The Education of Medical Students:
Ten Stories of Curriculum Change

September 2000

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Foreword

Medical schools are justifiably sources of civic pride, in no small part because they are the wellspring of the high-quality health care enjoyed by the people whose taxes, tuition payments, and insurance premiums subsidize them. Medical schools have prospered for most of the past century because they had broad public support. And that support is needed now more than ever, as medical education attempts to adapt to significant changes in what students must learn to be good physicians in the 21st century.

This report is designed to enhance our understanding about the nature and extent of those changes. Its findings are both encouraging and unsettling. The good news is that many medical educators are implementing curricular changes that are responsive to the latest advances in biomedical science, to the social and policy sciences relevant to medical practice, to the burden of disease, to the organization and financing of health care, and to the changing demography of the American population.

The unsettling news is that most contemporary curriculum reformers have not yet been able to make necessary changes in the second two years of medical education, when students receive their first intensive education in clinical practice. In the first of two essays that introduce this report, Michael Whitcomb, a senior vice president of the Association of American Medical Colleges, writes that this "lack of innovation . . . is almost certainly due to the fact that many members of the clinical faculty do not believe that changes are needed." The author of the second introductory essay, Kenneth Ludmerer, agrees with this analysis, as do the authors of most of the case studies that follow the essays. Ludmerer, a professor of internal medicine and history at Washington University, worries that "the approaches described in the case studies are insufficient to prepare the nation's medical students properly for the practice of medicine in the 21st century."

We commend the report to persons who have formal responsibility for higher education as well as to medical educators. Members of university governing boards and leaders of the legislative and executive branches of state government should be aware of current achievements and limits of curriculum reform in medical schools and of their potential consequences for American health care.

We also hope that medical educators and persons responsible to the public for higher education will discuss

the barriers to reform in the clinical curriculum. Some of these barriers are financial. Others are a result of the reward system in academic medicine. All of them are amenable to change as a result of collaboration among people within and outside medical education. Academic responsibility is the price we must pay for academic freedom.

Finally, we thank the authors of the studies, who are identified below, for drafting and redrafting them against tight deadlines and Drs. Ludmerer and Whitcomb for writing engagingly about controversial conceptual, political, and historical issues that have great practical importance.

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RESPONSIVE CURRICULUM REFORM: CONTINUING CHALLENGES

Michael E. Whitcomb

The studies presented in this report describe in some detail the changes occurring in the education of medical students in ten U.S. medical schools and the dynamics of the curriculum reform process at those schools. The Association of American Medical Colleges (AAMC) has recently surveyed all medical schools to collect information about the organization and management of their education programs. It is clear from this information that the kinds of changes described in the studies are occurring in a majority of schools nationwide. As reflected in the studies, medical schools are making major changes in the structure and organization of the curriculum, adopting innovative pedagogical strategies for enhancing students' learning,

improving the methods used to assess students' performance, and focusing greater attention on the professional development of faculty as teachers and educators. To support these activities, schools also are making fundamental changes in the management and financing of their education programs. Based on these observations, it is apparent that a major transformation is now under way in the education of medical students in this country.

Despite the importance of these changes, the studies presented in this report make it quite clear that the great majority of the curriculum changes that have occurred or are planned largely affect only the first two years of each school's educational program. The ten schools whose experiences are described in the report have found it difficult, and in some cases almost impossible, to make fundamental changes in the last two years of the curriculum, when most clinical education occurs. The data that the AAMC has collected about the organization and management of all schools' education programs indicate that the experiences described in the studies reflect the situation nationally. Although some schools have been able to introduce a number of structured small-group learning exercises into the final years of the curriculum, many schools, including some that have planned to do so, have not been successful in accomplishing even this relatively modest change. The lack of innovation in the last two years is almost certainly due to the fact that many members of the clinical faculty do not believe that changes are needed.

The attitude that change is not needed in the design and organization of the last two years of the curriculum ignores certain current realities. It is contradicted by published reports indicating that, at the time of graduation, medical students too often lack fundamental clinical skills that they should have acquired during their clinical education. It also fails to acknowledge that the entire curriculum—including the last two years—must change over time in response to changes in medicine and in society's expectations of medicine.

During the past two decades, important changes have occurred in medical practice that have critical implications for the content of students' clinical education. For example, concerns about the cost of medical care have led to major changes in the organization, financing, and delivery of medical care services. As a result, physicians now entering practice are expected to be able to provide high quality care in an efficient and cost-effective manner; to be skilled at accessing, managing, and using electronically stored information in clinical decision-making; and to understand the population-health dimensions of providing care to individual patients.

During the same period, society's expectations of medicine have changed. The public has come to recognize that the promises of curative medicine that dominated thinking about medical practice and medical education in the 1960s and 1970s were somewhat overstated. Americans recognize that that the emphasis placed on "biomedicine" during that period resulted in a devaluing of the humanistic dimensions of medical care, and they are dissatisfied with the impact this has had on doctors' professional behavior. People now want doctors who are able and willing to communicate more clearly with them and their families, who will respect them as persons and honor their wishes about their care, and who will continue to care for them when medical treatment is no longer indicated or desirable.

The goal of the curriculum must be to provide medical students with a general professional education that will ensure that they have opportunities to develop a strong foundation in the knowledge, skills, and attitudes required for clinical practice. To achieve this goal, the content of the curriculum must be aligned with evolving societal needs, practice patterns, and scientific developments. This alignment cannot occur if changes are made only in the first two years of the curriculum. In fact, given the nature of the issues now facing medicine, much of the new content would be better placed in the third and fourth years, when the clinical education of students is occurring. To gain a perspective on the pressing need for change in the last two years, it is useful to reflect on how little those years have changed since formal instruction in clinical medicine became an integral component of the medical school curriculum a century ago.

In the United States, the formal instruction of medical students in clinical medicine is largely a development of the 20th century. Until the late 19th century, medical schools, with few exceptions, included no formal instruction in clinical medicine in their curricula. In general, medical school graduates learned clinical medicine (such as there was to learn) on their own once they had entered independent practice or by apprenticing themselves to community practitioners. Some graduates, desiring some formal instruction in clinical medicine, would spend a period of time studying in Europe, where medical education was more advanced, or would find a "house officer" position at a hospital, where they could learn under the watchful, albeit somewhat distant, eyes of local practitioners.

Although in the mid-1800s some medical schools began to offer formal instruction in clinical medicine, the opening of the Johns Hopkins Hospital in Baltimore in 1893 is usually considered to be the signal event that

established clinical instruction as a necessary and required component of the formal education of medical students. Indeed, the approach to clinical instruction that William Osler established at Johns Hopkins became the model adopted by other medical schools. Osler believed that formal instruction in clinical medicine should begin in the third year, when students would observe clinical demonstrations conducted in the clinic and amphitheater. He thought that fourth-year students should deepen their knowledge of clinical medicine by being assigned responsibility for the care of a certain number of patients on hospital wards and that every few months they should rotate from one clinical service to another, thereby gaining experience in different clinical disciplines. The fourth-year experience that Osler instituted at Hopkins became the model for the clinical clerkships that came to dominate the clinical education of medical students throughout the 20th century.

By the 1920s, the medical school curriculum had become standardized. In this "2+2 curriculum," the first two years were devoted almost entirely to the study of the sciences of medicine and the last two to the study of clinical medicine. The first two years were composed of a number of discipline-specific, departmentally administered science courses. The last two years were composed of required clinical clerkships in internal medicine, surgery, obstetrics/gynecology, pediatrics, and psychiatry and elective rotations in these and other clinical disciplines.

In the 1950s, a few changes began to be made in the organization of the educational program. For example, some schools experimented with new approaches to organizing the material taught in the first two years. Rather than teaching the sciences in individual, discipline-specific courses, they taught relevant material drawn from each of the sciences in units organized around individual body organs or organ systems. This approach was adopted as a means for integrating content across the sciences as well as for integrating basic science and clinical discipline content to at least a limited degree. In virtually all schools, clinical clerkships were moved from the fourth year (the Osler model) to the third, with the fourth year now devoted to rotations in hospital clinics and to inpatient services in clinical disciplines not represented in the clerkship experiences. Over time, more and more schools set aside much of the fourth year for electives, so that students could gain experience in clinical disciplines of particular interest to them.

By the beginning of the 1980s, the last two years of the curriculum were generally composed of a series of required clerkships in the major clinical disciplines in the third year followed by a series of largely elective experiences in the fourth year. In virtually all cases, the educational design of the clerkship and elective experiences consisted solely of assigning students to teams composed of resident physicians and an attending physician. Even though most physicians spent the majority of their time caring for ambulatory patients, the focus of clinical education was on the care of seriously ill, hospitalized patients. This approach assumed that students could learn the skills required to provide care to ambulatory patients after entering practice—an assumption based on the belief that most ambulatory patients had either relatively minor, self-limiting conditions or were being seen in follow-up after a period of hospitalization for a life-threatening, acute disease.

The design of the clerkship experiences was largely governed by the idea that students could learn what they needed to know by observing resident and attending physicians in action in inpatient settings and by doing whatever they were asked to do. From an educational perspective, this design concept was highly flawed, because clerkship experiences (even within a single clinical discipline) were in actuality highly variable. Such variability was inevitable because of the variable nature of the clinical sites to which students were assigned over the course of any given year and the variable quality of the supervision and teaching provided by residents and attending physicians. This same conceptual flaw affected the elective experiences provided in the fourth year. The variable nature of these experiences likewise made it impossible to ensure that all students were having similar educational experiences, and neither the third nor the fourth year was designed to be a part of a coherent educational program that would ensure that all students would receive a comparable general professional education.

In the early 1980s, the AAMC impaneled a group of distinguished educators to review medical students' education and to make recommendations on changes that might be needed. The panel, which had the cumbersome title of the Panel on the General Professional Education of Physicians and College Preparation for Medicine (known as the GPEP Panel), issued its final report in 1984. That report, and a supplemental document prepared by a subgroup on clinical skills (the Working Group on Fundamental Skills), severely criticized the clinical education of medical students, specifically the clinical clerkship. The panel and subgroup concluded that clinical clerkships were often little more than unstructured apprenticeship experiences that lacked clear learning objectives and that did not contribute in a coherent manner to the general professional education of medical students.

The GPEP Panel made two major recommendations that addressed issues related to the clinical education of medical students. It recommended that a comprehensive study of clerkships be conducted so that deficiencies in those educational experiences could be better documented. The panel also recommended that medical schools provide more opportunities for medical students to be exposed to clinical medicine in ambulatory care settings. The rationale for this recommendation was based on the fact that clinical care was increasingly being provided in ambulatory settings. If students were to be exposed to the clinical problems more commonly encountered in medical practice, it was necessary to shift some of their clinical education to those sites.

The GPEP Panel's critique of the clinical clerkship was largely ignored by the medical education community, most importantly by deans and department chairs. Over the years, the chairs of the major clinical departments had become powerful forces within medical schools, and they refused to accept the notion that changes were needed in the traditional approach to clinical education. Since the clerkships that they controlled had provided generations of doctors with a sound clinical education, they saw no need for change. Absent support from clinical department chairs, no meaningful discussion occurred at the national level about undertaking a comprehensive review of the clerkship, as the GPEP Panel had recommended. As a result, no changes occurred in the experiences provided during the third and fourth years, and the organization of that portion of the curriculum remained unchanged.

In the 1990s, medical schools did begin to provide more ambulatory care–based experiences for their students. The schools developed these experiences partly in response to the recommendations of the GPEP Panel and those of other blue ribbon panels established in the late 1980s and early 1990s to review various aspects of medical education. Foundation and government grants often funded the experiences, at least in part. They primarily took the form of longitudinal preceptorships that placed students in the offices of primary care physicians for one-half day per week, generally during the first two years of the curriculum. The rationale for placing these experiences in the "preclinical" years was that they would provide clinical relevance for the basic science material that students were then studying. Additionally, educators thought that they would promote more favorable student attitudes toward primary care medicine before they entered the specialty-dominated clerkships.

In addition to the preceptorships, many schools began to set aside some of the time previously allocated for clerkships in the third and fourth years for ambulatory care–based experiences, primarily in internal medicine, pediatrics, obstetrics/gynecology, family medicine, and psychiatry. Schools often established these experiences because of hospitals' declining patient volumes—the result of the movement into ambulatory care settings of more and more of the care formerly provided in inpatient facilities. It bears emphasizing that these changes did not occur because of a recognition that the traditional clerkship experiences were somehow fundamentally flawed; the inpatient component of the traditional clerkships therefore remained unchanged.

The fourth year has remained more or less the same during the past few decades. In virtually all schools, a major portion of this year is devoted to elective experiences. Students and faculty support the current situation because it serves their mutual interests in addressing the transition that students must make from medical school to residency training. In general, students want ample elective time in the fourth year so that they can opt for rotations in the clinical disciplines that they hope to specialize in during their residencies. In fact, many students opt for multiple electives in the same discipline and arrange to take those electives at institutions where they might want to take a residency (the so-called audition electives). Students also want ample elective time so that they are relatively free to travel for residency program interviews. Relatedly, many faculty want ample elective time in the fourth year so that they have opportunities to recruit students to electives offered in their specialties, hoping that some of the students who opt for the electives will choose to train in these disciplines. Equally important, they want students who are interested in their residency programs to be able to take elective rotations (audition electives) on their services, so that they can gain some personal knowledge of students before making selections for their programs. In combination, these interests have made it difficult to make the fourth year of the curriculum part of a coherent educational program that provides a general professional education for all students.

Given the need to provide educational experiences that will allow students to acquire the knowledge, skills, and attitudes required by changes in medicine and in society's expectations, the traditional clerkship and elective experiences offered during the third and fourth years of the curriculum should be redesigned. Students cannot begin to acquire the attributes needed to care for patients in the evolving delivery system in clinical experiences that continue to emphasize the care of hospitalized patients. These experiences must be redesigned—not abandoned—so that they provide clear opportunities for students to learn how to

communicate well with patients and their families; to gain an appreciation of the impact that patients' cultural beliefs, patients' home environments, and the availability of community resources can have on care; and to understand the population-health dimensions of medical practice. Some of these objectives can be achieved by using the kinds of strategies described in several of the studies.

Some may suggest that students can begin to acquire the knowledge, skills, and attitudes needed for future practice during the preceptorship experiences that have become commonplace in medical schools. If this were the case, there would be less reason to be concerned about the design of the clinical education provided in the third and fourth years. There are good reasons, however, why these experiences cannot adequately serve this purpose. Recall that the preceptorship experiences generally occur during the first two years of the curriculum, before students have acquired the background knowledge and skills to take full advantage of the learning opportunities the preceptorships might provide.

Equally important, however, is the fact that the learning opportunities provided by these experiences are quite limited. The preceptorships generally occur only one half-day per week, provide relatively brief patient care encounters, and are based in primary care practices. They therefore do not provide adequate opportunities for students to explore in any detail the complex issues involved in caring for patients with serious chronic disease. Since preceptors are busy practitioners who volunteer their services, schools cannot expect them to spend a great deal of time exploring those complex issues with their students. Moreover, first- and second-year students are unlikely to devote the time needed to acquire the necessary attributes, since advancement during the first two years is largely dependent on how well they perform on examinations that test their knowledge of the basic sciences, not on how well they perform in the preceptorships.

The experiences described in the studies make it clear that there is a great deal of resistance to making changes in the third and fourth years of the curriculum. Those who do not see the need for change fail to recognize that it is no longer appropriate to focus the clinical education of medical students on the diagnosis and management of seriously ill, hospitalized patients with acute diseases. This focus has been justified over the years by the claim that students had to be ready for the kinds of patients they would encounter as interns or first-year residents and prepared to assist in the treatment of the most seriously ill patients they would encounter on entering practice.

This argument had some merit in the 1950s and 1960s, when a good number of medical school graduates planned to enter general practice after only one additional year of formal training (the rotating internship), but since this is no longer the case the argument no longer holds. Medical students certainly must learn enough about the care of seriously ill patients to be able to meet the patient care responsibilities they will face during the initial months of their residency experiences. But, in considering this issue, it is important to recognize that the degree of supervision now provided new resident physicians is substantially greater than in past decades. At issue, then, are the kinds of changes that should be made in the last years of the curriculum so that students are provided with experiences that contribute to a general professional education while also preparing them for the challenges they will encounter during the initial months of their residencies.

The GPEP Panel had it right more than 15 years ago when it called for a comprehensive review of clinical education. In fact, since there are several good reasons for believing that the quality of clinical education has deteriorated since that time, the need for such a review is today even more compelling. Not only are the traditional clerkships inadequate for developing the knowledge, skills, and attitudes required for the care of patients with chronic diseases in the new and evolving practice environment, but changes in the clinical environments where medicine is learned have undermined the quality of the teaching that occurs in those environments. Clinical faculty and, it should be noted, resident physicians alike claim that they do not have time to teach adequately, and, as noted above, published reports indicate that students too often lack fundamental clinical skills at the time of graduation. Moreover, medical schools now use many more sites for clinical rotations, which makes it even more difficult than in the past to maintain consistency of the educational experiences.

Accordingly, the AAMC will devote considerable time and effort in the coming year to a study of the clinical education of medical students. The association will analyze data available from a variety of sources (the LCME Annual Survey, the AAMC Graduating Student Questionnaire, the AAMC Curriculum Directory, and the Curriculum Management and Information Tool) to document and characterize the organization of the third and fourth years of the curriculum in U.S. medical schools generally. AAMC staff will visit a group of schools to obtain more detailed information about the design and conduct of the educational experiences offered in those years. The schools visited will be representative of the diversity of medical schools in the

United States. In advance of the visit, we will ask each school to provide information about the learning objectives for the clinical education experiences it offers, the approaches it uses for assessing students' performance during their clinical rotations, and the instruments its students use in evaluating these experiences. We will use this information to structure a series of interviews that will be held during each visit with clerkship directors, fourth-year students, and members of the dean's staff.

AAMC staff also will collect information about the attitudes that faculty who administer clinical education experiences have about medical students' education. We will hold focus-group sessions with directors of clerkships in core specialties. The focus groups will explore the degree to which the clerkship directors view the clerkships as part of the general professional education of medical students and how they believe the experiences might be modified to enhance students' learning. We will also obtain views on these subjects from others interested in medical students' education, including graduate medical education program directors.

The association will also explore a set of issues related to the teaching of clinical medicine. One often-repeated explanation for the decline in medical students' clinical skills is that clinical faculty no longer spend adequate time with students because of the pressures of clinical practice and the perception that medical school administrations do not value teaching. We will explore these issues by reviewing faculty productivity data, through focus-group sessions with clinical faculty, and through conferences devoted to the topic. If faculty are unable or unwilling to devote adequate time with students, little will be gained by reorganizing the third and fourth years.

As I have conveyed above, there are very good reasons for believing that the third and fourth years of the medical school curriculum need to be reorganized and that the clerkship and elective experiences provided in those years need to be redesigned. The ultimate purpose of any reforms that might be adopted is to ensure, to the greatest degree possible, that the third- and fourth-year experiences contribute to a coherent educational program that provides all medical students with a comparable general professional education.

The studies presented in this report offer evidence that trying to effect changes in the last two years of the curriculum is a formidable challenge. The design and conduct of the clinical clerkships and of many of the elective experiences are deeply rooted in the tradition and the culture of medical schools' clinical departments. Although over the years much has changed in medical education and medical practice, these departments have been steadfast in retaining their prerogative to conduct their student experiences as they see fit, and this has too often meant maintaining the status quo. This attitude must change if medical schools are to provide coherent educational programs designed to enable students to acquire the knowledge, skills, and attitudes needed for the practice of medicine in the 21st century. The curriculum reforms described in the studies in this report will not, of themselves, accomplish this goal. They have, however, set the stage for making the fundamental changes in the third and fourth years that will ensure that this goal can be achieved.

CURRICULUM REFORM 2000: AN ANALYSIS

Kenneth M. Ludmerer

The ten studies presented in this report illustrate that medical schools in the United States today are taking curricular reform seriously. The reports describe major changes during the past decade in both the content of the medical curriculum and the pedagogical strategies employed. Nevertheless, the approaches described in the case studies are insufficient to prepare the nation's medical students properly for the practice of medicine in the 21st century. This essay will describe in detail why the present medical curriculum is not accomplishing the desired objective.

I shall begin by discussing three educational principles that have guided medical educators throughout the 20th century. Then I shall describe the positive accomplishments achieved at the ten schools. Last, I shall examine why current curricular innovation is inadequate to meet the main educational challenges of the moment: the molecular revolution in medicine, the growing importance of chronic diseases in the United States, and, most important, the erosive effects on the learning environment that have occurred during the managed care era. Unless medical educators are able to address these issues successfully, the country faces the prospect that its physicians will be ill-prepared to meet their professional and public

responsibilities.

Educational Principles

The details of medical education are always changing. Each school regularly revises the content and organization of its curriculum and introduces new methods for teaching the subject matter and evaluating students. Nevertheless, medical education in the United States has developed around three underlying educational principles that have proved remarkably constant even as the specific details and strategies of the curriculum have continually evolved. Since the late 19th century these principles have served as the ideal of what medical education should encompass, though medical schools have usually fallen short of fully realizing their educational goals.

First, American medical education is based on the premise that the most effective learning occurs when students are allowed to "learn by doing." This philosophy, which was heavily influenced by John Dewey and the school of progressive education, relegates traditional teaching devices such as lectures and textbook-reading to relatively minor roles. Instead, it emphasizes "active learning" through laboratory work in the scientific subjects and hospital work with real responsibility for patient care in the clinical years. Since the late 19th century, medical educators have believed that active learning is the key that enables students to master biological principles, develop independence, and become problem-solvers, critical thinkers, and lifelong learners (Ludmerer 1985, pp. 63–71).

Second, medical educators' most important role in facilitating active learning is *not* that of structuring a formal curriculum per se but that of creating a rich, student-centered "learning environment" that permits active learning to proceed. Stimulating classmates, well-equipped laboratories, and a good library are among the components of a rich learning environment. So are a knowledgeable and creative faculty and a large amount of personal contact between students and instructors. Most important is the availability of clinical learning opportunities that allow students to have sufficient time to study patients in depth. It bears noting that, even though clinical learning takes place in the "real world" of health care delivery, not just any hospital, outpatient office, or clinical preceptor is considered acceptable. Rather, medical educators have long considered it axiomatic that good clinical teaching should illustrate exemplary patient care and thereby provide students with a model of how medicine should be practiced.

Third, much of who physicians are, particularly in terms of their attitudes, values, and behavior, is shaped not by formal course work but by the so-called "hidden curriculum"—the broad social and cultural milieu in which medical education takes place. Numerous sociological studies over the past five decades have documented the profound impact of the entire institutional environment of the academic health center on the attitudes, values, beliefs, modes of thought, and behavior of medical students. These studies have found that attitude formation results from the totality of students' interactions with faculty, house officers, patients, hospital staff, and one another in laboratories, classrooms, wards, and clinics (Fox 1989, pp. 72–107). No matter how much emphasis is given to caring and compassion in the formal curriculum, students are continually exposed to implicit messages about caring that emanate from the reality of how care is actually delivered in the academic health center. These messages often run counter to what medical educators are trying to convey. The effects of a brilliant lecture on caring to an assembled medical class can easily be undone should students return to a harsh ward culture where residents routinely speak of the "GOMERS" ("Get Out of My Emergency Room!"—a derogatory term for elderly or critically ill patients in the argot of house officers) who have just been admitted.

Ten Studies

Though strategies at the sample schools vary in detail, the ten studies presented here illustrate a number of common themes. Foremost among these are the attempts to incorporate relatively new subjects into the curriculum to help prepare learners for the exigencies of contemporary practice. These subjects include biomedical ethics, evidenced-based medicine (that is, the practice of basing patient management on well-conducted clinical studies whenever possible), disease prevention, health promotion, and population health (which addresses the health needs of a defined population, such as the individuals enrolled in a specific HMO). Many of the studies are also characterized by efforts to eliminate redundancy in the curriculum and to achieve greater coordination and integration between the basic science and clinical components of medical education. Another widespread initiative is the expanded use of new educational strategies, such as standardized patients, medical informatics, and Web-based medicine. Many of the schools are also placing more emphasis on tutorials and small-group discussions to achieve greater personal interaction among students and between students and faculty.

It is noteworthy that these studies report that the majority of innovations have been implemented during the first two years of the curriculum—the years when basic science is taught—and not during the last two years, which are typically devoted to clinical instruction. This will hardly surprise those familiar with the history of medical education in the United States (Ludmerer 1985, 1999). Medical faculties have always had complete control over the scientific work; in contrast, clinical instruction has traditionally occurred at teaching hospitals and other clinical venues that have not been directly controlled by medical schools. Moreover, basic science departments are relatively isolated from the turbulence of the contemporary U.S. health care environment, whereas the sites used in clinical teaching are directly affected by those forces. Accordingly, it is hardly a surprise that medical schools should concentrate on reforming that part of the curriculum that is under their direct control rather than the part that has the most influence on what kind of doctors students ultimately become.

Throughout the 20th century, the most important curricular experiments at U.S. medical schools have been led by strong deans committed to educational reform (that is, by deans who possess both vision and a strong command of institutional resources). These innovations include the "Yale system" introduced by Milton C. Winternitz in 1925, the organ-based system pioneered at Western Reserve in 1952 by Joseph T. Wearn, and the "New Pathway" program introduced at Harvard Medical School in the 1980s by Daniel Tosteson. The importance of the dean to curricular innovation continues to be apparent in the present ten reports. At schools where the dean has exerted strong leadership, as at the Medical University of South Carolina, educational reform has been more extensive. At schools where the dean has remained relatively uninvolved, as at the University of Utah School of Medicine, curricular reform has occurred only with the greatest difficulty and has accomplished relatively little in terms of effecting meaningful change.

Throughout the 20th century, good teaching at U.S. medical schools has been handicapped by faculty and institutional value systems that have rewarded research accomplishments (and, for the past quarter-century, the generation of clinical revenue) more than educational effectiveness (Ludmerer 1999, pp. 49–51, 215–8, 307–13). In this context, events at one of the sample medical schools represented here, the University of California, San Francisco, are truly extraordinary. There, the dean created an Academy of Medical Educators, which he funded with an initial commitment of $5 million of school reserves to establish 20 endowed chairs for unusually accomplished medical teachers. Additional fundraising plans for the Academy are under way.

Though some may view the establishment of such an academy as a "baby step," this in fact represents the first time in nearly a century that an American medical school has systematically attempted to reward good teaching with institutional resources. Early in the 20th century, medical schools introduced the system of full-time faculty appointments on the theory that research would enhance faculty members' teaching. As noted above, however, medical schools in practice have mainly granted promotions and other institutional rewards for research, not teaching. Indeed, the folk wisdom of academic medicine has long held that the sure way for an instructor not to be promoted is to win an award for good teaching. In this context, the UCSF's Academy of Medical Educators will bear close watching.

For all the promise of the ten studies, one disquieting fact must be kept in mind: schools' lack of effective tools to evaluate curricular reform. No school has ever been able to document scientifically the advantage of one curricular approach over another—however strong the theoretical rationale for a change or the subjective impressions among faculty that a change is making a difference. As the report from the University of Florida College of Medicine attests, "We continue to struggle to find ways to answer the biggest question regarding the effectiveness of change, 'Are we producing better physicians?'" The issue of curricular evaluation is especially difficult because the ultimate measure of effectiveness is not the examination scores of students today but what kind of doctors they ultimately become. It is possible that a dialogue might be initiated between medical schools and residency programs regarding how well-prepared a school's graduates seem to be at the start of residency training. None of the case reports discuss this approach, however.

The Limits of Curricular Reform

Though important changes in the medical curriculum are clearly occurring, the ten studies do not address three of the most fundamental challenges that presently face medical education. Two of these challenges arise from events internal to the development of medical science and practice; the third relates to the external conditions of the health care marketplace. The failure of the case reports to meet these challenges raises serious questions about the adequacy of the education that medical schools are currently providing.

The first issue pertains to the challenges to medical teaching posed by the molecular revolution in

biomedical science. For most of the 20th century, a distinctive feature of medical education in the United States was the integration of research with teaching and patient care (Ludmerer 1999, pp. 30–9, 148–51). The cohesiveness between teaching and research was possible because instructors taught students what they themselves were investigating. After 1970, however, as biomedical research became increasingly molecular in its intellectual orientation, teachers found it increasingly difficult to be cutting-edge researchers, and vice versa. Accordingly, the identification of qualified teachers, in both the scientific and clinical disciplines, became a difficult task.

Today, this difficulty is especially clear in the basic science fields, where the research interests of most faculty no longer directly relate to much of the subject matter still taught to medical students. Professors in these fields are in the awkward position of studying fundamental molecular and cellular biology, for which they are rewarded, while teaching clinically necessary subjects they do not particularly value, such as gross and microscopic anatomy, fluid and electrolyte metabolism, and classic organ physiology. In some fields, it has become difficult to find faculty who can still teach the classical subject matter. Gross anatomy is the prime example. Anatomy departments now depend heavily on surgeons, radiologists, anthropologists, and dentists for help in teaching, since the field is virtually dead as an area of active investigation among anatomy faculty (most of whom now work in cell biology). To a lesser extent, this problem affects instruction in the other basic science departments as well. At the dawn of the 21st century, officials at some schools are acknowledging the possibility that the basic science departments might be forced to split into separate research and teaching faculties.

Similar developments have occurred in the clinical departments, where the traditional cohesiveness among research, patient care, and education has substantially eroded. Until around 1970, the defining characteristic of clinical research was its focus on patients. This meant that clinical research went hand-in-hand with patient care and clinical instruction. In the molecular-biology era, patients are being bypassed. Although the results of this approach to clinical research have been gratifying in terms of medical discovery, a conspicuous separation of functions has occurred between clinical research and clinical teaching.

Clinical departments at many schools have responded by establishing two faculty tracks: a "clinician-teacher track" for faculty concentrating on education and patient care and an "academic track" for laboratory investigators. Most faculty members specializing in evidence-based medicine have opted for the clinician-teacher track because of their familiarity with the clinical literature and their expertise in delivering medical care. But such an approach merely highlights the fundamental problem it was meant to solve: the growing estrangement between teaching and research. Experts in evidence-based medicine seldom possess the clinical investigator's knowledge of the molecular mechanisms of disease and therapeutics, while today's clinical investigators are much more removed from day-to-day patient care and clinical teaching than were clinical professors of the past. In the clinical departments as in the basic science departments, no one has a good answer to the vexing question, "Who are the teachers?"

A second issue not adequately addressed by the ten studies is the preparation of students for the management of patients with chronic diseases. Medical educators created the hospital clerkship, the mainstay of clinical education, in the late 19th century, when Americans' life expectancy was barely 40 years and when the treatment of acute illnesses (infections, injuries, and acute manifestations of chronic diseases) dominated medical practice. Today, as a result of the success of public health and modern medicine, life expectancy in the United States is approaching 80 years, and chronic and degenerative diseases dominate the practices of most physicians.

The diagnosis and management of chronic diseases, unlike that of many acute illnesses, is largely an outpatient activity. Over the past two decades, there have been many calls for medical schools to provide more and better ambulatory experiences so that students might obtain greater exposure to patients with chronic illnesses. (The Association of American Medical College's GPEP Report in 1984 was the most prominent of these calls.) The ten studies presented here report some movement in this direction, particularly through the establishment of preceptorships with community physicians during the second year of medical school. Nevertheless, on balance, the schools represented here continue to rely on inpatient hospital clerkships for the lion's share of clinical instruction. Conspicuously absent from these reports is any discussion of how students are to acquire the knowledge, skills, and attitudes required for the care of patients with chronic diseases. It remains to be shown that today's students will be fully prepared for the most important challenge they are likely to face when they begin the practice of medicine.

The third—and most important—omission from the case studies is the recognition that present-day market forces are rapidly destroying the learning environment of clinical education. Throughout the 20th century,

American medical schools had two "homes": one in the university, the other in the health care delivery system. Of the two, the ties to the university have traditionally been far stronger. Since the passage of the original Medicare and Medicaid legislation in 1965, the patient care activities of medical faculties have grown enormously and medical schools' ties to the health care delivery system have correspondingly increased. These developments have resulted both from the financial incentives of the marketplace and from faculty members' enjoyment of the much higher salaries and benefits they have received in the Medicare era (Ludmerer 1999, pp. 3–348).

As a result of these forces, academic health centers today operate in the "real world" of health care delivery. Driven by intense, market-oriented competition, they are under great pressure to see as many patients (both inpatients and outpatients) as possible (Ludmerer 1999, pp. 349–99). This state of affairs has had deleterious effects on the ability of students to acquire the fundamental skills of clinical care and to learn caring attitudes and behaviors. Herein lies the overarching threat to the education of the country's physicians at the present moment.

The market's erosive effects on medical education are exerted in many ways. For instance, one consequence of the current situation is that fewer and fewer clinical faculty are available to serve as teachers and mentors. Instead, today's faculty are under intense pressure to be "clinically productive"—that is, to see as many paying patients as possible so that they can help keep the medical center financially afloat. (The common definition of "clinical productivity" at medical schools refers to the amount of professional fees generated, not to the quantity or quality of care. Delivering ordinary care to paying patients is considered clinically productive; delivering outstanding care to charity patients is not.) This writer has heard the chairman of internal medicine at a prestigious medical school tell his faculty, "If you want to teach, do so at lunch—and keep your lunches short." Because of such pressures, many clinical faculty presently have little time to teach, advise, serve as mentors, or conduct research. In addition, medical students' opportunities to observe faculty doctoring in a teacherly, caring way are dwindling (Ludmerer 1999, pp. 373–5).

These conditions have not escaped the attention of faculty. Instructors at many medical schools are troubled by being unable to teach medicine, engage in research, and take care of patients in a way that fulfills their criteria of clinical and moral excellence. In particular, they have bemoaned the new rules of faculty practice that insist on maximum clinical productivity because those rules interfere with their educational duties. In the words of a pediatrics professor at the University of Texas Medical School at Galveston, because of the pressure to maximize clinical earnings, "We don't see how we can be educators" (Mangan 1996). If there was one tenet of medical education that helped to ensure medicine's place as a university discipline in the 20th century, it was the importance of conducting medical education in a scholarly environment. This principle is being violated by the shift in emphasis from teaching and research to patient care and by the conversion of a scholarly faculty to an exclusively clinical faculty.

Though teachers are important to the learning environment, the opportunity for students to spend ample time with patients is even more critical. In this respect, the marketplace has again been extremely injurious to clinical learning. Through the mid-1980s, the average length of stay at teaching hospitals was 10 to 12 days. Now, it is three to four days. In part this change reflects technological advances in medical care, such as the growing use of minimally invasive surgery. However, it largely represents the attempt by third-party payers to reduce hospital costs. Short hospital stays have forced medical schools to conduct clinical education in an atmosphere in which speed is the principal mandate for patient care. As a result, students are being converted from active learners to passive observers, with deleterious consequences for their ability to acquire fundamental knowledge and skills.

Among the present clinical environment's negative effects on the education of students is its impact on the acquisition of cognitive skills. It is much harder for learners to develop problem-solving abilities when patients are admitted with their diagnoses known and treatment plans already determined. Clinical clerks in surgery, meeting patients under the drapes of the operating table, can still learn about removing a gall bladder, but such encounters do not teach students to recognize the patients who might actually need the procedure or to distinguish such patients from those who do not. Once admitted, patients are often discharged before a diagnosis has been made or the effects of therapy observed—or even before an attending physician has had the chance to confirm a physical finding. These circumstances deprive students of the opportunity to follow the course of disease and treatment.

Of equal concern are this hurried environment's negative implications for the all-important latent learning of the "hidden curriculum." Habits of thoroughness, attentiveness to detail, questioning, and listening are

difficult to instill when learning occurs in a clinical environment more strongly committed to patient "throughput" than to patient satisfaction. In addition, it is hard to imagine how it can be good for the development of caring attitudes to conduct medical education in a commercial atmosphere in which a good visit is a short visit, patients are "consumers," and institutional officials more often speak of the financial balance sheet than of the relief of suffering. Many of the ten case reports discuss the schools' attempts to develop professionalism through "white coat" ceremonies. None of the reports, however, addresses the issue of how such efforts can succeed if the internal culture of the academic health center no longer readily reinforces the values and principles that faculty wish to impart.

Conclusion

For the past century, the strength of clinical education in the United States has grown mainly from the exceptional learning opportunities available to students in the wards and clinics of teaching hospitals. A diverse array of patients was present, faculty were well qualified, and students actively participated in their care. There was time enough for teaching and for learning. Students could observe firsthand the natural history of disease and the course of therapeutics, learn the nuances of clinical medicine, and explore in-depth issues of particular interest.

In this context, the erosion of the learning environment at academic health centers represents the greatest threat to the education of physicians in the United States. The intellectual challenges to teaching posed by the molecular revolution are very real, as is the need to prepare students more fully in the area of chronic diseases. These challenges, however, are less pressing than that of maintaining a nurturing learning environment where teachers have enough time to teach, learners have enough time to learn, and institutional leaders care more about service to patients than cash flow or market share. If the medical profession and society do not address this problem, medical students will not be adequately prepared to practice.

Going forward, medical education's greatest need is to modify the internal culture of the academic health center so that it once again facilitates active learning and better reinforces the values and attitudes that medical educators wish to impart. Medical educators have spent much time in recent years discussing how they can accommodate education to inpatient and outpatient settings without slowing down the flow of patients. They will now need the courage to do just that—slow down the patient-flow in teaching settings—so that educational objectives can be better met. Of course, preserving the learning environment is no small task, since academic health centers have become far more commercial—and far less friendly to patients and students—than they were even a few years ago. Faculty and administrators might have to make personal financial concessions for the sake of preserving the quality of medical education and patient care at their institutions.

All who might ever be sick should hope that these steps will be taken. Until professional and public leaders succeed at making the internal culture of academic health centers less commercial, our efforts to produce competent and caring physicians will continue to be undermined.

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Baylor College of Medicine

Rebecca T. Kirkland

Executive Summary

Students entering Baylor College of Medicine today will have a very different educational experience even from that of students who entered less than a decade ago. In response to societal needs, calls for change from numerous national organizations, and an internal recognition of growth opportunities, the medical school has made many important and far-reaching changes to the governance, organization, and teaching format of its curriculum and has implemented innovative programs to develop, recognize, and reward its faculty. These changes have produced a more active, meaningful, and responsive learning climate.

What Are the Innovations?

Baylor faculty and students today have a greater awareness of the health needs of the populations we serve. This awareness, coupled with our desire to serve, have compelled the faculty to strive to incorporate into the curriculum contemporary topics such as pain management and palliative care, nutrition, genetics, child and adult abuse, cultural differences and spirituality, and alternative and complementary medicine. Clinical and community experiences now occur early in the medical school curriculum in order to relate the science to the care of patients. Later, in the fourth year, students revisit basic science in relation to disease topics. And to support active, lifelong learning, we have woven small-group problem solving, case-based learning, and problem-based learning sessions into the curriculum. We emphasize ethics, humane and professional behavior, and altruism throughout. We have implemented the Master Teacher Fellows Program, the Committee on Education Development (CED), and Medical Education Seminar Series (MESS) to improve teaching skills and demonstrate that we value teaching.

What Are the Innovations Expected to Accomplish?

Baylor's educational goal is to prepare skillful, productive, ethical physicians who will advance scientific discovery and who will apply technological innovation to the health needs of patients, families, and the greater society in a humane and professional fashion. We are developing innovations that enable our students to grasp new scientific knowledge in the context of patients' health needs, to communicate with their patients about health issues of concern to them, and to respond to societal concerns. The innovations encourage our students to become active, lifelong learners so that they will more naturally use and incorporate new knowledge into their medical practice. The innovations enable Baylor College of Medicine to offer pedagogical training to its faculty and to demonstrate to faculty members that teaching is valued by rewarding them for improvements in teaching.

What Are the Known Effects of the Innovations?

We know that students are more knowledgeable about the services available to patients in the community as a result of their exposure to these services. We know they are more involved in reaching out to the community through a student-run homeless clinic with faculty supervision. From student responses to the 1999 Medical School Graduation Questionnaire, we know that we are teaching more about contemporary issues in medicine than we had before. And we know that, immediately after its implementation, 80 percent of matriculants said they chose Baylor because of the new curriculum. In addition, the Master Teacher Fellows Program, the CED, and the MESS have enabled us to identify additional faculty with a renewed interest in education.

Introduction

Baylor College of Medicine in Houston is the only private medical school in the greater southwestern United States. Since its founding in 1900, the school has gained international respect for excellence in education, research, and patient care. Of the 126 medical schools in the United States, Baylor ranks among the top 15 in research funding.

Baylor College of Medicine's mission is to promote health for all people through education, research, and public service. The college pursues this mission in several ways—sustaining excellence in educating students, physicians, and scientists by advancing basic and clinical biomedical research; fostering public awareness of disease prevention and other health issues; and promoting the highest standards of patient care.

Background

In 1903, Baylor College of Medicine began an affiliation with Baylor University that lasted until 1969, when the medical school became an independent institution. In 1943, the college moved from Dallas to Houston, becoming the cornerstone of the Texas Medical Center. Since 1969, Baylor has received state funding under a legislative partnership that provides physician training for Texas residents.

In the 1999–2000 academic year, Baylor had 713 medical students, 341 graduate students, 357 postdoctoral fellows, 124 allied health students, and 954 resident physicians. A majority of the medical students were Texas residents; nearly 20 percent were underrepresented minority students; and more than 33 percent were Asian-American. The college has 10 Ph.D. programs, 3 interdisciplinary programs in the biomedical sciences, 1 combined M.D./Ph.D. program, 4 allied health programs, and residency programs for resident/fellow training in 21 medical specialties. Baylor has affiliations with Rice University, the University of Houston, the University of Texas Health Science Center at Houston, and Texas A&M University. These institutions allow Baylor medical and graduate students to receive credit for approved coursework, thus offering wide choices in the physical and life sciences. The Baylor/Rice Program in Health Sciences Management consists of a dual-degree (M.D./Ph.D. and M.B.A.) program with a focus on health care. In addition, Baylor has relationships with the University of Texas–Pan-American Premedical Honors College, the University of Houston Premedical Academy, and Rice University to prepare committed undergraduates for a career in medicine.

Baylor College of Medicine's patient care services extend to 18 institutions in Houston, reaching more than 135,000 inpatients and 1.7 million outpatients annually. Baylor has affiliations with six area hospitals, including the Methodist Hospital, Texas Children's Hospital, the Institute for Rehabilitation and Research, St. Luke's Episcopal Hospital, the Houston Veterans Affairs Medical Center, and the Harris County Hospital District's Ben Taub General Hospital. These affiliated hospitals provide a wide variety of patient experiences, including inpatient acute and chronic care, outpatient experiences, and primary care opportunities. Full-time Baylor faculty serve as the attendings in these hospital settings. The college also provides medical services for six of the Harris County Hospital District's community health centers and for the Thomas Street AIDS Clinic.

Baylor College of Medicine, with total research support of $207.9 million, operates more than 50 research and patient-care centers. These centers include the nation's only Acute Viral Respiratory Disease Unit, the national Children's Nutrition Research Center, the DeBakey Heart Center, a Human Genome Research Center, the Shell Center for Gene Therapy (a unit of the Howard Hughes Medical Institute), a Child Health Research Center, the Huffington Center on Aging, a Center for AIDS Research, and the Breast Care Center.

Baylor's research facilities are outstanding. The college is one of only three U.S. institutions to house two National Institutes of Health Heart, Lung and Blood Special Centers of Research, one devoted to the study of arteriosclerosis and the other to heart failure. It is also the site of the Matsunaga-Conte Prostate Cancer Research Center, one of only two specialized programs of research excellence for prostate cancer in the nation.

Baylor's faculty includes 1,569 full-time, 147 part-time, and 1,577 voluntary faculty. The basic science faculty includes 344 full-time members and the clinical faculty 1,225 full-time members.

Curriculum Prior to Change

For more than 20 years before implementing a new curriculum in 1995, Baylor College of Medicine had a relatively traditional medical curriculum in which a lecture-oriented, discipline-based preclinical experience was followed by clinical rotations. Somewhat unusual, however, was that for almost 30 years the basic sciences portion of this curriculum occurred over one and a half years followed by two and a half clinical years.

The one and a half years of basic sciences included 16 individual courses taught from 8 A.M. to 5 P.M. daily, five days a week; 14 of these courses were under individual departments' auspices, and there was limited communication between departments or between departmental faculty and their clinical colleagues. Only two courses were interdepartmental. The courses placed emphasis on exquisite detail rather than basic concepts, and the curriculum was heavily dependent on lectures, with few opportunities for active learning or reflection. There was no horizontal integration of courses (that is, the integration of content that occurs concurrently within a block). Moreover, efforts at vertical integration—the progression in learning that builds on what has been taught previously and prepares the student for what is to come—were minimal. These unsatisfactory conditions, which already made learning difficult, were intensified by a "parade of stars" approach: multiple lecturers who were unaware of what their students had been taught before or would be

taught after their own courses. A lack of communication among course directors regarding course goals and objectives made matters worse. The Curriculum Committee exerted very little influence over the organization and content of courses and rotations, and the Office of Curriculum/Education did not exist.

The absence of communication and the lack of centralized oversight led to serious omissions in the curriculum. We did not cover preventive medicine, public health issues, epidemiology, geriatrics, and women's health issues. Ethics and nutrition appeared only as electives in the basic science years. The curriculum did not emphasize professionalism and communication skills. Although we made some effort to introduce patients into the curriculum through clinical correlations during the first 18 months, the connection between basic sciences and clinical experiences remained weak.

The remaining two and a half years of medical school consisted of supervised clinical experiences in (required) clerkships and electives. The clinical curriculum included 16 core clinical rotations (a total of 68 weeks), each of which was organized by the appropriate department. The major rotations were 6 to 12 weeks in duration. The remainder were rotations of one to two weeks and were principally surgical subspecialties. The inclusion of so many required short subspecialty rotations set Baylor apart from other institutions nationally. For the most part, the sites for these required clinical rotations were the inpatient units and some outpatient units of the teaching hospitals affiliated with Baylor College of Medicine. The curriculum provided little opportunity for ambulatory experiences. Fifty-six elective credits, of which 32 were clinical elective credits, were required. The fact that teaching and evaluation by attendings were minimal on some rotations concerned us greatly (residents assumed much of the responsibility for the teaching and supervision).

Nevertheless, Baylor's combination of compressed coursework in basic sciences and longer clinical exposures was a successful format and enabled recruitment of high-quality students. Students viewed Baylor's comparatively long exposure to clinics as a major strength of the school's curriculum, particularly helpful in preparing for internships and determining ultimate career choices.

Rationale for Curriculum Change

Several forces led to the curriculum revision effort at Baylor:

1. Awareness of the national movement for reform in medical education, acknowledgment of pressures to become more responsive to societal needs, and the explosion of information and technology
2. The Liaison Committee on Medical Education (LCME) site visit in 1991
3. Internal curriculum reviews at Baylor

Each of these factors is discussed in detail below.

National Movement for Reform in Medical Education

The discussion leading to revision of Baylor's curriculum began with efforts to educate the faculty and leaders of the college about the national movement to improve medical education. We introduced the key issues through retreats, visits by educators from top schools, and questionnaires.

Traditional medical education in the United States has been successful in educating specialist physicians with strong backgrounds in biomedical and clinical sciences. While the need to improve the professional education of physicians had been discussed for many years, real efforts toward reform in medical education began with the 1984 publication of a report entitled *Physicians for the 21st Century: Report of the Project Panel on the General Professional Education of the Physician and College Preparation for Medicine* (Muller 1984). Two additional studies in the 1980s reinforced the GPEP Report's recommendations (Friedman, and Purcell, 1983; and Josiah H. Macy, Jr. Foundation 1988). The ACME-TRI survey, a follow-up to the GPEP Report, was conducted to determine whether any of the recommendations of the 1980s had been implemented and to discover what barriers were continuing to prevent schools from making the changes that leaders in academic medicine acknowledged should be undertaken (Swanson and Anderson 1993). While schools had implemented some recommendations, resistance to change continued to be evident at the school level. In the late 1980s, the education of medical students was for the "most part, little changed from that in the 1920's" (Swanson and Anderson 1993).

By the early 1990s, many leaders in medical education had become increasingly vocal and explicit about the inappropriateness of the ways in which medical students were taught and expected to learn:

> Grossly overloaded curriculums, rote learning, the inclusion of topics with little obvious relevance to medical practice, and inappropriate teaching methods having been blamed for stifling enthusiasm, inhibiting students' abilities to benefit from post graduate and continuum training, and even contributing to stress and depression in junior doctors. (Lowry 1993)

Eli Ginzberg, director of the Eisenhower Center for the Conservation of Human Resources at Columbia University, summarized the rationale for reform in this way:

> The pressures for reform come from a number of sources. From the complaints of students who object to being stuffed like turkeys during their first two years of medical school: they are taught about the most recent advances in the basic sciences which they cannot possibly absorb and much of which they will forget after they enter clinical training. . . . A growing current of criticism is also being voiced by members of the public, who complain that the physicians they need to care for them are not available or if they are, they cannot communicate effectively and thus cannot provide the counsel and help their patient needs. In addition to that, the payers for health care—both government and employers—are making the point that the out-of-control trend in medical care expenditures appears to be closely related to the faulty preparation that medical students (and residents) have received during their long periods of training. (Ginzberg 1993)

The movement to remodel the health care system led to calls for even more extensive reforms in medical education. The health needs of the population indicated that different competencies and skills would likely be required for future medical practice (Shugar, O'Neil, and Bader, eds. 1991; O'Neil 1993a; and Marston and Jones 1992). A recent survey by the Pew Health Professions Commission had found that only 19 percent of physicians who had graduated from medical school in 1960 or later believed that their schools had prepared them adequately to work in managed care settings (O'Neil 1993b), and the commission urged health professional schools to produce practitioners for the year 2005 who would possess an expanded set of competencies.

