SPECIAL ARTICLE

SHATTUCK LECTURE

# The Family Business — To Educate

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N Engl J Med 2006;354:1922-6.


When the Massachusetts Medical Society (MMS) was established in 1781, cofounder John Warren explained its purpose to the public. "The design of the above institution," he wrote, "is to promote medical and surgical knowledge." Throughout the years, one important mission of the MMS has continued to be the education of its members, as well as all medical professionals; in recent years, that mission has extended beyond the profession to the education of the public. Through its publications and continuing medical education programs, the MMS has promulgated new scientific knowledge that has been incorporated into undergraduate and postgraduate medical curricula. In 1921, the MMS purchased for the sum of $1 the journal that became the *New England Journal of Medicine.* A vital element in the vigorous growth of the *Journal* as a tool of education has been its editorial independence under the society's "benign proprietorship."

Surprisingly, though the MMS has cleaved to its mission of medical education, only 3 of the previous 114 Shattuck Lectures have been directly concerned with this subject. The 15th lecture, delivered in 1904 by George Summer Huntington, a general medical practitioner from East Hampton, New York, discussed the "Relation of Comparative Anatomy to Medical Education and Practice." Unfortunately, the text of Huntington's lecture is not available, but one must conjecture that he discussed his astute observations about the nature of familial chorea, which represented the best of the clinical investigations being undertaken in his day. One can only marvel at the enormous effect those observations had on the fields of genetics, neurology, and psychiatry in the decades that followed — and on the education of physicians in those fields.

James Faulkner was the dean at Boston University's School of Medicine when, in the 1954 Shattuck Lecture, he discussed reform of the medical school curriculum and the schism between the basic science and clinical faculties. He feared that the rising cost of medical education would change the composition of medical school classes. John Millis, speaking in 1967, was the first nonphysician to deliver a Shattuck Lecture, and he used his role as chair of the Citizens' Commission on Graduate Medical Education to elaborate on the "large and perplexing problems" besetting postgraduate medical education in the United States. Many of that commission's recommendations have been implemented, but many observers still share Millis's deep concern about the "severity of discontinuities" in medical education. Whereas Faulkner focused specifically on undergraduate education, Millis on postgraduate education, and Huntington on continuing education, I wish to address the entire spectrum of medical education.

One hundred years ago, the Carnegie Foundation initiated a review of college education in the United States. In the process of conducting this review, the foundation was sensitized to the disturbing variation in admissions requirements at the country's 150 medical schools. Abraham Flexner was selected by the foundation in 1908 to report on the facilities, resources, and methods of instruction at these schools of medicine. Flexner and the staff of the foundation visited all the medical

schools in the United States and Canada, and in April 1910, they issued a report that was expected by many to "revolutionize" medical education. In truth, many of the reforms advocated by Flexner and his associates had already been instituted at schools such as Johns Hopkins University, the University of Michigan, and the University of Pennsylvania. The report hastened the demise of profit-making schools, strengthened (or accelerated the formation of) ties between universities and medical schools, and stimulated the incorporation of laboratory sciences into the curriculum. Early contact between medical students and patients was another addition it inspired in the medical school curriculum. During the next 30 years, implementation of the report's recommendations raised the overall standards of medical education in the United States and Canada first up to, and then even above, those found in European medical schools.

My involvement in the education of medical students, house officers, fellows, and practitioners during the past 40 years has permitted me to observe directly the consequences of Flexner's influence. The impact of the National Institutes of Health on both basic and clinical research and the important contributions of such basic sciences as molecular biology, immunology, and genetics to the treatment and management of acute and chronic diseases have been both astonishing and gratifying. The opportunity to go on rounds with medical students and residents in both the hospital and the clinic and to observe, for example, survivors of acute leukemia, patients with cardiac transplants, and patients with mechanized limb prostheses is exhilarating. None of these treatments would have been possible 50 years ago. The biomedical sciences have made unbelievable progress in the past half century, yet our training of medical students, particularly in the clinical arena, has changed little. This dichotomy between advances in the biologic sciences and their effects on diseases, on the one hand, and the lack of progress in medical education, on the other, is striking.

## MEDICAL EDUCATION AS A SCIENCE

Until the middle of the 20th century, consideration of how humans learn was relegated to educational theorists and psychologists. Among these psychologists, Malcolm Knowles explored the field of adult learning and contrasted the teaching of adults (andragogy) with the teaching of children (pedagogy). He believed that as people mature, their self-concept shifts, so that their personality develops from a state of dependence to one of self-direction; learning is affected by each person's individual experiences, social role, unique problems, and other internal rather than external forces. But in recent years, with the advent of molecular biology, consideration of theories of human learning has been transferred to the realm of basic scientists. A leader in this burgeoning field has been Eric Kandel, along with his associates at Columbia University. At first, Kandel focused on the hippocampus, the part of the brain that is directly involved in complex memory, but he soon devised a reductionist strategy and began to study the simplest instances of memory storage.

