

# Learning Medicine in the 21<sup>st</sup> Century

## The Education of Medical Students The General Professional Education of the Physician

*“The interests of the general public have been so generally lost sight of in this matter that the public has in large measure forgot that it has any interests to protect. And yet in no other way does education more closely touch the individual than in the quality of medical training which the institutions of the country provide.”*

*“If the medical education of our country is in the immediate future to go upon a plane of efficiency and of credit, those who represent the higher ideals of the medical profession must make a stand for that form of medical education which is calculated to advance the true interests of the whole people and to better the ideals of medicine itself.”*

Henry S. Pritchett  
President  
The Carnegie Foundation for the  
Advancement of Teaching  
The Flexner Report, 1910

## Introduction

In the early years of the 20<sup>th</sup> Century, there were no uniform standards governing either admission to medical school or the design and conduct of the educational programs that purported to prepare students for the practice of medicine. A number of the schools in existence at that time offered only an assortment of didactic courses, generally spread over a two-year period, and failed to provide any formal instruction in clinical medicine.

In 1910, The Carnegie Foundation for the Advancement of Teaching issued the Flexner Report – a landmark document that described the state of medical students' education in the United States and Canada. By focusing attention on the woefully inadequate education being provided by many schools, the report catalyzed the widespread adoption of medical education reforms that had been proposed by leaders within the medical profession for decades and which had already been adopted by some schools across the country. In the years that followed the dissemination of the report, almost all of the schools deemed to be providing a substandard education closed, so that by the mid-1920s most medical students were studying in schools modeled along the lines recommended by Flexner.

In his report, Flexner focused on three issues that he believed had to be addressed to ensure that students were adequately prepared for the practice of medicine. First, he argued that medical schools should provide a four-year course of study. He recommended that during the first two years students study “the laboratory branches” of modern medicine, and that during the last two they study clinical medicine primarily by being involved in the care of patients. Second, he argued that medical schools should establish entry requirements that would ensure that the students who enrolled in the schools were adequately prepared for the course of study. He recommended that two years of college level science courses should be considered essential preparation for the study of medicine. And third, he argued that medical schools should become embedded in universities to ensure that their educational programs would provide students an appreciation of the growing importance to medicine of both advances occurring in the natural sciences and the application of the scientific method to medical practice.

The legacy of the Flexner Report persists to some degree even today, almost 100 years after the report was issued. For example, in most schools the curriculum continues to be four years in duration, with the biological sciences emphasized during the first two years of study and clinical medicine during the last two. And the study of the natural sciences is still viewed as the most appropriate preparation for students interested in the study of medicine. Finally, as Flexner recommended, the study of medicine occurs largely in medical schools embedded in comprehensive universities.

However, over the course of the past few decades, many changes have occurred in the approaches being used to educate medical students. Both the organization and content of the curriculum and the methods used in presenting material to students have changed considerably. To a great extent, the changes reflect advances that have occurred in the biomedical sciences; an increasing awareness of the importance of the social and behavioral sciences, the humanities, and biomedical ethics to the practice of medicine;

advances in the diagnosis and treatment of disease; and changes in society's expectations of medicine.

But it is also important to recognize that some of the changes that have occurred reflect the impact that changes in the organization, financing, and delivery of medical care have had on medical schools. The impact of those changes should not be underestimated. In his remarkable accounting of the evolution of medical education during the 20<sup>th</sup> century, Ludmerer expressed his view that the changes occurring in the health care delivery system were having a detrimental affect on medical students' education. He suggested that the inpatient environments of major teaching hospitals had lost much of their value as learning environments for medical students, in part because of the kinds of patients being admitted to those hospitals and in part because the growing dependence of medical schools on patient care income generated by clinical faculty had led to a decrease in faculty commitment to teaching.

Like the Flexner Report, the origin of this document can be traced to work of the Carnegie Foundation for the Advancement of Teaching. Several years ago, the foundation embarked on a project - the Preparation for the Professions Program (PPP) – designed to gain insight into how students planning to enter one of several professional fields (law, engineering, the clergy, nursing, and medicine) are being educated to meet those professions' responsibilities to the society at large. Given the design of the project, the number of medical schools that could be visited to gain insight into how physicians were being educated was limited. It seemed to us, therefore, that there would be value in producing a comprehensive description of the current state of medical students' education in this country, thereby providing a context for interpreting the findings emanating from the PPP. The document was prepared by analyzing school specific information contained in data bases and reference materials maintained by the Association of American Medical Colleges (AAMC); by surveying and visiting schools to collect additional information about particular aspects of their educational programs; and by reviewing a series of major reports issued in recent years, which describe changes occurring in medical education.

In keeping with the approach employed by Flexner, the first three sections of this document describe the nature of the educational programs conducted by medical schools, how present day students prepare for the study of medicine and gain admission to medical school, and the varied nature of the medical schools that exist in this country. The fourth section discusses the major challenges now facing the medical education community, which must be met if medical schools are to begin to prepare their students to meet the healthcare needs of their patients and of the society at large once they enter practice.

## The Educational Program

The Flexner Report had a dominant impact on the education of medical students for over half a century. Beginning in the 1970s, however, some medical schools started to make substantive changes in the design and conduct of their educational programs, thus

departing from the educational model advocated by Flexner. For example, The Ohio State University College of Medicine introduced an independent study program that allowed select students to forego attendance at standard course lectures. The Duke University School of Medicine implemented a curriculum that required students to complete only one year of basic science course work prior to entering the clinical clerkships at the beginning of year two. And the Stanford University College of Medicine offered a curriculum that was entirely elective. The success of those innovations convinced members of the medical education community that it was no longer necessary to employ the long standing, traditional approach for educating medical students (the Flexnerian model) and encouraged them to make changes in the nature of the educational programs they were associated with. As a result, in the 1980s, a number of medical schools began to adopt new educational strategies for enhancing students' learning.

During the same period, a number of professional organizations and foundations convened blue ribbon panels that were charged to review the state of medical education in the country and to offer recommendations on how it might be improved. The panels were formed in part to respond to an important reality, namely that the very purpose of the educational program had changed over the previous few decades. As residency training became for all practical purposes a requirement for entering medical practice, medical schools were no longer responsible, as they had been for much of the 20<sup>th</sup> century, for preparing their graduates to directly enter the practice of medicine. The medical education community ultimately agreed that the medical school curriculum should be designed to provide students a general professional education. Unfortunately, what was meant by a general professional education was never adequately defined. Although the reports issued by the various panels did not produce immediate changes in how students were being educated to achieve the stated goal, they clearly set the stage for the adoption of major curricular changes in the 1990s.

### Organization of the Curriculum

The medical school curriculum continues to be viewed by many as a four-year course of study in which the first two years are devoted to pre-clinical education and the last two to clinical education. In reality, the curriculum offered by most schools no longer fits that description. The educational program has evolved in most schools such that distinct periods of pre-clinical and clinical education no longer exist. While it is true that the biological sciences and clinical disciplines continue to be emphasized in the first two and last two years of the curriculum respectively, the modern curriculum is more accurately described as one in which content drawn from many disciplines is horizontally and vertically integrated throughout the four years of the educational program. The integrated curriculum structure has evolved as a strategy for allowing students to gain an appreciation of the clinical relevance of the material presented throughout the course of study.

The reforms of the past few decades have been focused primarily on the design and conduct of the first two years of the curriculum. The majority of medical schools have replaced most of the traditional discipline-specific, departmentally-controlled basic science courses with courses that integrate relevant content drawn from multiple disciplines. The

courses are intended to provide students with a conceptual approach for thinking about how the sciences of medicine relate to clinical conditions. To enhance students' understanding of how the course content relates to clinical practice, the introductory course work usually includes small group learning exercises organized around clinical cases. This approach makes it possible to integrate into individual courses content drawn not only from the biological sciences, but also from the social and behavioral sciences, the medical humanities, and bioethics.

