

# Barriers to and Facilitators of a Career as a Physician-Scientist Among Rheumatologists in the US

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**Objective.** To determine perceived barriers to and facilitators of a career in rheumatology research, examine factors leading rheumatologists to leave an academic research career, and solicit ways to best support young physician-scientists.

**Methods.** A web-based survey was conducted among the domestic American College of Rheumatology (ACR) membership from January through March 2014. Inclusion criteria were ACR membership and an available e-mail address. Non-rheumatologists were excluded. The survey assessed demographics, research participation, barriers to and facilitators of a career in research, reasons for leaving a research career (when applicable), and ways in which the ACR could support junior investigators. Content analysis was used to extract relevant themes.

**Results.** Among 5,448 domestic ACR members, 502 responses were obtained (9.2% response rate). After exclusions (38 incomplete, 2 duplicates, 32 non-rheumatologists), 430 responses were analyzed. Participants included fellows, young investigators, established investigators, mentors, clinicians, and those who previously pursued a research career but have chosen a different career path. Funding and mentoring were the most highly ranked barriers and facilitators. Protection from clinical and administrative duties, institutional support, and personal characteristics such as resilience and persistence were also ranked highly. The most commonly cited reasons for leaving an academic research career were difficulty obtaining funding and lack of department or division support.

**Conclusion.** This is the first study to examine barriers to and facilitators of a career in rheumatology research from the perspectives of diverse groups of rheumatologists. Knowledge of such barriers and facilitators may assist in designing interventions to support investigators during vulnerable points in their career development.

*It is the progressive decline in the number of new entries that constitutes the danger to the survival of the species in the numbers and quality needed to maximize the rate of progress against the serious diseases of mankind.*

James B. Wyngaarden, MD (1)

## INTRODUCTION

In 1979, James B. Wyngaarden, MD, future director of the National Institutes of Health (NIH), called the physician-scientist an “endangered species” as he noted rapid de-

clines over the previous two decades in the number of clinicians also trained in research methodology and simultaneously acting as a physician and “serious scientist” (1). While the American medical system has evolved and funding sources have risen and fallen in the decades following Dr. Wyngaarden’s paper, the same concern about the small pool of physician-scientists remains. Francis Collins, MD, current director of the NIH, recently commissioned a Physician-Scientist Workforce Working Group (PSWWG) with “analyzing the current composition and size of the physician-scientist biomedical workforce and making recommendations for actions that NIH should

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## Significance & Innovations

- The physician-scientist workforce is aging, fewer young investigators are entering the workforce, and maintaining a career in research is challenging. To our knowledge, this is the first study to examine barriers and facilitators of sustaining a career in rheumatology research and reasons for leaving a career in rheumatology research.
- While funding is a major barrier to (or facilitator of) a career in research, mentoring is critical to the development and sustenance of a career in rheumatology research.
- Protected research time, protection from clinical and administrative duties, personal characteristics, passion for the job, and institutional support were also highly ranked facilitators of a successful career in rheumatology research.

take to help sustain and strengthen a robust and diverse PSW.” The executive summary, published in June 2014, reports a shrinking NIH budget compared to previous levels of funding, an aging physician-scientist workforce, and a decline in the number of new physician-scientists entering the workforce (2). Additionally, a high rate of attrition exists among those initially choosing a research career, with significant dropout between receipt of an NIH career development award (K series) and obtaining an R01-level project grant (2).

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Physician-scientists in rheumatology have dramatically improved our understanding of rheumatic diseases, directly propelling the unprecedented growth of effective therapies such as biologic agents in the past 15 years. The aging workforce and smaller number of physician-scientists is particularly a concern in rheumatology (3). Continued understanding of rheumatic diseases and generation of novel therapeutics could thus be in jeopardy. Therefore, the development and cultivation of young rheumatology investigators is critical to the future of rheumatology.

While research and salary support for clinician-investigators is clearly a concern, the NIH PSWWG notes that other issues beyond funding also contribute. However, the specific barriers and facilitators for maintaining a career in research remain unclear. If such barriers and facilitators are identified, strategies may be developed to target obstacles and better support investigators, particularly young investigators launching their career.

