Continuing Attrition of Physician-Scientists (CAPS): A Preventable Syndrome?

The proliferation of responsibilities assigned to the physician-scientist (defined as a physician involved in clinical, translational, or basic research) results in a situation reminiscent of the peddler in the children's book "Caps for Sale"[1] (Figure 1) and can be a cause of CAPS—the continuing attrition of physician-scientists. Although contraction of the physician-scientist community has been discussed since the 1970s,[2–7] with some suggesting that the physician-scientist be designated an "endangered species," the problem has become more acute in recent years due to a perfect storm of economic and administrative challenges facing healthcare and biomedical research. In considering the problem, the AGA Institute Research Policy Committee concluded that a career as a physician-scientist was not one "that a reasonable person should undertake in 2007 and beyond."[8] While recognizing their concerns, I could not disagree more strongly with the committee's conclusion. A career as a physician-scientist remains exceptionally rewarding. Nevertheless, it is critical that we examine the factors responsible for and take measures to prevent CAPS.

One cause of CAPS may be increased competition for K and R series awards. Data supporting this hypothesis include the facts that while the number of MD–PhD matriculants increased by 39%, from 457 to 633 per year,[9] between 2002 and 2011, the number of MD-oriented career development awards[10,11] (K08 and K23) throughout the National Institutes of Health (NIH) fell 22%, from 489 to 380 per year, during the same interval[12] (Figure 2). The situation is somewhat better at National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), which strongly supports physician-scientist career development (Supplementary Table 1). Nevertheless, the number of new K08 and K23 awards within NIDDK has fallen by 15% over the past decade. Thus, even at the beginning of a nascent independent career, the number of awards for physician-scientists has shrunk while numbers of potential applicants have grown. CAPS also strikes at each major milestone of career progression, including award of a first R01, renewal of that R01, promotion, and tenure. Thus, it is essential that we take steps to enhance the survival of physician-scientists. These individuals who speak the 'languages' of both scientists and physicians play critical roles, including service as translators who catalyze assembly of collaborative research teams and accelerate application of investigative breakthroughs to diagnosis and treatment.

Figure 1. The proliferation of responsibilities assigned to the physician-scientist results in a situation reminiscent of the peddler in "Caps for Sale" and can be a cause of CAPS. (Copyright ©1940 & 1947 Esphyr Slobodkina. Copyright renewed 1968 by ESPHYR SLOBODKINA. Used with permission of HarperCollins Publishers.)

Why Is the Pool of Physician-Scientists Shrinking?

Abundant data indicate that the attractiveness of a career in biomedical research is waning for clinically trained investigators. This conclusion is supported by the comments received after a 2011 request for information by the Working Group on the Biomedical Workforce.[13] Of 498 unique ideas within the responses, 53 (11%) related to the reduced appeal of biomedical research careers.[14] Another 44 (9%) dealt with issues related to physician-scientists and the perception that this path is both less attractive and less attainable than in previous years.

One contributor to the declining popularity of a career as a physician-scientist may be the increase in age at time of first R series award. In 1980, the average age of MD–PhD and PhD first time awardees was ~36 years, and that of MD awardees was ~38 years. By 2002, these numbers had increased to ~42 years for MD–PhD and PhD first time awardees and ~44 years for MDs. Since 2002, the average age for PhD at first R award has remained constant, but the age has increased to ~44 or ~45 years for those holding MD–PhD or MD degrees, respectively.[15] By this age, professionals in other fields often have secure positions and significant professional success. In contrast, some physician-scientists are still working to pay education-associated debts.[16] Women and underrepresented minorities may face additional challenges.[17–19] Given that many medical schools have greatly expanded their faculties using a model that requires research-oriented faculty to provide a significant portion of their salary from grants, the implications in terms of job security are amplified by the relatively advanced age of today's first R01 recipients. A simple solution to this might be to discontinue MD–PhD degrees, as abundant examples demonstrate that well-trained MDs (without PhDs) can be outstanding physician-scientists. However, the data show that MD–PhDs who successfully obtain R series awards are slightly younger than MDs, which suggests that the extended duration of predoctoral studies has not delayed career progression for MD–PhD graduates. Moreover, because current medical school curricula include less basic science than those of the past, it may become more difficult to succeed in research without the foundation provided by PhD training. Finally, even if they do not remain active as physician-scientists, >60% of MD–PhD graduates remain in academic medicine.[20] The data therefore support the 2011 National Academy of Sciences recommendation of a 20% expansion of NIH-supported Medical Scientist Training (MD–PhD) Programs.[21]

What Can We Do to Enhance the Success of Physician-Scientists?