Some members of the academic community view these changes with concern. They argue that it is essential that medical students acquire a strong grounding in the sciences in order to apply that knowledge in the care of patients and to be able to use it in interpreting medical advances. In reality, however, there is substantial evidence that in making clinical decisions physicians use very little of the basic science content they were exposed to both in premedical courses and during medical school. Thus, at many schools, students are no longer required to learn detailed information that has no direct application in providing care to patients. Needless to say, however, the traditional view that the knowledge of the foundational sciences are critical to the practice of medicine and, thereby, to the education of doctors will continue to stimulate debate about the proper design and conduct of the medical education continuum.

In this context, it is worth noting that the traditional basic science departmental structure no longer exists in the majority of medical schools. Most schools have eliminated separate departments of anatomy, and many schools have combined two or more of the traditional, discipline-specific departments into a single department. A handful of schools now have only three basic science departments and several have only a single department (Florida State University). At Albany Medical College all of the basic science departments have been integrated into four interdisciplinary research institutes. And at the University of Texas, San Antonio, the basic science departments exist in a Graduate School of Basic Biomedical Sciences, which is distinct from the medical school. These changes reflect the decreasing role of basic science faculty in teaching traditional discipline-specific courses in the medical school curriculum and the changes that have occurred over the years in the nature of the biomedical sciences. In many institutions, the departments are being reorganized to focus the faculties efforts more clearly on interdisciplinary research.

The clinical preceptorships now offered by most medical schools in the first two years of the curriculum provide the best example of how the traditional distinction between the pre-clinical and clinical years of the curriculum no longer applies. In these preceptorship experiences, students are exposed to real patients during the first two years of study by having them spend as much as one-half day each week in the office of a practicing physician, generally a physician trained in family medicine, internal medicine, or pediatrics. The primary purpose of these preceptorship experiences is to allow students to gain some insight into the nature and challenges of clinical practice and to begin to develop some of the clinical skills that they will need throughout their professional careers. The experience gained during the preceptorship is complemented by formal courses that provide instruction on how to obtain a medical history from a patient and how to perform a physical examination. In addition, most schools now provide formal instruction in how to

communicate effectively with patients, their family members, and other health professionals involved in their care.

Although students begin their preceptorships as observers, they gradually take on additional responsibilities. At some point in time, they begin to see patients before the practitioner, and in those circumstances have the opportunity to take a history and perform a physical examination on their own. Students may also become involved in other office activities, such as patient education and triaging telephone calls. There is no question that the experiences allow students to begin to learn about the clinical manifestations and the approach to diagnosis and management of some clinical conditions. The exposure to real patients stimulates students to study the pathophysiology and pathology of the conditions they have encountered. Thus, these experiences clearly contribute to students' gaining a better appreciation of the clinical relevance of the material being presented in the formal course work during years one and two of their curriculum.

The teaching of clinical medicine in patient care environments is the most important of Flexner's contributions to how medical students are educated, and it continues to be the central element of the educational program leading to the M.D. degree. Medicine is, after all, an applied discipline in which practitioners must be capable of providing optimal care to real patients in real situations. Thus, medical schools must be judged by how well they prepare their students with the professional attributes and information management and clinical skills required to provide high quality medical care once they complete their training and enter practice. As will be discussed in Section 4 of this document, the redesign of the clinical education of medical students is the major challenge now facing the medical education community.

During most of the 20th Century, the approach for teaching clinical medicine was quite straightforward. Students were simply assigned for a predetermined amount of time to patient care teams composed of resident physicians and an attending physician. Since the teams were responsible for providing care to a number of hospitalized patients, the expectation was that students would begin to learn clinical medicine by observing the team at work, carrying out whatever tasks they were asked to conduct to assist in the care of the patients, and by receiving personal instruction from both the resident physicians and the attending physician. A great deal of the teaching was conducted at the bedside, where attending physicians could demonstrate how to take a medical history and perform a physical examination, and could focus students' attention on abnormal physical findings. By rotating from one clinical service to another, students were exposed to a wide spectrum of clinical conditions, at least those that resulted in patients being hospitalized. Since some patients were admitted for diagnostic work ups, students had opportunities to observe skilled clinicians as they made decisions about the diagnosis and management of the patients' conditions. This long standing approach to the organization of students' clinical education remains largely intact today despite the changes that have occurred in the delivery of care in inpatient settings.

In most schools, discipline-specific core clerkships are offered during the third year of the curriculum. However, in a growing number of schools, the required clerkships begin in the

spring of year two. In virtually all schools, students spend a predetermined amount of time (generally varying from four to twelve weeks each) assigned to clerkships in internal medicine, surgery, pediatrics, obstetrics/gynecology, psychiatry, and family medicine. In most schools, students now also spend time, generally in the fourth year, assigned to clerkships in emergency medicine and neurology, and to advanced clerkships, called sub-internships, in medicine and surgery. On these sub-internships students have more responsibility than they have on the third year clerkships. Most students spend the balance of the fourth year taking elective rotations in clinical disciplines of special interest to them and, in some cases, pursuing scholarly projects or participating in seminars focusing on various topics of interest.

In keeping with the goal of integrating relevant content throughout the curriculum in a time sensitive manner, schools are attempting to integrate throughout the third and fourth years of the curriculum content related to an ever increasing number of important contemporary issues in medicine - issues such as complementary and alternative medicine, end of life care, epidemiology and population health, nutrition, genomics, cultural competence, medical errors, and medical care quality - which are not discipline-specific, but which clearly relate to the practice of clinical medicine. Schools are also beginning to recognize the importance of integrating the social and behavioral sciences, humanities, and ethics throughout the students' clinical education experiences as well. Integrating all of these topics into the clinical curriculum has proven to be quite challenging, since for most of the third and fourth years students are assigned to discipline-specific core clerkships or are fulfilling required elective experiences.

Schools have used various strategies for integrating non discipline specific content across years three and four of the curriculum. Several schools have set aside days between clerkships, referred to as "inter-sessions," for structured learning sessions devoted to one or more of those topics. This approach is used to ensure that the students do not face a conflict between attending the learning sessions and attending to responsibilities related to one or another clerkship. Other schools have attempted to accomplish the same goals by removing the students from the clinical environment of a clerkship one half-day every week or every other week. Although the students are expected to attend the formal learning sessions, they are often hesitant to leave the clinical environment if they believe they may miss out on a valuable learning experience. Some schools have attempted to avoid this problem by assigning certain of the interdisciplinary topics to the clinical departments responsible for the clerkships with the expectation that the topics will be covered during conferences and didactic sessions conducted during the clerkships. It is fair to say that none of these strategies has been fully successful in achieving the goals established for them by the schools.

### Educational Strategies

In addition to the changes that have occurred in the structure of the curriculum, schools have also adopted a number of educational strategies designed to enhance students' learning. The various strategies that have been adopted serve a number of purposes. Perhaps most important, they allow students to be more actively involved in their own

learning throughout the course of study. In most schools the amount of time spent lecturing to students in the first two years of the curriculum has been markedly decreased, thus allowing time for students to work together in small groups or to engage in various independent learning exercises. Schools have also adopted approaches that allow students to enhance their knowledge and understanding of medicine, and to improve their clinical skills, without interacting with real patients. And they have also begun to assign students to a variety of different clinical settings so that they encounter patients with the kind of common clinical conditions that are seldom seen today in the inpatient settings of major teaching hospitals.

### Case Based Learning

Most schools now employ case based learning exercises during the course work presented during the first two years of the curriculum. The exercises require students to seek from various clinical or basic science disciplines information that relates to a set of case-specific learning objectives. In the course of pursuing the case objectives, students are exposed to facts and concepts that relate primarily to how the sciences of medicine inform clinical practice. But they also begin to learn about the manifestations of disease and to engage in the clinical reasoning process that is fundamental to the diagnosis and management of disease.