The objectives of this study were to 1) determine the perceived barriers to and facilitators of a career in rheumatology research, 2) examine factors leading to rheumatologists leaving a career in research, and 3) determine how the American College of Rheumatology (ACR) can best support young investigators through the early part of their career.

## SUBJECTS AND METHODS

**Participants.** We conducted a survey among the ACR membership living in the US. Inclusion criteria consisted of current or previous fellowship in rheumatology, membership in the ACR, and an available e-mail address. Non-rheumatologist members of the ACR were excluded. This study was approved by the University of Pennsylvania Institutional Review Board.

**Survey instrument.** The survey instrument was developed through the use of a Delphi method (see Supplementary Figure 1, available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22569/abstract>). The full survey is available in Supplementary Appendix A (available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22569/abstract>). The instrument included items reflecting demographics, including age, sex, underrepresented minority status, current position and job type (e.g., academics, private practice, industry), academic rank if applicable, and year entering rheumatology fellowship. Branching logic was used to identify current investigators, research mentors, and rheumatologists who have left research careers. Reasons for leaving a career in research were solicited both via a list of options and through free-text comments. Next, participants were asked to rank the top 10 barriers to and top 10 facilitators of a career in rheumatology research (ranked from 1–10). Participants were asked to select useful formats for providing support to young investigators (e.g., workshops, webinars, etc.). Free-text responses solicited ways in which the ACR can best support young investigators and any additional comments.

**Survey administration.** The surveys were sent on January 15, 2014 and closed on March 15, 2014, with one reminder e-mail on February 12, 2014. REDCap software was used to administer the surveys anonymously via an e-mail with a link to a web-based survey. Participants completing the survey were eligible to enter a drawing for complimentary registration for the 2014 ACR/ARHP (Association of Rheumatology Health Professionals) Annual Meeting in Boston, Massachusetts.

**Statistical analysis.** After excluding incomplete surveys and duplicates, demographics were summarized. Barriers and facilitators were categorized as important if ranked as 1, 2, or 3 of 10. The proportion of “important” ratings was reported for each barrier and facilitator. We then examined whether individual categories of participants (young investigators, mentors, fellows, and those who left a career in research) rated these barriers and facilitators differently from the remainder of the participants using a chi-square test.

Content analysis (4) was performed for free-text comments for 1) reasons for leaving a research career, 2) ways in which the ACR can support young investigators, and 3) general comments. Two coders (AO and YJ) developed a coding list (see Supplementary Appendix B, available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22569/abstract>) and iteratively applied these codes to the comments. Discrepancies were resolved through discussion with a third coder (UEM). Percent agreement between AO and YJ was 98%. Themes that emerged from the qualitative responses were discussed among the study team and are shown below.

## RESULTS

**Survey participants.** Among 5,448 domestic ACR members, 502 responses were obtained within the 8-week time-frame (9.2% response rate). Among the participants, 32 were excluded because they were not rheumatologists, 38 were incomplete, and 2 duplicates were identified and excluded. The final number of responses for analysis was 430. This included 309 adult rheumatologists, 62 pediatric rheumatologists, 42 adult rheumatology fellows, and 17 pediatric rheumatology fellows. Demographics of the participants are shown in Table 1. The majority of participants (71%) were working in academic medical centers. Among those with academic affiliations, 34 were instructors (or equivalent), 102 were assistant professors, 58 were associate professors, and 89 were professors.

Among the survey participants, 171 (40%) reported actively pursuing a career in research (147 faculty, 24 fellows). Of these, 64% were women. Types of research are shown in Table 1. Additionally, 52% of those actively pursuing research considered themselves a young investigator (defined as within 6 years of completing fellowship), and 44% indicated they were a mentor to a young investigator. Although the median percent effort dedicated to research was 15% (interquartile range [IQR] 2–70%) among all participants, young investigators reported a median percent effort dedicated to research of 75% (IQR 70–80%).

