Abstract

Medical education is facing a convergence of challenges that the authors characterize as the four horsemen of the medical education apocalypse: teaching patient shortages, teacher shortages, conflicting systems, and financial problems. Rapidly expanding class sizes and new medical schools are coming online as medical student access to teaching patients is becoming increasingly difficult because of the decreasing length and increasing intensity of hospital stays, concerns about patient safety, patients who are stressed for time, teaching physician shortages and needs for increasing productivity from those who remain, and increasing emphasis on translational research. Further, medical education is facing reductions in funding from all sources, just as it is mounting its first major expansion in 40 years. The authors contend that medical education is on the verge of crisis and that little outside assistance is forthcoming. If medical education is to avoid a catastrophic decline, it will need to take steps to reinvent itself and make optimum use of all available resources. Curriculum materials developed nationally, increased reliance on simulation and standardized patient experiences, and adoption of quality-control methods such as competency-based education are suggested as ways to keep medical education vital in an environment that is increasingly preoccupied with funding off the four horsemen. The authors conclude with a call for a national dialogue about how the medical education community can address the problems represented by the four horsemen, and they offer some potential ways to maintain the vitality of medical education in the face of such overwhelming problems.

In February 2005, the Association of American Medical Colleges (AAMC) made a call for increasing medical school class sizes by 15% to meet a looming shortage of physicians.1 This was subsequently increased to 30% less than 18 months later as the gravity of the situation became increasingly clear.2 This call was met in 2005 with plans to increase class sizes in 36 medical schools,1 with an additional 29 (totaling 65) in 2006,3 as well as the possibility of five new allopathic medical schools created.4

It is clearly a moving target, with the most recent report indicating that there are seven new allopathic medical schools in various stages of Liaison Committee on Medical Education (LCME) accreditation.5 However, medical education is facing a number of impending problems that will make increasing class sizes as well as responding to a changing health care environment challenging. In this article, we call attention to and describe these problems and argue for competency-based medical education, among other approaches, to mitigate their damage.

The Four Horsemen of the Medical Education Apocalypse

Medical education faces challenges that are unprecedented since the advent of the tripartite academic medical center (AMC). Dealing with them will take all the commitment and willpower that can be mustered. We refer to them as the four horsemen of the medical education apocalypse:

- Teaching patient shortages
- Teacher shortages
- Conflicting systems
- Financial problems

Teaching patient shortages

Patients are sicker and discharged quicker. The adage that patients are sicker and discharged quicker reflects a rising tide that has swept across health care as the need to cut costs has become increasingly acute. Reducing the high cost of inpatient services has been a target for cost reduction for more than 20 years. As a consequence, patients are not being admitted to the hospital until they are sicker than in the past.6,7 Not only has the hospitalized patient population become sicker and their problems more complex, the length of their stay in hospitals has been growing ever shorter.8,9 Patients who would formerly have stayed for days in the hospital are often treated on an outpatient basis. Because patients who are hospitalized spend much of their time undergoing tests or receiving active therapy, there is little time for patients to interact with students. Further, because they are sicker, patients may feel so poorly that they do not want to be part of a student learning event. The problem is not that there is a lack of patients, but that they are increasingly not available to medical students for their education. As health care costs have continued to outstrip inflation, the pressure to reduce patient admissions is also a factor.

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Patients in the outpatient setting have less time for being teaching patients. In the outpatient setting, patients are suffering the effects of the global economy. With competition for almost every sector of the economy coming from global sources, job benefits—especially health insurance, sick leave, and vacation—have become increasingly less generous. More people are working longer hours and multiple jobs, further eroding their time for seeing to their needs. There are also the competing time demands to care for children and dependent elderly parents as this population—called the “sandwiched generation”—ages. It has been estimated that 16 million Americans are struggling to raise their children while caring for an aging relative. The net effect is that patients are often strapped for time and have little of it available to donate to the education of students. As is the case in the inpatient setting, physicians in the outpatient setting are also being pressured to move patients through at a faster pace, reducing students’ opportunities for instruction and patient contact. Further, many patients are now being seen first by nonphysicians such as nurse practitioners or physician assistants. Thus, some of the patients who would have been seen by students and residents in the past are now being seen by other members of the health care team. Effectively, these patients are often “skimmed off the top” so that they may be unavailable for medical education encounters.

