education with Dr. George Simmons, secretary of the American Medical Association . . . ; second, to read the reports prepared for the Council on Medical Education of the association by Dr. N. P. Colwell.” He also traveled to Baltimore to meet with the leadership of the Johns Hopkins Medical School. Flexner was later to comment, “The rest of my study of medical education was little more than an amplification of what I had learned during my initial visit to Baltimore.” Flexner decided to use the model of the Johns Hopkins Medical School as the metric with which to evaluate the other medical schools in the country: “I had a tremendous advantage in the fact that I became thus intimately acquainted with a small but ideal medical school embodying in a novel way, adapted to the American conditions, the best features of medical ed-
ucation in England, France, and Germany. Without this pattern in the back of my mind, I could have accomplished little. With it I began a swift tour of medical schools in the United States and Canada—155 in number, every one of which I visited.”

Working closely with Dr. Colwell, secretary of the CME, Flexner visited these schools, using an analytic framework similar to that used by Colwell in the CME study and using the Johns Hopkins model as the frame of reference. Apparently, Colwell accompanied Flexner on a number of his medical school visits, although the actual number of joint visits remains unclear. In his 2002 biography of Flexner, Thomas Bonner comments that Flexner gave somewhat conflicting descriptions of how often he and Colwell traveled together as part of the study, sometimes reporting that he and Colwell “made many trips together,” and other times suggesting that the number of joint trips “could hardly have exceeded half a dozen.”

Flexner has described his methodology in the following terms:

In half an hour or less I could sample the credentials of the students filed in the dean’s office, ascertain the matriculation requirements . . . , and determine whether or not the standards . . . set forth in the school catalogue were being evaded or enforced. A few inquiries made clear whether the faculty was composed of local doctors . . . or the extent to which efforts had been made to obtain teachers properly trained elsewhere. A single question elicited the income of the medical school. . . . A stroll through the laboratories disclosed the presence or absence of apparatus, museum specimens, library, and students. . . . Finally, the situation as respects clinical facilities was readily clarified by a few questions. . . . In the course of a few hours a reliable estimate could be made respecting the possibilities of teaching modern medicine in almost any one of the 155 schools I visited.

Flexner completed his assigned task in eighteen months. The Carnegie Foundation published the results of his study, titled Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching, in 1910. That report has come to be known simply as The Flexner Report. While the bulk of the report focused on medical education and the need to reduce the number of medical schools, Flexner is quite explicit in the report about the standards of premedical education that should be adopted by American medical schools. Early in the report Flexner asks “how much education or intelligence it requires to establish a reasonable presumption of fitness to undertake the study of medicine under present circumstances.” Flexner’s comment, by which he frames the issue of premedical education, is notable for two reasons. The first is what might be interpreted as equating education with intelligence. He seems to be suggesting that the extent
to which a premedical student has succeeded in studying the sciences as an under-
graduate is a reflection of the student’s inherent intellectual ability and thus can be
used as an accurate gauge of the ability to succeed in medical school and as a physi-
cian. The second is his use of essentially the same wording to describe the role of
premedical education as Daniel Coit Gilman had used in 1878 when he described
the role of premedical education as determining which students are “F.S.M.—fit to
study medicine.” Here Flexner describes the role of premedical education as identi-
fying those students with “a fitness to undertake the study of medicine.” Flexner’s
conception of the role and content of premedical education seems to have been
heavily influenced by Gilman’s earlier work. In his autobiography, Flexner wrote,
“Those who know something of my work long after Gilman’s day, at the Carnegie
Foundation. . . will recognize Gilman’s influence in all I have done or tried to
do.”

Flexner goes on in his 1910 report to answer his own question about the prereq-
usites for medical education when he states: “The normal rhythm of physiologic
function must then remain a riddle to students who cannot think and speak in bi-
ological, chemical, and physical language. . . . Admission to a really modern med-
ical school must at the very least depend on a competent knowledge of chemistry,
biology, and physics. Every departure from this basis is at the expense of medical
training itself. . . . We have concluded that a two-year college training, in which the
sciences are ‘featured,’ is the minimum basis upon which the modern medicine can
be successfully taught.”

Flexner is breaking no new ground in his description of the “minimum basis” of
premedical education as involving two years of college with courses in chemistry, bi-
ology, and physics. As described in the previous chapter, these were precisely the re-
quirements adopted by the CME and the AAMC in 1905. While in 1905 there had
been some discussion of the need for one year of college versus two as sufficient to
complete the required courses in the sciences, by 1910 the consensus was that two
years was the necessary minimum. In 1910 each of the six medical schools we have
been following required at least two years of college with courses in chemistry, bi-
ology, and physics. Flexner was simply restating what had already become the new
orthodoxy of premedical education.