The Association of American Medical Colleges (AAMC) and the Association for the Study of Medical Education (ASME) established an agenda for change that urged medical schools to produce "physicians with the attributes that society is seeking for its next generation of physicians and beyond" (Community-bespoke Doctoring 1994).

Some medical schools (e.g., Brown University), responding to external pressures, had already redefined their curricula based on the competencies desired of their graduates. Other top schools (e.g., Harvard, Johns Hopkins) had begun a revision process including newer techniques such as problem-based learning and small-group sessions. That these respected schools had taken such action was another factor stimulating revision of the curriculum at Baylor.

Liaison Committee on Medical Education Site Visit

The Liaison Committee on Medical Education (LCME), a joint committee of the American Medical Association and the AAMC, is the major accrediting body for U.S. medical schools. The LCME's action following the accreditation visit to Baylor College of Medicine in February 1991 was a further stimulus to change. At the recommendation of the LCME, Baylor adopted an Educational Goals Statement later that year:

> The goal of the educational program at Baylor College of Medicine is to provide the highest quality educational experience in the art and science of medicine and to foster the drive for excellence among all students. The College is committed to educate young men and women to become compassionate physicians with high ethical standards and technical competence and a dedication to deliver the highest quality care to all people. The program should inspire student physicians to become leaders in their fields, to help provide the knowledge base for new treatment strategies, and to develop new approaches to the delivery of health services, disease prevention, and health maintenance.
>
> To achieve these goals, the program should be structured so that basic concepts are taught; it should be sufficiently flexible to allow students to develop and pursue their own interest in great depth. It should encourage students to seek additional training in the basic or clinical sciences, to participate in advanced degree programs such as the M.D./Ph.D. program, to conduct research, and to enroll in predoctoral fellowship programs. Graduates should be

prepared to pursue careers as primary care physicians, specialists, research scientists, academic physicians, and physicians involved in public health policy.

The LCME had requested that the "status of curricular evaluation, planning and implementation to achieve a coordinated and coherent program of education" be addressed. The committee specifically mentioned the need to control unnecessary redundancy and to ensure that sufficient prominence was given to medical humanities, health promotion/disease prevention, and community medicine. The LCME requested information on development of an Office of Education or its equivalent as a "focus of information and research on methods of teaching and evaluation, and as a resource supporting and enhancing the educational stewardship of the Curriculum Committee and faculty." This was seen as an essential step toward developing accountability for curriculum content and educational goals and objectives.

Internal Curriculum Reviews

Baylor's curriculum was reviewed internally four separate times during the decade prior to the initiation of reform. The occasions of these reviews were as follows.

- Medical Education Task Force—Executive Faculty Retreat, February 1985
- Curriculum Self-Study, June 1990
- Medical Education 2001 Task Force, 1990–1991
- Medical Education 2001 Task Force—Executive Faculty Retreat, April 1992

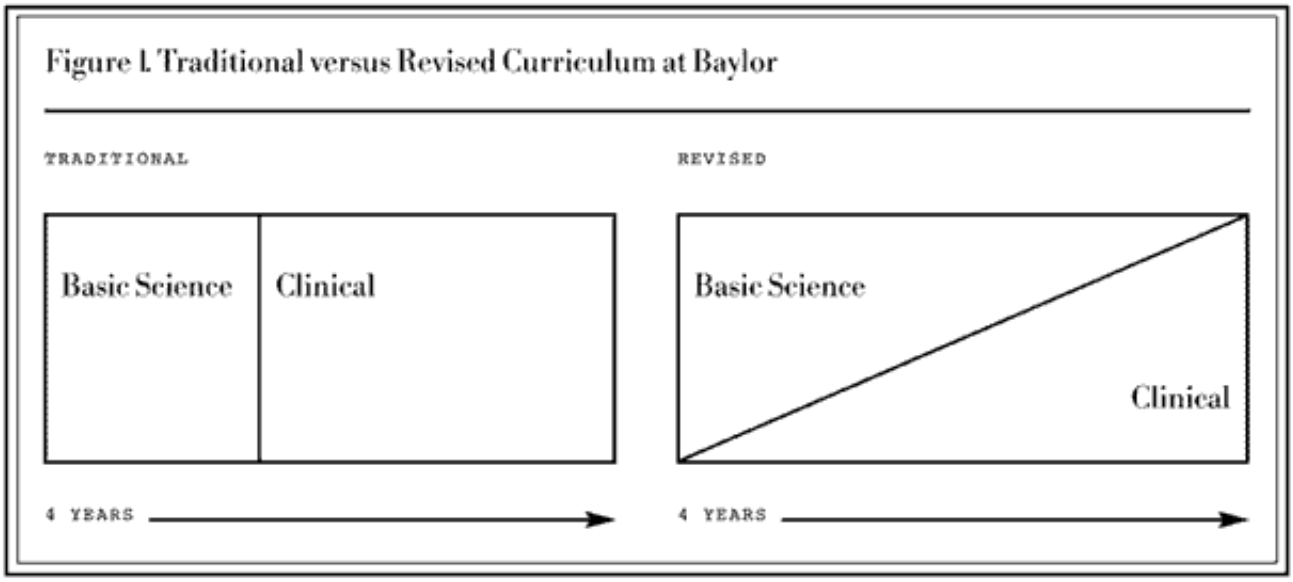
These reviews made a number of recurring recommendations for change: to promote students' independent learning and analytical skills; to reward faculty teaching; to evaluate faculty in supervision of medical students (i.e., to improve methods of medical student evaluation and evaluation of courses and curriculum); to teach nutrition, preventive medicine, computer skills, ethics, geriatrics, and public health; to reevaluate the then-current requirement that students rotate through each of the surgical specialties; to allow greater participation of students in curriculum design and implementation; and to change governance of the curriculum and empower the Curriculum Committee, appoint the associate dean, and establish resources. Steps toward planning for implementation were, however, stalled until governance issues were addressed by the Executive Faculty in 1992.

Foremost among the Medical Education 2001 Task Force's recommendations was the need to redesign and empower the Curriculum Committee. At the April 1992 Executive Faculty Retreat, the Curriculum Committee was empowered to formulate, implement, direct, and evaluate the college's medical education curriculum. The number serving on the Curriculum Committee, which had previously had 44 members (including 2 students), was reduced to approximately 16, who would include 13 faculty and 3 students; 2 administrative liaisons would serve as ex officio members. In addition, the task force recommended creation of an associate dean position to administer the college's medical education curriculum. In October 1992, a new Curriculum Committee was formed following interviews by the president and dean; appointments to the committee were based on faculty interests in education rather than departmental affiliations.

In summary, the message for the faculty was that change was needed. Students needed to be more effectively prepared to practice medicine in the changing health care environment of the 21st century, to meet the expectations of a diverse society, and to become lifelong learners.

Characteristics of Curriculum Change

A first important change was the initiation of the effort to move from the traditional curriculum, with its sharp demarcation between the basic science of the first 18 months and the clinical curriculum of the following two and a half years to a graduated curriculum in which basic science and clinical experiences are represented throughout the four years (see figure 1). The first step of this process involved instituting two new courses: Patient, Physician, and Society (PPS), which would introduce the student to clinical experiences from the outset, and Mechanisms and Management of Disease (MMD), which would carry basic science education through the fourth year.



The second step was to increase students' ambulatory experiences significantly by placing them in community practices with preceptors in the first and third years as well as providing additional outpatient experiences in the clinical core courses.

A third step was to emphasize small-group experiences, including problem-based learning and case-based learning. To accommodate small groups, the college remodeled its teaching facilities to provide 21 small-group rooms as well as computer space for computer skills and medical information management training.

Fourth was a move to a modular format for some courses in the second half of the first year and the first half of the second year. The modular format improved both vertical and horizontal integration.

Fifth, evaluation of teachers and courses led to more consistent assessment, giving the Curriculum Committee the ability to identify curriculum issues to which it should respond. The modular format and formalized evaluation process required building an administrative infrastructure to support the effort to integrate courses and evaluate them.

We identified faculty development as a need very early in the process. The sixth step was to develop the Master Teacher Fellows Program, making it the cornerstone of the faculty training and education program. A curriculum office providing infrastructure such as course administration and secretarial and evaluation support was also established, and a medical educator was hired to oversee the faculty development and evaluation process.

Seventh, the Curriculum Committee identified five themes that should be incorporated into the four-year program: genetics, pain management and palliative care, evidence-based medicine and critical appraisal, managed care/cost containment, and gender issues (with emphasis on women's health issues).

Both before and since the reform process was begun, we have asked students who matriculate at Baylor why they chose the school. Before the reform, there was no single dominant reason. Following the curriculum change, 80 percent of matriculating students have said that the new curriculum was a major reason for their having chosen Baylor.

Dynamics

The reconstituted Curriculum Committee met for the first time in October 1992. At this meeting, the committee prepared a mission statement and articulated the revised program's fundamental tenets. These tenets are as follows:

- The curriculum at Baylor College of Medicine should prepare students to function as medical professionals in the social and technological environment of the 21st century.
- The curriculum should be designed to foster self-directed learning and lifelong learning skills.
- The curriculum at Baylor College of Medicine should undergo evaluation that will guide its improvement.
- The Curriculum Committee should promote excellence in teaching.

The committee also crafted a statement of the reform's ultimate purpose (adopted April 1993; revised March 2000): "To prepare skillful, productive, ethical physicians who advance and apply, in a humane and professional fashion, scientific discovery and technological innovation to the health care needs of individual patients, their families, and to larger societal groups." Among the new Curriculum Committee's first agenda items was to consider the specific recommendations that had emerged from the earlier task forces. These included the following:

- Decreasing unplanned redundancy
- Considering the appropriateness of the short rotations
- Examining the quality of behavioral sciences courses
- Introducing contemporary topics in geriatrics, nutrition, ethics, women's health, cultural diversity, etc.
- Using contemporary teaching methods, including informatics, problem-solving, concept-learning, and lifelong-learning skills
- Enhancing ambulatory care experiences
- Preparing the generalist physician
- Rewarding teaching faculty

Faculty Initiatives

Given the Curriculum Committee's directive to implement and direct the undergraduate curriculum, it was important that the committee listen to the faculty's opinions about the strengths and weaknesses in the current curriculum as well as the barriers to and opportunities for change. Through a series of meetings and questionnaires with teaching faculty in 25 academic departments, a number of familiar themes emerged: the need to recognize and reward teaching excellence, the need to improve communication between basic sciences and clinical sciences, and the need to pursue ongoing training and improvement of faculty skills.

Curriculum change at Baylor College of Medicine formally began in the fall of 1992. Phase I was a grass-roots effort carried forward by a group of creative, dedicated faculty advocating for change. We spent considerable energy on informing the general faculty of national directions and bringing them up to speed on movements occurring around the country. A group of faculty made visits to other institutions to learn about new teaching techniques (such as problem-based learning) as well as the content and format of curricula at other colleges. Baylor was extremely fortunate to have had outstanding faculty who stepped forward to lead specific efforts. Eleven task forces were appointed to capture the ideas of as many faculty as possible. During this phase, we queried all medical students in all four years about the curriculum through a questionnaire, and each of the task forces considered their responses.

We held a mini-retreat in June 1993 to discuss the result of Phase I. During this meeting, we discussed the strengths and weaknesses of the curriculum. The faculty and student body reiterated the following major strengths and weaknesses:

Strengths

- Bright students
- Talented faculty
- One and a half years of basic sciences and two and a half years of clinics
- Exposure to diverse patient population
- Excellent clinical facilities in both the private and the public sectors
- Flexible scheduling
- Extensive clinical elective opportunities

Weaknesses

- Teaching often done by residents
- Accountability for curriculum content not evident
- Perceived low priority of medical education by senior administration
- Coordination and integration between basic and clinical sciences not evident
- Overemphasis on surgery and surgical subspecialties with an excessive number of required short rotations
- Didactic courses occur from 8:00 A.M. to 5:00 P.M.
- Newer important topics (i.e., nutrition, epidemiology) not taught
- Recognized weakness in some courses

- Some basic science courses provide too much factual detail
- Outstanding faculty inefficiently utilized

Resistance to Change

Early in the process, an "if it ain't broke, don't fix it" group was quite vocal in arguing against change. The basic arguments against reforming the curriculum were that Baylor students did well on standardized tests and performed well in residencies. Other negative comments included the following:

- "We have done this before—20 years ago."
- "We have done this before. It won't work."
- "We have done this before, and there's nothing new here. What goes around, comes around."
- "My course will lose its identity."
- "It's too labor intensive, and we're too busy doing research and generating clinical revenue."
- "We don't get paid to do that."
- "My chair doesn't recognize teaching as important."

This vocal minority eventually faded, however, as the "change train" left the station and gained momentum. Various strategies used to persuade the naysayers included these:

- Enroll and engage creative thinkers and innovators among the faculty
- "Agree to agree" on basic tenets and principles
- Find out what matters to the faculty and ensure that the entire faculty discusses and buys into the general directions of change
- Rely on leadership by the deans
- Emphasize external pressures for change (LCME direction and mandate; granting agencies' preferences and requirements; other schools' curriculum reforms and their usefulness as benchmarks to determine "best practice") and use them to indicate the urgency of reform and to engender the desire and will to achieve change
- Ensure that institutional funding will continue to support and maintain ongoing efforts to change

The administration's support enabling the design and remodeling of teaching space to create the 21 small-group rooms also had a very positive effect.

In the Curriculum Committee chair's visits to departments, in task force meetings, and in other discussions, faculty indicated that they would participate in the revision process but that the school needed to provide a system of recognition and reward for excellence in teaching. One of the first high-visibility programs to be instituted was the Master Teacher Fellows Program. The program identified 12 to 20 teaching faculty who received an 18-month program of didactic theoretical and practical experiences culminating in a fellow project. We formed a Faculty Training and Education (FTE) Committee, and it developed a prototype Educator Portfolio, but this was not implemented because the Faculty Appointments and Promotions Committee was not prepared to embrace this tool as part of the promotion and tenure process. With an influx of graduates of the Master Teacher Fellowship Program and the arrival of the director of the Office of Curriculum, the FTE Committee evolved to become the Committee on Educator Development (CED). The CED was charged with the general responsibility of creating a pro-teaching environment. Drawing support from a diverse group of faculty, the CED sponsored workshops to improve teaching skills, introduce new techniques, and provide orientation to teaching opportunities at Baylor. The CED developed an awards program to reward excellence in teaching and to acknowledge contributions in education (the Presidential Educator Award and the Distinguished Educator Award) as well as a peer-review program. The college identified funding for the Presidential Educator Award, which it implemented as the Barbara and Corbin J. Robertson, Jr. Presidential Teaching Award. The CED developed a Web site to permit easy access for the faculty to the teaching opportunities (http://www.bcm.tmc.edu/fac-ed/). The Web site provides an orientation to types of teaching at Baylor College of Medicine and to workshops, lectures, and seminars on teaching techniques and methods. The committee created a Medical Education Seminar Series was to provide a forum for discussion of contemporary issues in medical education.

The efforts to create opportunities for faculty to improve their teaching skills have been substantial. We developed and implemented a system of measuring teaching quality, including student and resident assessment of lecturers and clinical attendings. Nevertheless, the faculty continue to express dissatisfaction that their department chairs do not recognize the importance of their teaching contributions and that there are increasing pressures to spend more time with revenue-producing activities (i.e., performing research, grant writing, and patient care) at the expense of teaching. Faculty participation in multidisciplinary courses

where departments do not own the course has been particularly problematic.

Baylor's participation in the AAMC's Medical School Objectives Project has been particularly helpful in providing continuing exposure to new ideas; in developing instruments to measure professionalism, altruism, and dutifulness; and in enabling the school to share approaches to curriculum problems and issues, benchmarking, and "best practices."

Impact of Curriculum Change

The process of change that began with Phase I, assessment and review of curriculum, continued with Phase II, design of new templates; Phase III, development and further refinement of content and the piloting of a new course; Phase IV, a plan for implementation and additional pilots; Phase V, evaluation and revision; and Phase VI, ongoing "thematic" reform and continuous improvement. Important results of the implemented changes were these:

- We created an Office of Curriculum and hired an educator to direct its activities.
- We improved ongoing evaluation of courses, teachers, and curriculum.
- We eliminated unplanned redundancy.
- We incorporated opportunities for horizontal and vertical integration into the program.
- We introduced modular format (integrated) courses, such as The Nervous System and Infectious Diseases, in the second half of the first year.
- We now permit students three afternoons per week for independent study.
- We implemented the Longitudinal Ambulatory Clinical Experiences (LACE) program, including six months in community preceptors' offices and six months in community agencies in the third year (see below).
- We made nutrition, Evidence-based Medicine and Critical Appraisal, Radiology, and Ethics required courses in the second year. (Students leave the clinical rotations or electives for the "clinical half-day" each week.)
- The Patient, Physician, and Society (PPS) course emphasizes professional values, communication skills, and physical examination skills from the first week of the first year.
- Students and their faculty mentors conduct a "white coat ceremony" to emphasize professionalism.
- Integrated Problem Solving (IPS) promotes small-group participation, assessment of technology skills, use of technology, and lifelong independent learning.
- Students have more required ambulatory experiences. These experiences increased to 10 percent in the first 18 months; an additional 10 percent in the third year; and as much as 30 percent in clinical core rotations, such as the surgery rotation.
- Mechanism and Management of Disease (MMD) fosters integration of clinical and basic sciences in a modular format in the fourth year.
- Integrated Clinical Experiences (ICE), taught as an elective in the fourth year, prepares students for their internship experience. ICE includes advanced cardiac life support training as well as stress-management skills and role-play to help students learn how to counsel dying patients.
- The program puts additional focus on genetics, pain management, gender issues, cultural issues, and complementary and alternative medicine.
- Students develop improved teamwork, listening, and communication skills.
- We use a universal evaluation form, including an item to assess dutifulness in students, for clinical cores.
- Surgery is reduced to 12 weeks from 19 weeks and includes 4 weeks of ambulatory subspecialty experiences.

The community agency portion of the LACE course consists of modules on topics such as child abuse, elder abuse, alternative and complementary medicine, cultural differences and spirituality, hospice care/end-of-life issues, and geriatrics. Each module presents students with specific goals and objectives. We place students at specific agency sites in the community during each module, and, as part of the evaluation, the students must complete a "passport" regarding their experiences.

Both formal and informal assessment pointed to the revised curriculum's success. The medical school faculty indicated that, although the newer teaching efforts were more labor intensive, they enjoyed teaching more. Students also responded favorably, as can be seen from the fact that, immediately following implementation, 80 percent of the students in the matriculating classes stated that they came to Baylor because of the new curriculum. This indicated that student members of the Admissions Committee and student tour guides had communicated a positive view of the changes to applicants, since the matriculants

had no prior experience with the curriculum. Following the changes, many clinical attendings on the core rotations made comments (both spontaneous and solicited) to the effect that students were less hesitant to participate in the team and were more comfortable communicating and working with patients. Several attendings volunteered that the students on their teams were actually able to serve as resources for discharge planning because of the knowledge they had gained about social services and community agencies through the LACE program. Preceptors in the fourth-year Integrated Clinical Experiences course indicated that students who had been through the curriculum provided better feedback on evaluations and performed better in role-play.

The college's president, Dr. Ralph Feigin, and state government liaison representative, Tom Kleinworth, used the specifics of the curriculum changes to lobby the legislature for state support of medical school funding. This effort was successful. The medical school curriculum reform subsequently stimulated the graduate school and physician assistant program to undertake revisions of their own curricula.

Baylor students do very well on the United States Medical Licensing Examination Steps 1 and 2. Following the curriculum revision, Baylor students' mean scores on Steps 1 and 2 continued to be significantly above the national mean. In addition, the 1997 LCME site visit was very different in tone from the earlier one and was a positive reflection on the progress Baylor had made and on the school's commitment to build on initial reforms with continuous and ongoing improvement.

Student responses to the AAMC's Medical School Graduation Questionnaire in 1999 provided an additional measure of the success of Baylor's efforts to improve coverage in certain content areas. With a 91 percent response rate, the questionnaire showed improvement over the previous year in the following areas (based on 5 percent difference in "Appropriate" ratings): teamwork with other health professionals, clinical decision making, nutrition, geriatrics, pain management, public health and community medicine, community health and social service agencies, health promotion and disease prevention, clinical epidemiology, biostatistics, medical socioeconomics, medical care cost control, cost-effective medical practice, quality assurance in medicine, managed care, law and medicine, behavioral sciences, medical ethics, genetics counseling, and alternative medicine. In response to all questions on information technology, Baylor students ranked their level of knowledge and skills as equal to or higher than that of students from all other schools (based on 5 percent difference in "agree" or "strongly agree" ratings).

The Master Teacher Fellows program has been successful in identifying faculty members who become resources for curriculum activities requiring faculty input and guidance, such as developing skill-building workshops, the peer-review program, and the merit-based educator recognition program.

Plans for the Future

From 1992 on, the process of change at Baylor has been so challenging and intensive that we decided to promote continuous improvement—using evaluations, focus groups, and other tools for gathering feedback—rather than resorting to intermittent wholesale reforms of the curriculum.

Three task forces were appointed to evaluate our next steps. The Basics Committee worked for more than a year to identify trends and directions, eventually reaching consensus that Baylor needs to proceed in the direction of interactive, interdisciplinary labs and the greater use of technology in teaching. Some of the committee's recommendations have been implemented, but others are long-range goals and require the modernization of facilities. A second task force reexamined Fall I in an effort to further integration of courses. A third group, the Educational Facilities Committee, made recommendations for remodeling Baylor's medical education facilities to accommodate technology and make space more flexible. Committee members made visits to other medical schools to examine their curriculum and facilities. The college charged an Information Technology Strategic Planning Committee with examining methods for incorporating technology in education across the college's entire educational enterprise, including allied health, graduate school, and graduate medical education as well as undergraduate premedical education and continuing medical education.

Some changes have not met expectations or served the immediate purpose of advancing the curriculum:

1. Lectures still account for more than 60 percent of teaching time during the first year. Strategies are being developed to move toward fuller integration of first-year courses.
2. The curriculum database still does not capture the desired level of detail or reflect the integration of theme areas in patient cases or clinical cores. It does, however, broadly identify who is teaching what and the time generally spent on larger topics.
3. We still have not incorporated theme areas into all four years in a comprehensive way, which

indicates that we must find additional ways to address clinical teaching needs. We are developing strategies to identify clinical core content, to discover where emphasis should be placed, and to correct any omissions or unplanned redundancies.

4. We have not successfully resolved some governance issues. Identifying protected time (time set aside for and dedicated to teaching) for teachers and course directors remains an imperative. A coordinator must be appointed for the portion of the curriculum that occurs prior to clinical cores (the preclinical courses), and another must be appointed for the clinical-core years and given at least 50 percent protected time. Similarly, there needs to be improved accountability for the clinical curriculum. These steps would enable oversight of the entire curriculum to ensure that goals and objectives are consistently evaluated and met.
5. Space and infrastructure support remains inadequate. As more courses become integrated and centralized, individual departments cannot provide the required support, and coordinators and staff require space.
6. Demands on faculty to produce more research dollars per square foot of research space and to generate more clinical income by seeing more patients continue to interfere with educational goals and objectives. Furthermore, the implementation of Health Care Finance Administration (HCFA) compliance guidelines in ambulatory and inpatient documentation has eroded the amount of time faculty spend teaching in clinical venues. In response, we would like to implement mission-based budgeting. To move us in this direction, we have developed a relative value scale for education (RVSE) to enable the institution to document, recognize, and "compensate" faculty contributions to education. The proposed RVSE contains a comprehensive set of educational services (from lecturing to attending to committee participation), each with an assigned relative "value" of time-based credits. Each year, department, program, and course administrators will report individual faculty contributions to these services (e.g., number of lectures or months attending). By multiplying the number of reported contributions to each service by the value assigned it and then summing these calculations across all services, we will calculate a total RVSE value for each faculty member. Our intent is to create a single scale to apply to all faculty for all teaching endeavors.

   The following actions would help efforts to encourage faculty and residents to see themselves as educators and to foster a pro-teaching environment:

7. Faculty should be awarded incentive grants for innovation in education.
8. Funding should be provided to enable implementation of faculty peer-review and merit-based educator recognition programs.
9. The school must make additional efforts to improve residents' teaching, to help residents become role models, and to gather feedback on residents' teaching performance.
10. Effort is also needed to bring the cognitive and performance evaluation of students into line with the revised curriculum. "Students do not respect what you expect; they respect what you inspect," said AAMC president Jordan Cohen at an AAMC meeting in November 1994. The evaluation and assessment process needs to reflect the goals and objectives of each portion of the curriculum. Examination questions and other evaluation tools should reflect the integrated teaching approach. Performance-based examinations can be important measures of progress. Information technology would facilitate feedback and evaluation both of faculty by students and of students by faculty and residents.
11. The use of information technology to support active learning and to facilitate lifelong, independent learning needs to become pervasive across the curriculum. A task force is addressing and prioritizing information technology issues in education, including the use of hand-held computing devices, the use of simulation, the balancing of didactic lectures and information technology-based cases, the posting of course information on the Web, and the use of Web-based technology for gathering evaluations and feedback from a variety of off-site locations. Interactive, computer-based programs can provide an additional tool to support active learning so that students have the opportunity to use the information that they learn. We have a better chance of changing behaviors if information is owned and practiced rather than merely passively acquired.
12. The current health care environment no longer allows students with a faculty member to spend a comfortable hour and a half with a new patient or 30 to 45 minutes on a follow-up visit. Nor is inpatient service organized such that a student can follow a patient's progress from admission to discharge. Shortened hospital stays and the focus on "through-put" mean that students do not receive firsthand understanding of the stages of disease or extended exposure to experienced clinicians. Medical schools, including Baylor, need to examine medical students' clinical experiences and adapt them to the realities of today's clinical environment. We need to ensure that ambulatory experiences receive the same oversight and quality expectations as any other student activity.

Baylor College of Medicine has embarked on a three-month planning phase, called Vision 2005, to develop tactical plans in areas relating to its research, clinical care, and education missions. The Education Strategic Plan is addressing the need to create a fully integrated curriculum from preclinical through clinical years; to decrease didactic lecture time and increase active learning through small-group teaching; to diversify small-group learning venues; to support faculty development in technology and theme issues; and to integrate into the entire four-year program themes such as pain management and palliative care, health-related gender issues, cultural sensitivity, managed care and the health care environment, cost-effective health care, population health, medical informatics, communication skills and spirituality, and altruism and dutifulness. Baylor will provide opportunities to enable students with special interests to earn a certificate in topics such as research, international medicine, or medical informatics.

Finally, additional emphasis must be placed on patient–physician communication and professionalism throughout the four years. As the 1993 outcomes statement was revised in 2000, so should the Educational Goals Statement of 1991 be reevaluated to reflect patients' and families' desire for doctors who will enter into trusting, respectful relationships with them. Goals and objectives for each of the curriculum segments should reflect not only knowledge of scientifically based medicine and medical skills but also a heightened understanding of patients' familial, cultural, and spiritual circumstances. To achieve the desired professional behaviors, we need to focus on inclusion of literature in the humanities, on listening to patients' stories, on reflecting on what patients are really saying, and on identifying effective role models who can provide students with feedback regarding their professional behavior. Some of these issues were raised earlier in the decade, but they have recently been given a higher priority. The erosion of clinical skills and the lack of role models discussed by Kenneth Ludmerer (1999) are effects of the current cost-containment environment on teachers' ability to provide the quality educational experience their students need.

In summary, Baylor has made much progress over the last decade as we have moved from lecture-oriented, discipline-based courses toward integrated, interdisciplinary teaching; toward providing students with patient experiences earlier in their careers; and toward increasing students' ambulatory and active-learning experiences. We understand that we need to continue to break down the departmental silos and to integrate theme topics throughout the four years. We have strengthened our Curriculum Committee's oversight of content, developed an effective evaluation process, initiated a faculty development program to improve teaching skills and reward excellence in education, hired a medical educator to oversee the activities of a new Office of Curriculum, and gotten students more deeply involved in curriculum oversight and evaluation.

We have become more aware of what patients need and want from their physicians and the health care system. We understand that the educational program's content should reflect contemporary issues as well as the growth of scientific knowledge. We know that professionalism, in all its aspects, should be modeled from the outset so that the desired practice of the art of medicine is consistently demonstrated. And we recognize that we need to teach students about health care delivery systems in a way that emphasizes that these systems are dynamic, not static.

The good news is that the medical school of 2000 is not the extended college experience or the apprenticeship of past decades. Today, we have a much greater awareness of the populations we serve and, with this, an expanded desire to understand and meet their needs.

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University of California, San Francisco, School of Medicine

David M. Irby

Executive Summary

The University of California, San Francisco, School of Medicine was founded in 1864 and in the 1970s developed into one of the top ten research-intensive medical schools in the United States. Excellence in clinical programs followed. Beginning in 1998, the school has sought to match its stellar research and clinical programs with a world-class medical education program.

In the 30 years preceding 1998, the school instituted a series of changes in the curriculum in response to developments in medical science and changes in the practice of medicine. These curricular changes included creating a new second-year organ-system curriculum, introducing new content and courses, reducing lecture hours, and increasing small-group instruction.

Both external and internal forces prompted the 1998 reexamination of the curriculum. In 1993, the California State Assembly had mandated that 50 percent of University of California medical school graduates enter primary-care specialties, and in 1995 the University of California Board of Regents had banned affirmative action. These actions required changes in admissions and curriculum. In 1996, the Liaison Committee on Medical Education (LCME) accreditation team cited the school for lack of curriculum oversight. Then in 1997 the University of California Commission on the Future of Medical Education published a report calling for significant changes in curriculum. Internally, a mandate from the dean, new educational leadership, and the establishment of a planning process that brought interest in improving the curriculum to the surface motivated curriculum reform. This process engaged many faculty members, encouraged them to reexamine their assumptions about medical education, and offered them a new opportunity to address areas of concern in the existing curriculum.

The rationale and vision for change were anchored in several important concepts. These included the importance of creating an integrated and case-based curriculum, using instructional technology to enhance collaborative and self-directed learning, improving student communication and clinical exam skills, creating a supportive learning environment, strengthening support for the teaching faculty, and providing stronger curricular oversight.

Planning has occurred in three phases. The first phase (January–June 1998) established a foundation for change. This included a comprehensive evaluation of the curriculum, development of an educational mission statement and outcome objectives, and creation of planning guidelines. The second phase (September 1998–January 1999) explored alternative visions for the future of the curriculum. One task group, known as Greener Pastures, recommended incremental changes. A second task group, known as Blue Sky,

envisioned a radically new curriculum. At a school leadership retreat in January 1999, most of the recommendations of Blue Sky were endorsed. The third planning phase (January 1999–September 2001) involves design of the new curriculum.

The new curriculum will be integrated, case-based, and Web-supported. During the first two years, termed the Essential Core, new interdisciplinary block courses will be offered. Each course will weave together strands of basic, clinical, and social sciences in an integrated manner. Clinical cases will be used throughout to motivate learning, increase information retention, and facilitate transfer of learning. All courses will use Web courseware to promote collaborative and self-directed learning. In the third year, known as the Clinical Core, clerkships will be clustered into six eight-week blocks separated by four one-week intersessions. Intersessions bring all students back to the classroom for integrative, thematic sessions related to topics such as ethics, pain, and abuse. The fourth year, or Advanced Studies, provides opportunities for subinternships, electives, an anatomy selective, scholarship, and preparation for internship. A new clinical skills and simulation laboratory will be constructed to support the integrated development of clinical and communication skills. The new Clinical Core curriculum began in July 2000 and the new first-year curriculum will begin in September 2001.

Curriculum reform also resulted in the creation of an entirely new organizational structure known as the Academy of Medical Educators. This school-wide organization's purpose is to support faculty members who teach medical students and to promote teaching excellence. Only the very best teachers will be eligible for membership. Those who become members will receive protected time for teaching through endowed chairs, advocacy for promotion, faculty development, and instructional improvement grants. In return, Academy members will be expected to take leadership roles in teaching and mentoring junior faculty members in the art and practice of teaching. Over the next five years, 30 endowed chairs will be established in the academy.

Responding to changes in science, technology, and practice, UCSF is transforming the way it educates students for practice in the 21st century.

Vision

"I want the educational programs of the School of Medicine to match the world-class quality of the research and clinical programs of UCSF," stated Dean Haile Debas in 1997. As the newly hired vice dean for education, I found this challenge both exhilarating and daunting. While the medical school curriculum at UCSF had changed constantly over the preceding decades, the overall structure looked remarkably as it had 30 years before, when the last major curriculum reform took place. Could a school that prided itself on innovation in research and health care do the same in education?

Responding to this challenge, I initiated a series of conversations with key faculty leaders. Together, we envisioned creating an exceptional academic program that would attract the best students, be taught by distinguished faculty members, be designed around innovative curricula, be supported by instructional technology, and be guided by educational research. We hoped to create a learner-centered, case-based, integrated curriculum that would utilize the latest instructional technology, foster a supportive learning environment, and strengthen teaching. In short, we visualized a whole new approach to medical education that would transform the learning environment. This vision arose in the context of the unique institutional history of UCSF, prior changes in the curriculum, and the need to respond to both external and internal pressures.

Background

The UCSF School of Medicine is one of the oldest medical schools in the West. Founded in 1864 as Toland Medical College, it became affiliated with the University of California in 1873. After the San Francisco earthquake of 1906, the basic-science faculty and medical students in the preclinical curriculum moved to University of California, Berkeley. In the 1950s, the basic sciences returned to UCSF, and in the 1960s and 1970s the school became a nationally recognized leader in medical research. Today, UCSF ranks as one of the top ten medical schools in the nation, and it ranks third in research dollars awarded by the National Institutes of Health. It has approximately 1,300 full-time faculty, 1,400 residents and clinical fellows, 500 research fellows, 400 graduate students, and 600 medical students.

Current Program

Students may enter the M.D. program at UCSF (141 in the entering class) or at UC Berkeley in the Joint Medical Program (12 students). The latter program takes three years for the preclinical curriculum. In the

process, students earn a master's degree from the School of Public Health. They join UCSF students for the clinical curriculum in the last two years. Six students each year are also accepted into the M.D./Ph.D. program.

Primary clinical training sites for UCSF include the UCSF Medical Center hospitals (Moffitt-Long, Mount Zion, Langley Porter Psychiatric Institute) as well as San Francisco General Hospital, San Francisco VA Medical Center, and a multisite Fresno Medical Education Program. Both students and residents receive training at additional affiliated community-based hospitals in San Francisco (California Pacific Medical Center, Kaiser), Santa Rosa, and Salinas. In 1996, the UCSF medical school leadership was heavily involved in the creation of a joint venture with Stanford University, leading to the creation of UCSF Stanford Health Care in October 1997. After two and a half years of operation and large financial losses, the merger was dissolved in April 2000.

At the same time that planning commenced for UCSF Stanford Health Care, planning began for a second UCSF campus at Mission Bay. This 43-acre basic science research and teaching facility—a 20-minute drive from the existing campus—will be completed over the next two decades. Managing these two herculean tasks (Mission Bay and UCSF Stanford Health Care) plus curriculum reform stretched the capacities of the school's leadership and faculty.

Responsive Curriculum Change in Recent Decades (1969–1997)

Although the last major curriculum change occurred in 1969, since then there have been continuous, evolutionary revisions to the curriculum. The 1969 changes involved development of an organ-system curriculum, inclusion of the teaching of communication skills in the first year, and the creation of Introduction to Clinical Medicine in the second year. New courses in the social aspects of health and disease and in epidemiology were also added. A slight reduction in the clinical core clerkship curriculum was accomplished. The fourth-year curriculum was built around major pathways that provided guidance for students' choices of clerkship electives.

Over the ensuing three decades, incremental improvements, including the following, continued to be made: the reduction of lecture hours in the first two years, the increased use of small-group learning, and the creation of new interdepartmental courses (Cell and Tissue Biology and Foundations of Patient Care, the latter a two-year course that provides early clinical skills and preceptorships in primary care and community-based ambulatory practice). A federal grant funded this last innovation as part of the Interdisciplinary Generalist Curriculum Program. Over the past several years, further integration has occurred among second-year courses (Pathology and Introduction to Clinical Medicine, Pharmacology and Microbiology). And in response to changes in science and in health care delivery, UCSF has added new content to the curriculum in the following areas: managed care, integrative medicine, geriatrics, domestic violence, child and elder abuse, information management, end-of-life care, ethics, evidence-based medicine, and critical appraisal of the literature. (For a blueprint of the existing curriculum in 1999, see figure 1.)

Figure 1. Blueprint of the Curriculum in 1999

FIRST YEAR

SUMMER	FALL (11 WEEKS)	WINTER (11 WEEKS)	SPRING (11 WEEKS)
	Gross Anatomy	Head & Neck Anatomy	Neurosciences
		Organ System Physiology	
	Cell & Tissue Biology	Metabolism	Genetics
			Epidemiology/ Biostats
	Foundations of Patient Care		
		Psychiatry	

SECOND YEAR

SUMMER	FALL (11 WEEKS)	WINTER (11 WEEKS)	SPRING (11 WEEKS)		
"Pre-Fall" (3 weeks) Pathology Immunology	Pathology			Boards	Prep (1)
	Introduction to Clinical Medicine				
	Pharmacology				
	Micro & RGD	Radiology	Parasitology		
	Foundations of Patient Care				
		Psychiatry			

THIRD YEAR

Block rotations through core clerkships: 50 weeks (some spill over to fourth year)

Medicine (8)	FCM (6)	Surg. Subspec. (4)	+ Ethics (2)
Surgery (8)	Ob/Gyn (6)	Anesthesia (2)	
	Pediatrics (6)	Neurology (4)	
	Psychiatry (6)		

FOURTH YEAR

Required Advanced and Elective Rotations: 31 weeks

Senior Medicine (4)	(3) Med III
Additional Subinternship (4)	Anes III (ACLS)
5 months of "free" electives (20)	

To better prepare students for clerkships, we created a one-week course entitled Preparation for Clerkships. This course teaches procedural, information management, and coping skills for the clinical environment.

In 1999, we initiated a new, third-year longitudinal clinical experience was initiated with assistance from several managed care partners and with funding from a federal grant under the Undergraduate Medical Education for the 21st Century (UME-21) project. This preceptorship offers longitudinal clinical experience, creates stronger linkages with managed care organizations in the area, and teaches participants how to function effectively in managed care teams.

Over the past five years, UCSF has pioneered the assessment of professional behaviors in the clinical years. We developed and implemented a physicianship evaluation form to supplement existing evaluation mechanisms. This form identifies problematic patterns of behavior such as unmet professional responsibility (e.g., the student cannot be relied on to complete tasks), lack of effort toward self-improvement and adaptability (e.g., the student is resistant to feedback, abusive, or arrogant), unacceptable relationships with

patients and their families (e.g., the student demonstrates inadequate rapport, insensitivity, or lack of empathy), and poor relationships with members of the health care team (e.g., the student does not function as part of the health care team or is insensitive to the needs, feelings, and wishes of the health care team). In 1999, UCSF implemented a new professionalism standard for first- and second-year students as well.

To help support professionalism, the medical school initiated a "white coat ceremony" held during orientation week. In addition, several elective courses are offered, including The Healer's Art and a student-run retreat at the end of third year that deals with issues of professionalism, ethics, and student well-being.

In the 1970s, through federal funding from Area Health Education Centers, a medical education program in Fresno became affiliated with UCSF. This community-based program is located 200 miles from San Francisco in the Central San Joaquin Valley of California. While this is predominantly a graduate medical education consortium of several hospitals, medical students also rotate through required and elective clinical courses there. A program called Model Fresno takes eight to twelve third-year medical students for six months of core rotations and provides them with a community clinical experience in predominantly Hispanic communities. In 1999, we initiated a monthlong Medical Spanish course for students to take between their first and second years of medical school.

Forces Prompting Curriculum Reform in 1998

Although UCSF had incrementally enhanced its curriculum each year, in 1998 the school began a fundamental reexamination of the curriculum as a result of a number of external and internal forces.

External Forces

In 1992 and 1993, the California State Legislature passed several bills mandating that the University of California medical schools guarantee that 50 percent of their graduates would enter primary care training programs and that 50 percent of residency positions would be in primary care specialties. The California Academy of Family Medicine had lobbied heavily for this legislation and for significant increases in family medicine residency positions. The entire University of California appropriation was held captive to these bills, and stiff financial penalties were mandated if the University of California failed to comply. Although the governor vetoed these bills, in 1993 he mandated the creation of a memorandum of understanding between the governor and the University of California to implement these requirements over a ten-year period. Each year UCSF and the other four UC medical schools are required to report on efforts to comply with these mandates.

In 1995, the Regents of the University of California banned affirmative action in higher education—an action consistent with a ballot initiative that followed in 1996. Because of this, minority students no longer perceived California to be a welcoming environment, and the Regents' action had a chilling effect on recruitment of underrepresented minorities. The UCSF School of Medicine went from having one of the most diverse student bodies of any medical school in the country to merely being in line with national norms. The percentage of underrepresented minorities in the entering class declined from a high of 30 percent in 1995 to 13 percent in 1999. (Although the number of offers did not decline, the number of acceptances fell.)

The 1996 accreditation report by the Liaison Committee on Medical Education (LCME) cited the school for lack of curricular oversight and encouraged UCSF to create a new position of vice dean for education and to maintain diversity in the student body. The prior LCME report had also cited the school for curriculum inadequacies, and these criticisms together created a strong rationale for reexamination of the curriculum.

In 1996, the Office of the President of the University of California created a commission to examine California's health care needs, to investigate needed changes in medical school curricula, and to make recommendations for improvement. The final report of the UC Commission on the Future of Medical Education, published in 1997, offered an overview of the key environmental forces affecting academic medical centers: cost-control pressures on health care, competition with managed care organizations, changing locations of clinical education, pressures to incorporate new content into medical school curricula, and demographic shifts in California. The report also recommended defining educational outcomes, changing curricula to conform to those objectives, and changing the distribution of residency programs to produce more primary care practitioners. This report was shared broadly with department chairs and curriculum leadership at UCSF and provided further fuel for evaluation of the curriculum.

In sum, the school by the late 1990s found itself under substantial external pressures to reexamine the curriculum and to ensure that it was responsive to the current health care environment.

Internal Forces

Dean Haile Debas committed the school to a renewed investment in education. He completed his recruitment of me as vice dean for education in the fall of 1997 and asked me to focus my efforts on curriculum reform. To support this endeavor, Dean Debas consolidated all educational programs and resources under the vice dean for education. In early 1998, I appointed new associate deans for curriculum, Dr. Helen Loeser, and student affairs, Dr. Maxine Papadakis. The new chair of the Curriculum Committee, the distinguished behavioral psychologist Dr. Nancy Adler, also supported an active agenda for change. This new leadership team immediately began to create a process for envisioning and designing a new curriculum.

While students were generally happy with their learning experience at UCSF, complaints that had begun to emerge from some students during the spring of the second year and in the third year prompted a survey of student well-being in 1998. This coincided with the failure to attract a number of excellent underrepresented-minority applicants—in part because UCSF did not offer enough scholarships and in part because other schools' curricula were perceived to be more exciting.

Thus, momentum for change was also spurred on by concerns voiced by students and by a desire for change among some core faculty members who teach medical students. Strong new leadership for education brought together these issues and created a planning process to generate the best possible educational program for medical students.

Rationale for Change

Although UCSF student performance on national board exams was excellent, several task forces identified opportunities for improvement. Rapid advances in science, technology, health care, and education necessitated a fundamental rethinking of how to educate medical students for practice in the 21st century. The rationale and vision for change were anchored in several important innovations. These included the importance of creating an integrated and case-based curriculum, using instructional technology to enhance collaborative and self-directed learning, improving student communication and clinical skills, enhancing a supportive learning environment, strengthening support to teaching faculty, and providing stronger curricular oversight.

The starting point for rethinking the curriculum was the desire to integrate content across disciplines, to create a realistic context for learning, to fill content gaps, and to reduce unplanned redundancies. The new curriculum would weave strands of basic, clinical, and social sciences throughout all courses. We believed that such an integrated approach would facilitate student understanding and reflect the way that biomedical research is conceptualized—as an interaction between the biological/genetic factors, the behavioral factors, and the environmental factors influencing health and illness. We needed new content to respond to changes in science and practice in the areas of evidence-based medicine, teamwork, culturally competent care, geriatrics, and health care policy.

A second major question concerned how to motivate learning and improve retention. Learning is enhanced if content is perceived to be relevant, is embedded in the context of use, and actively involves the learner. We therefore decided that the new curriculum would be case-based and that every unit of instruction would include a clinical case.

Another priority was to promote collaborative and self-directed learning. One important strategy is to use instructional technology and the Web. All courses in the new curriculum will be Web-supported and will develop skills of self-assessment, identifying and organizing information, and critical appraisal of the literature.

To improve clinical examination skills and communication with patients, the Foundations of Patient Care course given in the first quarter now teaches physical examination skills, providing students with immediately usable skills for their preceptorships. In addition, planning has progressed on a new clinical skills center that will include a clinic with eight examination rooms, videotaping capability, a control room, and a conference center. All standardized patient training and performance assessment will occur in the lab. An adjacent simulation center will utilize the latest in patient simulators.

We are considering a variety of strategies to foster greater student-faculty interaction, including promoting longitudinal relationships, mentoring, career advising, and scholarship. One proposal involves the establishment of student/faculty groups called Societies. Each student class would be divided into five

groups and each group assigned a mentor. The purpose of the Societies is to promote student well-being, provide career advising, create a sense of community, and offer research and service opportunities. Another proposal recommends increasing opportunities for scholarship in the curriculum. Currently, more than half of UCSF medical students participate in some form of research. We envision an expanded and enriched program of scholarship as a more formal elective process, especially in the fourth year.

Teaching in the new curriculum requires cooperation among and coordination of faculty members from across the school, thus necessitating some form of interdepartmental support for faculty. In response to this need, the Academy of Medical Educators evolved. The Academy is a "program without walls" whose purpose is to support the teaching faculty and to promote teaching excellence. This honorary organization provides its members with protected time for teaching, advocacy for promotion, faculty development, and instructional improvement grants. Members of the Academy are expected to take leadership roles in the curriculum and to mentor junior faculty in teaching. (The Academy is described more fully below.)

Finally, new forms of central oversight over the curriculum had to be developed to prioritize and reduce core content, determine appropriate pedagogical methods, and ensure that unplanned redundancies were reduced. As the new curriculum structure began to emerge, new oversight committees were required to ensure appropriate integration across courses and years.

The Planning Process (1998–2000)

To envision a new future and to ensure that as many faculty members as possible became actively involved, we initiated a three-phase planning process in 1998. The first phase built the foundations for change (January–June 1998) and included a comprehensive evaluation of the M.D. program, development of an educational mission statement and outcome objectives, and creation of planning guidelines. The second phase (September 1998–January 1999) explored alternative visions of the future of the curriculum. The third phase began in early 1999 with the design of a new curriculum.

Foundations for Change

In January 1998 three task forces were appointed to work on evaluating the curriculum, writing a mission statement and outcome objectives, and creating planning guidelines. The three task forces presented their reports to a curriculum leadership retreat in March 1998. They subsequently revised the reports and submitted them for review and revision to the department chairs, the Curriculum Committee, and the School of Medicine Faculty Council (to which the Curriculum Committee reports). Major curriculum changes must be approved first by the Curriculum Committee and then by Faculty Council. Since major changes also require the support of the chairs, they were actively involved in the review process, as well.

Evaluation of the M.D. Curriculum

By all measures, UCSF does an excellent job educating its students. UCSF is highly selective in its admissions process, screening approximately 5,500 applicants each year for 153 offers. UCSF students score one standard deviation above the national mean on the National Board of Medical Examiners (NBME) certifying exams. While graduating seniors are generally satisfied with their education, they do not perceive the curriculum to be a major strength of the school.

Over the past three years, two-thirds of the graduating class have matched to their first-choice residency programs and more than 80 percent to one of their top three choices. Approximately 50 percent of UCSF graduates have entered primary care residency programs (family medicine, internal medicine, or pediatrics) over the past decade. In its surveys for 1998, 1999, and 2000, *U.S. News and World Report* ranked UCSF among the top seven medical schools generally, among the top five primary care schools, and among the top seven medical schools with a research orientation. UCSF is the only medical school to rank at the top of all three lists. In other words, the current student body and teachers are excellent. These results did not provide fuel for curriculum change. In fact, they led many to ask why UCSF should tamper with a successful program.

Educational Mission and Outcome Objectives

A separate task force worked on writing an educational mission statement and developing learning outcome objectives. Prior to this there had been no education mission statement, and the existing learning outcome objectives were outmoded and inadequate to guide and evaluate the curriculum.

The educational mission of UCSF is to provide a supportive and challenging educational environment within which students of diverse backgrounds prepare themselves for careers characterized by commitment to excellence, lifelong learning, and service to others through patient care, research, and teaching. The academic program is designed to provide students with core knowledge and skills that can serve as the basis for further education in any field of medicine.

Learning outcome objectives for UCSF graduates include a capacity for self-evaluation and moral reflection to sustain a lifetime of responsible, committed, and compassionate practice of medicine; a commitment to continued learning and to teaching patients and colleagues; an understanding of the scientific foundations of medicine with particular attention to common diseases and life-threatening emergencies; and a mastery of the core clinical skills needed to evaluate and care for patients. The task force compiled 30 specific outcome objectives clustered under these four basic goals.

Planning Guidelines

To direct the planning process, a third task force wrote guidelines to provide general directions for future curriculum planning and compiled criteria for judging proposed alternatives. Guidelines included creating an active interplay between the basic, social, and clinical sciences throughout the curriculum; preparing students to understand the social, cultural, and economic factors that affect health and health care; and providing students with the ability to access and integrate information electronically. According to the task force report, the curriculum should emphasize fundamental principles in the context of their clinical relevance and provide clear objectives, regular assessment, and effective role models. In addition, teaching excellence should be promoted and rewarded.