To find solutions, it is first necessary to ask if the obstacles facing physician-scientists are different than those of scientists who are not physicians. All scientists struggle with the challenges of building and maintaining a productive research program that continues to innovate over time. However, the physician-scientist must balance these with the responsibilities of patient care while continuing to learn about and integrate the latest knowledge regarding disease pathogenesis, diagnostic tools, and therapies. In addition, the patient must always be a priority, no matter whether one is in the midst of writing a grant or involved in other critical academic pursuits. In addition to the demands of research and patient care, the physician-scientist is responsible for medical licensure, certification and accreditation, billing, HIPAA compliance, and a plethora of other regulatory requirements.[3] As a result, the number of hats worn by the physician-scientist greatly exceeds that of the nonphysician-scientist and even of the peddler in "Caps for Sale." However, rather than selling their caps, physician-scientists cannot even give them away. Further, the successful physician-scientist is typically promoted and asked to don even more caps. It can be a recipe for CAPS. However, the administrative and other burdens that take their toll on the physician-scientist can be reduced through some relatively simple interventions. First, institutions could place limits on clinical, teaching, and other administrative activities during the first few years of each physician-scientist's faculty appointment. This could help to protect young physician-scientists from themselves and their well-meaning chairs and division chiefs. Providing support, such as dedicated nurses or research assistants, could also help to remove some of the caps that budding physician-scientists wear.

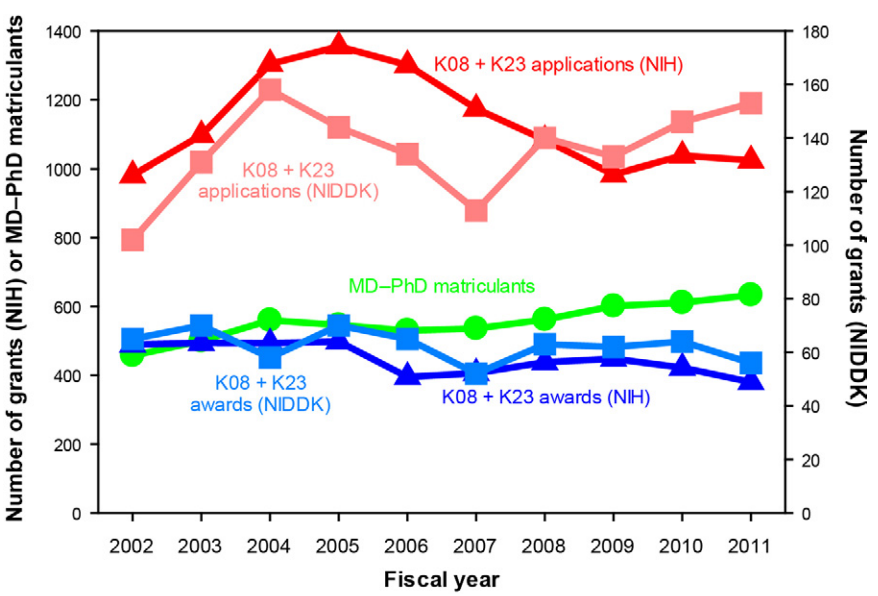

Figure 2. Number of MD–PhD matriculants per year, and sum of annual K08 and K23 applications and awards throughout the NIH and NIDDK from 2002 to 2011.

An Escape Clause?

All of this can make a combined career seem like more trouble than it is worth. Many physician-scientists must share the sentiments of Molelette, the fictional niece who corresponds with her uncle, Mole, in the wry commentary feature Sticky Wicket in the *Journal of Cell Science*. In one exchange Molelette confided that "I'm not sure I'd have the nerve to stick it out in the grant-writing track—even though I love it—if it weren't for the fact that I do have the back-pocket get-out-of-jail free card that comes from that other little degree I did on the side."[22] So, although most physician-scientists enjoy their blended careers, the option to abandon research and focus solely on medical practice is available if it proves too difficult to obtain research funding. Although this may be reassuring to the individual, it is exactly what the system must prevent, not only because of loss of the monetary and human investment, but because physician-scientists are a needed national resource. One prophylactic approach that might enhance job security among both physician-scientists and scientists would be to redefine determinants of research support. Given that the best predictor of future success is past success, the merit of the individual scientist and their history of success could be factored into these decisions. Ideally, such a system would support individuals, rather than projects, and thereby focus on the people who are, after all, our most valuable resource.