There is another important aspect of Flexner’s analysis of premedical education
that warrants discussion. Despite his report being about the importance of science
as the basis of medical knowledge and medical practice, he offers no scientific evi-
dence to support his claims regarding “the minimum basis upon which the modern
medicine can be successfully taught.” To state emphatically that “the normal rhythm
of physiologic function must then remain a riddle” to students who had not suc-
cessfully completed the specific premedical curriculum he describes, without offering sound evidence in support of his claim, is to ask the reader to accept as scientific fact what was instead the evolving system of beliefs regarding premedical education. While researchers in Flexner’s era may have considered Flexner’s compilation of descriptive data to be scientific, in reading his report today we quickly see how little scientific evidence it actually contains. Rather than a scientifically established association, his assertion regarding medicine remaining a “riddle” to those who had not studied the required sciences reflected his own belief and that of those he had relied on for advice.

It is important to appreciate that those who adhere to an orthodoxy often view their belief as having the weight of scientific truth. By modern research standards, though, Flexner conducted his study with substantial bias built into its methodology, using superficial data gathered “in the course of a few hours.” His claim that his research results presented “a reliable estimate” of the ability of the medical schools to provide an adequate medical education is open to question.

Regardless of the scientific accuracy of all its claims, the Flexner Report was to have a profound effect on medical education in the United States. Fifteen thousand copies were printed and distributed, and “newspapers accepted it as gospel.”34 Both public opinion and the laws governing the practice of medicine in the various states turned against the schools that had not adopted Flexner’s model of medical education and premedical education. Both the number of medical schools in the country and the number of schools not following the CME/AAMC precepts were reduced dramatically.35 In the 1906 study conducted by the CME there were 160 medical schools nationally, of which 78 (49%) did not meet the CME/AAMC standard. When the survey was repeated in 1915, there were only 95 medical schools still in operation, of which 29 (31%) did not meet the standard. In 1920 only 15 of the remaining 85 schools (18%) did not meet the standard.

In February 1914 the CME convened its Tenth Annual Conference. In his chairman’s address, Arthur Bevan reported on the progress the CME had made since first defining its standard of medical education and premedical education in 1905: “For the last nine years the Council on Medical Education and this conference have worked steadily and untiringly to bring about the adoption of this standard, and they have succeeded so far that this general adoption is now clearly in sight. . . . Then no state licensing board required more than a high-school education; now sixteen state boards require one or two years of college work, including courses in physics, chemistry, and biology.” Bevan went on to argue that “medicine has become not only a function of the state, but one of the most important functions of the state.”36 It seems clear that Bevan was relying on close collaboration among the
CME, the AAMC, and the National Conference of State Medical Examination and Licensing Boards to apply the force of law to the educational standard they had developed.

Victor C. Vaughan of Michigan also addressed the 1914 CME conference, restating in somewhat more vehement terms the position he had argued earlier: “No man is fit to study medicine, unless he is acquainted, and pretty thoroughly acquainted, with the fundamental facts in physical, chemical, and biological subjects. . . . The facts of the biological, physical, and chemical sciences are the pabulum on which medicine feeds. Without these sciences, everything that goes under the name of medicine is fraud, sham and superstition.” 37 If chemistry, biology, and physics were the premedical orthodoxy of the time, Victor C. Vaughan was one of the leading supporters of that orthodoxy.

The 1914 meeting of the CME heard a dissenting voice, however. After forty years as president of Harvard University, Charles W. Eliot stepped down and in 1909 was replaced by A. Lawrence Lowell. Lowell had graduated from Harvard Law School in 1880 and had entered the practice of law. In 1898 he joined the Harvard faculty as a professor of government. He had no training or first-hand experience with medical education or premedical education. Speaking to the CME in 1914, he expressed skepticism about the premedical standard they had adopted: “It would be presumptuous in me to question the validity of medical opinion on the content of the necessary premedical education, but one may properly inquire how well the rules adopted by this association are fitted to attain the object sought, and how far they may have the effect of excluding able men from the profession” (emphasis added). 38

Lowell went on to argue against expecting college freshmen to focus on completing their premedical requirements early in their college career at the expense of their broader education. From Lowell’s perspective, it would be preferable to have students use their early college years to strengthen their general academic abilities and then to tackle the premedical courses as college seniors, something they could do more efficiently and more effectively at the end of their college careers: “A college education which has any value in training the mind must make men more capable of grappling with difficult subjects than they were before, and, consequently, must fit them to acquire mastery of a subject more rapidly than before they went to college. If so, a man ought to learn a certain amount of physics, chemistry or biology in a shorter period and with less hours of lectures and laboratory work in his senior year than in his freshman year.” 39

Lowell points out that a standard course in the sciences taken in the freshman year would qualify a student for admission to medical school, whereas a shorter,
more focused course taken as a senior would not. “In short, you are requiring not a result but a process; you are ascertaining not whether the man has a proper preparation for the study of medicine, but whether he has gone through a régime of training which may in ordinary cases secure the result desired, but which is sometimes not necessary for the purposes, and often inadequate.”

Lowell does not appear to be rejecting the “ideal standard” of premedical education, but rather he seems to suggest that it should be one of multiple options in preparing for medical school. Some students may do well taking their premedical sciences early in their college career; some may do equally well avoiding the sciences until their senior year, instead focusing their early college years on acquiring a broad educational base for the subsequent study of medicine. By requiring the former, students who might do better with the latter are often excluded from medicine as a career.