The need for more teaching patients per student. Good-quality, well-organized, and appropriately supervised clinical apprentice experiences have been considered the gold standard in medical education. Since the early 1990s, there have been continuing efforts to provide these types of clinical opportunities for medical students earlier in their medical curriculum. The impact of this expansion has been to increase the need for clinical opportunities, especially ones that can accommodate medical students who have few, if any, clinically relevant skills. Whereas before there might have been third- and/or fourth-year medical students in the clinics, the expansion has meant there may now be first- and second-year students as well. Generally, these early clinical experiences have not supplanted those in the third and fourth years, so students see more patients than they had before the early clinical experiences were added. As medical schools increase their class sizes, the demand for teaching patients will increase, and this problem will worsen.

Competition with other learners. To make matters even more difficult, students are sometimes in competition with residents for patients. Students are ill equipped for this competition. Besides having substantially greater skills and abilities to contribute to patient care, residents have the Accreditation Council for Graduate Medical Education (ACGME) requirements to meet. Medical students have neither the direct accountability for their clinical time to make a claim on patient contact opportunities nor the skills and abilities to contribute more than minimally to patient care. Further, students often must leave clinic to attend required educational events such as lectures. By sometimes leaving in the middle of a major clinical event, or just not being around when things happen, student integration into the clinical team can be undermined.

The impact of teaching patient shortages. The net effect of decreasing access to teaching patients is to make the clinical environment increasingly less learner friendly, more variable, and less effective as a learning experience. Under these circumstances, there need to be mechanisms put into place that will monitor the quality of student clinical experiences and provide alternatives if any students’ experiences are inadequate.

Teacher shortages

Resident 80-hour workweek. On July 1, 2003, the ACGME instituted standards for all accredited residency programs, limiting the trainee workweek to 80 hours. These restrictions have made residents less available to do myriad tasks, including medical student teaching. Because residents play a significant role in the education of students, this has started to affect who teaches medical students and how much. Although it seems that some programs are finding ways to accommodate the restrictions while providing good learning experiences for residents, it is unclear how more efficient use of residents’ time has affected their teaching of medical students. However, in an analysis of medical student comments before and after implementation of the 80-hour workweek, Brasher and colleagues reported lower medical student satisfaction with resident teaching since implementation of the 80-hour workweek. Specific areas that received statistically significantly more negative comments or reductions in positive comments were residents as supervisors, residents as teachers, teaching activities, and bedside teaching.

Clinical productivity pressure. Another factor affecting teaching for medical students is that teaching time affects an AMC’s bottom line. Efforts to improve clinical efficiency have made it more difficult for clinicians to find time to teach. It has been estimated that having a student in clinic adds 20 to 40 minutes per half-day clinical. General physicians interviewed about challenges they face in teaching in the outpatient realm described space constraints, work pressure, productivity targets, patient expectations, and the time/cost of teaching. Thus, even elite medical schools in major population centers are finding it difficult to recruit clinicians to serve as medical student preceptors.

Conflicting values and metrics. The problem of physician teacher shortages is made more acute because of AMCs’ conflicted value systems. AMCs generally strive for equal valuing of the teaching, research, and clinical roles of faculty, but doing so in practice is virtually impossible. Patient care is at the center of medicine. That alone makes equally valuing the research and teaching roles a daunting challenge. When the overwhelming financial rewards of patient care are added, the value structure becomes conflicted. Research fares somewhat better than teaching, in part because of the dollar returns from research grants and consulting. Teaching has its own allure that many faculty find intrinsically rewarding, but it does not have the direct link to revenue return that makes measuring and rewarding accomplishment easy. To measure the quality of teaching requires an appreciation for how difficult and time-consuming it is to teach well. The tendency is to fall back on easy measures such as student satisfaction and contact time rather than a nuanced analysis—for instance, of the ability to present material in multiple methods to meet the needs of students with different learning needs.
When clinical and research dollars returned are compared with student ratings and contact time, the problem of differential valuing of teaching may reside as much with valuing the metrics as it does the activity. Salaries, one measure of what institutions value, can be quite disparate, with the star clinicians and researchers eclipsing the star teachers. The net effect is that the teaching role often feels woefully undervalued by faculty in the AMC.