What Can Be Done to Prevent CAPS?

Physician-scientists need mentoring. Not only the mentoring we provide to scientists and physicians separately, but also mentoring that helps the physician-scientist understand how to integrate their professional identity. This is particularly critical as budding physician-scientists enter residency training and make choices regarding subspecialty as well as the venue and focus of their postdoctoral research training. These young trainees are often brilliant, but, understandably, spend precious time seeking additional experiences to ensure clinical medicine as a fallback position. Unfortunately, there is a direct relationship between the effort spent preparing different caps and the risk of developing full-blown CAPS. In addition, physician-scientists generally pursue an area of investigation that complements their clinical activities. Thus, in contrast to nonphysician-scientists, who are able to choose a field free of constraints, physician-scientists are more often drawn to questions related to diseases they treat. Although potentially limiting, this is advantageous and rewarding, as clinical experiences can directly impact one's scientific perspective. Integration of clinical and research interests also allows development of a unique niche. Thus, physician-scientists who choose to separate their clinical and research interests fail to capitalize on the synergy that can drive their success. Further, they run the risk of contracting CAPS and having the choice between medicine and science made for them, because it is unlikely that one who splits, rather than integrates, their interests will be successful in our increasingly competitive environment.

In many institutions, the absence of an available group of peers can also contribute to CAPS, particularly at times of career transitions. Nobelists Goldstein and Brown recognized this 15 years ago when they wrote, "The beleaguered individuals who continue to combine basic science and clinical medicine often feel like the chimeric creature in the painting by the famous surrealist René Magritte. Half human, half fish—they are not at home on land or in the sea."[6] Although this could be interpreted as a clash inherent in trying to do two different things, a more integrated approach would be to think of physician-scientists as amphibians who, unlike the chimera, are well-suited to both land and sea. Nevertheless, the financial realities of modern academic medicine make it nearly impossible for physician-scientists to comprise a significant fraction of the faculty in most departments. Thus, new approaches are needed to create a community that supports physician-scientists and prevents them from being seen as "fish out of water."

How Can Physician-Scientists Build a Personal Professional Community?

Communities of physician-scientists, such as that supported by the annual combined meeting of the ASCI, AAP, and AFMR, once existed.[6] Today, the increased specialization within both research and medicine has reduced both the popularity of these general meetings and the potential benefits of networking with those interested in different clinical and scientific problems. The AGA has addressed this issue by creating an Academic Skills Workshop for postdoctoral fellows and young faculty.[23] Similar to the NIDDK symposium for K recipients (next symposium planned for April 20–21, 2013), individuals attend this event only once. In contrast, it might be better for individuals to attend meetings designed for physician-scientists more than once. Such meetings could focus on the complexities of blending clinical practice with research, including techniques to manage these competing demands, discussions of realistic levels of clinical involvement, and analyses of reasonable expectations of grant support. Although lectures could be included, the goal might be more effectively accomplished if the meeting emphasized small group workshops with active physician-scientists. In the best circumstances, these workshops would also facilitate the development of mentoring relationships that provide continuing guidance in real time.

Is There a Special Role for Mentors?

Mentoring is necessary at each stage of the physician-scientist's career. It is particularly important that physician-scientists have the opportunity to establish long-term relationships with successful physician-scientists in the same field, because the need for mentorship is not limited to early career stages. In seeking the best opportunities possible, physician-scientists often complete clinical and research training at separate sites or with different mentors who, in many cases, are not physician-scientists. This partitioning can exacerbate the tension between medical practice and investigation and may also fail to provide guidance in the special challenges of driving a productive research laboratory while providing outstanding clinical care. Some support in learning to balance these demands and overcome other obstacles can be provided within one's own institution, as demonstrated by the success of some faculty development programs.[7] Nevertheless, there is also a role for external mentors who are free of intra-institutional conflicts of interest, such as those provided by the AGA Mentor and Advisor Program.[24] Of course, for this multi-mentor approach to be effective there should be open communication between all who mentor and are invested in the future success of the young physician-scientist. Although this places an extra burden on senior physician-scientists, many of whom may already be wearing too many caps, it is a responsibility that should not be ignored.