**Participants who have left a research career.** Ninety-seven participants (23%) indicated that they had previously pursued a career in research, but decided to switch career paths. This career change occurred a median of 10 years prior (IQR 3–20 years), with a median transition point 7 years after fellowship (IQR 2–14 years) (see Supplementary Figure 2, available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22569/abstract>). Previous research types and current positions are shown in Table 2. Approximately half of the participants were women. The most commonly reported reasons for leaving research were difficulty obtaining funding and lack of department or division support. In free-text comments (n = 51), participants cited additional reasons for leaving research, including great clinical burden and insufficient protected time to be successful in research endeavors, financial factors (e.g., difficulty supporting family financially, difficulty covering loans with low salary), lack of mentorship, an unsupportive environment or institution, and personal reasons (e.g., new opportunities in administration, teaching, and/or clinical care; need to move to a new geographic area without opportunities for research; increasing age; need for increased job security; and fear of having to move if not successful in obtaining funding or achieving tenure):

“I had to see more patients to support my salary in academic medicine. This made it difficult to pursue research. The university used to pay [a] large part of our salary, but they stopped doing that, requiring rheumatologists to see patients to generate their income.”

“I had to move for family reasons. I would have preferred moving to academia in the geographic region of interest, but there was not a realistic amount of protected time available in the jobs I considered to be able to conduct research. Also, because of the number of years spent with inadequate compensation, I needed higher pay to support putting the kids through college.”

When asked what would have kept these rheumatologists in research, the most common responses included increased protected time and availability of internal grant funding mechanisms. Analysis of free-text comments revealed additional issues, including the need for job security, improved mentorship, less politics, and more supportive institutional environments:

“Job security was what drove me out of academics. I was at a high-powered academic center and I loved it, but I calculated my odds of getting tenure at about 50%. R01 funding at NIAID [National Institute of Allergy and Infectious Diseases] at that time was under 10% and the rule for tenure at my institution, as I understood it, was 2 grants. MANY junior faculty were not getting tenure. My kids would have been in the middle of high school when my time for a tenure decision arrived, and I decided not to risk having to move them.”

**Barriers and facilitators.** Barriers to and facilitators of a career in research are outlined in Figures 1 and 2, respectively. The most highly ranked barrier to and facilitator of a career in research was funding. This was of significantly greater concern to young investigators than to

**Table 1. Demographics of survey participants with complete data (n = 430)\***

	Value
Current position	
Adult rheumatologist	309 (72)
Pediatric rheumatologist	62 (14)
Adult fellow	42 (10)
Pediatric fellow	17 (4)
Place of employment	
Academic medical center	306 (71)
Clinical practice	97 (23)
Industry	20 (5)
Government	3 (1)
Retired	4 (1)
Academic appointment	
Instructor or other junior faculty	34 (8)
Assistant professor	102 (24)
Associate professor	58 (13)
Professor	89 (21)
Other or not applicable	147 (34)
Year completed fellowship, median (IQR)	2005 (1987–2012)
1960–1969	8 (2)
1970–1979	31 (7)
1980–1989	82 (19)
1990–1999	56 (13)
2000–2009	102 (24)
2010–2013	81 (19)
2014–2016	64 (15)
Missing	6 (1)
Female sex	241 (56)
Medical school in the US	318 (74)
Underrepresented minority†	28 (7)
Effort, median (IQR) %‡	
Clinical	50 (20–75)
Research	15 (2–70)
Teaching	5 (4–10)
Administrative	5 (0–11)
Successful funding	
Foundation fellowship/postdoc award	92 (21)
Foundation career development award	99 (23)
NIH Loan Repayment Program	24 (6)
NIH K series or VA career development award	76 (18)
NIH R01 award	59 (14)
Other NIH awards	71 (17)
Any other grants	141 (33)
Current researcher	
Total	171 (40)
Young investigator	88 (20)
Mentor to young investigator	76 (18)
Research effort ≥50%	134 (31)
Research effort ≥70%	100 (23)
Type of research§	
Clinical	88 (51)
Epidemiology/health services	18 (11)
Translational	99 (58)
Basic science	53 (31)
<p>* Values are the number (percentage) unless indicated otherwise. IQR = interquartile range; NIH = National Institutes of Health; VA = Veterans Affairs.</p> <p>† An underrepresented minority within rheumatology was defined as African American, Hispanic, or Native American (i.e., American Indian, Alaska native, and native Hawaiian). This information has not been collected among American College of Rheumatology members in general. However, among early career rheumatologists in the Rheumatology Workforce Survey, approximately 9.7% ascribed to similar categories (3).</p> <p>‡ Effort estimates exclude fellows.</p> <p>§ Among those currently engaged in research (n = 171), &gt;1 answer per participant was allowed; therefore, the total adds to greater than 100%.</p>	

