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Clinician Innovator: A Novel Career Path in Academic Medicine A Presidentially Commissioned Article From the American Heart Association

Maulik D. Majmudar, MD; Robert A. Harrington, MD; Nancy J. Brown, BS; Garth Graham, MD, MPH; Michael V. McConnell, MD, MSEE

The practice of medicine is transforming substantially and a pivotal driver of this change has been the accelerating pace of technology innovation. Traditional healthcare innovation has focused on the development of new diagnostics, drugs, and devices for use in hospitals and clinics, with more recent expansion to include quality-improvement and cost-containment efforts. The explosion of digital health technologies, centered around smartphones and connected devices, and enabled by advanced low-cost, miniaturized electronics, presents significant opportunities for clinicians, researchers, and healthcare administrators.¹ This is coinciding with the rapid growth of personal and population “big data”—from genome to physiome—that can help us diagnose and treat illness more effectively and efficiently, including in heart disease and stroke care. As these advances in healthcare accelerate, academic medical centers should play an active role in collaborating with industry in championing innovation, including implementation of technology-enabled healthcare solutions. More than ever before, innovators in academic medicine need to be trained and appropriately supported in their career path to meet the needs of a changing, and challenging, healthcare system.

The American Heart Association (AHA) recently convened clinicians, scientists, engineers, and entrepreneurs at the first Heart Tech Forum in Austin, Texas to inspire and increase collaboration and innovation toward AHA’s 2020 goal of

reducing heart disease and stroke.² A key component of the meeting was discussion and promotion of career development in this rapidly emerging area. Academic medicine has always been a significant contributor to innovation, with the advances in basic research providing the foundation of healthcare innovation. However, as we continue to witness unprecedented change in technology and health care, there is a need for academic medicine to promote, educate, and support trainees for a career at the convergence of basic and translational research, healthcare delivery and implementation science, and emerging digital health technologies. The growing number of digital health tools and other novel forms of technology require new training paradigms and thinking to understand their appropriate place and value in clinical practice. Additionally, young trainees and faculty are needed in this area and may require career paths that incorporate new analytical or technological tools, including connected devices, behavior change, and social media.

Cardiovascular Care and Innovation

The major advances in the diagnosis and treatment of cardiovascular disease and stroke have revolutionized how we approach the No. 1 and No. 5 causes of death in the United States, respectively. From 2001 to 2011, death rates from cardiovascular disease declined 31%, while the actual number of cardiovascular deaths per year declined by 15.5%.³ Similarly, during the same time period, the relative rate of stroke death fell by 35.1% and the actual number of stroke deaths declined by 21.2%.³ From 1999 to 2010, Medicare data also show significant improvements in the care of patients hospitalized with acute myocardial infarction or stroke. One-year mortality declined 23.4% for myocardial infarction and 13.1% for ischemic stroke.⁴

Despite the progress, management of chronic diseases continues to dominate the healthcare system. In 2012, roughly half of all adults had 1 or more chronic health conditions.⁵ The number and financial burden of individuals with chronic conditions is likely to grow as the population ages—roughly 20% of Medicare beneficiaries account for 80% of Medicare costs. It is important to note that technology innovation has played an instrumental role in improving and

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enhancing cardiovascular care over the past 2 decades (eg, percutaneous coronary intervention, implantable cardioverter defibrillator, left ventricular assistive device), yet there is an urgent need to look at other innovations (eg, population health management, delivery and payment system reform, health information technology, including digital and mobile health solutions for patient engagement, and quality improvement) that may help achieve the goals of high quality health care for all at acceptable societal cost.

Traditional Academic Career Paths

Academic medicine has traditionally put forward the tripartite mission of clinical care, biomedical research, and education as its guiding principles. As the expertise and time demands needed to excel at each discipline have increased, gone are the so-called “triple threats” while instead, faculty lines of appointment and promotion have been developed to reflect career options that emphasize different components of the academic mission. Fuster et al launched a series in *Circulation* on “Careers in Cardiovascular Research” by discussing academic career models and highlighting the challenges and opportunities facing the cardiovascular “clinician-scientist.”⁶ The article acknowledged that many academic careers now focus on 1 or 2 of the disciplines, and often involve being part of larger research teams. Also, within research, there is a broad range of pathways. At one end of the spectrum is the scientist-physician, where the large majority of time is spent doing laboratory or clinical investigation. At the other end is the clinician who primarily cares for patients, but also participates in clinical trials. In between there are many combinations of clinical and research, from translational (“bench-to bedside”) research to clinical trialists to investigators in prevention, outcomes, health services, health policy, biostatistics, and epidemiology. Thus, today’s physician-in-training or junior faculty typically chooses among these established academic career paths. While these careers require “hard work, motivation, and passion,” they also involve a well-established path that combines advanced training, mentorship, scholarly publications in major journals, and career development grants.

