
Editorial

Medical Schools in the Year 2000 and Beyond*

To contemplate the destiny of medical schools in the year 2000 and beyond is an exceptionally challenging and provocative assignment. Yet, like any forecast with numerous unknowns, it is a perilous undertaking rife with opportunity to make a fool of oneself.

One of the principal goals of a medical school continues to be the maintenance and development of outstanding programs in health sciences in order to advance the knowledge in those disciplines judged to be important for the future. An equally important goal is to educate medical students in the most modern aspects of the science and practice of medicine. I anticipate that US medical schools will continue to embrace the fundamental tenet of the indivisibility and interdependence of research and education, each stimulating the other for mutual benefit and growth.

To achieve these goals, we will need to give the highest priority to recruiting and retaining the very best and most exciting young persons for all active medical specialty areas and also those areas that we wish to develop for continued evolution and growth. Nonetheless, growth has its inherent limitations that go beyond the mere constraints of space and funds. Bigger is not necessarily better, particularly if bigger means straining internal communications and diluting

the standards of excellence along the outer margins. Of course, the need to regulate growth by no means negates the fact that emphasis now and in the future must be on creating new space. To forestall the threat that pernicious lack of space will endlessly overshadow the future, schools that want to remain in the forefront beyond the year 2000 must learn how to manage growth and how to allocate resources for optimal institutional benefit, in both scientific and clinical activities. For example, all plans calling for initiation of new, or expansion of existing, major research projects must be critically reviewed to identify those that are highly resource-consuming but offer only marginal intellectual or educational returns. Such projects, unfortunately, often escape external peer review because funding is offered by commercial enterprises or is solicited from private sources. In the clinical areas, external and internal market forces will continue to shift the composition of our patient population in the direction of specialties or superspecialties. This trend may eventually cause a major clinical imbalance that is likely to encroach on some of our institutions' major academic goals. Such a result would undoubtedly raise difficult policy issues such as defining the optimal size of individual clinical units and developing ways in which their expansion beyond desirable limits may be curbed without interfering with their continued vitality.

Traditionally, an academic institution is governed by consensus, a process that is cumbersome and slow but has worked remarkably well. The faculty as a whole must become more actively engaged in this consensus-building process if these crucial issues that invariably will be confronted in the near future are to be resolved successfully. In pressing instances, administrative decisions must be made, even in the face of isolated faculty resistance.

Developments in the Basic Sciences.—Many basic science departments already are in

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the forefront in charting the directions of their future. In response to the powerful revolution in biology that was precipitated by the advent of recombinant DNA technology, the basic sciences increasingly are disregarding traditional department boundaries in favor of new interdisciplinary alliances and functional groupings whose versatility and flexibility allow them to focus on novel complex research subjects. Astonishingly, after decades of progress in divergent directions, cell and molecular biology, oncology, virology, genetics, immunology, and now structural and developmental biology seem to be reversing course and converging instead on the central theme of how individual cells achieve their differentiated functions. This trend has found its early expression in the formation of novel interdisciplinary and interdepartmental units such as the Program in Biological Sciences, or PIBS, at the University of California, San Francisco. PIBS chooses its own membership, sets its own standards of excellence, has its own financial support, manages its own integrated graduate program, and eventually will be assigned space by the dean's office. Most important, such units serve as a powerful unifying force that brings together groups of investigators of widely different backgrounds, all of whom speak the common language of modern biology. These units are playing a progressively prominent role in shaping a school's educational programs and setting standards of excellence. Functional interdepartmental programs such as PIBS provide the investigative flexibility and multidisciplinary basis that are necessitated by the rapid evolution and technical complexity of modern biology. At the same time, they preserve the stability of the traditional department structure. In fact, the Government-University-Industry Research Roundtable of the National Academy of Sciences recently issued an incisive publication entitled "Multidisciplinary Research and Education Programs in Universities: Making Them Work,"¹ which lists the essential principles for the future success of such programs.