While a diversity of opinions was expressed and there was considerable discussion, the mission, objectives, and planning guidelines were unanimously adopted in June 1998 and became the foundation for planning alternative futures.

Alternative Visions of the Future

In the fall of 1998, the Curriculum Committee appointed two separate task forces to propose alternative futures for the curriculum. They were encouraged to examine the literature and to contact other medical schools to learn what they were doing to create new curricula. Faculty members and students on these task groups contacted and visited other medical schools, including Cornell University, Harvard Medical School, the University of Calgary, UCLA, and the University of Pennsylvania.

Greener Pastures

The Curriculum Committee charged this task force with reviewing the current status of the medical school curriculum and to make recommendations for incremental change. The intent was to build on the strengths of the current curriculum while addressing weaknesses and deficiencies. This task force made 19 recommendations that included improving the quality and consistency of clinical teaching, increasing emphasis on learning how skilled clinicians approach patients, developing a core curriculum that extends throughout the clerkships, strengthening the linkages between the first two years of medical school and the clerkships, creating opportunities for sustained relationships between students and faculty members, and decreasing the subjectivity and inconsistency of evaluations of student clerkship performance.

Blue Sky

The Curriculum Committee charged the second task force with generating both a conceptual framework and an overall design for a bold and entirely new approach to undergraduate medical education. The task force was encouraged to avoid ideas that were essentially modifications of the current curriculum.

The Blue Sky task force's recommendation was to design a curriculum around the theme of "The Contextual Practice of Medicine: Clinician, Scientist, Healer." The task force envisioned a curriculum that would provide students with a broad exposure to the contexts that determine the health and care of individuals who are sick; focus on problem-solving and conceptual understanding; and provide an environment conducive to exploring the humanistic and spiritual aspects of medicine.

The task force proposed a new curricular timeline to weave together the teaching of basic science, clinical science, and social sciences throughout the curriculum; to begin full-time clinical training in the middle of the second year; and to provide students with a minimum of four months in the fourth year to complete an

independent scholarly project.

One of the most radical and intriguing of Blue Sky's proposals related to the need for a new organizational unit to support faculty members who teach in the medical school curriculum: the Academy of Medical Educators. This would comprise a large group of gifted medical educators selected for their interest in and passion for teaching medical students. They would receive funding for teaching, curriculum development, and innovative projects.

Dean's Leadership Retreat

The two task forces worked independently throughout the fall and wrote a combined report for the Dean's Leadership Retreat in January 1999. All the vice and associate deans, department chairs, organized research unit directors, Curriculum Committee members, and School of Medicine Faculty Council members as well as a selected group of students attended the retreat. Half the retreat was devoted to discussing the two task force reports and half to examining how to evaluate and reward teaching.

After discussing Blue Sky's and Greener Pastures' recommendations, the leadership group was asked to prioritize its preferences for the new curriculum. When the votes were cast, most of the highest priorities came from the Blue Sky recommendations. These included creating an Academy of Medical Educators; developing a new structure to better connect students and faculty members in longitudinal relationships; improving clinical teaching by residents and attendings; redesigning the curriculum by integrating basic science content into larger blocks that would span disciplines; creating cross-clerkship structure and content; and establishing a required scholarly project.

The retreat generated a great deal of enthusiasm for educational reform—and especially for the Academy of Medical Educators proposal. The dean had proposed that the school's revenue from UCSF Stanford Health Care be committed entirely to providing incentives for clinical teaching and asked the chairs to determine an equitable way to distribute the annual allocation. At the retreat, the chairs recommended committing the funds to the Academy, thus ensuring its operational support.

Designing a New Curriculum

General Design for the New Curriculum

Following the Leadership Retreat in January 1999, the Curriculum Committee appointed task forces to begin work on each of the high-priority recommendations: Essential Core (the first two years of the curriculum), Clinical Core (third year), Advanced Studies (fourth year), Scholarship (student research and scholarly activities), and Societies (to promote longitudinal relationships between students and faculty members as well as career advising).

The task forces presented preliminary reports at the March 1999 Curriculum Leaders Retreat. This two-day spring retreat became an opportunity to work more intensively on the recommendations of each task force. Using a model adopted by the National Institutes of Health, several behavioral science faculty members helped to move the curriculum plan beyond a simple organ-system model. The NIH model conceptualizes health and illness as comprising three components: biological and genetic, environmental, and behavioral, and the interaction between them. The faculty members used this model to envision new courses and course planning strategies.

The most exciting part of the retreat occurred when Dean Debas made the surprise announcement that he was committing $5 million in matching funds for 20 endowed chairs in the Academy of Medical Educators.

Preliminary Report to Chairs

Planning continued until May 1999, when each of the task forces presented preliminary recommendations to the Curriculum Committee, Faculty Council, and department chairs. A summary report then clustered recommendations under the priorities set at the January 1999 Dean's Leadership Retreat. The recommendations called for redesigning the basic science curriculum into larger, better integrated blocks that would weave together basic, clinical, and social sciences; establishing core clinical competencies and cross-clerkship content through creation of several intersessions; creating more time for advanced electives and a scholarly project; establishing Societies to promote sustained relationships between students and faculty members as well as career advising; and launching an Academy of Medical Educators.

I had hoped to receive enthusiastic endorsement for these proposals. Instead, the chairs' responses ranged from excitement to outrage. Many of them were surprised by the boldness of the recommendations and concerned about endorsing such a broad set of changes without adequate specificity. They requested that broader input be sought throughout the summer so that the faculty as a whole could participate in discussions about the future of the curriculum. They agreed to postpone a vote on support for the plan.

Associate Dean for Curriculum Dr. Helen Loeser and I spent the summer discussing the proposal with most of the departments. Most of these meetings with chairs and faculty were constructive and productive, but a few were hostile and confrontational. Some faculty members saw no need for change and were angry about the prospect of having to spend time planning a new curriculum.

We provided the concerns and new ideas garnered from this process to the two working groups: Essential Core and Clinical Core. We put Advanced Studies (fourth year) on hold until the first three years were configured and the implications for the fourth year became clear.

Further Development of Essential Core (August–December 1999)

A small group of core teaching faculty, some of whom opposed the proposed changes, worked to consolidate ideas and make the Essential Core proposal more specific. Dr. Loeser initially chaired the Essentials Task Force, but in August 1999 she appointed Dr. Donald Ganem to chair a much smaller task force. Dr. Ganem is a highly respected physician-scientist and teacher. His vision, energy, and commitment to create a new curriculum worthy of UCSF were critical to getting Essentials approved. Without his stature and enthusiasm, the Essential Core planning process might have failed.

This small Essentials planning group consisted of some of the best teachers in the basic science curriculum. Besides Dr. Loeser, a pediatrician, and Dr. Ganem, a microbiologist, the group included Diane Colby and Roger Cooke, biochemists; Daniel Lowenstein, a neurologist; Susan Masters, a pharmacologist; Pat Patterson, an anatomist; and Leslie Zimmerman, an internist. This small group worked intensively throughout August and September. In early October, they presented a 30-page document describing how the content would be redistributed in the new structure. They also proposed guidelines for instruction, with half of the time to be used for lectures and half for small groups. Each course committee would be free to determine what formats would work best for their teaching faculty and content, though total contact hours per week would be limited to 24 (20 hours for integrated block courses and 4 hours for Foundations of Patient Care). The committee also recommended increasing the use of Web-related teaching resources.

The proposed curriculum structure began with a Prologue that would present a significant part of the foundations of several subjects, including anatomy, histology, pathology, pharmacology, and culture. The Prologue was followed by a sequence of block courses, each approximately eight weeks in length, including Major Organ Systems (Cardiovascular/Respiratory/Pulmonary) followed by a one-week clinical interlude; then Cancer; Brain, Mind, and Behavior; Infection, Inflammation, and Immunity; Metabolism and Nutrition; Life Cycle; and Case Consolidation. Foundations of Patient Care would continue to run throughout the entire Essential Core and would provide consistent, ongoing focus on medical communication, physical exam skills, clinical reasoning, and professional development.

The one-week clinical immersion experience would occur after the cardiovascular portion of the Major Organ Systems course and just before the December break. In this experience, students would be assigned to a ward team to observe the practice of medicine firsthand and to witness how the scientific and psychosocial topics they had learned relate to the actual care of patients. The goal would be to help them appreciate the importance of mastery of science in medicine and to encourage them to persevere in their efforts to learn.

Each block course would utilize clinical cases that embody major themes within the block. The cases would be chosen to illustrate not only the clinical manifestations of disease but also the related basic science, psychosocial, epidemiological, and public health issues. The cases would serve to unify the course content and motivate learning.

The Essential Core would end with a collection of short consolidation cases. These cases would provide an opportunity to review important clinical topics from the perspective of a student who is ready to begin the Clinical Core, to learn about more complicated clinical topics, to refine differential diagnosis skills, and to offer some structured review for NBME certifying exam Step 1.

The success of the proposed Essential Core curriculum will depend on strong interdepartmental administration and cooperation. Interdepartmental course committees will accomplish detailed planning and

implementation of each block. Each committee will have representation from the basic, clinical, and social sciences. An Essential Core Steering Committee with broad representation will oversee content integration across blocks and make final decisions regarding issues common to all blocks. The basic science chairs proposed that they each serve as stewards of one or two block courses and provide the key faculty and administrative and support staff needed for the course.

Further Developments of the Clinical Core (August–December 1999)

While the Essential Core task group was fleshing out the block courses for the first two years, the Clinical Core task group under the leadership of Dr. Molly Cooke (Medicine) was continuing to work with clerkship directors on three tasks:

1. To complete revision of the clinical objectives expected of every medical student by the end of the third year.
2. To find a workable way to hold intersessions, given that clerkships vary in length (2, 4, 6, and 8 weeks). The solution was to create six 8-week rotations with four 1-week intersessions in between. Preliminary cross-disciplinary themes for these intersessions were identified (e.g., ethics, violence, and pain management), and a general structure for each week was outlined.
3. To shorten the length of the clinical requirements to fit into one year. The Clinical Core will be 54 weeks, with 44 weeks of required clerkships, four weeks of intersessions, a two-week December break, and four additional weeks of vacation and/or elective time. The new eight-week block requirement will include Medicine, Surgery and Anesthesia, Psychiatry and Neurology, Family Medicine and Surgical Specialties (Ophthalmology, Orthopedics, Otolaryngology, and Urology), Obstetrics and Gynecology with two weeks of electives/vacation, and Pediatrics with two weeks of electives/vacation. We introduced two intersessions into Clinical Core in the July 2000 academic year. We will add two additional intersessions when the full curriculum change is implemented.

We are conducting several initiatives to strengthen teaching in the clinical curriculum. UCSF has offered faculty development workshops on topics such as giving feedback, evaluating clinical performance, teaching in the ambulatory setting, and teaching to facilitate learning. The school has also conducted similar workshops with residents and fourth-year students. We expect all clerkships to have clear objectives, an effective means of assessing accomplishment of objectives, and clear grading criteria. We will implement a Web-based evaluation system to improve timely evaluation of student performance and faculty teaching.

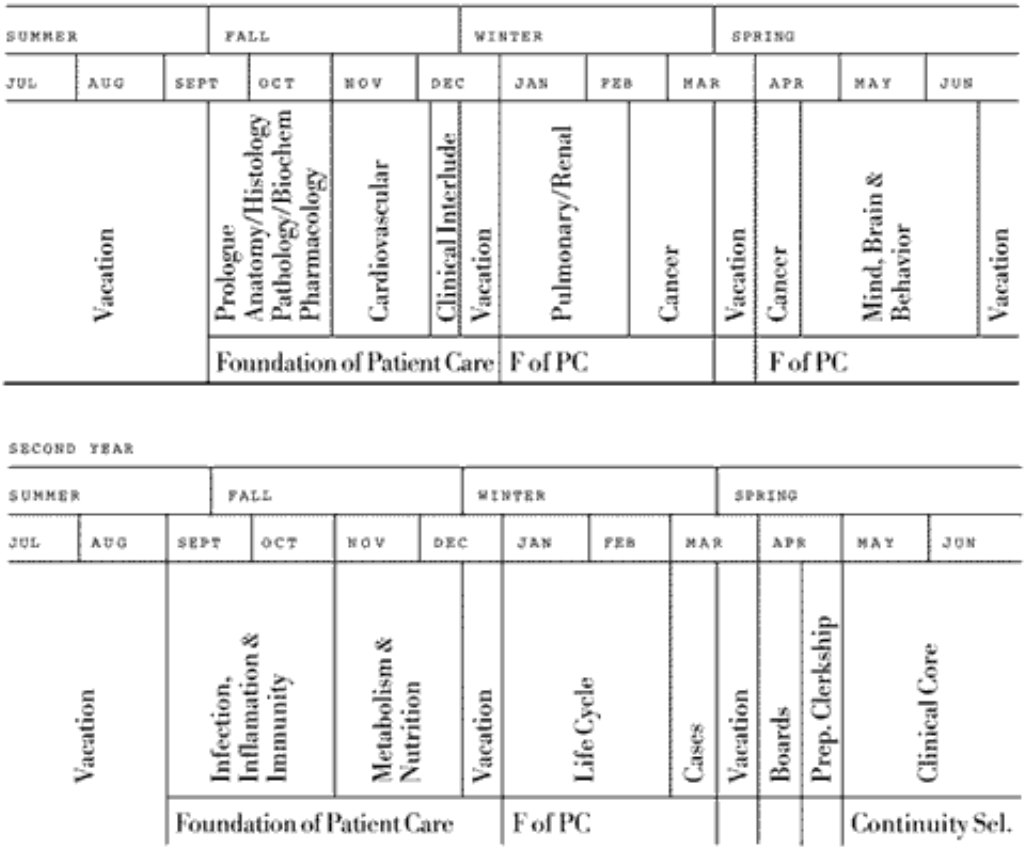
We initiated a new longitudinal ambulatory experience in July 1999 as part of the UME-21 project. One half-day a week for six weeks, students participate in the same practice. We will further develop this longitudinal clinical experience in the new curriculum.

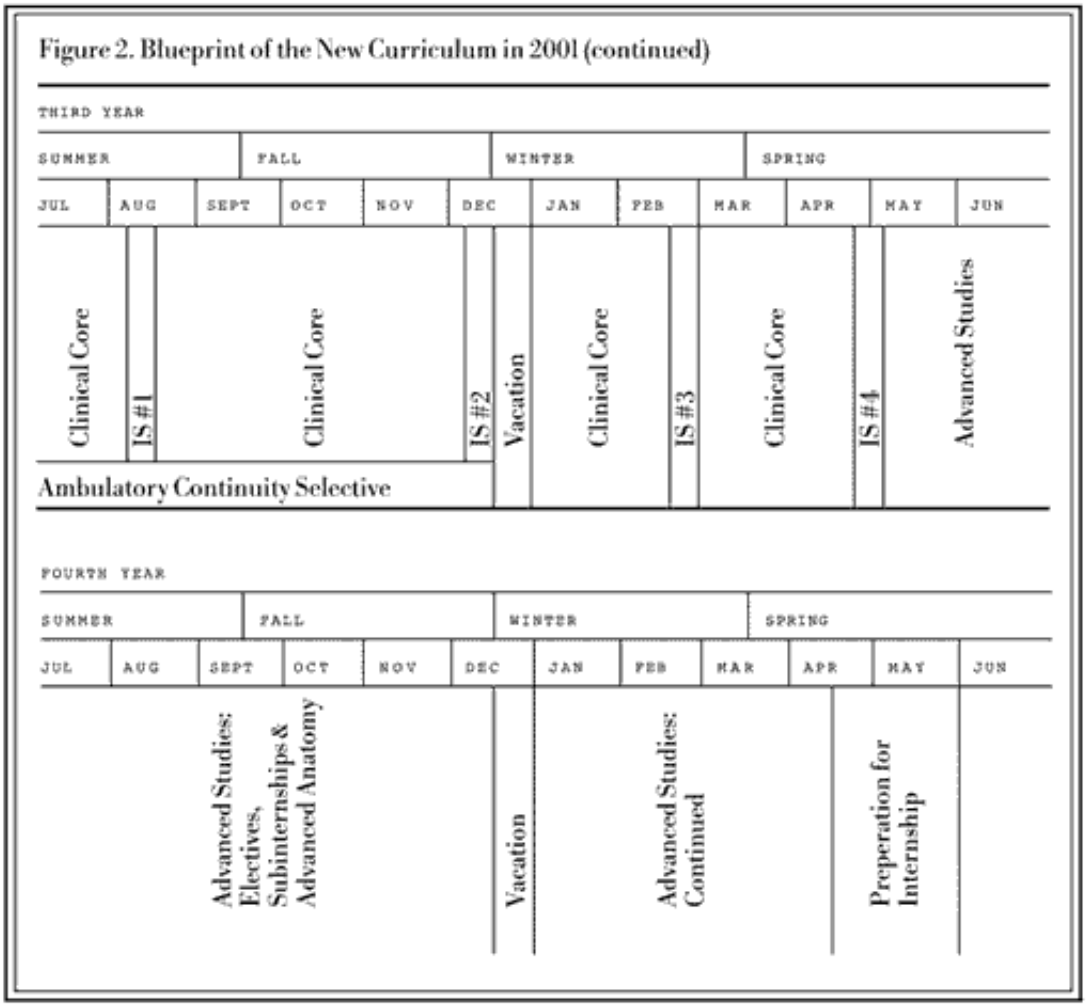
An additional enhancement of the clinical curriculum began in October 1999 with a pilot Objective Structured Clinical Examination to assess individual students' clinical skills and patient communication abilities as well as to assess the curriculum. We gave this eight-station, high-fidelity exam to a sample group of senior students. In this exam format, students see 8–10 trained patients in 10-minute intervals and are required to complete a specific task (e.g., take a focused history, do a physical exam, provide patient education). We videotape the student's performance, and the patient and faculty rate it. This form of assessment will become part of the evaluation process in the future.

Advanced Studies

Planning for the fourth-year curriculum began again in the spring of 2000. The committee recommended requiring a subinternship in medicine or family medicine and an anatomy selective, offering optional research electives, and expanding the course on preparation for internship. The one-month clinical anatomy selective is designed to compensate for the reduction in formal anatomy instruction in the first and second years. One section would be for students going into primary care specialties and the other for students entering surgical specialties. The former would emphasize anatomical features necessary to support effective clinical examinations, common procedures, and interpretation of diagnostic imaging. The latter would highlight dissection as well as correlating diagnostic imaging and related anatomic/pathologic specimens. We will expand the number of research electives to encourage more research. Time will be available for research during the fourth year and in the summer between the first and second years. A research database will communicate research opportunities to students as one means of connecting students with research opportunities. (For a blueprint of the new curriculum, see figure 2.)

Figure 2. Blueprint of the New Curriculum in 2001





Academy of Medical Educators

The "Blue Sky" planning process envisioned a new mechanism to support interdisciplinary teaching of medical students. Following the Leadership Retreat in January 1999, the dean appointed an Academy Task Force to develop a mission statement for the Academy, to articulate its goals and functions, and to develop an organizational structure and a business plan. Dr. Daniel Lowenstein, who conceptualized the Academy, was appointed to serve as the acting director.

A subset of faculty members who are exceptionally gifted teachers have traditionally set the standards of teaching excellence at UCSF and have taken a prominent role in the organization of the curriculum. The Academy of Medical Educators is designed to support and nurture these faculty members and to increase the critical mass of talented and highly motivated teachers without depriving departments of their ongoing responsibilities for medical student education. While departments are the medical school's primary organizational units, the revised undergraduate curriculum requires an integrative and cross-departmental approach to organization, management, and teaching.

The single purpose of the Academy, a "program without walls," is to support teachers of medical students. The functions of the Academy are to support and reward faculty members who are outstanding teachers, to encourage interdisciplinary approaches to undergraduate medical education, to provide funding for innovative educational programs, to sponsor faculty development, and to facilitate mentoring of teachers.

Membership in the Academy is achieved by application and peer review. Full membership requires fulfillment of at least three out of these five criteria: (1) multiple nominations for, or receipt of, teaching awards; (2) leadership in curriculum development; (3) leadership as course director; (4) national scholarship in medical education; and (5) an outstanding track record as a mentor.

Members of the Academy become eligible for endowed chairs for teaching, accelerated faculty promotions, partial salary support for dedicated teaching time, and grants to support innovative teaching efforts and curriculum development. In return, members are expected to take a leadership role in undergraduate

medical education and to mentor junior faculty in teaching.

Over the next five years, UCSF anticipates raising funds for 30 endowed chairs in the Academy. The dean has committed matching funds for 20 chairs that will be jointly shared with individual departments. In addition, the Academy is committed to raising funds for ten "Academy-owned" chairs to be used for support of core leadership positions in the new, integrated curriculum. The typical appointment to an endowed chair will be for a renewable term of five years, subject to the approval of the dean, academy director, and department chair. Support levels will vary but are anticipated to cover 10 to 40 percent of an Academy member's salary.

Faculty members who are not in the Academy will be encouraged to participate in Academy-sponsored programs. Furthermore, Academy membership will also include the category of Academy Fellows—students, residents, and junior faculty members who wish to advance their skills as teachers under the mentorship of a regular member of the Academy. The Teaching Scholars Program, a part-time faculty development fellowship program for educational leaders, will be incorporated into the Academy.

As acting director of the Academy, Dr. Daniel Lowenstein presented recommendations regarding the Academy of Medical Educators to the department chairs in October 1999, and they enthusiastically endorsed them. In the winter of 2000, the dean approved a business plan for the Academy. In the spring, the dean appointed a search committee to select the first director; it recommended Dr. Molly Cooke, and the dean appointed her and created the first endowed chair that summer.

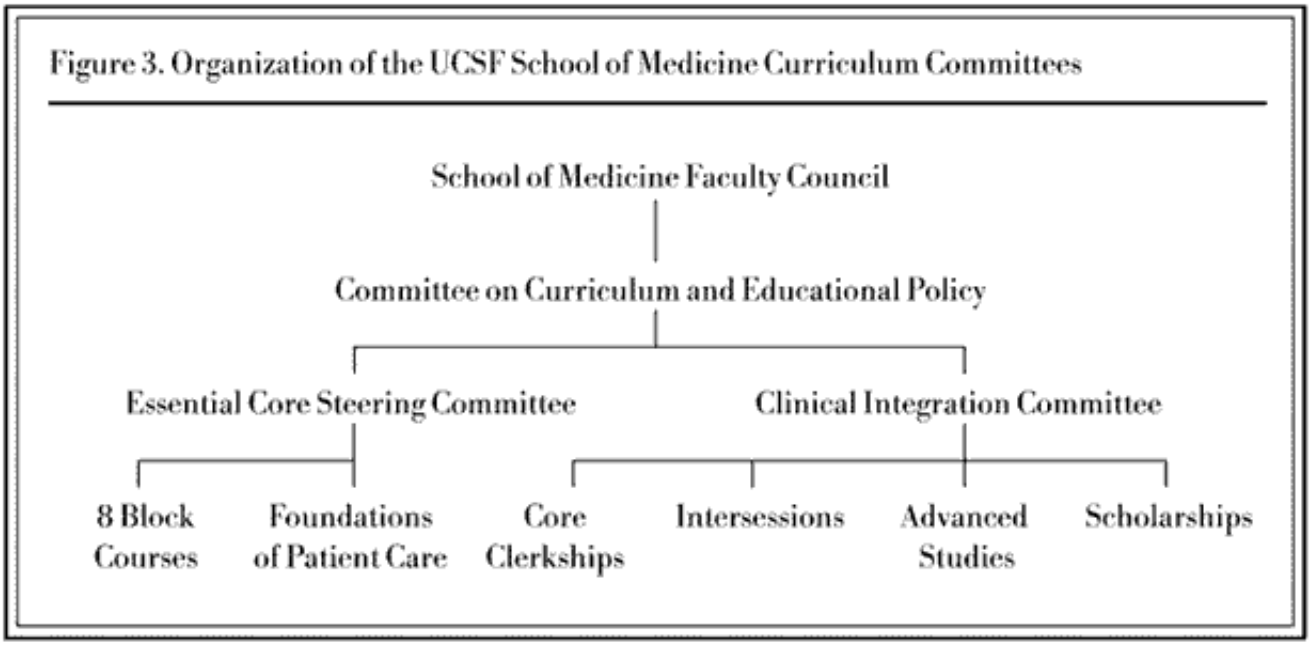
The Academy offers a new multidisciplinary approach for maintaining the highest standards of teaching excellence and is an alternative means for distributing resources in support of the teaching mission of the medical school.

Review and Approval Process

The chairs of each of the task forces presented recommendations for the Essential Core and Clinical Core to the Curriculum Committee, Faculty Council, and the department chairs in meetings held from November 1999 to February 2000. There was virtually unanimous approval and support for the proposals.

As part of the approval process, we created a new curriculum organizational structure. We established a Steering Committee for Essential Core to oversee development and implementation of the Essential Core. The Steering Committee, in turn, appointed the block planning committees. We created a new Steering Committee for the Integrated Clinical Core to monitor development of the Clinical Core clerkships, intersessions, student scholarship, and Advanced Studies. The organizational chart for the Curriculum Committees is found in figure 3.

Figure 3. Organization of the UCSF School of Medicine Curriculum Committees



All the new courses will be on the Web. Selection of Web courseware was a collaborative process involving

UCSF's three other professional schools and the university library. We are creating the new courses on the Web, and a new curriculum database is under development.

We anticipate that implementation will occur in two stages. The Clinical Core was implemented in July 2000 and the new Essential Core will begin in September 2001.

Impact of Curriculum Change

Curriculum change came at a difficult time. During this period of self-examination and planning, UCSF Stanford Health Care was undergoing development, then dissolution. The merger was not well supported by faculty or staff. As deficits mounted during the merger's second year, anger and frustration intensified. Faculty members became wary of new initiatives, tired of promised improvements that never materialized, discouraged by the frustrations of the hospital system, and disheartened by the increasing pressure for clinical productivity at the expense of education. The institutional culture was tense, testy, and not inclined to risk another major change that might make things worse rather than better. Faculty were also unenthusiastic about the amount of planning required to create the new curriculum, and it was difficult to persuade them to work on something that moved so slowly and required so much political negotiation and consultation.

Simultaneously, planning for the new campus at Mission Bay began to take shape. This new biomedical research and teaching campus, when completed in 2020, will be larger than the current campus. Because it is located 20 minutes from the existing campus, faculty members were worried about the separation of basic scientists and clinicians. The planning effort and the resulting tensions created by this new opportunity further strained the faculty's capacity for change.

The process of reviewing the curriculum has had a positive impact, however, on the culture of the school. It has forced reexamination of assumptions about education and science. Clinicians and basic scientists are communicating about what is relevant and important to teach. We have reduced teachers' isolation from one another and from outside constituents. Work with our managed care partners has brought their input into the planning of the clinical curriculum. They have also provided educational experiences for our students.

There is greater oversight of the curriculum. Never before has there been such significant oversight of the content of each course or such an effort to determine the clinical relevance of the content presented. To monitor change and evaluate the new curriculum, a new longitudinal database is being designed to track changes in input, process, and outcomes. Five critical success factors will be monitored: quality and number of applicants, quality of courses and teachers, student well-being, learning outcomes, and practice profiles (specialties, locations, and academic positions).

We have narrowed the gulf between preclinical and clinical curricula. We now see instruction as a continuum of knowledge and skill that is based predominantly in foundational disciplines (basic, social, and clinical sciences) to primarily practice-based disciplines (e.g., medicine, pediatrics, surgery) with support from basic and social sciences.

The Academy of Medical Educators is an innovative idea that would not have surfaced had it not been for the effort to think about the curriculum in a new way. The Academy has spurred the faculty to a new level of excitement about education.

Case Western Reserve University School of Medicine

Marcia Z. Wile and C. Kent Smith

Executive Summary

In the years since the major curriculum "revolution" in 1952, Case Western Reserve University School of Medicine has engaged in an ongoing process of curriculum review, evaluation, and self-examination, including annual education retreats, aimed at ensuring that the curriculum remains responsive to feedback from faculty and students, and open to innovation. In making these reforms, the school has been guided by the premise that the curriculum is basically sound and the assumptions underlying the 1952 curriculum are

still germane in the 21st century. However, the school acknowledged the need for significant improvements in coordination, integration, and delivery of the curriculum, coupled with selective, focused modifications of some components. Students have expressed the need for curricular integration of the first two years, their concern about the six-day school week of the first two years, and the length of the third year. Fourteen months of required core clerkships have reduced the elective time for students to pursue individual interests, including obtaining dual degrees.

The dean and vice dean for medical education, with affirmation from the Committee on Medical Education, established two councils composed of the teaching leadership of the first three years of the curriculum: the Curriculum Leadership Council (CLC), with responsibility for the strategic planning, content, design, selection of teaching leadership, and oversight of the Core Academic Program in the first two years; and the Clinical Rotation Development Council (CRDC), with responsibility for the core clerkships in the third year. We implemented the reformed curriculum for the first two years in August 1999 with the Class of 2003. The revised curriculum for the third year started in July 2000 with the Class of 2002.

Structural Changes in Years I and II

The principal goals of the first year of the reform effort were to improve integration and coordination within and among the basic science and clinical science components of the curriculum. Sequencing of normal structure, function, and pathophysiology of each organ system was reorganized to create a consistent pedagogic structure throughout Years I and II. In the new curriculum, all of the body's organ systems are covered from the standpoint of normal anatomy and physiology (in Year I), prior to revisiting each organ system from the standpoint of pathophysiology (in Year II). The reform substituted a more comprehensive introduction to the macrostructure and microstructure of the human body and revised gross anatomy and histology teaching. The elimination of Saturday classes resulted in a net loss of 8.5 percent of scheduled time.

Year III: 12-Month Core Clerkship Year

Scheduling a 12-month core clerkship year was the CRDC's first project. Among the purposes was to allow increased time for research and for pursuing dual degrees in the fourth year. Educational priorities included opportunities for interdisciplinary integration with a cohesive education across the entire third year. Preserving clerkship integrity and core inpatient experience was also important. Through a process of negotiation, we eliminated the one-month Primary Care Clerkship and a 48-week schedule consisting of three 16-week blocks evolved.

> Block 1: Neurosciences (4 weeks), Psychiatry (4 weeks), Surgery (8 weeks)
>
> Block 2: Inpatient Medicine (8 weeks), Ambulatory Medicine (3 weeks), Family Medicine (4 weeks), Psychiatry (1 week)
>
> Block 3: Obstetrics/Gynecology (7 weeks), Newborn Nursery (1 week), Inpatient Pediatrics (4 weeks), Ambulatory Pediatrics (3 weeks), Psychiatry (1 week)

Continuity learning groups are required on an ongoing basis; they will allow students to process their clinical experiences in a structured, nonjudgmental setting and explore topics in professionalism, ethics, and communication relevant to clinical practice.

Major Issues Related to the Learning Environment

Major learning environment issues were: development of learning objectives for every component of the curriculum; continued development of the Electronic Curriculum, with integrated Web-based electronic resources for the entire four-year curriculum to improve opportunities for self-directed learning, exploration, and integrated evaluation; and increasing student accountability to the curriculum.

Introduction

Case Western Reserve University (CWRU) is a major independent research university located in Cleveland, Ohio's University Circle, a 550-acre concentration of approximately 50 cultural, medical, educational, social service, and religious institutions. The origin of Western Reserve University dates to 1826; the School of Medicine was established in 1843. However, the university in its present form is the result of the 1967 federation of Western Reserve University with Case Institute of Technology. CWRU is a national university

with strong regional roots and education, research, and service missions. The university is private, but receives some state support for the medical school. It has a clear and constructive relationship with other state medical schools through the Board of Regents, the statewide Area Health Education Center, and other mechanisms.

For more than 150 years, the CWRU School of Medicine has earned an international reputation for excellence in medical education and research. From its earliest days, the school has been a leader in medical education. In 1902, Abraham Flexner, who conducted an extensive study of United States medical schools, reported that Western Reserve was second only to Johns Hopkins as the best medical school in the country. Fifty years later, the school initiated the most progressive medical curriculum in the country at the time. The innovations included: organ-system-based teaching of the basic sciences by "subject committees" (interdisciplinary faculty teams), introduction to patients and clinical experiences beginning in the first year, anonymity in grading and pass/fail system in the first two years, unscheduled afternoon time in the first two years, traditional discipline-based core clerkships, opportunities for independent learning in the elective program, and faculty ownership of the curriculum.

Four CWRU educators have been recipients of the Association of American Medical Colleges' Abraham Flexner Award for Distinguished Service to Medical Education. Joseph T. Wearn, M.D., T. Hale Ham, M.D., and John L. Caughey, Jr., M.D., received their Flexner awards for developing and implementing the 1952 curriculum. Dean Emeritus Frederick C. Robbins, M.D., a Nobel prize winner for developing the propagation of poliovirus for tissue culture, was the fourth CWRU winner of the Flexner Award, in recognition of his educational leadership.

While acknowledging its history with pride, the school anticipates continuing its role as a leader in medical education, research, and patient care well into the next century. In 1999 there were 279 full-time basic science and 1,222 clinical science faculty, and 114 part-time basic science and 1,978 part-time clinical science faculty, for a total of 3,593 faculty members in the School of Medicine. An entering class of 145, of which 60 percent are Ohio residents, leads to a student body of 580 undergraduate medical students, including a significant number enrolled in the school's expanding Medical Scientist Training Program and other dual degree programs in the academic year 1999–2000. CWRU School of Medicine has four major affiliated hospitals; none is owned by the university.

The School of Medicine also has a strong tradition as a research institution. The school in 1999 was 13th among the nation's 124 medical schools in research support from the National Institutes of Health (NIH). Included in the school's $200 million annual budget is $142 million in sponsored research, primarily from the NIH. The school's large and diversified research program is the result of the conviction that exemplary research procedure and skill are prerequisites for excellence in the education of both physicians and Ph.D. scientists.

Nearly five decades have passed since the faculty and administration of CWRU School of Medicine undertook fundamental and sweeping reform of the medical school curriculum, a process that led to profound change not only at CWRU but at medical schools nationally and internationally. The new curriculum that was implemented in 1952 advanced to a second stage in 1968. These stages of the curriculum are described in detail in the book, *Western Reserve's Experiment in Medical Education and Its Outcome* (ed. Greer Williams [New York: Oxford University Press, 1980]).

Robert H. Ebert, M.D., former chair of the Department of Medicine, listed in the book's foreword (p. vii) what he considered to be the underlying assumptions on which the "revolutionary Reserve" curriculum of 1952 was based:

1. It is impossible to learn everything there is to know in medicine. Therefore, some selections must be made and this is the responsibility of the faculty at large.
2. The curriculum should be designed as a logical continuum by the faculty as a whole and not by departments.
3. Teaching should be interdisciplinary since medical knowledge is derivative and depends on many disciplines. Disciplinary teaching, both clinical and preclinical, tends to hinder the integration of medical knowledge and causes the student to compartmentalize his or her thinking.
4. The medical school curriculum should not be sharply divided between preclinical science and clinical medicine. Rather, there should always be a mix, gradually changing from one with a major emphasis on the basic medical sciences to one with a major emphasis on clinical medicine.
5. The product of this educational experience should be an undifferentiated physician, educated to think scientifically, but imbued with a humane concern for the individual patient. All physicians, whether

they intend to become surgeons or family physicians, should have the same basic medical education before they specialize.

Rationale for Curriculum Change

In the years since the major curriculum "revolution" in 1952, the School of Medicine has engaged in an ongoing process of curriculum review, evaluation, and self-examination, including annual education retreats, aimed at ensuring that the curriculum remains responsive to feedback from faculty and students, and open to innovation. As the trends in health care change so does the curriculum; the school continually reviews and updates its content to prepare students for their role in the next century.

New curriculum reforms have grown out of this ongoing process and have been designed in particular to respond to specific opportunities and areas of concern identified during the past decade. As one of the 23 schools participating in the Association of American Medical Colleges' Medical School Objectives Project (MSOP), the school also has a national perspective on curriculum change.

The new reforms were guided by the premise that the curriculum is basically sound and the assumptions underlying the 1952 curriculum are still germane in the 21st century. However, we acknowledged the need for significant improvements in coordination, integration, and delivery of the curriculum, coupled with selective, focused modifications of some components. Students expressed the need for curricular integration of the first two years, concern about the six-day school week of the first two years, and the length of the third year (actually 14 months of required core clerkships, which reduced the elective time for students to pursue individual interests, including obtaining dual degrees).

The rationale and need for change was also influenced and accelerated by the dramatic changes in the science and health care environment and hospital affiliations, and monumental developments in informatics (computer technology used for encoding, storage, communication, manipulation, and use of information in digital form) and the Internet. The impact of managed care, hospital closings, increased demands on the clinical faculty, and need for more generalist physicians and generalist physician leaders presented challenges.

CWRU School of Medicine is a forerunner in the development and implementation of a curriculum that is optimally enhanced by modern technologies to provide opportunities for self-directed learning and exploration. It was the first medical school in the country to provide laptop computers to its first-year students, starting with the class of 1997, matriculating in 1993. In 1989, CWRU became the nation's first university campus to develop an all fiber-optic computer network by launching CWRUnet. All medical students have access to this network, both from their desks on campus through Ethernet connection and off campus through modems. Today's curriculum uses laptop computers for effective communication in the ongoing information explosion while strengthening the group dynamics and problem-solving skills that will be required in tomorrow's health care environment.

This report focuses on the new first-year curriculum initiated with the class entering in August 1999 (Class of 2003), the activities relating to the revised second-year curriculum to start in August 2000 with the Class of 2003, and the third-year core clerkships implemented in the 2000–2001 academic year with the Class of 2002. The school officially designated the four years of the new curriculum as Years I, II, III, and IV, replacing the previous terminology of Years One, Two, Three, and Four.

This document also includes a description of the school's Electronic Curriculum and information about the Robert Wood Johnson Foundation Generalist Physician Initiative, which started in 1994 with the Class of 1998. A guiding principle of the curriculum renewal efforts is the school's statement of purpose:

> Case Western Reserve University School of Medicine will graduate physicians who: have a scholarly foundation in the basic and clinical sciences, [have] recognized expertise in individually selected areas of special interest, possess the ability to integrate science and humanistic values across disciplines, are responsive to the needs of individual patients and to their communities, and take the initiative to become scholars and leaders in their chosen fields.

The curriculum renewal endeavor started in the summer of 1997 with the goal of implementing a revised curriculum for the first-year class entering in August 1999 and full implementation by June 2003. The Steering Committee of the Curriculum Revision Project and the Committee on Medical Ethics sent a mailing to all faculty inviting them to identify content that should be included in the first two years and to submit this

information to the Committee on Medical Education by December 1997. The vice dean for medical education and academic affairs assembled an Advisory Committee with broad representation from basic science, clinical departments, students, and alumni to develop the overall goals and themes of the curriculum. An Administrative Steering Committee had the task of coordinating ongoing activities. A School of Management faculty member served as organizational change consultant. The Administrative Steering Committee created several working groups: Integrated Basic Science Content; Integrated Clinical Science Content; Elective Program; Teaching and Learning Methods; Evaluation; and Professionalism. A faculty retreat was held in February 1998 and faculty members were encouraged to present their ideas to the Committee on Medical Education after the retreat.

In January 1999, the chair of the Committee on Medical Education and the coordinator of the Core Academic Program presented a proposed schedule and organization of the revised first-year curriculum to the faculty. The faculty felt more input from the teaching leadership was desirable and necessary for effective curricular reform. To accomplish this, the dean and the vice dean for Medical Education and Academic Affairs, with affirmation from the Committee on Medical Education, established two councils composed of the teaching leadership of the first three years of the curriculum: the Curriculum Leadership Council and the Clinical Rotation Development Council.

Curriculum Leadership Council

The Curriculum Leadership Council (CLC), composed of the basic science and clinical science faculty teaching leadership of the first two years, was established in February 1999. David M. Katz, Ph.D., the chair of the second-year Nervous System Subject Committee and an elected member of the Committee on Medical Education was appointed as CLC chair. The CLC is responsible for the strategic planning, content, design, selection of teaching leadership, and oversight of the Core Academic Program for Years I and II. Its members jointly oversee integration and coordination among the basic science and clinical science components of the two-year curriculum. The faculty teaching leadership is actively engaged in an ongoing, cooperative effort to deliver a better-coordinated, better-integrated, and higher-quality curriculum. The subject committee chairs are more aware of what each other's committee is teaching after having conducted an hour-by-hour review of the curricula for both Year I and Year II.

Starting Assumptions

The existing organ-system-based curriculum is basically sound. The primary needs are:

- Significant improvements in coordination, integration, and delivery of the curriculum
- Selective, focused modifications of the curriculum
- Specific efforts to elevate the intellectual level of the learning process
- Structural changes that are consonant with educational goals.

Years I and II: Structural Changes

- Reorganization of the sequencing of normal structure, function, and pathophysiology of each organ system to create a consistent pedagogic structure throughout Years I and II
    - The major emphasis in Year I is on normal structure and function of each organ system, whereas the major emphasis in Year II is on pathophysiology
    - The endocrine, reproductive, gastrointestinal, and musculoskeletal systems are now each taught in a two-year sequence, as was already the case for the other organ systems
    - The basic concepts introduced in Year I are revisited and reinforced in Year II
- Seamless integration with the basic science disciplines
- Reorganization of the teaching of gross anatomy and histology
    - Hold students accountable for mastering these components of the curriculum
    - Create a clear line of faculty accountability
- Coordination of the oversight for major longitudinal themes, i.e., geriatrics, cancer biology
- Elimination of Saturday classes
- Integration of the basic and clinical sciences in Year I

Major Issues Related to the Learning Environment

- Development of learning objectives for every component of the curriculum
- Development of electronic integrated Web-based electronic resources for the entire four-year curriculum to improve opportunities for self-directed learning, exploration, and integrated evaluation

- Increased student accountability to the CWRU curriculum

Characteristics of Curriculum Change

Coordination and Integration: Revision of the Curriculum Governance Structure in the New Year I and Year II Curricula

Since its curriculum was revised in 1952, CWRU has continued to develop innovative approaches for combining education in the basic biomedical sciences during the first two years with early exposure of students to patients and clinical problem-solving. The addition of the Core Physician Development Program (CPDP), a longitudinal-problem-based learning course, in the past decade led to a further expansion of the Patient-Based Program components in Years I and II. Feedback from students and faculty revealed that significant opportunities to integrate teaching of the basic sciences and clinical sciences were being missed through a lack of coordination among the various components of the curriculum of the first two years. The Curriculum Leadership Council, composed of all of the basic science subject committee chairs and the directors of the Clinical Science Program in the first two years, is the keystone for this effort.

In addition, the Clinical Science Program directors decided to combine their activities into a single coordinated program, the Integrated Clinical Experience (ICE). Individual components of the ICE program remain unchanged. These are the Clinical Science lectures, preceptor groups, interviewing, the renowned Family Care Program, the CPDP problem-based learning groups, the Fundamentals of Medical Decision-Making course, and the journal club. The result of this restructuring is that the various components of the ICE program use the same clinical case models, which are directly related to the concurrent basic science content. These changes not only provide a more cohesive Clinical Science Program but will considerably strengthen the use of clinical correlations for reinforcing basic science content.

As of August 2000, the Clinical Science Program includes another component: the teaching of Physical Diagnosis in Year I. First-year students participate in Physical Diagnosis I weekly, from mid-September through mid-December. Students meet in clinics for two to two and a half hours one evening a week for 12 weeks. The Clinical Science Program is now known as the Introduction to Clinical Medicine (ICM) Program, and consists of the first two-year components of the school's Patient-Based Program. The coordinator of the Patient-Based Program, Jay B. Wish, M.D., chairs the ICM, and there are different co-directors for the various components of the overall program. The ICM coordinator and co-directors reevaluated and reformulated the goals of the ICM curriculum for the 2000–2001 academic year into the following format:

- doctoring, including doctor-patient relationship skills, communication skills, physical examination skills, and professionalism
- evidence-based medicine, including epidemiology and biostatistics and critical appraisal skills
- ethics
- public health and economics
- applications of clinical science to basic science
- problem-based learning skills/self-directed learning skills (Year I)
- clinical reasoning skills (Year II)
- group process and teamwork skills

Restructuring the Sequence of Topics in Years I and II

The CWRU curriculum was originally designed so that the major emphasis in the first year would be on normal structure and function, and in the second year on pathophysiology. However, over time, some components of the curriculum had drifted from this principle so that students were being exposed to rather detailed pathophysiology in Year One prior to completing coverage of normal structure and function of related organ systems. As one example, students were learning about osteoporosis prior to learning about normal endocrine function. Therefore, in the new curriculum, the normal anatomy and physiology of the organ systems are covered prior to revisiting each organ system from the standpoint of pathophysiology. This is not to say that basic science and clinical science are divorced. Clinical correlations continue to be used in Year I to illustrate basic science principles. In fact, the use of clinical correlations is strengthened in the new curriculum by the deliberate integration of the basic science and clinical programs and by the use of paradigmatic diseases across multiple subject committees. Although the organ system approach has been successful and both gross and histologic anatomy are well integrated, the CLC felt a more comprehensive introduction to the human body was needed and initiated this in the first-year curriculum starting in August 1999.

Themes in the Year I and II Curriculum

Some topics in basic and clinical biomedical science are relevant to multiple components of the curriculum for Years I and II and therefore are integrated throughout the two years. These topics include geriatrics, growth and development, and cancer biology. Multiple strategies are used to accomplish this integration.

Elimination of Saturday Classes in Years I and II

Traditionally, scheduled activities in the CWRU medical school curriculum have occurred on Monday through Saturday, between 8 A.M. and 12 noon, with afternoon time reserved for the Family Care Program, the Interviewing Program, Physical Diagnosis, electives, research, and individual study. In the new Year I curriculum as of the 1999–2000 academic year, scheduled activities take place Monday through Friday: between 8 A.M. and 12 noon on Monday, Tuesday, and Thursday; and between 8 A.M. and 1 P.M. on Wednesday and Friday. This resulted in a net loss of 8.5 percent of scheduled time, which was accommodated in various ways by each of the subject committees, including elimination of unnecessary redundancy. As of the 2000–2001 academic year, Saturday classes are eliminated in Year II. One goal of eliminating Saturday classes was to open up a time slot for optional activities, such as reviews, that would not conflict with the students' very full afternoon schedules.

Student Accountability to the CWRU Curriculum in the First Two Years

The integrated nature of the traditional CWRU curriculum had unintended consequences for evaluation of student mastery of gross anatomy and histology. In any one subject committee, gross anatomy may account for a relatively small percentage of the total hours of material presented. Since the subject committee interim examinations are constructed to reflect the proportional representation of topics within the subject committee, students could do poorly on gross anatomy and still pass the subject committee. To remedy this, gross anatomy and histology teaching remain integrated, but the scores are kept separate and each student receives a gross anatomy subject committee cumulative score and a histology subject committee cumulative score. Students are required to pass this material at the same level as any other component of the curriculum. As of the 2000–2001 Year II academic year, pathology scores are kept separate and students are responsible for mastering pathology content.

Evaluation of the Year I and Year II Programs

The evaluation system of the previous Year One educational program was retained for Year I of the new curriculum and Year II of the Core Academic Program in the 1999–2000 academic year. These procedures, approved by the Committee on Medical Education and the Committee on Students, have worked successfully. Interim examinations, administered at the end of the first- and second-year subject committees or sections of the Core Academic Program, are used to assess interval performance and to guide students and faculty in planning effective learning and teaching strategies. The faculty creates a comprehensive examination, administered at the end of the first year. All examinations are secure. The Office of Biomedical Information Technologies is developing a computer-based examination delivery system that will link students to the appropriate material in the Electronic Curriculum to help them remediate content they have missed on the examination. Students must also complete the requirements of all components of the curriculum in a satisfactory manner. The Committee on Students is charged with final recommendations regarding promotion and graduation. At the end of Year I of the new curriculum, the Committee on Students reviewed the evaluation protocols.

Third-Year Curriculum Revision: Driving Forces

In the 1999–2000 academic year core clerkship requirements were three months of medicine, two months each of pediatrics, surgery, obstetrics/gynecology, psychiatry, and family medicine/primary care, and one month of neurosciences, for a total of 14 months. This required students to complete their core clerkship requirements during July and August of the fourth year, making it difficult for them to do concentrated research, pursue dual degrees, accept acting internships, or take other career exploration electives prior to making decisions regarding residency applications. As a result, the school decided to reduce the duration of core clerkship requirements in stages, toward the goal of a 12-month core clerkship year starting July 2000.

Additional factors that motivated the revision of the third-year curriculum included efforts to promote integration of teaching in the clerkships; to improve the consistency of teaching, content, and evaluation across clerkship sites; to increase reinforcement of basic science knowledge during the third and fourth years; and to improve the availability of hospital sites for clerkship rotations.

For 1999–2000, we viewed the third-year curriculum as a temporary, transitional iteration to pilot a number of changes in both form and content for potential incorporation in future years. The CRDC developed a plan to allow students to complete all core clerkship requirements during the third year except for neurosciences, which could be taken any time during the fourth year. For this transition year, the duration of core clerkships was in multiples of four weeks rather than multiples of one month. Core clerkships in pediatrics, surgery, obstetrics/gynecology, and psychiatry changed from two months to eight weeks in length. We eliminated the primary care month of the family-medicine/primary care clerkship. We combined four weeks of family medicine with 12 weeks of medicine into a 16-week block. The total duration of the core clerkships during the third year was 48 weeks. There were two weeks of vacation time at Christmas/New Year's and one week of vacation time at the end of June, prior to commencing the fourth year.