Unfortunately, following these traditional career paths has major challenges, which have not abated in the years since the articles by Fuster et al, and Harrington et al in the *Circulation* series.^{6,7} National Institutes of Health funding levels in both absolute dollars and grant success rates have continued to decline. In 2011, National Institutes of Health invested only 4% of its budget on heart research, just 1% on stroke research, and only 2% on other cardiovascular disease research.⁸ This is not reflective of the number of people impacted by cardiovascular disease or the direct costs (medical expenses) and indirect costs (productivity) that

accrue to the country. Furthermore, the system of scholarly publication has become relatively archaic and slow in a social media world, which is particularly challenging and disheartening for trainees, where they have limited time to document evidence of their research to be competitive for grant and faculty applications. When combined with the perceived need for advanced clinical and research training, it is not surprising that the age of starting faculty and first independent grant funding continues to rise (Figure).⁹ All of these factors, plus the greater demands of clinical relative value units generation, family responsibilities, and student loan debt, have made the equation even more challenging than in past generations for choosing an academic career over clinical practice. In stark contrast to the continuing decline in funding traditional research, the longer time for development/approval of drugs and devices, and the increasing age of starting faculty, the field of technology innovation outside of medicine has seen dramatic increases in size, scope, speed, and impact. In mobile and information technologies, products can be developed, deployed, and iterated over months, with rapid evaluation through the use of “lean methodologies,” such as A/B testing, measuring “clicks” or downloads, and data analytics. These have engaged young engineers, designers, and entrepreneurs to invest their creative energies and garnered substantial funding from the private sector. Health care has started to benefit from the rapid rise in technology innovation being applied to medicine, particularly in the digital/connected/mobile health arena.

Trying to fit this rapidly moving field into the traditional career silos is fraught with risk of stifling important contributions to health and discouraging the next generation of clinicians needed to help translate these innovations into improved clinical care and outcomes. This is particularly important as chronic disease continues to grow worldwide and there is the need to move health care out of high-resource/high-cost medical facilities and into more continuous and value-driven care in patients’ homes and communities.

This background provides a challenge to the academic medical community of how to design training programs, ensure appropriate mentoring, provide career development funding, and develop metrics of success beyond publications in order to nurture trainees in these emerging areas. In addition, faculty career paths are needed that carry these ideas forward in the appointment and promotion criteria for this new generation of “clinician innovators.”

The Role of Clinician Innovators

The passage and implementation of the Patient Protection and Affordable Care Act of 2010 (ACA) has incentivized academic medical institutions to take a closer look at their operations, potentially making them more accountable for the care they

