Novel Prescriptions From Medical Schools for Physician–Scientist Training and Engagement in the Twenty-First Century

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Abstract

Physicians engaged in biomedical research are well positioned to directly focus the discovery process on human biology. However, the relative proportion of investigators engaged in both caring for patients and conducting research is decreasing. To address the dwindling numbers of physician–scientists nationally, the Burroughs Wellcome Fund created the Physician-Scientist Institutional Awards Program by dedicating 25 million dollars to new initiatives at 10 degree granting, accredited medical schools in North America, awarded on the basis of institutions' proposals. The perceived barriers to physician–scientist training, program initiatives, and commitment to training a diverse group of future researchers were articulated in each application. In all, the Burroughs Wellcome Fund review committee considered 136 distinct proposals from 83 medical schools, representing 54% of all accredited medical schools in North America. Barriers identified by more than one-third of the applicant institutions included the absence of both mentors and role models, student indebtedness, institutional cultures that valued clinical care delivery above the discovery process, limited prior relevant research experience, and structural barriers that limited scheduling flexibility during training. Awards were granted to institutions with programs designed to be sustainable and overcome critical, prospectively identified barriers to training and retention of physician–scientists. Potential solutions from the 10 funded programs were focused on different stages of the training experience. Though a determination about the relative success of each of the initiatives will take many years, careful consideration of the barriers identified and more general application of specific program component may be beneficial in increasing the numbers of physicians actively involved in biomedical research.

Physicians are an important part of the biomedical research community. However, the percentage of physician–scientists in the biomedical workforce has been declining for decades. In 1979, James Wyngaarden,[1] director of the National Institutes of Health (NIH) at the time, called the physician–scientist an endangered species and asked for additional programs and support to enable medical degree physicians to pursue research careers. A number of subsequent publications have drawn attention to the smaller proportion of physician–scientists relative to PhD scientists in the biomedical workforce and have provided suggestions for how to correct this perceived shortfall, as well as describing its causes.[2–7] Although physicians are well positioned to conduct laboratory and patient-based experiments, and also to analyze and interpret data derived from large-scale data sets generated by hospitals, medical records, and genomic studies, most have little or no exposure or training in methods to analyze data effectively. In the basic science, biotechnology, and clinical trial communities, there is wide appreciation that the perspectives of physicians, experts in human biology, add meaningful value to the discovery process. Specifically, physician–scientists provide a perspective that is informed by clinical experience and, often, well suited to motivate patient-centered, solution-oriented inquiry. Yet, barriers persist and the number of physician–scientist investigators continues to decline.[8]

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Promoting Solutions

In recognition of both the opportunities and challenges for physicians pursuing a research career, the Burroughs Wellcome Fund (BWF) in 2017–2018 established and dedicated 25 million dollars to its Physician-Scientist Institutional Awards Program, a program to fund medical schools to implement programs encouraging and supporting physicians to become active biomedical researchers. To publicize the opportunity, the BWF issued an open call for applications that included press releases, letters to all accredited medical schools in North America, and advertisements in medical and scientific journals. By supporting new programs designed to increase the number of physicians equipped to pursue research, the BWF sought to augment the pool of approximately 600 MD–PhD students trained annually. Specifically, the BWF program was designed to tap the pool of individuals completing medical school with a medical degree (approximately 21,500 new medical students annually), but not a PhD degree, as a source of researchers.