Clinical Rotation Development Council

The Clinical Rotation Development Council (CRDC), which parallels the Curriculum Leadership Council for the clerkship year, was established in April 1999. The CRDC's chair is Marjorie Greenfield, M.D., who is also an elected member of the Committee on Medical Education and a former director and educational coordinator of the obstetrics/gynecology clerkships. Its function is "faculty-driven consensus-based curriculum revision" for a 12-month core clerkship program beginning July 2000, with students completing all required clerkships by July 1 of their fourth year as its goal.

Although all clerkship directors are members of the CRDC, the group was too large and clinicians could not meet regularly. Therefore, the CRDC designated a Steering Committee, with representatives from each core clerkship discipline, the Primary Care Track, and Administration. Its purposes were to obtain goals and ideas from the faculty and to make the process an inclusive one—"concerns voiced during the process will carry more weight than complaints after the fact." The Steering Committee presented its recommendations to the full CRDC for comments and ratification at an all-day retreat in September 1999 attended by clerkship directors, departmental representatives, administrators, and students.

Process

The CRDC chair and a medical educator interviewed a total of 40 clerkship directors and clinical department chairs about the overall goals of the clerkship year, the current strengths and weaknesses in the clerkships, the skills, attitudes, and knowledge that physicians of the future will need, and a personal wish list. They sent surveys to the same 40 interviewees and conducted focus groups with 15 students and six residents. The CRDC presented the results of the interviews and surveys at the September 1999 retreat and requested priorities.

First CRDC Project: The Schedule

The CRDC chose the third-year schedule as its first project because the students' highest priority was third-year curricular change, because commitments were made to the students in 1999 that a change would be made, because the Dean charged it with clearing the fourth year of requirements to allow students more flexibility, and because it was scheduled to be implemented in the 2000–2001 academic year.

12-Month Schedule Quest

Priorities were based on the data collected from the interviews, surveys, and September 1999 retreat. The Steering Committee included representatives of all sites, clerkship departments, and affected programs. It sought out clerkship schedules from other medical schools. It reviewed the Liaison Committee on Medical Education's guidelines regarding which disciplines and which aspects of care should be included in clerkships.

Principles

Determining the clerkship schedule was a process of negotiation, and the CRDC interpreted "consensus" as "we can live with it." The CRDC heard all stakeholders and sought creative solutions. No new rotations were considered, and the existing ones would be consolidated. A proposed schedule was to be ready by the next all-day retreat in November 1999.

Priorities

Priorities in creating the 12-month schedule were: maintaining clerkship integrity, providing opportunities for

interdisciplinary integration and cohesive education across the year, and preserving the core inpatient experience. Other considerations were: improving the continuity of relationships with patients, faculty, peers; incorporating unassigned core topics such as ethics, communication, and ophthalmology; and providing adequate ambulatory coverage.

The Negotiation

The CRDC requested faculty members to submit proposals for one-year schedules. It reviewed fifteen proposed schedules and their variations. During the process of negotiation, the CRDC emphasized fairness to all stakeholders and gaining consensus. A final 48-week schedule consisting of three 16-week blocks evolved, as shown in figure 1.

Figure 1. 12-Month Block Schedule. Numbers indicate number of weeks;
❊ = open weeks for vacation or activities

BLOCK 1	BLOCK 2	BLOCK 3
Neurosciences - 4	Inpatient Medicine - 8	Obstetrics/Gynecology - 7
Psychiatry - 4	❊❊	Nursery - 1
General Surgery - 8	Family Medicine - 4	Inpatient Pediatrics - 4
	Psychiatry - 1	Ambulatory Pediatrics - 3
	Ambulatory Medicine - 3	Psychiatry - 1
❊		❊

Within the blocks, 4- and 8-week units can be exchanged. The CRDC proposed a two-week vacation period at the end of the year and a one-week spring break. The chair of the CRDC presented the final schedule at the retreat on November 12, 1999, and then to the Committee on Medical Education on December 9, 1999. The Committee on Medical Education approved the process. The Faculty Council approved the schedule in December 1999. The chair of the Faculty Council reported the favorable vote for the 12-month core clerkship year to the Faculty of Medicine at its January 2000 meeting. When the CRDC chair presented this schedule to the current second-year students, the first class to rotate into the 12-month clerkship year, they were enthusiastic and pleased.

Continuity Learning Groups: The Contemporary Learning in Clinical Settings (CLICS) Program

The mission of the continuity learning groups is to allow third-year medical students to process their clinical experiences in a structured, nonjudgmental setting and to explore topics in professionalism, ethics, and communication that are relevant to clinical practice. Through participation in this required program, small groups of students, led by a faculty facilitator, develop continuity of relationships with fellow students and faculty leaders, engage in self-reflection about the third-year experience, identify and discuss strategies to maximize learning in diverse clinical settings, and acquire basic knowledge about specific topics in their clinical experiences.

Each continuity group consists of one or two faculty preceptors, a fourth-year student, and 10 third-year students. The groups meet on the third Tuesday of each four-week clerkship block from 4 to 6 P.M. throughout the entire year. This is a required component of each four-week clerkship block, with a total of 12 sessions. The topics, with readings and learning objectives, consist of a variety of topics not covered

elsewhere in the third year. The topics are explored from the vantage point of the students, using their real-life experiences, in an environment that supports personal growth and reflection.

The principle supporting the CLICS program is the need of third-year students to reflect on their experiences in a structured way. The sequenced topics support personal growth, learner development, and basic content. The first four topics planned for the 2000-2001 CLICS program are "Adjusting to the Third Year," "Professional Boundaries," "Ethical Issues Unique to the Medical Student," and "Difficult Patient Encounters."

Evaluation of Year III Clerkships

The current student evaluation process for the core clerkships was retained for the 1999–2000 academic year as well as for the 12-month clerkship year starting in July 2000. The effectiveness of the curriculum changes will be assessed through student performance on standardized examinations, student satisfaction surveys (distributed at the end of each core clerkship), the Association of American Medical Colleges' fourth-year student questionnaire, and input obtained at the quarterly meetings of clerkship directors.

The Future of the CRDC

Plans are for whole-day retreats once or twice per year for the full CRDC and other faculty, and a few extended afternoon meetings if questions arise that need full participation. The CRDC Steering Committee will meet monthly as necessary. Working groups established by the Steering Committee for projects will meet as needed. Information will be sent by e-mail to the full group for comments.

The Electronic Curriculum

In 1992, the School of Medicine initiated the conversion of its 6,000-plus page syllabus for the basic science curriculum for the first two years of the Core Academic Program to an electronic format. The electronic syllabus has evolved into a Web-based Electronic Curriculum (EC) through the four-year curriculum. It provides the students with Web-based learning objectives and with resources to achieve the learning objectives for each student-faculty interaction, as well as a means of communicating electronically with the faculty. Student-faculty interactions include lectures, small group discussions, problem sessions, laboratories, clinical cases, core clinical rotations, and clinical electives.

For each student-faculty interaction, this multimedia, hyperlinked electronic learning resource contains:

1. an identifying title
2. the name of the faculty member in charge of the interaction
3. a hyperlink to that faculty member's personal homepage on the Web
4. a hyperlink for writing an e-mail message to the faculty member
5. a hyperlink to an electronic bulletin board where questions and answers can be posted by students and faculty
6. a hyperlink to a question bank that students can use for self-evaluation
7. a hyperlink to a medical dictionary
8. learning objectives for the student-faculty interaction
9. a reference or hyperlinks to a learning resource or resources that allow the students to achieve the learning objectives

These resources may include traditional print textbooks, manuscripts from the literature, hotlinks to other sections of the EC, or hotlinks to electronic resources (electronic textbooks, computer-based simulation programs, original literature in electronic format, etc.). The learning resources may also include original material created by the faculty.

The EC is also available on CD-ROM or can be downloaded to the hard drive of the individual student's computer. This allows students access to this resource independent of connectivity to the Internet. Of course, other Web-based resources, such as linking to the medical dictionary or e-mailing the faculty member in charge of a subject committee or section, are not accessible in this portable format.

The EC facilitates active learning and enhanced interactions with the faculty. Faculty members are encouraged to include hotlinks to electronic learning resources whenever appropriate to provide immediate access to the resource. Faculty may create their own learning resources, such as textual material, illustrations, digitized slide collections, voice-annotated slides, sound files, video clips, or PowerPoint files of

class presentations. We have established a collaboration with the Cleveland Institute of Art to create original animations and illustrations to facilitate the learning of difficult concepts. Three such animations have been created to date, and added to the EC.

The dean established the Office of Biomedical Information Technologies in 1996 to develop, deliver, and coordinate the use of computer-based learning resources throughout the medical curriculum.

The Primary Care Track

The mission of the Primary Care Track (PCT) is to provide an innovative educational environment that encourages students to explore primary care while supplying them with an outstanding foundation for any career in medicine. The program began with the class of 1998, as the Robert Wood Johnson Foundation Generalist Physician Initiative.

In the first two years of medical school, students in the PCT complete the same Core Academic Program as their classmates. In addition, they begin physical diagnosis training in the first year and practice these skills in a community-based longitudinal primary care continuity experience. They also participate in a seminar series devoted to topics of interest to future primary care physicians. In the summer between the first and second years of medical school, students in the PCT complete a project of inquiry in primary care.

The third year of the PCT covers the core clerkships of Medicine, Pediatrics, Obstetrics/Gynecology, Surgery, Family Medicine, and Psychiatry in an integrated fashion, across twelve months. Each student spends the entire third year at a participating affiliated hospital. Across these sites, the classic third-year focus on core clinical knowledge and skill development is preserved. Each student's performance is evaluated according to the usual criteria for the core clerkships. In addition, each student participates in a primary care continuity clinic, a series of small group tutorials focused on interdisciplinary topics, and an end-of-year generalist-objective-structured clinical examination.

Year four of the PCT is designed to give students considerable time for electives. A Health Policy clerkship is required of PCT students.

Interest in the PCT among students continues to grow. Approximately 30 students in each class now participate. A record number of students applied to enter in the 1999–2000 year (39 applicants for 30 spaces). PCT has grown from 10 students in the first class, which started in summer 1994, to 114 students distributed across all four years of medical school in the spring of 2000. Over the past three years, 79 percent of graduating PCT students have entered primary care residencies, compared with 43 percent of non-PCT students at CWRU.

Two innovations in education developed and tested in the PCT have been incorporated in the traditional curriculum in the 2000–2001 academic year. These are physical diagnosis in Year I and integrated interdisciplinary learning in the 12-month clerkship in Year III.

Dynamics of Curriculum Change

The following principles were critical in effecting change:

- Involving of stakeholders early and persistently, including faculty, department chairs, and students
- Developing consensus on the principles to guide innovation
- Identifying ways for all stakeholders to benefit from the changes, especially the faculty who contributed time and effort
- Identifying "core" content felt to be important for every student
- Making students accountable to the curriculum

Impact of Curriculum Change

The curriculum reform has had a major effect on the structure for medical education. The dean of the School of Medicine charged a faculty committee to examine the organization of the educational authority and curriculum governance. The chair of this committee presented the proposed structure for medical education at the February 2000 faculty retreat and the March 2000 faculty meeting.

Governance of the educational program resides in the Faculty of Medicine, which is responsible for the content, implementation, and evaluation of the curriculum. The dean serves as the School of Medicine's chief academic officer, with overall responsibility to the University for the entire academic program. The vice

dean for medical education and academic affairs carries the dean's academic and administrative authority and has direct supervisory responsibility over the units that lead and support the curriculum.

The faculty committee established three curriculum councils. The Curriculum Leadership Council is responsible for the strategic planning, content, design, integration and coordination, selection of teaching leadership, and oversight of the Core Academic Program of the first two years of the curriculum. The Clinical Rotation Development Council is responsible for the third-year core clerkship. The Flexible Program Council is composed of the program chair, faculty representatives, and curricular leaders participating in the Flexible Program. An advisory committee assists the Council's planning and implementation of the Flexible Program.

The faculty's Committee on Medical Education serves to evaluate, review, and make recommendations concerning the major units of the medical education program. This committee evaluates the achievement and outcomes of curricular objectives and reviews the curriculum as a whole. The faculty elects the majority of the committee's members; student representatives also serve on this committee and its various subcommittees.

Plans for the Future

A challenge that still faces the Office of Information Technologies is to fully incorporate the creation and administration of a computer-based examination system into the Electronic Curriculum. There are several conditions that necessitate the move to electronic administration of examinations. The amount of curricular time used for examinations is great. Electronic testing could return valuable curricular time to the teaching and learning hours. Implementation of electronic administration of Step 1, Step 2, and Step 3 of the United States Medical Licensing Examination (USMLE) has made it imperative for students to have multiple opportunities to take the examinations on computer. Experiencing examinations with the look and feel of the electronically delivered USMLE will assist students in interacting with this medium. Additionally, specialty certification and recertification examinations are being offered in electronic format. As the students progress through their career, they will constantly be faced with electronic examinations. As lifelong learners, the students will need the skills to deal with electronic assessments.

The software for creating an examination system from a bank of test questions, administering an open examination over the Web or a secure examination in the classroom, immediately grading the examination, providing immediate test analysis to faculty, and providing links to the appropriate places in the Electronic Syllabus is presently under development.

Outcome assessment activities for the reformed curriculum for the first three years will have high priority. In addition, there will be a review of the electives (Flexible Program). A major endeavor will be the institutional self-study in preparation for the school's reaccreditation visit by the Liaison Committee on Medical Education in spring 2002.

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University of Connecticut School of Medicine

Bruce M. Koeppen

Executive Summary

This case study summarizes the comprehensive curriculum review and revision conducted by the University of Connecticut School of Medicine beginning in 1990. This effort, which spanned nearly eight years, was the first time the curriculum had been substantively revised since the school's first students entered in 1968. The revision resulted from the faculty's recognition that fundamental changes in curriculum content and format were needed in order to provide students with the core knowledge, skills, and attitudes they would require to

successfully meet the needs and challenges of the health care system of the future. To this end, the school designed the new curriculum to: (1) improve integration of basic medical science and clinical science; (2) emphasize student-motivated and -initiated learning, and the development of skills for effective problem solving and lifelong learning; (3) reorient the location and organization of clinical training experiences to reflect the full spectrum of clinical care, including prevention and health maintenance, continuity of care, and chronic care; (4) provide greater exposure to the biopsychosocial aspects of medicine as well as the legal and ethical ones; and (5) equip students with the tools to acquire new information and critically appraise its validity and applicability to the problems they face in the care of patients.

The new curriculum was fully implemented with the Class of 1999. Structurally, the curriculum contains no departmental courses or clerkships. Instead it is organized into 10 interdepartmental and multidisciplinary courses. Integration of the basic medical science disciplines into five multidisciplinary courses has been highly successful. In contrast, integration of the core clinical disciplines into three multidisciplinary courses has been less successful, in large part due to the constraints imposed by the discipline-based structure of the health care delivery system in which the education is embedded. Key elements of the new curriculum include: (1) a reduction in the didactic hours devoted to basic science instruction; (2) improved integration of basic medical science courses; (3) formal introduction of problem-based learning experiences; (4) expanded exposure to clinical experiences early in the curriculum; (5) reorientation of the clinical experiences to better reflect the health care delivery system; and (6) a three-year clinical continuity experience.

Initial outcome measures have shown significant improvement in student performance on the U.S. Medical Licensing Examination (USMLE) Step 1 and Step 2 exams. Student mastery of fundamental clinical skills, as assessed by standardized patients, has also improved. The interdepartmental and multidisciplinary course structure has greatly improved faculty interaction and collaboration on educational issues, and has facilitated the placement of longitudinal themes (e.g., managed care and evidence-based medicine) throughout the curriculum.

Efforts to assess the impact of the curriculum change on the school's graduates, and to use this information to continuously revise and improve the curriculum into the future, are ongoing. In addition, the school is applying resources to augment the school's use of information technology in the curriculum.

Introduction

The University of Connecticut School of Medicine is a public institution established by the Connecticut Legislature in 1961. The first faculty were recruited in 1963, and the first class of 29 students was admitted in 1968. Class size increased progressively, reaching 80 students per year in 1973, and it has remained at that level ever since. The size of the faculty has also grown over this period. In 1968, the school had 33 full-time faculty in basic science departments and 29 in clinical departments. Today, the school has 85 basic science and 304 clinical faculty. In addition to these full-time faculty, there are more than 2,100 volunteer clinical faculty who participate in the educational programs of the school.

Many of the founding faculty were recruited to Connecticut from Western Reserve University, where significant and innovative curriculum reform had occurred in the 1950s. Therefore, the initial curriculum at Connecticut reflected much of what was in place at Western Reserve at that time. For example, the initial basic medical science curriculum was organized into interdisciplinary subject committees, most of which were organ-system-based. The core clinical curriculum consisted of a 12-week introductory clerkship followed by clerkships in medicine, surgery, pediatrics, obstetrics, and psychiatry, each of which was eight weeks in duration. In their fourth year, we required students to complete a three-month research project and six months of clinical electives.

The curriculum evolved somewhat over the ensuing years, and table 1 summarizes its structure just prior to the curriculum revision described in this report. The basic medical science portion of the "old" curriculum (years 1 and 2) consisted of 21 separate courses, some of which were organized by discipline (primarily year 1) and others that were organized as organ systems (year 2). The basic medical science courses instruction were primarily in lecture format (46 percent of class hours), with some laboratory exercises (18 percent) and small group sessions (36 percent). Clinical exposure in the first two years was limited to a total of 238 hours, with much of this time focused on teaching the essential components of the medical history and physical examination. Patient interactions occurred primarily in an acute care inpatient setting, and increasingly with extremely sick patients who were less and less appropriate for beginning or novice students. With the exception of the Primary Care clerkship, which included content and experiences in general internal medicine, pediatrics, or family medicine, we organized the clinical core rotations as departmental clerkships. During the 56 weeks of required clinical rotations, students spent 34 weeks in

tertiary care hospitals and 22 weeks in ambulatory settings.

Table 1 "Old" Curriculum Structure: 1994

BASIC MEDICAL SCIENCES (YEARS 1 AND 2)	
Number of Courses:	21
Class Hours:	1,890
INTRODUCTION TO CLINICAL MEDICINE (YEARS 1 AND 2)	
Class Hours:	238
CLINICAL SCIENCES	
Required Core Duration (weeks)	56
Medicine	12
Obstetrics and Gynecology	8
Pediatrics	8
Psychiatry	8
Surgery	12
Primary Care	8
Elective (minimum weeks required)	28

In October 1990, the school initiated formal planning for a new curriculum, and in August 1995, implementation began. We achieved full implementation across all years of the curriculum during the 1997–98 academic year. Planning and implementation of the revised curriculum spanned nearly eight years, and involved students across multiple classes and faculty from the basic science and clinical departments at the main campus, as well as volunteer clinical faculty from the community.

Rationale for Curriculum Change

Initial discussions about the need to revise the curriculum occurred among the school's faculty and administrators during an institutional self-study in 1988–89 as part of the school's Liaison Committee on Medical Education (LCME) reaccreditation. At that time, the faculty voiced several concerns about the curriculum, including these needs:

1. To achieve a proper balance between fundamental basic science instruction and the presentation of clinical examples and integrate preclinical experiences more fully into the clerkships;
2. To incorporate information management into the educational experience;
3. To enhance the clinical education by making additional community-based and ambulatory experiences available; and
4. To work toward a better balance between information transfer and the application of principles in an active problem-solving format, and toward encouraging more independent student learning.

The faculty also noted that the committee structure for curriculum governance was highly fragmented, and the mechanisms for setting educational policy were cumbersome. As a result, there was a failure "to interrelate the objectives of individual curricular segments into a well-coordinated whole."

In response to the self-study conclusions and the findings of the LCME survey team, the dean formed the Curriculum Oversight Committee in September 1989. The committee was composed of faculty with prominent teaching roles, some department chairs from both the basic science and clinical departments, and dean's office staff involved in administration of the curriculum. The dean chaired the committee, which had as its single charge to determine if the curriculum as it existed at that time would adequately prepare the school's graduates to practice medicine in the year 2010. Over several months of meetings, and after reviewing the faculty's recommendations outlined in the self-study documents as well as the LCME survey team's findings, the committee concluded that (1) the curriculum as it existed would not adequately prepare students for the health care future they would face, (2) the school should therefore embark on a comprehensive review and revision of its curriculum, and (3) this process should encompass all four years.

At the recommendation of the Curriculum Oversight Committee, an ad hoc Curriculum Review and Revision Committee was formed in October 1990 to lead and oversee the curriculum revision process. This committee was to serve as the "change agent" for curriculum revision. However, as noted below, the final decision-making body was the School of Medicine Council (the faculty body with bylaw authority over the educational programs of the school).

The Curriculum Review and Revision Committee, with the dean for academic affairs and education as its chair, had as its members three basic scientists, three clinicians, and a member of the volunteer faculty. The committee invited other faculty and students as necessary to participate in its work. The committee's first task was to review the entire content of the existing curriculum. In addition, the committee obtained faculty and student opinions about the curriculum, and how it might be changed. It also reviewed reports and recommendations from several national groups (U.S. Department of Health and Human Services 1990; Marston and Jones, eds. 1992; O'Neil 1993). With this information as background, and after surveying curriculum revision efforts at other schools, the committee began to develop the goals and objectives of a new curriculum (see table 2) and the career competencies expected of graduates (i.e., educational outcomes; see table 3). In January 1993, the School of Medicine Council unanimously approved the goals and objectives of a new curriculum and the career competencies.

Table 2. Curriculum Goals and Objectives

1. Students should develop a fund of knowledge and acquire skills that will enable them to pursue successfully the type of postgraduate training necessary for their chosen career.
2. There should be appropriate integration of basic science and clinical science, which should take place across all four years. This process should foster the appreciation of scientific investigation and its impact on the growth of medical knowledge.
3. The educational process should emphasize student-motivated and -initiated learning, and developing skills for effective problem solving and lifelong learning.
4. In general, the curriculum should stress important core concepts, supported by details as appropriate.
5. The location and organization of clinical training experiences should be chosen to reflect the full spectrum of clinical care.
6. The curriculum should be reinforced by a student evaluation system that is consistent with the goals of the educational program.

Table 3. Career Competencies

The foundations for acquiring career competencies must be established in the undergraduate curriculum. Following additional postgraduate training, graduates should be able to provide high-quality cost-effective clinical care, which includes these abilities:

1. Defining, analyzing, and solving clinical problems by
   - considering the wide range of normal and abnormal attributes among individual patients and differences in how individual patients respond to treatment;
   - recognizing the extent and limits of their knowledge base and clinical skills; and
   - continually updating and improving their knowledge base and clinical skills.
2. Integrating the biomedical and psychosocial aspects of medical care by
   - establishing effective patient-physician relationships sensitive to the rights and needs of the patient;
   - recognizing the impact of the physical, psychological, and social environment on health;
   - interacting effectively with other health care providers and all facets of the health care system; and
   - promoting health and practicing preventive medicine.
3. Critically appraising the efficacy of new diagnostic and treatment modalities and applying them appropriately to one's practice by
   - utilizing cost-benefit assessments comparing different modalities and
   - developing strategies for utilizing new modalities in an environment of limited health resources.
4. Acquiring new information and critically appraising its validity and applicability to one's professional decisions, including the application of information systems technologies to facilitate the acquisition, storage, and retrieval of information.
5. Clarifying and contributing to the resolution of the legal and ethical issues inherent in health care.

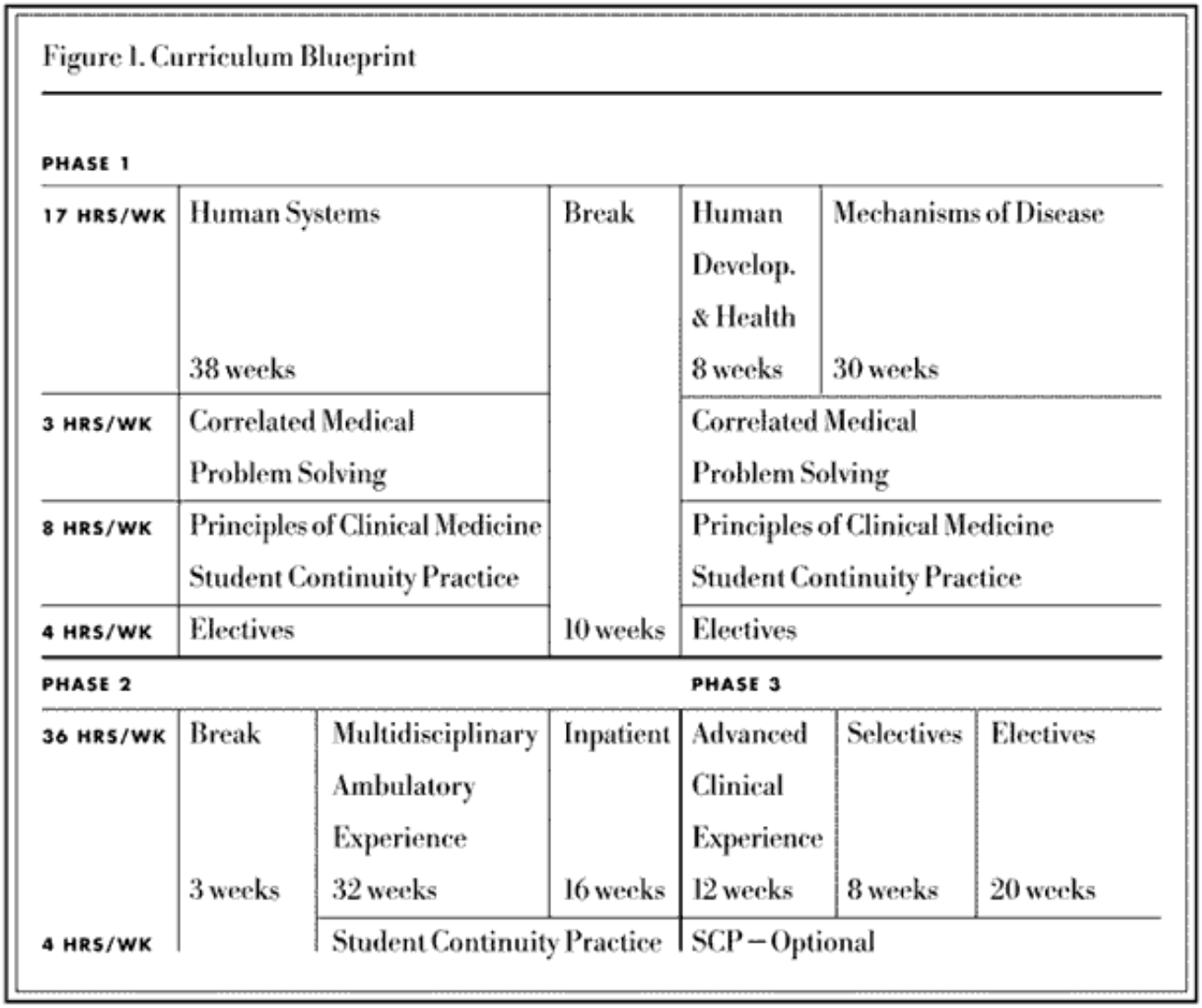
Subsequent to this, the committee developed a curriculum "blueprint" to accomplish the stated goals and objectives and provide experiences by which students could acquire the requisite career competencies. The School of Medicine Council approved the new curriculum blueprint in December 1993, with only a single dissenting vote.

Over the ensuing months, the committee completed the details of the structure and content of the new curriculum, and the dean approved the implementation plan in October 1994. The school implemented year 1 of the new curriculum beginning in August 1995 with the Class of 1999. We implemented years 2 and 3 the following year, and achieved full implementation during the 1997–98 academic year.

Characteristics of Curriculum Change

The new curriculum is divided into three phases (see figure 1). Phase 1 spans the first two years, and provides the core basic medical science instruction as well as the foundations of clinical medicine that students need for successful involvement in their clinical experiences. Phase 2 (year 3 of the curriculum) provides the core clinical experiences required of all students. Phase 3 (year 4 of the curriculum) requires clinical experiences that build on the clinical foundation of phase 2, and provides students with elective opportunities to tailor their educational experience. The curriculum was also designed so that as students progress through the three phases of the curriculum, they are presented with opportunities and experiences that require more self-directed learning and independent decision making.

Figure 1. Curriculum Blueprint



Phase 1

Phase 1 extends through the first two years of the curriculum (each year is 38 weeks in length), and consists of five courses, plus electives. A major emphasis of phase 1 is related to the basic medical sciences. Students begin their study of the basic sciences with the Human Systems course, which presents the basic elements of human anatomy, histology, biochemistry, physiology, and genetics. Also included are an introduction to biostatistics and the principles of epidemiology. This is followed in the second year by the Human Development and Health course, which provides an overview of the organization, delivery, and effectiveness of health care services; a multidisciplinary survey of psychological and social development from birth to late life; an investigation of the behavioral and social influences on health, illness, and health care; an introduction to principles of medical law and ethics applied to doctor-patient relationships and health care problems; and an introduction to principles of clinical epidemiology and their applications to medical practice. Phase 1 concludes with the Mechanisms of Disease course, which presents the pathology and pathophysiology of the organ systems; infectious diseases; oncology; and principles of therapeutics, especially pharmacology. Each of these courses meets for 17 hours per week, primarily inlecture format (50 to 60 percent on average), but also includes small group conferences and laboratories. The Correlated

Medical Problem Solving courses meet for three hours each week, and run through phase 1 in parallel to Human Systems, Human Development and Health, and Mechanisms of Disease. They are designed to assist students in their development as independent learners, and to promote the acquisition of skills related to problem solving, access to information, and group interaction and communication. The instructional format is problem-based learning, with students divided into groups of eight, with two faculty facilitators (one clinical and one basic science). Instructors choose case content to correlate with topics being presented concurrently in the Human Systems, Human Development and Health, and Mechanisms of Disease courses.

Phase 1 also begins preparing students for the clinical aspects of their program through the Clinical Medicine Course, which extends through phases 1 and 2. It has two major sections: the Student Continuity Practice and Principles of Clinical Medicine. Each section meets one afternoon per week for four hours. The content presented in Principles of Clinical Medicine and the Student Continuity Practice are intimately linked, and together they are designed to complement the basic medical science courses running concurrently. Principles of Clinical Medicine takes place at the medical school, while the Student Continuity Practice occurs in the offices of physicians practicing in the community.

Principles of Clinical Medicine is concerned with the knowledge, skills, and attitudes students will need in interacting with patients. It is an experiential course that builds on and augments the experience of students in their Student Continuity Practice. Emphasis is on student-patient interaction and small group seminars, where standardized patient encounters, role-playing, and peer teaching are important components. The goals of Principles of Clinical Medicine focus on the professional development of students. Students acquire an understanding of the doctor-patient relationship as a framework within which their professional work is accomplished. They develop the skills necessary to cultivate that relationship and simultaneously begin to build an appreciation of the associated privileges and obligations. Students develop specific clinical skills to engage patients in a dialogue to obtain information for counsel and negotiation of strategies to improve the patients' health and to respond to illness and injury. Communication skills important for professional interaction among colleagues, supervisors, and members of the health care team are also learned and practiced. Principles of Clinical Medicine also introduces fundamental principles of community health and population medicine. Students learn to understand communities as systems that affect the health of their members—the physical and social environments in which patients live, work, study, and play—and how these environments influence health. They also acquire an understanding of the many settings in which ambulatory medical practice occurs and the resources available in those contexts. Students also learn principles of disease and injury prevention, as well as health promotion. They gain skills to assess protective and risk factors in patients, families, and communities, and they develop the ability to counsel patients and families to reduce risk and promote health.

The Student Continuity Practice is an important and unique component of the revised curriculum. Students are assigned to a single ambulatory site, where they spend one half-day per week through the first three years of medical school. Preceptors for this experience are family practitioners, general internists, or pediatricians. The fundamental goals of the Student Continuity Practice are to expose students to patients in a continuity setting from the beginning of their training, and to allow them to become increasingly involved with patient care as their knowledge and skills develop. At their assigned site, students interact with large numbers of ambulatory patients with diverse medical conditions who receive ongoing comprehensive care. Students also become knowledgeable about the communities served by the practice. The Student Continuity Practice fosters the direct integration of basic medical and social science principles into the care of individual patients. During the first two years of medical school, expectations for students in their Student Continuity Practice are linked to those of Principles of Clinical Medicine, as well as the basic medical science courses.

Students have the opportunity for elective course work in both phase 1 and phase 3 of the curriculum. The elective program is designed to provide students with the opportunity to: (1) pursue a subject area in greater depth than might be presented in the core components of the curriculum; (2) provide options to develop or refine skills; (3) fill in gaps in prior educational experience; (4) examine fields for future study and emphasis; and (5) experience a closer faculty-student interaction, since most of the electives consist of small groups or one-on-one interactions with faculty. Phase 1 electives expand on the basic medical science core, and provide students with the opportunity to broaden their academic skills. Students can select from a wide range of elective options including classroom activities, clinical experiences, and research opportunities.

Phase 2

By the time students enter the clinical rotations in phase 2 of the curriculum (year 3), they are experienced in

interacting with patients, having seen 200 to 300 patients in their Student Continuity Practice. They are active learners and adept at solving problems. They have an understanding of the relevance of what they have learned in the basic medical sciences, and function on a more sophisticated level in a variety of clinical settings.

There are two courses during phase 2 of the curriculum, Multidisciplinary Ambulatory Experience and Inpatient. The Multidisciplinary Ambulatory Experience is 32 weeks in duration and the Inpatient course is 16 weeks in duration. Throughout phase 2, students continue to attend their Student Continuity Practice. As originally envisioned, phase 2 was to involve students in interdisciplinary ambulatory and inpatient rotations, with each clinical discipline providing appropriate content and experiences around core competencies. Unfortunately the health care delivery system was structured in a way that could not facilitate or allow this interdisciplinary educational approach. Despite this reality, the interdisciplinary approach underlying both the Multidisciplinary Ambulatory Experience and Inpatient courses were retained from a planning and administrative perspective. Thus, an interdisciplinary team of faculty makes decisions regarding discipline-specific content and experiences, as well as evaluations of student performance.

The Multidisciplinary Ambulatory Experience contains rotations in family medicine, internal medicine, pediatrics, and obstetrics and gynecology that are each six weeks in duration. We also require a three-week general surgery rotation as well as one-week rotations in otolaryngology and orthopedic surgery. A fourteen-week (one half-day/week) psychiatry rotation completes the Multidisciplinary Ambulatory Experience.

The Inpatient course has rotations in internal medicine, surgery, and psychiatry, each of which is four weeks in duration. There is also a required two-week rotation in pediatrics. A unique component in the Inpatient course is the two-week Beginning-to-End rotation, in which students follow patients from admission in the Emergency Department through discharge, regardless of the service to which the patient is admitted. The focus of this experience is on the entire spectrum of activity involved from the decision to admit a patient to the challenges of discharge planning. Students have regular meetings with a faculty preceptor. During this rotation, students (1) learn to distinguish, from a large unscreened group presenting complaints, those that require admission in a contemporary cost-conscious setting; (2) observe the process of ongoing review and the relationship between the hospital, the care team, and the payer in determining how the care plan will proceed; (3) gain additional experience in fundamental clinical skills, including the generation of a differential diagnosis, and therapeutic and patient education plans; (4) learn the importance of a multidisciplinary approach to care delivery; (5) are exposed to the challenges of proper discharge planning and provision of home care; and (6) observe the importance of the "handoff" from inpatient to outpatient follow-up. In addition, all students spend one day at a chronic-care/rehabilitation facility. Students work with Emergency Department triage personnel to screen patients, selecting three to seven to follow; interview utilization review personnel regarding criteria for admission and continued stay; evaluate the patient with a complete history and physical, and generate "mock" orders and progress notes; learn critical pathways, as applied to the patients they are following; and, when possible, be present at the first outpatient visit following discharge. For each patient seen, the student must submit an initial history and physical, including diagnosis, treatment plan, patient education plan, mock orders, daily progress notes, discharge summary, a running log describing episodes of care or intervention, and a critique of the hospitalization process, for review by the preceptor.

Interspersed throughout phase 2 are three Home Weeks. Home Weeks provide an opportunity for all students to return to the main campus for testing and didactic sessions. We administer both written exams and clinical skill exams utilizing standardized patients at this time. Didactic sessions cover a wide range of topics, including radiology, pain management, telephone medicine, nutrition, neurology, managed care, death and dying, physical diagnosis, urology, domestic violence, ophthalmology, case presentations, evidence-based medicine presentations, law and ethics, occupational medicine, and alternative/complementary medicine.

Phase 3

Phase 3 (year 4) consists of three components. A three-month Advanced Clinical Experience, a two-month Selectives experience, and a minimum of four months of Electives are required. Students may customize this phase of the curriculum, taking any of the components in their preferred sequence. The Student Continuity Practice may be continued throughout phase 3 as a longitudinal elective.

The Advanced Clinical Experience provides students with an intensive inpatient experience and exposure to issues related to critical and emergency/urgent care. It is divided into three sections: Advanced Inpatient, Emergency Care, and Critical Care. Each section is one month in duration. In the Advanced Inpatient

section, students choose a subinternship rotation in family medicine, surgery, internal medicine, or pediatrics. During the Emergency Care rotation, students participate in patient care as it is delivered in an emergency setting. A rotation in a medical intensive care unit, surgical intensive care unit, medical/surgical intensive care unit, or pediatric/neonatal intensive care unit completes this course.

The Selectives course is designed with the recognition that being a physician encompasses the roles of researcher, educator, and advocate for community health. The Selective provides students with the opportunity to establish an experiential and knowledge base for these roles. In essence, the Selective represents a mini-thesis emphasizing self-directed and independent learning. Students identify a topic in one of the general areas of research, education, and community health and, with the help of a faculty adviser, develop and carry out an independent project. Examples of such projects include: (1) development of a healthy heart nutrition program as part of the Hispanic Health Council's PANA (Programa para Aprender Nutricion y Alimentacion) nutrition program for preschoolers; (2) research on sensorineural hearing loss following epidural anesthesia; (3) creation of a children's story to teach parents about child discipline; (4) a national survey of pediatricians and family physicians about screening for adolescent depression and suicide risk; (5) development of an educational unit on providing care to gay, lesbian, bisexual, and transgender patients; and (5) development of a module to teach clinical reasoning to second-year medical students.

Clinical elective opportunities during phase 3 are available in all specialty and subspecialty areas of medicine. Students may also take elective rotations at other institutions.

Table 4 summarizes the difference between the old and new curricula. We made several important changes in the educational programs, including:

1. a reduction in the didactic hours devoted to basic science instruction;
2. improved integration of basic science courses;
3. formal introduction of problem-based learning experiences;
4. expanded exposure to clinical experiences early in the curriculum;
5. reorientation of the clinical experiences to better reflect the health care delivery system (e.g., increased ambulatory education); and
6. provision of a three-year clinical continuity experience.

Table 4. Curriculum Comparison

	OLD CURRICULUM	NEW CURRICULUM
BASIC MEDICAL SCIENCES (YEARS 1 AND 2)		
Number of Courses	21	5
Total Class Hours	1,820	1,520
Didactic	1,820	1,292
Problem-Based Learning	0	228
ELECTIVE (YEARS 1 AND 2)	0	80
CLINICAL COURSES (YEARS 1 AND 2)	238	608
CLINICAL SCIENCES		
Weeks of Required Experiences	56	60
Weeks of Elective Experiences	28	16
Weeks of Inpatient Experiences	34	28
Weeks of Ambulatory Experiences[a]	22	32
CORE CLINICAL DISCIPLINES (REQUIRED WEEKS)		
Family Medicine	NR[b]	6–10[c]
Internal Medicine	12	10–14[c]
Obstetrics and Gynecology	8	6
Pediatrics	8	8–12[c]
Psychiatry	8	5.5
Surgery	12	9–13[c]
Critical Care	NR[b]	4
Emergency Medicine	NR[b]	4
Continuity Practice	NR[b]	10

[a] Includes Student Continuity Practice in years 1–3.

[b] Not required.

[c] Variable length reflects student choice of subinternship in year 4.

Dynamics of Curriculum Change

As noted above, initial interest in curricular change started in 1988 with the institutional self-study conducted as part of the LCME accreditation survey. The process became more formalized when the dean established the Curriculum Oversight Committee in 1990. The Curriculum Oversight Committee was short-lived, but its recommendation to create the Curriculum Review and Revision Committee that would conduct a comprehensive review and revision of the curriculum was critically important in calling the faculty's attention to the need to reorient the school's educational programs.

Coincident with the formation of the Curriculum Review and Revision Committee, the School of Medicine Council also established and agreed on several process rules. First, the committee was to review and revise

the curriculum in its entirety. The fact that a course had a specific amount of curricular time allotted to it in the old curriculum did not guarantee a similar allotment of time in the new curriculum. Indeed, there was no guarantee that a course from the old curriculum would even be offered in the new curriculum. In short, the curriculum was to be rebuilt from the ground up and not necessarily on any part of its old foundation. Second, the Curriculum Review and Revision Committee would serve as the initiator of ideas and issues, and develop models for consideration by the faculty. While the committee was the driving force for the curriculum revision, ultimately the School of Medicine Council would have to approve the revision plan. Third, the revision process, while iterative, would be progressive. It was further agreed that the School of Medicine Council would formally approve the goals and objectives of the new curriculum, as well as the overall curriculum blueprint.

Once the curriculum blueprint was approved, implementation committees were formed for each of the courses in the new curriculum. These committees were asked to define the goals and objectives of the course, its content, the allotment of hours, the instructional formats to be used, and the resources needed for implementation. Although the School of Medicine Council did not have to approve the implementation plans, it received regular updates. Once the committees finalized the implementation plans, the dean reviewed them and then allocated resources for implementation.

As noted previously, the 1988 LCME accreditation institutional self-study determined that the existing curriculum governance structure was highly fragmented and cumbersome. This, and the multidisciplinary and interdepartmental nature of the new curriculum, required that the existing governance structure be revised. The new governance structure, which was implemented coincident with the new curriculum, is summarized in figure 2.

Figure 2. Curriculum Governance Structure

The new governance structure is designed to provide a mechanism for addressing issues related to policy, operations, oversight, curriculum evaluation, strategic planning, and educational innovation. Moreover, it attempts to link responsibility for the curriculum with the authority to effect appropriate and necessary changes in the educational program. It reflects and supports the multidisciplinary structure of the new curriculum, and provides broad representation of important stakeholders in the educational program. Representation within the governance structure includes faculty, students, and members of the dean's office.

The bylaws of the school invest the faculty, through the School of Medicine Council, with oversight of the educational programs, making them responsible for overseeing the general form and content of the undergraduate curriculum and assuring its quality. This council is a representative body of the faculty with membership from each of the departments, as well as several members elected at large from the full-time faculty.

The Committee on Undergraduate Medical Education, a standing committee of the School of Medicine Council, is the primary educational-policymaking body. It develops policies for all aspects of the undergraduate curriculum, and it sends its recommendations to the School of Medicine Council for

ratification. Its responsibilities include: providing regular oversight of the educational program; insuring periodic review of the educational program; receiving recommendations from any constituency regarding all medical student educational policy; developing plans and policy proposals concerning curricular organization, student evaluation, and all other student-related academic issues; initiating and overseeing strategic planning for the educational programs; assessing long-range needs regarding the direction and evolution of the educational program; and exploring and evaluating trends in medical education. The dean for academic affairs and education chairs this committee, and appointed by the School of Medicine Council appoints faculty members. The committee also has one student representative from each of the second-, third-, and fourth-year classes, who are elected by their peers.

The Curriculum Operating Committee reports to the Committee on Undergraduate Medical Education and deals primarily with operational issues related to the undergraduate medical curriculum. Its responsibilities include: developing yearly academic calendars; integrating and coordinating the presentation of material throughout the curriculum; suggesting needed policy changes; considering issues and innovations in curriculum development, instruction, and evaluation; piloting and incorporating appropriate educational innovations into the educational program; and conducting periodic review of curricular content and allocation of time to specific subject areas. The dean for academic affairs and education chairs this committee, also, and membership includes the course directors, educational support staff, and one student from each class.

Broad departmental input into the governance of the curriculum occurs via the Curriculum Advisory Committee. This committee advises the other two committees on any issues related to the curriculum, instruction, and student evaluation. Its members also participate in the identification of educational and curricular problems. Members of the Curriculum Operating Committee elect a course director to chair this advisory committee. Committee membership includes a representative from each department in the school, two students elected from each class, and two alumni of the school appointed by the associate dean for student affairs.

Ultimately, implementation of the curriculum rests with the course directors. The dean for academic affairs and education appoints course directors, pending approval of their respective departmental chair. A portion of a course director's salary may be paid by the dean for academic affairs and education, if necessary, to ensure that the faculty member serving in this important capacity has sufficient protected time to devote to the oversight of the course. If the course is subdivided into sections, the course director is responsible for appointing faculty to serve as section leaders. As is the case for course directors, the dean for academic affairs and education pays, if necessary, a portion of the section leaders' salary. Course directors, together with their section leaders, are responsible for all aspects of the course, which include: determining and organizing the content of the course; developing course goals and objectives; coordinating all aspects of the course; enlisting faculty to teach in the course; ensuring the quality of the course; developing a method of evaluating the course and the quality of faculty teaching; and specifying the academic standards that students must meet, and thus assign each student a final course grade.

Implementation of the new curriculum was a significant undertaking. It required a considerable expenditure of time and effort by a large number of faculty and students. Reflecting on the changes made, and especially the processes that contributed to successful implementation, shows that several factors were critical to this effort.

Strong Leadership by the Dean

The curriculum planning and implementation process spanned the tenure of three deans, one of whom also served in an interim capacity during this time. Nevertheless, each provided strong leadership and direction for the curriculum reform process, and each allocated appropriate resources to ensure its success.

Dr. Eugene Sigman was dean when the curriculum revision process was initiated in 1990. He clearly and repeatedly articulated to the faculty and university leadership that education was the primary mission of the school, and that attention needed to be paid to the curriculum. He not only called for a comprehensive review and revision of the existing curriculum, but also provided funds to support this effort. Most important in this regard was his creation of an Office for Faculty Development. The primary mission of this office is to explore new educational strategies, and to assist the faculty in acquiring new teaching skills as needed in the new curriculum.

Upon Dr. Sigman's retirement in 1992, the chairman of the Department of Surgery, Dr. Peter Deckers, was named interim dean. He continued to support the curriculum reform process during the critical stage of "blueprint" development. In addition, he prevented an attempt by the state legislature to modify the clinical

phases of the existing curriculum. This legislative effort was intended to increase the number of graduates pursuing careers in primary care. Unfortunately the proposed legislation would have structurally defined the clinical rotations in the third year (two-month rotations in family medicine, internal medicine, obstetrics and gynecology, pediatrics, psychiatry, and surgery), and if passed, would have essentially halted the school's own efforts toward curriculum reform. Finally, he led the development of a strategic plan for the school, which was funded by the state legislature. Included in the plan were funds that ultimately supported the new curriculum.

Shortly after being named dean in 1994, Dr. Ward Bullock was asked to approve and fund the implementation plan for the new curriculum. Using some of the strategic plan funds, and with the addition of other school funds, the school successfully launched the new curriculum and provided it with a sustainable funding base.

Dr. Deckers succeeded Dr. Bullock as dean in 1995, shortly after the new curriculum was implemented. Dr. Deckers continued his strong support for the implementation process by supporting the salaries of faculty who were devoting large portions of their time to the implementation process. He also worked with university leadership to allocate funds that allowed a complete renovation of the teaching space to better match its configuration to the needs of the curriculum (i.e., small group meeting rooms and enhanced access to information technology).

Financial Support by the Dean's Office

In total, the dean's office allocated nearly $5.5 million toward the planning and implementation of the new curriculum. Some of these funds came from reallocation of existing resources provided by the state, while some represented new funds associated with the institutions strategic plan. Approximately $1.4 million was allocated to create and staff an Office for Faculty Development. This office serves several functions including; assisting faculty in assuming new teaching roles (e.g., facilitating and case development for problem-based learning [PBL]), improving faculty teaching skills, and training community-based physicians (Student Continuity Practice and Multidisciplinary Ambulatory Experience preceptors) to be better teachers of our students. An additional $2.6 million was used to renovate the primary teaching space. This renovation provided appropriate space for small group sessions (e.g., PBL), upgraded the gross anatomy suites, and brought the latest in information technology into the classrooms. Because the new curriculum expanded the use of standardized patients, $350,000 was used to expand the Clinical Skills Assessment program and renovate its space. Nearly $600,000 was made available on a onetime basis to various faculty who had to teach their content area twice in one year in order to accommodate students in both the old and new curricula. The faculty who received these funds could use them to enhance their academic activities. Finally, the dean for academic affairs and education was given $150,000 in discretionary funds for unanticipated needs associated with the implementation process.

The dean's office provides approximately $400,000 a year on an ongoing basis for preceptor stipends. These stipends are provided to community-based physicians who are preceptors in the Student Continuity Practice and Multidisciplinary Ambulatory Experience components of the curriculum (more than 200 physicians). Annual operational support for the Office for Faculty Development and for the Clinical Skills Assessment program also continues. Finally, as noted previously, the dean's office provides partial salary support, as necessary, for course directors and section leaders.

Defined Planning and Implementation Process

Before we initiated the curriculum revision process, the faculty, dean's office personnel, and the existing committees charged with curricular responsibility and oversight agreed to the planning and implementation process (see above). Most important, they agreed on what the critical decision points were, and who would have the authority to make these decisions. Prior agreement on these rules, and adherence to them throughout the process, helped move the process forward in an orderly fashion.

Communication

We made considerable effort to keep all faculty informed about the curriculum planning process. To accomplish this task, members of the planning committees made frequent presentations to various faculty groups. The dean for academic affairs and education also made regular presentations to the departmental chairs and to faculty at the school's affiliated institutions. Finally, we developed a newsletter as a vehicle for widespread dissemination of information about the curriculum revision. The end result of these efforts was that all decisions were made from an informed perspective and had the benefit of widespread input and

debate.