The most widely touted, and best studied, method of case-based, self-directed learning is the problem based learning (PBL) approach. The development of PBL was based to a large degree on the belief that students who are required to seek, either on their own or in collaboration with a small number of classmates, information that can be used to provide insight into specific clinical problems are more likely to retain that information than if it is presented using a traditional lecture format. It was also believed that PBL would allow students to develop problem-solving skills that would make them more effective learners as they progressed through their formal education and beyond. The purpose of PBL was not for students to correctly diagnose the cases presented, but rather for them to acquire information that could explain the patient's clinical manifestations, allow them to understand the pathophysiology leading to those manifestations, and recognize the pathology that might be responsible for the altered physiology. Thus, the exercises require students to seek information from both the sciences that provide the foundation for medicine and various clinical disciplines.

Medical schools that employ PBL do so in a number of different ways. In a small number of schools, most of the pre-clinical curriculum consists of a series of PBL exercises (e.g. The University of Missouri-Columbia and Southern Illinois University). In those schools, the cases have been carefully designed to ensure that students fulfill all of the objectives of traditional basic science courses, while at the same time gaining an understanding of the relevance of basic science content to clinical medicine. When this approach was initially introduced in schools, it was not uncommon for the PBL curriculum to be offered as a track for a small group of students. As it became clear over time that students in the PBL track performed satisfactorily, schools tended to convert the PBL track into the curriculum format for all students. However, PBL has not been adopted by most schools as the main

strategy for promoting students' learning. Instead, PBL exercises are employed in conjunction with traditional, lecture and laboratory based courses as a strategy for allowing students to gain an understanding of the clinical relevance of the course content, while at the same time developing problem solving skills and other learning skills that will be of value throughout their careers.

### Technology Applications

The application of information technology (e.g., computers, networks and the Web) has become a major strategy for integrating content drawn from multiple disciplines throughout the curriculum. A growing number of medical schools are now providing online Web based materials to support curricular objectives. Information technology applications (either developed on site or acquired commercially) provide increasingly sophisticated tools for presenting basic science material (e.g., virtual microscopy that eliminates the use of microscopes and slide collections; and computerized, three dimensional depictions of human anatomy, which enhance students' learning of gross anatomy), as well as for conducting the case based learning exercises now included in the preclinical curriculum. The use of information technology clearly presents an opportunity to foster the use of "distance learning" for a geographically distributed student body. In addition, because the materials are online and accessible at any time, students rotating through clinical clerkships can review material presented in the first two years of the curriculum when they encounter patients with relevant conditions. In addition, the ability to rapidly access pools of disease-specific information and to search the medical literature from many locations, including the clinic and hospital wards, has greatly facilitated the teaching of evidence-based medicine (EBM), a process that requires students to engage in an analytic, scientific based approach to clinical medicine by applying the findings of clinical research studies to the management of a patient with a specific clinical condition.

New technology has also led to the development of approaches for teaching certain aspects of clinical medicine. For example, models that can simulate clinical conditions, primarily mannequins, are being used increasingly for the purpose of enhancing the learning of clinical skills and problem solving. The first mannequins, largely mechanical in nature, were used to teach students, physicians, and the lay public cardiopulmonary resuscitation techniques and to train students and residents in the examination and evaluation of cardiovascular physical findings (heart sounds, murmurs, pulsations, etc.). Making use of evolving computer technology, and the example of flight simulators used to train airline pilots, sophisticated patient simulators that mimic a variety of complex clinical conditions have been developed over a relatively short period of time. Once again, these approaches facilitate the integration of material across the entire curriculum, because they can be utilized initially at any time during the course of the curriculum and repeated when needed.

At present, computerized simulators fall into two broad categories - those designed for learning clinical procedures and those designed to teach the diagnostic and management skills needed to care for patients with acute, unstable patho-physiological states (e.g., shock and acute heart failure). In the first case, the models enable trainees to practice procedures such as laparoscopy or endoscopy without risk or inconvenience to real

patients. These models for minimally invasive patient procedures usually have virtual reality capability.

The second category of patient simulators provides high fidelity, reproducible diagnostic and interventional experience in acute medical conditions. These simulators are most often used for graduate trainees in emergency medicine, anesthesiology or critical care medicine, but they are used increasingly for interactive student learning exercises focused on clinical physiology and pharmacology. Current simulated anesthesia and critical care patients are life-like models, programmed for a variety of clinical scenarios, that allow airway intubation, manifest transmitted voice, vascular pulses, heart murmurs, and reactive pupils, as well as producing blood pressure, respiratory rate, blood oxygen saturation and electrocardiogram data that can be observed on physiological monitoring equipment. Although very expensive to purchase and maintain, state of the art patient simulators appear to be cost-effective when real patient availability, inconvenience and risk, as well as faculty time, are considered.

The use of computer based virtual reality is another approach for simulating real life conditions. In the pre-clerkship curriculum, medical students' learning about spatially complex topics (e.g., human anatomy and molecular biology) can be facilitated by the use of dynamic, 3D virtual images. The greatest potential for virtual reality in medical education, although as yet largely unrealized, appears to reside in a number of clinical applications. These include virtual human organ system models for learning and practicing surgical procedures; simulations of difficult person-to-person interactions (e.g., psychiatric interviews or patient counseling activities); and virtual, multimedia simulations of patients. Patient procedure simulators usually are computer/ mannequin hybrids that supply the real life operator with accurate 3D images of anatomy and haptic sensation during the procedure. At present, virtual training in surgical and minimally invasive procedures that include an array of endoscopic applications is most frequently used in graduate medical education programs, whereas virtual patients – computer generated patient encounters - are being developed for use in the medical student clinical curriculum.

Virtual patients allow visual and voice interaction for interviewing and physical examination purposes, and they can display graphic data from imaging, laboratory and pathology studies pertinent to the case. Some medical schools are developing a roster of virtual patient cases to insure that all medical students on a clinical clerkship are exposed to important medical problems regardless of the availability of real patients. Another use of this technology is for interactive teaching about interdisciplinary topics such as clinical nutrition or genetic diagnosis and counseling. The most sophisticated virtual cases permit students to follow branched chain logic pathways as they collect data and use clinical reasoning to formulate and solve problems regarding patient diagnosis and management, while the computer can evaluate the accuracy and efficiency of the student's analysis. Although virtual reality technology has been available and used in other fields (e.g., military, business, and entertainment) for a number of years, its development and application for medical education has been slow and limited to a relatively few schools, because of the cost, in terms of money and time, to develop these sophisticated programs,

and the lack of familiarity with the required technology on the part of most medical faculties.

### Standardized Patients

Recognizing the difficulties of teaching clinical skills in patient care environments, schools are utilizing various approaches for supplementing or replacing encounters with real patients to ensure that students encounter patients with conditions appropriate for their stage of learning. The most frequently employed of these approaches is the use of standardized patients (SPs). SPs are persons trained by medical educators to simulate patient illnesses or health problems. The development of this valuable technique in medical education now spans four decades. Over the past decade the majority of U.S. schools have utilized standardized patients to teach and assess clinical skills in required components of their curriculum. SPs are commonly used for teaching non-cognitive skills, such as history taking, physical examination techniques, and physician-patient interactions. In addition to the practice of clinical skills for the diagnosis and management of medical and psychiatric diseases, SP encounters can be focused on evaluating health risks and learning behavioral modification skills for health promotion and disease prevention.

Appropriately trained SPs can assess students' non-cognitive skills using predetermined checklists for content and method, and they can also provide narrative comment on students' behavior and communication abilities during the clinical encounter. Since SPs can offer formative feedback to students during teaching exercises, they can substitute for faculty and resident physician educators in the labor-intensive process of working with individual students or small groups for the learning and evaluation of clinical skills. An important limitation of SPs is that abnormal physical findings (e.g., heart murmurs, enlarged organs, etc.) cannot be demonstrated, and students cannot learn to detect and evaluate these abnormalities, unless a real patient is trained to simulate a clinical circumstance.

Many studies have established the accuracy of SP case portrayal, consistency between SPs, and reproducibility of case portrayal over multiple student encounters. Thus, examination of students' clinical skills using SPs can be standardized and scored in an objective manner within institutions, and recent studies indicate that this also pertains to "high stakes" examinations of clinical skills conducted nationally. The demonstrated utility of SPs in medical education has led many schools to establish SP training programs and to establish large rosters of SPs who represent a wide range of clinical scenarios. Many schools have also developed "clinical learning centers" that feature video monitored and computer linked patient exam rooms where SPs and medical students interact for teaching and clinical skills evaluation. SPs can be employed at any point in the curriculum to enhance the teaching and assessment of clinical skills in a developmentally appropriate manner.