Physician-Scientists.—As much as we are dazzled by the creativity of the basic scientists, one of their greatest potential influences un-

doubtedly lies in their interaction with physician-scientists who are conversant with both the new biology and clinical medicine. As Kilbourne² recently noted, basic scientists "...may have most of the answers. But the physician-scientist may have most of the questions." Many of these questions about the causes or nature of disease are now within reach of solutions because modern techniques of cell and molecular biology are also applicable to the study of entire organs, functional systems, or disease entities, such as cancer or the cardiovascular, endocrine, or nervous system. It is predictable—and perhaps already evident—that clinical investigation in the forthcoming years is destined to undergo a revolution no less profound than that which has occurred in the basic sciences. If the current and future leaders of our medical schools, and particularly the clinical chairpersons, are able and willing to catch this wave, they could make an epochal contribution to medical science. Undoubtedly, such a scientific thrust would bring significant benefits to patient-care activities, as it would foster an intellectual atmosphere that is conducive to the best and most advanced health-care delivery possible. Finally, it would make a substantial contribution to the education of future physician-scientists, whose nationwide ranks are dwindling—an ominous trend that strikes at the vital link that connects advances in the basic sciences to improvements in health care.

Developments in Clinical Areas.—For attainment of this exciting and enticing goal, research activities in clinical departments must undergo an evolutionary change similar to that taking place in the basic sciences. Traditional department boundaries will have to give way to more centralized interdisciplinary research units in which physician-scientists, regardless of their departmental affiliation, can join forces in using similar approaches to study human biology and sharing the most advanced research techniques and equipment available.

Although physician-investigators participating in such research units would retain membership in their parent clinical departments, they would also have the opportunity of being ap-

pointed to a basic science department. Recruiting would be a joint responsibility. Such a development would greatly expand the interface between basic and clinical research, a scientific and educational goal that lies at the heart of any outstanding medical school and was the guiding principle of the late Julius Comroe, one of the most influential leaders at the University of California, San Francisco. Such interaction would benefit from centrally located lounges or coffee rooms, common facilities that probably would contribute more toward the success of these interdisciplinary ventures than the most enthusiastic support by the dean's office!

In contemplation of the future of clinical departments, there is little need to stress that clinical specialization is here to stay and that it will most likely progress further, particularly in the technology-based invasive specialties. Even in the nonsurgical areas, specialization is advancing with such logical irreversibility that a modern department of medicine or pediatrics has begun to resemble a loose federation of semiautonomous specialty programs, rather than the integrated unit some of us older physicians may still envision. If professional fragmentation is allowed to continue, it may stifle institutional communication and eventually lead to intellectual isolation—a development that would run counter to the most basic of academic interests and goals.

Rather than swim against prevailing currents, it seems reasonable and promising to try to join what already has affinity. Therefore, I suggest that we consider vertical integration of related medical and surgical specialties (including their supporting services) to form new, discrete functional units. For example, the medical specialties hematology and nephrology have much less in common than do pediatric and adult gastroenterology, invasive radiology, gastrointestinal pathology, and abdominal and transplant surgery. Similarly, cardiology, hemodynamic physiology and electrophysiology, sonography, thoracic radiology, and cardiac surgery could form a functional unit that is likely to prove more meaningful as a basis for clinical activities than the traditional structures along department lines.

Accordingly, future wards and clinics could be organized along such functional principles and could thereby provide added continuity and depth of patient care and an expanded scope for the training of house staff. This suggestion does not imply that currently existing departments would be dissolved forthwith; on the contrary, they would continue to serve as indispensable administrative and organizational structures. If they are abolished, predictable conflicts would arise, both within the institution and externally with professional and legal entities. Nevertheless, a functional reorientation of patient services, such as I have outlined, would demonstrate the resolve to move deliberately in directions that are likely to serve as future models for tertiary health-care organization.

