

Transactions of the American Clinical and Climatological Association

Trans Am Clin Climatol Assoc. 2023; 133: 81–92.

PMCID: PMC10493740

PMID: [37701598](#)

LEARNING TO PIVOT: DEVELOPING TALENT AND A CHAMPIONSHIP TEAM

[W. Kimryn Rathmell](#), MD, PhD

Nashville, Tennessee

Correspondence and reprint requests: W. Kimryn Rathmell, MD, PhD, 1161 21st Avenue, Suite D3100, Medical Center North, Vanderbilt University Medical Center, Nashville, TN 37232, 615-875-1526, Kimryn.Rathmell@VUMC.org

[Copyright](#) © 2023 The American Clinical and Climatological Association

ABSTRACT

Developing the future leaders of biomedical science is fundamentally the most important role that we play in academic medicine. Similar to the path to elite championship athletics, the path begins early: engaging young minds to find excitement in science, enlightening medical students on the importance of curiosity, challenging faculty to achieve milestones and mature as leaders. Coaching strategies are critical and are different at each developmental stage. It may seem that it is becoming harder to entice young talent to pursue a career in biomedical research, or that the perpetually leaky pipeline is corroding to the point of hemorrhage. This perspective will explore the factors contributing to this loss, with flow further compromised by low input volume and high demand, and survey the coaching strategies that inspire the drive to pursue biomedical inquiry and the range of skills that must be developed to enable our workforce to thrive.

BACKGROUND

The 2014 Workforce report published by the National Academy of Medicine and the National Institutes of Health (NIH) provided the quantitation of a trend we had internally sensed and broadly suspected: individuals choosing to pursue a career at the intersection of medicine and science were facing a massive challenge (1). This is not a new worry. In fact, published addresses of Presidents of the American Society of Clinical Investigation, going back nearly 100 years, are littered with references to the “dying breed,” the “leaky pipeline,” etc. (2,3). The consistency of that lament may be enough to assure us that in fact nothing is different today, compared to 50 or more years ago. But I will argue here that things are different and that the time is now to take significant action to change the way we cultivate talent.

Let me start by highlighting a review of the landscape for aspiring physician-scientists and those involved in training them (4). This manuscript details the many points of leakage in the pipeline and illustrates the complexity of navigating the path from trainee to independent researcher. The clearest pathway is the dual completion of an MD and PhD, followed by a physician-scientist train-

ing program (only available in some specialties) and a supported period of academic mentoring in the transition to academic practice. Other mechanisms allow so-called “late bloomers” to arrive in the same place.

This perspective will address the bottlenecks in our pipeline, including those that not only slow throughput but also contribute to the spillage. We will then compare our profession to the sports industry, via a thought experiment that may encourage a different way of thinking about this pipeline, and discuss a future state that embraces the coaching philosophies espoused by elite athletes in order to overcome the insatiable demand for talented scientists and physician-scientists. Let us first set up the assumption that we do in fact need to stabilize or expand the pipeline. The major argument for this stance is bolstered by the incredible pace of scientific discovery and the demand to further these explorations and translate findings to benefit human health (5). As an oncologist, I have witnessed during the span of my career the revolution in cancer care from diseases that were universally incurable to cancers that are now commonly curable. I want to keep seeing these advances and would love to see them emerge even faster. As a health system leader, I also see the incredible difference that health makes for an individual, a family, and a community. The clearest path to a healthy reality relies on individuals who are both skilled in science and those who can incorporate the science effectively into policy and practice.

EXAMINING THE BOTTLENECKS

If we consider this as an economic process, let's consider where the bottlenecks are occurring (see [Table 1](#)). Simply stated, these can occur at the entry point, in the complexity (and duration) of training, in the way we define a physician-scientist, and finally, in the range of career paths that mark the termination of this training period.

The Entryway–Sacrifice

If we first tackle the entry point, it is important that we recognize why young people don't choose the physician-scientist career path. Perception plays a major role in decision making, and there is an embedded perception that this career path is dominated by sacrifice. Indeed, that perception bears out, but there is mythology here as well. Let's be blunt. Talented individuals are dissuaded by the sacrifice of salary, by the long duration of training, by the uncertainty of success, and by the early expectation of a lifelong commitment.

