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## Sustaining the Rheumatology Research Enterprise

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Workforce; Education

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Rheumatology academic divisions have historically been comprised of physician-scientists conducting both basic and clinical research with each scientist leading a group of technical staff and trainees. Recent substantial changes in how science is conducted and funded and in the make-up and demographics of the Rheumatology workforce are causing disruptions to this paradigm and are threatening the health of academic divisions nation-wide. How we as a community deal with this threat will affect the future of our specialty in the coming decades.

In this issue, Ogdie et. al., on behalf of the ACR Young Investigators Committee, report the results of a survey of 430 Rheumatologists and trainees (1). The survey questions were based on a comprehensive list of barriers to and facilitators of a successful research career compiled based on a literature review with further modifications after discussion by the committee. The survey was distributed online to all US ACR members with a response rate of 9.2%. Although the response rate was low the survey captures a relevant group of rheumatologists, many of whom are fellows or junior faculty in academic institutions and 40% of whom are actively pursuing a research career. The survey also included 97 respondents who left a research career, and identified reasons for this attrition.

The results of the survey clearly indicate that funding and institutional supports are the major factors that contribute to the successful transition to or failure-to-launch of an independent research career. The availability of an outstanding mentor is an additional facilitator. These results are similar to those of surveys of young physician-scientists in other specialties and reflect the current perilous state of research by physician-scientists in academic medicine. Large numbers of free comments by the survey respondents contribute many suggestions for improving the landscape for young investigators (1) -Table 3).

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## Insufficient Funding is Strangling the Academic Research Pipeline

The survey by Ogdie et. al. has correctly identified insufficient funding as a major barrier to starting and maintaining a research career. The NIH is the major source of funding for biomedical research in the US with new investigators typically supported by “K” awards, 5-year grants that provide a research salary and foster progression to independence under the guidance of a mentor.

Over the last decade, however, Congress and two Presidents failed to recognize the importance of NIH funding to the sustainability of the biomedical research enterprise, and authorized budgets that effectively decreased available funding. Today’s NIH budget, when adjusted for inflation, is >20% lower than it was in 2003 (2). Beginning in 2003 these budgetary constrictions led to decreases in the number of NIH-wide mentored awards for physician-scientists including basic science K08 and clinical science K23 awards. Clearly, this decline has had an impact on the career choices of trainees. Between 2006 and 2014 there were striking declines in NIH-wide mentored grant applications, including a 42% decline in K08 and a 23% decline in K23 applications (3).

Funding declines have also imperiled the post-training period. The erosion in NIH research funding has had drastic repercussions for the Rheumatology community. From 2010 to 2014 there was a 30% decrease in the number individual investigator RO1 grants awarded to ACR members (4). This number is ominous since investigators who lose their resources may close their laboratories or stop maintaining their databases and permanently discontinue their research activities. Although foundations have stepped up awards to investigators at all stages and have made essential contributions to both the financial and intellectual support of the scientific community, particularly in RA and SLE, this support only partially stems the tide. Foundation grants encourage innovative new lines of research and are typically of 2–3 year duration, providing a less stable source of support than 5-year NIH “R” level funding for established projects. Shorter-duration grants effectively increase investigator workload as more grants need to be written more often in order to sustain research endeavors. As a result, the level of anxiety is raised, especially for young researchers in need of stability. This is evidenced by the themes summarized in Table 3 and the free comments of the survey respondents. The impact of these changes is a decline in the number of new physician-scientists, especially those conducting basic science research necessitating large amounts of protected non-clinical time.

Hospitals and medical schools are also under increasing financial stress and are no longer able to provide the protected time and start-up packages that are required to generate preliminary data and write competitive grant applications. Indeed, apart from lack of funding, lack of divisional and/or institutional support and increasing demand for clinical activities to support academic salaries were cited as major barriers to progressing in a research career and were the most frequent reasons cited for leaving academia.

## The Perfect Storm: Mentors Wanted, But Lacking

The quality and quantity of mentoring is crucial to the development of research scientists. In the report by Ogdie et. al. mentoring was cited as an important facilitator to a successful

research career; however, its absence was less well recognized as a barrier to achievement. Mentoring has always been time-consuming, and today it requires even greater efforts than in past years. Current conditions place extra stresses on mentors who are competing for their own research funding and face increasing administrative responsibilities. In addition experienced mentors are increasingly in short supply. There has been a general aging of the biomedical workforce as evidenced by the increase in the average age of physicians at the time of receipt of their first RO1 grant, and the age of established physician-scientists in all specialties. In Rheumatology there has also been a drain of qualified mentors to the pharmaceutical industry. As the number of mentors decreases, more demands are placed on the remaining workforce, resulting in a “perfect storm” in which more mentoring is required but less is available.