Lowell goes on to cite statistics he had gathered at Harvard and published in 1911, which we will examine in more detail in the following chapter. Using as his measure of success the percentage of students who graduated from Harvard Medical School with cum laude honors, Lowell summarized his findings by concluding “that a large amount of scientific preparation is not an essential, or indeed a highly important preparation for medical studies, and that a small amount is not a hindrance to successful work. . . . [F]or the study of medicine, excellence in college work is more important than the subjects that have been pursued.” Interestingly, Lowell followed up his remarks with a comment specifically about the need for courses in chemistry as an undergraduate. Contradicting the principal premedical focus on the study of chemistry that had been established by his predecessor, Charles W. Eliot (a chemist), Lowell suggests, “No doubt a certain command of chemistry, for example, is necessary. . . . But this may be acquired in ways other than college courses.”

Despite Lowell’s suggestion, an important change took place in 1914 in Harvard’s admission requirements for its medical school. For the first time two years of undergraduate chemistry were required: one year in inorganic chemistry and one year in organic chemistry. Michigan had switched in 1913 from one year of required chemistry to two years. Columbia switched to two years of chemistry in 1916; the University of California switched in 1915. Consistent with the state-mandated adherence to the admission requirements established by the AAMC, Stanford first required both inorganic chemistry and organic chemistry in 1919. Johns Hopkins had required two years of chemistry for some time.

By 1920, the established norm for premedical education had become a requirement of two years of chemistry, a year of physics, and a year of biology. This was the requirement at the six schools we have been following; it was becoming the national
standard that was being enforced by a growing number of state licensing boards. Over a period of forty years, this series of required courses had evolved from the unorthodox to the orthodox. For the next seventy years this norm would change little. With the shift to English as the principal language for publication of medical research, the requirement of a reading knowledge of German and French has been dropped, as has any reference to a familiarity with Latin. More emphasis is placed on having taken undergraduate courses in English and mathematics. However, for a student applying to medical school in 1920, a student applying to medical school in 1951, and a student applying to medical school today, the requirements were the same: two years of chemistry, a year of physics, and a year of biology. As we will see in the following chapter, other than Lowell’s study from 1911 that questioned these requirements, there was essentially no scientific evidence in 1920 that this mandated preparation in the sciences was a valid indicator of a student’s “fitness to study medicine.”

Questioning the Standard Premedical Curriculum, 1926–1952

At their annual meeting in 1925, the AAMC adopted a revised set of “minimum entrance requirements” that would be applied to its member schools. They published these requirements in 1926 in the inaugural issue of the Bulletin of the Association of American Medical Colleges, the association’s new journal.42 (Previously, the AAMC had relied on the Journal of the American Medical Association, and before that the Bulletin of the American Academy of Medicine to publish its proceedings.) Those requirements were largely the same as those of 1914. They called for 60 semester hours of collegiate instruction, with 30 hours comprising one academic year. Of the 60 hours spent as an undergraduate, 44 hours of specific classes were required, which included:

- Chemistry—16 hours
- Physics—10 hours
- Biology—12 hours
- English Literature and Composition—6 hours

While these 44 hours, comprising 73 percent of the available hours during the specified two years of college, were the minimum requirement, the AAMC also identified some additional classes that were “recommended” or “highly desirable.” These additional, optional classes included: “a supplementary course in the elementary physical chemistry”; additional work in organic chemistry, including “a fair proportion of laboratory work”; and an elective course in physics “suitable for students who desire more knowledge of physics than the general course affords.”
The AAMC listed no required or recommended course in French or German. By this time much of the then-current medical literature was published in English. As described by Dr. Hugh Cabot, dean of the University of Michigan Medical School, “The practice of the modern medical student does not use what knowledge he has [of French and German] and the time spent upon it may, therefore, be adjudged to have been largely wasted.”

To complete the subjects required by the AAMC in two years of college, a student would have to spend nearly all his time studying the premedical sciences. Even if a student spread his undergraduate work out over three years, he would be spending nearly two-thirds of his time in the science classroom or laboratory. Since these were the standards set by the AAMC, those states that had established their licensure laws based on those standards essentially forced premedical students to spend their college years focused almost exclusively on science. As more educators became aware of this issue, they began to voice concerns and reservations about the direction premedical education had taken.

Dean Hugh Cabot of Michigan voiced these concerns in the lead article in the inaugural issue of the AAMC’s *Bulletin*:

> At the present time, the most striking characteristic of the premedical course is the large proportion of elementary science. . . . It seems not impossible that this large proportion of science as compared to what might be called “the Humanities” would be apt to result in the selection of students interested in science and having capacity in this field rather than those interested in the humanities and in mankind.

> I am not prepared to admit at the present time that in the equipment of the practitioner a knowledge of science is of more real value than a knowledge of the way in which mankind has behaved in the past and how he is on the whole behaving at the present time. The problems of medicine, on the whole, are quite as likely to require sound judgment based on a knowledge of history, sociology, philosophy and psychology as on the facts of science.