History of the School

The University of Connecticut School of Medicine is a young school, having admitted its first class in 1968. As a result, history or tradition did not encumber it. In addition, when its first curriculum was developed, it adopted the organ-system model for basic medical science instruction. This interdisciplinary approach to teaching was widely accepted by the faculty and facilitated the acceptance of the new curriculum blueprint that extended interdisciplinary experiences into the clinical portions of the curriculum.

Absence of External Funding

Although the school did apply for external funding for its curriculum revision efforts, it was unsuccessful in obtaining any grants or awards. In retrospect, this lack of funding, although disappointing at the time, had two powerful and positive effects. First, the faculty understood that the curriculum revision was not being driven by the need to meet goals and objectives of a grant, but was fully under their control and direction. Second, and perhaps more important, it caused the leadership of the school to allocate funds from existing resources (see above). This served to reinforce to the faculty that curriculum reform was a priority, with durable funding provided to sustain the new curriculum.

Impact of Curriculum Change

The implementation of the new curriculum has affected the institution in several ways. The most important is that student performance on several measures has markedly improved. For example, the USMLE Step 1 total score increased by 10 points and the Step 2 total score increased by 15 points. These performance increases exceeded those of the national cohort (3 points on both Step 1 and Step 2), and elevated the class ranking from just below the national mean to above the national mean on both exams. Moreover, discipline-specific scores improved on both exams, and in almost every instance the increase in performance exceeded that of the national cohort over the same time period.

The school has administered a Clinical Skills Assessment examination to all fourth-year students for many years, and passing the exam is a requirement for graduation. The exam consists of 14 encounters with standardized patients portraying cases from the core clinical disciplines. With the old curriculum, approximately 5 to 7 percent of each class failed the exam and were required to complete remedial programs prior to graduation. No students have failed the exam with the new curriculum, and overall performance in the elements of the exam has increased. For example, in the past, 65 percent of the class would perform 80 percent or more of the elements correctly. In the new curriculum this increased to 89 percent of the class.

Faculty expectations for student performance in the core clinical rotations in years 3 and 4 have increased. This was prompted by faculty observations that students beginning their phase 2 (year 3) clinical rotations were already performing at a level typically only seen during the latter half of the year under the old curriculum. Faculty attributed this increased performance to the Student Continuity Practice in years 1 and 2, since during this period students had already seen and interacted with 200 to 300 patients.

The interdisciplinary and interdepartmental nature of the curriculum has fostered a new cooperative spirit among the faculty, focused on the school's educational mission. Faculty have come together to share new and exciting ideas on topics to teach, and better ways to teach certain topics. Indeed, the whole process of curriculum revision has created an atmosphere where experimentation and innovation are encouraged. Additionally, the absence of rigidly defined departmental courses and clerkships has greatly facilitated the introduction of cross-discipline themes. For example, managed care and evidenced-based medicine themes have been successfully embedded into a number of courses in both phase 1 and phase 2.

Finally, the Board of Trustees of the University, members of the state legislature, and even some members of Connecticut's congressional delegation have recognized the school as being proactive in improving its educational programs and attempting to train our graduates better for the health care environment in which they will eventually work.

Plans for the Future

Overall, the reaction of students and faculty to the new curriculum, and to the process used for its development and implementation, has been positive. There have not been calls for any major modification of

the new courses or the curriculum as a whole and, indeed, only minor adjustments have been made. Nevertheless, one concern some faculty, and especially a significant number of students, have voiced is that the curriculum may have shifted the balance between inpatient and ambulatory teaching too much (see table 4). While both faculty and students acknowledge and accept that more health care is being delivered in ambulatory settings, residency training programs nevertheless are still largely hospital-based. Accordingly, there is some fear that our students will have difficulty in the transition from medical school into their residency training program. While students have expressed concern on this issue prior to starting their residency training program, results of a survey administered approximately six months into their residency has not supported this concern. Specifically, 82 percent of graduates from the new curriculum (Class of 1999) reported that they were adequately prepared in medical school to provide care in an inpatient setting. This compares to 85 percent of graduates from the old curriculum (Class of 1997).

One of the goals of the new curriculum was to improve the integration of basic science and clinical science across all four years of the curriculum. While we successfully introduced expanded clinical experiences into the first two years of the curriculum, inclusion of meaningful basic science material into years 3 and 4 has been unsuccessful, including an initial attempt to provide an evening seminar series during phase 2 (year 3). Options utilizing other formats are currently under discussion.

The immediate plans for the future are to expand the use of information technology in all aspects of the curriculum. To this end, we are developing a Health Sciences Education Center (HSEC). As envisioned in its full form, the HSEC will provide centralized equipment and support services to assist faculty in developing educational materials that use and emphasize information technology. In addition, it will manage the educational information technology infrastructure to support the students' use of these materials. Operational costs are estimated at $6.2 million and capital equipment costs at $2.4 million for the planned five-year implementation period.

Additionally, the school has developed a formal system of course and curriculum review. This system is intended to ensure that all courses are reviewed on a regular basis, especially with an eye to educational effectiveness, and the degree to which the course attains the overall goals and objectives of the curriculum and helps students attain the basic elements of the desired career competencies. We anticipate that this process will also allow the school to monitor changes in the health care environment, assess their impact on the educational programs, and appropriately evolve the curriculum into the future.

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University of Florida College of Medicine

Robert T. Watson and Larry Rooks

Executive Summary

The University of Florida College of Medicine was founded in 1956. Our curriculum has passed through four distinct phases. Phase 1 lasted until 1970 and can be characterized as the traditional Flexner model, with a departmentally based curriculum organized as two years of basic science followed by two years of clinical science. A revolutionary curriculum reform occurred in the 1970s under the leadership of an education-oriented dean. This yielded a novel curriculum with several innovative features: (1) early exposure to clinical medicine, (2) integration of basic and clinical science around biological principles and organ systems, (3) interdepartmental curriculum organization, and (4) a return to basic science following the clinical rotations.

With the growth of departmental power and without a clear funding allocation for the educational program, this plan faltered. Phase 3 occurred during the 1980s and reflected a return to the Flexner model. Very little innovation or reform took place during this decade.

The 1990s ushered in our current curriculum phase, which is best characterized as evolutionary change and continuous curriculum renewal. The multiple innovations and reform efforts that have occurred over the past decade have been made possible by strong education leadership and deans who have been very supportive of that leadership. Change during this past decade has centered on four themes:

1. *Organization and financing.* We created a strong education infrastructure to support the education mission. More important, we developed the concept of mission-based budgeting that clearly linked specific revenue streams to the education mission.
2. *Principle-based education planning.* We identified desirable characteristics of the education program and developed goals directly from them.
3. *Competency-based curriculum.* We answered the questions, "What is our end product?" and "What should our graduates look like?" Our answer was a set of competencies that defined the general professional education of medical students. All our students must demonstrate their achievement of the competencies, often by performance-based evaluation.
4. *Proven concepts of adult learning.* Our education planning began to acknowledge what we have learned about adult learning over the past 30 years. We began replacing traditional learning methods, such as lectures, with learning experiences proven to be more effective with a group of highly capable learners.

Introduction

The University of Florida College of Medicine (UFCOM), the second allopathic medical school in Florida, was founded in 1956. It is now one of four medical schools (three allopathic and one osteopathic) in Florida. The college is part of an Academic Health Center (AHC) comprising six health science colleges. The main medical school campus is in Gainesville, a community of approximately 200,000 residents. Thirty of our students do their first year of medical school at Florida State University in Tallahassee before transferring to Gainesville. We have an urban clinical campus in Jacksonville, Florida, a city with a population of about 1 million. In Gainesville we have grown from a single medical sciences building of 210,625 gross square feet (gsf) to the present AHC, containing more than 5 million gsf. There has never been a time when plastic tarps did not separate new construction from those of us going about our daily business. We currently enroll 460 medical students, most of them Florida residents. There are approximately 600 full-time faculty members in Gainesville and an additional 250 in Jacksonville and about 900 residents in 60 graduate medical education programs on the two campuses. We receive about 10 percent of our funding from the state of Florida, with the remainder coming largely from clinical revenue and extramural grant support.

Conferring the M.D. degree remains the only unique thing colleges of medicine do, and the cornerstone of UFCOM is its education program for medical students. Improvement and innovation in our education program emerge from a dedicated faculty who enjoy teaching and from high-quality students who enjoy learning.

The college takes seriously its missions of educating future generations of physicians, providing the highest quality health care to the sickest patients and those who face the most complicated circumstances, and making discoveries in the basic and clinical sciences. One principle by which our Curriculum Committee (CC) operates is to be responsive to the changing needs of society, and this entails constantly monitoring changes in health care delivery, alterations in how health care delivery is funded, and innovations in patient care. The dramatic changes that have occurred in health care over the past decade represent a challenge to everyone entrusted with educating physicians and make the need for curriculum renewal more urgent.

Curriculum at UFCOM has passed through four phases. Each of these phases is described below.

The Traditional Flexner Model (1956–1970)

The curriculum was originally organized according to the Flexner model: as two years of basic science followed by two years of clinical science. At the heart of this model is the assertion that science should be the basis of medical practice—that training a student to be a good scientist will produce a good physician. We required all our students to do a research project, to present it orally, and to write a scientific paper. It remains critical that students understand the sciences basic to medical practice, but changes in the external environment required rethinking the Flexner model.

A Revolutionary Model (1970–1980)

Under the leadership of an innovative dean, Emanuel Suter, UFCOM instituted a revolutionary change in curriculum—the Phase Curriculum. It was based on the idea that complete professional development should begin much earlier in medical education and that learning science should be fully integrated with learning clinical medicine. Students should experience the clinical setting early in order to establish the context for learning the science of medicine.

The curriculum was in three phases: Phase A was a one-year overview of basic science; Phase B a year of clinical clerkships—those that traditionally occur during the third year of medical school—moved to the *second* year; and Phase C two years of combined clinical electives and a return to the basic sciences. The return to basic sciences provided students with an opportunity to learn the relevance of the sciences based on their personal experiences with patients.

This curriculum was radical for its time. The faculty considered it reasonably successful during its tenure and more so in retrospect. Upon the departure of its originator, more conservative elements allowed the curriculum to devolve to the traditional 2-and-2 split (two years of basic science and two of clinical experience). Yet the Phase Curriculum remains a valuable legacy, and our current education renewal plan is based on many of its principles.

Back to the Flexner Model (1980–1989)

During this period, when UFCOM had several different deans, we returned to the traditional curriculum. There were many course and clerkship innovations, but the overall education program underwent little scrutiny or change.

Evolutionary Change and Continuous Curriculum Renewal (1989–present)

The current effort to reform and renew UFCOM's curriculum began in 1989, and the remainder of this article will focus on these changes, which are still occurring. (More discussion of the college's curriculum renewal can be found in Watson et al. 1998.) The scope of the changes is sweeping, and we have reevaluated our basic assumptions by asking the following questions:

- What is our end product? What should our graduates look like?
- What courses should we offer and what should their content be?
- What learning methods are best for an unusually capable group of adult learners?
- What structure is appropriate for our curriculum?
- How do we evaluate the success of our students as individuals and our education program as a whole?

Rationale for Curriculum Change: Bears and Squirrels

Changes are always occurring, and the question is whether to ignore changes while hoping for the best, observe changes and respond to them, or anticipate changes and plan prospectively for them. It's like being startled by an animal. Whether one goes back, stands still, or goes forward depends on whether it's a bear or a squirrel. In medical education many external forces are bears and most internal forces (the relatively harmless academic environment) are squirrels. But we find ourselves in a challenging era—one in which the bears have entered the squirrels' home. Faculty face a dilemma: the easiest course of action is to let others make changes in response to new forces and then try and pick the best of their changes. It is much more challenging to be a leader for change. Planning for and implementing change provide an opportunity to be flexible, to adapt to always-changing external forces, and to remain relevant.

Some of the "bears" prompting us to move forward were these:

1. Rapid advances in biomedical sciences
2. Rapid changes in the health care delivery system, with shifting priorities and relocation of services from inpatient to outpatient facilities
3. Changes in health care financing that influence the environment in which the physician-patient encounter takes place, including caring for increasing numbers of uninsured patients
4. Information technology that is redefining how we catalog, manage, and retrieve information

The Substance of Change

A critical question occurs early in the process of change: What are the characteristics of change you can't control? If you don't get the right answer, a lot of energy and time will be wasted and frustration and failure will result. We attempted to assess the things we *could* change.

Organization and Financing

The substance of change at the University of Florida was different from that at other medical schools. We believed it was the organization and financing of medical education that most needed changing and that, unless this happened, real and lasting curriculum change could not occur. We asked how it was possible that U.S. medical schools could have a total of 26,000 preclinical faculty (an average of 208 per school), including 17,000 full-time preclinical faculty (140 per school), and yet not enough faculty to lead small-group discussions during the first two years of medical school. We asked how it was possible that U.S. medical schools could have a total of 235,000 clinical faculty (an average of 1,885 per school), including 81,000 full-time clinical faculty (651 per school), and yet not enough clinical faculty to teach second-year physical diagnosis. How could we be hearing that faculty don't have enough time to teach when the total preclinical faculty–to–preclinical student ratio stood at 1.3 to 1 and the total clinical faculty–to–physical-diagnosis student ratio was 14 to 1? The answer seemed clear: medical schools had experienced enormous growth and profitability, but neither had occurred for the sake of medical education. The growth had occurred to take advantage of revenue sources, and the result was predictable:

> The casual observer might surmise that undergraduate medical education, the singularly distinctive mission of schools of medicine, has become in many institutions somewhat of a byproduct of their principal business lines of research and clinical service delivery. . . . The education of medical students has become to many faculty a distraction. (Korn 1996)

The outcome of curriculum revision was also predictable. Bloom (1989) termed it "a history of reform without change, of repeated modifications of the medical school curriculum that alter only very slightly or not at all the experience of the critical participants, the students and teachers."

A 1991 survey of medical educators' views on medical education reform (Cantor et al. 1991) found widespread belief that fundamental change in medical student education was needed. In discussing why significant change had not occurred the authors concluded,

> Any contemplated move by a medical school toward true structural reform must also consider a shift in the existing balance of power within the school toward those who are most interested in, and responsible for, medical student education. Therefore, new solutions must be developed and tested that embrace both *organizational and financing* reforms. (*emphasis added*)

A review of reform initiatives in medical education from 1906 until 1992 (Enarson and Burg 1992) found that recommendations for reform had not been widely implemented and emphasized "the need for the medical education community to evaluate critically the effectiveness of alternative educational, *financing, and organizational* strategies (*emphasis added*)."

The reason for such congruent conclusions is that massive changes in health care and research have not been accompanied by changes in the internal organization and budgeting of most medical schools. Faculty clinical practice plans now exist to generate clinical revenue "to protect the academic missions." Basic science faculty are recruited, promoted, and tenured based on their ability to publish and compete successfully for extramural research funding.

UFCOM's current period of change began when a new dean, Dr. Allen Neims, was appointed in 1989. He established a new position, that of Senior Associate Dean for Educational Affairs, and delegated responsibility for and authority over the education mission to this position. The College of Medicine Education Center (COMEC) was created to strengthen the education infrastructure, to assume responsibility for collecting evaluation data, to create and manage an extensive database, and to implement the CC's plans. Dr. Neims' next step was to change the financing of medical education. We accomplished this by developing the concept of mission-based budgeting (Watson and Romrell 1999). We allocated a prospective budget for the education mission; we instituted measures of education effort and its quality; and we directly linked the outcomes of these measures to funding. A change in organization, an office empowered to manage the education mission, and a budget not commingled with funds for research and patient care formed the substrate needed to make significant curriculum change.

Principle-based Education Planning

We at UFCOM believe that educational reform should be guided by a set of principles that determine the curriculum structure and objectives, and methods of instruction and evaluation.

From 1995 to 1997 a much larger group of faculty, including the Curriculum Committee and course and clerkship directors, began looking in detail at the conceptual basis of our curriculum. We started by asking, "If we were starting a new medical school, on what ideas and concepts would we base the curriculum?" This process culminated in the adoption by the CC of a document entitled "The Educational Program Renewal Plan" (EPRP). The components of the EPRP were as follows:

1. Principles of Educational Program Planning and Implementation
2. Goals of the Education Program
3. Graduation Competencies
4. Clinical Presentation Lists
5. Vision of Professionalism

(More information about the EPRP can be found on the Curriculum Committee's Web site at http://www.med.ufl.edu/oea/cc)

The EPRP began with the question, "What are the principles of educational design on which our curriculum should be based?" The set of principles developed in response to this question—shown in the box—became our yardstick for measuring the desirability of any contemplated change. In the past, program goals and objectives and strategic plans were developed in large part by the dean's office. The principles were unique in that they originated from the CC and had a much broader ownership. Since we adopted the principles, the process of change has become more focused and the rate of change has increased. Having articulated the concepts that underlie the change, we have proceeded with more confidence, and each contemplated innovation has been scrutinized with greater clarity.

We also started effecting change at a deeper level of design. Earlier changes focused on new techniques of learning and evaluation; current changes focus more on education design, content determination and integration, and matching clearly articulated learning objectives with appropriate teaching methodologies. An important addition during this phase was the development of a comprehensive evaluation system under the auspices of the CC. (Again, more details are given on the CC's Web site.) This system looks at student development, the quality of faculty teaching, course and clerkship quality, and the curriculum as a whole. We are now in a better position to evaluate the effects of the changes instituted.

The following is an example of a change that resulted from this new principle-based approach. Principle 3 states, "A conceptual framework for defining knowledge promotes learning and effective utilization of that knowledge and serves as a basis for curriculum integration." This principle recognizes that we need some way of rationally deciding how to limit the domain of knowledge appropriate to medical student education. Traditionally, each basic science and clinical department made that decision independently, and there was no strategy for making content decisions programmatically. We became interested in the clinical presentation model developed at the University of Calgary (Mandin 1995). This model bases content decisions on the knowledge needed to address a series of common clinical presentations. These presentations may come from an individual, a community, or a society. Examples include headache, nausea or dizziness in an individual patient; an infectious disease outbreak in a local school or community; and drug abuse or teenage pregnancy across a whole society. UFCOM independently developed a list of clinical presentations (included on the CC's Web site), which was very similar to the Calgary list. If we include basic and clinical science content that contribute to the understanding of this list of clinical presentations then we will have provided a sound method for integrating basic and clinical science and a sound scientific basis for the practice of medicine.

Principles of Educational Program Planning and Implementation

1. All students must be provided with a general professional education.
2. The education program and evaluations will be competency-based.
3. A conceptual framework for defining knowledge promotes learning and effective utilization of that knowledge and serves as a basis for curriculum integration.
4. The ability to learn independently is essential for the physician to provide quality health care.
5. Incorporation of the characteristics of outstanding physicians in the education

program is essential for complete professional development of students.
6. Effective health care delivery requires the consideration of family and community contexts.
7. Appropriate faculty and clinical settings are essential for students to master the competencies.
8. Information technology is essential for effective utilization of information by students and practitioners.
9. The education program must be responsive to the emerging needs of society.
10. Discovery of new knowledge and solutions is part of the medical profession.
11. Health care delivery requires individual and team efforts.
12. Learning and professional development require a humane environment that fosters respect, personal integrity, service orientation, and a sense of personal well-being.

The illustration above represents a departure from our previous way of contemplating change. In the past, someone might have read about the clinical presentation model and brought it to the attention of the CC. The CC's members would have debated the proposal from multiple perspectives and decided if it was promising or not. In the new paradigm we started with the principle, asking, "Which models can help us get a handle on the domain of knowledge appropriate for medical student education?" The clinical presentation model was the most promising way to satisfy the principle and was thus adopted.

Competency-based Curriculum

We also concluded that the curriculum leading to the M.D. degree should be outcome-driven. The outcome —described as the knowledge, skills, and behaviors acquired by our graduates—needs constant revision as science, concepts of caring, and the structure and financing of health care delivery evolve.

This view forced us to answer the question, "What is our end product?" The CC concluded that our task is to impart a set of knowledge, skills, and behaviors that *all* medical students should master regardless of their subsequent specialty choice. The intent was to produce competent and caring physicians—that is, to prepare any graduate to pursue a career in clinical science rather than educating all students to become physician-scientists.

As part of the EPRP, the CC elaborated a set of competencies that we believed all our students should possess upon graduation. These included competencies in the following categories:

1. Human relationships and communications
2. Professional behavior
3. Core discipline
4. Diagnosis
5. Information management
6. Health care management
7. Health service delivery
8. Procedure
9. Scholarship and Research
10. Team building
11. Problem solving

Competencies are becoming our education currency. In order to ensure competency development in our students we have asked our course directors to determine their competency-attainment objectives. This, in turn, has entailed rewriting course syllabi, which has been partly accomplished. Everyone is now using the same language when talking about the outcomes of our education effort, and we have a method of deciding what should be taught and what needs to be improved.

The idea of competencies led us to reexamine our method of evaluating students. We had always had a traditional grading system, and we were aware of its inadequacies—for example, that it did not always allow us to evaluate student development (or the lack thereof). To correct this, we superimposed a second system, which is competency-based, on the grading system. Students' competency attainment is now tracked independently of grades. Basic science faculty are observing students' professional behavior as early as the first semester. We anticipate that, because of this change, we will be in a much better position to identify at a much earlier stage both our exemplary students and those who need remediation.

The concept of competency provides the basis for ongoing change. We recognize that the set of knowledge, skills, and behaviors required to create an excellent physician evolves with society. Society has long been infatuated with science and technology but now perceives that physicians' growing scientific and technological expertise has come at the cost of their ability to "care." Our curriculum must constantly reexamine the set of competencies required to be a skillful and caring physician. We are currently involved in the formulation of a new approach to teaching "professionalism" that raises interesting questions: How responsible are we for ensuring that students possess an attitude of true caring? How can this be measured?

Proven Concepts of Adult Learning

Finally, we at UFCOM have come to realize that instruction and evaluation should utilize the proven concepts of adult learning.

Medical students are among the learning elite. They are bright, highly motivated, and even adept at extracting what they need from educational experiences that are poorly designed. These talents can lead to complacency on the part of instuctors. Our current educational reform is focused on applying what has been learned about adult learning during the past 30 years. One question we had to answer was whether our curriculum fosters independent, lifelong learning.

We initially focused on the curriculum structure for the first two years. We wanted to get away from spoon-feeding our students, which primarily prepared them for examinations, and to turn instead toward helping them set learning goals and providing the resources and time to allow them to learn independently. We limited required didactic sessions to either the morning or afternoon of each weekday. This structural change has had a significant impact on both faculty and students.

Early in the process of evolutionary change we recognized that the "tried-and-true" system of lectures and multiple-choice examinations fell short of communicating and assessing the developmental package of knowledge, skills and behaviors the students were pursuing. We needed a way to determine that their learning was translating into the ability to perform as physicians. This need culminated in the establishment of the Harrell Professional Development and Assessment Center. A nationally prominent educator who is an expert in the training and use of standardized patients was appointed as its director, and the center has provided us with a tremendous resource for developing the competency-based education program.

We are now turning our attention to instructional methodologies and information management. We have made significant strides in both areas, but much work remains to be done.

The Dynamics of Change

How was change accomplished at our institution? What forces coalesced to make things move forward? There were several factors, external and internal, that encouraged change.

External Factors

Dramatic changes in the financing of health care delivery have had a serious impact on the financial structure of academic medical centers. Clinical revenue to subsidize academic missions is no longer so readily available, and clinical faculty must spend more time generating revenue, at the expense of teaching and research.

In the 1990s, the Liaison Committee on Medical Education (LCME) started stressing more centralized control of curriculum design. The LCME specifically stated that, in order to accredit, it needed to see evidence that a school was moving away from a departmentally controlled curriculum toward an empowered CC that provided strong central planning. This paralleled our realization that the CC needed revitalization.

The Medical School Objectives Project, sponsored by the Association of American Medical Colleges, was an additional external factor. This provided a set of objectives believed to represent the complete set of competencies for the contemporary student. This event paralleled our efforts to produce our own competency list and added credibility to our effort.

Internal Factors

Our people are the main internal factor spurring curriculum change at UFCOM, and, among them, the most important person has been the dean. Our renewal started with the appointment of Dr. Allen Neims as dean

of the college. Before his appointment, we had become too comfortable, and Dr. Neims faced the challenge of having to modify the culture of our medical school. As outside forces began to exert a negative impact on academics, he had to create an environment that would allow change.

One of his early decisions was to appoint Dr. Robert T. Watson as senior associate dean for educational affairs (SADEA). Students recognized Dr. Watson as a premier teacher and a strong advocate of their interests, and he was respected as a physician by his peers. His goal was a high-quality education program, and he assembled an effective team from the education leadership of the college. A critical internal factor was the working relationship between the dean and the SADEA. The dean delegated responsibility and authority, was steadfast in his defense of the CC, and was always available to help with ideas and implementation. The SADEA has provided stable and effective leadership through the process of change described in this article, despite serving under different deans.

One of Dr. Watson's early decisions was to appoint the college's second dean, Emanuel Suter, to coordinate the LCME accreditation visit of 1993. He had developed and implemented the phase curriculum during the 1970s, and medical education is his passion. He possesses a wealth of experience and a keen understanding of how academic health centers function. This allowed him to work with numerous groups, including administrators, department chairs, the admissions committee, and the CC. He was an invaluable resource who worked with us for seven years and whose impact was enormous. Perhaps his greatest contribution was to guide our attempts to consolidate our thinking about the conceptual basis of responsible change.

In 1996 Dr. Neims resigned as dean, and in 1997 a new dean, Ken Berns, was selected. He reappointed Dr. Watson as SADEA, which maintained the continuity of education leadership. This was important, since many of our initiatives might otherwise have stalled. Dean Berns expresses a strong interest in the education program, as his regular attendance at CC meetings demonstrates. His ideas, encouragement, and involvement add credibility to the process of change. Furthermore, he encourages us to look more comprehensively at teaching methodologies, which heretofore has not been on any CC's agenda. The CC believes that, despite his other responsibilities, the education program is critically important to Dean Berns. It cannot be overemphasized that strong leadership from the dean is essential for curriculum change.

Another factor that aided the process of change was what might be called "the back door phenomenon." Our faculty and administration were so focused on our institution's changing financial picture that the education group was able to slip in reform without too much notice.

A final dynamic was trust. The education leadership slowly convinced the faculty that the goal was to improve the quality of our education program. Leadership acted in ways that acknowledged departmental integrity and value while at the same time moving toward institutional consistency in the education program. Many chairs played vital roles in supporting the plans of the CC, and departmental opposition to the proposals for change waned. Based in part on the leadership role of the chairs, the faculty started to trust the CC and its intentions. That process may never be complete, but we have made great progress.

Resistance to Change

Our contentment was a problem. For the most part, the students and faculty were happy with the way things had been going. We have never had an education crisis. Our students do well on national examinations, are successful in landing competitive residency positions, appreciate the faculty, and enjoy most of the courses. The faculty felt content that they were doing well and that the overall program was in good shape.

This contentment gave rise to a common response whenever curriculum change was mentioned: "If it ain't broke, don't fix it." We retorted by pointing out that the corollary to this statement is "Wait 'til it's broke, then try and fix it." We also asked the question, "What is it?" Did we really know what we were doing, or were we simply plodding along, doing what we had always done, having forgotten the rationale behind it? Even if we remembered the rationale, we still had to ask, "What should 'it' [the curriculum] be compared to 40 years ago?" We also had to be very careful to preserve the things about "it" that were good. We needed to evolve in order to remain relevant in a constantly changing world.

Resistance also took the form of genuine opposition. There were those who simply believed we were on the wrong track. The number of opponents is decreasing, however. We have treated them with respect, listened to their viewpoints, and remained on task.

The Impact of Curriculum Change

The students and faculty remain content, but change invariably leads to anxiety. There has been enthusiasm about the innovations that occurred during the first period of experimentation, and most have recognized that the resources and technologies that these changes provided have been definite advances in our program. We are continuing to add resources, but we have also entered a phase in which we are redirecting our educational philosophy by attempting to redefine educators' roles in both basic and clinical sciences. This type of change is much harder to accomplish because it asks individual instructors to think differently when they stand before a class and to ask themselves what they intend to accomplish. To this point, however, resistance has been minimal. We like to think that this is because there is a growing confidence in the expertise of the education leadership and a growing trust that our intentions are good and well considered and that we understand the pressures faced by the faculty. In implementing change, we must be idealists and realists simultaneously.

It is too early to judge the overall impact of change. We have just established a mechanism for examining the education program as a whole. We continue to struggle to find ways to answer the biggest question regarding the effectiveness of change: "Are we producing better physicians?" That is a difficult question to answer. Past indicators remain stable: board scores are high; students compete well for residency positions; our graduates' performance as residents is significantly above average compared to that of students from other medical schools; and our students remain happy about being at UFCOM. We have data to prove these things; we do not have data to tell us what kind of doctors our students will ultimately become. This remains a challenge for all medical schools.

Issues for the Future

For the immediate future, our direction is set. We have good resources and well-conceived courses and methodologies. From learning how to plan, we have moved to implementing change and to continuous renewal. One issue, at least, will continue to challenge us significantly: how can we ensure that our graduates are truly *caring* physicians? The public has become disenchanted with the technically competent physician who is a poor communicator and who may be perceived as uncaring. Medical schools are attempting to approach this problem under the label of "professionalism." The task is to maintain high standards in the learning of medical science and technology while admitting and nurturing students who are kind and caring.

When does change become the status quo? Will today's innovators become the next decade's conservatives? These questions raise critical issues, since a health care system of the not-too-distant future may bear little resemblance to the current system. Computer technology will allow the acquisition of knowledge to proceed exponentially. Genetics will make many current health problems things of the past, and entire specialties may become obsolete. The new "basic sciences" may predominately be information management, ethics, economics, and law. The growing numbers of those over age 65 will force medicine to focus on chronic illness rather than on acute care and to deal with issues such as health care rationing and euthanasia. The delivery of routine care will largely be via distance technology, and the utilization of robotics for distance treatment will not be far behind. The health care system will become more worldwide in its reach. In the first quarter of this millennium we will see a fusion of reality and virtual reality, and then of artificial intelligence and intelligence. Continuous curriculum renewal is essential. We must remember that the last step in the process of change is to start over.

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Northwestern University Medical School

Raymond H. Curry

Executive Summary

Northwestern University Medical School was founded in 1859 by a small group of physicians who felt that existing area medical schools were not producing the mature, comprehensively educated physicians needed by the growing city of Chicago. The school has continued to be active in educational innovation throughout its history. Its most recent major curriculum change was a direct response to the AAMC's 1984 *Report on the General Professional Education of the Physician.* Several years of planning, consensus building, and pilot projects led to the inauguration of a new first- and second-year curriculum in 1993. Active advocacy and consistent support by the medical school dean were essential to the success of this effort.

The revised first- and second-year curriculum emphasizes the development of broadly educated, responsible physicians equipped with the skills necessary for continuous professional growth and adaptation to societal changes throughout their careers. The curriculum in the basic medical sciences is interdisciplinary and utilizes a variety of learning strategies. A comprehensive introduction to the social roles and responsibilities of physicians, an innovative curriculum in interpersonal and clinical skills, and an emphasis on health promotion/disease prevention are also prominent features of the curriculum.

The school is now actively engaged in further review of students' educational needs in the third and fourth years of the curriculum. The plan will include extension of the formal emphasis on professional growth and development issues into the third and fourth years, renewed attention to the provision of appropriate educational opportunities in ambulatory settings, and new opportunities to learn effective habits for continuing self-education.

These efforts of the past 10 to 15 years have done more to improve medical education at Northwestern than had been accomplished for decades. It is our obligation to maintain this progress and continually seek to further improve our students' preparation for a career of effective and compassionate service.

Background

In 1859 six Chicago physicians dissatisfied with the quality of medical education in the city organized a new school, known initially as the Medical Department of Lind University and later as Chicago Medical College. Formal affiliation with Northwestern University began in 1870; in 1906 the college surrendered its independent charter and became known as Northwestern University Medical School. Since the late 1920s, with the completion of the A. Montgomery Ward Memorial Building, the medical school campus has been located just north of the central downtown area on the shore of Lake Michigan. The undergraduate campus of Northwestern University is 14 miles farther north, in Evanston.

Since 1966 the medical school has functioned as an integral component of the McGaw Medical Center, an educational consortium of the university and six hospitals. Three of these hospitals—Northwestern Memorial Hospital, the Rehabilitation Institute of Chicago, and the Chicago VA Health Care System, Lakeside Division—are located on the Chicago campus. Children's Memorial Hospital is some four miles north, and Evanston Northwestern Healthcare's two hospitals are near the undergraduate campus. The university, medical school, and all its affiliated hospitals (except the VA) are private institutions. All are independent of any religious affiliation.

During the 1999–2000 academic year, 689 students were enrolled in the four-year program leading to the M.D. degree. Approximately 30 of these students were enrolled in a combined M.D./M.P.H. degree program

and four in a combined M.D./M.M. program offered in conjunction with the university's Kellogg Graduate School of Management. Another 30 were taking time off from the M.D. curriculum to pursue Ph.D. degrees as part of the Medical Scientist Training Program of the National Institutes of Health. The medical school has approximately 80 full-time basic science faculty and 1,000 full-time faculty in its clinical departments. All full-time clinical faculty are members of one of three multispecialty faculty practice plans. An additional 1,300 clinicians at the McGaw hospitals serve as volunteer ("contributed services") faculty. The clinical teaching environments also incorporate 850 residents and fellows within 67 programs approved by the Accreditation Council on Graduate Medical Education.

Throughout much of the 20th century, Northwestern was known primarily for its clinical and educational programs. Until about 1970 the clinical faculty was composed almost entirely of private physicians with contributed services appointments. Over the past quarter-century, however, the medical school has created one of the largest multispecialty full-time faculty practices in the country and has integrated and expanded its graduate (Ph.D.) programs in the life sciences. As a result, Northwestern has become a comprehensive, research-intensive academic medical center, ranked by most measures of research funding and productivity within the top quartile of U.S. schools. Meanwhile, the traditions of clinical and educational excellence, and that of active and substantive involvement of the volunteer clinical faculty, remain very much alive. The school takes great pride in its overall balance of clinical, educational, and research missions.

The History of Medical Education Innovation at Northwestern

Northwestern University Medical School also has a long tradition of curricular innovation. Nathan Smith Davis, one of the founders of the school (and of the American Medical Association) was an early proponent of reform in medical education. At its inception in 1859, the school became the first to offer a "graded" curriculum—that is, a distinct and progressively advanced series of lectures for each of the two years of instruction. (The prevailing model at the time required students to attend the same series of lectures in the second year as in the first, whereupon they received a diploma.) A few years later, Northwestern added a required third year of study in the hospital, creating a three-year, graded course of instruction—a general model that, with the later addition of a fourth year, has remained the norm in North America (Arey 1979; Flexner and Flexner 1993, p. 221).

A second notable period of curricular innovation occurred in the 1960s, with the creation of two new programs that have become common features at many schools. The Honors Program in Medical Education (HPME), founded in 1961, was one of the first combined baccalaureate-medical degree programs in the country (Cooper 1961; Ludmerer 1999). In 1963, Northwestern became one of the first three medical schools to receive a grant from the National Institutes of Health to establish a combined M.D./Ph.D. program. Leadership in both these new initiatives was provided by John A.D. Cooper, then associate dean of the medical school and later (1969–86) president of the Association of American Medical Colleges.

The pertinence of these two previous eras of reform to this discussion lies in their dependence on strong and visionary medical school leadership. LuAnn Wilkerson emphasizes this point in an editorial comparing Northwestern's most recent reform efforts with those at Harvard and UCLA: each has been led by strong deans who made educational innovation and reform a priority (Wilkerson 1997). For Northwestern, this leader was Harry N. Beaty (dean, 1983–97). As chair of the AAMC Council of Deans (1992–93) and of the AAMC's Advisory Group on Assessing Change in Medical Education (1990–92) (ACME-TRI 1993), Dean Beaty was an astute and active contributor to educational reform discussions at the national level, and he made certain that the school he led was an active participant in the process.

When Dean Beaty arrived in 1983, the medical school's curriculum was very much the same as that of the majority of U.S. medical schools. We presented the basic medical sciences in a series of 15 courses, each organized by a specific department. Students began learning the skills of interacting with and examining patients in a physical diagnosis course during the second year and in a brief introduction to medical interviewing. Though reasonably well developed, the medical ethics curriculum was elective. In the third and fourth ("clinical") years, rotations through the different disciplines were conducted almost exclusively within hospital settings, with minimal exposure to primary care principles.

The Rationale for the Reforms of the 1990s

Curricular reform at Northwestern began in earnest in 1984, when Dean Beaty charged a task force of senior faculty with addressing issues raised in the AAMC's recently published *Report on the General Professional Education of Physicians*(the GPEP Report) (Muller 1984). The major recommendations of that task force, issued in 1986, focused on the need to centralize administrative influence over the curriculum

and to restructure the Curriculum Committee as a body representing the faculty at large rather than one representing departments and major courses. In addition, the task force saw a need to clarify educational goals and learning objectives, to limit the amount of time students spend in passive learning modes, and to facilitate self-directed learning. The task force, in short, simply reiterated the major messages of the GPEP Report, placed them in a context specific to Northwestern, and provided the imprimatur of a group of respected senior faculty.

The ensuing path toward meaningful curricular change has been described in two previous publications (Winter et al. 1997; Makoul and Curry 1998). Initially, most discussion and planning occurred in the Curriculum Committee and in the dean's administration. In these discussions, several specific arguments for curricular change began to be defined:

1. The continued growth of medical knowledge has become a progressive impediment to student learning, in part because factual material is presented in piecemeal fashion without sufficient opportunity for integration.
2. The expectations of society for the medical profession are not well addressed. This is particularly relevant to communication skills, to ethics and cultural diversity, and to health promotion and disease prevention.
3. Similarly, public health policy and the organization and economics of medicine have not been adequately addressed.
4. Modern medicine's dependence on technology has diluted the pedagogical emphasis on fundamental clinical skills.
5. The ways in which physicians use information to make clinical decisions should be explicitly taught in medical school, as should the science of information management itself.
6. Medical students need to be imbued with a firm commitment to independent, lifelong learning.

The first visible product of these efforts was a statement of eight general goals essential to the curriculum (see box). The dean promulgated and widely advertised them, and we used them as a point of reference for discussion of existing and proposed curricular elements, departmental annual reports, and so on. By presenting such areas as communication skills, medical decision-making skills, and preventive medicine as equal in importance to knowledge of basic science concepts and clinical assessment skills, this document was instrumental in communicating the dean's vision for the curriculum to the faculty.

Curriculum: General Goals

The goal of the medical curriculum is to prepare broadly educated, responsible physicians capable of pursuing postgraduate medical education in any clinical discipline and/or pursuing a career in medically related research. This requires each student to attain facility in each of eight areas:

- Knowledge of the scientific basis and language of medicine
- Information management
- Communication
- Clinical data gathering
- Clinical decision making
- Professional attitudes based on an appreciation of medical ethics and humanities
- Commitment to health promotion and disease prevention
- Commitment to lifelong learning

By 1988, the Curriculum Committee was ready to initiate a pilot course utilizing problem-based learning (PBL). Course requirements in medical ethics were also expanded (Bresnahan and Hunter 1989). Though successful in accomplishing their objectives, these new initiatives increased the formal class time in an already overburdened curriculum, as the underlying curricular structure did not change.

The Curriculum Committee then addressed the third and fourth years, and in 1990 several substantive, though not revolutionary, changes were made in the required clerkships. A new, one-week Introduction to the Clinical Clerkships was designed to better prepare students for the transition to clinical learning environments; a new primary care clerkship was created; and initial attempts were made to coordinate the teaching of clinical skills from clerkship to clerkship.

By 1991 there was sufficient understanding among the faculty about the need for reform and enough familiarity and experience with the PBL pilot to produce a critical mass of "believers" in student-centered learning methods. A retreat of all course and clerkship directors, other departmental representatives, Curriculum Committee members, and the dean's administration quickly produced a plan for generating a new first- and second-year curricular structure. Eight thematically oriented task forces, coordinated by the Curriculum Committee, then worked in parallel, and a new first- and second-year curriculum came into being within 18 months (fall 1993). This process did not further revise the third and fourth years, though new means of coordination between the first two and the latter two years were proposed.

Another development at the medical school during this period deserves mention in the context of the school's responsiveness to societal needs. By 1990, Northwestern was one of only 17 U.S. medical schools without a family medicine department. There was no particular need to add family practitioners from the standpoint of the school's clinical practices, and the academic general internists and pediatricians then on staff provided an appropriate environment for research in primary care areas. Based solely on our students' need to have excellent faculty role models in family practice—now the nation's second largest medical specialty—and to have educational experience in family practice settings, the medical school created a new Department of Family Medicine in 1995. Its newly recruited chairman arrived early in 1997 and proceeded to build a core of full-time faculty now actively involved in all four years of the curriculum.

Characteristics of Curriculum Change

In addressing the six specific curricular needs noted above, two fundamental "paradigm shifts" emerged. These guided further refinement of our first- and second-year curriculum plan and continue to serve as basic curricular principles. The first is a change in the way we expect students to learn medicine. Our students are regarded as adult learners with a wide variety of backgrounds, aptitudes, and learning preferences. Adult education models embrace this diversity and provide a framework for continuous self-directed education beyond the formal curriculum. Moreover, the very nature of the profession demands that students learn to think on their feet, relating different areas of knowledge to each another and serving as critics of their own and others' reasoning processes. To these ends, the curriculum provides a variety of learning formats with emphasis on interactive, discussion-based small-group activities. It also includes new models for explicit teaching of the processes and tools physicians use to make clinical decisions (Curry and Makoul 1996).

The second new emphasis is a dramatic increase in the attention paid to issues of professional perspectives and professional skills. As detailed by Curry and Makoul (1998), medical schools' attention to students' interpersonal skills and attitudes and to the interface of the medical profession with society at large had grown steadily for some years. Not until the early 1990s, however, did schools begin to address these issues comprehensively. The conceptual framework of *patient-centered medicine* has been instrumental in bringing about these changes. Ian R. McWhinney describes the concept quite succinctly:

> In the traditional doctor-centered method, physicians try to bring the patient's illness into their own world, and interpret the illness in their own pathological frame of reference. The essence of the patient-centered method is that physicians try to enter the patient's world, and see the illness through the patient's eyes. To understand patients in this way requires in the physician certain qualities not usually emphasized in medical education: self-knowledge, moral awareness, a reflective habit of mind and a capacity for empathy and attentive listening. (McWhinney 1986)

The new Northwestern curriculum attempts to nurture these qualities in our students.

Major New Elements in the Curriculum

The first- and second-year curriculum is composed of four courses, each presented in a series of discreet, topically focused units. Each course and nearly every unit is interdisciplinary in nature and draws faculty from a number of departments; all are managed and funded centrally by the dean's administration.

There are two courses in the basic medical sciences—one in each of the first two years. Each involves approximately ten hours of lectures per week for the entire academic year, complemented by problem-based learning sessions, laboratories, and small-group discussions and tutorials. Structure-Function, the first-year course, begins with a review of cell and molecular biology, genetics, and signal transduction, then addresses gross and microscopic anatomy, biochemistry, and physiology in a consecutive sequence of organ systems. The Scientific Basis of Medicine, in the second year, begins with an overview of immunology, microbiology, and infectious diseases and then details the pathology, pathophysiology, and pharmacology specific to each

organ system.

The Medical Decision Making course occupies three short blocks of time—the initial week of the first year, two weeks later in the first year, and two more weeks in the final portion of the second year. This innovative course allows students to develop the knowledge and skills in information management, epidemiology and biostatistics, and clinical problem-solving essential to the contemporary practice of medicine.

The Patient, Physician & Society course (Makoul and Curry 1998) is devoted to the development of clinical skills and professional perspectives and provides each student with the opportunity to develop mentoring relationships with a variety of faculty preceptors. The class is divided into four "colleges," each led by an experienced clinician. Colleges meet two afternoons per week throughout the first two years. One afternoon offers learning experiences centered around clinical skills development (Curry and Makoul 1996) and the provision of an integrated bio-psychosocial perspective on illness and patient care. The other afternoon's course sequence addresses ethical and social issues, including public health and health policy. Students have several opportunities to pursue their interests in history, religion, and other cultural contexts of medicine. Activities in both afternoon tracks incorporate health promotion and disease prevention as guiding principles of the practice of medicine.

Problem-based learning groups, mentioned above as part of the Structure-Function and Scientific Basis of Medicine courses, are important components of the first- and second-year experiences. These small, student-directed sessions are designed to promote the learning of basic scientific concepts in the context of clinical problems and to stimulate development of critical reasoning skills in clinical decision-making. The PBL sessions also develop and reinforce information management skills.

The third year requires 48 weeks' rotation through clerkships involving the major clinical departments—medicine, pediatrics, family medicine, surgery, obstetrics and gynecology, neurology, and psychiatry. The respective clinical department organizes and manages each clerkship, with the exception of the primary care clerkship. This four-week, office-based experience, established in the 1990 curriculum revision, is jointly staffed by the Department of Medicine's Division of General Internal Medicine and by the Department of Family Medicine, and the medical school's Office of Medical Education administers it. Although all other clerkships are administered at the departmental level, their leaders have a secondary reporting relationship to the Associate Dean for Educational Programs, and they work together to coordinate learning objectives, maintain common performance evaluation mechanisms, and monitor the quality of the clerkship experiences.

In the fourth year, only two specific experiences are currently required: a six-week acting internship in either internal medicine or pediatrics, and a two-week clerkship in Physical Medicine and Rehabilitation. The remainder of the fourth year consists of elective clerkships and research experiences. Most students elect to do one or more such rotations at other institutions, with a significant number seeking international opportunities.

Impact of Curricular Change

The breadth and comprehensiveness of this sort of educational reform makes it difficult to evaluate reliably the specific impact of any component. Nor do many of our intended outcomes—a heightened capacity for empathy, for example—lend themselves to easy analysis. We have, however, been able to gather useful information from a variety of sources.

We have been most intensely interested in assessing the impact of the Patient, Physician & Society course, given the absence of external means of measuring our students' professional growth (as certification board scores do for their mastery of basic science knowledge). To this end, Gregory Makoul developed the Student Perception Survey (Makoul and Winter 1997) shortly before our curriculum transition and has since administered this survey to all our students upon matriculation and at the end of the second medical school year. We have also provided the survey to several other U.S. medical schools, with the agreement that they will share their data with us and thus provide us with appropriate, contemporaneous comparison groups.

The Student Perception Survey contains several brief sections assessing students' perceptions and expectations regarding their educational goals, career plans, learning orientation, and social orientation as well as their expectations of the medical school faculty. It also elicits their perceptions of the nature of health and of the role of medicine and their views regarding the importance of various aspects of doctor-patient communication.

The first few years' data are very encouraging. The first cohorts of students to experience our new curriculum reported more progress toward a number of educational goals that had been targeted for emphasis than did the previous class. The Classes of 1997, 1998, and 1999 reported significantly more progress toward "improving problem solving skills," "becoming more aware of ethical issues in medicine," "gaining a full appreciation for political, economic and social influences on health care," and "mastering skills for providing information to patients" than did the Class of 1996 when its members were surveyed at the end of their second year (Makoul, Curry, and Thompson 2000). These differences appeared immediately with the Class of 1997 and were sustained over the ensuing two years.

Educational outcomes for the basic science curriculum are more difficult to interpret. The certifying examinations of the National Board of Medical Examiners provide an excellent external data source. And, in fact, the mean scores of Northwestern students on Step 1 of the U.S. Medical Licensing Examination have risen progressively since 1993. The national mean scores, however, have also been drifting upward due to increasing selectivity in medical school admissions in the early and mid-1990s, and it would be very difficult to attribute the rise in our test scores to the new curriculum. It is safe to say, though, that the new approach has not led to any *decline* in students' understanding of the basic medical sciences.

The lack of recognized measures of facility in clinical reasoning impedes evaluation of the medical decision-making curriculum. We are attempting to develop such measures for use in our performance-based clinical skills assessment program, assaying our students' ability to search medical sites on the Internet and to interpret the information appropriately in the context of our existing clinical skills examinations. We do have some information, obtained as our students have completed the curriculum, from the AAMC Graduation Questionnaire. In response to questionnaire items related to medical decision-making and use of information technology, our Class of 1999 reported a degree of confidence in their knowledge and skills that was consistently higher than the mean national responses.

Plans for the Future

The reforms of 1993 have clearly changed the "curricular culture" at Northwestern. Discussion of students' personal growth and development, of the need to ensure high-quality educational experiences in end-of-life care, and of other such issues—previously dismissed as "the soft stuff"—is now common among department chairs and faculty committees. There are well-defined, structured formats for teaching these and other subjects, and increasing numbers of faculty are gaining experience and skill in new teaching roles. The basic curriculum framework is flexible, however, and able to accommodate new emphases as our understanding of students' needs changes over time.

The major shortcoming of our efforts to date is obvious. The original intention of Northwestern's faculty, as the task force organized to respond to the 1984 GPEP Report reported, was to create a new plan for medical education across all four years of the curriculum. Almost all the major curriculum changes we have undertaken in the past decade, however, have been confined to the first two years. This problem is by no means peculiar to Northwestern and has its origins, at least in part, in the organizational structure of the medical school. Interdepartmental collaborations and centralized responsibility for management are much easier to attain in a curriculum based largely in the classroom setting. When attempting similar integration in the clinical curriculum, it becomes very difficult—and possibly inadvisable—to separate students' educational experiences from the department- and site-specific venues where clinical care is provided. The competing priority, the assurance of meaningful participation in patient care activities to facilitate experiential learning, might not be well served by efforts to transcend existing departmental boundaries.