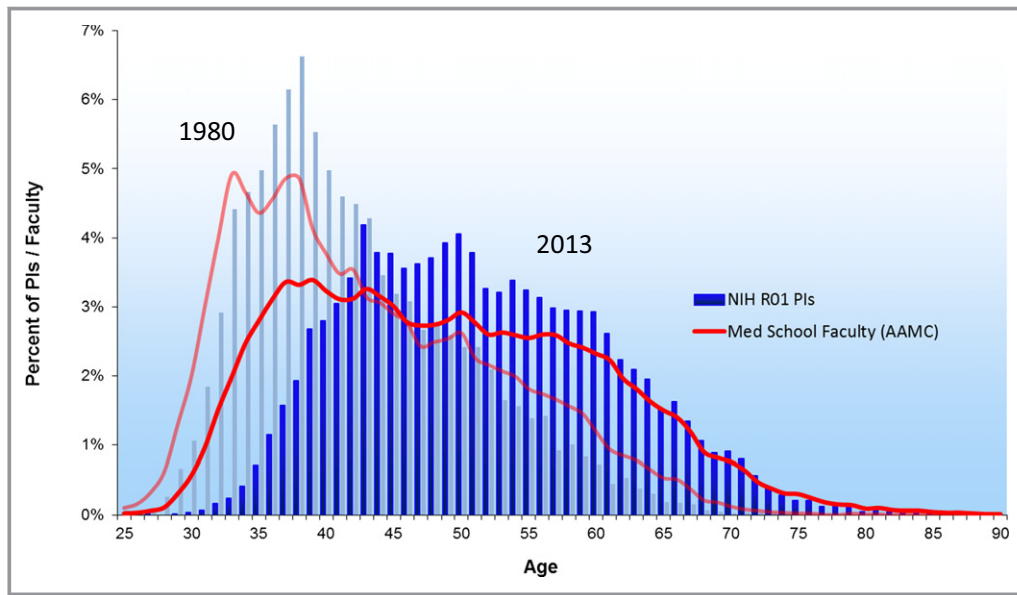


Figure. Age distribution of Association of American Medical Colleges Medical School Faculty and NIH R01 Principal Investigators. Reproduced with permission from the National Institutes of Health Office of Extramural Research, Division of Statistical Analysis and Reporting.⁹ The Medical School Faculty data used in this figure were provided to the National Institutes of Health Office of Extramural Research Division of Statistical Analysis and Reporting by the Association of American Medical Colleges.

deliver. This and other changes in the environment present an immense opportunity for better alignment among various healthcare stakeholders, including health systems, payors, providers, and private industry, to develop innovative solutions that address gaps in healthcare delivery. It is likely that the most disruptive solutions, those with the biggest clinical impact and largest return on investment, will not emerge from those within health care, but rather those who are on the outside, but interact closely with the healthcare system—at the convergence of disciplines such as medicine, quantitative science, engineering, design, and the social sciences, including behavioral psychology.^{10,11}

This evolving healthcare landscape presents a unique opportunity for clinician innovators to be a critical component of the changing role of academic medicine.¹² The clinician innovator pathway presents a new career path within academic medicine that may be ideal for trainees interested in the intersection of healthcare delivery and emerging healthcare technologies. Clinician innovators are, by their nature, competent, creative, and collaborative individuals who are also forward-thinking, technology-savvy, and risk-tolerant. They share in common diverse experiences and a keen interest in designing new care delivery models to address the challenges that they observe daily in the care environment. Clinician innovators can serve as an excellent source of idea generation, solution design, and validation, as they not only possess in-depth knowledge and experience in care provision, but are equally well versed in product design, development,

and implementation as well. They also bridge the gap between academia and industry, by serving as liaisons to connect clinical, administrative, technical, and business needs and are responsible for creating desirable, sustainable, and scalable solutions.

Unfortunately, physicians trained under the traditional academic model are not well equipped to succeed in this new career path. Such a rich and diverse set of skill sets and experiences cannot be adequately garnered through traditional medical school, residency, or fellowship training programs. The clinician innovator pathway, a new career track in medical training, requires a fundamentally different, outside-the-box, approach that includes redesign of the training curriculum, as well as redefining mentorship structure, project support, and success metrics, including promotions criteria. In contrast to the resources dedicated to the development of physician-scientists and clinician-educators, there has been little recognition of the need for training, mentorship, and resource allocation towards the growth and development of clinician innovators.

Building an Ecosystem of Innovation

Building an ecosystem of innovation through the clinician innovator pathway may better encourage clinicians to translate and combine varied experiences into a pathway that helps to improve health outcomes. Today, trainees bring nontraditional interests to the table; many may have had prior

careers or interests that encompass the technological, entrepreneurial, or policy side of health care. This in a time where healthcare delivery systems are being called upon to analyze and understand data and move from just collecting and reporting to doing more predictive modeling and simulation to better understand the impact of a changing landscape. This creates a very practical need for innovators who appreciate the various components of the delivery process and contribute to an ecosystem of innovation.

The building of this new ecosystem is likely to directly benefit academic medicine by allowing for more rapid analysis, adaptation, and dissemination of appropriate changes to improve the delivery of care. The demand for clinician innovators exists and is perhaps more timely today than ever before; however, its success depends on an academic system that rewards and nurtures innovation by providing trainees with the right tools and resources to succeed. It first requires the recognition that a formal or informal designation of an individual as a clinician innovator acknowledges their unique contribution in the academic healthcare environment.

Training programs interested in promoting and supporting the next generation of clinician innovators should invest time and resources in implementing a curriculum that includes didactic lectures, collaborative mentorship, action learning electives, and assignment of individual projects that are to be completed and presented by the completion of professional training. The didactic lecture series should include innovators with a proven track record and should cover topics as diverse as healthcare economics, health information technology, health policy, quality and outcomes, lean startup methodology, human-centered design, big data, medical writing, intellectual property, innovation and entrepreneurship, as well as leadership and management. The curriculum should be designed to ensure sufficient exposure from outside personnel, including policy makers, faculty at engineering and business schools, funding agencies, as well as local entrepreneurs and healthcare investors.