### Clinical Education Venues

In addition to the changes that have occurred in the organization of the third and fourth years of the curriculum, the clinical sites used to allow students to begin to learn clinical medicine have changed over time. In addition to the traditional practice of assigning students to inpatient-based patient care teams in the academic medical center, schools are increasingly using community-based sites to support the clinical education of their students. As a general rule, those sites have been located in the same city as the medical school, making it possible for students to commute back to the medical school when necessary and for the medical school faculty, particularly those responsible for the administration of clerkships, to maintain regular contact with the volunteer faculty teaching at those sites. However, some schools assign students to sites quite distant from the medical school for individual clerkships (e.g. the University of Washington, the University of Colorado, and the University of North Carolina). In addition to assigning students to the inpatient services of local community hospitals, schools have also assigned students to multi-specialty clinics or practitioners offices to provide more ambulatory-based experiences. In each case, the school has developed policies and procedures to ensure appropriate management of the educational experiences offered at those sites, but they face a continuing challenge to train community physicians as teachers and to maintain the quality of those experiences given that the sites are somewhat autonomous and function with few resources committed by the schools.

The establishment of regional clinical campuses is another strategy employed by schools to provide clinical education for some of their students. Regional clinical campuses are clinical education sites located some distance from the parent medical school where the school has partnered with a local community hospital that has agreed to provide the school's clinical curriculum for a cadre of its third and fourth year students. Depending upon the criteria that are used to define the educational program offered on site (usually the number of required clerkships that are offered), more than twenty traditional medical schools are presently providing educational experiences at regional campuses. Some schools have established more than one regional campus (e.g. West Virginia University). At present, both the number of schools sponsoring regional campuses and the number of sites is increasing. While the current interest in regional campuses is being driven by the pressure on medical schools to increase class size, the number of sites has increased significantly in the past decade or so, largely because schools have been searching for ways to provide more appropriate clinical experiences for their students.

At the majority of the regional campuses, a cadre of students moves to the site for all or most of the third and fourth years of their medical school experience. But at some sites, students will rotate in and out for different clerkship experiences. This occurs in some cases because the site does not offer all of the required clerkships. At other schools, a decision was made not to assign a cadre of students to the site, but to allow all students to experience the advantages of the regional campus during parts of some clerkships. For the most part, the students who are assigned to a regional campus for their third and fourth years of medical school are students who elected to be assigned to the site.

As a general rule, the organization of the educational program (the clinical curriculum) offered at the regional clinical campus site is identical to the program offered by the medical school at the academic medical center and its local affiliates. In many cases, the

regional clinical campuses are perceived both by students and by members of the medical school's administration to offer certain educational advantages to the students assigned to them. It is generally recognized that the kinds of patients encountered at those sites are more appropriate for students at their stage of learning than are the patients encountered at the main academic medical center. In addition, students uniformly believe that they receive more personal attention from the faculty at those sites than they do from faculty at the primary affiliate. This is almost certainly true. Since the regional clinical campus faculty are generally not involved in research and other academic pursuits to the same degree as are faculty at the primary site, they are able to devote more of their time to the clinical instruction of medical students. Students also believe they benefit from the fact that there are fewer students at the site competing for instructional time and fewer residents and fellows competing for procedures (such as spinal taps, obstetrical deliveries, etc). And finally, there appears to be no differences between the students assigned to regional clinical campuses and those who are not with regard to their performance on standardized examinations and other assessment methodologies.

### Maintaining Educational Quality

The medical profession and the medical education community employs two major approaches for ensuring that the educational quality of the undergraduate medical education programs offered by medical schools remains high. The programs themselves are subjected to evaluation by a national accrediting body – the Liaison Committee on Medical Education (LCME). The LCME, which was established in 1942 as a cooperative effort of the American Medical Association (AMA) and the Association of American Medical Colleges (AAMC), is certified by the U.S. Department of Education and conducts a rigorous review of existing programs at least every 8 years. The LCME also monitors closely the development of new schools and new educational tracks proposed by existing schools.

In addition to the LCME's review of the educational programs, there is in effect a national audit of the programs' quality based on assessment of the performances of medical school graduates on national licensing examinations. The United States Medical Licensing Examination (USMLE) is jointly sponsored by the National Board of Medical Examiners (NBME) and the Federation of State Medical Boards (FSMB). The scores achieved by students on the three major examinations that comprise the USMLE are available to schools, thus allowing them to monitor the performance of their students and to compare their performance to nationally derived data reflecting the performance of students in all other schools. The individual student results are used by residency program directors in making decisions about rank ordering applicants to their programs.

For many years the major methods used by individual medical schools for assessing students' clinical performance were written examinations and faculty ratings of clinical skills performed during bedside and clinic encounters with students. However, as one of the primary goals of assessment in medical education became the reliable measurement of student clinical performance, the highly subjective nature of faculty ratings, coupled with

considerable variability in the comprehensiveness of student skills assessment, led to dissatisfaction with this method as the sole approach to assessing observable clinical skills. The search for additional assessment tools led to the development of objective structured clinical examinations (OSCEs) some three decades ago. Now used in the great majority of medical schools, OSCEs have proven to be a valid and reliable method for assessing clinical skills.

During an OSCE, students rotate through a number of stations that consist of standardized or simulated patients. At each station, the student conducts a limited examination focused on a specific medical problem or organ system and then reports his/her findings and clinical conclusions. Students are graded by faculty experts, and sometimes by the standardized patient, using a predetermined, objective-marking scheme. Valid OSCEs are expensive to conduct, both in terms of resources needed and personnel time, but they offer the major benefits of consistent examination scenarios and uniform evaluation schemes. Current challenges include the need to set appropriate standards for OSCEs used to determine student advancement, and the development of effective programs for the remediation of students who do not meet these standards. The Education Commission for Foreign Medical Graduates (ECFMG) has successfully used an OSCE to assess the clinical skills of international medical graduates seeking certification to enter U.S. graduate medical education programs, and the USMLE has begun using OSCEs to examine the clinical skills of U.S. medical students as an additional step in the licensing examination sequence.

## Preparation for Medical Studies

As a general rule, individuals who wish to pursue a career in medicine must first complete an undergraduate course of study in a four-year college or university, during which time they must perform exceedingly well in the courses that medical schools have established as requirements for admission. Although the admission requirements vary from school to school, they generally include courses in mathematics, physics, chemistry, and the biological sciences - requirements quite consistent with the vision Flexner espoused almost 100 years ago. There is general agreement within the faculties of medical schools that in addition to completing the pre-medical courses required by their schools, applicants should demonstrate their knowledge of the natural sciences, their critical reasoning skills, and their written communication skills by taking the Medical College Admission Test (MCAT), a standardized examination that assesses applicants' performances in those areas. With few exceptions (three schools in 2005), medical schools require individuals applying through their regular admissions process to take the examination, and the results of the examination are weighted heavily in making admissions decisions.

It is important to note that a growing number of faculty believe that continued emphasis on preparation in the sciences in the admissions process is no longer appropriate. While they recognize that a strong preparation in the sciences has traditionally predicted success in medical school, they argue that this no longer pertains given the changes that have

occurred in the design and conduct of the pre-clinical curriculum. They also note that undergraduate science courses do not help medical students develop a conceptual framework for understanding how advances in the biological sciences will affect medical practice, nor help them prepare to learn clinical medicine. They argue that given the importance of the social sciences, behavioral sciences, humanities, and bioethics to modern medicine, schools should require that students obtain an adequate grounding in them during their undergraduate studies. Many believe that medical schools have retained the science requirements simply as a means of screening applicants for admission to medical school.