### **Organizational and Cultural Barriers to Research Sustainability**

Several other factors are increasing the challenge of initiating and maintaining a research career. While the potential of translational research to improve patient health has never looked brighter, experimental approaches have become increasingly technology driven, necessitating the formation of investigator groups with multiple layers of expertise; these changes are making the research model of the one PI-one laboratory/clinical center obsolete. Today’s research success is frequently the work of large groups most often led by highly seasoned and successful investigators. These structures can inhibit the meaningful entry and contribution of young physician-scientists whose success is essential to the sustainability of the research enterprise. Recent literature describing the dynamics of group meetings and the failure to adequately recognize the contributions and ideas of women (5) are disturbing in this regard and need to be taken seriously by all working groups within the Rheumatology community.

More broadly, as the survey by Ogdie et. al. shows, there is a growing emphasis among younger physicians on greater work-life balance compared to decades earlier. In particular, women face the demands of child-bearing and child-rearing, which may significantly impact their career choices. Women comprised 64% of the researchers surveyed by Ogdie et al, and constitute ≈60% of our current Rheumatology fellows compared with 40% of currently practicing US Rheumatologists (6). Even male physicians are now most likely to be part of two-career families in which work-life balance needs to be achieved, and relocation for career advancement becomes difficult. The severe shortage of research funding combined with the increasingly common institutional requirement that investigators generate a minimum number of research dollars per square foot to cover facility and administrative costs (i.e. indirect costs), has developed simultaneously with this desire for greater work-life balance, making a career in medical research much less attractive. Women are additionally prone to institutional gender biases that affect their career advancement at every level and make it difficult to meet the career advancement expectations and promotion clock set by many institutions (7–8). Multiple studies have shown that the cultural environment of medical schools is not one in which women faculty feel accepted or are given the support necessary to succeed, and this is evidenced by the general lack of women faculty in leadership positions. In 2014 52% of instructors in Departments of Internal Medicine but

only 19% of full professors were women. Similar disparities apply to the percentage of tenured faculty (9).

In response to these challenges, the research enterprise needs to change in a way that does not simply follow the path of least resistance. There has been a recent trend to replace physician-scientists with clinician-educators who carry the clinical load demanded by financially strapped institutions, and with PhD scientists who are integrated into academic divisions. These groups however, are not replacements for our current aging population of physician-scientists who are the most likely to perform and lead investigator-initiated translational work. There needs to be commitment at the divisional and entire community levels to strengthen the pipeline of young physician-scientists. Metrics to determine the status of our young physician- investigator enterprise and their workforce needs will be required so that planning can be undertaken at the national level to ensure the continuing health of our academic divisions.

### **Solution #1: Increase Research Funding from All Sources**

There has clearly been a substantial decline in national funding for research over the last decade. Unfortunately, there does not seem to be interest in restoring the NIH budget to an inflation-adjusted spending level, let alone increasing it to capitalize on new discoveries and technical advances. While the recently convened NIH Physician-scientist Workforce Working Group recommended welcome increases in funding for the training of young physician-scientists (2) the shortage of 5-Year independent investigator R awards means that newly independent physician-scientists will still struggle to maintain their nascent research careers. Experienced mentors will also continue to be over-extended and their numbers limited. In short, unless more funds are also available for established scientists it is difficult to envision substantial growth in the physician-scientist workforce.

Foundation funding has traditionally helped to support young Rheumatologists; however, there has been steady erosion in trainee funding from foundations as they have switched their focus to investigator-initiated awards. Fortunately, funding to trainees from the Rheumatology Research Foundation (RRF) has been stable. With grants designed primarily to support young investigators up to the K level the RRF has become the major source of funding to young Rheumatologists entering a research career. Due to the decrease in K applications, the current NIH success rate for K grants has been maintained between 30–40%, allowing at least some of our young investigators to transition successfully to these awards. The importance of this award cannot be overstated since previous receipt of a K award markedly enhances success in obtaining a subsequent R award. A particularly successful RRF mechanism therefore has been the K “Bridge” Award that supplies one year of funding to K applicants who missed the payline so that they can resubmit their applications. Since the inception of this award 15/19 recipients of the Bridge Award have received their K funding, rescuing investigators who have already made a substantial investment in their research careers (Amy Kane, Rheumatology Research Foundation, personal communication). Nevertheless there is considerable drop-off of young physician-scientists during the entire training period with conversion of a K award to an R award (with its current 15% success rate for new investigators) being a particularly perilous stage (2, 4).

A commitment by the Rheumatology community to substantially increasing the endowment of the RRF would go a long way towards buffering the effects of austerity at the NIH. Collaboration among foundations and between foundations and academic groups will also help in developing a national plan for support of the Rheumatology research endeavor. The recent partnership between the Arthritis Foundation and CARRA to align scientific agendas and expand research in the area of juvenile arthritis is an example of a mechanism to attract new donors to a large research area.

