POLICY FORUM: MEDICINE

Physician-Scientists—Endangered and Essential

Leon E. Rosenberg

As the next millennium nears, the medical research enterprise of the United States seems poised to make ever greater contributions to humanity's health and well being—and, hence, to both the national and international interest. However, there is a defect in the structure of the country's medical research edifice, which must be repaired. This defect is the progressive, dangerous decline in the number of physician-scientists. The term "physician-scientist" represents the entire species of M.D.'s who devote all or a majority of their professional effort to seeking new knowledge about health and disease through research. This is meant to be an inclusive designation, covering basic, disease-oriented, patient-oriented, population-oriented, and prevention-oriented investigations.

This decline is not a new problem. Former National Institutes of Health (NIH) director James Wyngaarden first called attention to it 20 years ago in his paper entitled, "The clinical investigator as an endangered species" (*1*). In 1984 Gordon Gill wrote, "The end of the physician-scientist?" (*2*). Subsequently, the problem has been called to our attention repeatedly (*3*), but with an important shift of emphasis away from those doing the science and toward the kind of science being done, namely, patient-oriented investigation (*4*). Despite all this activity, the problem must be readdressed for a number of reasons. First, the entire species of physician-scientist is at risk—not only those doing patient-oriented research. Think of it as conservation biologists would: we've been so focused recently on the spotted owl (that is, physicians who do patient-oriented research) that we haven't noticed that all owls are at risk (that is, all physician-scientists). Second, endangering physician-scientists endangers everyone concerned with medical research. Third, the actions taken to date cannot solve the problem. Finally, this threat can be averted only by bold, concerted action on the part of all of the participants in the country's medical research enterprise.

The evidence of the problem comes largely from detailed analysis of trends in applications for NIH project grants and traineeships. Support from NIH is not, of course, the only way to establish or sustain a research career, but it is a bellwether because of NIH's size, national scope, and reputation. Throughout a nearly 30-year interval, the success rates for M.D.'s and Ph.D.'s have been virtually identical, but physician-scientists have become a progressively smaller minority of those seeking and obtaining NIH project support (Fig. 1).

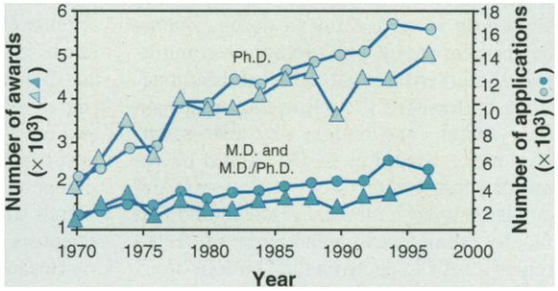

Fig. 1. NIH research project grant awards, 1970–1997.

Even more disturbing are recent trends in the populations of new investigators and trainees (Fig. 2). The actual number of first-time M.D. applicants for NIH research project grants has plummeted in the past few years: a 31% drop from 1994 to 1997. If this progression were to continue linearly, there would be no first-time M.D. applicants by 2003. Further, the drop in first-time M.D. applicants was not compensated by an increase in applications from M.D./Ph.D.'s.

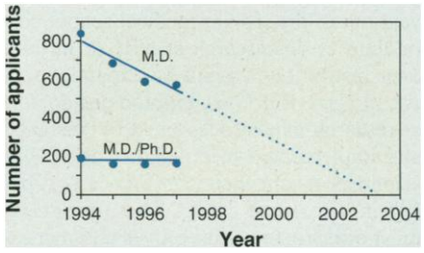

Fig. 2. First-time applicants for NIH research project grant awards, 1994–1997.

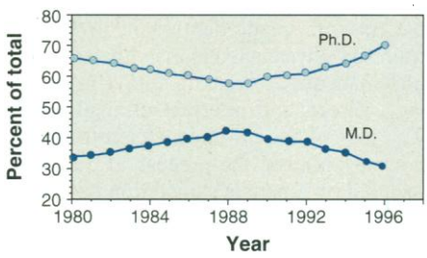

Fig. 3. NIH postdoctoral research training positions, 1980–1996. Numbers include individual fellowships and training grant slots.

