BIOMEDICAL POLICY

Translating science to medicine: The case for physician-scientists

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The coronavirus disease 2019 (COVID-19) pandemic and resulting vaccines are a potent reminder of the definitive impact of biomedicine and the unique ability of a workforce steeped in both basic research and clinical medicine to respond to a medical crisis. However, the reminder arrives at a critical juncture, with fewer and fewer physicians trained in both biomedical research and clinical medicine. How we address this declining workforce will affect our ability to improve health and our readiness for the next global health emergency.

The current pandemic highlights how physicians who see patients, teach the next generation of doctors, and do research to understand disease are impaired by constraints on reimbursement, time, and funding. We fear that physician-scientists may dwindle toward obsolescence under the harsh realities of 21st-century health care.

This modern era that sees us diagnosing disease by genome sequencing, developing RNA-based therapeutics, and finding once-unimaginable cancer cures reinforces the necessity of the physician-scientist to continue the momentum of discovery and its translation to public health.

Here, we share our recommendations for supporting a resilient supply chain of physician-scientists and for guaranteeing a successor generation whose members are as diverse in race, gender, class, and disability as they are driven by intellectual curiosity and humanism. Our recommendations originate from the February 2020 National Academy of Medicine meeting in collaboration with the Physician-Scientist Support Foundation (www.thepssf.org/pssf-nam-meeting/).

PITFALLS IN THE PATHWAY

The need to replenish the ranks of physician-scientists is urgent. The proportion of U.S. physicians engaged in research has declined from 4.75% of the overall physician workforce in the 1980s to approximately 1.5% today (*1*). This reduction has been precipitated by curricular, institutional, financial, and cultural factors. Such factors include attrition of the basic science curriculum; attrition of faculty, role models, and mentors; lack of financial support; rapid evolution of scientific information; and a shifting ethos.

The 2-year basic science grounding in medical school from decades past seems extravagant by today's standards. This formative training has been supplanted by an abbreviated approach. For example, the Consortium of Accelerated Medical Pathway Programs offers a 3-year program to alleviate the debt inflicted by 4-year programs and to address the urgent need for primary care providers. This organization has seen an increase from 8 member institutions in 2015 to 21 member institutions today (www.acceleratedmdpathways.org/member-schools). Contributing to the attrition is the heightened emphasis on Step 1 Board examinations favoring preparation for standardized tests at the expense of foundational science and problem-solving skills.

Many medical students were inspired to take the physician-scientist path by attending physicians and other mentors who were both clinicians and researchers. Today, encounters with clinicians who do research are increasingly uncommon. Funding and recertification challenges have led some physician-scientists to abandon their clinical practice for full-time research. Clinical and hospital trainees lack role models and mentors who see patients, teach, and do research.

The cost of medical school and postgraduate expenses continue to rise, yet forgiveness programs continue to decline. Post-training salary support is provided for clinicians, but the physician-scientist is required to garner external grant support to fund not only their research program but also a major portion of their salary, forcing many to devote 40 to 50% of valuable time to grant writing.

The exponential growth of knowledge, the rapidity of technological advancement, and the increasing complexity of datasets produced by new technologies pose daunting challenges for today's physician-scientists (*2*), who additionally must step away from science for ~5 to 7 years to complete clinical training. Perhaps the most distressing trend in medicine is the slide toward the more corporate ethos of major consulting firms and legal practices. In the fierce competition for funding and patient care revenues, the building-the-village approach that was once the defining hallmark of the medical profession is being supplanted by a survival-of-the-silo mentality.

A MULTIPRONGED STRATEGY TO REBUILD

It would be easy to succumb to the discouragement of these trends. However, our obligation to patients is too great, the need to discover is too strong, and the talent

pool is too promising. We offer the following multipronged strategy to rebuild the physician-scientist pathway.

An immersive research experience for medical trainees

Science is foundational to medicine. Whereas exposure to core principles is critical, the depth of engagement needs to be tailored to a student's interest, with medical schools coupling a core curriculum with intensive experiences in specific research areas. Ideally, aspiring physician-scientists would receive intensive basic science exposure and exposure to research careers at multiple points along the training continuum.

We advocate for increased access to opportunities such as formal Medical Scientist Training Programs and other immersive research experiences and for the expansion of year-long research programs outside of preclinical and clinical training. Prestigious programs established by the U.S. National Institutes of Health (NIH), the Howard Hughes Medical Institute (HHMI), and the Sarnoff Cardiovascular Research Foundation have provided stipends to medical students to take a medical research gap year. However, the NIH-funded program requires travel to Bethesda, Maryland, creating logistical issues for many. HHMI had allowed students to conduct research at institutions of their choosing but unfortunately terminated its program in 2019. The Sarnoff Cardiovascular Research Foundation program and a few other scholarships are available, but there are far too few funded positions for medical students to receive extensive research training.