Others have written about the salary disparity and financial barriers across health care models (6). Skilled physicians in the U.S. command some of the highest salaries in the nation. Even in academic medical centers, physicians are often compensated handsomely for the lucrative procedural specialties of patient care. In contrast, laboratory-based research is compensated conservatively. Further, individuals are obliged to budget salary using the NIH cap, currently set at \$203,700. Finding the appropriate balance to reward the work of physician-scientists is a major challenge when the primary funding stream maxes at a salary lower than most physician pay scales. The effect is clear, with more physicians pivoting to the physician-scientist role in the lower-paying specialties and a paucity of physician-scientists in higher-paying fields. Universities identify creative solutions, or individuals are drawn into increasing revenue-generating patient care.

The sacrifice of time is a more precious resource. Training for many years can defer not only compensation but also years of scientific productivity. Time impacting child-rearing or being able to meet other obligations can appear overwhelming. The increasing clamor for work-life balance can appear to be at cross purposes with this career.

One may argue that the expectations of current generations about what is rewarding in life are different. In some respects, they are. Fortunately, many role models demonstrate proactively the flexibility that this career can offer and the immense satisfaction that can negate the perceived sacrifice. Nonetheless, perception equals reality, which produces a barrier to potential talent from embarking on this career from the outset.

Forces Causing Attrition

One barrier is the set of challenges produced by our one size fits all training model. Let's dissect some of the problems. We have created highly competitive and rigid tracks that create a linear path to being a physician-scientist. While this Medical Scientist Training Program (MSTP) to Physician Scientist Training Program (PSTP) to K award to faculty works for some, it creates a pedestal phenomenon that dissuades others from choosing an alternative path. Achievement of these highly competitive milestones is held in high esteem, and failure to attain this elite track can be a strong deterrent. This is not how physician-scientists were cultivated previously. Historically, physicians in training developed a fascination with some aspect of medicine, found the time to explore it in depth, and emerged as physician-scientists. That pathway is almost impossible today, owing to the highly proscribed clinical training and deterrence from mentors to allow a "late bloomer" to discover their passion in their lab or research group.

Let's stop some of this nonsense. They are not late bloomers. These individuals are discovering a career focus and interest at exactly the right time. We must create additional flexibility for these transitions beyond the current programs and recognize that there are fewer MD-only developmental programs today than there were even five or ten years ago. There is a cultural component as well, requiring a cultural realignment for lab heads to embrace more MD students, residents, and fellows to learn in our laboratories. By embracing their curiosity and seeking to discover new truths in medicine, these are physician-scientists. All physician trainees should be learning not just the protocols of medicine but also to be curious and to think scientifically. In that regard, all trainees asking questions at the boundary of what is known and what is unknown are physician-scientists, and encouraging that direction is an important step for engaging someone for a life of pursuing questions at this interface.

Another issue in our training model is the double dipping phenomenon of our graduate students, postdocs, residents, and fellows really functioning as the work engine for much of what we do in academic medical centers while being classified as trainees (7). Much effort has gone into ensuring that abuses of the past are not tolerated, but there remains incentive misalignment, with short training periods presenting a challenge to the longer-term projects of the lab and the needed stability. Labs funded largely by NIH grants can't afford to run with a higher portion of permanent staff and a smaller portion of trainees, who are funded on training grants and university stipends.

This is a financial model that contributes to the lengthening periods of training, and one that we should at least reconsider, recognizing that laboratories and universities are perennially strapped for funds.

Finally, we must address the expectations of mentored persons to demonstrate their readiness for independent discovery. While it is necessary to endow students and postdocs with skills in scientific methods and communication and writing skills, the mandatory peer-reviewed first author publication is a rite of passage. However, manuscripts have become massive, with expectations from reviewers contributing to extensive data sections on top of comprehensive primary figures. To be published in a high-tiered journal for a student or a postdoc means more years and competition rather than collaboration among peers. Because only one person can be first, the system is inherently unjustly treating teamwork (8). Perhaps new preprint models such as what eLife is proposing (9) will provide the radical shift in how we get important information and discovery into the public domain and award the necessary credit to demonstrate that trainees have earned their degrees or that faculty are ready for promotion.