Cabot is raising some of the same concerns Lowell raised in his cautions to the CME in 1914. These concerns were echoed in 1926 by Samuel P. Capen, the chancellor of the University of Buffalo. Capen suggested that “the transfer to the premedical curriculum of the basic sciences previously taught in medical school” had defeated the purpose initially established by the CME, that of assuring, “the broader and sounder general education of the physician.” Capen asked, “Which is more important for the medical student, thorough grounding in the basic sciences or wider general education?” Capen went on to suggest an experiment that, if carried out,
would answer his question: the creation of an experimental, alternative curriculum, and a comparison of the quality of the premedical education in the experimental curriculum with that in the standard curriculum. His experiment “would set up for prospective physicians a curriculum . . . [that] would include a considerable amount of the social sciences, especially psychology, sociology, history, and economics. Necessarily the time allocated to scientific and linguistic preparation would be somewhat curtailed.”

A few months after the remarks of Drs. Cabot and Capen were published, Franklin D. Barker, a professor of zoology from Northwestern University, argued against any dilution of the premedical sciences. Speaking to the AAMC’s national meeting held in October 1926, Prof. Barker described the practice at Northwestern: “In determining the fitness of the premedical student, we have applied the ‘Harvard yardstick.’ . . . In evaluating his scholarship, we have found that his record in the biological sciences was the most reliable index of his fitness for the study of medicine and his standing in chemistry the second best indicator” (emphasis added).

This controversy over the extent to which science courses should predominate in the premedical curriculum raised concerns within the AAMC. In 1925 the AAMC appointed its own Commission on Medical Education (not to be confused with the AMA’s Council on Medical Education). The commission was charged with conducting a study of the changing nature of medical education in the context of the changing needs of society. A. Lawrence Lowell, president of Harvard University, was appointed as chairman of the commission. Its secretary was Dr. Walter Biering, representing the Federation of State Medical Boards of the United States. Hugh Cabot of Michigan and Samuel Capen of Buffalo were members of the commission, as was Dr. Ray Lyman Wilbur, president of Stanford University and formerly dean of the Stanford Medical School (1911–16), president of the AMA (1923–24), and president of the AAMC (1925–26). The individual chosen to conduct the actual study and to report on it was Dr. Willard C. Rappleye, then on the faculty of the Columbia College of Physicians and Surgeons, and from 1931–1958 the dean of that medical school. One of the first things the commission did was to negotiate with the Federation of State Medical Boards a moratorium on any new state-mandated premedical requirements until after the commission had completed its study and filed its report.

Dr. Rappleye published an article in 1930 describing the history and purpose of the commission. In his paper he paid particular attention to problematic issues that had arisen in premedical education: “Premedical subjects have been prescribed with little regard to the student’s knowledge of these subjects. Many premedical subjects are subdivided into special fields of study which provide relatively little training in
the most important features of the subject. . . . There seems to be little doubt but
that a reorientation of the subject-matter in the preliminary sciences could easily
provide students with a better comprehension of the principals of these subjects, not
only for medicine but equally so for general education.”

The commission issued its final report in 1932. The Report described its pur-
pose as studying “the broader relationships of medical education to general and uni-
versity education and to the shifting problems of medical practice, community
health needs, and medical licensure” (2). The Report paid particular attention to the
issue of premedical education. It identified the problems facing premedical educa-
tion at that time: “The tendency of medical schools and regulatory bodies to define
in detail the range and character of premedical preparation is contrary to the spirit
of a real education, which should be general and not preprofessional in purpose. A
sound general education is of more value to students of medicine than a narrow
technical training in the premedical sciences” (267).

The authors of the Report acknowledged the growing practice among medical
schools of using success in the premedical sciences to screen students for admission:
“Inasmuch as most medical schools have a large number of applicants with more
than the present minimum premedical education than they can accept, there is lit-
tle inclination to change their policy of giving preference to the applicants who . . .
present the best preparation. . . . The increase in premedical education has been due
in part to the desire of medical school officers to set up mechanical or objective
methods of selecting students” (270–71). The authors expressed concern over this
mechanistic approach. As they saw it, “It is not wise to create detailed requirements
which make it difficult for superior students who may not have followed a pre-
scribed course of earlier education to study medicine” (271). Rather, the authors rec-
ommended that medical schools recognize “that the most important requirements
for admission to medicine are character, ability, personality, a mind prepared by a
sound plan of general education, and a grasp of the principles upon which medicine
is dependent” (272).

As described in the commission’s Report, part of the problem in creating a pre-
medical curriculum that over-emphasizes the sciences is the tendency of science in-
structors to teach not just the principles of their discipline, but a level of detailed
knowledge that is only useful to practitioners within that science:

Much of the science teaching is presented from the special interest of the teacher
or the department. Organic chemistry is frequently taught from the standpoint of
the dyes and similar industrial uses and much or inorganic chemistry emphasizes
its commercial applications. . . . Physics is likely to be taught in its relationships to
engineering and industry. . . . In general these subjects are not presented from the
to point of view of either general education or the specific preparation for medicine,
but from that of preparation for advanced work in the separate sciences. (274)

The authors of the Report state their conclusions regarding premedical educa-
tion in very explicit terms:

There has been a tendency on the part of individual medical schools to increase
the premedical requirements, particularly in chemistry. . . . It is quite likely that
the medical profession is losing men and women of high native ability and char-
acter who desire to study medicine and who have not been able to meet the spe-
cific premedical requirements in the usual college course. . . .

