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Editorial: The Graying of the (Funded) Musculoskeletal Scientist

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In 1979, James B. Wyngaarden MD, the physician and biochemist who would go on to become the Director of the NIH, declared the physician-scientist an “endangered species” [16]. Happily, reports of the death of biomedical research have proven premature. Nevertheless, pressure on this critical segment of our professional community continues to mount.

Even though relatively few orthopaedic surgeons devote their careers to research, and only a tiny minority of

those ever will receive an NIH grant [13], the pressures our musculoskeletal scientists and clinician-scientists face must matter to all of us. These pressures determine who enters the field as well as which questions they explore. Our shared goal must be to continue to attract the best young minds to musculoskeletal research, to make sure they have the wherewithal and guidance to tackle the most pressing research problems, and to ensure they can make a stable career at it.

After adjusting for inflation, NIH’s budget in 2013 was 21.9% below its 2003 level [11]. In part as a result of this, the average age of a first NIH award has risen continuously since 1999 [11], and more than half of the MD/PhD scientists in the United States will celebrate a 43rd birthday before a first NIH grant. The population of funded biomedical scientists is graying.

Further worsening matters is the fact that most university research scientists now need to cover every dollar of their salaries through grant support [3, 5]. In the vernacular, the contribution of grant support to a scientist’s salary line is called soft money, while hard money is salary support from departments or institutions that does not depend on grant funding. Hard

money is precious because it does not disappear in times of scarcity. Few scientists have access to sources of hard money; in fact, most scientists get hired into soft-money jobs with no institutional salary backstops [3, 5]. Because of this, an important tension exists each time scientists receive a grant: To cover enough postdocs, graduate students, and staff to get the work done, or to use the soft money to cover enough of their own compensation to remain employed. Given that most NIH grants fund only a fraction of scientists’ salaries, that fewer than 25% of NIH-funded scientists have more than one large NIH grant [12], and that budgets are similarly flat at the other major extramural funding sources like the National Science Foundation [8], there is diminishing hope for stable, secure careers in science.

Durable, substantial extramural funding for clinician-scientists is likewise scarce. Only one in 33 academic orthopaedic surgeons carry NIH grants [13] and few orthopaedic surgeons are university-based. But even if most of us do not feel the financial bite personally, this issue affects all of us, as well our patients. And any solutions need to be mindful of the horns of this dilemma: The most transformative

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ideas come from undirected basic science, but the ideas most likely to have the largest impact on patients in the near-to-intermediate future will be those that have some direct connection to clinical practice. We do not want our best minds to go to industry, where remuneration is more secure, but the clinical research is not always driven by the immediate needs of our patients.

We believe that solutions can and should be found at four levels: Departmental, institutional, and federal. We believe also that the American Academy of Orthopaedic Surgeons (AAOS)—as our professional organization—has a role to play.

Departmental Strategies

Orthopaedic departments work at the micro level of a large and complicated system, but the steps they can take would make meaningful differences. Departments can use clinical and philanthropic revenue to hire faculty with expertise in biostatistics and epidemiology, and fund those hires in ways that do not depend on soft money. This investment will allow a broader cross-section of the faculty to have greater success in obtaining meaningful grant funding. In time, at least a portion of the costs incurred will be offset by extramural salary support raised by the biostatisticians or epidemiologists.

Departments also can develop and leverage more creative approaches through intellectual-property arrangements and, again, philanthropic endowments. The latter should focus, where possible, on unrestricted donations. The goal must be to create hard-money safety nets for laboratory scientists. Finally, it is of course at the departmental level where inspiration begins and careers launch: Meaningful resident-research positions (one year or greater in duration, with full funding, and close mentorship) can light fires that burn long, and even small intramural seed grants can help young careers to blossom.

Institutional Solutions

Institution-level solutions offer perhaps the best balance of plausibility and potential impact. In general, medical-center deans are remembered for building buildings, not for growing programs. We have come through an era which saw a great deal of building; the pendulum needs now to swing back to program support. We believe it is unreasonable and unsustainable to expect researchers to subsist entirely on soft money. Some portion of every scientist's salary line needs to come from institutional sources. Institutions should set aside bridge funding to allow investigators to continue their

research endeavors when funding lapses threaten a productive researcher's career. But the hard money must come from somewhere. The degree to which indirect costs might be usable to support programs is controversial, as is the degree to which the incentives created by federal indirect-cost-recovery programs advance or retard goals that all involved care about [1, 2, 4, 6, 9, 14]. Indeed, even the three of us could not agree on how to modify indirect-cost calculations or how those funds should factor into institution-level solutions. We do agree, though, that the lights need to stay on, that administrative support is necessary for preaward and postaward management and compliance, and that old buildings from time to time need to be refreshed.

Finding hard money will require hard choices. Deans must evaluate program size and diversity, and cut unproductive programs so as to focus limited resources on sustaining the best ones. Cost sharing with federal funding sources is another controversial but important topic. Here, the term "cost sharing" refers to institutional funding lines for scientists created in some proportion to the extramural salary dollars received. Some federal agencies mandate that institutions provide such support; others do not [15]. Forward-thinking deans will make programming and faculty-size decisions as though federal cost-sharing

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requirements were more common across all federal funding sources, as they may someday be. Necessarily, this will require reallocating resources from other priorities, and perhaps decreasing the overall size of the faculty, increasing class sizes, or raising tuition. Though unappealing, any of these options would be preferable to the system now, which offers career promises to young scientists based on illusions of available support.