Because of the emphasis placed on the natural sciences by the medical schools' admissions processes, it is not surprising that approximately 70 percent of the applicants to medical school have traditionally majored in the biological sciences, physical sciences, or mathematics and statistics. About 15 percent majored in humanities or social sciences, and an additional 10 percent majored in a variety of other subjects. An additional 4 percent are graduates of other health sciences programs. Acceptance rates vary between 40-60 percent for students in each of those categories.

The majority of students entering medical school do so directly after completing an undergraduate course of study in a four-year degree granting institution. But there are alternate pathways. For example, some students are granted a provisional acceptance to medical school either at the time they enter college or early in their undergraduate experience by enrolling in a special undergraduate pathway that is directly associated with a medical school. As a general rule, the students accepted into those programs have excelled in high school. Almost a quarter of the medical schools offer the opportunity for high school graduates to enroll in one of these combined B.A.(or B.S.)/M.D. programs, and approximately 2 percent of the students entering medical school have gained admission by participating in one of these programs.

The programs vary in design, length, and the requirements that students must meet prior to beginning the medical curriculum. It generally takes eight years to complete the combined program, but there are programs that are six or seven years in duration, and one affiliated with an engineering college is nine years in duration. For example, the University of Missouri-Kansas City admits exceptional high school graduates into a combined undergraduate/M.D. program that allows students to complete medical school in six years. In contrast, the program offered by the University of Missouri-Columbia (UMC) requires students to enroll in the Honors College at UMC, and to complete the four year undergraduate program before matriculating into the medical school.

Although the programs are limited in most cases to students enrolling in an undergraduate college of the medical school's parent university, some medical schools offer provisional acceptance to students enrolled in undergraduate programs offered by other universities. For example, students who are admitted into the program conducted by the Northeastern Ohio Universities College of Medicine (NEOUCOM) can complete medical school in six or seven years. The students spend their first two or three years at one of three different universities in northeastern Ohio – the University of Akron, Kent State University, or

Youngstown State University – before transferring to the medical school in Rootstown, Ohio. The University of Cincinnati also offers a combined undergraduate/M.D. program that is available to students enrolled in several different undergraduate institutions. Students enrolled at the University of Cincinnati, Xavier University, Miami University, Dayton University, and John Carroll University may participate in the program. Unlike the NEOUCOM program, the students must complete the four year, undergraduate course of study prior to entering the medical school. The Albany College of Medicine offers joint degree programs to students enrolled in special programs conducted by three different universities. The program conducted in partnership with Rensselaer Polytechnic Institute is a seven year program that emphasizes preparation for careers as physician scientists. The program conducted in partnership with Siena College is an eight year program that has a special emphasis on humanities. And the program conducted with Union College is an eight year program that is designed to prepare graduates for medical leadership careers.

Finally, the Sophie Davis School of Biomedical Education of the City University of New York conducts a seven year combined program in conjunction with five New York medical schools and the Dartmouth School of Medicine in New Hampshire. The students spend their first five years at Sophie Davis completing the requirements for an undergraduate degree and the first two years of medical school before transferring to one of the partnering medical schools for the final two years of medical school.

In marked contrast to students who enroll in a provisional acceptance program, some individuals decide to go to medical school only after they have taken graduate studies in various fields or worked for a period of time. Virtually all of those individuals must complete the pre-medicine course requirements and take the MCAT before applying. Those individuals can complete the course requirements for admission in one of several ways. They may simply take individual courses at a local college or university but, in addition, there are almost one hundred institutions that offer special programs for college graduates who need to complete the pre-medicine course requirements so they may apply to medical school. These so called post-baccalaureate programs are organized in different ways. Some are formal graduate programs that lead to a Masters degree or a special graduate program certificate. Others are undergraduate programs that may or may not lead to a special certificate. At present, approximately 15 percent of the students entering medical school have participated in or completed one of the post-baccalaureate programs.

In the past few years, more than 35,000 individuals have applied for admission to medical school each year. Since students may follow multiple pathways for admission to medical school, it is not surprising that the age distribution of medical school applicants and those matriculating is quite wide. The majority of students accepted to medical school are between 21 and 28 years old at the time of matriculation, but in recent years students as young as 17 and as old as 53 have been accepted. It is noteworthy that the number of women applying and matriculating in medical schools has increased remarkably over the past few decades. At present, the number of female applicants exceeds the number of male applicants, and it is anticipated that a growing majority of those entering medical school in the years ahead will be women. It is disconcerting to note that for the most part the racial and ethnic diversity of those enrolling in medical school has not changed much over the

same period of time. Black and Hispanic students accounted for 7.8% and 7.1% respectively of medical school applicants in 2004, and 6.5% and 7% respectively of matriculants. On the other hand, the number of Asian students has increased substantially over the past two decades.

Individuals who wish to study medicine are faced with the challenge of financing the cost of their education. The tuition charged by medical schools generally falls between \$15,000 and \$40,000 per year, depending on whether the school is a private or public school, and if a public school, whether the student is a legal resident of the state or not. In some cases the tuition at private schools, and that charged to out of state residents by some public schools, exceeds \$40,000 per year. As a result, the great majority of medical students graduate with a sizeable amount of debt. The average indebtedness of students who graduate from public medical schools exceeds \$120,000, while the indebtedness of those graduating from private schools exceeds \$160,000. A growing number of graduates have debt in excess of \$200,000.

There is growing concern within the medical education community about the impact that the cost of a medical education is having on undergraduate students considering a career in medicine. There is some data to suggest the cost and duration of a medical education is influencing some potential applicants who are qualified for the study of medicine to seek alternate careers. Indeed, some evidence suggests that just the cost of applying to medical school is becoming a deterrent for some students, particularly minority students and students from families with limited financial resources. In a recent report issued by a Working Group of the AAMC Executive Council, the members of the group suggested that continued increases in the cost of attending medical school would make it difficult for students not coming from wealthy families to seek or accept admission to medical school in the future. In fact, it is already the case that almost 70 percent of new medical school matriculants come from families in the top quintile of family income.

The results of a recent analysis have shown that the most effective way to decrease the cost of a medical education, thereby alleviating the long term financial implications of the debt burden incurred by medical students, is to decrease the length of the curriculum by one year. In order to accomplish this, medical schools would have to redesign their programs so that the core content of the educational program, to include the clinical experiences that medical students must participate in, is provided in only three years. This approach would allow students who wish to graduate from medical school and enter residency training at the end of a three-year period of study to do so. There is a wealth of experience showing that this is possible. Most medical schools have for many years presented the core curriculum in only three years, but because they have required a variable number of elective experiences, they have not allowed students to graduate at that time. In this regard, it is worth noting that for more than thirty years, the Duke University School of Medicine has presented its required core curriculum of biomedical science courses and clerkships in only two years, followed by two years of elective experiences in clinical disciplines and scholarly research, and that at two Canadian schools (Calgary and McMaster), students graduate at the end of a three-year period of study.

## Medical Schools

There were over 150 schools in the country when Flexner issued his report. Largely as a result of the findings contained in the report, the number of medical schools decreased steadily over the next few decades, so that by the end of the 1930s only 75 schools remained. But beginning in the 1940s, new schools began to be established across the country. Ten new medical schools (10) were established during the 1940s and 1950s, primarily in states that did not have a school within its borders at the time. And in the 1960s and 1970s, a large number of schools (38) were established. Those schools were established primarily by states in response to federal government incentives to establish new schools. The federal programs that provided funds for the development of new schools were based on the widespread belief that the country needed to increase medical school enrollments because of an impending shortage of physicians.

Because of the complexity of establishing new schools modeled along the lines of the traditional institutions, most of the schools established in the 1960s and 1970s were established as community-based schools. That is, they were designed to utilize existing community hospitals and local practitioners to provide the clinical education of their students. As a general rule, they were established as components of universities located in relatively small communities, recruited few full time faculty, and enrolled a relatively small number of students.