An adequate knowledge of the principles and methods of these sciences for the
purposes of medical education could probably be secured more satisfactorily by
good students in less time than is now required . . . if the course were modified
and focused properly upon the needs of the student. A change in the methods of
presentation and in the motivation of the present courses, rather than additions,
is needed. (275)

The authors offer a clear message to the admissions committees of medical schools:
“It is probably true that a considerable number of very well qualified and desirable
students are lost to medicine each year through the insistence on the letter rather
than the spirit of the regulations regarding premedical education. The character,
personality, ability, and promise of the student rather than specific courses and
credit hours in prescribed subjects are the important factors to be considered”
(277–78).

In closing the section of the Report that focused on premedical education, the
authors state:

A sound general training is of more value as preparation for the study of medicine
than a narrow, technical training limited largely to the premedical sciences. . . .
Attention in the selection of students should be given to evidence of a grasp of the
principles and philosophy of the scientific method, rather than to the amount and
division of time spent in individual subjects. . . .

It is a question of different, not longer or more courses in physics, chemistry,
and biology and of discrimination in the subject matter and illustrative laboratory
exercises. (282)

Less than two decades after the CME and the AAMC had called for more strict
enforcement of premedical standards by medical schools and state licensing boards,
leaders of those same organizations were calling for restraint. It seems that as an un-
intended consequence of their efforts to standardize premedical education around a
series of courses in chemistry, biology, and physics, the quality of the general edu-
cation of college students hoping to become physicians had been impaired. These
leaders called on medical schools to de-emphasize premedical sciences and broaden
the criteria by which they selected medical students.

It is one thing to admonish medical schools to de-emphasize the sciences in their
admission process, but it is altogether another to actually see that change come
about. Speaking to the Premedical Club of Amherst College in 1936, Dr. Harold
Plough, professor of biology at Amherst, cautioned premedical students at Amherst
about what it took to get into medical school. He read to them an excerpt from the
final report of the Commission on Medical Education. He then acknowledged for
his audience the reality of medical school admissions in 1936: “In spite of all the
statements that training in a non-specific field is desirable, the schools continue to
show preference for those whose advanced training has been in one of the fundamental
scientific fields” (emphasis added). For premedical students at Amherst in the
1930s, it was best to have as the “purpose of life” success in chemistry, biology, and
physics—despite what the authors of the CME’s Report said.

**Encouraging a Liberal Education versus
Using Science Classes to “Weed out” Students**

The years surrounding World War II saw a series of changes in medical education
and premedical education made to accommodate the war effort and the surge in the
need for medical personnel associated with the war. After the war things settled
down somewhat, but a growing tension developed between the need to encourage
and support a broad liberal education among premedical students and the tendency
to select students for medical school based on their performance in chemistry, biol-
ogy, and physics. Increasing national emphasis was being placed on using standard-
ized tests, combined with grades in the premedical science classes, to select students
for medical school.

Writing in 1948, F. J. Mullen, dean of students at the University of Chicago
Medical School, cited the worrisome statistics that 11 percent of the approximately
6,000 students who entered medical school in 1946 were no longer enrolled after
the first year. For the class that entered medical school in 1944, 15 percent failed to
graduate. “If we could so select our students as to eliminate at the start this 15 per-
cent who are apparently intellectually or emotionally unable to make the grade,”
Mullen suggested, “we could increase the output of trained physicians from our
schools by this quantity without the necessity of starting any new schools or spending any more money than we do now for medical education.” Mullen described research being done at his medical school to use a combination of undergraduate grades and the results of various personality tests to select the best students for medical school.

Writing in that same year, Donald B. Tressider, president of Stanford University, cautioned about the negative aspects of relying too heavily on students’ performance in the premedical sciences, suggesting, “We require, therefore, an exhaustive re-examination of both medical and premedical education.” Tressider identified what he saw as two fundamental weaknesses of the American system of medical and premedical education: “First, many of our graduates are, indeed, well trained technically but are poorly educated. Not only have we failed to provide them with a broad, general education, but all too many of them are deficient in the primary art of communication. . . . Secondly, many of our graduates do not possess an adequate understanding of the social problems of our complex modern society and fail to realize the extent of their own social responsibility.” Tressider described the untoward effects of a premedical curriculum that is too heavily structured around the sciences: “By our insistence on strict adherence to definite patterns of courses at the college level as a condition of admission to medical school . . . we have contributed significantly to the growing chaos in general education.” He closed his paper by saying, “As medical educators, we must be concerned with education at all levels and lose no opportunity to participate in the broad purposes of our entire education system to the end that we produce competent doctors who are above all else responsible citizens.” (Shortly after Tressider made these remarks, he died suddenly while on a trip to New York.)