Conflicting systems
Patient safety has always been an important issue, but it has taken on a public presence since the 1999 publication of the Institute of Medicine (IOM)'s report, To Err Is Human: Building a Safer Health System. The report states that medical errors cause between 44,000 and 98,000 patient deaths in hospitals each year in the United States. In response, hospitals are increasingly geared for safe, efficient, and high-quality patient care. Students generally do not contribute to efficiency or quality, and it is not clear whether they contribute to safety problems. It is possible that having a student present makes it more difficult to attend to safety issues, as it is one more complex task that the health care team must accommodate. Because as learners students do not have a clear role in patient care, they may be seen as nuisances by health care team members.

One systems-level problem is that hospital systems and the clinical “ethos” often do not mesh seamlessly with educational systems. Clinical faculty and team members often have difficulty tracking when students are absent for scheduled teaching activities, whether excused or unexcused. Some consider any student absence to be inexcusable, even if it is a mandatory teaching event. This contributes to the difficulty students have being accepted and integrated into the health care team.

Another problem is that information systems for hospitals and clinics are often built on computer platforms and software that offer little compatibility with educational platforms and software. Compounding this, federal requirements for security of patient records mandated by the 1996 Health Insurance Portability and Accountability Act sometimes conflict with students’ needs for information about teaching patients. However, the greatest conflict arises from the fact that teaching at an AMC operates decidedly in a nonprofit mode, whereas the clinical operation competes in a for-profit corporate health care system, which accounts for approximately 16% of the GNP. The clinical operations of the AMC often outstrip the expenditures of the remaining part of the medical school and the parent university, sometimes by many multiples. To compete in that environment requires a corporate mentality and reward structure. Clinical productivity targets are facts of life for many clinicians at AMCs. Research has become almost corporate in that there are expectations for faculty of minimum salary support from grants that are established in many AMCs, with financial incentives sometimes linked to higher productivity. Consulting opportunities, patents, technology transfer, and publications are all linked to the incentive structure. Teaching, however, still is considered nonprofit. There have been efforts to put it on similar footing with relative value unit systems, but it still rarely is incentivized on the same level as the other two missions.

The difficulties with education are not limited to their differential incentives. The larger culture does not value teaching in the same way it does other parts of its professional structure. In medicine, a contempt for how challenging it is to teach is reflected in the adage, “see one, do one, teach one.” That one would think it is okay to let someone who had just seen one and done one then teach the skill belies the difficulty of being a good teacher. Teaching a task has a different skill set than executing it, and it is very time-consuming if done well, which often goes unappreciated. This is then reflected in lower salaries, fewer benefits, or less prestige. To be a teacher in this culture demands people who love to teach or who have no other options. Unfortunately, there are too many of the latter.

Financial problems
Financial problems constitute the fourth and most pervasive horseman. Historically, medical education has been buffered from major financial damage by a distributed financing system that involves (1) tuition, (2) clinical revenues (Dean’s tax), (3) direct and indirect graduate medical education payment, (4) research grant indirect revenues, (5) state support (where applicable), (6) federal grants, and (7) gifts and philanthropy. For probably the first time in the history of the modern AMC, all these forms of support are eroding. In addition, medical education had to absorb costs for compliance with the Americans with Disabilities Act (ADA), the eighth component of the following discussion.