During the same period, the Veterans Administration Medical Assistance and Health Training Act of 1972 authorized the Veteran Administration to partner in the development of five new medical schools. Under the provisions of the law, selected universities were allowed to establish schools on the grounds of existing Veterans Administration hospitals (Marshall University, East Tennessee University, University of South Carolina, Texas A&M University, and Wright State University). These schools share many of the characteristics of the community-based schools. In addition, in the mid-1970s the federal government also established a free standing medical school within the organizational framework of the Uniformed Services University of the Health Sciences on the campus of the Bethesda Naval Hospital in Bethesda, Maryland. And during the same period, the Mayo Clinic Foundation established a small medical school that conducts its education and research programs almost entirely within the confines of its clinical operations.

The perceived need to increase medical school enrollments not only led to the establishment of new schools in the 1960s and 1970s, it also prompted many traditional schools to increase their class size by expanding existing laboratory and class room facilities so as to accommodate more students on site. In addition, some developed innovative approaches for expanding their enrollments by creating multiple campuses within a state or region of the country. For example, the University of Washington School of Medicine (UWSOM) established a unique educational program that provided opportunities for residents of three northwest states that did not have medical schools to be admitted to the UWSOM. The students completed the first year of the medical school

curriculum in one of their own state universities. The program, named the WAMI Program to represent the states involved (Washington, Alaska, Montana, and Idaho), has recently been expanded to include the state of Wyoming. The Indiana University School of Medicine is another school that developed multiple sites for the pre-clinical education of its students. The main campus of the medical school is located in Indianapolis, but the first two years of the curriculum are taught at seven sites around the state.

The proliferation of new schools and expansion of enrollments by existing schools ceased in 1980 when the federal government discontinued providing funds for those purposes. Not only were no new schools established during most of the 1980s and 1990s, two schools actually closed. As a result, medical school enrollments remained relatively constant (at approximately 64,000) over the past quarter century. The first new allopathic medical school established in this country in more than two decades was established by Florida State University in 1999.

There are now 125 allopathic medical schools in the United States that provide educational programs leading to the M.D. degree. The medical school associated with Oral Roberts University closed in 1991 and the Medical College of Pennsylvania and the Hahnemann University College of Medicine merged in 1994. That school has recently become a component of Drexel University in Philadelphia. One hundred and twenty-two of the schools are located in the continental United States and three are located in Puerto Rico. Degree granting medical schools are located in the District of Columbia and every state of the union except Maine, Delaware, Alaska, Idaho, Montana, and Wyoming. Seventy-five of the schools are public institutions and 50 are private. It is worth noting that Florida International University, University of Central Florida, Texas Tech University, and Touro College have received approval from the higher education commissions in the states where they are located to open new allopathic medical schools, and it is almost certain that additional schools will be approved in the coming years.

Medical schools vary to a significant degree in the sizes of their student bodies. There are in excess of 64,000 students enrolled in the 125 medical schools. The average enrollment for the schools is approximately 500 students (125 per year). But the sizes of the entering classes vary from 42 to over 250. Because of concerns about a looming shortage of physicians in this country, schools have been encouraged to increase their enrollments by as much as 30 percent if possible. Some schools plan substantial increases, while others will be unable to increase because of resource limitations, primarily access to adequate sites to provide clinical education experiences. Schools that plan to increase enrollments are using various approaches for doing so. Some are developing or expanding regional campuses (University of Oregon), while others are developing special programs such as B.A./M.D. programs (University of New Mexico) or special curricular tracks (University of Miami).

Although the focus of this report is on U.S. allopathic medical schools, it is important to recognize that there are other pathways for studying medicine, which each year produce a large number of the medical school graduates who enter graduate medical education programs and may ultimately be licensed to practice medicine in this country. There are

now over twenty schools of osteopathic medicine located in the country, and the number is likely to increase. The educational programs provided by these schools are in many ways identical to those conducted by allopathic schools. One major difference is the inclusion of course work and clinical experiences related to the principles of osteopathic spinal manipulation. It is also the case that these schools depend to a much greater degree than do allopathic schools on community-based sites for their clinical clerkship experiences. The majority of the graduates of osteopathic schools choose to pursue specialty training in allopathic residency programs.

In addition, a large number of graduates from foreign medical schools enter residency training in the United States each year. While the majority of those graduates are citizens of other countries and have attended a medical school in their own country, a substantial and increasing number are U.S. citizens who attended medical schools in other countries. The great majority of U. S. foreign medical graduates have attended a medical school located in the Caribbean basin. Most of the graduates of those schools have actually participated in clinical clerkships based in U.S. hospitals that are affiliated with U.S. medical schools and that sponsor approved residency programs in a variety of specialties. Less is known about the medical education received by these students than is known about the education received by graduates of U.S. or Canadian medical schools.

#### Organizational Arrangements

The majority of U.S. medical schools are embedded in one way or another in the organizational structure of comprehensive universities. For the most part, the schools serve as the centerpieces of university-based health sciences centers – administrative units that include one or more of the other health professions schools, such as nursing, dentistry, public health, pharmacy, and allied health. Many of the health sciences centers are located on the main campus of the sponsoring university (e.g. The Ohio State University, the University of Michigan, and the University of Washington), but some are located off campus, either within the same city where the campus resides (e.g. Boston University and Johns Hopkins University) or in a different city (e.g. Cornell University and Northwestern University).

In addition, a number of medical schools are embedded in free standing health sciences centers – that is, health sciences centers that are administratively distinct from a comprehensive university. In many cases, these centers are part of a state wide university system (e.g. University of Texas, University of California, and the University of Tennessee). But in some cases, they are structured as separate health sciences universities (e.g. University of Medicine and Dentistry of New Jersey, Oregon Health and Sciences University, and the Medical University of South Carolina). The federal health sciences center – Uniformed Services University of the Health Sciences – falls into this category

There are also a few medical schools that are, in a sense, free standing – that is, they are not embedded in comprehensive universities or independent health sciences centers (e.g. Albany Medical College, Medical College of Wisconsin, and the Baylor College of Medicine). The majority of the institutions are private. Although they are identified as

medical colleges, they offer degrees in other health professions, most commonly nursing, public health, and allied health sciences. One of those institutions, the Medical University of Ohio, which is located in Toledo, just merged with the University of Toledo to become part of a comprehensive university.

The great majority of medical schools exist as discreet and prominent academic units (colleges or schools) within the organizational framework of their parent universities. The University of Chicago Pritzker School of Medicine is an exception of sorts in that it is organized within the Biological Sciences Division of the university. Finally, there are several medical schools that have a very loose affiliation with their parent university. These schools generally evolved as hospital-based schools and remain embedded to some extent within large clinical delivery systems (e.g. Mayo Medical College, Mt. Sinai School of Medicine in New York City, and Rush-Presbyterian Medical School in Chicago).

Many health sciences centers also include a university owned and/or operated teaching hospital. Approximately 120 hospitals are considered to be part of an integrated academic medical center by virtue of serving as the primary clinical affiliate of one of the country's medical schools. Slightly more than one-third of those institutions are owned by the parent university of the affiliated medical school (e.g. University of Michigan, University of Iowa, University of Missouri), and 15 percent that were at one time university owned are now free standing (e.g. George Washington University, Georgetown University, and Tulane University). The remaining institutions – ones that have always been separately owned - have had strong traditional ties with their affiliated medical school for many decades (e.g. Columbia Presbyterian Hospital and the Massachusetts General Hospital).

More than 100 Veterans Administration Medical Centers also serve as important clinical affiliates for medical schools largely as a result of a system-wide affiliation agreement developed by the Veterans Administration in 1946. Many medical school faculty hold appointments in those hospitals and receive a portion of their salaries from the hospitals. In addition, the affiliation arrangements provide opportunities for faculty to conduct research in VA facilities and for students to gain clinical experience by being involved in the care of patients receiving care in those hospitals or associated clinics. In addition, a number of municipal hospitals (city or county owned) play important roles in supporting the education and research missions of a medical school.

### Programmatic Activities

There is substantial variation among schools in the size and scope of their programmatic activities. This is reflected in the sizes of their faculties. There are over 105,000 individuals who hold full time faculty appointments at one of the 125 schools, an average of almost 850 per school. However, the number of full time faculty members varies considerably from institution to institution. Despite the large number of individuals who hold full time faculty appointments, individuals with part time appointments, or who serve as volunteer faculty members, make major contributions to the educational programs conducted by many schools.