The most notable statistic is the time that it takes for an individual scholar to reach independence, as quantified by the age of receiving a first R01 grant from the NIH, which is currently around 46 years of age for physician-scientists (10). The trend line for this statistic is disturbing, even as it appears to be showing signs of flattening. If the first R01 marks the entry of a physician-scientist as a driver of creative energy, then having a mere 20 years to really develop their program and make significant discoveries is a very short runway. We must admit that this metric is hampering scientific advancement. In truth, these individuals are likely ready much earlier, but they are being handcuffed in mentored positions by career development awards that protect their salary but curtail their ability to launch. The R01 pool is already tight, so adding an additional decade of investigators to this crowded playing field will likely shrink pay lines further. As we approach a real tipping point and see talented individuals walk away from careers in science, all options need to be on the table.

A Different Off Ramp—The Need for a Bigger Pipeline

Historically, physician-scientist positions were largely relegated to academic medical centers. Transitions to positions in government and industry were less common, in part due to the guarantee of tenure and an array of career opportunities within the academic halls. Even a decade ago, the conversations about physician-scientists leaving the traditional pathway were largely considering the pivot to lucrative careers in private practice. Now, financially secure positions are available in biotech and pharmaceutical sectors, giving these talented individuals opportunities that blend medically relevant research with product outputs and direct impacts on patients (7). Government opportunities at the FDA and CDC also place capable and highly trained individuals in roles where they can make a difference. We need to see this shift as different than the allure of full-time patient care. Individuals make decisions based on finances, geography, stability, and mission. The opportunities that demand and make good use of the combined skills of physician-scientists have effectively doubled, if not tripled.

Does this mean we need to double down on strategies to combat this threat? Or do we acknowledge the need to have skilled investigators with medical backgrounds in these arenas, embrace the new reality, and work to increase the workforce?

Many have written about the looming workforce shortage, particularly on the heels of the COVID-19 pandemic ([11](#)). Suddenly, we are finding ourselves with not only a field that has features that are unattractive to aspiring candidates, but we are also not bringing in nearly the numbers of individuals needed to keep up with the societal needs in this arena. Demand is far outpacing supply.

HOW IS TRAINING PHYSICIAN-SCIENTISTS SIMILAR TO THE PROFESSIONAL BASKETBALL INDUSTRY?

Let's do a thought experiment.

The National Basketball Association (NBA) needs roughly 60 new players to complete its draft every year (a few more get in, but this is the baseline). Do we train that number of players at the collegiate level? No, we prepare hundreds and hundreds for this opportunity. Let's take it a step earlier. Where do college athletes come from? Thousands and thousands of kids play basketball, in national programs through schools, recreational leagues, and for-profit programs that allow early exposure to the sport. The skill level that is expected by top performers at the college level is extremely high. What happens to the multitudes who don't make it to the NBA? They find their way into other careers, but often remain consumers in the industry. They know the history, the players, and the rules. They buy tickets, purchase gear, and watch on TV. They take positions in the industry that are not as players. They continue to participate as amateurs and hobbyists in school gyms and playgrounds around the country. The level of appreciation of the sport is engrained from early days for those who participate more than casually.

The contrast with training physician-scientists is stark. If we (academic medicine physician-scientists) are the equivalent of NBA players, we have a pipeline that is barely larger than the number of individuals who will take tenure track positions. We create an aura of elitism that is on par with the elite athlete, but where is our fan base? Who is cheering when our legacy members are awarded Nobel Prizes or Lasker Awards or elected to the National Academies (our equivalent of the Basketball Hall of Fame)? Why don't we have lay citizen-scientist fans following our discoveries, celebrating the approval of new drugs, and recognizing the incredible feat that accompanies curing another disease? Why do we look down with disdain on individuals who dabble in science as amateurs or enthusiasts?

I spent my early faculty years at UNC-Chapel Hill, a public institution widely recognized for its academic as well as athletic prowess. We applied the mantra of "Play Smart, Play Hard, Play Together," as legendary Coach Dean Smith quoted and wrote about in *The Carolina Way: Leadership Lessons from a Life in Coaching*, in everything we did ([8,12](#)). We embraced the concept of coaching and the wisdom and experience of our famous coaches. Why don't we have coaching embedded throughout the life experience of physician-scientists? The NBA (and college athletics) pays coaches hand-

somely for the important role they play—ensuring the endurance and fitness of talented athletes and directing them to play together as a team and to successively develop skills that keep them winning.

Vanderbilt has embraced this concept for its top leaders. I have worked with a coach since my arrival and found the experience to be exactly like the coaching I experienced as a high school basketball player (13). Drills in fundamentals coupled with practiced plays, and daily interactions (like game day), give opportunities to continue to practice skills in a variety of settings. Examples of the developmental stages of an academic leader include learning the community and building relationships, developing personal style, establishing structure and rhythm, and expanding reach (13).