Tuition. Tuition has been rising faster than inflation. It currently is at historical highs, with average debt at graduation well over $100,000. According to 2007 Graduate Questionnaire data from the AAMC, the median debt burden for graduates has risen to $122,279. Medical education debt per student was 4.8 times higher in 2007 than it was in 1984, growing well beyond the consumer price index. Recent declines in students selecting primary care residencies are being attributed, at least partially, to the lower wages in primary care and longer debt retirement. High debt has been linked to depression, burnout, and feelings of excessive burden among residents. There are few who would recommend raising tuition to address the financial challenges facing AMCs; in fact, there have been calls for caps on tuition increases. In many cases, rising tuition has been used to offset the erosion of funds from other sources. The increasing class sizes projected by many schools could provide additional tuition revenues to provide some buffer, but there will in turn be costs associated with the larger class sizes. It is unclear how tuition caps and rising class sizes affect the financial health of AMCs.

Clinical revenues. The Dean’s tax is a percentage of faculty clinical revenues that is used to support the medical school. In the United States, the average medical school Dean’s tax is 10% of clinical revenues, which provides approximately 36% of total medical school revenues. The outlook for continued revenues from the Dean’s tax is not clear. Health care costs have outpaced growth of the GDP by 2.7% during the last 30 years, but this is expected to decrease to 1.9% through 2017. It is difficult to know what impact the reduced growth will have on the Dean’s tax. With the baby boomers reaching old age, it may be felt by a greater need for services and what may be a reduction in actual payment for services rendered. Clinical revenues are also...
Facing various efforts to reduce costs such as the Medicare Sustainable Growth Rate formula that systematically reduces physician payments for Medicare patient services (a 10.6% reduction in physician fee payments for Medicare patients as of July 1, 2009). Reduced health care spending will affect medical education directly through the physicians with whom students apprentice in various clerkships, and indirectly through the Dean’s tax on clinical revenues. As clinical revenues decline, the funds earmarked for medical education from the Dean’s tax will most likely diminish.

**Direct graduate medical education and indirect medical education payment.**

Medicare has paid AMCs a share of what it costs to train the nation’s medical residents since it was established in 1965. The payments are divided into what is called Direct Graduate Medical Education (D-GME) and Indirect Medical Education (IME) payments. In 1983, the IME payment to teaching hospitals was established by Congress to help cover the higher costs associated with treating sicker patients who need more complex medical care. It has been gradually reduced from 12% of Medicare costs to 5.5% in FY 2008 and beyond.

The impact that D-GME and IME have on medical education is indirect. The funds flow to teaching hospitals, which then provide the training and salaries for residents. Reductions in resident support may leave hospitals with more things to do and less time for medical student education. The rising number of medical graduates in recent years will not automatically solve the problem, because even the 30% increase called for by the AAMC will only displace the foreign medical graduates from the resident ranks. It will take more residency positions to increase the number of medical residents, and foreign medical graduates will still fill whatever new slots are added even if the 30% increase is achieved.

**Research grant indirect cost returns.**

The National Institutes of Health (NIH) saw unprecedented growth in its budget from 1998 to 2005. Interestingly, because of a rapid growth in the research infrastructure and the number of new scientists, the percentage of grants receiving funding in 2005 (<20%) was 10% lower than in 1998. It is doubtful that the NIH will see the rapid increases it received during this period anytime in the foreseeable future. Further, it seems that there will be a shake-out in the research-intensive AMCs. The Clinical and Translational Science Award (CTSA) program may presage the future, making only 60 awards, whereas there were 80 to 90 institutions funded by its predecessor, the General Clinical Research Centers. The CTSA may define whether institutions are among the research-intensive AMCs. Making the process more intense is the institutional match being required. Some institutions are putting up tens of millions of dollars to be competitive for these funds. It is not clear where institutions are obtaining these funds. Because each CTSA has an educational component, the potential for institutions to redirect funds from the operation of the undergraduate curriculum to the educational components of the CTSA would seem difficult to resist. Whether the two are compatible and maybe synergistic remains to be seen.