Thoughtful observers—including the current director of the NIH [7] and the past editor of *Science* [1]—have questioned whether it is appropriate any longer for research scientists to depend so substantially on soft money. We believe it is not.

Federal Approaches

The NIH and other large federal funding sources can change the rules of the game. In terms of specific approaches, we favor expanding the K99/R00 program, which helps transition postdoctoral fellows into new faculty, though we recognize that doing this in a budget-neutral way would require shifting resources from elsewhere. We feel the benefits justify this shift, since this program helps investigators to hit the ground running in new-faculty roles better than most other funding mechanisms. We also

believe that the NIH ought to relax restrictions on how much time a clinician-scientist needs to spend in the lab when funded by a K-award. Currently, these generally require a principal investigator to devote 75% effort to the project [10], which makes it impractical for young clinician-scientists to compete for these awards and remain clinically active.

We also believe the NIH needs to focus on right-sizing indirect costs, and to evaluate continuously the regulations associated with them, in order to ensure that the incentives these payments create drive institutional behavior in desired directions. One reason indirect costs are so high is that institutions are held to a dizzying array of regulatory standards, which vary tremendously even among the US federal funding sources. Harmonizing compliance requirements, as the feds did with Grants.gov, will help universities streamline institutional responses and may help lower indirect costs across the board, allowing the funding of more grants.

What the Academy Can Do

The fact that so many important clinical questions remain unanswered harms patients, and imposes heavy costs on our economy. Vendors introduce (and surgeons employ) expensive implants without any proof of

superiority; new surgical treatments enter practice with no demonstration of greater efficacy. National societies such as the AAOS might be well positioned to lead a consensus-driven national process to identify the most pressing unanswered questions that scientists and clinicians can tackle together. The Academy also can spearhead solutions—in partnership with philanthropic agencies (such as the Orthopaedic Research and Education Foundation) and federal entities—to help prioritize the funding of those projects. Requests for proposals on topics of importance seem more likely to deliver answers to the questions that matter most than processes allowing applications on any topic research scientists find interesting. More federal funding should be directed towards answering high-priority questions identified by the AAOS and the Orthopaedic Research Society, to which the NIH already does look for guidance; members of those societies are well positioned to continue to make the clear case for why this is so important. Finally, Academy members should serve on NIH study sections when asked, and they should help identify the clinically important questions we all know need to be answered. Although this kind of participation is time consuming, it is the most direct way surgeons have to guide a critically important process.

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References

1. Alberts B. Overbuilding research capacity. *Science*. 2010;329:1257.
2. Alberts B, Kirschner MW, Tilghman S, Varmus. Rescuing US biomedical research from its systemic flaws. *PNAS*. 2014;111:5773–5777.
3. Benderly BL. Does the U.S. produce too many scientists? Available at <http://www.scientificamerican.com/article/does-the-us-produce-too-m/>. Accessed on April 28, 2016.
4. Bienenstock A, Arvin AM, Korn D. Perspective: Have universities overbuilt biomedical research facilities? Available at <http://issues.org/31-3/perspective-have-universities-overbuilt-biomedical-research-facilities/>. Accessed on May 1, 2016.
5. Biomedical Research Workforce Working Group. Biomedical research workforce working group draft report. June 14, 2012. Available at http://acd.od.nih.gov/bmw_report.pdf. Accessed on April 28, 2016.
6. Bourne H. Why ignore these icebergs—1. Available at <https://biomedwatch.wordpress.com/2012/07/06/why-ignore-those-icebergs-i-3/>. Accessed on April 28, 2016.
7. Collins FS. Opportunities for research and NIH. *Science*. 2010;327:36–38.
8. Editorial: Don't hide the decline. *Nature*. 2014;507:139.
9. Ledford H. Indirect costs: Keeping the lights on. *Nature*. 2014;515:326–329.
10. National Institute of Mental Health. Table of K parameters. Available at <http://www.nimh.nih.gov/funding/training/table-of-k-parameters.shtml>. Accessed on May 3, 2016.
11. Research Portfolio Online Reporting Tools (RePORT). Chapter 2: The physician-scientist workforce: Past, present, & future. Available at https://report.nih.gov/workforce/psw/historic_al_concerns.aspx. Accessed on April 28, 2016.
12. Rockey S. Update on myth busting: Number of grants per investigator. Available at <https://nexus.od.nih.gov/all/2011/05/13/update-on-myth-busting-number-of-grants-per-investigator/>. Accessed on May 2, 2016.
13. Stavrakis AI, Patel AD, Burke ZDC, Loftin AH, Dworsky EM, Silva M, Bernthal NM. The role of chairman and research director in influencing scholarly productivity and research funding in academic orthopaedic surgery. *J Orthop Res*. 2015;33:1407–1411.
14. Stephan P. Research efficiency: Perverse incentives. *Nature*. 2012;484:29–31.
15. University of Michigan, Research and Sponsored Projects. Cost sharing requirements. Available at <http://orsp.umich.edu/cost-sharing-requirements>. Accessed on May 5, 2016.
16. Wyngaarden JB. The clinical investigator as an endangered species. *N Engl J Med*. 1979;301:1254–1259.