In a series of ingenious studies of the neural circuits of the giant marine snail aplysia, Kandel elucidated the molecular biology and physiology of short- and long-term learning. By examining the siphon- and gill-withdrawal reflex, he uncovered the neural phenomena that account for short- and long-term memory and then proceeded to elaborate the molecular mechanisms that accompany these changes in neural circuits. Short-term memory involves cyclic adenosine monophosphate (cAMP) and the activation of protein kinase, whereas long-term memory requires protein synthesis and involves the nuclear translocation of protein kinase A and mitogen-activated protein kinase and the activation of cAMP-responsive element–binding protein 1. Kandel and his colleagues have demonstrated that the cellular and molecular strategies used by aplysia for strong short-term and long-term memory are present in higher animals; short-term memory involves synaptic changes, whereas long-term memory involves synaptic changes with activation of gene expression, new protein synthesis, and the formation of new connections. Although these studies seem far removed from the complexities of human learning and memory, they clarify a molecular basis for memory that is preserved from the snail to humans. Although humans surpass all other species in sophisticated cognitive abilities and emotional complexities, we share with invertebrates the physiological mechanisms that permit the brain to learn from experience.

These studies provide new insights into the molecular mechanisms of learning and memory

and place learning among the biologic processes to which we can relate specific cellular functions. Learning, conceived as a muscular contraction, has a molecular, cellular, and physiological structure. Moreover, there are conditions in which these physiological states are flawed or disordered. Thus, the science of learning has given rise to the physiology and pathophysiology of learning. We now understand that different people learn in different fashions and that some have difficulties in learning, or learning disorders. The taxonomy of these disorders or disabilities is still in the early stages, and the diagnosis of learning disabilities in adults is complex. But recognizing that these disorders can be present in adults and understanding their pathogenesis will enable educators to tailor instructional material to individual students.

My experience with medical students during the past 18 years has included a number of surprises related to learning disorders. Dyslexia and attention disorders that come to the fore when students are challenged by the stresses of clerkship and board examination are not exceptional, although the efforts whereby these students have previously compensated for their disabilities are extraordinary. Most striking has been a small group of students who have earned such kudos as Rhodes Scholarships, election to honorary societies, and the highest awards for undergraduate studies yet who have difficulty taking standardized examinations. Both short-term and long-term learning and memory may be intact in these students, but they have not developed the ability to integrate and apply their knowledge in the highly structured environment of complex multiple-choice examinations. How this lack of development influences their ability to function as physicians is not known. Among the most challenging students are those who grew up in an environment in which English was not the primary language. It is unclear why some such students report that they must translate every question they are asked into their native language before responding, whereas others who grew up in similar environments seem to adapt easily. As it faces such questions, the science of learning is progressing rapidly.

It has often been said that all doctors are teachers, since the word "doctor" comes from the Latin word for "teacher." And medical trainees are introduced early to the "see one, do one, teach one" method of clinical education. The implication is that teaching is a simple task — that anyone with an M.D. degree is automatically a teacher. This assumption is nonsense. Teaching requires not only knowledge about the learning process, but also an appreciation of students' goals, motivations, and experiences, as well as a learning environment suitable to the medical student. Medicine has not always appreciated the "science" of teaching; it is time for a change.

In the late 1940s and early 1950s, the "triple-threat" football player vanished: players who could run, pass, and punt were replaced by specialists in each of these skills. Similarly, in medicine we once had "triple threats" — physician-researcher-teachers. I would contend that we have few, if any, such triple threats today. We have been slow to recognize medical teaching as a specialty. Teaching continues to be an orphan, usually financially supported by a professional's primary activities as a clinician or investigator. It is time for medicine to catch up with football: punters are now paid substantial salaries, and we must pay medical teachers well enough to relieve them of their orphan status.

## MEDICAL EDUCATION AS A CONTINUUM

Medical education is currently disjointed, with tenuous links among its components; there is no smooth progression from undergraduate to postgraduate education. This lack of continuity arises primarily from the demand for intensive service and patient care during residency training, but also from the basic organizational structure of medical education. Although undergraduate programs are slowly embracing the concept of competencies endorsed by the Accreditation Council for Graduate Medical Education, the link between the two phases of education is still weak and theoretical. Professional development and lifelong learning, both essential aspects of the education of physicians, are too frequently downplayed in graduate medical education. The opportunities to reflect on one's experiences are minimal during residency, and although in-service examinations assess the cognitive aspects of knowledge, there is little evaluation of attitudes or of trainees' ability to communicate.