There have been previous warnings of the federal government’s reducing funding research from previous levels. The government started ratcheting down the rates of indirect costs it will pay, and it capped salaries it would pay off grants in the late 1980s. Mandated institutional research infrastructure costs have also steadily risen, eroding flexibility in use of indirect funds (animal care requirements; IRB–human use committee expansion). Whereas grant indirect funds are highly coveted for their flexibility and coverage of infrastructure costs, the direct costs of doing research may now consume more money than institutions are being reimbursed. Research indirect cost recovery is often used to cover faculty research start-up costs and support for faculty labs during periods when there may be lapses in grant support. As research indirect funds, once considered generous, are being consumed for the direct costs for conducting research, covering costs for research infrastructure support has meant an increasing diversion of resources from general funds to cover costs formerly paid for by research indirect funds. This diversion bleeds funding for competing institutional missions such as education. Recent tightening of restrictions on service and other activities, such as writing renewal grant applications, has put additional stress on the financial picture.

**State support.** Except for line-item support for expansion of the research infrastructure, many states have seen deficits in recent years that have led them to reduce support for higher education across the board. States have bigger educational concerns than professional education, such as the poor performance by primary and secondary students in the public school systems.

Although there may be some legislative interest that can be mustered to support expansion of class sizes and creation of new medical schools, it is doubtful that they will bail medical schools out of their financial problems. In fact, the increases in class sizes and creation of new medical schools may simply dilute state support even further. For example, the two new medical schools in Florida increased their original requests by $11 million to conform to LCME requirements for accreditation. This comes at the same time that the budget for Florida State University School of Medicine is being slashed by 2.7% ($1.5 million) in recurring monies. The potential for resources for existing medical schools to be consumed by newly created or expanding schools is real.

**Federal grants for medical education.**

Although direct federal support for research received unprecedented increases from 1998 to 2005, such support for research in health professions education has been declining. The Health Resources and Services Administration has long been the primary federal agency supporting projects related to medical education. It has been a target for budget reductions almost every year, and grants to primary care have been markedly reduced, from $89 million in 2005 to $41 million in 2006 to zero in 2007. Other types of grants for medical education have become extinct or require increasing rates of institutional matching funds and a commitment to bear costs after the grant terminates.

An unfortunate change about a decade ago was the capping of indirect cost recovery for educational grants at 5%. This has been followed by capping administrative support costs that can be recovered at approximately 15% of direct costs. Education is as labor intensive as...
any other academic activity, perhaps even more so. Salary caps are particularly challenging for involving physicians in projects because they often do not provide cost recovery commensurate with clinical income. Also problematic are the 15% restrictions on direct costs for administration that fund support and technology staff. Educational interventions tend to be heavily dependent on materials creation and consensus-building activities such as meetings and visits by consultants. The conduct of and arrangements for such activities are better done by individuals who specialize (not faculty).

Gifts and philanthropy. Gifts and philanthropy are becoming increasingly important in the operations of AMCs. Gabriel describes the increasing importance of these funds at both the department and college level and how administrators are increasingly having to spend time cultivating relationships with potential donors. However, educational applications of gifts and philanthropy have to compete with clinical and research applications. Less glamorous than curing a disease, education may have to compete with direct costs.

ADA requirements. Enacted in 1990, the ADA defined a disability for individuals as (1) a physical or mental impairment that substantially limits one or more of the major life activities of an individual, (2) a record of such an impairment, or (3) being regarded as having such impairment. This act has provided for medical students with physical limitations such as hemi- and quadriplegia as well as blindness to enter and complete medical school. Probably the most common disabilities faced by medical schools are those that affect learning. Accommodations for disabilities can include physical plant changes to allow wheelchair access to surgical suites, using larger type or braille for visual disabilities, accompaniment of a blind student in his or her clinical interactions with patients, and allowing more time and distraction-free environments for tests and other instructional activities for students with learning disabilities. Accommodations are required to be made at no cost to the student.

To meet ADA requirements, AMCs have had to allocate space and hire people to provide needed accommodations. As medical schools increase their class sizes, they are likely to encounter a higher proportion of students needing accommodations, which is likely to put more financial stress on AMCs.

