alded; and where successful physician-scientists are visible, prominent role models for future generations. These desired cultural shifts cannot occur as long as medical schools and academic health centers feel imperiled by a seemingly obligatory focus on the financial bottom line, or if institutional leaders feel that sustaining the physician-scientist career path is a luxury. The cultural renaissance we envision requires the active participation of deans, chairs and the many existing physician-scientists who were fortunate enough to have entered this most rewarding career path when it was easier to do so. In the final analysis, these individuals now bear the heaviest responsibility to ensure that the emerging opportunities for young physician-scientist careers are seized.

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The other physician-scientist problem: Where have all the young girls gone?

NANCY C. ANDREWS

There has been much discussion about the declining number of physician-scientists, and their potential impact on biomedical research and discovery. However, less attention has been paid to the fact that women are underrepresented in this area. Remarkably, as a woman physician-scientist, and director of the Harvard-MIT MD-PhD Program, I had never given it much thought. However, after talking with students and colleagues, I am convinced that women find physician-scientist careers much less attractive than do men. The initial 'pipeline' only carries a trickle, and it leaks. As Charles Vest, the President of MIT, wrote in his preface to the landmark 1999 report on women faculty[1], "I have always believed that contemporary gender discrimination within universities is part reality and part perception. True, but I now understand that reality is by far the greater part of the balance." The bottom line is that there are valid reasons for women opting out.

The problem

Among investigators of the Howard Hughes Medical Institute (HHMI), a leader in biomedical research in the United States, less than 2% are women with MD degrees. This is in marked contrast to the situation for men—24% of the investigators are men with MD degrees. It is not that HHMI excludes women—about 18% of HHMI investigators are women with PhD degrees. The situation is similar for the American Society for Clinical Investigation, an honor society for physician-scientists—only 12% of active members and less than 4% of senior/emeritus members are women. Of its 94 past presidents, only 1 was a woman.

Part of the explanation can be found in patterns of application to graduate educational programs. Taking Harvard Medical School as an example, it is encouraging to see that approximately 50% of the applicants to the MD program and 50% of the applicants to the PhD programs are women. This has been the case for some time, and matriculants generally reflect these proportions. In contrast, however, only 30–35% of the applicants to the Harvard-MIT MD-PhD program are women, and this fraction has not changed over the past 12 years. Of the 310 Harvard MD-PhD graduates since 1974, only 53 (17%) have been women, owing to both fewer female applicants and more attrition among female students. Proportions in other MD-PhD programs are not markedly different[2]. In other words, women are less likely to enter combined MD-PhD degree programs than they are to enter either MD or PhD degree programs.

Although MD-PhD programs are the most visible pathway for training physician-scientists, they are not the only route, as discussed by Varki and Rosenberg in this issue[3]. Documented numbers of women entering physician-scientist careers as 'late bloomers', that is, physicians who become focused on research after medical school, are not easy to obtain. However, there is no indication that more women are entering by this route—if anything, the proportion may be smaller.

The reasons

Women in their early 20s consistently cite 4 reasons why they are less likely to choose this career path. Firstly, they are concerned that it will be impossible to combine a successful career with childbearing and family life. There is no question that this was once true, as carefully detailed by Elga Wasserman in her interviews with women members of the National Academy of Sciences[4]. However, as she also points out, it is decidedly not true now and has not been true for several decades. Most women in science, including women physician-scientists, have husbands and children. But most physician-scientists do not finish their formal education until they are 30 years or older, and they must subsequently negotiate residency and fellowship before they have independent control over their hours. This makes it very difficult to find flexible periods for pregnancy and infant care. Most people still expect women to assume the major responsibilities of caring for children and running the household. These are heavy duties, and the unpredictability of academic careers makes them seem even more daunting.

Secondly, many women feel that they have to be better than their male counterparts to be considered equal. They worry that they will not be able to 'super-compete' at a more advanced level. They feel less comfortable promoting themselves and their work than their male counterparts seem to feel. This problem is exacerbated in physician-scientist training, which is relatively amorphous, has fewer defined milestones and requires more academic entrepreneurship among its trainees.

Thirdly, women receive very little encouragement to become physician-scientists. They hear the same message that men do—that it is hard to succeed as a physician and as a researcher—and are often told that it is even more difficult for women. This message comes from many directions—from family, undergraduate advisors, career counselors and even from individuals assigned to interview them for MD-PhD programs.

Fourthly, they feel that they lack compelling role models. They meet few, if any, women who are highly successful as physician-scientists. They empathize with the struggles faced by younger women faculty. They sense the quiet discontent felt by more senior women who, as documented in the 1999 MIT faculty report, face marginalization and chronic inequities in salary, lab space, recognition, resources and response to outside offers[1]. At all steps of the tenure ladder, women are uneasy with the culture of academic medicine, and have the perception that one must be highly aggressive to succeed.