Even within the undergraduate component of

medical education there is a disjunction. In his 1954 Shattuck Lecture, Faulkner alluded to a growing schism between the faculties in the basic sciences and the clinical disciplines and described the obstacles to developing an integrated curriculum. That schism persists. Indeed, it may be partially responsible for another serious disjunction — that experienced by medical students making the transition from the preclinical realm to the clinical world. These students have acquired a basic understanding of such sciences as molecular biology and genetics and have developed rudimentary clinical skills, but they are thrown into the chaos of a modern academic medical center to further their education. In a setting in which patients come and go rapidly or suddenly are whisked off for imaging studies or to see another specialist, and are often too sick to provide students with an opportunity for extensive communication or to perform a complete physical examination, students are expected to swim with the tide. We take students who are still essentially riding on training wheels and place them on a busy expressway. No wonder they become cynical about medicine. Over the past 50 years, although the wards and clinics have changed drastically, little change has occurred in the format of clinical clerkships. We persist in using the same old educational model.

Efforts to reform the clerkship format that was developed in response to the Flexner report have been hampered by traditional boundaries among departments; each specialty governs a piece of the pie, and efforts to integrate the pieces into an orderly whole are disparaged by traditionalists. A group of colleagues and I have initiated a program at the Cambridge Health Alliance whose curriculum incorporates the main clinical disciplines of medicine, surgery, pediatrics, and obstetrics, as well as radiology and neurology, and ensures medical students contact with experienced clinical mentors and advisors. Currently in its infancy, this experiment is an attempt to formalize clinical instruction, to help medical students cope with the turmoil that distracts them from learning, and to provide guidance from experienced faculty members. To some extent this is an experiment in which the best and most appropriate methods for the clinical education of medical students are being tested. During the past two decades, we have been inundated with randomized clinical trials involving treatments in various specialties; similar trials of educational methods and the instruction of medical students are rare or nonexistent. As a community of scholars, we need to do more such experiments.

## MEDICAL EDUCATION FOR OPTIMAL PATIENT CARE

The ultimate goal of medical education is to ensure that students can be transformed into the most effective deliverers of patient care that is possible. It must transcend enabling students and physicians to achieve passing scores on board examinations, meet licensure requirements, or attain recertification. There should always be a feedback loop between outcome data derived from clinical reviews and the design of the medical curriculum — a long-standing principle that applies to both teaching and nonteaching hospitals. In teaching hospitals, this loop must involve all segments of the medical education spectrum. When mishaps due to medication errors are uncovered in the intensive care unit, the designers of curricula for undergraduate, postgraduate, and continuing medical education must be alerted to address the root cause of the errors. Undergraduate medical students must be introduced to the systems that constitute an academic medical center and learn early in their careers about system failures and their effects on patient care. But the educational programs for residents and faculty members should also incorporate these mishaps into their curricula. And similar feedback loops may be used by non-teaching hospitals to enhance the skills and performance of their medical, nursing, and ancillary staffs.

Since the advent of the hospitalist movement, the tendency in some communities has been for practitioners to shun or reduce their participation in hospital-based medical education. Thus, the medical practice office becomes the prime location for the physician's education. An important deterrent to keeping up with the medical literature is the incessant demand for measured clinical productivity. Time for reading and reflection becomes problematic. Journals pile up. Electronic systems that will incorporate the learning process into patient care are being developed and should soon be widely available. Electronic technology has streamlined much of medical practice; it will soon do the same for medical educa-

tion. The goal should be to tailor the information to the individual practitioner and to build in methods of assessment of the physician's knowledge base, performance, and efficiency.

Recent studies indicate that continuing medical education is in trouble. A RAND study revealed that the appropriate treatment is given in only 50 percent of visits to general physicians. Another meta-analysis indicated that greater clinical experience on the part of the physician actually correlates with an inferior quality of care. When these findings are combined with data on the extent to which continuing medical education is supported by pharmaceutical firms, they amount to a clarion call for the restructuring of continuing medical education. In truth, the analogy between the state of undergraduate medical education in 1905 and the state of continuing medical education 100 years later is striking. Clearly, we are in dire need of another Flexner or Carnegie.

Presented as the 115th Shattuck Lecture at the Annual Meeting of the Massachusetts Medical Society, Boston, May 14, 2005.