Another potential source of research funding, particularly for supporting infrastructure for clinical studies, is pharmaceutical companies. The recent Accelerated Medicine Partnerships project, in which the pharmaceutical industry has partnered with the NIH to provide funds to 11 groups of investigators across the country for basic research in rheumatoid arthritis and SLE, is a new mechanism that, if successful, may form the basis for similar endeavors in the future. Inclusion of young scientists within these groups is essential in order to provide an unparalleled training opportunity in “big science”, and maintain our workforce pipeline.

Philanthropy is an alternative source of funding for academic divisions, especially those in wealthy areas of the country. Institutional support in form of expertise in the development of philanthropic campaigns can greatly assist physicians identify and approach grateful patients who may be willing to ‘give back’ and help the research enterprise. Of the many challenges in this area is the fact that patients typically fund research for their own disease, so important diseases may be underfunded if they don’t affect many patients with philanthropic capacity.

Finally, individual Rheumatologists can make a big difference. Our Rheumatology foundations need more support and the whole community can help by soliciting funds from grateful patients, making personal contributions or volunteering time for administrative functions. Political action may also help to improve funding at the state and national level.

## **Solution #2: Changes in Institutional Visions**

A career in research requires persistence and resilience, and our current situation places a huge demand for these qualities in our young investigators. Nevertheless, institutions can make important changes to their policies to help foster the careers of physician-scientists.

Firstly, it is no surprise that mentoring makes a great difference to the success or failure of a research career. Provision of mentoring to young investigators will require greater supervision and planning at the medical school and divisional levels to help ensure that young scientists identify and enlist the support of appropriate mentors. These mentoring relationships can benefit from a formal support structure. For example, NYU Langone Medical Center provides training opportunities for mentors and mentees that include grant writing assistance and requires that junior faculty select and report to mentoring committees that oversee and help define individualized goals and timelines. Mentors can also help ensure that young investigators are actively included in team science activities such as meetings and conference calls that may be crucial for their development. Similarly, disease-focused, multicenter interest groups should institute mechanisms for ongoing recruitment of young members and provision of mentoring. Rheumatology divisions can also make optimal

use of the K24 mechanism that frees up mentoring time for mid-career investigators performing clinical research.

Institutions also need to be flexible about their metrics for success. With this in mind, using the number of RO1 grants as a primary metric for promotion/tenure is no longer relevant and new criteria that recognize the varied contributions of academic faculty to team science should be established. Similarly, timelines for generating full salary support from external sources need to be reexamined in light of current funding constraints. Protected time to generate high quality preliminary data, together with strong mentoring oversight is a required investment for any young investigator seriously pursuing a research career. It has been the knee jerk response of institutions to demand more clinical productivity of young investigators who do not yet have full external support for their salaries. Such an approach may be counterproductive. Indeed, at the Feinstein Institute our clinical investigators are salaried and do not directly rely on patient billing for their income. This allows the necessary time for the building of physician-patient relationships that facilitate recruitment of patients to investigator-initiated clinical trials that have attracted a strong portfolio of external funding.

Finally, given the large numbers of women now entering the Rheumatology workforce, we cannot afford to ignore the biases that impede the careers of women in academic medicine. An emerging literature over the last decade has documented the nature and consequences of these biases (8); interventions to improve career outcomes for women are beginning to be instituted at the NIH and at several larger medical schools. These include gender equity with respect to salary, provision of on-site childcare or sick childcare, part-time work strategies, individualized career plans, a more flexible promotion clock, skill development workshops, provision of role models and institution of new policies in a transparent and accountable fashion. The successes of institution-wide interventions at Stanford Medical School and at the University of Pennsylvania Medical School are examples of what may be achieved with an appropriate institutional commitment (10–12).

Despite the current austere conditions a number of our academic divisions continue to thrive. It would be helpful for these divisions to develop and share a set of “best practices” that could be adapted by others. In addition we need to continue to recruit the best and brightest residents to a career in Rheumatology, particularly MD, PhD graduates who have the best metrics for success in obtaining research funding. Rheumatology divisions need to lobby for early exposure of medical students and residents to outstanding Rheumatology clinicians who can inspire them to “Choose Rheumatology”.

## Conclusions

Physician-scientists are crucial in our increasingly science driven specialty to initiate new innovations in biomedical research, improve health care delivery for our patients and educate the next generation. The Rheumatology research enterprise is clearly under threat as a result of decreases in funding, changes to the structure of health care delivery, and demographic and cultural changes in our workforce itself. The Rheumatology community needs to develop a cohesive plan for solutions that address the barriers to a successful

research career and help grow the Rheumatology physician-scientist workforce in a sustainable manner. Part of this planning needs to incorporate changes that are conducive to the retention and promotion of women in our academic workforce. Nevertheless, without an expeditious restoration of NIH funding to pre-austerity levels, or the emergence of major alternative sources of funding for investigators at all career levels, only few of our academic centers are likely to be able maintain investigative groups of sufficient critical mass to advance discoveries that will improve patient care.

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