Responding to the continuing concerns about the potential adverse effects of an overly structured premedical curriculum, in 1947 the AAMC and the CME appointed a joint committee to undertake a Survey of Medical Education. A core element of this survey was to be the Subcommittee on Preprofessional Education, to be chaired by Dr. Aura Severinghaus, dean of admissions at the Columbia College of Physicians and Surgeons. The subcommittee gathered data from 115 undergraduate colleges and universities, seeking to address three issues: (1) to define the qualifications that a person should have for a successful career in medicine, (2) to ascertain the extent to which undergraduate colleges are producing the kind of students the medical schools need, and (3) to make certain recommendations on the basis of their investigation. The subcommittee issued its report in 1953, corroborating many of the concerns expressed by Dr. Rappleye and the Commission on Medical Education in 1932 and President Tressider in 1948:
Unfortunately, however, the medical profession and the present medical school admission requirements are attracting to our liberal arts colleges, as the gateways to medical school, a vocationally oriented group of students, many of whom have little interest in those items typically in the undergraduate program which, in their opinion, do not obviously contribute quite directly to the occupational objectives. . . . These students have little or no conception of the meaning of a liberal education; they have come to college to prepare themselves to earn a living.

On the very next pages, however, the authors begin to discuss the flip side of the issue of premedical education: assuring that students who enter college with the intention of studying medicine are indeed fit to study medicine:

The liberal arts college, therefore, has the important responsibility of trying to prevent students from cherishing inappropriate professional ambitions too long. . . . Effort should be made as early in the student’s college career as possible to determine whether, on the basis of personality, character, motivation, and academic performance, he is qualified to go into medicine. If it is decided he is not qualified, then every intelligent device, including aptitude and interest tests, should be used to persuade him to reevaluate his professional objective.

The authors seem to be arguing simultaneously that (a) it is important for colleges to encourage premedical students not to sacrifice the quality of their general education by taking too many science courses; and (b) it is the college’s responsibility to identify students who are not “qualified to go into medicine” and to “persuade them to reevaluate” their professional aspirations.

The authors of the report go on to make a statement that holds particular relevance in light of the comments of the students in our research study described in chapter 1. Once students who do not perform well in the early premedical sciences are “persuaded” to reevaluate their career goals, the authors then ask about “the extent of the responsibility which the undergraduate college should assume for those students who are weeded out of the group seeking admission to medical school” (emphasis added). The authors were clear on the form this “weeding out” process takes at many schools: “We noted also an unduly tough attitude on the part of many chemistry teachers who claim with pride that only students of good ability who work very hard can get through their chemistry course.”

By the 1950s, medical schools had acknowledged a fundamental need to reduce the number of students who were selected for medical school but who, for either personal or academic reasons, were unable to complete medical school. The way they approached this issue was to identify explicit predictors of medical school fail-
ure and then to identify those premedical students who exhibited these characteristics. While sometimes the characteristics used to “weed out” students were personality traits, most often it was a student’s early performance in science courses, principally chemistry, that was used to this end. In 1893, Daniel Coit Gilman had described the use of the premedical curriculum established at Johns Hopkins in 1878 to “prune and graft our promising vines.” In 1953, Aura Severinghaus described how that same curriculum should be used to “weed out” students who are not “qualified to go into medicine.” One of the Stanford students quoted in chapter 1 seems to be describing precisely this process when he described Stanford’s premedical curriculum and the adverse impact it had had on his aspirations for becoming a physician: “Everyone says it’s more like a weeding-out process than anything [else] and I just ended up being one of those people.”

The 1953 Subcommittee Report commented on the growing pressure experienced by premedical students. They acknowledged that “students who get poor grades in the sciences and rely on better grades in the nonscience courses frequently have trouble getting into medical school.” This pressure to get high grades in the science courses had led to a growing sense of competition among premedical students, resulting in precisely the type of outcome the subcommittee had hoped colleges would avoid: “Although the situation is much improved today, many medical schools in the past have used achievement in the physical and biological sciences, measured in terms of academic grades, as their principal yardstick in evaluating applicants for admission. Acting on the impression that this practice still prevails, the premedical student devotes himself assiduously to these subjects, sometimes to the neglect of the nonscience part of his program.”

Commenting on the effects of these perceptions on the culture of premedical education, Daniel Funkenstein of the Department of Psychiatry of Harvard Medical School wrote in 1955 about the plight faced by the premedical student: “Seeking counsel from his colleagues, premedical advisors, doctors, and friends, he becomes more and more anxiety ridden as he contemplates the almost super-human test before him of securing entrance to medical school. With great trepidation he . . . enters what the Harvard Crimson calls the ‘rat race.’” Funkenstein cautioned that “when medical schools state, as they have in recent publications, their opposition to such educational practices, and their belief in a broad liberal education as the best preparation for medical school, they are met with a very resistant attitude.” It is all well and good for medical schools to preach the benefits of a broad liberal education. The premedical students knew, however, at least in the 1950s, that the true orthodoxy of medical school admissions expected from the students success in chemistry, biology, and physics.