Mentoring as a Partnership

For their part, local mentors must be ready to fulfill their own implicit commitments within the relationship. Ideally, mentors share both their interests and projects with trainees while helping mentees to develop independence. Mentors, of whom most are already established in their own fields, can afford to be generous in giving credit to and creating exposure for their trainees. In addition, mentors are able to permit mentees to take an important project area as a foundation for their own independent laboratories and resist the temptation to continue working on the topic until the mentee has developed their own identity. This was the standard practice of my mentor, James Madara, who has a strong record of success in training both physician-scientists and nonphysician-scientists. In his lecture accepting the 2010 Davenport Award of the American Physiological Society, Madara observed that one's own laboratory merely contributes to the growth of scientific knowledge for a brief period and that the work of direct mentees, and their mentees, will ultimately be more important than one's own if only because it builds on knowledge developed previously. On this basis, he concluded that mentoring is a prime variable that determines the rate of advances in scientific knowledge. Such unselfish mentoring is critical to the future successes of all trainees.

The NIDDK as a Stabilizing Influence

Finally, it is critical that, as a scientific community, we communicate our passion for what we do to young physician-scientists. Despite the ongoing constriction of NIH funding, those working in the fields of gastrointestinal health and disease are among the most fortunate. NIDDK has established nominal paylines for FY 2012 of the 13th percentile for most R series awards and 18th percentile for new investigators.[25] This is in spite of the flat NIDDK appropriation and contrasts sharply with paylines well into the single digits at other institutes (eg, 7% at the National Cancer Institute).[26,27] Thus, although there is often a palpably somber mood when funding issues are discussed among investigators, this may be an inappropriate extrapolation in the case of those studying gastrointestinal pathobiology. Indeed, active portfolio management at NIDDK has afforded significant protection to physician- and nonphysician-scientists studying gastrointestinal disease and, as a result, the future of gastrointestinal-oriented biomedical research. Senior investigators should use these data to encourage and reassure junior investigators.

The Rewards of a Career as a Physician-Scientist

Despite challenges, many physician-scientists cannot imagine receiving the same satisfaction from any other career path. Although some choose to be physicians and scientists at different times in their careers, simultaneous activity in both domains can, ironically, provide stability. For example, when progress in one's own lab seems too slow or grant and manuscript reviewers seem unreasonable, time spent in clinical pursuits can reinvigorate by providing both opportunities to succeed in helping patients and a reminder of the ultimate goals of biomedical research. Conversely, when the limitations of modern medicine feel more like personal failures, advances in the lab and trainee accomplishments can provide needed energy and excitement. Further, a career as a physician-scientist allows one to choose from the entire spectrum of research, from basic to translational and clinical investigation; and the choice is not irreversible. The very lucky may even be able to care for patients being treated using approaches developed in their own labs. Despite this exhilarating blend, challenges unique to physician-scientists have grown and strategies to enhance their likelihood of success at each career stage must be developed. These interventions are critical if we are to prevent CAPS and accelerate discovery of cures for medical maladies.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Gastroenterology* at www.gastrojournal.org, and at doi:10.1053/j.gastro.2012.07.0203.

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Supplementary Table 1. K Series Awards, Applications, and Success Rates, 2002–2011.

	NIDDK new awards			NIH new awards		
Year	K01	K08	K23	K01	K08	K23
2002	35	51	14	179	293	196
2003	46	54	16	216	280	214
2004	51	38	20	179	267	226
2005	34	48	22	198	266	232
2006	38	47	18	180	215	180
2007	38	31	21	183	189	217
2008	40	35	28	172	222	216
2009	31	35	27	144	221	227
2010	33	37	27	185	211	211
2011	35	35	21	151	177	203
	NIDDK applications			**NIH applications**		
	K01	K08	K23	K01	K08	K23
2002	56	76	26	422	560	421
2003	90	91	40	503	592	505
2004	122	97	61	563	669	635
2005	103	86	58	645	676	679
2006	97	86	48	654	635	666
2007	106	58	55	578	524	650
2008	75	74	66	443	509	574
2009	70	71	62	395	466	517
2010	96	74	72	465	480	558
2011	104	70	83	441	425	599
	NIDDK success rate (%)			**NIH success rate (%)**		
	K01	K08	K23	K01	K08	K23
2002	63	67	54	42	52	47
2003	51	59	40	43	47	42
2004	42	39	33	32	40	36
2005	33	56	38	31	39	34
2006	39	55	38	28	34	27
2007	36	53	38	32	36	33
2008	53	47	42	39	44	38
2009	44	49	44	36	47	44
2010	34	50	38	40	44	38
2011	34	50	25	34	42	34

NOTE. Data from the NIH Data Book.[12]