To achieve this goal, the BWF called for novel and innovative proposals detailing the strategies and tactics that the recipient institutions would employ to support single-degree physicians

(non-PhDs) to launch and maintain careers as independent physician–scientists. Implicit in the approach was the recognition that proposals coming from individual institutions might be more likely than national-level initiatives to recognize important regional and intrainstitutional barriers to physician–scientist training and thereby articulate relatively underexplored strategies. The BWF's review committee evaluated each institution's support of the program, the commitment to diversity and inclusion, the scalability of the program to other institutions, and the plan for longitudinal evaluation of the program by the recipient institution. The review committee gave a higher priority to programs with a high level of innovation, a strong research component, and potential for sustainability. The applications were reviewed and scored without consideration of regional representation or the scientific focus of the proposal. Fifty-four percent of accredited medical schools in North America were responsive to the BWF's call for proposals with 136 distinct proposals from 83 medical schools submitted. The goal of this article is to provide empirical, summative data regarding perceived barriers to physician–scientist training, as well as the potential solutions put forth by the most competitive applicant institutions.

In the first year of the award, the application process included a preliminary and secondary evaluation. In the initial (2017–2018) award cycle of the Physician-Scientist Institutional Awards Program, there were 92 applications from 78 different institutions, comprising more than 50% of all accredited institutions in the United States. In the second award cycle (2019), the BWF reviewed 44 applications from 40 institutions, 5 of which were new to the award competition. In the course of the review, current perceived barriers and opportunities relative to physician–scientist training were identified. Though many, but not all, of these barriers have been addressed in previous publications, in particular in the 2014 NIH Physician-Scientist Workforce Working Group Report,[3] the detailed responses from 83 different institutions are a rich, and previously unavailable, source of normative data to better inform strategies designed to increase the numbers of physician–scientists nationally.

Barriers to Physician–Scientist Training

Mentoring and role models

The most common barrier identified by institutions was the absence of effective mentoring, noted by over half of the applicants. Research at all levels of the enterprise requires strong and knowledgeable mentors to help guide the science trainees, both in terms of the significance of the questions to be pursued and the methods to apply. Medical school students and other trainees are increasingly exposed to faculty devoted almost solely to delivery of clinical care, as opposed to faculty engaged in both clinical medicine and research. Limited exposure to faculty actively engaged in both clinical medicine and research leaves trainees without role models for a research-based, clinically engaged career.

In general, physician–scientists are better represented in the subspecialties compared with the primary care services. Clinical faculty, especially hospital-based primary care providers, may be less aware of ongoing research opportunities for trainees. This issue is compounded by changes in the design of clinical services wherein trainees are supervised by primary service providers or hospitalists and subspecialists serve as consultants, often without residents assigned to the subspecialty service. Thus, trainees interested in a research career interact less frequently with physician–scientists. The majority of the applicants identified effective mentoring through all phases of training as important for the development of researchers. As stated by one applicant: "Mentoring is the single, most effective intervention."

Research experience

About one-third of applicants identified the lack of exposure, limited opportunities, and absence of contiguous time intervals to undertake research as significant barriers. Many considered early career stage exposure to research as one of the most effective strategies to encourage trainees' careers in research. Undergraduate research and early medical school experiences are generally considered as the ideal stages for trainees to be initially exposed to substantive research. Although 75% of entering medical students have had an undergraduate research experience[9,10] and many have had further research opportunities in medical school, these experiences are often relatively brief and focused on technical skill acquisition as opposed to more creative, cognitive aspects of scientific investigation. These introductions are often not exciting or substantive. Unfortunately, "doing" such research is oftentimes seen as a means to be more competitive for a position in highly selective residency training programs, rather than as a pathway to a research career. Integrating medical and research training so that activities can be undertaken in parallel might amplify the value of science and discovery even in the delivery of care at the bedside of patients.

Finances and funding

Almost one-third of applicants explicitly identified finances as a key barrier. Medical students often accumulate substantial debt. In 2019, the Association of American Medical Colleges presented data to the United States Congress detailing that students graduate with a median debt of $200,000.[11] Research careers generally entail longer training intervals and relatively lower salaries than clinical positions. Furthermore, clinical departments are increasingly dependent on clinical revenues. The structure of early career awards from the NIH or other foundations often requires that clinical departments share the costs of the time physician–scientists devote to research. Current compensation models in many medical schools value the relatively certain revenue streams derived from clinical care over the inherently uncertain and incomplete support associated with research grants. Hence, early-career investigators in clinical departments are often socialized to believe that time devoted to clinical care is more worthwhile than time spent on research. There is often insufficient institutional support for research conducted by the medical degree-only faculty. Additionally, obtaining external funding to support the launch of a research career such as a K award or in the K to R award transition may be difficult, placing a further barrier to conducting research.