Summary. In summary, AMCs are facing almost universal reductions in their diverse funding streams. As a composite index of the funding problem facing medical education in total, for public allopathic medical schools the percentage of their revenues from all state and federal sources has fallen from 70% in 1965 to 30% in 2005. The resulting dependence on tuition and clinical revenue has pushed tuition to the breaking point, and clinical revenue is predicted to rise at a markedly reduced amount, leading to substantial uncertainty.

Medical Education Meted Out by the Four Horsemen
Some of the rule of the four horsemen will be the continuation of trends that have been building for years, such as the decreasing availability of teaching patients. Other aspects of their rule will be new and painful. In this section, we describe the worst-case scenario of what a medical education world ruled by the four horsemen will be like.

Student services decline
As the financial situation worsens, schools will decrease their nonteaching staff. Student services not mandated by the LCME will be phased out, and the rest will be cut back as far as possible. Wait times will increase for career counseling services, and students experiencing academic or personal problems will be referred to the university or hospital services. Such services will be much less convenient for students than previously, and the staff will have little experience or expertise in dealing with the types of problems faced by medical students. As a consequence, problems that would have been dealt with while they were relatively small will become bigger. Correspondence and actions pertaining to admissions will take longer, and errors and delays will increase. Students who are wait-listed will not receive their final status until later, causing some to matriculate in schools they hear from sooner rather than their preferred school. This will cause additional delays and more work for an already depleted admissions support staff. Staff turnover will increase as job dissatisfaction mounts. With an ever-changing staff, training becomes a continual process.

Faculty teaching support suffers extinction
Faculty will experience a reduction in teaching support as staff are reduced. They will have to produce their own teaching materials, copy their own handouts, grade their own exams, and enter grades into the computer grading system. Similar reductions are already occurring for research support, resulting in a 10% to 15% reduction in their productivity. For teaching staff, the reduction in productivity will lead to less time for planning for instruction and an increased tendency to pull “canned” lectures to deliver. Dedicated time for faculty to lead small groups will become less protected as patient-care demands override all else, leading to leaderless small groups. Faculty office hours will become unpredictable as they are called to clinic or ad hoc meetings to produce grant applications. Faculty salaries will decline as clinical incentives are decimated by cuts in reimbursement. As the grant funding declines, all base salaries will be frozen (or cut) until the time when university funding and tuition can cover them. Faculty morale will reach all-time lows, and talk of unionization will move closer to a reality.

Curriculum operations will cease to operate
Faced with reduced staff and overwhelmed teaching faculty, curriculum planning will be delayed or abandoned. Curriculum infrastructure will be put on delayed maintenance, and teaching supplies will be obtained from lower-cost vendors. Technical support for computer-based delivery and data-management systems will be scaled back. Problems faculty encounter with computers and projectors will result in extended delays as technicians are less knowledgeable and less available. Also, students find that course syllabi cannot be trusted as changes that needed to be made failed to happen. The effect is most keenly felt when some exam dates are wrong and lectures in some courses do not coincide with the syllabus. Small groups will get scheduled to meet in the same room and time. Some small groups will have to meet in a common space, because there is insufficient space for all
to meet independently. Students who do not get to lecture early will have to go to an overflow room where they can view the lecture on a computer monitor. The computer monitor in the overflow room is a third-generation model that has been put on an extended maintenance schedule, so it rarely works. Course Web pages will be habitually two weeks behind, and some of the information contained in them has yet to be updated from the previous year.

**Laboratories will be laborious**

Laboratory modernization will be delayed, leading to fewer laboratory experiences for students and a preponderance of outdated equipment and expired reagents and other supplies. As a consequence, those experiences that occur will have a high failure rate. Laboratory materials increasingly will be shared among laboratory groups, diluting effects and making them harder for students to detect and have a meaningful learning experience. With too many students for the laboratory space available, students will rotate onto observational teams where they observe a student group and then discuss what they saw. For critical laboratory techniques, students in observational groups will come back in the evening and weekends to practice; however, there will be no faculty to provide feedback.