The incorporation of this newer kind of thinking also requires us to create a growth environment that includes potential mentors, the identification of different funding streams, and new methodologies to calibrate success. The mentors may include individuals from more diverse backgrounds than is typically done, but that also include clinical mentors who help their mentee continue to develop and hone clinical competence in a relevant area of interest; administrative mentors who provide guidance on additional leadership skills that may be needed to drive change in a healthcare environment; and entrepreneurial mentors who may or may not be outside of the academic setting who help to keep a pulse on technology or other forms of innovation that may be rapidly advancing outside of the traditional research environ-

ment. In addition to identifying different types of mentors, it will be equally important to create opportunities that facilitate discussions and foster collaboration.

For example, Stanford has had a long-standing innovation program, called Biodesign, which brings together multidisciplinary teams to tackle unmet medical needs, starting with needs identification through early-stage implementation.^{13,14} As described by Brinton et al, Stanford Biodesign created the first academic fellowship program of this type, where fellows from clinical, engineering, and business backgrounds are trained together in the process of innovation, with mentors from the faculty and industry. The program is now in its 15th year of training fellows with a strong track-record of success in academics and industry, fostering the development of numerous successful companies and healthcare innovations. In recent years, the program has recognized the growing global and mobile innovations in health care and has integrated these into the fellowship program. There is also a year-long series of Biodesign courses, encompassing mobile health and team-based innovation, available to clinical fellows in other training programs. The Department of Surgery has seen this as a valuable approach for its clinician-innovator trainees, with the option for an extended 2-year Biodesign fellowship during the research period of residency. More recently, the Healthcare Transformation Lab at Massachusetts General Hospital launched Co.Create, a new co-development program that aims to accelerate the translation of early-stage ideas into scalable and sustainable healthcare ventures. The program pairs multidisciplinary teams of student innovators with subject matter experts and successful entrepreneurs, and also provides clinical access, funding, prototyping space, and project management support. Co.Create, which is in its inaugural year, was developed in collaboration with Hacking Medicine, Massachusetts Institute of Technology's healthcare entrepreneurship initiative that popularized "healthcare hackathons"¹⁵ and MassChallenge, the world's largest startup accelerator.¹⁶

Funding remains a major challenge, though there are some changes on the horizon. The ACA created a number of new funding streams that encourage and help foster an environment of healthcare innovation. The Centers for Medicare and Medicaid Innovation Center, created by the ACA, was initially funded at 10 billion dollars over 10 years to award grants and other kinds of support to pioneer new innovative care delivery models as well as test new payment designs. In addition, the Patient Centered Outcomes Research Institute provides funding for and encourages various innovative strategies around comparative effectiveness research. Outside of the federal government, a number of foundations/nonprofits have created direct funding streams to support clinician innovators. For example, the California Healthcare Foundation created the Health Innovation Fund designed to invest in companies that

innovate to improve care delivery. Similarly, the Aetna Foundation recently launched the Healthier World Innovation Challenge, providing new resources for clinician innovators who are leveraging technology to improve the care of chronically ill patients.

In addition to funding, clear and concise metrics of success have to be established to drive a culture of innovation. It will be important to derive an appropriate balance between traditional metrics (eg, grants, publications, etc) with nontraditional metrics (eg, advisory roles, patents and software licenses, etc), while giving individual institutions the flexibility to be innovative in how they structure the metrics to meet the needs of their environments. An array of nontraditional metrics should and must be considered in order to fully integrate the clinician innovator pathway into academic medicine. Nontraditional metrics could include the following: patents and software licenses; advisory roles and mentorship to the entrepreneurship community; the identification of new therapies and approaches to delivery of care; new measures or strategies for achieving cost-effective care; technologies or methodologies that allow patients to take a more active role in their health care; and publications with high impact (both peer reviewed and non-peer reviewed). Some have even advocated that the impact and influence that one has throughout social media channels might be considered as demonstrating academic/scholarly accomplishment.

Conclusions

The changing healthcare environment and the need for continued progress in cardiovascular care innovation presents a unique opportunity for clinician innovators to play a pivotal role in contributing to the emerging advances in the practice of medicine. Academic medical institutions should adapt to serve as champions of technology-enabled innovations designed to improve care delivery and health outcomes. This call to action emphasizes the need for the integration of the clinician innovator pathway in academic medicine to advance the development and clinical translation of these ongoing transformations and help further drive care improvements.

Disclosures

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