Institutional barriers

Just over 20% of the proposals described the lack of internal mechanisms to support research, such as lack of organizational oversight, inflexibility,

presence of departmental silos and walls between research and the clinical practice, and the lack of structured pathways to train physician–scientists as barriers.

Pressures of the clinic and medical school culture

One of the most discussed barriers—but one difficult to explicitly quantify given its impact in so many areas, including finances—was the conflict between doing research and spending time on patient care. Central to this challenge is moving nimbly between laboratory and clinic and back while maintaining proficiency and productivity in each domain. Manifestations of this implicit tension included the departmental pressure exerted to be clinically productive, the length of clinical training, the enormous time pressures of clinical practice, the requirements for recredentialing, and oftentimes a lack of understanding of research demands by clinical practitioners.

Career and work–life balance

Many of the applications commented that to encourage a career as a physician–scientist, there must be a sense that an equitably well-compensated, stable, and rewarding career exists at the end of training. The perceived instability of funding, coupled with the uncertainty of the academic job market, may make it difficult for a physician to choose the physician–scientist pathway, especially when contrasted with the higher compensation and relative security of a clinical practice. Work–life balance and financial concerns also lead many potential physician–scientists to a clinical career. In recent years, other rewarding career options have also emerged, such as employment in the biotechnology and pharmaceutical industry, as hospitalists, and at companies entering the health care spaces such as Google, Apple, and Wall Street firms.[12,13]

No single approach or program can address all of the barriers, as was reflected in the diversity of approaches proposed by the applicants for the BWF Physician-Scientist Institutional Awards Program. It is clear, though, that solutions that address 1 or several of the above barriers have the potential to increase the number of medical degree-only physician–scientists.

Programs Funded

The committee carefully reviewed all the proposals submitted in the 2017–2018 and 2019 cycles, examining the potential effectiveness of promoting a discovery-intensive career through approaches that reduced or eliminated barriers to such a career while increasing the diversity of the physician–scientists being trained. Across both cycles, the 10 institutions selected by the BWF for funding supported individuals at a variety of stages in training, from undergraduate to medical student through fellowship and junior faculty appointment. In 2018, the first 5 institutions were funded. A brief summary of their key programmatic features follows.

- The University of Texas Southwestern Medical Center program is residency-focused and will provide a 2-year laboratory-based research program in pediatrics, surgery, or medicine with continuous support through the transition to a faculty position.
- Duke University School of Medicine will establish an office of physician–scientist development providing oversight for the MD-only physician–scientists from medical school through junior faculty. The program will include a structured and adaptable mentoring program (concierge mentoring), a basic research training program using a flipped classroom curriculum, funding for research technicians for participants to enhance productivity, and integrated training pathways.
- The underrepresentation of surgeons and procedure-based specialties among basic science researchers will be addressed at Vanderbilt University School of Medicine by introducing medical students to the possibilities of a basic science research career in the laboratories of interventionalists. This program entails extended research training time and debt forgiveness during residency and fellowship training, including the support of technical personnel and supplies during completion of trainees' final 2 clinical training years.
- Stanford University School of Medicine is developing a 5-year medical school curriculum that blends preclinical courses, intensive research, and clinical rotations followed by a short-track residency program. Some of the medical students who enter this pathway will pursue a sixth year of dedicated research.
- The University of Pittsburgh School of Medicine will allow physician–scientists to enter in year 4 of medical school or during the residency or fellowship period. The focus will be on the development of a laboratory and resiliency skill set, with interventions targeted on maintaining work–life balance and support for laboratory work while entering and exiting the clinical phases of training.