**Remote and hostile clinical experiences**

AMCs eager to provide students with early clinical experiences to further their education and to off-load some of the costs of education are desperate for clinical sites that will accept students with little clinical experience. For their part, clinical sites find the continual request to take more students to be a drain on staff time and energies. Good clinical sites that will accept students with little clinical experience will automatically provide a satisfactory experience. The 45 minutes that having a student adds to their workday will cut into clinicians’ income, already suffering from reductions in reimbursement from Medicare. Clinicians will be less than thrilled to see that a student is under their wing for a clinic half-day, a hostility that students will find extremely uncomfortable. Further, commuting to the remote clinical sites will take valuable time from students’ days and will be a significant financial burden.

**Crushing tuition**

Tuition is the one financial instrument that AMCs have control over, raising it time and time again. As the time to debt retirement grows and physician salaries decline, the attractiveness of medicine as a career will affect the applicant pool. AMCs will be faced with more positions to fill than there are applicants. With competition from Europe, Canada, and Australia for foreign graduates who have adequate English-language skills, even the pool of foreign graduates will not make up the shortfall.

**Discussion: Some Possible Solutions**

The four horsemen of the medical education apocalypse we’ve described—teaching patient shortages, teacher shortages, conflicting systems, and financial problems—are creating overwhelming problems. In the scenario we’ve painted, there is no apparent help to come to our aid and a compelling need to ramp up production of medical graduates to address physician shortages. We cannot continue the practice of expecting faculty to “work harder and longer” as, for the most part, they are already overextended. Further, as physician shortages take hold, we can expect to see depletions of clinical teachers, so we will need to find alternatives to maintain a minimum number of educators. We can no longer expect that clinical experiences will automatically provide students with all that they need to make progress toward becoming physicians.

In the face of these challenges, medical education will need to “reinvent” itself. We must find ways to extend faculty, clinic, and patient resources and more efficiently integrate teaching systems with the clinical systems that students must negotiate. This may require that we rethink long-standing traditions and herd some sacred cows.

**Should we adopt a standard curriculum?**

A standard curriculum would reduce faculty need to engage in the continuing debate over curriculum form and structure. It could also reduce faculty time needed for developing measures of student progress. Perhaps one of the greatest benefits would be to enable the pooling of resources and creation of faculty extenders such as audiovisual materials and simulations that would be of high quality and that could be universally adopted. Generally, however, faculty have been loath to adopt standard curricula.

However, we already have standardized expectations for the cognitive and performance requirements for medical students via the United States Medical Licensing Examination (USMLE) Step examinations. How the students meet these requirements has been left to the designs of the faculty at each medical school, but they do serve to ensure that the curricula meet at least minimum standards. Were we to adopt a standardized core curriculum designed from the USMLE content specifications, it would serve as a starting point from which high-quality faculty, clinical, and patient extenders could be created. Medical schools would be free to embellish the core curriculum as they wished, but at least the basics would be covered.

**Should we employ technology as faculty, clinical, and patient extenders?**

Technological solutions have been considered the “holy grail” to reduce the cost of educating medical students for more than 50 years. Videotape led educators to think there would be a time when it could substitute for much of what faculty did. Although videotape proved to be an important instructional adjunct, it is not a substitute. Many medical schools record lectures and make them available to students for study. However, there are few instances where videotapes (or their more modern equivalents) have supplanted lectures. Such high expectations for technology have generally led to disappointment. A recent review of the effectiveness of simulations was also disappointing in its relatively equivocal findings. Yet, although technology has not been proven...
to be superior to other educational delivery methods, there is no question that it never gets tired and can be called on 24/7. This makes it much more flexible than a typical faculty member. It can also be designed to provide simulations with varying degrees of fidelity to the real-life patient encounter. Although they do not yet provide an equivalent experience, simulations can be a satisfactory alternative if there are no real-life patient encounters readily available. However, this will take having appropriate software (and, potentially, hardware such as mannequins) available and updated on a regular basis.