Table 2. Participants who decided to leave a research career (n = 97)*	
	Value
Female sex	45 (46)
Years since transition, median (IQR)	10 (3–20)
Year of fellowship completion, median (IQR)	1993 (1983–2005)
Years after fellowship when transition occurred, median (IQR)	7 (2–14)
Current position	
Adult rheumatologist	78 (80)
Pediatric rheumatologist	14 (14)
Adult fellow	5 (5)
Pediatric fellow	0 (0)
Place of employment	
Academic medical center	52 (54)
Clinical practice	24 (25)
Industry	17 (18)
Government	2 (2)
Retired	2 (2)
Academic appointment (current)	
Instructor or other junior faculty	6 (6)
Assistant professor	14 (14)
Associate professor	21 (22)
Professor	22 (23)
Other or not applicable	34 (35)
Previous type of research	
Clinical	47 (48)
Epidemiology/health services	8 (8)
Translational	36 (37)
Basic science	49 (51)
Factors contributing to decision to leave	
Difficulty obtaining grant funding	55 (57)
Lack of division/department support	51 (53)
Better compensation	38 (39)
Lack of mentorship	38 (39)
Tired of writing grants	33 (34)
Personal reasons†	26 (27)
Desire to spend more time in clinical care	20 (21)
Exciting opportunities in industry	10 (10)
Did not enjoy research work	6 (6)
What would have retained you in a research career?	
Provide internal grant funding mechanisms	54 (56)
Increase protected time	50 (52)
Increase income	31 (32)
Increase work flexibility	25 (26)
Provide greater leadership opportunities	25 (26)
Nothing would have incentivized me to stay in academics	9 (9)