In 1957 the AAMC held a special Teaching Institute to follow up on these issues.
In its report, *The Appraisal of Applicants to Medical Schools*, the AAMC again acknowledged the importance of balancing intellectual characteristics (such as grades in chemistry) and nonintellectual characteristics (such as motivation, emotion, and integrity) in selecting students for medical school.\(^{62}\) While we will consider in the following chapters the specific methods they proposed for measuring and assessing these characteristics, the comments of one workshop participant are especially pertinent. T. R. McConnell, professor of education and director of the Research Project in Higher Education at the University of California, Berkeley, pointed out that “in the case of medicine . . . we have the problem of predicting at least two things: first, success in medical school, and second, professional performance.”\(^{63}\) From the time studies of predictors of medical school performance first began in the 1930s to the period of the 1950s, predicting “success” in medical school meant either predicting who would graduate from medical school and who would not, or who would get high grades in medical school and who would not. McConnell was pointing out that an equally important outcome to measure was how good a physician a student would eventually become.

Those attending the conference agreed that there were several measures available (of varying validity and reliability) to predict performance in medical school but almost no valid means of predicting quality as a practicing physician. This point was emphasized by Funkenstein, who said, “The importance of research in this area cannot be emphasized too much. We need follow-up studies beyond medical school of both the men accepted and those rejected. The most pressing, and in many ways the most difficult item on such a research agenda would be successful criteria of a successful medical career.”\(^{64}\)

For a period of decades following the studies published in the 1950s by the AAMC, discussion and debate would continue surrounding the issues of obtaining a broad liberal education vs. preparation in the sciences and of selecting students based on performance in the sciences vs. using noncognitive predictors of ultimate quality as a physician. In 1961 the Commonwealth Fund published a book edited by Dr. George Miller of the University of Illinois College of Medicine in which he and his fellow authors wrote of the “thankless task” faced by medical school admissions committees “to discriminate from a pool of applicants the potentially good medical student when the criteria by which the ‘good medical student’ can be identified have never been clearly delineated.” Miller and his colleagues comment on the continuing dilemma facing the premedical student:

The problem is of the sort which sophisticated journalists like to refer to as schizophrenic. On the one hand, medical school catalogues and forceful spokesmen in
the field of medical education exhort the student to gain breadth of vision, a sociological and humanistic orientation, a “liberal” education. On the other hand, admissions committees appear for the most part to emphasize academic, particularly scientific, achievement. The hopeful candidate’s best bet is to follow what he perceives to be the policy of the admissions committee.

Miller closes with a comment about the medical school selection process: “But it must be kept in mind that the prediction concerns successful medical school performance, not successful performance as a physician. The latter awaits adequate demarcation of the characteristics of a good physician.”

In the 1970s, Lewis Thomas was one of the most respected writers in medicine, publishing a regular series of essays in the *New England Journal of Medicine* under the moniker Notes of a Biology Watcher. In May 1978, in one of these essays, titled “How to Fix the Premedical Curriculum,” Thomas wrote, “The medical schools used to say they wanted applicants as broadly educated as possible, and they used to mean it. . . . There is still some talk in the medical deans’ offices about the need for general culture, but nobody really believes it, and certainly the premedical students don’t believe it. . . . They concentrate on science with a fury, and they live for grades.”

Thomas seemed to be describing precisely what Rappleye had described in 1930. In a series of papers published in 1999, historian Gert Breiger describes the evolution of the thinking about the balance between a broad liberal education and one focused on the sciences. He points out that while medical schools have historically emphasized the sciences, they have come to realize that majoring in science as an undergraduate gives little advantage to a student compared to selecting a major in a non-science subject. Studies by Dickman and colleagues and by Zeleznik and colleagues confirm Breiger’s assessment.

A review of the admissions policies of the medical schools we have been following confirms Breiger’s view that by the 1960s a student’s choice of a major had little effect on his chances of admission, at least in theory. As early as 1960, the bulletin of the Harvard Medical School stated, “Provided [the applicant] is able to demonstrate competence in the natural sciences, the field of his college major will not influence consideration of him by the Admission Committee.” In 1981 the bulletin of the medical school at the University of California, San Francisco, stated that, in addition to the science and math prerequisites, “Humanities courses such as literature, history, and the arts are recommended to provide the best basis for increasing students’ understanding of human beings.” In 2000, the Columbia bulletin stated, “The student may have concentrated on any subject—in the natural sci-
ences, social sciences, humanities, or arts—but evidence of a balanced education, as well as demonstrated interest and ability in the natural sciences, is preferred.” De-
spite these clear statements that premedical students should feel free to select the un-
dergraduate major that interests them most, a study of medical students entering the UCLA School of Medicine in the early 1990s found that “the overwhelming major-
ity of our medical students still major in the natural sciences during their college years, despite an admissions policy that allows for the acceptance of students with a broad range of academic backgrounds.”

It may be accurate to say that today an English major can stand on an equal foot-
ing with a biology major in the eyes of most medical school admissions committees, provided that student has performed well in the required courses in chemistry, biology, and physics. However, it is still true, as we observed in chapter 1, that at both Stanford University and the University of California, Berkeley, incoming freshmen who aspire to become physicians face substantial pressure to enter the established pre-
medical curriculum early in their college careers. In most cases this means enrolling in freshman chemistry, followed in sequence by courses in biology and physics.