The marked differences in faculty size are largely due to differences in the size and scope of the research and clinical programs the schools have developed during the past four decades. The development of these programs can be traced primarily to government programs that began in the mid-1960s to substantially increase both the funding of biomedical research and the funding of patient care services provided to poor and elderly patients by the newly established Medicaid and Medicare programs. These government programs have had an enormous impact on the budgets of many schools.

At present, the total revenues reported by the 125 medical schools exceed 50 billion dollars. Of that, a little more than one-third are revenues from the provision of clinical services and just under one-fourth are revenues received from grants and contracts provided by government agencies, foundations, and other private philanthropies for conducting research. In contrast, sources of revenue that can be considered as providing direct support for the schools' education programs - state and local government appropriations and tuition and fees - account for only 10 percent of revenues. As a general rule, private schools generate a larger percentage of their revenues from clinical care and research programs than do public schools. In contrast, most public schools receive a significant percentage of their revenues from state and local appropriations that are generally not available to private schools.

Differences in the scope of the programmatic activities conducted by medical schools can be appreciated by examining the revenues reported by different institutions. For example, the top twenty-five research intense medical schools have total revenues that exceed on average one billion dollars annually, while the approximately twenty community-based schools have average revenues of about 100 million dollars annually. It is worth noting that in recent years, the research intense schools, and those schools wishing to increase the size of their research enterprise, have made some very fundamental changes in the organization and management of the faculty research efforts. Instead of allowing the research activity to continue to be managed solely through departments, they have created more centralized approaches for accomplishing that. This trend is reflected in part by the number of research centers and research institutes that have been established in medical schools in recent years. In addition, many schools have centralized to some degree the management of their institutional research programs in the deans' offices.

In virtually all of the schools, the single largest source of revenue is that derived from providing clinical care. The growth of the schools' clinical enterprises is reflected by the large and growing number of faculty holding full time appointments in clinical departments. The majority of the almost seventy thousand full time clinical faculty holding an M.D. degree spend a significant amount of their time providing care to patients in the hospitals that serve as the medical schools' primary clinical affiliates. It is important to recognize that the clinical revenue reported by medical schools does not represent discretionary income that can be used by the schools for any purpose. In most schools, the distribution of clinical revenue is governed by arrangements with their primary hospital affiliates, or by the provisions of the faculty practice plan, which is often organized as a separate corporate entity.

The management of the business aspects of the faculties' clinical practice activities varies a great deal. In some schools, the faculty function as a single multi-specialty practice group

with centralized billing and collections systems. In other schools, faculty act as individual practitioners, or as members of departmentally-based, specialty-specific group practices. Most of the income generated by the clinical practice is used to pay all or some of the base salaries of clinical faculty, or to provide bonus payments to faculty members heavily engaged in clinical practice. Some of the income covers the expenses incurred in conducting the clinical practice activities (billing, collections, office expenses, etc). A small percentage may be distributed to the dean's office and/or the department chair's office to help underwrite the costs of certain academic activities.

The educational program leading to the M.D. degree was described in Section II. It is important to recognize that most medical schools are responsible for educational programs other than the program leading to the M.D. degree. The majority conduct programs leading to advanced degrees in the biomedical sciences, public health, and allied health fields. And more than half of the schools are the institutional sponsors of graduate medical education programs (residency training programs) conducted by their clinical faculty in the schools' primary hospital affiliates.

One of the more interesting trends occurring in medical education is the growing number of joint degree programs offered by medical schools. These programs allow medical students to complete the course and research work required for the granting of an advanced degree in another field while they are completing the requirements required by the medical school for the granting of the M.D. degree. At some medical schools students can acquire an M.D./Ph.D., an M.D./M.P.H., an M.D./J.D., an M.D./M.B.A., an M.D./M.H.A., or some other advanced degree combinations. While a significant percentage of those who acquire an M.D. and Ph.D. are known to pursue a research career, the various career paths pursued by those who acquire other degrees is not clear.

The largest number of programs are those that allow students to receive both the M.D. and a Ph.D. In most cases, the Ph.D. is in one of the biomedical sciences, but it may be in other disciplines as well. Forty-one medical schools conduct M.D./Ph.D. programs funded by the federal National Institutes of Health (Medical Scientist Training Programs). These grants currently support over 900 trainee positions. Most of the medical schools not funded by a federal MSTP grant offer their students an M.D./Ph.D. program supported by institutional funds. As a general rule, students enter the Ph.D. program after completing the first two years of the medical school curriculum. It generally takes students three years to complete the Ph.D. requirements, at which time they embark on the last two years of the curriculum and then receive two separate degrees at the time of graduation from medical school.

In most cases, the Ph.D. is granted by the same university granting the M.D. degree. But several medical schools have established partnerships with other universities that are able to grant degrees in key disciplines not available at the school's parent university. For example, the Robert Wood Johnson School of Medicine (UMDNJ) has partnered with Princeton University, so that their medical students can study in Princeton's Department of Molecular Biology. The Baylor College of Medicine has partnered with both Rice University and the University of Houston, and Weill Cornell has a partnership arrangement with the Rockefeller University and the Sloan-Kettering Laboratories. Two medical

schools that conduct part of the pre-clerkship curriculum at multiple university sites across the state have identified one of the campuses as a preferential site for students interested in careers as physician scientists, even though the M.D.-Ph.D. program is offered at other sites as well. The University of Illinois conducts its program that emphasizes the physician-scientist path at the university's main campus in Urbana, while the University of Indiana's program is conducted at the university's main campus in Bloomington.

The second largest number of the joint degree programs are those leading to M.D.-M.P.H. degrees. There are now over 75 schools offering these programs. In the majority of schools, it takes students five years to complete the requirements for both degrees, but the required course work can be completed in four years at two schools (Northwestern University and Tufts University). As with the M.D.-Ph.D. programs, students usually complete the required course work at a single university. However, some medical schools have partnered with schools of public health at a different university (e.g., Duke/University of North Carolina, Stanford/University of California, Berkeley, and medical schools in New York City/Columbia University).

## Contemporary Challenges

The greatest challenge facing the medical education community at present is to redesign the clinical education of medical students. The typical inpatient services of major teaching hospitals – the settings for much of the student clerkship experiences – are no longer optimal learning environments for medical students. Patients admitted to those services tend to have acute, episodic conditions, major complications of a chronic disease, or complex disorders that can only be managed in a tertiary or quaternary care center. Studies have shown that less than one-half of one percent of the individuals who seek medical care in a given month will be hospitalized in a major teaching hospital. Thus, most of the patients students encounter in those settings are far from typical of the patients they will encounter once they enter practice. In the second case, changes in the organization, delivery, and financing of medical care have accelerated the pace and increased the intensity of the care provided on most inpatient services. As a result, it has become increasingly difficult for residents and attending physicians to devote the time required to teach students fundamental clinical skills and to integrate them in meaningful ways into the patient care team.

The design and conduct of the clinical curriculum must ensure that students have the opportunity to acquire a deep understanding of what it means to be a member of the medical profession in the first half of the 21<sup>st</sup> century. To accomplish this objective medical schools must provide students with clinical experiences that will allow them to gain an understanding of certain realities of modern medicine: (1) providing high quality care to patients with chronic illness is the major challenge facing modern medicine; (2) human behavior is a key factor in the prevention and management of disease and culturally related forces are key determinants of human beliefs and behaviors; (3) socio-economic status is an important determinant of health and, independently, of access to health care;

(4) medical care is overwhelmingly delivered in community-based ambulatory settings, including emergency rooms; and (5) many health care services are increasingly being delivered by non-physicians and teams composed of physicians and other health professionals. It is clear that the traditional clinical clerkships, which continue to be conducted much as they have been for decades, do not provide the kind of experiences that will allow students to gain a deep appreciation of those issues. Thus, medical schools need to make some very fundamental changes in the organization of the clinical curriculum.

