Clinician-scientists are an endangered species in ophthalmology. The decline of the proportion of physicians engaged in research (from 5% in 1985 to 2% today) parallels a decline in new molecular entities that successfully pass clinical trials (from 22% in 1980 to 5% today), and an increasing ratio of development costs to successful new drugs and devices. These phenomena likely are more than coincidence. While near-term industry pipelines are related directly to pharmaceutical cadres of basic scientists and programs, leadership given by clinician-scientists in clinical trials and identifying key pathways to target is critical to long-term success. As research is ceded to PhDs, loss of clinical perspective diminishes a sense of what is important and what is feasible. Certainly, grant funding troubles at the National Institutes of Health (NIH), regulatory burdens (often especially stifling in universities), and major pharmaceutical companies withdrawing from basic science are serious issues. Yet, a critical problem is structural challenges in training creating a “leaky pipeline” of clinician-scientists.

The medical scientist training program (MSTP, for MD-PhD development) and the K-series (K08, K12, K23 [which fall under the research career development program]) grants are the principal programs that promote clinician-scientist development. Both have failed. Among different specialties, Ophthalmology attracts a disproportionately high fraction of all MD-PhDs, yet has the highest proportion of MD-PhDs who choose private practice. With respect to K grants, the proportion of awardees going on to earn an R01 grant (the most common research project grant) has fallen off a cliff: 61% of National Eye Institute (NEI) K awardees from 1996 to 2000 went on to this important milestone of a research-oriented career, while only 13% of those from 2001 to 2005 earned an R01, and only 1 of 28 K awardees from 2006 to 2010 did so. Even within NEI-supported K12 programs, only 2 of 9 K12 awardees who did not switch to a K08/K23 earned an R01. While we may have trained too many clinician-scientists during the NIH doubling era, these grim numbers are below the rate of funding for all NEI R01 applications, likely because MD-PhDs can pursue a fully clinical career.

Not only are the MSTP and K failures, but they misallocate scarce training capital. An MSTP slot costs upwards of $350,000 in direct costs alone of 4 years of medical school tuition and 7 to 9 years of stipend. A K award costs $1.1 million in 5 years of support for a 75% research salary, benefits, and supply costs. With present outcomes, it could be inferred that these programs, whatever their original intent, have morphed into subsidies to support existing research fiefdoms rather than engender a critical mass of new talent.

Furthermore, the MSTP and K grants create a vacuum of research exposure in critical training periods of residency and fellowship, a sort of “missing bridge” (Fig.). The resources in these programs should be redeployed to more effective avenues, as opposed to continued misallocation based on inertia. Residency and fellowship are when trainees form their life goals and choose their career paths; it is ironic that we bemoan the disappearance of the clinician-scientist when we do not expose residents and fellows to research in a supportive and exciting way. As an academic clinician-scientist and an MD-PhD student in the final year of graduate research training, we would like to propose a model “Learn-and-Earn” program that could be attractive and integrate research training to bridge the gap in the formative phase of ophthalmology training, after medical school, but before starting a practice. The residency and fellowship phases of this could be either linked or separate, based on departmental emphases and priorities.

**Learn and Earn in Residency**

Ophthalmology residency currently is 1 year of internship (with very loose requirements) + 5 years of ophthalmology

Keywords: education, training, clinician-scientist

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Clinician-scientists are becoming increasingly rare in medicine as a whole, but especially in ophthalmology. There is a structural gap between MD-PhD training and K-series awards where interested candidates go through residency and fellowship without any structured research exposure or involvement. Furthermore, the success rate of the MD-PhD and K awards leaves much to be desired. The authors propose a redeployment of training resources to reconfigure residency and fellowship training programs for interested candidates with sufficient additional time for a credible research project, augmented salary, and sound mentoring. Opportunities for research training in nontraditional pathways to diversify skill sets and build interdisciplinary teams also would be a prime objective of this novel “Learn-and-Earn” approach.
rotations; residents typically make $50,000/y in salary (with significant geographic variation). What if major academic department residencies created slots for a research residency for interested candidates (perhaps 1 per year) by adding 2 research years to make a total duration of 6 years, and augmented the salary to $85,000/y? This would entail a marginal cost of $310,000 (+benefits, 2 years of $85,000/y + 4 years of an extra $35,000/y), but raising salaries to an upper-middle class level would make extra years of training more palatable, at a cost less than an average MSTP slot; transferring funds from the MSTP program to a new research resident program could be a more efficient use of societal training capital. Transferring 3 to 4 elective months from internship and 2 to 3 months from residency, combined with the 2 additional years, would permit 30 months for a substantive research experience in residency. Unlike programs that offer research experience before starting ophthalmology residency, the lion’s share of research time should follow PGY-2 or -3 so that trainees grasp ophthalmology, major problems in clinical practice, and personal interests. Structuring ½ day a week for research on clinical rotations and ½ day a week of clinical training during research time would allow sustaining a research project in collaboration with a technician or postdoc, while maintaining clinical and surgical skills in the research years, and cultivating relationships on “the opposite side of the building.” Interspersing time in this manner would not compromise building of clinical skill sets and knowledge. It must be acknowledged that there would be logistical challenges (matching, rotation and clinical service staffing, accreditation), but these should be manageable with thoughtful scheduling and documentation.