Common denominators among all these programs are formalized and dedicated mentoring with mentors who in many cases will receive formal training, along with a demonstrated enthusiasm by key personnel, a well-planned program to increase diversity, and the strong administrative and meaningful financial support of the medical school leadership.

Encouraged by the number of applicants for awards in 2018 and the high quality of both the funded and unfunded programs, the BWF conducted the award competition again in 2019. Five institutions were selected to receive awards:

- Texas A&M University Health Science Center College of Medicine and the College of Engineering will enter into a partnership with Houston Methodist Hospital and the Texas Medical Center to establish a pipeline to attract engineers to medical careers as physician–engineers that will include support during residency and as junior faculty. Interestingly, this was one of only 8 of the 136 proposals submitted that focused on the use of computer science, artificial intelligence, or multidisciplinary training programs involving engineering, mathematics, or computer science.
- UCLA David Geffen School of Medicine will develop a leadership structure and program within the Dean's office and recruit medical students, residents, and fellows by offering differing and overlapping approaches for each level of training. Because of an inadequate number of role models for women and failure to address gender disparity, special emphasis will be placed on selecting women during the fellowship period and providing them with an additional 2 years of protected research time and support.

- The University of Chicago Medicine's program will support and catalyze the entry of MD-only medical students into research careers by using an evidence-based longitudinal program to remove 6 identified barriers that discourage entry into research careers. A key component is a stipend to support an additional research year in medical school plus a full-tuition scholarship for the final year of medical school.
- Washington University School of Medicine will establish a program that spans a trainee's career stages from medical school to a junior faculty appointment. The program will provide a faculty appointment, salary, loan repayment support, and protected research time.
- Weill Cornell Graduate School of Medical Sciences will be built on 3 core tenets: start early, stay focused, and stay connected. To implement these tenets, potential MD researchers will receive financial support to lessen work–life balance issues, participate in an individualized and multidisciplinary mentoring process, and be integrated into a multi-institutional consortium.

Evaluation of the Programs

Given the length of time required to train physician–scientists, determining the success of these programs will take a number of years. The primary outcome measure is relatively unambiguous—more physician–scientists who only hold a medical degree. The intent of the program was to catalyze program development at the funded medical schools. As such, the BWF provided funding for 5 years with the expectation that programs would be self-sustaining thereafter. At present, there are no definitive plans for funding beyond 5 years. The successful applications and programs provide an annual progress report to the BWF peer review committee. However, there are shorter-term outcomes that will provide early indicators of whether the programs are moving in the right direction. These include measuring the number of trainee applicants and participants; participants' time spent in the laboratory, number of publications, and course evaluations; trainee retention rates through the program; and NIH grant support (such as K awards and the K to R transition) and initial faculty appointments for participants. Each of the programs plans to conduct annual surveys of its trainees to measure satisfaction levels and gauge progress toward the development of critical research skills. Not only will the trainees be interviewed but also the faculty and staff will be polled to assess their level of satisfaction with the program and its progress. To this point, the recipient institutions have provided progress reports for two years of funding. The program directors have expressed unanimous support for the initiative. Each of the programs has received matching funds from the host medical school, indicating a meaningful level of intrainstitutional support.

Concluding Remarks

The relatively small number of medical degree-only research scientists is an ongoing concern—we note that 54% of all accredited medical schools in North America applied to the BWF program. Most applicant schools identified similar themes relative to the obstacles faced by physician–scientists. Despite these challenges, medical school faculty remain optimistic about potential strategies that might over time increase the ranks, and the perceived value, of physician–scientists. The BWF hopes that by seeding and supporting the efforts of 10 institutions, the number of physician–scientists will be increased through innovative programs that are created and tested. Further, by carefully tracking, assessing, and sharing what has worked in these programs, we are confident that they can serve as models for other institutions that wish to increase their number of physician–scientists.

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