Updating software is a major, high-cost challenge. With only 129 medical schools in the United States, home to 16,000+ students, the economics have not been favorable. However, technological extenders for faculty, clinical experiences, and patients could make the costs of creating more medical schools and increasing class sizes much more manageable and offset the high start-up investment needed to produce high-fidelity software. At least the costs would amortize over a larger number of institutions and students. As we see the millenial generation—the first to have grown up with the Internet—entering medical school, the challenge may be to have the technology keep up with their sophistication in its use. Students are using it in ways in which their instructors have limited experience. MySpace, Facebook, Second Life, and iPods could be potential tools for medical education that have yet to be fully explored or exploited. High-fidelity computer games modeled after some of the most successful commercial products could also provide a mechanism for engaging, yet effective, educational experiences.

Should we create a national bank of curriculum materials that can be shared among medical schools?

The ability to draw educational materials from a national source, as needed, could yield considerable time savings for faculty. Moreover, the quality of the materials could be improved, because there would be data from multiple schools to assess how well the materials function. To do this, however, we need to overcome the “not invented here (NIH)” syndrome and be willing to investigate the utility of curriculum materials that are created elsewhere.

Reluctance of faculty to adopt educational materials developed elsewhere has been a major hurdle to developing technological alternatives for medical education. This has been characterized as arrogance by some, but it really has much to do with the speed with which knowledge, skills, and abilities change in medicine as well as the uncertainty that exists in what we know and do not know. Texts are workable because they are easily augmented with updated lecture material, handouts, and manuals. The problem with computer-based educational programs is that they are complicated to create and not so easily modified or augmented. They tend to stand alone, which makes any deviation from what an instructor believes to be the best methods of instruction difficult to overcome, and keeping such materials up to date is a continuing challenge.

The MedEdPortal initiative of the AAMC offers a start to achieving this goal by creating a catalogue of peer-reviewed materials. The catalogue is searchable, and authors of materials can be contacted for permission for use. The next level is to indicate the competencies that materials would promote. Were a national competency-based curriculum adopted, materials could be linked to achieving specific competencies, unifying search terms, and aiding development of educational materials for areas with limited options. It would also help to ensure that ADA standards are met by all software and that educational technology products meet minimum specifications so they can be operated by any machine or software. However, the reluctance of faculty to adopt educational materials developed elsewhere has been a major hurdle to adopting shared educational resources.

Should we give students more control over their education?

Generally, the education of students is structured and scheduled by the faculty. The expectations for student learning are also externally defined by tests and assessments. Students generally have limited control over what and how they learn or over how their attainment of goals and objectives is measured. An alternative is to tell students that, at certain benchmarks (i.e., at the end of each semester), one should be able to do x, y, and z (e.g., take a patient history, perform a physical exam, and interpret laboratory findings); offer them resources to help achieve x, y, and z; and leave it in their hands. It would then be up to the student to learn x, y, and z such that they can demonstrate that they have achieved the objectives at the benchmarking assessment. This is actually the logical extension of a completely implemented competency-based curriculum. Students would know what is expected of them as well as the means by which they can acquire the skills and abilities to meet expectations. The students would then be responsible for employing the available resources to achieve the competencies and demonstrating their achievement in an acceptable manner.

The main potential advantage to such a student-driven system is that it gives leverage to the people who have the most at stake (students) to advocate for education. With students also needing to demonstrate competence, it puts their educational needs on a more even level with those of residents in competing for educational opportunities. It gives students a legitimate claim to more forcefully seek faculty attention for their educational needs. As thoughtfully noted by Wear, competency-based education is no panacea; however, as faculty numbers become depleted and those who remain become increasingly distracted by the need to fend off the four horsemen, it may be one of the few ways to secure faculty attention to education for what and when it is really needed.

Some of the four horsemen are upon us; others have yet to arrive. Some schools may be under their control to a greater extent than others. We think it is essential that a national dialogue begin about how we are going to address the problems associated with the four horsemen. The options we describe are only a few that could be used in defense of education. A national dialogue would put the problems on the table and allow the creative talent of the entire medical education community to contribute. No matter what your feelings or beliefs are about a national curriculum, use of technology as educational extenders, adopting educational materials from a national repository, or adopting a competency-based curriculum, we need creative solutions for the problems we face. We can wait and watch the four horsemen wreak their damage, or we can take action.