Who are the coaches in the pre-college and college spaces, and what skills are we giving to individuals who show interest? Are our mentors at the graduate and postgraduate training stages suitably trained as coaches? Certainly, mentorship and teaching are central tenets of our field. As Dr. Kaushansky wrote in his 2004 ASCI Presidential Address, we must teach, teach often, and teach widely (14), but do we prepare individuals to be an effective teacher/coach? Is such coaching accessible, and is it equitable? The unfortunate truth is that access to high-quality coaching in medical scientific thought is limited, and it is not equitably distributed. To what extent have we engaged stakeholders from government and industry, if this is in fact the destination for many of our trainees? Finally, can coaching programs impact our pipeline, our training pathways, our identity, and our community?

THE ARGUMENT FOR EXPANDING OUR NETWORK OF COACHES

If our pipeline is leaky, we aren't bringing enough talent in, and we have an expanded demand for our talent assets, we have a classic economics problem. We have created artificial bottlenecks designed to stem the tide. We need instead to create new interest in the field, lower barriers to entry, dissipate the perception that this career is too hard (by embracing the fact that there are numerous valuable ways to participate), recruit from previously under-tapped talent pools, and create energy. Like basketball, the skills involved are best instilled by a coach.

We can't continue to rely on intrinsic interest in the field of medical science, and balancing our economic supply and demand will require a coordinated and massive effort. There are good examples of early phase pipeline programs all over the country. We need more, and we need to connect them to collegiate, graduate, postdoctorate, and senior levels.

Take for example the Aspirnaut program sponsored by Vanderbilt University School of Medicine (<https://aspirnaut.org/>). This program targets high-risk youth from the rural South and offers a scientific home base over successive summers and a community of virtual support throughout the year. The coaching that accompanies this program is intensive, including a discovery science experience (scrimmage) bundled with lab skills training (practicing the fundamentals), professional skill development including communication and college test preparation, and self-discovery training to connect them with 1-on-1 career mentors and wellness and fitness training. This is a small program, but it has had a national impact over 14 years. Like the basketball analogy, out of 183 graduates six are in MD-PhD training. That 3% conversion rate to physician-science training is a

number to celebrate. This is accompanied by a further 47 in medical school, 24 in graduate school, 34 with master's degrees, and others in dental school, veterinary school, pharmacy school, law school, and other science fields. All have a lifelong appreciation of science and a working knowledge of the health science industry.

IMAGINE THE FUTURE

What if every medical school had such a program (or larger programs connected to every elementary, middle, and high school in the country)? What if we tapped into not only the field of Westinghouse winners but also at-risk youth who show aptitude and underprivileged kids seeking a route out of poverty? Would we have a different dialogue today about pandemic preparedness and health in general?

What if we selected and trained coaches to focus on researcher skill development in medical school and graduate school? T32 programs already exist with the NIH to accelerate and facilitate robust training, and integration of the Center for the Improvement of Mentored Experiences in Research (CIMER) and other mentor trainings are becoming the expectation. There is room for coaching to transform education within our existing training framework.

What if we revised the early-stage investigator R01 to allow a co-PI who serves as a coach? Could this R01 be sought at the first sign of readiness, whether the individual is an early career faculty member, a postdoc, or even a prescient graduate student? Are there other models that accelerate and reward individuals who show the coalescence of talents early? Even the NBA occasionally takes talent straight from high school; these early individuals sometimes emerge early as superstars, transform the sport, and play for prolonged periods.

Finally, if our talent is now divided between academic and industry pursuit, can we partner with industry and government leaders to support coaching-based programs to create the workforce we all need?

ACKNOWLEDGMENTS

Dr. Rathmell would like to acknowledge the coaching she has received from Dr. Dick Kilburg, Executive Coach.

DISCUSSION

Zeidel, Boston: Terrific talk and a fresh look at an ongoing problem. We have another large cohort—obviously, this early coaching program will look into that cause. I think it's great. We have thousands of medical students, and it used to be that there was a form of transference in the first two years for some because they would actually see scientists giving the lectures. But now we have a very different curriculum, which is far more effective. I believe we're actually getting the information across, but somehow it separates the students from investigators, so you don't get that "aha moment" perhaps from that form of transference. Is there some way that in the first two

years of the curriculum, or the so-called pre-clinical years, where we can expose students repeatedly to terrific people who are doing science and put out the message: create a culture that you're trying to describe? "You should all think about becoming investigators—it's a fabulous career."