Providing sufficient educational experiences in the ambulatory setting has been more difficult than we imagined. As noted above, clinical education occurs most naturally, and effectively, when it is designed to occur in concert with direct patient care activities. As our faculty increase the proportion of their clinical activity in ambulatory settings, however, they have also encountered several new time constraints. The contemporary practice environment demands that they schedule less time per patient; in addition, they have lately faced more rigorous expectations for documentation in patient records and billing records. In this setting, effective supervision, observation, and teaching of students presents a sizable challenge. Our primary care clerkship and a new ambulatory segment of the pediatrics clerkship have been very successful, due mostly to the large number of committed volunteer faculty in the primary care disciplines. Initial attempts to create additional ambulatory components within the other required clerkships have not, however, proven sustainable.

Despite these challenges, there is a great deal we can do to better ensure the cohesiveness of the clinical curriculum and its coordination with the curriculum of the first two years and to further educational

opportunities in primary care. We are currently beginning a new round of curricular revisions in the third and fourth years, modifying some of the formats and strategies from our earlier reforms that have been most successful. We are most interested in extending formal emphasis on professional growth and development issues into the third and fourth years. Although students in the first and second years easily and thoughtfully engage in examination of their professional responsibilities these concepts and issues become much more immediate and meaningful later on, when students are active participants in daily patient care.

We will most likely address such areas, and ensure centralized management of these educational experiences, through new, two- or three-day classroom-based sessions intercalated between clerkship periods in the existing rotation schedule. This mechanism should also prove useful in providing students with the opportunity to continue regular contact with faculty mentors from the preclinical years and to participate in reflective discussion sessions outside the more hectic clerkship environment. In addition, we can provide sessions within these "inter-clerkship" periods for presentation of new material related to human genomics, medical economics, or other topics likely to have changed significantly even over a one- or two-year period. Attention to these needs might more effectively impress on students their need for continued scholarship and lifelong learning within the profession.

We will also be considering ways to encourage community service during the latter years of medical school. An overwhelming majority of our students become involved in volunteer activities during the first two years, many of them created and managed by the students themselves. Only a minority, however, continue these activities during the clinical clerkships, at least partly because of the scheduling complexities and stresses this part of their medical education brings. If we are to enhance students' understanding of medicine as a service profession and effectively nurture the idealism and compassion they exhibit on entering medical school, we would do well to provide more opportunity for and expectation of continued community service throughout the student body.

Finally, we will be working to further increase the cultural diversity of our medical classes and to enhance the "cultural competence" of each individual student. There is already considerable ethnic diversity within the student body. One item in the Student Perception Survey asks students to describe their ethnic background; each year we receive about 60 different descriptions from our 170 students. Nevertheless, we still fall far short of our goals for enrollment of underrepresented minority students. We are seeking ways to partner with the Rehabilitation Institute of Chicago to further opportunities in medicine for the physically disabled, another group underrepresented in medicine. With respect to each student's skills in working with patients from other cultures, Chicago's cultural diversity offers a wealth of opportunity. We are creating a new program to ensure that every student has the opportunity to learn basic medical Spanish and increasing opportunities for clerkship experiences in ethnic neighborhoods.

Epilogue

Hilliard Jason, a pioneering medical educator, has said that "of all the works of man, few can be more complex, or potentially more important to society, than the business of creating physicians" (Jason 1972). Over the past decade, more has been done to improve the process of medical education, at Northwestern and elsewhere, than since the early decades of the 20th century. It is our obligation to maintain this progress and continually to seek further improvements in our students' preparation for their careers as physicians.

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College of Medicine, Medical University of South Carolina

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Executive Summary

The College of Medicine of the Medical University of South Carolina (MUSC) has been in continuous operation since 1824. In the past four decades, it has graduated about 140 medical doctors each year. One-third of the graduates eventually practice in a primary care specialty, and about one-half practice in South Carolina.

Since 1990, when Dr. Layton McCurdy was appointed dean of the College of Medicine, the college has significantly changed its curriculum in response to the needs of patients, the expectations of our society, the burgeoning information in science and medicine, and the information technology revolution. The Undergraduate Education Strategic Plan, which articulates the fundamental competencies that all graduates

should possess, has guided the content of the new curriculum. These include demonstration of the knowledge, skills, and attitudes necessary for (1) continued self-directed learning and the critical evaluation of new scientific information, (2) understanding the scientific basis of medicine and its application, and (3) effective diagnosis, treatment, and prevention of disease. Graduates also should demonstrate the personal characteristics required for the best possible patient interactions and medical care. The curriculum renewal process is based on the overarching themes of (1) integration of basic and clinical science education, (2) emphasis on self-directed learning, (3) early exposure of students to patient care, (4) emphasis on preparation of a generalist physician, and (5) use of multiple methods of learning and assessment. The curriculum renewal process has effected major changes in the structure and delivery of medical education and in the evaluation of the competency of the student at all stages of professional development. The changes have occurred in each of the four years of the medical school curriculum. The renewal process has incorporated methods of evaluation of the effectiveness of the curriculum as well.

Significant challenges remain to the continuation of effective and dynamic curriculum reform. Continued strong leadership from the dean is of paramount importance, as are central control of the curriculum and its renewal and also direct effective funding of the education process.

The MUSC College of Medicine has had a strong advocate for education and curriculum reform in Dean McCurdy. His dedication to innovation in medical education has been evident throughout his career.

The traditional structure of the college is one of strong departments with departmentally "owned" courses. All funds are historically generated in each department or funneled through it. Departments assume that the dean's allocation to them is permanent, especially their portion of the state appropriation funds for education. Earnings from the clinical enterprise have for decades supported education and research activities and sustained phenomenal growth at MUSC. The funds have been commingled and revenue streams are not clearly directed to support the mission for which they are generated or appropriated. In the present climate of diminishing clinical dollars and decreasing faculty availability for teaching, the new curriculum is emphasizing interdisciplinary education, which is labor intensive and occurs outside of the departmental structure. Proper identification and alignment of the dollars coming for education among departments and for central, nondepartmental education has become a contentious and high priority. A program at MUSC that will align revenues to specific missions is progressing concurrently with the curriculum renewal.

Appropriate dynamic change in the medical school curriculum will be sustained through continuous evaluation and feedback to effect further improvement. Evaluating the needs of society and measuring the success of our graduates in meeting those needs will be difficult, but the college is developing new outcome measures to augment the ones it presently uses.

Introduction

Historical Overview: 1824 to the Flexner Era

The Medical University of South Carolina is situated at the confluence of the Cooper and Ashley rivers on the peninsula of Charleston, South Carolina. MUSC is a freestanding Academic Health Science Center that includes the MUSC Medical Center, University Medical Associates, Carolina Family Care, Carolina Specialty Care, and the Colleges of Graduate Studies, Dental Medicine, Health Professions, Pharmacy, Nursing, and Medicine. The College of Medicine was the first of these entities to be chartered and has been in continuous existence since 1824, graduating a class of physicians every year hence except for three years during the Civil War.

Faculty members who were influenced and educated by the best physicians from Edinburgh and Philadelphia created the first curriculum. The college operated as a proprietary school and raised tuition by selling tickets to medical lectures. In the post–Civil War era, poor conditions and meager means prompted the faculty to be quite creative and self-sufficient, as evidenced by the hand-crafted models of anatomy specimens presently displayed in the Waring Historical Library on the campus.

The first major curriculum reform came following the Flexner Report of 1910 that designated the College of Medicine of the State of South Carolina as a proprietary school that should be closed. The leaders of the college at the time knew they did not have the capital to improve the curriculum to a satisfactory level, so they sought political help. The coalition of supporters, some of whom were unlikely allies, succeeded in obtaining support and money from the state legislature. State funds have supported and assisted the college, now a university, ever since.

The Flexner Era to the 1990s

Following the Flexner Report, the curriculum adhered to the traditional model of two years of basic science and two years of clinical education. The college used this traditional curriculum to educate and train hundreds of physician practitioners for the state, and beyond, for decades thereafter. In the late 1960s and early 1970s, driven by good pedagogical reasons, the faculty revised the basic science curriculum into a systems and organ approach, with no change in the clinical instruction in the preclinical and third and fourth years. This curriculum model was short-lived, however, due to the absence of a strong centralized curricular authority with a strong centralized organization and budget. Thus, subjected to the continuing force of a decentralized departmental organization and funding structure, the curriculum gravitated back to the discipline-based approach to education in the basic sciences, such as anatomy, biochemistry, and physiology. In the subsequent years, curriculum changes were course- and department-driven, based on the faculty's assessment of the future needs of a graduating general physician.

In the early 1970s Dr. Layton McCurdy, a faculty member who subsequently became chair of the Department of Psychiatry and eventually dean of the College of Medicine, initiated a novel method of teaching psychiatry. His vision for a better way to teach clinical psychiatry resulted in the establishment of the Psychiatry Learning System (PLS). Under the PLS, students learned about psychiatric diseases by viewing video "trigger" tapes of patients who showed signs and symptoms of psychiatric illness. The viewings trigger discussion of the meaning of the signs and symptoms and the diagnoses to which they would logically lead.

The curriculum at MUSC College of Medicine for the past 20 years, at least, could be described as a traditional, horizontally stratified curriculum. Departments of Basic Sciences provided courses such as Anatomy, Biochemistry, Histology, Physiology, Microbiology, Immunology, Pathology, and Pharmacology, which commanded most of the medical students' attention during the first two years. One exception to the discipline- and department-based courses in the first two years was the course that delivered the "art" and clinical skills to medical students. Called Introduction to Clinical Medicine (ICM), it included the study of behavioral science, medical interviewing, ethics, medical jurisprudence, and clinical reasoning and physical diagnosis. Although these segments of the ICM course were sequenced thoughtfully and properly for more than a decade, a seamless integrated patient-centered curriculum was never achieved within the course. Correlation with the basic science courses occurring at the same time during the first two years was nominal, at best. Agreement on synchronization of schedules was even an elusive goal. Cooperation and flexibility were not strengths of the medical school faculty, and curriculum continued to evolve departmentally and historically as the sciences were founded and were matured.

The third and fourth years in the medical curriculum were traditionally hospital-based patient care experiences in the disciplines of Internal Medicine, Surgery, Psychiatry, Pediatrics, and Obstetrics/Gynecology, with seven months of clinical electives selected by the student.

The school evaluated student achievement and curriculum effectiveness with multiple-choice question examinations and the National Board of Medical Examiners ("Board") examinations, given at the end of the second year and again in the senior year. The clinical faculty with whom the students worked in the third and fourth years assessed student professionalism, clinical reasoning, and clinical skills.

Precursors of Curriculum Change

Upon his appointment as Dean of the College of Medicine in 1990, Dr. McCurdy initiated an internal assessment of all of the clinical care, research, and education missions of the college. His leadership and insistence that the college develop and implement a strategic plan forced the faculty to examine critically the college's educational activity. During Dr. McCurdy's tenure as dean, the college has experienced many changes. The method of providing clinical care was drastically reorganized with the creation of a feeder system of community practices. The faculty practice was consolidated and moved into one newly renovated 12-story building, which included most of the necessary ancillary services. The dollar amount for research grew more than 100 percent, to $100 million in awards per year. Internally driven demand for an educational strategic plan based on an assessment of the needs of the citizens of South Carolina and society at large, as well as the changes in scientific knowledge and clinical practice, fostered curriculum innovation and change. The Deans' Subcommittee on Medical Education of the Commission on Higher Education commissioned the assessment, which was based on data from the Office of Research and Statistics of the Budget and Control Board. One such assessment study indicated that, based on the present population needs, projected population growth, and the number of medical (and other health professional) students and residents, the state was producing an adequate number of medical school graduates. However, among those graduates, too few were entering primary care or choosing to practice in rural areas or areas with

underserved populations.

There had been major attempts to integrate the basic science and clinical science curricula in the past. Initially, the organ and systems courses in the 1960s and 1970s were somewhat successful in doing that. That approach required much cooperation among teachers and, in a departmentally organized institution, it took much goodwill and resolve on the part of the faculty. At the same time, clinical teaching was reemphasized in the first and second years with some integration, albeit only primarily sequencing and scheduling, between the basic science and clinical components.

Dr. McCurdy's penchant to foster innovation in education was again evident when he returned as dean in 1990. He not only encouraged renewed curriculum change immediately and through the strategic planning in education process, but he presided over the agreement process between the faculty and administration which resulted in a codified and formalized agreement for the "Curriculum of the Millennium."

The dean challenged the faculty to develop different approaches to education. The first of these was a demonstration project called the Parallel Curriculum. The Parallel Curriculum is a "pure" problem-based-learning curriculum within the first two years of education. Learning is student-driven, and occurs in small group settings called Societies. Each Society is composed of six students and two faculty members. The education begins with a patient case study from which students develop learning issues that guide their study and discussion. Faculty do not give any lectures but they do provide correlative didactic sessions when requested by the students. Students in the Parallel Curriculum also have early and integrated patient contact experiences on campus and in the community. By all measures, this learning method has been as successful as the traditional method. The students and faculty say they enjoy this approach to learning, and the students seem better able to adapt when they begin the clinical cores in the third year. Because the Parallel Curriculum was an unqualified success and demand was so great for it, the dean and faculty increased the opportunity for students to enroll in it by one-third. Presently, 24 students (of a class of 135) a year are enrolled in the Parallel Curriculum.

The Parallel Curriculum has been of great value to the College of Medicine and to the university, as well. It demonstrated clearly that students could learn in ways other than through the traditional methods of lecture and laboratory. It provided a venue for faculty development in a different type of education and evaluation. The college has derived additional value from the Parallel Curriculum experiment, as well. We have interwoven many of the methods of teaching and learning into the traditional curriculum, since the same faculty teach in both curricula. Even faculty who were the most reticent or even adverse at first became supporters of the pedagogical method used in Parallel Curriculum. Also, through the efforts of the directors of the Parallel Curriculum, this curriculum has become the first educational effort to have its own budget. It pioneered the first real budget for education that tied expenditures to the goals and objectives of the education process. Thus, the College of Medicine knew how much it cost to educate each student in that curriculum for at least the first two years of learning. That budgetary model was used for each subsequent curriculum innovation.

Other changes occurred within the first five years of Dr. McCurdy's tenure as dean. The South Carolina Academy of Family Physicians had, for many years, advocated for a Family Medicine course in the third year of medical school. The students were to receive one month of training in a general practice setting at one of the residency training sites established throughout the state. Preparations and negotiations were going on for several years but it was very difficult to get traditional disciplines such as Internal Medicine and Surgery to give up one of their three months of instruction in the third year. Further, one month of Family Medicine would have been difficult to insert into a curriculum divided into two-month rotations. We reached a compromise in 1992 that exchanged one month of Internal Medicine and Surgery for one month again in the fourth year. This arrangement allowed each student to experience a month each of Family Medicine and Neurology in year three and one additional month each of Medicine and Surgery in year four. Serendipitously, this arrangement fostered the principles to be articulated later in the 1994–1996 Strategic Plan, which called for a curriculum that would graduate a generalist physician, and would make better and more meaningful use of time in the fourth year.

Because of the legitimate and vocal concerns of the faculty over the drastic nature of these changes in curriculum, it was important that the Parallel Curriculum and Family Medicine be recognized as immediate successes. The fact that they were was the result of the extraordinary attention and work of the faculty and staff who came forward to lead and carefully evaluate both curricula. We evaluated the curricula as they were implemented, while the students and faculty were experiencing each, and later through nationally comparative measures such as Board examinations.

Coinciding with the development of the Parallel Curriculum and the clerkships of Family Medicine and Neurology was the dean and faculty's recognition of the need for new facilities for small-group teaching and evaluation of the clinical skills of the students. Through an allocation of $1.2 million from the dean's budget, the college established the Center for Clinical Evaluation and Teaching. It presently houses the Parallel Curriculum societies; provides small-group meeting space, which allowed innovation in the curriculum toward small-group teaching; and it is the home of the Standardized Patient Evaluation program, through which curricular innovations in teaching of clinical skills are evaluated and certified.

Rationale for Curricular Change and Strategic Plan

Although the curriculum was changing, the change was piecemeal and episodic. What was missing was a plan of action to put mechanisms in place to assess and respond to needs, as well as allow for a continuing process of curriculum evaluation and change.

In response to the changes in expectations for physicians of the new millennium, and also to the market forces effecting major change in health care delivery, the dean and other leaders of the College of Medicine initiated a strategic planning process, which initially spanned the years 1994–96. This faculty strategic planning effort resulted in a consensus about the changes occurring that would affect the nature of the product of the curriculum: the graduating physician.

The entire medical landscape appeared to be changing and so were the needs and demands of the individual and society. The faculty was concerned about the public's devaluation of personal physicians. The faculty recognized the growing needs and demands for care of diverse populations (such as the elderly and underinsured). It saw a need for reemphasis on disease prevention and public health, for education about practicing in a diverse multicultural and economic environment, and for a change from hospital-centered to outpatient- and community-based health care delivery. Managed care, emphasizing primary care physicians as gatekeepers, and the intrusion of market forces on the practice of medicine appeared to mandate a change in curriculum as well. Overall, the faculty concluded that the new curriculum should produce doctors with different capabilities and skills than those being learned at the present time.

Science was in an accelerated phase of change as well. Medicine appeared to be at the threshold of understanding disease at the genetic level. There were rapid developments in mechanistic sciences, such as developmental biology and neuroscience, requiring a more fundamental understanding of science and medicine than what is required by most of the descriptive sciences presently occupying the teaching and learning in medical school. The faculty concluded that although not all of the information could be learned, fundamental principles should be imparted to the students, along with the skills to access information as the need arose in the clinical setting.

Finally, the information technology revolution had markedly changed the delivery of information, education, and health care. The faculty agreed that graduating physicians must learn how to be continuous learners, able to access the knowledge they need rather than being repositories of a finite body of knowledge at graduation.

Although there were perceived and real exigencies felt at MUSC and in South Carolina—financial pressures, clinical affiliations, and legislative forces—these were not the direct, primary, or mandating reasons for curriculum change. Rather, the innovations in medicine and science, and the way these innovations could benefit society today and in the future, drove curriculum change at MUSC. A forward-thinking dean and faculty began the process of strategic planning that included clinical, research, and educational missions and engaged faculty, students, and alumni in preparing for the new millennium. In fact, the process became the identifying theme for curriculum renewal in the College of Medicine, known as the Curriculum for the Millennium.

In the arena of education, faculty, students, and alumni described the overarching themes, goals and objectives for the Curriculum of the Millennium and put into place a procedure for curriculum revision. The College of Medicine's Undergraduate Education Strategic Plan articulated the fundamental competencies all graduates should possess. The broad categories of competency are:

- The knowledge, skills, and attitudes necessary for continued, self-directed learning and for the critical evaluation of new scientific information as it might relate to the diagnosis, treatment, and prevention of disease
- The fundamental knowledge necessary for understanding the scientific basis of medicine and its application

- The knowledge, skills, and attitudes necessary for the effective diagnosis, treatment, and prevention of disease
- The personal characteristics required for interacting with patients and other health care professionals to achieve the best possible medical care

These fundamental competencies and other goals and objectives were remarkably similar to those developed nationally by a group of medical schools working in the Medical School Objective Project at the Association of American Medical Colleges, as one might expect.

Initially, almost every constituency of the College of Medicine, whether faculty, students, or administration, thought any change would be unnecessary and adversely affect them. Conversely, the MUSC interns and residents who had graduated from the College of Medicine and other alumni who were surveyed were strongly in support of change; perhaps their vantage point and experience in practice broadened their perspectives. This sampling of comments from the faculty, staff, and students convey the resistance to change that one encounters in a traditional school of medicine:

- From faculty members: "I'm about to retire, please don't ask me to change my course again, wait until I leave" and "If it's not broken, why fix it?"
- From a third-year student: "Wait until the class after us to change anything."
- From a new first-year student: "A new curriculum will affect my competitiveness for a residency."

Process of Curriculum Change: Developing Infrastructures and Centralizing Resources

In the process of reforming the curriculum, the College of Medicine created a new central organization of its people and facilities. An additional $500,000 from the dean's budget also helped. This combination was essential for negotiating and agreeing on a curriculum and fostering a spirit for and willingness to change.

The Education Policy Council (EPC) was the first of the infrastructure changes proposed in the Strategic Plan and effected by the dean, who also served as chair. Composed of senior faculty and the associate deans for Students, Graduate Medical Education, and Continuing Medical Education, the council would oversee the integration of medical education from undergraduate through graduate and continuing medical education.

One of the first acts of the EPC was to call a retreat of the key members in the College of Medicine to discuss the proposals of the Strategic Plan. The main theme, which emanated loudly and clearly from the EPC retreat, was that curriculum change would be an "evolution, not a revolution," at MUSC College of Medicine. Furthermore, the changes would maintain the departmental structure. The departmental structure was the traditional basis for faculty recruitment and retention, the distribution of compensation and rewards, and the clinical care delivery system and research effort.

It was affirmed several times at the retreat that the faculty was the college's greatest asset. Its members would have to lead and participate in curriculum change whenever possible. It was also acknowledged that some centralization of control was needed to meet the vision of the strategic plan.

In addition to the Education Policy Council, which provided for longitudinal continuity in medical education, the Curriculum Coordinating Committee (CCC) was formed and charged with the task of developing and implementing a new curriculum. A budget was earmarked from the Dean's Office's central funds to support the curricular renewal. The CCC is composed of a basic scientist and a clinician for each year, to serve as curriculum change coordinators, and two clinician coordinators for the Doctoring Curriculum. Each is a member of the faculty who has been recognized as a leader in education in the college or at the university level or nationally. Their salaries are partially offset (15 to 30 percent) by payment from the Dean's Office to the departments in which they hold their primary appointments. The committee also includes members from the MUSC Medical Center staff who are alumni of the college, and student members.

The members of the CCC propose the methods and procedures that would attain the education themes, goals, and objectives of the new curriculum. During the 1990s, there had been regular curriculum renewal and, more recently, substantive major change at MUSC. The process is based on the overarching themes for the Curriculum of the Millennium, which prescribe how the content of the curriculum would be presented and learned. These overarching themes flow from the fundamental competencies expected in all graduates as articulated in the Education Strategic Plan and guide every decision made about curriculum change. They include:

1. Integration of basic and clinical science education;
2. Emphasis on self-directed learning;
3. Early exposure of students to patient care;
4. Emphasis on preparation of a generalist physician; and
5. Use of multiple methods of learning and assessment.

The curriculum change coordinators also negotiate the changes and secure acceptance from all constituencies, especially the teaching faculty and students. The committee members meet several times a week. They visit departments, hammer out agreements, achieve compromise, and sometimes recommend and request money for needed changes. They supervise the implementation of new curriculum changes and evaluate the outcomes. Sometimes they face a hedgerow-by-hedgerow battle, as even those who agree in principle about the curriculum reform are resistant when it comes to their own particular part of the curriculum or discipline.

During 1997 and 1998, the CCC initiated "virtual" site visits for the faculty to study curriculum change. Through telecommunication with other institutions that were committed to curriculum renewal, groups of faculty and students of each school met to discuss how they did it. Several teleconferences between MUSC and each of three other medical schools concentrated upon the dynamics of the process of curricular change, not necessarily the curricular product. Participants thought that the product of curriculum renewal would be different for each medical school as determined by its specific history, purpose, missions, and political climate. The study of the process would help MUSC learn from the mistakes of others and would allow a more efficient curriculum renewal process.

In the virtual site visits, an individual was identified to act as a consultant to MUSC. The individual was a leader in curriculum reform in a program that appeared to demonstrate best the kind of change process that might be successful at MUSC. The consultant, who visited the campus and spoke with many faculty and students, was an outside expert who affirmed the school's process for curriculum renewal.

The associate dean for primary care, in a newly created academic post, has primary responsibility for the new curriculum as chair of the CCC. He and the CCC report to the Undergraduate Curriculum Committee (UCC) and its chair, the associate dean for students. That body, composed of a wider circle of faculty, staff, and students, oversees the work of the CCC. The CCC also receives input from the Education Policy Council and keeps it informed of decisions regarding curriculum changes.

The Dean's Office provides central support for curriculum change. It includes support staff to help the faculty create and present the new curriculum, staff to evaluate the curriculum, and staff to support interdisciplinary courses and central services such as evaluation and testing. The budget for these functions is approximately $1 million. Prior to the curriculum changes in the nineties, we gave little attention to identifying the budget for education infrastructure at MUSC. Much still needs to be done in the future to identify all expenditures for education. Through an ongoing process called Mission-Based Management, the College hopes to achieve that goal.

The process of curriculum reform is not a pretty one. Meetings and forums seem, at times, interminable. They occur among the associate deans for students and for primary care, each department, faculty contacts, and later between curriculum coordinators and faculty. Special meetings with members of the central administration and the dean are occasionally necessary, to ensure that the dean remains informed, committed, and willing to step forward when progress seems to be at an impasse.

Curriculum of the Millennium

The initial implementation of the curriculum revisions occurred in August 1999 for the first-year students. The new curriculum emphasized more small-group interaction, less lecture and nonessential content, self-directed learning, basic science and clinical correlation, and early patient contact.

Specifically, the students' educational experience was as follows. We reduced didactic content in some courses by 30 percent and emphasized continuous self-directed learning in basic sciences. We combined courses and rearranged content to make logical sense and eliminate redundancy. Instead of Gross Anatomy, Embryology, Biochemistry, and Genetics in the first semester, the basic science courses offered are Anatomical Basis of Medicine (which integrates anatomy and embryology) and Molecular Basis of Medicine (which includes biochemistry, cell biology, and molecular genetics). During the second semester, the basic sciences courses offered are Physiology, Neuroscience (which includes Neuropathology), and Cell, Tissue, and Organ Biology.

Correlated with the basic science learning is the students' concomitant enrollment in the Doctoring Curriculum course. Included in the course are clinical lectures and demonstrations correlated with and enriching the basic science material being presented. The students are introduced to clinical skills and have the opportunity to practice them on patients throughout the first year. For instance:

- When the human female breast is studied, a specialist in breast cancer treatment will deliver a correlative lecture.
- The orthopedic bone/joint examination is presented simultaneously with study of those body parts in the anatomy lab.
- The male urological examination is demonstrated and practiced when the students are learning the basic science of reproductive physiology.

Students are placed in Primary Care community practices every third week to hone their skill in taking the portions of medical history they learned the previous two weeks with standardized patients. During the first semester, students learn and demonstrate proficiency in patient interview techniques while obtaining appropriate information from children, adolescents, adults, and geriatric patients.

During the same semester, they also study and discuss "paper" cases demonstrating human behavior in settings of alcohol addiction, domestic abuse, and dementia in a format similar to the Parallel Curriculum.

Under the old curriculum, examinations were given in a sequence that fostered a pattern of cycle-studying for the discipline to be tested that week. Now there are two examinations during the term and one final examination per semester, each one preceded by a weeklong study break. Practical examinations, which test proficiency in identifying anatomical structures, the techniques of medical interviewing, and patient-student interactions, are administered the day following each comprehensive written examination.

Although the schedule and expectations were demanding overall, students said they enjoyed the first year in the new curriculum. The students indicated that it made the basic sciences they learned relevant while keeping the patient in perspective as their reason for becoming a doctor.

As of August 2000, MUSC will continue to implement the changes and innovations of the Curriculum of the Millennium in the second year of instruction, emphasizing the same principles of correlation between basic and clinical science, self-directed learning, and continued patient contact. In developing new courses, the same principles applied in the first-year renewed curriculum are followed. General Pathology, Microbiology, and Immunology, as well as clinical genetics and diseases of blood, are combined under the new Mechanisms of Disease I and Immunity and Infection courses. In the second semester of the second year, the students will take Mechanisms of Disease II, which includes descriptive pathology along with correlative clinical sessions of pathophysiology, and pharmacology and therapeutics. The Doctoring Curriculum continues with physical diagnosis and clinical reasoning, ethics, and psychopathology, in close correlation with what is being presented in the basic science courses.

As in year one of the new curriculum, the two regular term examinations and one final examination each semester are preceded by a weeklong study break. Practical examinations, which test proficiency in techniques of medical interviewing, physical examination, and clinical reasoning are tested the day following each comprehensive written examination.

A new clinical experience for the students in their third year was initiated in July 1999. The Deans' Rural Primary Care Clerkship is a collaborative initiative of the Medical University of South Carolina College of Medicine and the University of South Carolina School of Medicine. The purpose of the clerkship is to broaden the focus of student learning from providing care to individual patients to improving the health of defined underserved populations in rural South Carolina.

Students are assigned to a primary care practice site in a rural, medically underserved community of South Carolina for the four-week clerkship. Students learn cultural competency skills and continuous improvement principles and tools. Community activities include home visits with selected patients from the clinical practice and participation in a community health-related project. Students work with interdisciplinary health care providers (i.e., nurse practitioners, pharmacists, health educators, public health specialists, social workers, and others, depending upon the site) and are immersed in rural community life during the clerkship. For the 1999–2000 academic year, 29 primary care practices throughout South Carolina participated in the clerkship.

The clerkship is named in honor of the two visionary deans who spearheaded the cooperative effort, Dean

McCurdy at MUSC and Dean Larry R. Faulkner at USC. Both are psychiatrists and professional friends who recognized that the needs of the citizens would best be met by the graduates of medical schools supported by the state, and that cooperation between the schools is coming to be expected by the government and citizens of the state, who generously support both schools.

The initial evaluations of the Deans' Rural Primary Care Clerkship have been overwhelmingly positive. The students and faculty expressed satisfaction with both the experience and the knowledge gained at the rural practices and communities. In addition, the students performed well in objective and practical tests, showing that they mastered the content and processes of the clerkship and fulfilled its educational goals and objectives. To make room in the third year for the Deans' Clerkship, we moved one month of Psychiatry to the fourth year, where the department will develop a curriculum emphasizing community-based psychiatric care.

Another significant change in the education of students in their clinical years is intended to promote the continuous self-education theme and facilitate the vertical integration of undergraduate medical education. A new course, Foundations of Clinical Medicine, builds on previously acquired knowledge and skills. The format of the course is based on the education model demonstrated in the Parallel Curriculum. Third-year students will have the opportunity to come together from each of the clinical clerkships to participate in weekly case-based discussions of the basic science and clinical aspects of patient problems. These small group sessions will include, whenever appropriate, information or exercises that build on concepts and knowledge introduced in their first two years. Some content areas of special concern include ethics, health maintenance and disease prevention, patient-physician encounter, end-of-life care, nutrition, pain management, and geriatrics. As in the Parallel Curriculum, the students will be introduced to a case in the first week. Then, after discussion and independent study, they will return for two subsequent sessions in the second and third weeks of each month. Thus, within one clinical year, such as the third year, the students will have the opportunity to study 12 cases, each of which encompasses many aspects (e.g., scientific, clinical, psychosocial, ethical) of an important disease entity.

For many years, the traditional hospital-based third- and fourth-year curriculum, as described earlier, was immutable. Now, in addition to hospital exposure, the students have greater exposure to ambulatory settings and excellent exposure to patients in the community and around the state. They experience an educational model that reflects medical care as it is practiced most of the time: in interdisciplinary settings, in the community, and with emphasis on population health promotion and prevention of disease. Further, basic science and psychosocial principles are reiterated in a self-sustaining educational model.

We will require students to demonstrate their proficiency in the acquisition and use of knowledge and clinical skills at all levels of the curriculum. In the new curriculum, at the beginning of the fourth year, a comprehensive Clinical Practice Examination will test clinical skills, clinical reasoning, and patient interaction skills. We will use the outcomes of the examination to measure the strengths and deficiencies of the students and the curriculum, with the goal of continuously improving the professional quality of the individual student and the effectiveness of the curriculum. The Clinical Practice Examination will require additional commitment of faculty, staff, and funding to support the expanded role for the Center for Clinical Evaluation and Teaching, to train standardized patients and to develop validated testing and evaluation procedures. Faculty will provide mentoring, counseling, and remediation for discovered weaknesses in the students' preparation. To this end, the Undergraduate Curriculum Committee has charged a clinical electives task force to overhaul the elective opportunities for the fourth year. Specifically, it must create guidelines for clinical electives, for half-month and semester- or yearlong linear electives, for pathways of electives, for remediation of clinical practice deficiencies, and for greater flexibility of electives in general.

Impact of Curriculum Change

Without a doubt, the curriculum change process has had several beneficial outcomes. First, it demonstrated that centralization of the curriculum governance and support is critical. The process included empowerment of a central core of change agents from the faculty, control of a central budget for educational change, and removal of poor teachers or ineffective course directors. One important by-product of the changes in the curriculum at MUSC has been the recognition that the infrastructure for education needs support. Centralized funding of faculty and staff is necessary to run demanding, high-maintenance courses, such as the Doctoring Curriculum, the Parallel Curriculum, and the Deans' Rural Primary Care Clerkship. Central funding is necessary to maintain excellent evaluation programs for assessing the quality, relevance, and cost-effectiveness of the curriculum and curricular innovations. Funds are necessary to allow continuous improvement in the quality of the curriculum and in the abilities, knowledge, and doctoring skills of the

students. Of course, some difficult decisions had to be made in the process. Some of the faculty who had been leaders chose to step down or were removed as course directors. Personal evaluation by members of the faculty and students provided closer scrutiny of the new curriculum. This led to ongoing dialogue and counseling and, in one instance, to a vote of no confidence in some faculty members who were poor teachers. With central support and input, department chairpersons were able to help unsatisfactory teaching faculty to improve. The chairpersons have received monetary awards to allow them to make required changes in the education provided by their faculty. These changes included procuring educational equipment, computers, and educational software, as well as bridging salaries between retirees and new faculty hires to the university community.

We have recognized the importance of increased communication among the faculty and between faculty and students generated by changes in curriculum. In the curriculum change process, we (the dean and associate deans) have met with each departmental faculty at their departmental meetings. We have held forums for faculty and students to discuss and describe curriculum changes. "The Medical Educator," providing information about new curriculum reforms and success of the changes, is published monthly in the centerfold of the university newspaper. The school even created a logo for the initiative that uses the slogan "College of Medicine—Curriculum of the Millennium—MUSC." All parties have become more involved in discussions about education. Course directors meet regularly among themselves and with the students to discuss course plans. Schedules and the integrated examinations have required intense cooperation between the faculty. Communication between the staff and students, directly and through the "Medical Educator" section of the newspaper, has been very effective in allaying the students' and faculty's concerns about change. The curriculum itself, and the discussion and concern over it, has made education a vibrant issue in the College of Medicine. Students and faculty are more involved and aware of the dynamics of the curriculum and of learning. There has been excellent discussion between students and faculty, among the faculty, and between faculty and administration about the students' education and the curriculum. The importance of the faculty cooperation cannot be overestimated in planning and implementing a new curriculum. Because any small change in class time can alter the whole structure of this curriculum within the present framework of interdisciplinary integration and vertical alignment, the faculty's cooperation in discussions, preparation, and evaluation is indispensable.

Since the new curriculum places our students in the local and statewide communities for part of their education MUSC has experienced much good will from the citizens, physicians, and politicians who meet and interact with them. Data from satisfaction surveys indicate that both preceptors and students rate their experiences in the first-year Doctoring Curriculum and the third-year Deans' Rural Primary Care Clerkship as extremely rewarding to them. Reaction from political leaders, from the media, and from the citizens in the state has been quite positive, especially concerning the presence of the students in their small towns. There, the local administrators, media, and citizens celebrated the presence of students, who were highly valued as respected professionals and as possible recruits to practice.

From the university community at large, the College of Medicine's curriculum renewal has received both positive and negative reactions. The interdisciplinary nature of some courses complemented the educational plan of the other health sciences colleges of MUSC. However, these same changes presented competition for community clinical sites and resources. One concern was that the minor incentives that the College of Medicine uses to attract and reward community-based volunteer teachers would raise the expectations of the community practice teachers that the other MUSC colleges use. The need for more small-group teaching space that the new curriculum called for places the college in direct, increased competition for the same space used by the other colleges. Finally, the "Medical Educator" section of the campus newspaper, dedicated exclusively to the College of Medicine curriculum, has generated some negative feedback as well.

Students have been generally positive about the changes because they feel that what they are doing is relevant and related to patient care. The new curriculum reaffirms their reasons for coming to medical school to become physicians. They are flattered when they are recognized and valued by the patients, the citizens, and the communities. In the communities, the students are relatively unique and valued whereas on the campus and in Charleston, although they are similarly valued, there are 1,000 other doctors to be found.

Challenges to Continuous Curriculum Change

The process of continuous change requires much effort and stamina on the part of those who are responsible for planning and implementing the program. Although the implementation of the new curriculum in the College of Medicine at MUSC is in the early stages, it is apparent that involving more faculty in planning for changes and effecting continual curriculum renewal will be major challenges. We anticipate that

those who are leading change now will need help to keep renewal at full momentum and to broaden input into the learning process of the students.

The new curriculum and the varied pedagogical methods within it create a demand for more faculty, especially for small-group teaching and clinical demonstrations. Although the faculty members seem to enjoy this kind of student interaction and are intrinsically motivated, pressures to generate more money from grants or clinical work are distracting them from teaching, especially in intensive venues such as the small group. A budgetary shortfall of $10 million is forecast for fiscal year 2001 in the College of Medicine. The full effect of the Balanced Budget Act of 1997 and a rise in the number of underfunded and nonfunded patients seen at the MUSC Medical Center accounts for the expected deficit. The Dean's Office's budget has been cut by 12 percent and departmental budgets by 5 percent. The challenge will be to continue to emphasize the curriculum change and support of central services and interdisciplinary courses while engaging faculty in new educational initiatives. We have been able to preserve much of the incentives for the faculty directly involved in the curriculum reform initiatives, but only for the next year and thereafter on a year-to-year basis. Meanwhile, our efforts to match the educational effort with the revenue stream for education (Mission-Based Management initiative) have been given highest priority.

Fiscal constraints have become an important consideration in balancing what we would like to do in education and what can be supported. The Parallel Curriculum was begun as a demonstration project with the purpose of facilitating different pedagogical approaches. When much of its methodology and philosophy of education became incorporated into the traditional curriculum, a consolidation of the curriculum was anticipated. We are fast approaching that goal. Although some of the infrastructure that now supports the Parallel Curriculum will be necessary to sustain the innovations in the reformed traditional curriculum, we may be unable to continue to sustain both curricula due to monetary and manpower shortages. Intensive thought, deliberations, and negotiation are presently taking place over this dilemma.

A recent study of the basic science course directors and teaching faculty of the College of Medicine showed many to be approaching or beyond the possible retirement age. Their willingness to teach well beyond the retirement age is a strong indicator of their dedication to teaching. They enjoy teaching medical students and they are excellent at what they do. On the other hand, the college needs to identify junior faculty to pair with the older teachers, who can act as mentors, coaches, and critics to develop the junior faculty into the next cadre of dedicated, excellent teachers.

Movement of student education to new clinical sites on the campus—and into the surrounding communities and throughout the state—will also create new challenges. It is important to educate students where patients and settings are suitable for the purposes of receiving a general medical education. Many of the hospitals traditionally utilized for medical education give students the opportunity to see severely ill patients with well-differentiated disease processes. This is not representative of the majority of the encounters between patients and their doctor. Therefore, medical students are more frequently being educated in outpatient offices, whether on campus or in the community. This shift requires an infrastructure of staff to maintain coordination and quality of the curriculum. It imposes new requirements for faculty development and rewards, especially for those not directly receiving stipends. Our challenge will be to find methods to shift the rewards for education to those individuals who are responsible and accountable for the education of medical students as designated by the continuing curriculum renewal.

The traditional departmental structure is simultaneously a strength and a weakness in curriculum change. Accountability and reward for education may be well managed through a department chairperson, as is presently the case in many departments in the College of Medicine. On the other hand, education is now frequently being provided by interdisciplinary teams and in venues outside the department or campus, which requires some central governance and evaluation, and a change in the system of compensation for the educators.

Mission-Based Management is a method of matching effort with reward. The State of South Carolina has been generous in its support of the education of medical students through its appropriation to MUSC from the legislature. More than $28 million is earmarked for the education of medical students. Over the years, money coming into the college was not specifically directed to support one or another mission. Now that funds earned by the clinical enterprise, the hospital, and practice plan have been severely curtailed, it is important to gain control over the funds for education and apply that money to support education exclusively. Mission-Based Management is supposed to direct the stream of money that comes to the College of Medicine to the faculty, staff, and locations that are educating its students. Although many of the teaching faculty perceive this method as a threat, this system will ultimately appropriately recognize and reward effort

and excellence in education. It will be a continuing challenge to involve the faculty and obtain their help in the evolution of the Mission-Based Management model.

Plans for the Future

The major challenge to the faculty and administrators of the College of Medicine will be to sustain curriculum renewal in a time of momentous changes in science and health care needs and delivery, and of severe personnel, monetary, and time constraints.

Faculty members and deans must be aggressive in using the results of knowledge-based examinations and the Clinical Practice Examination to monitor and improve the quality of the curriculum over time. Similarly, information from the Graduation Exit Questionnaire and the expectations of accrediting entities must be taken into consideration in preparing new changes to the curriculum. We must also recognize and develop new curriculum initiatives based on evolving societal needs and new scientific discoveries. Some of these changes might be based on the impact of the human gene project, or on the shift from disease treatment to disease prevention and health promotion. Demand for change may grow from advances in neuroscience and geriatric medicine, or from societal concerns about end-of-life care and pain control. What should be included or excluded from the curriculum will be a pressing question for the faculty. At MUSC, task forces of faculty and students are assessing the expectations and requirements in some of these areas. The Curriculum Coordinating Committee has charged each group with creating a white paper describing a plan for the development and assessment of the curriculum for each area. Their deliberations will ensure that all of the elements that are essential in the training of a generalist physician are present in the curriculum. A basic function of the task forces is to determine how new knowledge may be vertically integrated into the curriculum, interweaving through all four years and beyond, by building continuously on previous knowledge and skills and utilizing the MUSC themes for curriculum renewal.

Future plans for the College of Medicine include continued development and renewal of the curriculum based upon how effective it is in achieving its goals and objectives. The development of a process of continuous evaluation linked to a process of continuous improvement in quality of the curriculum is critical to sustaining the renewal far into the 21st century. The continuous review process is being put into effect through the new office of the assistant dean for curriculum evaluation. This process includes a plan for regular debriefing of students and the development of program evaluation techniques that fit the learning methodologies. The many faculty involved in the small-group teaching modules will keep their fingers on the pulse of student feedback. The Curriculum Coordinating Committee, Semester Committees, and Course Directors will conduct debriefings and formal evaluations via questionnaires with the students. Student performance on objective term tests and on national Board examinations will be assessed carefully. Finally, studies of the outcome of our curriculum, as measured by how our graduates practice medicine, will be the ultimate external litmus test. The South Carolina Data Base for Evaluation of Medical Outcomes is a rich data repository that may be used to evaluate the practices of physicians in the state. Although it may be difficult to attribute physician practice behavior to the education and training the physician received in medical school, a large number of physicians practicing in South Carolina received both their medical education and their postgraduate training in the state. The Education Policy Council is presently formulating a plan to evaluate their practice patterns and to relate them to curriculum changes.

Further plans include the development of a Center for Education. The purposes of the center will be to create new knowledge about medical education and evaluation and to improve faculty recruitment into education and faculty development in education. Through the Mission-Based Management initiative, we expect to see changes in the mechanisms of funding for education, rewards to the faculty for excellence in education, and improvements in the distribution of the money to those who do the educating.

Tufts University School of Medicine

Mary Y. Lee

Executive Summary

Since opening its doors in 1893, Tufts University School of Medicine (TUSM) has remained innovative and

resourceful. One of the few schools to welcome women from day one (28 percent in 1893 and nearly 50 percent now), TUSM is respected worldwide for its outstanding record of teaching, patient care, and medical research. TUSM has responded to recent, growing challenges to medical education by creating new ways of teaching and learning.

Most notable is the Tufts Health Sciences Database (Tufts HSDB), an unprecedented electronic curriculum resource. In a collaborative effort, the Health Sciences Library, educational dean's office, faculty, and students have developed the Tufts HSDB expressly to serve the learning needs of students. Using open-source software and a nonproprietary database system, the Tufts HSDB stores teaching resources (text, images, sound, video, slides, etc.) as individually labeled pieces of data in an object-oriented, relational database. These pieces can be infinitely manipulated, reused, and shared (like interchangeable Legos®) by multiple faculty, can be linked with any other piece(s), can be searched with the nationally standardized medical thesaurus, and can be easily transferred to the next new technology. The power of this system to change the way students learn and faculty teach is just beginning to be realized. The HSDB model holds great potential for sharing resources with other schools and organizations.

Tufts Managed Care Institute, a nonprofit educational organization cosponsored with Tufts Health Plan, provides health care professionals with learning resources to understand and work effectively within the changing health care environment. We have created exciting programs and learning materials for all levels of training that emphasize underlying managed care principles applicable to any system.

TUSM's five combined degree programs train health professionals with added expertise in public health, business, bioengineering, basic science, and law and diplomacy. Students can obtain both the combined medicine and public health (M.D./M.P.H.) and medicine and business (M.D./M.B.A.) degrees within the four-year medical curriculum.

Introduction

Tufts University School of Medicine opened its doors in 1893, thanks to an indomitable group of seven faculty members from the Boston College of Physicians. The founders, supporting the fledgling school with their own funds, received no pay or operating budget from Tufts College for a three-year trial period. Those austere beginnings established a TUSM character of self-reliance and resourcefulness that persists today.

The founders of Tufts Medical School had a simple goal: to produce good doctors. TUSM quickly earned a reputation for training competent, generalist physicians for New England. By the 1960s, the school was attracting students from across the country and producing not only respected generalists but also internationally recognized specialists and researchers. Despite recent major changes in the organization and financing of medical care and corresponding changes in medical education and health care delivery, TUSM remains true to our founders' goal. Flexible and innovative, TUSM and its affiliated hospitals continue to maintain an outstanding track record of teaching, patient care, and medical research.

Today, TUSM is respected worldwide for its innovative educational programs and biomedical research. The Sackler School of Graduate Biomedical Sciences, with strong faculty and administrative links to the medical school, annually produces a strong cadre of Ph.D.s consistent with Tufts' record of achievement that earned the university its Research-I rating from the Carnegie Commission, placing it among only 38 private institutions so recognized. Tufts University's schools of veterinary medicine, dental medicine, and nutrition, as well as the nutrition school's prestigious USDA Human Nutrition Research Center on Aging, have symbiotic and synergistic relationships with the medical school. Moreover, TUSM has developed joint academic degree programs with the university's school of engineering, its Fletcher School of Law and Diplomacy, and other university programs. These close associations address society's growing need for physicians with augmented training in specialized areas of health care. Also in response to this need, the university has established several combined degree programs for medical students, including programs in biomedical science (M.D./Ph.D.), public health (M.D./M.P.H.); health management (M.D./M.B.A.), international health (M.D./M.A.L.D.), and bioengineering (M.D./B.S./M.S.) as well as freestanding programs in public health (M.P.H.), nutrition (M.S.), health communications (M.S.), clinical care research (M.S./Ph.D.), and pain research, education, and policy (M.S.).

TUSM's enrollment has expanded from 80 medical students in 1893 to about 660 today. TUSM has admitted women from day one—28 percent in 1893 to nearly 50 percent now. In addition, the Sackler School has some 200 students seeking the Ph.D. degree, while TUSM has another 80 students in the freestanding degree programs noted above. There are approximately 100 faculty in the basic sciences and another 3,000 clinical faculty at 8 major medical centers and more than 40 affiliated clinical teaching sites.

While maintaining close ties with major academic hospitals, TUSM pioneered and developed strong clinical teaching affiliations with community hospitals throughout New England long before the current shift to community-based teaching. During its last major curriculum revision, in the 1980s, TUSM was one of the first U.S. medical schools to adopt problem-based learning methods that emphasize problem-solving, critical thinking, and developing research skills within small groups. Since then, TUSM has had a model "hybrid" curriculum that captures the best of both problem-based learning and traditional teaching methods.

Responsive Curriculum Changes of the 1990s

The scope and complexity of the preparation one needs to become a competent physician have grown dramatically over the last two decades. Recent changes in our health care system, exploding medical knowledge, and increased societal expectations of health care delivery have created complex issues that demand new responses from medicine and society. The challenges that face us are the result of factors such as:

- The Balanced Budget Act of 1997
- The managed care revolution of the past two decades
- Information overload and the rapid growth of information technology
- Major scientific discoveries (e.g., in genetics) and developments in medical technologies (e.g., imaging)
- The need for physician leadership in bridging disciplines
- The growing public interest in preventive health, nutrition, and alternative medicine
- The movement toward ambulatory care and community-based medicine
- Societal concerns about the erosion of professional values
- The need for accountability in all programs—educational, clinical, and research

At TUSM, we have both anticipated and responded to these challenges. The curriculum reforms implemented at TUSM during the past ten years all share common goals, and focus on providing our students with the following:

- A coherent, integrated medical education grounded in strong basic and clinical sciences
- The resources, skills, and attitudes for a lifetime of learning
- The knowledge to cope with—and direct—a changing health care system
- Greater options in their future careers
- An ethic of professionalism and service to the community

TUSM's curriculum reform is also built on a set of three principles regarding how best to achieve the desired change:

- Change should be generated by those most immediately involved in education (faculty and students).
- Curriculum review and means for improvement must be ongoing and systematic.
- Mutual respect, honesty, teamwork, and trust are essential for effective change, whether radical or incremental.

Key Initiatives at TUSM

Table 1 summarizes TUSM's key initiatives that address six major challenges regarding how we educate medical students and prepare them for careers as physicians in contemporary American society. Each of these initiatives is discussed in detail below.