These data indicate that progressively fewer young M.D.'s are interested in (or perhaps prepared for) careers as independent NIH-supported investigators. This conclusion is supported by examining data on trainees (Fig. 3). Since 1992, there has been a 51% decrease (from 2613 to 1261) in the total number of M.D. postdoctoral trainees supported by NIH through individual fellowships and training grants. If this trend is not changed, there will be no M.D.'s in this pool by 2006. Recent data from the Howard Hughes Medical Institute (HHMI) are just as discouraging. In the past 2 years, the number of M.D.'s applying for the prestigious HHMI postdoctoral fellowships has fallen from 174 in 1996 to 74 in 1998—a 57% drop (*5*). Finally, 14% of medical students graduating in 1989 expressed a strong interest in research as a career; that fraction fell each successive year, reaching 10% in 1996 (Fig. 4).

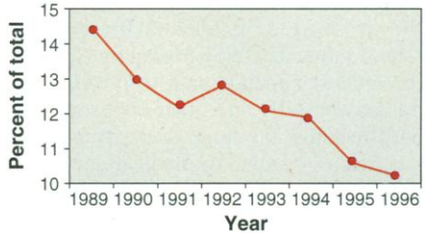

Fig. 4. Graduating medical students with strong research career intentions, 1989–1996.

Some might ask if, at a time when there are increasing numbers of well-trained Ph.D.'s, it matters if the physician-scientist species disappears. The answer is that in the absence of physician-scientists, the bridge between bench and bedside will weaken, perhaps even collapse. Who will ask why our ability to cure Hodgkin's disease is so much better than that for most other cancers if there are no scientifically trained oncologists who have had to discuss treatment options and prognosis with a teenage girl newly diagnosed with Hodgkin's disease? Who will ask how lithium prevents manic and depressive episodes if there are no research psychia-

The author is in the Department of Molecular Biology, Princeton University, Princeton, NJ 08544, USA. E-mail: lrosenberg@molbio.princeton.edu

CREDIT FOR FIGURES 1 AND 2: IMPAC; NIH; FIGURE 3: NIH; FIGURE 4: AAMC QUESTIONNAIRE

trists who have helped rescue a suicidal patient with manic depression? Who will train the physician-scientists that the biopharmaceutical industry employs to design, direct, and interpret clinical trials? The loss of the physician-scientist would not only impede the process of questions inspired by a patient's condition becoming a research topic, it would also impede the flow of disease-relevant information from Ph.D.'s to their clinical colleagues. Physician-scientists can communicate and collaborate with Ph.D. scientists on one side and with health care providers on the other as no other group can. They can make the strongest case for the clinical relevance of basic research to health agencies, advocates, and legislators.

The stated reasons for the decline in physician-scientists are many and varied.

- For 30 years medical educators, medical students, and physicians in training have been hearing from the general public that physicians should think more about primary care and less about specialization, devote more of their energies to the underserved and underrepresented, and care more about public interest and less about self-interest. These messages have not been balanced by other equally important ones: that improving health care requires more research, and that, because of their unique perspective, physicians must be key participants in medical research.
- There is a set of economic disincentives that have tended to push the youngest members of the medical profession away from research. These disincentives include the growing debt burden for medical school graduates, now averaging $80,000; the modest stipends paid to postdoctoral trainees by NIH and other sponsors; and, until recently, the large disparity between incomes of practicing medical specialists and those doing research. There has also been a progressive increase in the number of years of postdoctoral training required for physicians undertaking careers in research (often stretching to 10 or more) and a widely perceived decrease in the adequacy of research training programs, particularly in clinical departments
- NIH-supported research careers are seen as increasingly unstable. The success rate in achieving funding is falling, resulting in more time spent on grant applications and increasing competition from Ph.D. applicants. Poorly constituted study sections have been biased against patient-oriented research; furthermore, the "half-life" of funding for new and established investigators is short and there are few alternative sources of research funding.
- The explosive growth of managed care has imposed financial constraints on all academic health centers. To make up for this revenue shortfall, leaders of clinical departments have demanded that their faculties see more patients, which means less time available for research.