Rathmell, Nashville: Yes, I couldn't agree more that we need to be able to do that. The training in medical school is really, really tight and finding that extra time is hard but it's an investment that we have no choice but to try to make. That's why I put it in the vernacular of coaching. I think that there's a potential to be able to put those students together in groups or with coaches who somehow can identify the opportunities for them to see. The kind of science that lives behind all of the things that they're learning in medical school. I think a lot more of our medical students need to be funneled into physician-scientist pathways.

Schwinn, West Palm Beach: I want to look at the other end of the spectrum and examine science education starting in elementary school. Interestingly, I was considering a position at Oxford approximately 20 years ago when our youngest daughter was in 5th grade. To be considered for a private school in Oxford, she had to take the Common Entrance exam. Given her American education, she did fine in English and math but had never been exposed to most of the science principles required on that exam. The United Kingdom clearly embeds principles of physics, chemistry, and biology in elementary school, from first grade onward. If I heard your talk correctly, you would predict these principles might be absent in the United States because our elementary teachers have developed "antibodies" to science from their own lack of training in this area. They really don't know science, so how can we start getting early science coaches in American schools?

Rathmell, Nashville: Yes, I think we need to make sure that our teachers understand and appreciate science. We probably need to be more visible out there in the community so that people can see what a scientist really is—that it's not some up-on-a-pedestal type of person. I think we can make requirements for what needs to be taught early on. There are lots of examples out there of small programs and communities where people put kids together in groups that work on science. I was invited to one that happens in San Diego (because we are able to do things via Zoom) where I talked to eight-year-olds about what I do in the lab, and it was incredibly interesting to see how they're thinking. This is organized by parents so I think that it could also be a grassroots type of afterschool or at-home type of thing, but I think it would be better if it were somehow institutionally embraced in the school systems.

Carethers, Ann Arbor: Kim, that was a wonderful discussion. I like the idea that you put forth about embedding this in T32 grants. Some institutes like the NCI do have programs that go down to high school. I don't think they go down to elementary school, but they fund some of the pipeline. I guess they focus on trying to get diverse members involved in science. My question is about the Aspirnaut program and other programs. One of the things I didn't see in the curriculum was the necessary exposure to people that look like them. You're a woman—you probably inspire other women. What about the handful of people who might be from underrepresented backgrounds? Are they being exposed to the program, and are there role models with whom they might identify?

Rathmell, Nashville: Yes, I mean it definitely is a part of the program. We have several really wonderful faculty members who have made their services accessible to these folks. Walter Clair, whom you might know from our institution, is one who's been very involved with the Aspirnaut program and actually takes these kids under his wing weekly over the whole summer. So yes, but we don't have enough diversity of our faculty and there's a cost as well to asking people to do that. I generally find that people are excited to do so.

Ludmerer, St. Louis: We're delighted to have you with us in this organization and thank you for that lovely presentation. What particularly resonated with me was your emphasis on mentoring, role models, and personal relationships. These, of course, represent "internal" factors—things that we within a medical school might do individually. What is your view regarding "external" factors that also are at work here? I'm thinking of a brewing anti-intellectualism within medicine that manifests itself in various ways. For instance, there is a competency movement that has much merit to it but seems to focus on competency without underscoring the importance of excellence, contribution, and service. Another "externally" induced change is in the value system of medical schools and teaching hospitals. Once upon a time, these institutions measured their success on the basis of the quality of work; today, they measure their success much more in finances and income. I would be interested in your thoughts on the external context of the problems you address and whether there is anything we might do to address that.

Rathmell, Nashville: Yes, I didn't go quite all the way but my pie in the sky thought is that if we could enlist some really major coaching type of effort like this, it would be generational—it would change the way people understand and communicate about science. I think that would have an impact on sort of the trust in science. I think that's maybe what you're talking about. Science is hard and complicated, but we've made it so hard and complicated that people then go to Google and think that they're understanding science in a different way. But if we had a community of people who really appreciated what it is that we're doing in the scientific community I think that would be game changing for our community overall.