Table 1. Challenges and Key Initiatives

CHALLENGE	INITIATIVE
Information management, delivery, and sharing	Tufts Health Sciences Database (Tufts HSDB)
Major changes in an evolving health care system	Tufts Managed Care Institute (TMCI)
Physician leadership in bridging disciplines	Combined degree programs
Health maintenance and prevention	Ambulatory models, nutrition
Erosion of professional values	Culture of professionalism
Accountability and quality	Tufts Evaluation System

Coping with the Information Explosion: The Tufts Health Sciences Database

Keeping a medical curriculum up to date is a constant challenge to faculty. Health sciences information is increasing at a pace that cannot be managed by the individual physician or faculty member. The Internet has added to the burden, with a proliferation of health-related Web sites for the public and for health care providers (more than 17,000 at last count). In addition, medical students now entering medical school expect sophisticated computer services, Web access, and online resources.

Responding to these challenges, TUSM has created a powerful online curriculum resource, the Tufts Health Sciences Database (Tufts HSDB), that is the first of its kind in medicine. The Tufts HSDB combines the capabilities of a digital library, course delivery system, and administrative curriculum management system. Its integration, scope, flexibility, expandability, and resilience are unparalleled in medical education. The Tufts HSDB is not only changing the way our faculty teach and our students learn but is facilitating the exchange of key educational resources across campus and around the world.

The Tufts HSDB started in 1995 as a modest project of the Tufts Health Sciences Library. The original idea was to create an image database to improve student access to study slides by making the images available online. With the help of startup funds from TUSM and a grant from the National Library of Medicine, the project quickly expanded to include course syllabi (many of which are as complex and detailed as textbooks), video clips, lecture slides with audio, self-assessment quizzes, and other elements. Whereas many schools are using CD-ROMs or Web-based course materials that superficially resemble the Tufts HSDB, there is a crucial difference between the two approaches. Most Web-based course materials are entered into "shells" that stand alone and can only be used in that format. At Tufts, teaching resources (text, images, sound, etc.) are taken apart and entered as individually labeled pieces of data into a robust, object-oriented, relational database infrastructure. These pieces can be reused and shared (like interchangeable Legos®) by multiple faculty, can be linked with any other piece(s), can be searched with the nationally standardized medical thesaurus, and can be easily transferreed to the next new technology. Herein lies the power of the Tufts HSDB. Teaching resources "living" on the Tufts HSDB remain flexible and adaptable as medicine and technology evolve at a dizzying pace—key benefits in a discipline that requires constant updating and in a technological environment in which specific communications technologies quickly become obsolete.

By the end of 1999, materials from 60 percent of the required courses of the first two years of the curriculum were part of the Tufts HSDB. The impact on the curriculum has been significant. Students appreciate the easy access to course materials, including bibliographies with full-text journals, teaching images (particularly before exams!), and lecture slides. There is no longer any need for furious note-taking during class, which

allows students to listen more closely for better conceptual understanding. Faculty state that students are better prepared, so that lectures can emphasize key concepts and become more interactive.

All materials are labeled with standardized search terms, established by the National Library of Medicine, which students will use when searching online literature throughout their careers. We teach students how to access all Tufts materials as well as relevant Web-based materials. Students can personally annotate any text or image viewed online and can retrieve the attached notes on demand. They can also store the notes as links for easy review in personal "electronic learning folders," which can be filed in several ways for quick retrieval.

Options allowing users to compare materials from different classes—for example, by juxtaposing images of normal and abnormal pathology on the same screen—have greatly increased course integration by faculty and students alike. Faculty collaborate to link to each other's materials for both concurrent as well as subsequent courses, minimizing redundancy and encouraging planned reinforcement. Students compare materials across multiple courses and even across years as they learn and review. Encouraged to learn collaboratively in groups, students find learning more efficient and engaging.

While placing course materials online, faculty are prompted to think critically about their course objectives—what they are trying to teach—which encourages them to reflect on their content and methods of teaching, including whether their objectives might be better met online. The ability to link their own content to other faculty materials and to outside resources, including online full-text journal articles, stimulates faculty to keep their material current. As students use the Tufts HSDB and provide feedback to faculty on how and where it helps them learn, they have the opportunity to become more thoughtful learners. By asking themselves questions like, "What am I trying to learn?" and "How and where can I best learn for the classroom as well as for patient care?," students are laying the necessary groundwork to become skillful information searchers, knowledge managers, and lifelong learners.

Tapping its longstanding tradition of resourceful teamwork, TUSM developed the powerful, unique Tufts HSDB from the ground up and did so specifically *to serve the learning needs of our students.* This electronic curriculum resource has evolved through the collaboration of library experts, talented programmers, members of the Curriculum Committee and the educational dean's office, enthusiastic and dedicated faculty, and an evaluation system that allows rapid student feedback. There is growing support for using the Tufts HSDB as the model for a university-wide digital library and course delivery system, and many other medical schools have shown interest in adopting the Tufts HSDB model. At a time when information technology use is exploding and faculty time to create new materials is eroding, the potential for the Tufts HSDB infrastructure to become a model for a national or even an international database for medical education is both feasible and attractive.

Educating Physicians in the Managed Care Era: Tufts Managed Care Institute

In 1995, TUSM partnered with Tufts Health Plan to launch Tufts Managed Care Institute (TMCI), a nonprofit educational institute whose mission is to provide health care professionals with resources for understanding the changing health care system and working effectively within it. TMCI has developed programs for all levels of training (from students to practicing clinicians) and has teamed with TUSM on several major educational initiatives.

For medical students, TMCI has been instrumental in assisting TUSM in incorporating the principles of managed care throughout the four-year curriculum. To help students develop a broad understanding of the relevant issues, TUSM and TMCI concluded that integrating "the underlying principles of managed care" and "how the health care system works" into existing courses and programs would be much more effective than creating a separate "managed care" course. The emphasis is on key concepts and elements that are relevant nationally and long-term rather than on specific, local, short-term changes. Distilling extensive research on effective practices in evolving systems, we transformed underlying principles into curriculum components and a case-writing framework used at Tufts and shared with other schools. The underlying principles of managed care now permeate the Patient-Doctor-Society and geriatrics courses, problem-based learning cases in years one and two, clerkship cases in year three, and emergency medicine cases in year four, to name but a few parts of the curriculum where these principles have been integrated. Our goal is to educate students about how the health care system works and how they can help shape that system for the better as future practitioners and leaders.

With a three-year, $1.28 million grant from Partnerships for Quality Education (sponsored by The Pew Charitable Trusts), TMCI worked with TUSM and Tufts Health Plan to create a curriculum for primary care

residents called "Preparing Residents to Succeed." The completed four-module curriculum includes (1) a framework for residents to participate in managed care, seminar-based modules on (2) patient-centered care and (3) the evaluation and use of clinical guidelines, and (4) an interactive CD-ROM on the underlying principles of managed care. We have distributed the CD-ROM to more than 400 primary care residency programs throughout the country, and have trained more than 100 faculty to use the four-module curriculum. We released new versions of the CD-ROM for medical students, practicing physicians, and surgical residents this year. Faculty particularly value the ability to select the curriculum components most relevant to their specific program needs.

TMCI's current work includes developing online learning resources for residents and practitioners—resources that are focused on delivering high quality, cost-effective care. We have assembled a national advisory committee composed of leaders from medical education, health care delivery systems, and managed care organizations to provide oversight and direction for this exciting initiative.

Physicians Making a Difference in Health-Related Fields: Tufts' Combined Degree Programs

Physicians have long had multiple alternative career options: they could, for example, work as public health officials, hospital administrators, international consultants, or biomedical researchers. But interest has grown in obtaining specialized academic credentials for these possible future careers. For years, some physicians have sought public health degrees. Recently, more physicians are earning business degrees, either to manage increasingly complex clinical practices or to move into careers that require knowledge of both disciplines. Physicians with combined degrees are "translators" between medicine and other disciplines that deal with health-related issues. These translators bring major benefits to both sides of any task by leveraging the strengths of and creating bridges between disciplines. In response to the interest in and societal need for such translators, Tufts has developed five combined degree programs that allow students to earn a medical degree and a second advanced degree, usually simultaneously. Two of the five programs allow for completion of both degrees in four years. Medical school requirements are not compromised in any of the combined degree programs. Our goal is that the students become "physicians first and foremost" even as they gain additional knowledge and skills in another discipline.

The M.D./Ph.D. and M.D./M.P.H. programs were both established in the 1980s, preceding the curriculum reform of the 1990s. The M.D./Ph.D. program takes seven to eight years to complete, with the doctoral research work conducted during a hiatus between the second and third years of medical school. This program emphasizes scientific and clinical skills that prepare physicians for research and teaching as well as clinical practice. The carefully integrated M.D./M.P.H. program allows students to achieve both degrees in four years. The public health courses provide training on health promotion and prevention from a population-based perspective, enriching a medical student's clinical understanding of these issues.

Even more careful integration was necessary to create the four-year M.D./M.B.A. program in health management, which was started in 1995—at that time the only such program in the country. Offered in collaboration with Brandeis and Northeastern Universities, the program takes advantage of Brandeis's health policy and social services curriculum and Northeastern's business administration program. The goal is to provide students with a foundation in business problem-solving and health care management to prepare them to become leaders in health care delivery. The first cadre of these specially trained students graduated in May 1999.

The two newest combined degrees, both approved in the last few years, are conducted in collaboration with Tufts' Engineering School and Tufts' Fletcher School of Law and Diplomacy. The M.D./B.S./M.S. in bioengineering was developed in response to the need to prepare professionals who understand both sides of high-technology medicine, with expertise in social, economic, and policy issues related to technology and health care. Students receive early acceptance into the medical school while pursuing both bachelor's and master's degrees in engineering, with a focus on biomedical applications. The M.D./M.A. in law and diplomacy (from Fletcher), a five-year program, prepares physicians to relate basic principles of international law, politics, economics, and business to health practices throughout the world.

Our experience with combined degree programs suggests that carefully chosen students can effectively pursue two fields of study simultaneously, particularly when the programs are well coordinated. About 25 percent of Tufts medical students are now enrolled in one or another of the combined degree programs. To our knowledge, no other medical school has the number and variety of combined degree programs that TUSM offers. Combined degree students bring invaluable perspectives to case discussions and other course work. To enhance their contributions, we specifically assign these students to different small groups throughout our programs. In recent years, TUSM has developed several other freestanding specialized

degree programs in response to other growing health care needs: master's degree programs in health communications and in pain research, education, and policy; a dual degree program in nutrition and public health; and an M.S./Ph.D. in clinical care research.

Staying Healthy: Health Maintenance, Disease Prevention, and Nutrition in New Educational Models

Over the past 15 years, the generalist movement has emphasized broad training in medicine, while the advent of managed care has necessitated increased emphasis on health maintenance, prevention, and cost containment. A growing reliance on outpatient care and a corresponding decrease in hospital-based medicine have pushed medical schools to reevaluate and refocus clinical education. Simultaneously, the need has arisen to integrate many fundamental discoveries in molecular sciences, genetics, and nutrition into the curriculum.

In the early 1990s, managed care was just beginning to have an impact in the Boston area. TUSM began to examine exactly what students were—or should be—learning in the third-year clerkships, with the goal of emphasizing knowledge and skills appropriate for generalist physicians. This goal required a new approach to clerkship content—in effect, a renewed emphasis on "core competencies," with more attention given to prevention, health maintenance, and common medical problems.

To address clerkship content, a faculty working group created lists of core competencies. Asking the question, "What does a TUSM third-year student absolutely need to know?" the group placed less emphasis on specific diagnoses and greater emphasis on problem-solving approaches involving patients presenting with different symptoms. This group also examined the overall content and integration of the clerkships with each other, and then invited faculty from the first two years to review these competencies to discuss what prerequisites were required. This process resulted in extensive integration and coordination of curriculum across the traditional boundaries of basic sciences in years one and two, and the clerkships in year three. Faculty collaborated to develop clinical case examples for use in basic science courses. Material from clinically oriented courses, such as nutrition, was integrated with material from basic science courses, such as biochemistry; for example, biochemistry lectures on lipids were followed by nutrition lectures on cholesterol and heart disease. Both courses gained from the collaboration, and successes paved the way for integrating material between other courses.

At the same time, we integrated and expanded courses related to clinical skills under the umbrella of the new Principles and Practice of Medicine Program (PPM) that extends throughout the first two years of the curriculum. PPM includes material on interviewing skills, growth and development, physical diagnosis, nutrition, geriatrics, ethics, and health care systems. Coordinating these courses under one program reduced redundancies and reinforced the importance of these materials for lifelong learning.

While our faculty working groups were addressing core content for a generalist curriculum, the clerkship directors began moving traditional ward teaching into ambulatory settings, where the majority of patients were now being seen. In 1992, the Internal Medicine clerkship moved one-third of its three-month rotation into ambulatory clinics—just before the 25 to 30 percent drop in inpatient census that occurred in most Boston-area hospitals as a result of managed care. Both students and hospital-based faculty were initially skeptical about the quality of education that clinics could provide. Students quickly realized, however, that ambulatory settings gave them the opportunity to see more patients with a larger variety of clinical conditions than they had seen on the wards. Rather than seeing hospitalized patients who were already diagnosed and admitted for procedures and treatment, students were examining patients with initial manifestations, which tested their problem-solving and diagnostic abilities. As students kept logs of patient encounters, faculty were able to assess the richness of the new clinic experiences objectively.

Given the rapid patient flow in the outpatient setting, faculty requested that students be better prepared in clinical skills before entering the third year. As a consequence, we expanded programs to teach practical clinical skills during the first two years. For students desiring additional experience, we created the Primary Care Preceptorship Program in the early 1990s. Up to 50 students in each entering class are selected to work in a carefully selected primary care physician's office for one afternoon a week for two years. The faculty preceptor introduces the student to his or her practice and also serves as a role model and mentor.

Other students can expand their clinical experience in the first two years through the selectives program. Each semester, students choose either a clinical site or a clinical research project to pursue one afternoon each week. One out of the four semesters' selectives must involve community service.

Several years ago, TUSM students created the ultimate community service project by establishing

Sharewood, a fully student-run (though faculty adviser-supervised), free community clinic near the medical school. At Sharewood, which is open one night per week, year-round, students have cared for several hundred patients under the guidance of volunteer faculty. All supplies, equipment, and testing are donated or paid for through student fundraising. Students routinely cite their experience at Sharewood as one of the most rewarding in their early education. From the ground up, they learn every aspect of setting up a practice and dealing with the challenges of caring for patients who have no regular physician and who face additional barriers of culture and language differences. Through these experiences, Sharewood students have become very active in working with faculty to incorporate "cultural competency" training into the curriculum.

Nutrition is a key component of health maintenance and disease prevention. TUSM has had a longstanding commitment to the integration of nutrition into its curriculum. The medical school currently has a 27-hour course on nutritional biochemistry and clinical nutrition in year one and incorporates nutrition into a course on interviewing and a multidisciplinary course in geriatric medicine in year two. Recently awarded a five-year grant for nutrition education from the National Heart, Lung, and Blood Institute, TUSM is applying these funds toward the development of a clinical nutrition education program for third-year medical students, residents, and faculty at several Tufts teaching hospitals. This program will include training in evidence-based nutrition, approaches to incorporation of nutrition assessment into the standard history and physical examination, and behavioral approaches to lifestyle change.

Tufts also has been a leader in nutrition education for both health care practitioners and the public. Several years ago, TUSM established the award-winning Tufts University Nutrition Navigator, an online guide to nutrition Web sites that employs expert "filters" for Web-based information. In 1998, Tufts launched *Nutrition in Clinical Care,* a peer-reviewed journal that provides physicians with the background and tools to incorporate nutritional strategies into their medical practice. Key contributors to the journal and the Nutrition Navigator are faculty in the TUSM nutrition course, providing national expertise and perspective to the curriculum.

Reaffirming Eroding Values: Professionalism in TUSM's Curriculum and Culture

Physicians are experiencing unprecedented pressures on their time and productivity. Some say professional values and ethics are eroding. Is this the result of managed care, or is there something more basic happening in our culture—something that is causing the public to advocate for "character training" in the public schools as well as in the professions? Whatever the cause, TUSM has introduced professionalism into every aspect of the curriculum and medical school life, so that students experience elements of professionalism formally in the classroom as well as informally in encounters with faculty and administration.

For example, the "White Coat Ceremony," in which students receive their first white coats from faculty advisers, is conducted for the entering class. The ceremony emphasizes the Hippocratic oath and the core values of doctoring. Later, students grapple with clinical ethical dilemmas and compose personal Hippocratic oaths during a first-semester course that explores physicians' relationships with patients, society, and the health care system. The personal oaths are printed, mounted, and returned to the students on the first day of their physical diagnosis course in year two. These ceremonies are mutually reinforcing and, according to students, affirm the values that led them to pursue careers in medicine.

One faculty member has been shepherding the work on a "professionalism" document that has evoked extensive discussion among students and faculty about how professionalism relates to student life and how it can be taught, promoted, and assessed. Another faculty member is initiating discussions on the school honor code and how to move responsibility for adherence to the code to a student-run system. Both faculty members periodically report on the progress of the ongoing discussions to the Curriculum Committee and appropriate subcommittees.

The evaluation system for our curriculum (described below) also has been designed to reinforce professionalism. Students are encouraged to comment freely on their educational experiences on the formal evaluation forms, in education committees, and in focus groups. The educational dean's office guides students on how to use appropriate language when providing constructive criticism to faculty and gives students specific feedback on the quality of their remarks. Student and faculty committees, particularly those dealing with difficult issues requiring conflict resolution, are established with ground rules for mutual respect, thereby modeling the behavior expected of health care professionals. All these efforts are aimed at giving future physicians a strong foundation in professionalism and ethical values.

Making Medical Education Accountable: A Dynamic, Comprehensive Evaluation System

Perhaps no initiative better reflects the principles underlying our curriculum reform than TUSM's system for ongoing evaluation and quality improvement of courses and teaching. TUSM has created a vigorous evaluation system that incorporates multiple avenues for obtaining student and faculty input and just as many ways of responding to their feedback through constructive action steps and dissemination of results.

We require every student to fill out an online evaluation of every course and clerkship through the Tufts HSDB, described above. Compliance is almost 100 percent, but more impressive are the thoughtful, respectful comments. The evaluations, reviewed for immediate action, are used in the more formal, in-depth peer review performed every three years on all required courses and clerkships. Between these in-depth reviews, faculty evaluators present annual progress reports to the Curriculum Committee noting what corrective actions have been taken and what remains to be done. Course directors take time on the first day of a course to describe what changes have been made as a result of last year's student evaluations and focus groups. Students may even see changes made in the middle of a course as a result of concerns brought to faculty via the evaluation system.

We have made substantial curriculum improvements under the new evaluation system. For instance, spurred by student feedback and course reviews, numerous courses have integrated their material—biochemistry with nutrition, anatomy with clinical skills and physiology—melding course objectives, content, teaching methods, and examinations. Clinical clerkships in the third and fourth years, which occur at geographically dispersed hospitals and clinics, traditionally have had weaker means of evaluation than have classroom or laboratory courses. The new evaluation system allows direct comparison with other sites in the same clinical discipline, encouraging discussion of problems and solutions (as well as some friendly competition). Lower-than-average evaluations at a particular site lead to faculty reflection on possible causes, including teaching methods and faculty attitudes. The group brainstorms possible solutions and often identifies new topics for annual faculty development workshops in clinical teaching. One of the greatest benefits of the new evaluation system is how it encourages collaboration among faculty and students and thus results in significant integration and improvement of content and methods throughout the four-year curriculum.

Supporting Change: TUSM's Culture of Collaboration and Innovation

No single curricular initiative could begin to meet the myriad challenges facing medical education. All initiatives must support others and be a part of an overall fabric of dynamic curriculum change. The *process* used in their creation and implementation is therefore just as important as the specific initiatives and is vital to their success. TUSM's culture, under the dean's leadership, encourages the necessary innovation and collaboration for change. The facilitators of our curricular evolution insist on collaboration, flexibility, and reflection in almost every phase of their work. Consequently, the curricular changes have a wide base of student and faculty involvement to ensure that change is dynamic and sustained. The "hidden curriculum" includes learning that change is an integral part of the TUSM system and that we as physicians, students, and faculty members can effect change.

Change needs support. In 1993, internal and external factors led to the creation of a new curriculum task force as part of the school's strategic planning. The next year, TUSM created the Office of Educational Affairs (OEA) to expand and implement the task force's recommendations. The OEA provides TUSM with a much-needed infrastructure of educational support and coordination as well as leadership. The proof of the OEA's value lies in the curriculum changes that continue to evolve and in the systems that ensure that this evolution is responsive and appropriate.

A key partner in our curriculum evolution is TUSM's 40-member Curriculum Committee. TUSM has broken with the tradition of having department chairs or their appointees constitute a curriculum committee. Two-thirds of our Curriculum Committee members are elected. Faculty members run at-large (not via their departments or programs) for a three-year term and include many teachers who consistently receive teaching awards. The committee's eight student members are elected annually by their peers. The committee is responsible for providing a framework for what should be taught and when, reviewing new initiatives and guiding the evaluation system.

The Curriculum Committee is both a source of new ideas and a sounding board for ideas and projects brought to it by the dean for educational affairs and the committee's energetic chair. Through a collaborative process with the Curriculum Committee, faculty are encouraged to share teaching material and to integrate new material into existing courses while deleting old material. These changes are incremental, nonthreatening, and inclusive. The committee often approaches faculty to develop pilot projects with new content or teaching methods. The success of these projects promotes change and catalyzes further reforms.

Impact of Curriculum Change at TUSM

TUSM curriculum reform is incremental, ongoing, and faculty-driven. This process has created a fabric of change that is more revolutionary than any top-down master plan could ever hope to be. A core group of faculty is now heavily invested in the curriculum. They know that they have made a difference and will continue to do so for the foreseeable future because of the strong process of constructive change. Faculty see the administration as supportive, not obstructive, and frequently "check in" during all phases of new projects. Such collaboration between faculty and administration facilitates coordination of efforts and ensures that we are following the general guidelines of TUSM's mission statement and strategic plan.

The university has recognized the medical school as one of the most dynamic components of its academic community, raising the school's stature and visibility. As TUSM gains more recognition for its innovative programs, affiliated hospitals are more eager to maintain ties with the school—reinforcing critical affiliations for TUSM's clinical teaching needs. Also, faculty at affiliated sites have become more involved in school committees and projects, providing much-needed support to the core faculty on campus.

Students are attracted to TUSM because of its innovative programs. When students experience the curriculum and the process of change, they remark on the atmosphere of inclusiveness and dynamism. Students learn that they can approach faculty and administration about new ideas and be taken seriously. They feel very much a part of the process, and witnessing changes energizes them about the curriculum. Parents, learning about TUSM's programs and encountering the spirit of the TUSM community on Family Day, often comment that they now understand why their children selected Tufts.

Students and faculty see for themselves how the evaluation system affects curriculum initiatives. Many improvements to the Tufts HSDB have resulted from student and faculty input; student feedback and course reviews have stimulated faculty to increase integration between courses; and student and faculty feedback have catalyzed faculty development initiatives. The evaluation system, a constant reminder that the curriculum is dynamic, itself benefits from continuous review and updating.

Our successes have reinforced the faculty's commitment to "teaching for a lifetime." Because our student pass rate on licensing exams is greater than 99 percent, our faculty do not need to "teach to exams" but can concentrate on what is needed for lifelong learning. Through a new curriculum strategic planning subcommittee, faculty are now exploring other major changes to improve the curriculum even further.

Plans for the Future

Below are examples of the specific impact that some of our initiatives have had—and their implications for the future.

Tufts Health Sciences Database

The reputation of the Tufts HSDB as a model for information management and delivery has drawn representatives of medical schools from around the world to our campus. Singled out for high praise by a recent medical school accreditation team, the Tufts HSDB has been highlighted in recent publications by the Association of American Medical Colleges and other national organizations and is serving as a model for a university-wide digital library and course delivery system. Aside from the Tufts HSDB's clear impact on lifelong learning and interdisciplinary teaching, the possible use of its infrastructure as a model for a national or even an international database for sharing educational resources is particularly exciting and challenging.

Some national organizations have suggested that medical schools should share their curricular resources—in other words, that each school should share its best. As schools move curricular resources online, however, sharing will remain difficult unless content is placed in flexible databases that follow national standards for content organization, labeling, and storage. Such standards do not yet exist for the health sciences. With our medical, veterinary, dental, basic science, and nutrition schools already using the Tufts HSDB infrastructure, we are uniquely positioned to propose "metadata" standards and "XML datatypes" for health sciences curricula that would allow resources to be easily shared among schools and health science organizations. (*Metadata* provide a common set of terms by which data is described, while *XML datatypes* allow common organization of data. Both allow rapid sharing and manipulation of individual pieces or clusters of data.) Much more work needs to be done in this critical area, but the Tufts HSDB's potential to provide a common language to label resources and a common (or at least compatible) database infrastructure promises to have a tremendous impact on health education nationally and internationally.

Another rate-limiting step for sharing online resources is having a sufficiently user-friendly interface for entering course materials into a database and editing them online. As the Tufts HSDB has moved from the demonstration phase of the past few years to a robust, resilient production phase, the need for rapid content entry and faculty control has been evident. This data entry/editing problem is not unique to the Tufts HSDB but exists throughout Web-based systems in industry, business, and law, where entries and updates by content experts require the aid of a programmer to upload onto the Web. Solutions appear close at hand, and Tufts is exploring potential partnerships to hasten the progress. As this system evolves, the Tufts HSDB is clearly becoming an unprecedented instrument for interactive, integrated, continual learning; for information management; and, we hope, for sharing resources.

Tufts Managed Care Institute

Through Tufts Managed Care Institute, Tufts has become known for its expertise in managed care education resources, helping a wide range of professional health care-related institutions educate their constituencies. TMCI and TUSM faculty recently offered a training program to Health Resources and Services Administration (HRSA) staff on managed care curricular content and its effects on medical education and interdisciplinary training. HRSA grant applicants are working in this evolving environment, and HRSA program staff need the background to understand issues raised when reviewing grants. TUSM will continue to work closely with TMCI to provide innovative programs where needed. The next major project is to develop an online curriculum addressing key content areas synthesized from the work of an advisory group composed of national leaders in health education, administration, and practice. Again, the emphasis is on principles that underlie systems of care—principles that will remain valid no matter how our current managed care system metamorphoses in the future.

TUSM Evaluation System

TUSM's evaluation system is critical in maintaining continuous improvement and dynamic change in the curriculum. Rather than catching up with change every decade or two, the evaluation system is ongoing and has been carefully designed to be administratively sustainable within the educational dean's office and Curriculum Committee so that action plans generated by the faculty receive prompt administrative support for implementation. Most important, the system has modeled the process of evaluation and change—one that emphasizes accountability and community involvement. Discussion, collaboration, and responsive feedback loops for students and faculty provide the means for continuous quality control, course integration, and improvement. The system itself receives feedback, enabling it to streamline reports and processes and to get information quickly to those who need to respond. The structure and process of the TUSM curriculum and its evaluation system reinforce students' belief that they can make a difference. We expect our students to take that lesson into practice and to have a positive impact on our evolving health care system.

Work has begun to extend the evaluation system to track graduates in their residencies and first few years of practice. Feedback from faculty and alumni helps ensure that our curriculum remains relevant to current practice. While most graduates are reporting that they feel very well prepared, it has also been reassuring that most of their suggestions about what to add or change have already been incorporated into the curriculum—that, in fact, we are anticipating the needs of our graduates. Understanding long-term outcomes —including tracking the strengths of our combined degree program graduates and these specialized leaders' contribution to health care—is essential for assessing the value and deficits of the TUSM curriculum.

Finally, for change to continue, TUSM's work on faculty development, recognition, and rewards must continue and grow, especially with clinical faculty. Curriculum change requires extensive faculty time and effort, and that effort should be recognized with appropriate academic promotion and other rewards. New means must be found to encourage clinical faculty to continue teaching, despite mounting pressures. Current, strong faculty development efforts through TUSM's Center for Learning must expand, particularly to increase on-site training for community-based faculty. Work in this area has begun with the help of the national General Internal Medicine Generalist Education Leadership (GIMGEL) project, which is sponsored by the six major internal medicine organizations and the Human Resources Services Administration (HRSA). TUSM plans to expand this model to the other clinical disciplines at all major affiliated sites. As TUSM dean John T. Harrington, M.D., has said, "Our faculty are our living endowment"—a true statement not only at TUSM but at all medical schools throughout the country.

In just one generation, medicine has changed dramatically. Few of our students will work in an environment as simple as the home office of yesterday. Advances in biomedical research have led to new drugs, new treatments, and hope for many conditions that were previously untreatable. Public health initiatives have helped to prevent disease and improve health. Despite the progress, however, much remains to be done.

Tufts University School of Medicine, with its tradition of resourceful teamwork, creativity, and foresight, will continue to embrace the privilege and responsibility of preparing young physicians for the challenges of future practice.

University of Utah School of Medicine

T. Samuel Shomaker

Executive Summary

The University of Utah School of Medicine undertook a major curriculum reform initiative, the first significant change in the education program in more than 20 years, beginning in 1994. During the 1999–2000 academic year, the school implemented the final aspects of the new curriculum. This case study describes the many lessons that we learned during this complex six-year process.

The University of Utah School of Medicine is a research-intensive public school, with 800 full-time faculty and 400 medical students, located in Salt Lake City. The school undertook curriculum reform in response to a combination of external and internal pressures. Given the tremendous advances in the biological sciences and the dramatic changes in the medical practice environment, the faculty felt that the graduates of the School of Medicine were not being optimally prepared to face the challenges of 21st century medicine. Given the school's social responsibility to produce well-trained physicians for the state of Utah, the faculty decided that change was warranted. In addition, there were pressures from students and applicants to take a more progressive approach. Finally, a Liaison Committee on Medical Education site visit was scheduled for the 1996–97 academic year, adding extra impetus for change.

With the efforts of more than 100 faculty and students, we planned the new curriculum. It was designed around six key themes: professionalism, humanism, information management, critical thinking, evidence-based medicine, and self-assessment. We created a series of new courses and reformatted some existing courses to achieve the educational objectives established as a blueprint for the reform. In addition, we introduced new teaching modalities, such as problem-based learning, and broadened methods of student assessment to include evaluation of clinical competency via objective, structured clinical examinations. These changes affected all four years of the curriculum.

We devised a curriculum assessment plan to track the effects of curriculum reform. The first data from this effort, although still preliminary, are encouraging. Students feel that they are more connected to faculty and that their education is being given a high priority. They receive better instruction in computer, communication, and literature assessment skills. They state that critical thinking is emphasized more and rote memorization less in the curriculum.

These results are positive, but not everything has gone smoothly. Design and logistical problems have plagued several courses. Educational facilities are inadequate to stage a fully modern, multimedia-intensive curriculum and the budget has been inadequate to recruit the substantial number of faculty required for a small-group-intensive curriculum or to provide optimum logistical support.

While efforts to deal with these problems are ongoing, the curriculum reform project at the University of Utah has already addressed many of the concerns the faculty set out to remedy. Perhaps most important, curriculum reform has reemphasized to the faculty the importance of the school's responsibility to the citizens of Utah to equip its graduates with all the tools they need to provide the public with the most up-to-date medical care going forward into the 21st century.

Introduction

The University of Utah School of Medicine embarked on a major curriculum reform initiative in mid-1994. The first phase of the new curriculum began with the incoming freshman class in September 1997, and implementation is complete as of the academic year 1999–2000. Although the reform process affected major aspects of the curriculum, much remains to be done to ensure that the curricular design continually evolves to keep pace with developments in the science and practice of medicine and that the host of new

questions that our efforts to date have raised are dealt with. In many ways, the real work of ensuring that the educational program we have put in place attains the highest possible quality has just begun. That being said, it seems appropriate to reflect on the last six years of effort, now that full implementation has been accomplished. The purpose of this case study is to describe the motivations for undertaking reform, the process employed, and the lessons learned during that period of time.

The process of curriculum reform has been extremely interesting, not only from the standpoint of the debate on educational techniques and curricular design but also as a study in institutional dynamics and academic leadership. Institutional politics surrounding medical education are particularly complex and can be at times quite contentious. Although the curriculum produced by the hundreds of hours of faculty and staff effort is a marked improvement over its predecessor (based on an assessment of the data collected to date), in some ways the amount of true reform achieved has been disappointing. In part, that was a result of the resources that were available to accomplish the task, but it was also a function of the great diversity of opinion held by the large number of individuals who were called upon to participate in the curriculum reform initiative on the best way to educate medical students. Although many of these individuals were extremely committed to the goal of achieving a comprehensive curriculum reform, others were more comfortable with the status quo and their efforts in support of the process were correspondingly less vigorous, resulting in varying degrees of progress toward fundamental restructuring.

The University of Utah School of Medicine, a public medical school, was established as a two-year program in 1906. The school was housed on the campus of the University of Utah, the oldest state university west of the Missouri River, which was founded in Salt Lake City in 1850. Through the 1920s and 1930s, the school grew slowly and still had only 60 students in the two classes, with 8 full-time and 20 part-time faculty in 1942. Spurred in part by the growth of Utah's population and that of the Intermountain West and in part by the increased need for physicians precipitated by World War II, the University Board of Regents voted to expand the medical school to a four-year degree-granting program in 1942. At that point, the need for a clinical facility became acute and the Salt Lake General Hospital, a county hospital, was pressed into service as the main teaching site.

The inadequacies of Salt Lake General Hospital were quickly recognized and a new medical center was built and opened in 1965. At that time, the school had 72 full-time and 300 volunteer faculty and a class size of 65 students per year. By the mid-1970s, the medical school had outgrown that space and a new University Hospital was christened in 1981.

Presently, the University of Utah School of Medicine admits 100 students annually and has 850 full-time and 1,200 volunteer faculty. It is the only medical school in the Intermountain West, an area encompassing one-tenth the landmass of the United States. Its budget is nearly $300 million, about 7 percent of which comes from the state of Utah. The school relies heavily on clinical income as a major source of support and has an active faculty group practice, as well as a wholly owned University Health Network that has clinics distributed geographically across the state. The school is research-intensive, ranking in the top 40 institutions in the country in National Institutes of Health grant funding. The school has 500 residents and fellows, a physician assistant program, a regional dental program, a medical laboratory technician program, a masters in public health program, and active graduate programs in the basic sciences, particularly in the areas of molecular biology, biological chemistry, and neuroscience. The school also provides continuing medical education programs for physicians throughout the state and region.

Until 1973, when the school undertook the last major curriculum reform initiative, the curriculum at the University of Utah School of Medicine was exclusively discipline-based. In 1965, first-year students spent an average of 300 hours on gross anatomy and also had courses in physiology, pharmacology, microbiology, and pathology. Biochemistry was also taught in both lecture and laboratory settings. Students spent the third and fourth years in clinical clerkships in the medicine, surgery, pediatrics, obstetrics and gynecology, psychiatry, radiology, and neurology wards.

The school introduced significant changes in 1973. The first and third years of the curriculum remained largely unchanged, but the reform introduced an organ-system format in the second year, which brought together the teaching of pathophysiology, pharmacology, and clinical aspects of each body system. In addition, the fourth year was made largely elective. The school created time for these innovations, especially the organ-system courses, by reducing the time devoted to the discipline-based basic science courses.

The curriculum remained largely unchanged from 1973 to 1994, with exception of the addition of a required two-week ethics course to the fourth year. Prior to the 1994 curriculum reform initiative, students spent an average of 35 hours a week in classes in the first two years, each of which was 36 weeks in duration.

Students had 46 weeks of clerkship requirements in the third year. A total of 36 weeks of credit was required in the fourth year, all but two of which were elective. No schoolwide educational objectives existed to guide curriculum decisions. The mode of instruction was predominantly lectures. Small-group teaching was limited to a few case-based discussions during the organ-system courses in the second year. Multiple-choice examinations were the prevalent method of student assessment. The school undertook little if any systematic effort to evaluate the educational effectiveness of the curriculum. Yet, despite these shortcomings, the national board scores of the students were quite good, with consistent performance nearly one standard deviation above the national mean.

Rationale for Curriculum Change

A series of events and pressures culminated in the decision to move forward with curriculum reform in 1994. Early that year, the dean of the School of Medicine created the new position of assistant dean for medical education. Previously, the associate dean for student affairs and education had been expected not only to deal with all student affairs issues, but also to oversee the curriculum and its development. With the press of student affairs issues, medical education had been given short shrift and little had been done to assess the curriculum systematically. After a brief survey, it was concluded that the School of Medicine's curriculum was well taught, but seriously dated and in need of reinvigoration. Even more important, pressures for reform were evident both internally and externally.

Internal Pressures for Reform

The faculty began to recognize that, as a public medical school, the University of Utah has a significant obligation to contribute to improving the health of Utah's citizens. In the 20 years since the last curricular reform, much had changed in the medical practice environment and the school's graduates were not being optimally prepared to face the challenges thus presented. The explosion of knowledge across the biomedical sciences was evident. The increasing awareness of the molecular and genetic basis of much of health and disease was not appropriately emphasized in the curriculum. The challenges presented by the advent of managed care and new ways of practicing medicine were not being addressed in the existing curriculum. These developments called for new skills and knowledge in the areas of information management, epidemiology, disease prevention and health promotion, evidence-based medicine, and cost-effective medical care that were not being provided to the students. Lecture attendance averaged no more than 60 percent of students in the typical basic science class. Students commented on the lack of clinical relevance and amount of detail presented in many basic science courses. In short, the faculty came to realize that they were not living up to their social contract with the citizens of Utah to produce physicians who had the tools needed to practice the most scientifically advanced medicine. Clearly, reform was necessary.

Applicants to the University of Utah School of Medicine, who were aware of the curricular inadequacies of the school through the applicant "grapevine," provided another important motivation to change. In a 1994 survey, 14 of the 33 individuals who were offered places in the freshman class and opted to go elsewhere cited the outdated curriculum as the primary reason.

External Pressures for Reform

Many external forces were also adding to the growing pressure for curriculum reform. A series of reports issued by national foundations and blue ribbon panels pointed out the need to reconsider the way in which teaching and learning was occurring in medical schools across the country (Panel on the General Professional Education of the Physician and College Preparation for Medicine 1984; Shugars, O'Neil, and Boder 1991; Robert Wood Johnson Foundation Commission on Medical Education 1992; Association of American Medical Colleges Advisory Group 1992). The reports issued by these panels came to many of the same conclusions over a period of years, including the need to (1) increase the institutional importance of and the resources devoted to medical student education, (2) establish clear educational objectives, (3) provide faculty with improved teaching skills, (4) revise the process of student evaluation to focus more directly on assessing desired competencies, (5) increase emphasis on the development of information management skills and foster lifelong learning as major goals of the curriculum, and finally (6) capitalize on the advances in our understanding of how adults learn best by incorporating more active, context-based learning experiences into the curriculum. The consistence of these recommendations over a number of years was not lost on the faculty or on the curriculum committee. Also important were the curricular reform efforts taking place in a number of medical schools across the country including Harvard, the University of Oregon, and the University of New Mexico.

Finally, the activities of the Liaison Committee on Medical Education (LCME) were important. The LCME was scheduled to reaccredit the University of Utah School of Medicine in 1996. A review of the accreditation standards revealed new emphasis on increasing the use of active learning techniques, decreasing lectures and class hours, and adding subjects that physicians would need to practice in the modern health care environment. This provided a powerful stimulus for curricular reexamination and revision.

It became clear to the dean, to members of the administration and faculty, and to students that the existing educational program was not adequately preparing graduates to practice in the modern health care environment and we made a decision to proceed with a major curricular reform initiative in mid-1994.

Design Process and Curricular Characteristics

In November 1994, the dean convened the Ad Hoc Committee on Curriculum Reform (Ad Hoc Committee) and charged it with the responsibility of guiding the curriculum reform initiative at the School of Medicine. This committee, which worked in parallel with the existing curricular governance structure, was a 21-member representative group of basic science and clinical faculty, medical students, community physicians, and alumni of the School of Medicine, chaired by the assistant dean for medical education. The committee called for an analysis of the situation, a draft of the educational objectives, and the actual curriculum reform plan to be completed by January 1996.

A communications campaign provided periodic updates, in a variety of settings, to the school community on the progress of the reform initiative. The assistant dean for medical education also engaged in extensive one-on-one discussions with the school's opinion leaders, including the department chairs, hospital administrators, and administrators from the Office of the Vice President for Health Sciences, to collect data and gather opinions as well as to share philosophy and progress. These meetings proved to be very effective as a tool for soliciting support from key decision makers.

As the planning process unfolded, one major obstacle became apparent. The dean of the School of Medicine, although privately supportive of the curriculum reform initiative, was unwilling or unable to make strong public pronouncements in support of the work of the Ad Hoc Committee. This left it to the assistant dean for medical education and members of the Ad Hoc Committee themselves to carry the flag for curriculum reform. Although curriculum reform eventually succeeded, the inability to count on the dean's strong and unwavering support hindered the process as it unfolded.

Shortly after it began meeting, the Ad Hoc Committee settled on six themes for curricular renewal, which would serve as the philosophical underpinning for the entire effort: (1) professionalism and ethics, (2) humanism and clinical excellence, (3) information management, (4) critical thinking and problem solving, (5) evidence-based medicine and lifelong learning, and (6) self-assessment and personal health. The themes would be emphasized through incorporation in multiple courses across all four years of the curriculum. Using these themes as a platform, the committee went about assembling information and learning from the examples of educational redesign provided by other schools.

The Ad Hoc Committee wrote the school's first set of curriculum-wide educational objectives, to serve as the blueprint for the curriculum design. The committee grouped these objectives under functional headings: knowledge, skills, attitudes, learning environment, assessment, teaching methodologies, and curriculum governance and administration. The Executive Committee of the School of Medicine, the school's governing body, unanimously approved the objectives in January 1996.

The Ad Hoc Committee also completed the curriculum reform plan in January 1996. The plan, which affected all years of the curriculum, incorporated some modified components of the existing curriculum and included a series of new courses designed to achieve the educational objectives that had been established.

Year one kicked off with a new four-week course called Introduction to Medicine, designed to serve as a transition to medical school for incoming freshman students. We kept academic expectations low to allow students to adjust to the workload of medical school, and we planned social activities to allow the students to get to know one another and to establish a sense of unity. We also designed the course to introduce some of the new themes in the curriculum. We demonstrated humanism and clinical skill through panels in which patients discussed their experience of disease and their encounters with physicians. We addressed information management in a series of classes in how to use Medline, e-mail, the Internet, and slide presentation software, designed to bring all students up to a minimum level of computer literacy. We introduced ethics and professionalism through sessions on the role of the physician in society, ethical tensions in medicine, and substance abuse in medicine. We emphasized personal health and self-

awareness through fitness testing and a personal health inventory. A ceremonial distribution of white coats to the students marked the completion of the course.

In the second month, the students entered the regular curriculum and, as an organizational principle, we reformatted the existing basic science classes into groups of courses dealing with related subjects. In addition to grouping the courses, we fundamentally reassessed the material taught in those courses to ensure that it was clinically relevant and presented at an appropriate level of detail. We divided the first year into three blocks. The first block, entitled Structure, was 12 weeks long and presented an integrated approach to gross anatomy, histology, and embryology. Block two, entitled Cellular Processes, comprised biochemistry, genetics, and cell physiology and was taught over a 9-week period. The first year concluded with block three, the Biological Basis of Disease, a 10-week block encompassing microbiology, immunology, principles of pathology, and principles of pharmacology.

In the second year, the students had two blocks. The first was a 10-week Neuroscience block that grouped the disciplines of neuroanatomy, neurophysiology, psychiatry and behavioral medicine, neurology, neuropathology, and neuropharmacology. The second block, entitled Organ Systems, spanned 25 weeks. Discussion of normal physiology initiated the study of each individual organ system followed by pathophysiology, clinical issues, and pharmacology related to that organ system.

We designed the afternoon such that either two or three days a week the students had a series of new interdisciplinary courses that ran longitudinally from the beginning of the first year to the end of the second year. We reserved the remaining afternoons for independent study. The new courses included Art of Medicine, designed to emphasize communication skills, history taking, and physical examination, as well as cultural and ethical issues in patient care; Social Medicine, a case-based, small-group investigation of issues in humanism, ethics, community health, and health care delivery; Science of Medicine, which focused on evidence-based medicine and used journal articles as a tool to develop critical reading, thinking, and analysis skills and introduced the principles of research methodology and study design; and Patient in the Community, which exposed students to clinical issues early in their medical education by placing them in community service agencies to give them perspective on the social issues that patients face, and assigning them to community physicians offices to solidify the history-taking and physical-examination skills learned in the Art of Medicine course.

At the end of the second year, a schoolwide clinical competency examination was created to assess student competence in information management, history taking, and physical examination skills, using standardized patients in an objective structured clinical examination (OSCE) format. We designed this exam to give students feedback on their clinical skills; passing was not required to progress further in the curriculum.

Year three of the curriculum consisted of a series of clinical clerkships, including medicine (12 weeks), surgery (8 weeks), obstetrics and gynecology (6 weeks), family medicine (4 weeks), psychiatry (6 weeks), pediatrics (6 weeks), and neurology (4 weeks). During the clerkships, we added a new course called Topics in Medicine to carry forward and build on the thematic domains introduced in the first and second years, including evidence-based medicine, information management, humanism, ethics and professionalism, and clinical decision-making. Students were excused from their clerkship responsibilities one afternoon every other week and gathered in small groups to manage a simulated panel of patients typical of a primary care practice. Patient problems were based on 20 to 25 medical conditions commonly seen by outpatient generalist physicians to ensure students were exposed to a standardized core curriculum of general medicine topics. In each session, students met one or two new patients and conducted follow-up visits on two or three others. Techniques used included standardized patients, video clips, simulated phone calls, and paper cases.

The third year concluded with a schoolwide clinical competency examination, also in OSCE format, with each clerkship contributing a patient case. This exam, like the one following the second year, was to give feedback to the students, who were not required to pass it to continue.

The fourth year included a number of new requirements, including a subinternship, which served as a transition to residency; a Basic Science in Clinical Medicine course, which presented the basic science concepts learned in the first two years in a clinical context in order to demonstrate their importance in patient diagnosis and management; and the Primary Care Preceptorship (PCP). The PCP was intended to be a capstone curricular experience, in which students would serve a six-week preceptorship in a rural or medically underserved urban site. A primary objective of the PCP was to require students to employ previously acquired skills in information management, evidence-based medicine, epidemiology, and public health to complete a public or community health research project. The remaining 14 weeks were left for

student electives.

The Executive Committee of the School of Medicine approved this curriculum plan in March 1996. The design phase began immediately thereafter and lasted through September 1997. An Executive Advisory Committee composed of department chairs and senior level administrators oversaw the design work. Day-to-day design issues were the domain of the Implementation Committee, which was composed of the chairs of the teams established to design each individual course. We established additional committees to deal with logistics and implementation, competency assessment examinations, and information resources.

The Executive Advisory Committee selected course directors for the new courses through a competitive application process. Although as a public school, the University of Utah receives state funds, it proved impossible to consider reallocating any of those monies to the curriculum effort, given the tightly stretched department budgets. However, we obtained a small budget of $400,000 through a 0.5 percent add-on to the dean's tax for paying course directors for the time expended in design work. Other members of the design teams served on a volunteer basis.

At this point, curriculum reform had considerable momentum and, despite numerous problems, the design process moved forward. One of the primary issues was the inadequacy of the budget that had been allocated for curriculum reform. The initial budget of $400,000 did not give adequate, protected time to those charged with major design responsibilities. This led to some compromises in the design of courses, resulting in less than fundamental change in a number of cases. This was especially true in the reformatted basic science courses. Logistical support, including secretarial, computer, and office resources, were also in short supply, which also hindered the design work.

Other major issues soon surfaced. The Art of Medicine, Social Medicine, Science of Medicine, Patient in the Community, Introduction to Medicine, Topics in Medicine, and Basic Science in Clinical Medicine courses all called for small-group teaching, but it proved impossible to recruit enough facilitators to stage all of these courses in a problem-based, seminar-type format. Topics in Medicine also suffered from the resistance of clerkship directors who were reluctant to release their students from clinical duties for one afternoon every other week. Finally, the course director selected for the fourth-year Basic Science in Clinical Medicine course was unable to come up with a course design satisfactory to the Executive Advisory Committee. Lacking an alternative director for the course, the committee decided to abandon the course concept and added six weeks of elective time back into the fourth year.

In October 1996, during the process of curriculum design, the school underwent its reaccreditation by the Liaison Committee on Medical Education. LCME reaccredited the school for the maximum seven-year term and commended the school for its efforts to revise the curriculum. However, the site visit team was concerned about the adequacy of the school's available resources in money, educational facilities, and faculty time to fully realize the potential of the new curriculum.

Also, during the design phase, administrative changes took place with the dean's resignation, and an interim dean taking over leadership of the school. Despite these challenges, work on the curriculum redesign continued.

For academic year 1997–98, the year of initial implementation, the school was able to provide a budget of $1.4 million, half of which was derived from University Hospital and the other half from the dean's office and the clinical departments. Although this was an improvement over the previous year's budget, it still represented a relatively small amount with which to compensate faculty for the time and effort required to both design and teach the new curriculum. The Implementation Committee monitored design work as it proceeded, and heard presentations from each new course director to ensure that progress was being made toward implementation of the new curriculum with the entering freshman class in September 1997. Despite the problems encountered in the design phase, the deadlines were met and the new curriculum began on September 2, 1997.

Dynamics of Curriculum Change

A curriculum renovation of the magnitude attempted at the University of Utah School of Medicine was a major institutional undertaking. It involved a host of individuals with different motivations and perspectives. In some cases, individual prestige and ego were at stake, and difficult interpersonal and financial issues were faced at many stages. It required major commitments of time and effort. In spite of these setbacks, the process went quite smoothly overall, but a number of discrete issues needed to be addressed.