At this point, a question may be posed about where and how primary care fits into such a scheme. Primary care should and must play a crucial role in any comprehensive medical center, let alone in medical education, but having several quasiparallel primary-care services, most of which may not be self-supporting, seems unnecessary. I believe that much could be gained by merging departments of family and community medicine with the general pediatric and general medical services to establish a new, resources-rich unit of primary-care medicine. Such a reconstituted unit would serve not only as a comprehensive provider of primary health care but also as an effective intake mechanism for our tertiary-care specialties. Moreover, such a reinforced primary-care department could be assigned major responsibility for geriatrics, environmental medicine, clinical nutrition, and epidemiology, as well as those aspects of health care that lie at the interface of medicine and society. Brash as these proposals may seem, they are stepping stones to the future, and I anticipate that by the year 2000 economic and societal pressure (if not simple expediency) will have brought about many of these changes.

Medical School Education.—Finally, let me look at the future of medical school education. The faculty will continue to insist that medical school classes have the broadest possible diversity of ethnic, socioeconomic, and

educational background. I am also convinced that well-conceived and highly successful minority recruitment programs will flourish in the future, supported by faculty members who serve as important role models.

With regard to medical school curricula, I fail to see the need to initiate major or comprehensive revisions, at least for the foreseeable future. Such undertakings tend to generate more heat than light and to polarize the faculty. Instead, I prefer gradual, stepwise changes, provided progress is being made toward goals that have been defined, understood, and accepted.

In the coming years, the following educational issues will need particular attention:

1. The volume of information to which medical students are exposed should be reduced to a manageable and digestible level. Sufficient time should be available for individual study and for providing appropriate guidance for discerning what is important from that which is trivial.

2. Passive didactic teaching should be progressively replaced with active, participatory learning based on self-initiated study and problem solving.

3. The learning process should be individualized, and increased flexibility should be available, particularly for those students who enter medical school with advanced standing in the sciences or for those who exhibit a strong desire to immerse themselves in a serious research project. An important element of this issue is to foster informal contact between students and individual faculty members.

4. Students' interest in original research should be stimulated, as part of the formal curriculum, during summer vacation, in free time throughout the academic year, or by taking off an entire year for research.

5. An effective mechanism should be organized to plan, implement, monitor, and evaluate interdepartmental courses of instruction.

The medical school curriculum will gradually adapt itself to the revolutionary changes in biomedical science and the relentless specialization in clinical medicine. The basic sciences will reclaim much of the first 2 years of instruction, a process that I support if more emphasis is

given to demonstrating the power and relevance of modern science to the resolution of human disease.

Between the second and third year of medical school, the transition from the basic sciences to clinical medicine, which has always been an incomplete linkage, will require renewed attention. Two parallel courses of approximately 2 months each could be considered. One course would deal with the scientific basis of disease—that is, molecular pathology and pathophysiology—a responsibility primarily assigned to the physician-scientists and the department of pathology. The other would be a practical interdisciplinary course that provides extended experience in the basic clinical skills of history taking, physical examination, elementary laboratory procedures, and interpretation of the resultant data.

In the clinical clerkships, the advancing specialization and particularly the expansion and refinement of diagnostic and therapeutic technology will make it desirable to dissociate the teaching of medical students from that of the more advanced house staff. I anticipate for the third year an extended series of clinical core clerkships, focusing on primary-care medicine, general surgery, and psychiatry, all intended to familiarize students with the fundamental elements of clinical practice before exposing them to the marvels of specialized technology.

The fourth year would call for the students' selection of a series of more specialized clerkships, a process that would allow considerable flexibility of choice. I believe that by the end of this century, most of us will be comfortable with the idea of specialized education tracks, such as a primary-care track, or tracks that emphasize the surgical, medical, neurologic, or perinatal areas. Such a scheme would have the added benefit of reversing the current trend of treating the fourth year as if it were an appendix to the curriculum, rather than its fruition.

Summary.—This, then, is my vision of medical education in the next millennium: a deep and fruitful integration of basic science and clinical medicine; a gradual adaptation of the curriculum to reflect the realignment of scientific and

clinical specialties; and a value system mandating that growth and expansion be immutably linked to maximal intellectual and educational returns.

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