This problem is not unique to the US. Concerned about the under-representation of women among its grant awardees, the Wellcome Trust commissioned a study to understand the issues[5]. They discovered that success rates were nearly identical for men and women, but that fewer women were applying. The reasons for the discrepancy were similar to those voiced in the US: women were more likely to have family responsibilities that altered their career trajectories, less likely to hold senior tenured positions and less likely to report adequate mentoring[5].

It is discouraging to see how deeply rooted these problems are and how little progress has been made over the past several decades in spite of good intentions. It is now obvious that good intentions are not enough. Very few believe that they are actively discriminating against women, yet the MIT reports (1999 and 2002) show that women from all parts of that institution suffer multiple disadvantages that compound over time. It is unlikely that any other elite research institution has a better track record—it is simply that MIT has been publicly introspective, and has attacked the problem head on.

The solutions

Women are not men, and should not be pressured to behave like men. As every parent who has children of both sexes knows, there are personality differences that are hard-wired. Women are more collaborative and less likely to compete at the expense of others. They are less likely to be aggressive for their own benefit, and more likely to be team players. These are unfavorable qualities for competing in the job market, and can lead to subtle professional handicaps. The present culture of academic medicine evolved at a time when there were very few women in the workforce, and it must now be brought up to date. We should value the traits that make women different, and appreciate the benefits that they offer to the scientific enterprise.

If we are going to make progress, it will be important to make fundamental changes not only at medical schools, but also at undergraduate colleges. In an article analyzing the reasons for poor success in diversifying academic faculties, Trower and Chait observed that student bodies are now very diverse, but "Who teaches matters…the most accurate predictor of subsequent success for female undergraduates is the percentage of women among faculty members at their college."[6]

There can be little doubt that having more women role models will encourage more women students to become physician-scientists. Past efforts to recruit women faculty have been inadequate. Although most search committees at major institutions are instructed to make a special effort to identify female job candidates, they do not always take that mandate seriously. The first time that I was asked to be a member of a faculty search committee, I received a copy of a letter to the department chair listing the names of the committee members. It had "(woman)" marked next to my unambiguously feminine name. I was surprised to learn that this is the routine, and just as surprised to find that I was never once invited to a meeting of that committee.

If the culture is to change, women must not only be recruited for senior faculty jobs, but also for key leadership positions in the administrations of medical research institutions. To do that, a bold, deliberate and sustained effort must be made at the highest levels. Women students and junior faculty need to see that their female role models are as important and as respected as their male colleagues. They need to feel that women mentors not only share their feelings, but also have the clout to make a difference in their careers.

Despite advances in fertility research, at present we cannot change the biological clock that forces women to bear children during crucial, decisive years in their developing careers. However, we can work towards creative solutions to aid in work/family balance. Some institutions have established small grants and perturbations of the tenure track to try to help women coordinate career and family responsibilities. For example, Harvard Medical School and its affiliated hospitals offer almost 40 individual, two-year fellowships of $25,000 per year on a competitive basis to junior faculty who document need in this area. However, with a junior faculty numbering in the thousands, this welcome attempt does relatively little to ease the problem.

It is important to view this issue broadly. Selectively helping young women will only serve to reinforce traditional roles if it provides no incentive or opportunity for young men to be more involved in parenting. It is not hard to find men who would like to take on an equal share of the responsibility for having and raising children. Many of the most successful women physician-scientists owe their success, at least in part, to enlightened partners who have made their own unrecognized and unrewarded career sacrifices to help the women succeed. But there are few grants or tenure track adjustments for these men. Promotions committees should consider that male

faculty members may have assumed an equal or greater amount of the responsibility for caring for young children. Family/work balance must be accepted as an issue that affects young faculty of both sexes, or the traditional division of labor will be perpetuated and the de-valuation of women for time spent on family will continue.

Once again, MIT has taken an important lead and implemented aggressive initiatives for confronting the issue of work/family balance. They delay the tenure decision by one year for women who bear a child, provide one semester's paid release from teaching and service for any faculty member who is the primary caregiver for a new child, and offer half-time appointments to tenured faculty members who choose to be the primary caregiver for any family member[7]. Other institutions should consider similar moves. Obviously, these measures will not affect the lives of young women considering physician-scientist careers in the short term, but they will help to change the outlook over the long term, and make medical research careers more appealing and feasible.

The problems are difficult and there is no quick fix. But a statement in the Overview to the 2002 report on the Status of Women Faculty at MIT (ref. 7) serves as a powerful reminder of the resources that we can bring to bear on this problem:

"In a conversation with Provost Brown, in which one woman expressed her concerns about whether these complex problems were really fixable, the provost, an engineer by profession, seemed quite taken aback. "This is MIT," he replied. "We're engineers. Engineers solve problems."

We should adapt that attitude to the problem of bringing more women into physician-scientist careers. If we have the audacity to believe that we can find cures for cancer and understand the human genome, why should it be hard to believe that we can fix the culture of our profession?

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