Because this problem affects all participants in our national enterprise, its solution, too, demands their involvement. No single agency can meet this challenge alone. I believe a collaborative national effort can be fashioned best by a legislative solution along the lines of a bill originally proposed by Senators Mark Hatfield and Ted Kennedy in 1996. Such a bill would mandate appointment of a broad-based national panel composed of leaders from NIH, academia, industry, foundations, and public life, and charge the panel to develop their initial recommendations in fewer than 12 months.

First and foremost, the panel should propose ways to reestablish a supportive environment in academia. Medical school admissions committees should recruit more students with demonstrable commitment to, and aptitude for, research. Medical students should be encouraged to seek intensive research experiences early and should be rewarded for so doing. Deans, department chairs, and promotion committees should ensure that their words and actions underscore the value they place on the research contributions physician-scientists make. Hospital CEOs should be reminded that tomorrow's medical care depends on today's medical research and that faculty doing research should be protected regardless of impacts on the "bottom line."

Second, it is necessary to create or expand attractive training programs for medical students, M.D./Ph.D. students, postdoctoral fellows, and junior faculty. NIH's role here is central, but HHMI and others must participate as well. The newly established K23 and K24 awards for young and mid-career faculty are a small step in the right direction. The Medical Scientist Training Program should be expanded and modified to permit sequential study toward the M.D. and Ph.D. degrees and to include students with interests in such fields as biostatistics, computer science, epidemiology, and population health. Programs enabling medical students to take a year out of the regular medical school curriculum to do research at NIH or in their own institutions should be expanded and encouraged. Rigorous, tailored postdoctoral research experiences must be designed and implemented in order that physician-scientists regain their confidence and belief in a research career. These programs must offer financial incentives commensurate with national need.

Third, the panel should establish a national network of clinical research units by linking the Clinical Center at NIH with the general clinical research centers and clinical trials programs in academia. Such a network would foster collaborative educational efforts, training programs, and research projects aimed at strengthening patient-oriented research. It would also heighten the visibility of clinical research.

Fourth, it will be necessary to increase participation of foundations, biopharmaceutical companies, health insurance firms, and the managed care industry. Foundations should expand the range of training opportunities and career awards. Insurance companies and the managed care industry should support population studies and outcomes research, as well as the young people being educated to carry out such studies. Biopharmaceutical companies are ideally positioned to provide mentors, training sites, research projects, and funds. As a recent example, the Pfizer Corporation has contributed $1.5 million to NIH to support medical students who spend a year at NIH doing research.

Fifth, I would urge such a panel to propose that a national database of physician-scientists be developed and maintained. This database should track the numbers of medical students and M.D. graduates entering research training; M.D.'s supported by NIH and other research sponsors; established investigators in academia, NIH, industry, and independent institutes; M.D.'s leaving research careers at all levels; and physician-scientists needed by the various sectors.

Because we have all waited too long, recovery will take many years and will be costly. We must act now to change the climate in which today's physician-scientists work because their words and actions will influence the choices their students make. We must act now to create a national environment conducive to creating a new generation of physician-scientists who have been trained rigorously and are confident in their ability to compete and succeed. Above all, these young investigators must be imbued with the belief that their efforts are essential.

References and Notes

1. J. Wyngaarden, *N. Engl. J. Med.* **301**, 1254 (1979).
2. G. Gill, *Am. Sch.* **53**, 353 (1984).
3. S. Their, *Clin. Res.* **28**, 248 (1980); J. L. Goldstein, *J. Clin. Invest.* **78**, 848 (1986); B. J. Culliton, *Nature Med.* **1**, 281 (1995); J. L. Goldstein and M. S. Brown, *J. Clin. Invest.* **99**, 2803 (1997); R. W. Schrier, *Acad. Med.* **72**, 589 (1997).
4. E. A. Ahrens, *The Crisis in Clinical Research* (Oxford Univ. Press, New York, 1992); *Careers in Clincal Research* (Institute of Medicine, Washington, DC, 1994); L. E. Shulman, *Acad. Med.* **71**, 398 (1996); J. Thompson and J. Moskowitz, *J. Am. Med. Assoc.* **278**, 244 (1997); G. H. Williams, D. W. Wara, P. Carbone, *ibid.*, p. 227; D. Nathan, *ibid.* **280**, 1427 (1998); A. N. Schechter, *ibid.*, p. 1440.
5. Personal communication from HHMI.