An annual subsidy of approximately $6 million would support an additional 100 medical students per year to spend a gap year in a research laboratory. To put this amount into perspective, $6 million is ~0.01% of the $40.3 billion NIH budget, 0.009% of the White House $65 billion pandemic-preparedness plan, or 0.003% of the pharmaceutical industry's $180 billion research and development budget. In other words, the cost of placing 100 medical students in research laboratories for 1 year amounts to a mere rounding error in government and industry budgets. However, this strategy would provide substantial return on investment by training physician-scientists who are essential to meeting our nation's biomedical research mission.

Optimal timing of research for medical trainees is much debated. However, there is not just one ideal time for training physician-scientists. Some students are exposed to science early, while others are not. To build an inclusive physician-scientist workforce, we must ensure that medical trainees have adequate exposure to the excitement of research, enabling them to seek answers to medicine's many unanswered questions.

Lower financial barriers

Today's high school student contemplating medical school faces 11 to 15 years of training with tuition of $40,000 to $65,000 per year (www.aamc.org/data-reports/reporting-tools/report/tuition-and-student-fees-reports). The prospect of decades of debt causes many to forgo research-oriented institutions for less expensive compressed-curriculum schools, maybe even to abandon medical education altogether. For aspiring doctors from low-income families, these monumental costs are a particular deterrent and have been cited as a key factor among those declining admission. To boost enrollment and meaningful diversity in our ranks, we call for an increase of debt-free programs such as that offered by Weill Cornell Medicine, whose acceptance pool demonstrates a statistically significant increase in enrollment by students from groups underrepresented in medicine (https://jamanetwork.com/journals/jama-health-forum/fullarticle/2774066).

In addition to loan forgiveness, young physician-scientists need a living wage. They need stipend support for research training during residency and fellowship, educational debt reduction through programs such as NIH's Loan Repayment Program, financial support for family and dependent care, and funding for the transition to their first independent faculty position. Although funding from NIH and nonprofit organizations such as the Burroughs Wellcome Fund and Doris Duke Charitable Foundation provide some support, funding remains insufficient to remove the financial burden to entering and committing to the physician-scientist pathway.

Restoring the educators and mentors

We call for a reorientation to a culture that values mentoring and collegiality. University-based medical research stands unique in requiring researchers to secure their own research funds and salaries. This system marginalizes young investigators, discourages research on challenging topics, and is a key barrier to diversifying academic medicine. The 2020 American Medical Association Workforce Report shows that 78% of tenured professors in U.S. medical schools are white, 2% Black, and 3% Hispanic (www.aamc.org/media/8906/download?attachment). Of the 18,414 tenured professors, only 16 are American Indians or Alaskan Native. The lack of diversity hurts innovation and affects the health of our nation. Medical academic institutions can remedy this situation by reallocating resources and funding priorities to support faculty studying critical problems that require time and resources and who commit to mentoring, teaching, and research.

Building a leak-free physician-scientist network

We call for the formation of a tightly woven network of nonprofit, academic, and clinical institutions to ally with organizations such as the Physician-Scientist Support Foundation. The goal is to advocate for and monitor the restoration of basic science to the curriculum; to reincentivize faculty and mentors; and to make available funding, debt forgiveness, and research opportunities for physician-scientists. This network will ensure that funding and support are available for the entirety of the pipeline, from student to professor. The network will be an advocate for physician-scientists, changing the leaky pipeline of physician-scientists to one that no longer leaks.

CATALYZING A NEW GENERATION OF INVESTIGATORS

One hundred years ago, the devastating Spanish flu pandemic and a world at war gave birth to the physician-scientist. Today, COVID-19 and the war against science call for a reforging of our profession. We must ask ourselves: How strong is our commitment to supporting the successor generation and to ensuring a critical supply chain of physician-scientists that is agile and sustainable?

We end where it begins: The task to replenish the physician-scientist pipeline starts in medical school. A coordinated, nonprofit network will catalyze a new and resilient generation of physician-scientists who are research-centered and patient-centered, fortified by their diversity, and uniquely driven to uncover the inner workings of biology that will improve human health.

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Acknowledgments: This article is dedicated to the memory of Tadataka Yamada, a champion, leader, and friend of physician-scientists. We thank S. Dickow for expert administrative assistance and the participants at the National Academy of Medicine Working Meeting for insights into physician-scientist career pathways. **Funding:** P.J.U. was funded by a Burroughs Wellcome Fund Physician Scientist Institutional Award. The Physician Scientist Support Foundation was funded by Doris Duke Charitable Foundation. **Competing interests:** B.K.K. is a cofounder of and paid consultant for ConfometRx Inc. V.J.D. has served as a member of the board of Alnylam Pharmaceuticals and Medtronic Inc. P.J.U. serves as a paid consultant of 4D Molecular Therapeutics, Immunic, and Seronova.

10.1126/scitranslmed.abg7852

Science Translational Medicine

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Sci. Transl. Med., 14 (632), eabg7852. • DOI: 10.1126/scitranslmed.abg7852