LEARN AND EARN IN FELLOWSHIP

Ophthalmic fellows typically are 1 to 2 years in length and generally earn less than residents (often approximately $35-40,000/y). What if we created research fellowships that subsumed (and shifted) the K program resources into fellowship training, and were modeled on the K99/R00 mechanism available to PhDs? This could mean 3- to 4-year fellowship durations where individuals would be paid $125,000/y (along with benefits and $50,000/y for supply budget), obtain clinical training in their subspecialty, but perform research at a fairly senior level in a mentored capacity for at least 24 months. At a maximum direct cost of $860,000 per trainee over 4 years, this would cost less than a typical K award.

OBJECTIVES

Trainees should immerse themselves in basic research (as a solid, but focused postdoctoral experience that is vanishingly rare in clinical training), clinical trials, outcomes research, or technology development, in concert with mentors who can model successful, fulfilling, and happy careers. A cultural shift in academic ophthalmology should be targeted toward: (1)
selection of medical students and residents with intellectual curiosity, logical rigor, and personal stamina, as well as (2) creation of teams with complementary skills (statistics, basic science, pharmaceutical science, engineering, public health) that could mentor a trainee would be key elements for long-term success; and (3) structured opportunities for a Masters in Cell Biology, Genetics, Bioengineering, or Clinical Investigation, which should be made available so that trainees can acquire a focused, useful credential without superfluous classes or drama of a PhD dissertation.

Building a portfolio of publications relevant to the expected career trajectory should foster a rapid transition to independent research funding without prolonged sequestration from clinical time, which dissuades young ophthalmologists (for income and surgical skill concerns) from pursuing research. Loan repayment could be restructured into “Debt for Discovery” swaps contingent on a certain number of years of academic service/research (like military medicine programs), which could be a means for academic departments to make long-term research opportunities for clinician-scientists more viable and competitive with private practice. Backloading surgical experience in the program would foster retention and a smoother transition to the first faculty position. Ultimately, this will rebuild the bridge between bench and bedside, enabling future therapies to more rapidly and successfully cross the valley of death to the clinic while enhancing leadership in ophthalmic and vision science.

THE ELEPHANT IN THE ROOM

Would these initiatives be for naught if NIH funding percentiles continue to stay low? Hardly. First, while total government budgets are not in the control of the ophthalmology and vision science community, NEI priorities and implementation strategies can and should be. Study section compositions at NEI currently are 90% PhD, 10% MD with predictable consequences for young MD researchers. Changing these compositions will require more MDs to volunteer their time, as well as encouraging NEI leadership to constitute study sections in a more interdisciplinary fashion (perhaps equally represented among PhDs, MDs, epidemiologists, health economists, and industry scientists) to better gauge translational impact.

Second, even if NEI funding remains challenging, encouraging young MDs to stay in research through other extramural programs (Veterans’ Administration, Department of Defense, Patient Centered Outcomes Research Institute, private foundations, industry grants) will have salutary effects. Better structured clinical trials, keener awareness of scientific principles in clinical practice, generation of targeted research questions and hypotheses from practice, and enhanced clinical impact of bench research are important “public goods” that would benefit our field.

It is past time for leaders in our field to change the ecosystem of vision research by making learning new knowledge a way to earn a good paycheck, lest the storied pathway of the clinician-scientist become extinct.

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