The expectation of undergraduate courses beginning with chemistry early in the college experience, followed by courses in physics and biology, became the norm for medical school admissions between 1893 and 1905 because people like Daniel Coit Gilman, M. Carey Thomas, Charles W. Eliot, and Victor C. Vaughan believed fervently that these courses, modeled on the German model of medical education, were an absolute prerequisite for any student to attain the status of “Fit to Study Medicine,” as Gilman referred to it. Their belief was an essential part of their wider belief that only by infusing medical education with a core of scientific knowledge could medical practice in the United States become part of the modern era. But their belief was just that—a belief. They neither had, nor felt the need to have, scientific data to support their belief that only through college courses in chemistry, biology, and physics could a student be adequately prepared for medical school. Because they believed it, they worked (very effectively) to make that belief the standard of premedical education for the twentieth century.

Today English majors can go to medical school, so long as they do well in chem-
istry, biology, and physics. Economics majors can go to medical school, so long as they do well in chemistry, biology, and physics. Art majors can go to medical school, so long as they do well in chemistry, biology, and physics. The earlier they start their chemistry, the more competitive they will be when they enter the medical school ad-
missions process. This is the mantra students at Stanford and UC Berkeley hear when they enter college. I suspect it is the mantra most college freshmen who aspire to become physicians hear as soon as they walk on the college campus.
In 1893 Daniel Coit Gilman used the metaphor of pruning a vine to describe the need to select for medical school only those students with an adequate preparation in the undergraduate sciences. In 1980 Dr. Edmund Pellegrino published an editorial in *JAMA* that used the metaphor in a different way. In his article Pellegrino criticized the historical tendency of medical school admissions committees to “[make] their choices on the strength of the Medical College Admissions Test scores in science or in that eternal verity—organic chemistry.” For most members of medical school admissions committees, “the idea that medicine is synonymous with science is so inextricably insinuated into their minds that it is now an ideology.” Pellegrino acknowledged the difficulty in changing deeply rooted ideas: “If there is anything harder than planting a new idea, it is uprooting an old one. Everyone shrinks from the periodic pruning that old ideas demand if they are to remain healthy. To evict an old idea is to precipitate a panic of identity.”

In 2007 I attended a national meeting that addressed the need to increase the racial and ethnic diversity of the health professions in the United States. At that conference we heard from a panel of three health professionals—one physician, one nurse, one medical student—all from underrepresented racial or ethnic groups. Each had been remarkably successful; each had experienced severe difficulty in early undergraduate science courses. During a coffee break after their presentation as I was chatting with the head of a leading university, I remarked, “The panelists we just heard from certainly don’t fit the model. Maybe the model is broken.” The university leader replied, “No it’s not. Everyone needs two years of chemistry, a year of biology, and a year of physics before they can go to medical school.” Without thinking much about it, and adopting my best social-scientific skepticism, I asked him, “Can you prove that?”

Much to my embarrassment, he became quite angry, refusing to discuss the matter further and gesticulating as he turned and walked away. I had not meant to be flip or disrespectful. I had genuinely wanted to know if he had ever considered whether his obviously deeply rooted belief in the role of chemistry, biology, and physics was supported by scientific data.

Pellegrino’s editorial had been in response to the article by Dickman and colleagues, cited above. That article concluded that “one’s undergraduate major does not lead to an appreciable difference in subsequent performance in the clinical sciences of medical school.”72 As Pellegrino suggested in his editorial, “These conclusions will be heretical to many educators.”73 My discussion with the university leader was not about a student’s choice of major. It was about the expectation that all premedical students must have courses in chemistry, biology, and physics. It appears that to him my remarks were heretical.
In 1997, *Academic Medicine*, the journal of the AAMC, published an exchange of letters that addressed this apparently controversial issue. Dr. Pascal Imperato of State University of New York, Brooklyn, suggested that the “trend in medical education should logically lead to a discussion about reforming premedical undergraduate requirements in biology, general and organic chemistry, mathematics, and physics. Yet such a discussion has hardly begun.” Members of a working group established by the AAMC responded to Dr. Imperato’s suggestion: “First, the working group believes that medicine must continue to be a science-based profession, and therefore undergraduate requirements in chemistry, general and inorganic chemistry, and physics are essential.”

Recall the comments of Dr. Ezekiel Emanuel in JAMA in 2006, cited in chapter 1. Dr. Emanuel asked, “Why are calculus, organic chemistry, and physics still premed requirements? Mainly to ‘weed out’ students. Surely, it would be better to require challenging courses on topics germane to medical practice, research, or administration to assess the quality of prospective medical students, rather than irrelevant material.” As did Dr. Imperato’s suggestion in 1997, Dr. Emanuel’s suggestion that we prune the historical premedical requirements met with strident opposition.

The controversy continues. Are courses in chemistry, biology, and physics essential to premedical education? Would a reformed premedical curriculum adversely affect the quality of the medical practice of the graduates of such a reformed curriculum? These questions await an answer derived from well-designed scientific observation. While we wait, substantial numbers of highly qualified college students at places such as Stanford and UC Berkeley, many of them from underrepresented racial and ethnic groups, enter the chemistry classroom in the belief that becoming a physician requires them to be there, only to have their professional aspirations founder. In the following chapters, in an effort to address these questions, I review the data that allows us to identify which factors accurately predict success in medical school and in medical practice.