Leadership and Communication

As mentioned previously, lack of support from the top was an obstacle. Although the dean was unwilling to make strong public pronouncements about the importance of going forward with curriculum reform, the assistant dean, who became associate dean, was able to lobby each chair individually about the importance of curriculum reform. This tactic proved highly successful, as gaining the chairs' input and trust allowed problems to be dealt with before they became major and prevented the entire process from bogging down.

Another strategy that helped convince the faculty of the importance of the project was the enlistment of a small group of dedicated curriculum zealots who shared the belief that curriculum reform was long overdue. These individuals helped to publicize the need for curriculum renovation by working behind the scenes considerably as well as playing prominent roles in the design and implementation phase of the project.

Communication was another important consideration. We kept curriculum reform before the medical school community through electronic and print publications, town meetings, and one-on-one conversations with department chairs and influential faculty.

The students themselves also played an important role in the process. They were enthusiastic and helpful participants in all phases of the design and planning process and they served as excellent ambassadors for curriculum reform, talking to faculty, their fellow students, and applicants about the importance of curriculum reform.

Funding

The budget for the curriculum reform initiative was always extremely modest and even now, with the curriculum fully implemented, it continues to be small. This has made it difficult for the school to adequately compensate those with major responsibilities for curriculum administration and student teaching for the time they devote to their work, and made it hard to pay the faculty so that they could gain release time from other commitments to teach.

Faculty

With the faculty under increasing pressure to generate income from clinical and grant-writing activities, it has been very difficult to secure enough faculty to stage a small-group-intensive curriculum. This has been a vexing problem and has forced some undesirable compromises in the original curriculum design. Many of the courses that were intended to be taught as problem-based, small-group courses were converted to largely lecture-based courses due to the unavailability of adequate faculty. In other cases, the shortage of faculty forced the course directors to make student groups larger than desired, cutting down on the effectiveness of the small-group format. Faculty availability continues to be a key ongoing issue.

Logistical Support

A half-time educational specialist provided valuable suggestions on pedagogical technique, curriculum design, and curriculum evaluation. However, a larger office of medical education to assisting with course design, provide faculty with enhanced teaching skills, and help with assessment of the curriculum would have been extremely useful. Additional resources have gradually been made available in the areas of secretarial support and information technology as the budget permits, but the dream of an office of medical education staffed by educational professionals remains to be realized.

Educational Facilities

The school continues to struggle in the area of educational facilities. A curriculum of the type it has implemented would ideally need at least 10 small-group rooms, a computer laboratory with 50 workstations, two or three state-of-the-art large classrooms, and a clinical skills laboratory with 10 simulated exam rooms. Unfortunately, the school presently has only six small-group rooms, a small computer laboratory with 35 workstations, one modern large classroom, and no clinical skills laboratory. Much staff time and effort is expended in trying to find adequate facilities in other areas of the hospital and health sciences campus to stage the curriculum.

Impact of Curriculum Change

The ability to assess the impact of the changes featured prominently in the planning process. The faculty was very interested in monitoring whether the changes put in place were having the desired effect on

educational outcomes. The curriculum assessment plan has a number of components, some of which have been available for many years, such as student performance on national board examinations and the results of the Association of American Medical Colleges' Graduating Student Questionnaire, but a variety of new measures were also developed. These include: performance on the objective structured clinical examinations at the end of the second and third years; an institutionally developed student questionnaire dealing with educational attitudes and ethical issues that is administered to each class twice, once at the beginning of the freshman year and the second time at the end of sophomore year; monthly focus groups held with small groups of students to provide a forum for discussing issues or concerns on any subject, including the curriculum; participation in a consortium of schools utilizing a standardized student survey; and an extensive individual course evaluation process that consists of a standardized, Web-based individual student assessment of each course along with an evaluation of each course by a small student committee using a standardized form.

Results from these curriculum assessment tools are just beginning to become available and data are preliminary at this point. That being said, the initial results are encouraging. The performance of the first class of students taking Step 1 of the U.S. Medical Licensing Examination with the new curriculum appears to be similar to that of classes educated under the old curriculum. The clinical competency examinations following the second and the third years of the curriculum have been staged twice and have provided valuable feedback with respect to the Art of Medicine (physical diagnosis) course and the clinical clerkships. The curriculum surveys are particularly important because they allow comparison between the results from the last class in the traditional curriculum and the results from those studying under the new curriculum.

The survey has thus far been administered four times to three classes. Though still preliminary, the results indicate the following trends:

1. Material is more integrated and clinically relevant in the first two years.
2. The faculty is more accessible, more concerned with student well-being and progress through the curriculum, and more open to student input.
3. The amount of rote memorization expected of students has decreased and critical thinking skills are emphasized more.
4. Students are provided with more timely feedback.
5. Students see medical student education as a higher priority for the faculty and the school.
6. Students are more comfortable using Medline and other informatics tools as adjuncts to their studies and clinical activities.
7. Students see the new curriculum as aiding the transition to medical school.

In general, the reaction to the new curriculum has been positive both from students and faculty alike, but there have been a number of persistent problems to deal with. Faculty recruitment has already been discussed as a major ongoing issue. The Social Medicine course was forced to convert from a small group to a lecture-based format. The Science of Medicine course started out as exclusively small-group-based but we quickly determined that the students needed a more basic grounding in biostatistics and epidemiology before they could embark upon case discussions or assessment of the medical literature. Therefore, we converted the course to a format that emphasized biostatistics in lecture format in the first year and literature analysis in small groups in the second. The Patient in the Community course has proved to be popular with the students, who enjoy the community and physician office experiences. However, as with all logistical undertakings of this magnitude, problems in recruiting community sites and standardization of experience have been difficult to resolve.

Similarly, the Art of Medicine course has been plagued with logistical problems. As the single largest course in the curriculum, it represents a formidable amount of organizational and preparation work and many of these issues have not been completely resolved to date. There have also been problems in recruiting sufficient numbers of preceptors to provide students with enough close supervision and practice of history and physical examination skills.

The most popular of the new courses with the students, Introduction to Medicine, has also been altered from its original format. Students felt that a one-month introductory period was too lengthy and thus the course has been shortened to two weeks, although the core philosophy of its providing a transition to medical school has remained the same. The basic science block concept has worked reasonably well, though the Curriculum Steering Committee felt it appropriate to appoint one faculty member, to be compensated from the dean's office, from among those teaching in each block to organize the schedule and to attempt to integrate block content with other courses in the curriculum. Thus, each basic science block now has a block

director, who meets monthly with the other block directors to integrate material and exchange ideas.

The third and fourth years of the curriculum have also evolved since we implemented the new curriculum. We have redesigned the Topics in Medicine course so that the cases the students deal with correspond to the clerkship on which they are rotating at the time. Thus, pediatric cases are discussed during the pediatric clerkship, medicine cases during the medicine clerkship, and psychiatry cases during the psychiatry clerkship. The course's focus on information management, evidence-based medicine, and professionalism has remained intact. This course is now well received by students and faculty.

The Primary Care Preceptorship is now fully operational. Students were originally concerned that spending six weeks in a rural or underserved urban practice site would represent a large burden to their lifestyle and that of their families. This was especially problematic given that nearly half the students are married. However, after much debate, we developed a number of placement sites within commuting distance of Salt Lake City, and we have implemented the preceptorship. Many students have had very positive experiences in the preceptorships, and some of their community health projects have even been of publishable quality. The timing of the preceptorship as a fourth-year requirement has also presented some scheduling issues for students with regard to fourth-year away electives and residency interviews.

Plan for the Future

In general, the picture of curriculum reform at the University of Utah School of Medicine is mixed. Although much positive change has occurred, considerable work remains to be done to ensure that the modifications that have been implemented have the maximum possible impact on the students' education.

On the plus side, a major renovation has taken place, resulting in a curriculum that is much more responsive to current practice conditions and to changing societal expectations of the medical profession. The faculty can, with confidence, attest that students are getting more of the knowledge and skills they need to effectively deal with the challenges of the modern health care environment. We have vastly reduced class time; we have cut the amount of detail presented, especially the basic science courses; we have broadened assessment methodologies; and we have created additional time for students to pursue independent study and to assimilate material they are learning. We have reemphasized education as an institutional priority and those who teach receive greater recognition financially and in promotion decisions. For the first time, we have established an educational budget, which we are using to compensate those who carry the major administrative and teaching loads in medical student education. Students and faculty members have largely responded positively to these changes. The Curriculum Steering Committee has evolved from an operational committee to a budget and major policy committee. Outcomes assessment has become a regular feature of the educational plan.

On the negative side, a number of the course concepts that looked good on paper were not operationally successful. The reasons ranged from flawed course concepts to poor choices in course leadership to the general scarcity of faculty, space, and money. We have raised the profile of education at the School of Medicine but the educational budget is still quite small and many faculty members are still not receiving specific compensation for the large amount of time they spend teaching. Education has received more emphasis in the promotion process, but it is still more difficult for faculty who spend a large amount of time teaching to get promoted compared to those who spend their time in research.

In some cases, the curriculum revision has resulted in change without real reform. There is still too much detail being taught in many courses, and inadequate contact between the clinical and basic science faculties continues to plague efforts to make the basic science material clinically relevant and to present it at a level appropriate for the learners. Courses requiring large expenditures of time, effort, and organizational resources have proved notoriously difficult to stage and logistical issues continue to impede their effectiveness. Educational facilities remain inadequate to stage the curriculum optimally. It is still very difficult to recruit adequate faculty to provide the type of intensive, small-group, problem-based instruction that the school would like to offer. Despite all of these concerns, the balance sheet is still strongly in favor of the investment of time and energy made.

At the moment, a number of developments are in progress that will profoundly affect the curriculum. The school has initiated a Mission-Based Management process, which has for the first time given it definitive information on the true costs of staging its educational mission. The preliminary data shows that far too little funding is devoted to education. Over the course of the next several years, the school must find a way to expand the educational budget. A second initiative is to improve the organization of the Art of Medicine course. Some major changes will be necessary to make this important course of the highest possible quality.

Third, although there is currently some educational development of faculty, including a yearly curriculum retreat and periodic visiting professorships in medical education, more formal faculty development activities in the area of education are warranted. Linked to this is the Steering Committee's desire to have an office of medical education, which is capable of engaging in curriculum development, curriculum assessment, and medical education research to further the evolution of the curriculum.

Having devoted six years to the development and implementation of the new curriculum at the University of Utah School of Medicine, the faculty are now reflecting on whether, in retrospect, the time and effort have been well spent. The general reaction is yes, although there have been and continue to be disappointments along the way. In the process of curriculum reform, not only have the members of the faculty made a positive impact upon our students, but they have also learned a lot about themselves and the school. While much remains to be done, the school remains optimistic about the direction it has taken and where that path will lead.

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WAKE FOREST UNIVERSITY SCHOOL OF MEDICINE

Cam Enarson

Executive Summary

The Wake Forest University School of Medicine "Prescription for Excellence" Curriculum represents an innovative approach to medical student education. With the introduction of this new curriculum, we have made substantive changes in the medical student curriculum with respect to the organization and structure of the curriculum, the primary methods of instruction and evaluation, professionalism and population health education, community-based education, clinical education, and the use of information technology within the curriculum. Of particular note are the innovative use of information technology to enhance student learning and the focus on preparing students to be active lifelong learners. The faculty has made a renewed commitment to the teaching of medical students and to the creation of an optimal learning environment in both the preclinical and clinical years.

Several important factors influenced the curriculum change process at Wake Forest. The primary impetus for change was internal, coinciding with the appointment of a new dean. The focus was directed toward the future, utilizing the school's 100th anniversary in 2002 as a beacon. Recognition of the changes taking place in the health care system, as well as the changes in population demographics and societal expectations, helped provide a rationale and direction for change.

Wake Forest is implementing the Prescription for Excellence Curriculum across a four-year period. The first students to complete the new curriculum will graduate in 2002. The new curriculum drew national attention at an early stage when the basic curriculum model was cited by an Association of American Medical Colleges representative at the 1998 national combined meeting of pediatrics chairs and clerkship directors meeting as being a "model for innovation." Subsequently, the school has received invitations to present the

new curriculum at medical schools in Norway and China. A presentation to the alumni board at one of its twice-yearly meetings generated significant alumni enthusiasm for the new curriculum. Wake Forest University School of Medicine's dean presented the process of curriculum change and an overview of the school's new curriculum at one of the major plenary sessions at the 1998 AAMC annual meeting. We anticipate that this curriculum will continue to evolve in response to national, regional, and local trends and the commitment of the school to produce students who possess the requisite knowledge, skills, and attitudes that will allow them to meet the health care needs of the population in the 21st century and beyond.

Introduction

The Wake Forest University School of Medicine (WFUSM) was established in 1902 as a two-year program. In 1941, the medical school moved from the city of Wake Forest, North Carolina, to Winston-Salem and expanded to a four-year program. The medical school is a part of Wake Forest University, and is a private institution. There are 29 academic departments with more than 750 faculty. Research and research training awards exceeded $77 million in fiscal year 1999. The medical school annually enrolls 108 students, approximately half of whom are North Carolina residents.

The medical school initiated the last major curricular change in 1984 following release of the *General Professional Education of the Physicians Report* (GPEP). Planning for the introduction of a problem-based track, the Parallel Curriculum, was completed during the next three years. This track began in 1987 with 18 students and expanded to include 24 of the 108 students in each class. The goals of the Parallel Curriculum included self-directed learning, learning in context, an interdisciplinary knowledge base, and development of clinical reasoning skills. Small-group, problem-based tutorials with six students and two faculty facilitators served as the foundation for the curriculum. During the first year, students met in small groups three times per week, and in the second year, twice per week. The Parallel Curriculum introduced basic science correlates in anatomy, biochemistry, histopathology, and radiology during the first 20 weeks of the first year. During these weeks, it also emphasized early clinical skills development with history-taking and physical examination skills sessions, followed by bedside teaching and a half-day per week of clinical experience later in the first year. Students spent eight weeks with a community-based primary care preceptor in the summer between the first and second year. This experience provided the opportunity to develop additional clinical skills as well as to pursue basic and clinical sciences learning issues generated by patients actually seen by the students. Student evaluation was multifaceted and included observation of a history/physical examination conducted on a standardized patient in addition to an oral examination of the students' clinical reasoning process and knowledge acquisition.

The Traditional Curriculum was discipline-based and included courses in gross anatomy, biochemistry, and physiology in the first-year and organ-systems pathophysiology (e.g., cardiology), pathology, and pharmacology in the second year. Lectures were the primary educational methodology utilized, although there was a trend toward inclusion of more small-group activities in the curriculum in the five years preceding the initiation of the curriculum change. Within the Traditional Curriculum we implemented an expanded ethics course, Medicine as a Profession, as well as a doctor-patient interviewing course stressing listening skills. Eighty-four of the 108 students were enrolled annually in this curriculum.

All students participated in the same clinical curriculum in the third and fourth years. The third year consisted of 45 weeks of instruction, including 8 weeks each of internal medicine and surgery, 5 weeks each of pediatrics, obstetrics and gynecology, and psychiatry, 4 weeks each of family medicine and neurology, and 1 week each of anesthesiology and radiology. The fourth year was 40 weeks in length and consisted of three one-month selectives chosen from offerings in internal medicine, pediatrics, obstetrics and gynecology, and surgery; one month of emergency medicine; 2 months of community medicine; and 4 months of electives.

Rationale for Curriculum Change

Several important factors influenced the curriculum change process at Wake Forest. The primary impetus for change was internal, coinciding with the appointment of a new dean. The curriculum change process was conducted within a national framework, however, and was informed by a review of the best elements of the school's two existing curricular tracks. The process focused on the future, utilizing the school's 100th birthday as a beacon. Recognition of the changes taking place in the health care system, as well as changes in population demographics and societal expectations, helped provide a rationale and direction for change.

At the time the curriculum renewal process began, WFUSM had two distinct curricular tracks, as has been noted. The school had completed a successful Liaison Committee on Medical Education site visit, with no deficiencies noted, in 1994. Student and faculty satisfaction with the curriculum was high and student scores

on the Step 1 and Step 2 exams had been at or above the national mean since the introduction of the new Step Examinations.

Dr. James N. Thompson was appointed dean of the WFUSM in July 1994. During the 1995–96 academic year, Dr. Thompson presented his "Vision for 2002" to the board of trustees, faculty, staff, alumni, and students. The year is significant in that Wake Forest will celebrate the centennial anniversary of the founding of the medical school in 2002. The Vision for 2002 document contained six major objectives: to maintain quality and excellence; to align institutional resources with our mission; to assure accountability; to maximize efficiency; to prepare for change; and to sustain the culture. The latter two are of particular note and are reproduced here:

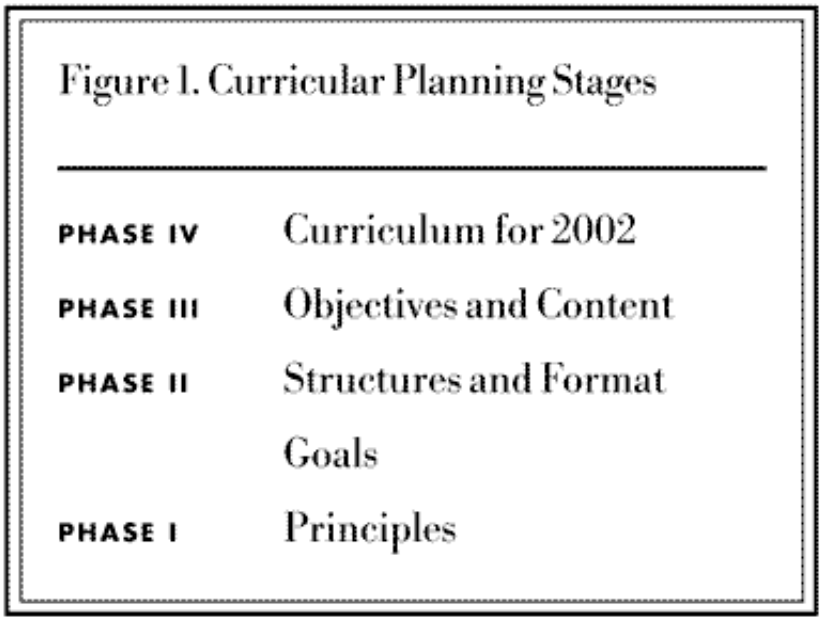
> *Prepare for Change.* It is critical that we approach our future with enthusiastic optimism. We must become adaptable to change in order to assure our successful passage into the twenty-first century. There are tremendous opportunities to coordinate our strategic direction on institutional, departmental and individual levels. The input of all stakeholders within the institution will be critical to the process.
>
> *Sustain the Culture.* As we initiate change within the medical school, it will be critically important for us to sustain the culture of the institution. The culture of the school has always been one of trust, cooperation and collaboration between faculty and staff. We must remember the values on which our school was founded and strive to maintain an environment that rewards excellence and encourages individual initiative as well as group success.

The Vision for 2002 document also contained specific goals for each of the school's four major mission areas: education, patient care, research, and community service. The preamble statement under education noted that "In the year 2002, we celebrate our first 100 years of medicine at Wake Forest. As we enter our second century of medicine, we should have a clear vision of just what kind of student we should be preparing for the twenty-first century." The document noted six objectives: to consolidate the two curricular pathways; to prepare new leaders; to emphasize professionalism; to increase ambulatory education; to expand informatics; and to emphasize prevention and health maintenance. Under the consolidation objective, the document noted that "The unification of the educational experience of our medical students will bring the best of both pathways (lecture-based and problem-based learning) together so that all students may benefit from both curricula and once again, unify our graduates."

The strategic objectives for education noted in the Vision for 2002 document complemented the primary strategic goals for education developed during the medical center's strategic planning process conducted in 1993–94. The strategic goals and initiatives developed in that strategic planning process served as the foundation for the goals and objectives developed for the Vision for 2002 document. These in turn, provided the framework for the curriculum reform, which was to come.

In the mid-1990s, major changes were under way in the health care delivery system in the United States. Managed care was increasingly being adopted as a strategy for cost control and extensive networks of primary care physicians were being created. The demographics of the population were also shifting with respect to age and ethnic composition. Societal expectations of physicians were changing with increased recognition of the importance of the doctor-patient relationship and the need for enhanced communication skills. These changes in the external environment, in part, influenced the curriculum change at WFUSM to prepare students to practice in the 21st century.

Included in the strategic plan for undergraduate medical education in 1995 was a four-phase plan for curricular renewal (see figure 1):



Phase I: Development of Curricular Principles
Phase II: Development of Curricular Structure and Format
Phase III: Development of Curricular Objectives and Content
Phase IV: Implementation

In the fall of 1995, the dean appointed the Curriculum for 2002 Phase I Committee, consisting of university and community representatives, eleven students, and two residents. The membership of the 35-person committee was diverse to ensure that a spectrum of viewpoints would be represented in discussions. The committee was charged "to consider the educational philosophy and basic principles of medical education, which should guide our undergraduate curriculum into the second century of medicine at Wake Forest University." Faculty forums provided opportunities for broader faculty input. Simultaneously, the Committee on Undergraduate Medical Education (CUME) was completing a review of the existing curriculum. The CUME is a standing committee that advises the dean on medical education policy and curriculum. The CUME established seven subcommittees corresponding to the school's seven educational goals and a subcommittee on student evaluation with the charge to review the extent to which those goals were being met.

In September 1996, the chairs of the Phase I Planning Committee presented the principles of the Curriculum for 2002 to the Faculty Executive Council (FEC) and the council adopted them as the guiding principles for the undergraduate medical curriculum. The FEC requested the addition of a principle relating to the preparation of leaders in medicine. The 10 principles are:

1. The curriculum should promote and encourage the highest level of scholarship and provide the foundation for students to be future leaders in medicine.
2. The curriculum should encourage and enable students to acquire the skills necessary to be active life-long learners.
3. The curriculum should stimulate the development of creativity, forward-thinking skills, and the ability to apply medical knowledge to exploration and discovery in medicine.
4. The curriculum should prepare students for the practice of medicine, both as an individual and as a member of a health care team. This preparation should occur in academic- and community-based contexts, and should impart an appreciation of how principles of ethics, law, and economics apply to the biomedical sciences and clinical medicine.
5. The curriculum should emphasize the importance of professional attitudes and behaviors, explicitly recognizing devotion to the well being of one's patients as a prime responsibility of highest importance, and should inspire and enable students to develop these attributes.
6. The curriculum should enable students to acquire an understanding of the physicians' role in the health of the community and the underlying principles of population-based health care delivery in order to promote health and prevent disease.
7. The curriculum should be based upon a teaching-learning process that (a) promotes self-directed and

independent study, (b) emphasizes the integration of basic science knowledge and clinical reasoning through experience with patients and increasingly complex problem-solving, (c) encourages the development of analytical and critical thinking skills, and (d) fosters the ability to communicate reliably and act cooperatively.

8. The admissions process should support and be congruent with the stated goals and principles of the curriculum serving to select candidates possessing the necessary humanistic, intellectual, physical, and emotional abilities to develop into well-balanced, collegial, and capable physicians.
9. The student evaluation process should further the principles and goals of the undergraduate medical curriculum and include written, performance-based, and observational assessments. These evaluations should encompass all aspects of professional development, providing students both graded standards and feedback.
10. The medical school should support the principles and goals of the undergraduate medical curriculum through (a) the development of faculty members' teaching skills, (b) the recognition and reward of commitment and excellence in teaching, and (c) the assignment of teaching responsibilities to faculty in keeping with their capabilities.

The linkage between the dean's Vision for 2002 objectives and the curricular principles above should be noted. For example, principle 1 addresses the objective to prepare new leaders, principle 4 recognizes the importance of ambulatory-based education, principle 5 emphasizes professionalism, and principle 6 addresses the objective relating to prevention and health maintenance.

In October 1996, the dean appointed the Phase II Committee to make recommendations about the organization and format for the new curriculum utilizing the 10 principles developed during Phase I as a foundation. The Phase II Committee consisted of 42 faculty members, 2 residents, and 16 medical student members. It identified medical schools that were in the process of or had recently completed curriculum reform and reviewed information from these schools to ascertain major curriculum renewal themes. The committee identified the following themes: integration of basic and clinical sciences as a continuum across the entire curriculum; use of adult learning principles, with greater emphasis on clinical reasoning skills; self-directed learning and lifelong learning skills; improvement of skills in computer-based information management and utilization; achievement of a better balance between ambulatory and inpatient settings for clinical education; and the development of methods and instruments to evaluate knowledge, skills, attitudes, and behaviors. This information was extremely useful, as it provided a national framework for curriculum change. The Phase II Committee reaffirmed the school's existing seven educational goals, which had been developed in 1993: self-directed learning and lifelong learning skills; core biomedical science knowledge; clinical skills; problem-solving and clinical reasoning skills; interviewing and communication skills; information management skills; and professional attitudes and behavior. The school had also volunteered to join the Association of American Medical Colleges Medical Schools Objectives Project Curriculum Consortium, which provided a national template for the changes being discussed at the local level.

The Phase II Committee also reviewed the school's two existing curricular tracks. Important elements identified during this review included: teaching in context; early patient contact; integration of basic and clinical sciences education; utilization of different instructional methodologies; increased faculty contact with students; emphasis on problem-solving rather than on memorization; development of lifelong learning skills; and the importance of noncognitive skill development and evaluation. The committee developed a model for the structure and format of the new curriculum during a half-day retreat in March 1997. This model emphasized a 46-month education continuum with integration of basic and clinical sciences throughout. Students would have early clinical contact and the curriculum would utilize clinical cases to provide the contextual basis for learning across all four years. In addition, the curriculum would emphasize the development of professionalism and population/community health. Phase II of the planning process was completed with a presentation to the FEC in June 1997.

The dean charged the Phase III Curriculum for 2002 Committee in July 1997 to make recommendations concerning the details of curricular content and scheduling. A 19-member steering committee consisting of faculty, students, and an alumni representative oversaw the activities of 11 subcommittees. Subcommittees included core biomedical knowledge, core clinical experiences, professional issues, information technology, and student evaluation.

A composite picture of the 46-month curriculum emerged following with presentations of the subcommittee chairs to the Phase III Committee and of the committee chairs to the Faculty Executive Council in February 1998. The Phase III Committee chairs then presented the final report, "Curriculum for 2002," to the Committee on Undergraduate Medical Education that same month, and the CUME unanimously approved it.

The planning process led to the development of a curriculum comprising five curricular phases. Following its approval, the faculty was solicited concerning the final name for the new curriculum, and the dean approved selection of the name "Prescription for Excellence: A Physician's Pathway to Lifelong Learning."

It should be emphasized that the new curriculum was developed within the context of the changes under way in medical education at a national level and that the societal changes previously described influenced it to a significant degree. The specific curricular structure adopted reflects the institutional values and preferences of WFUSM. We placed particular emphasis on adopting curricular structure and content that reflect a general professional education.

Characteristics of Curriculum Change

Wake Forest made substantive changes in the medical student curriculum when we implemented the Prescription for Excellence Curriculum. There were major changes in (1) the organization and structure of the curriculum, (2) the primary methods of instruction and evaluation, (3) professionalism and population health education, (4) community-based education, (5) clinical education, and (6) the use of information technology within the curriculum.

Curriculum Organization and Structure

The basic structure of the new curriculum is organized around five phases, which extend for 46 months (see figure 2). The difference between the phases of the planning process (I–IV) and the phases of the curriculum (I–V) should be noted.

Figure 2. Wake Forest University School of Medicine's Prescription for Excellence: A Physician's Pathway to Lifelong Learning. *This chart outlines the basic structure of the curriculum.*

MONTHS 1 — 7 **AUGUST THROUGH FEBRUARY**

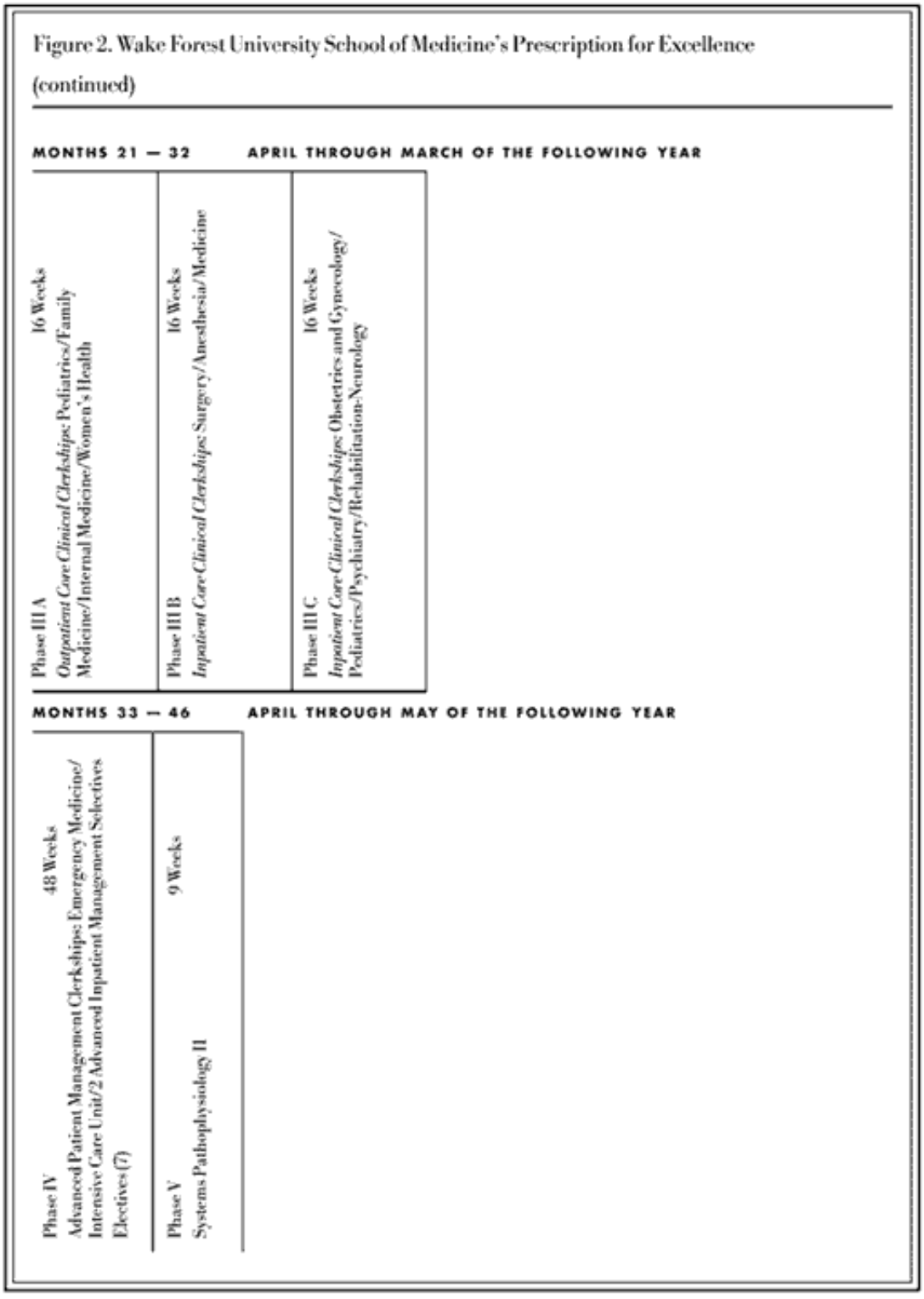
Orientation	
Phase I A Core Biomedical Knowledge: Human Structure and Development Medicine as a Profession/ Foundations of Clinical Medicine/ Population Health/Epidemiology Basic/Clinical Science Problems I	12 Weeks
Exam Week 1	
Community Experience 1	
Phase I B Core Biomedical Knowledge: Cellular/Subcellular Processes Medicine as a Profession/Foundations of Clinical Medicine/ Population Health/ Epidemiology Basic/Clinical Science Problems I	12 Weeks
Exam Week 2	
Community Experience 2	

MONTHS 8 — 20 **MARCH THROUGH APRIL OF THE FOLLOWING YEAR**

Phase II A Systems Pathophysiology I A Medicine as a Profession II Foundations of Clinical Medicine II/ Evidence-Based Medicine Basic/Clinical Science Problems II	9 Weeks
Exam Week 3	
Community Experience 3	4 Weeks
Research/Scholarly Project/Vacation	12 Weeks
Phase II B Systems Pathophysiology IB Medicine as a Profession II/ Foundations of Clinical Medicine II/ Evidence-Based Medicine Basic/Clinical Science Problems II	9 Weeks
Community Experience 4	
Phase II C Systems Pathophysiology IC Medicine as a Profession II/Foundations of Clinical Medicine II/ Evidence-Based Medicine Basic/Clinical Science Problems II	12 Weeks
Exam Week 4	
Holiday Break	2 Weeks
Phase II C (continued) Medicine as a Profession II/Foundations of Clinical Medicine II/ Evidence-Based Medicine Basic/Clinical Science Problems II	8 Weeks
Exam Week 5	
Community Experience 5	
Vacation and USMLE Preparation	4 Weeks

Figure 2. Wake Forest University School of Medicine's Prescription for Excellence

(continued)



The organization of the new curriculum represents a major change from the previous two-year preclinical, two-year clinical structure. Core biomedical science courses are organized on a multidisciplinary basis rather than along strict departmental lines, as in the previous curriculum. The required clinical clerkships underwent significant reorganization with the introduction of a 16-week ambulatory block. We added new third-year clerkships in women's health and rehabilitation medicine. In Phase IV, we added a new intensive-care medicine clerkship and developed advanced inpatient management clerkships. We also expanded elective time in the new curriculum was expanded from five months to seven to allow students more flexibility in the choice of experiences to complement their required clerkship experiences.

Instructional Methods and Evaluation

The second major change involved the primary methods of instruction and evaluation utilized in the new

curriculum. During the planning process, the importance of preparing students to be active lifelong learners had been recognized and had significantly influenced the discussions about the incorporation of various learning formats into the curriculum. In the new curriculum, we reduced the number of lectures and increased the amount of time available for independent study. There are significantly more small-group sessions in the new curriculum, which provide opportunities for enhancement of group interaction and discussion skills. The curriculum utilizes small-group sessions in all of the major courses in Phases I and II. Two problem-based learning sessions of two hours duration serve as anchor points at the beginning and end of each week of instruction. Students work through clinical cases in small groups of six students with one basic science and one clinical faculty facilitator. These sessions emphasize the development of clinical reasoning skills and the enhancement of students' ability to work effectively in groups. We also use small-group sessions in the Doctor-Patient Interviewing component of the Foundations of Clinical Medicine course and in the Population Health–Epidemiology (Pop-Epi) and Medicine as a Profession courses, which will be described below. Students also get a minimum of two half-days per week completely free of scheduled activities to allow time for independent study.

We have also changed the student evaluation system. We require all students to participate in four Standardized Patient Assessments (SPAs). The SPAs are modeled after the Independent Process Assessment (IPA) examinations used in the Parallel Curriculum. Part I of the SPA involves clinical faculty observation of students' history-taking and physical examination skills utilizing standardized patients. Part II assesses students' clinical reasoning and knowledge acquisition skills via an oral examination conducted by a basic science and clinical science faculty team. During Part II, students have 48 hours to complete a standardized clinical case and to research learning issues related to the case.

After the first 12 weeks of school, students complete a formative (practice) SPA Part I, with feedback provided by second- through fourth-year medical students. Following the end of Phase I (end of the 26th week of school), students complete a graded SPA Part I with clinical faculty as evaluators. This second SPA also provides an opportunity for students to complete an abbreviated practice Part II. At the end of the first academic year, students complete a graded SPA Part II, with the standardized case provided to them on the computer network. The fourth SPA is conducted in December of the second year and includes a graded Part I and Part II. The SPA examinations provide a formal assessment of skills that are important to the practice of medicine, including clinical reasoning, interpersonal, presentation, and independent and self-directed learning skills.

Professionalism and Population Health

The Prescription for Excellence Curriculum has an increased focus on professionalism and on population health. In the curriculum planning process, we recognized the importance of these two topical areas, and we developed principles specifically to address these areas. The standard schedule for Phases I and II allocates one half-day each week to professionalism and population health. Involvement of both basic and clinical sciences faculty in small-group discussions with students provides diverse perspectives and facilitates the development of faculty in these topical areas, as well.

During the Phase I Population Health–Epidemiology course, concepts related to community and population health and study design are presented in lecture and small-group format. Phase I also includes an introduction to the organization and financing of the U.S. health care system. In the Phase II Evidence-Based Medicine course, students learn specific skills related to diagnosis, therapeutic decision-making, and prognosis.

The Medicine as a Profession course focuses on ethical, legal, and professional issues of particular importance to physicians. Topical areas include end-of-life decisions, risk management, sexual boundary issues, doctor-patient confidentiality, and stress management. Course topics are synchronized with the clinical problem-based learning case of the week. For example, students attend a lecture on breaking bad news to patients in the same week that they are asked to role-play a discussion in their problem-based learning sessions involving the mother of a patient who died suddenly. Lectures are followed up by a small-group discussion of articles relating to the same topic the following week.

Community-Based Education

We identified the importance of providing students the opportunity to gain experience in community-based sites during the initial phase of the curriculum planning process. Prior to the implementation of the new curriculum, WFUSM students completed two four-week Community Medicine Experiences, one of which had to be in North Carolina. With the advent of the new curriculum, we introduced a Community Practice

Experience (CPE) course. This eight-week course extends through Phases I and II of the curriculum. Students are assigned to a community primary care practitioner in North Carolina and return to work with the same physician as preceptor for all eight weeks when possible. Course objectives include the continued development of communication, history-taking and physical examination skills as well as population/community health issues. The initial one-week experience occurs in the 14th week of school and the second one-week experience occurs in week 28. Students spend one month with their preceptor in the summer after the first academic year and return for two additional one-week experiences during Phase II of the curriculum. They must complete a community project, which includes a community health diagnosis and a prescription for change with respect to a particular health need in that community. Students also have the opportunity to participate in community activities with their preceptor, which reinforces the community service role of physicians.

The Office of Regional Primary Care Education (ORPCE) of the Northwest Area Health Education Center (AHEC) facilitates preceptor recruitment and training. North Carolina is fortunate to have a well-developed AHEC system and the ORPCE assists with placement of medical students throughout the state. Preceptors supply information regarding the challenges they face in the changing health care environment and the AHEC system assists WFUSM in addressing the concerns that relate to medical student education. The operational goal in these efforts is to create an optimal learning environment for students. Overall, students have been very pleased with their community-based experiences and the mentorship provided to them by their community-based preceptors. The ORPCE system also assists with placement of students during the Phase III ambulatory clerkships, which are described later in this report.

Clinical Education

We made important changes to the clinical skills education of students in the first two phases of the new curriculum. Previously, physical examination skills development was emphasized in the Parallel Curriculum and interviewing skills development was emphasized in the Traditional Curriculum. Recognizing the importance of both skill areas, we combined the best elements of the instruction in the two previous curricular tracks in the Foundations of Clinical Medicine course in the new curriculum. During Phase I, students spend 11 weeks learning to listen to patients and gathering important history information. Students learn how to look for the emotion surrounding a patient's illness and how to identify and support the patient's expression of this emotion. Topics addressed in the course include the sexual history, physical and sexual abuse, gender and cultural differences, and facilitation skills. Students alternate interviewing sessions with development of physical examination skills. The major elements of a physical exam are addressed in 11 sessions in Phase I. In Phase II, students learn how to conduct clinical breast and pelvic exams utilizing standardized patient instructors. During this phase, students also teach first-year students basic physical examination skills and participate in bedside teaching and preceptorship experiences. Skill development is evaluated via faculty observation in addition to the SPA examination previously described.

Profound changes were also made to the clinical clerkships in Phases III and IV of the new curriculum in recognition of the need for change in the clinical education of students. Students spend one-third of the 48-week Phase III in ambulatory clerkships: Internal Medicine, Pediatrics, Family Medicine, and Women's Health. All four clerkships utilize community-based ambulatory sites in addition to ambulatory clinics at the medical center. The ambulatory Internal Medicine clerkship includes an emphasis on evidence-based medicine, and the ambulatory Pediatrics clerkship includes experience with underserved patients at a local health center operated by the school's primary teaching hospital. The Women's Health clerkship is multidisciplinary and includes faculty from various departments, including Obstetrics and Gynecology, Surgery, Radiology, and Internal Medicine. The four clerkships have cooperated in the development of a common curriculum, which is presented one half-day per week to all students rotating on the "ambulatory block."

We have also made changes in the Phase III inpatient clerkships. We reconfigured the Surgery clerkship to reflect objectives related to general surgical concepts and principles rather than specialty-based topics. Students in the eight-week inpatient Surgery clerkship spend one day per week assigned to Anesthesiology, providing them a longitudinal experience rather than a block rotation. Radiology teaching is incorporated throughout all the clerkships, which represents a change from the old freestanding one-week Radiology clerkship. We added rehabilitation medicine to the existing Neurology clerkship in recognition of the students' need for specific knowledge and skills in the rehabilitative care of patients.

Phase IV consists of 11 one-month clerkships. Four of these clerkships—one each in intensive care medicine and emergency medicine, and two in advanced inpatient management—are required. We added

the latter two to provide students with enhanced experience and increased responsibility for the care of acutely ill inpatients. We also expanded elective time for students to seven months in the new curriculum to allow students to round out their clinical education. The Office of Student Affairs carefully monitors students' choices of electives to ensure consistence with a general professional education.

The changes in clerkship structure were accompanied by discussion among the clinical faculty regarding the purpose of the clinical education component of the curriculum. The faculty made a conscious decision to focus the Phase III clerkships on the acquisition of basic clinical knowledge and skills, with Phase IV being used to provide advanced clinical experience. The faculty also discussed the impact of the changing clinical milieu on the education of medical students. At WFUSM, as at other medical schools, faculty members are being asked to enhance the efficiency of their practice and to maximize their clinical productivity. Providing excellent clinical education to medical students in this relatively new clinical practice environment presents a major challenge for the faculty. With the introduction of the new curriculum, we have increasingly recognized the importance of clinician-teachers, and are evaluating mechanisms to support them in their educational role. The clerkship directors have also recognized the importance of identifying measurable objectives for student education, such as specifying the number and type of patients all students should see as they progress through their education. The LCME standards in this area have been particularly helpful in effecting change.

Information Technology

The final area that had substantive changes in the new curriculum was information technology. Beginning with the introduction of the Prescription for Excellence Curriculum, each matriculating student has been provided with a laptop computer. The growing importance of information technology within our society, as well as the curricular goals of self-directed lifelong learning and information management skills, was the primary basis for this decision. The curriculum is now computerized, with the students' schedule and lecture/lab content available via the network. The Academic Computing Office developed a Web-based format, which includes an institutionally developed search engine that allows students to access topical material across the five phases of the curriculum. We renovated the lecture halls and small-group rooms to provide more than 900 ports of access to the network, and multimedia equipment was installed in the major lecture halls and small-group rooms. On-line access to the library's resources, external Web-based resources, and software are available via networked parts. Access to computerized learning resources has greatly enhanced student participation in the problem-based and self-directed learning activities of the new curriculum. We have also computerized student evaluations of courses and faculty. We have completed a major effort to identify the information technology infrastructure needs related to the initiation of Phase III. This effort required identifying the current needs in the clinical teaching areas as well as determining what would be needed when the students began the new Phase III clerkships. Students also receive palm-top devices prior to starting Phase III to facilitate patient tracking and clinical data storage. These devices have greatly enhanced the students' clinical education, and their use by students has also stimulated use by residents and faculty.

Dynamics of Curricular Change

The curriculum renewal process at WFUSM was divided into four phases, with each one serving as the foundation for the next. We explicitly structured the Phase I Committee to include community representatives and Wake Forest University alumni, faculty, and students to provide diverse views on the principles for the new curriculum.

We broadened the membership of the Phase II Committee to include faculty educational leaders with significant experience in the two existing curricular tracks. We also included faculty members who had expressed concern about the need for curricular change in this phase to provide an opportunity for their voices to be heard. Some, including a few department chairs, had questioned the need for curriculum reform at all, given the apparent success of the two existing curricular tracks. The dean played a critical role in reinforcing the need for change and in listening to faculty feedback about the change process.

We encountered the greatest resistance to change in Phase III of the planning process. This was the phase in which the faculty determined the specific content of the curriculum and assigned blocks of time. Curricular areas, which previously had been "owned" by departments, were combined into multidisciplinary topics and curriculum management became more centralized. These changes, along with the decrease in lectures and the increase in small-group teaching in the curriculum, were the basis for much of the resistance noted above.

At the first meeting of the Phase III Committee, a faculty member questioned the need to continue the curriculum renewal process. As associate dean for medical education, I reminded committee members that the phase was intended to delineate the specific content of the new curriculum and that the dean had already made the decision to proceed. Several members of one subcommittee also produced a minority report calling for retention of departmental control over the content and methods of teaching. Again, the dean's support for continuation of the renewal process and the work of the Phase III committees was critical. On more than one occasion, the dean publicly stated that the question was not *if* the curriculum was going to change, but *how*. Prior to release of the final report, we held a series of faculty forums to allow for additional faculty feedback on the curriculum plan. The leadership of the dean and senior leadership of the school in these forums was important in reminding those present that the curriculum was a work in progress and would continue to evolve.

One of the most important decisions that we made during the renewal process was to leave the basic curriculum management structure intact. The Committee on Undergraduate Medical Education (CUME) has responsibility for educational policy development and curriculum oversight at Wake Forest University School of Medicine. The committee meets bimonthly and is chaired by the associate dean for medical education, with an appointed member from each medical school department and two voting student members from each class. Department chairs receive notification of CUME meetings and the meeting agendas and are welcome to attend the meetings, although they cannot vote. The committee has broad latitude in curricular decision-making, with the exception of matters that affect the accreditation or financial status of the school. Each phase of the curriculum has an oversight committee composed of the course or clerkship directors within that phase. These subcommittees of CUME oversee the details of their portion of the curriculum, including curriculum planning. Another subcommittee, the Evaluation Committee, reviews all plans for student evaluation and recommends approval of these plans to CUME.

During the curriculum renewal process, the curriculum planning committees provided reports to the Faculty Executive Council for its feedback. The actual approval of the structure and content of the Prescription for Excellence Curriculum occurred at the level of the CUME. We considered the continued representation of specific departments on the CUME essential to getting departmental feedback on the curriculum. We increased centralization of the course and clerkship management structure with the support of staff in the Office of Medical Education. The biggest organizational change that occurred was directly related to the introduction of computers into the curriculum. The dean established the Office of Academic Computing and appointed an associate dean for academic computing and information technology. The creation of this office was crucial in providing support for faculty, with respect to computerization of lecture and lab materials.

Impact of Curriculum Change

The Prescription for Excellence Curriculum is being implemented across a four-year period. The first students to complete the new curriculum will graduate in 2002. There have been some important outcomes since the new curriculum began in 1998. The curriculum drew national attention at an early stage when the basic curriculum model was cited by Michael Whitcomb of the AAMC at the March 1998 joint meeting of pediatrics chairs and clerkship directors as being a "model for innovation." Subsequently, the school has received invitations to present the new curriculum at medical schools in Norway and China. The alumni board received a presentation on the curriculum at one of their semiannual meetings, which generated significant alumni enthusiasm for the new curriculum. The dean presented the process of curriculum change at WFUSM and an overview of its new curriculum at one of the major plenary sessions at the 1998 AAMC annual meeting.

The administration of the university has also responded favorably to the introduction of the new curriculum and the incorporation of information technology within the curriculum. The university president held a university administrative cabinet meeting at the medical school to allow top administrative officials to hear about the new curriculum. Medical students in the new curriculum have responded favorably to the curriculum change. Students have reported that, following conversations with peers at other schools, they recognize the benefits of the new curriculum in which they are enrolled. Faculty leaders have been supportive of the new curriculum and department chairs are working with the administration to establish a system for assignment of faculty teaching by department.

Plans for the Future

We introduced Phases III and IV of the new curriculum in April 2000 and are implementing a limited trial of Phase V for the Class of 2001. Planning for the expanded Phase V, which will be implemented in March 2002, has commenced.

Information on course and clerkship content is being entered into the AAMC's CurrMIT (Curriculum Management and Information Tool) database. This information will be utilized for program review and as a vehicle for mapping of the new curriculum. We have developed a plan for program evaluation linked to the goals and objectives of the new curriculum. The various phase committees and the CUME will see program evaluation data to facilitate regular review of the curriculum. The student-run Curriculum Evaluation Committee is continuing its regular review of courses and clerkships using a computerized course/clerkship evaluation system. Review of the first year of Phase I and Phase II of the new curriculum has already resulted in changes in teaching format and course scheduling. For example, we discontinued the Basic Principles week at the beginning of Phase II B to allow more time for the Cardiovascular and Pulmonary topics and the topical material from this week was absorbed into Phase I B. A remaining challenge is to incorporate the identified themes within the new curriculum. These themes include nutrition, geriatrics, women's health, substance abuse, and information technology.

The Prescription for Excellence Curriculum represents an innovative approach to medical student education. We developed the curriculum in response to changes taking place within medicine and society as a whole and builds on the unique culture and strengths of the Wake Forest University School of Medicine. This report has highlighted the changes made within the curriculum as a direct response to societal needs and the faculty's desire to prepare students for the changing practice of medicine. Of particular note are the innovative use of information technology to enhance student learning and the focus on preparing students to be active lifelong learners. Also noteworthy is the enhancement of student learning related to population health, evidence-based medicine, and professionalism. The faculty has renewed its commitment to teaching medical students and to creating an optimal learning environment in both the preclinical and clinical years.

It is generally recognized at the school that the curriculum is a work in progress. The dean has repeatedly reinforced this concept during meetings with the faculty and chairs. The principles, goals, and objectives that we identified during the curricular planning process continue to serve as the foundation for the evaluation of the Prescription for Excellence Curriculum. We anticipate that this curriculum will continue to evolve in response to national, regional, and local trends and the commitment of the school to produce students who possess the requisite knowledge, skills, and attitudes that will allow them to meet the health care needs of the population in the 21st century.

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