Humphrey, New York: Kim, that was a fabulous talk. I'm excited about not only the big picture concepts that you presented, but also the fundamentals, in terms of early exposure to science. Based on the experience you had as the leader of an MSTP program, and now as chair of the Department of Medicine, I am eager to hear your thoughts about early exposure to science-based curricula during medical school. Finally, if you are not familiar with *Good Mentoring: Fostering Excellent Practice in Higher Education* by Hooker, Shernoff, and Nakamura, this book lays out a most beautiful representation of the power of mentoring and coaching. The authors use the physicist Niels Bohr as an example of being a part of an amazing lineage of Noble Prize winners whose approach to discovery was passed down from one generation to the next. I think in so many ways that's exactly what you just outlined so thank you, Kim, great plan.

Rathmell, Nashville: Yes, thank you. Thanks for those comments and the book recommendation. I've heard of it but haven't read it so I will now. Also, I'll say several medical schools are really pushing to get immersive periods of time for their medical students. I think that's really essential.

Footnotes

Potential Conflicts of Interest: None Disclosed.

REFERENCES

1. Feldman AM. The National Institutes of Health Physician-Scientist Workforce Working Group report: a roadmap for preserving the physician-scientist. *Clin Transl Sci*. 2014;7(4):289–90. [PMCID: PMC5439807] [PubMed: 25123835]
2. Cheung VG. Vitalizing physician-scientists: it's time to overcome our imagination fatigue. *J Clin Invest*. 2017;127(10):3568–70. [PMCID: PMC5617652] [PubMed: 28968256]
3. Koretzky GA. The future of the ASCI (American Society for Clinical Investigation): a lesson from 2000 presidential election. *J Clin Invest*. 2001;108(7):s3–s7. [PubMed: 11669074]
4. Gallagher EJ, Rockey DC, Kontos CD, et al. Pearls of wisdom for aspiring physician-scientist residency applicants and program directors. *JCI Insight*. 2022;7(6) [PMCID: PMC8986063] [PubMed: 35315364]
5. Utz PJ, Jain MK, Cheung VG, et al. Translating science to medicine: the case for physician-scientists. *Sci Transl Med*. 2022;14(632):eabg7852. [PubMed: 35171650]
6. Williams CS, Rathmell WK, Carethers JM, et al. A global view of the aspiring physician-scientist. *Elife*. 2022;11. [PMCID: PMC9470153] [PubMed: 36098684]
7. Wosen J. 'The tipping point is coming': unprecedented exodus of young life scientists is shaking up academia. 2022. Available at: <https://www.statnews.com/2022/11/10/tipping-point-is-coming-unprecedented-exodus-of-young-life-scientists-shaking-up-academia/>.
8. Douglas HM, Elliott KC, Settles IH, et al. Authorship climate: a new tool for studying ethical issues in authorship. *Account Res*. 2022;1–25. [PubMed: 36288536]
9. Eisen MB, Akhmanova A., Behrens TE, et al. Peer review without gatekeeping. *Elife*. 2022;11. [PMCID: PMC9584602] [PubMed: 36263932]
10. Lauer M. Long-term trends in the age of principal investigators supported for the first time on NIH R01-equivalent awards. 2021. Available at: <https://nexus.od.nih.gov/all/2021/11/18/long-term-trends-in-the-age-of-principal-investigators-supported-for-the-first-time-on-nih-r01-awards/>.
11. Armstrong K. Covid-19 and the investigator pipeline. *N Engl J Med*. 2021;385(1):7–9. [PubMed: 33761205]
12. Smith D, Bell GD, Kilgo J, et al. *The Carolina Way: Leadership Lessons from a Life in Coaching*. Penguin Press, HC; 2005.
13. Rathmell WK, Brown NJ, Kilburg RR. Transformation to academic leadership: the role of mentorship and executive coaching. *Consult Psychol J*. 2019;71(3):141–60. [PMCID: PMC6884359] [PubMed: 31787830]
14. Kaushansky K. ASCI Presidential Address: mentoring and teaching clinical investigation. *J Clin Invest*. 2004;114(8):1165–8. [PMCID: PMC522277] [PubMed: 15489964]

Figures and Tables

TABLE 1

Economic Logic and Bottlenecks Affecting the Physician-Scientist Workforce

Low-volume entryway:

- Time sacrifice
- Financial sacrifice
- Security sacrifice

Forces for attrition:

- One size fits all training model
- Overly competitive
- High barriers to late entry
- Delayed independence

Diversified off-ramp opportunities:

- Rewarding work in industry
 - Expanded need for skilled workforce
-