Clearly, there is value for students in being exposed to the kinds of patients admitted to major teaching hospitals. But the value of those experiences must be balanced by the fact that students currently do not gain sufficient experience with patients who have conditions most prevalent in the population – hypertension, diabetes, asthma, depression, and coronary artery disease. Students can not be expected to gain an appreciation of the challenges of caring for those patients if they are not provided ample opportunity to participate in the care of those patients in ambulatory care sites – the sites where the patients receive their care.

If students are to be provided with the kinds of experiences that will allow them to gain an appreciation of what it means to be a doctor in the 21<sup>st</sup> century, they must be assigned primarily to clinical venues in which they will encounter patients in the settings in which doctor-patient interactions usually occur. Accordingly, the clinical education of medical students should de-emphasize inpatient experiences in tertiary and quaternary hospitals and emphasize the following types of patient encounters: (1) patients seeking care for acute events and chronic illness in emergency departments and community health centers; (2) experiences in following patients discharged from the hospital to their homes, nursing homes, and hospice centers, so students gain an understanding of, and appreciation for, the challenges patients face when they return to their home and community; (3) ambulatory-based, longitudinal patient care experiences that emphasize the care of patients with chronic illness; and (4) longitudinal contact with a “medical practice” group of patients so that students can gain a meaningful understanding of the importance of the doctor-patient relationship that only comes from repetitive interactions with patients over time.

As clinical education experiences are reorganized and structured to focus on the issues noted above, medical schools need to reaffirm the fundamental role that apprenticeship plays in learning the skills and decision making process necessary to practice medicine. This means acknowledging that medical students and doctors in training learn how to practice medicine by observing skilled clinicians caring for patients and by participating in the care of patients under the supervision of skilled clinician teachers. Efforts should be directed to improving the key elements of the apprenticeship experience in all clinical education venues, i.e. academic center hospitals, community hospitals, outpatient clinics, and physician offices. It must be recognized that the degree of involvement in the care of patients, and the settings where that experience is gained, will vary for learners at different stages in their professional development. For example, the inpatient units of today’s academic medical center hospitals usually are not a desirable apprenticeship venue for third year medical students who should start to learn the data collecting and analytic skills

required of a competent practitioner in venues where faculty members can effectively mentor the student apprentice.

Needless to say, the role of the teaching faculty is of paramount importance if medical schools wish to improve the quality of the clinical education being provided students. Therefore, medical schools must place special emphasis on developing and supporting a cadre of clinical faculty who will commit to this effort. There can be little doubt that the emphasis placed on research and clinical care in the modern medical school has had a negative affect on the education mission in some schools. Twenty-five years ago, medical schools and their clinical departments were still operating within the framework of the traditional academic model that assumed that virtually all members of the full-time faculty would be involved in patient care, teaching, and research activities. For practical purposes, this model is no longer relevant. The increasingly complex nature of biomedical research and clinical care in academic settings has made it necessary for members of the faculty to focus their time and effort if they hope to have a productive academic career.

While all members of the faculty are expected to teach when they encounter students in the course of their daily duties, the tremendous growth in the size of faculties means that the contact that individual members of the faculty have with students is only sporadic. Furthermore, because most of the members of the faculty are devoting almost all of their time and effort either to research or patient care, they are generally unwilling to assume the responsibility for educational program activities, such as serving as course directors or members of the education policy committee (curriculum committee) or to engage in activities aimed at improving the quality of the educational program by developing new approaches for educating students.

Medical schools initially attempted to resolve these conflicts by creating special faculty tracks for individuals who would serve as clinician/teachers or clinician/educators. The rationale for these tracks was based on the assumption that individuals providing clinical care on a near full time basis would be capable of providing substantial amounts of clinical teaching in the course of meeting their clinical responsibilities, would be willing to serve as clinical course directors, or would be stimulated by their patient care activities to use their "protected" time to develop improved methods for teaching clinical medicine. While this approach has been somewhat successful, it has become apparent in recent years that a more focused approach is needed if medical schools are to achieve their medical education goals.

Medical schools must commit to the implementation of a system of mission-based management and budgeting that will allow faculty to be explicitly rewarded for their teaching efforts. As a general rule, medical schools have simply allocated internal funds (tuition, state allocations, and endowments) to departments without any consideration for how those funds might be used. There has been an assumption that the funds supported the departments' contributions to the education mission, but the funds tended not to be distributed in proportion to the relative contributions made by individual departments. Perhaps more important, there was no explicit sourcing of funds in support of the salaries of the members of a department's faculty who were primarily making those contributions

to education. Thus, the individuals involved generally believed that they were not being compensated for their efforts and contributions to their school's education mission. Needless to say, this has prompted many of them to question whether their efforts and contributions are really valued by the institution. Given the specialized roles that members of the faculty now play in pursuing their school's patient care, teaching, and research missions, medical schools must modify traditional budgeting practices to ensure that those committed to the education mission are appropriately rewarded for their efforts and contributions.

## Summary

It is clear that there have been substantial changes during the past century in the ways medical students are educated. The most dramatic changes have occurred during the past quarter century, as medical school deans and faculty have attempted to respond to changes occurring in the biomedical sciences, the practice of medicine, and societal expectations of medicine. The challenge the schools face, of course, is that they have not yet fully adapted their programs to the current realities of medical practice while the pace of change in the practice environment continues unchecked. Thus, medical schools must commit to continuously searching for, and implementing, better ways to prepare their students for the challenges they will face as their careers evolve.

One of the reasons why it has been difficult to make some of the desired fundamental changes in the ways students are being educated is that there continues to be little understanding within the medical education community about the very purpose of the educational program. The last major effort to reach a consensus on this issue occurred with the establishment of the Panel on the General Professional Education of the Physician and College Preparation for Medicine (GPEP Panel) by the AAMC in 1981. In establishing the panel, the association's leadership at the time hoped that the panel's work would lead not only to a consensus on the fundamental principles that should guide the general professional education of the physician (primarily undergraduate preparation and the medical school experience), but would also focus attention on the need to define more clearly the personal attributes that physicians should possess given their unique position of trust and responsibility in society. Many were disappointed that the panel's 1984 report failed to answer the key question: What is the purpose of the educational program? While the panel made clear that the purpose of the program was to contribute to the general professional education of the physician, it did not provide specific guidance on how the program should be designed and conducted to achieve that objective.

It is not surprising, therefore, that many continue to view the program's primary purpose as preparing graduates with factual information and a set of skills for the practice of medicine, or at the very least, as preparation for residency training. The result is that there is substantial resistance to the idea that the clinical education of medical students should be redesigned, with particular resistance to making changes in traditional clerkships. Nevertheless, deans and faculties must understand that their shared responsibility is first

and foremost to provide their students with a general professional education that will embed in them through experiential learning a clear understanding of what it means to be a physician. The purpose is clear: regardless of which clinical specialty the graduates chose to pursue, they should embark on that path with a clear understanding of the responsibilities that physicians have to the patients they care for, and with ingrained attitudes that will ensure to the degree possible that their professional behaviors will always be in the best interests of those they are caring for. To achieve this goal, medical schools must prioritize how they conduct their educational mission as they strive to meet the other extraordinary challenges they face.

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## Acknowledgements

We would like to thank M. Brownell Anderson, senior associate vice president at the AAMC, for her assistance in collecting information from medical schools, which we have used in preparing this document. Brownie's original survey of medical schools, published as a supplement to *Academic Medicine* in 2000, was a valuable resource. As well as the

additional information she collected for us by surveying the schools again in 2004. We would also like to thank staff at The Carnegie Foundation for the Advancement of Teaching - Lee Shulman, Bill Sullivan, and Anne Colby - for allowing us to participate in the PPP. Their invitation to us to prepare a background document for review at the beginning of the project, and our involvement in the early planning of the project, got us thinking about the need for a document that would provide a more comprehensive description of the state of medical students' education in the early years of the 21<sup>st</sup> century. We would also like to thank them, as well as David Irby and Molly Cooke, for their encouragement, support, and advice during the preparation of the document.