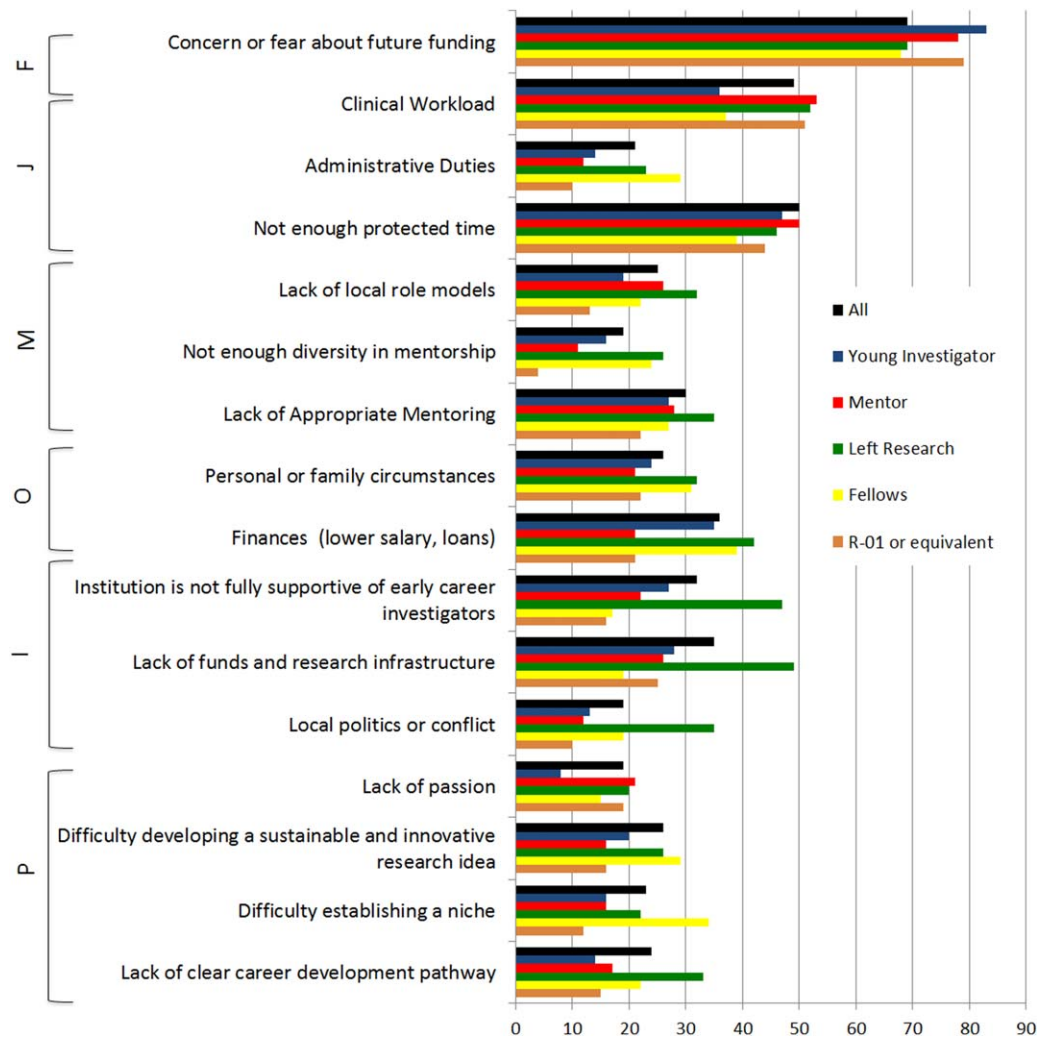
\* Values are the number (percentage) unless indicated otherwise. IQR = interquartile range.  
† Personal reasons included desire to move geographically (n = 16) or desire to spend more time with family (n = 15).

other participants. After funding, the next most commonly reported barriers were clinical workload, insufficient protected time, lower salary, and lack of institutional research infrastructure. Facilitators of a career in research, aside from sufficient funding, were protected research time, outstanding mentors, institutional support, and funding for young investigators, as well as personal skills or traits such as hard work, resilience, initiative, persistence, and passion for the job.

We next examined differences in the frequency of barriers and facilitators reported by subgroups (see Supplementary Table 1, available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22569/abstract>). Beyond funding, participants who had left a

career in research were significantly more likely to report lack of institutional research infrastructure, lack of access to key people in the field, lack of diverse mentorship, local politics or conflict, poor relationship with the division chief, and lack of a clear career development pathway as important barriers, and noted formal research training and ability to establish a niche as important facilitators. Fellows were more likely to report presentation skills and difficulty establishing a niche as important barriers.

Evaluation of free-text comments revealed only a few additional themes. Several participants (n = 8) indicated that gender issues still remained a barrier to pursuing a career in research. Others indicated that the need to care



**Figure 1.** Barriers to a career in research. Among all survey participants, the most commonly cited barriers are shown for all participants and then subgroups of participants. The x-axis shows the percentage of participants ranking each item as important (defined as ranking the item as 1, 2, or 3 of 10). The barriers are split into the following categories: F = funding; J = job duties; M = mentoring and networking; O = outside influences; I = institution; P = personal skills and characteristics. Additional barriers and *P* values for differences between groups are shown in Supplementary Table 1 (available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22569/abstract>).

for young children and the inability to allow flexibility in grants for time off to have children and part-time work prevented their continuing research careers:

“The majority of ACR leadership seems to be men, while younger members are more likely to be women. ACR should also have a program for young women investigators who go through pregnancy. . .etc.”

“The early investigator definition of 6 years from fellowship completion disadvantages young women with babies/young kids during that timeframe from participating in onsite workshops.”

“I was a classic example of the female academic who falls off the tenure track.”

“There is no room at the academic table for us lowly clinician educators or for women who still have to deal with the numerous micro hits that torpedo our careers.”

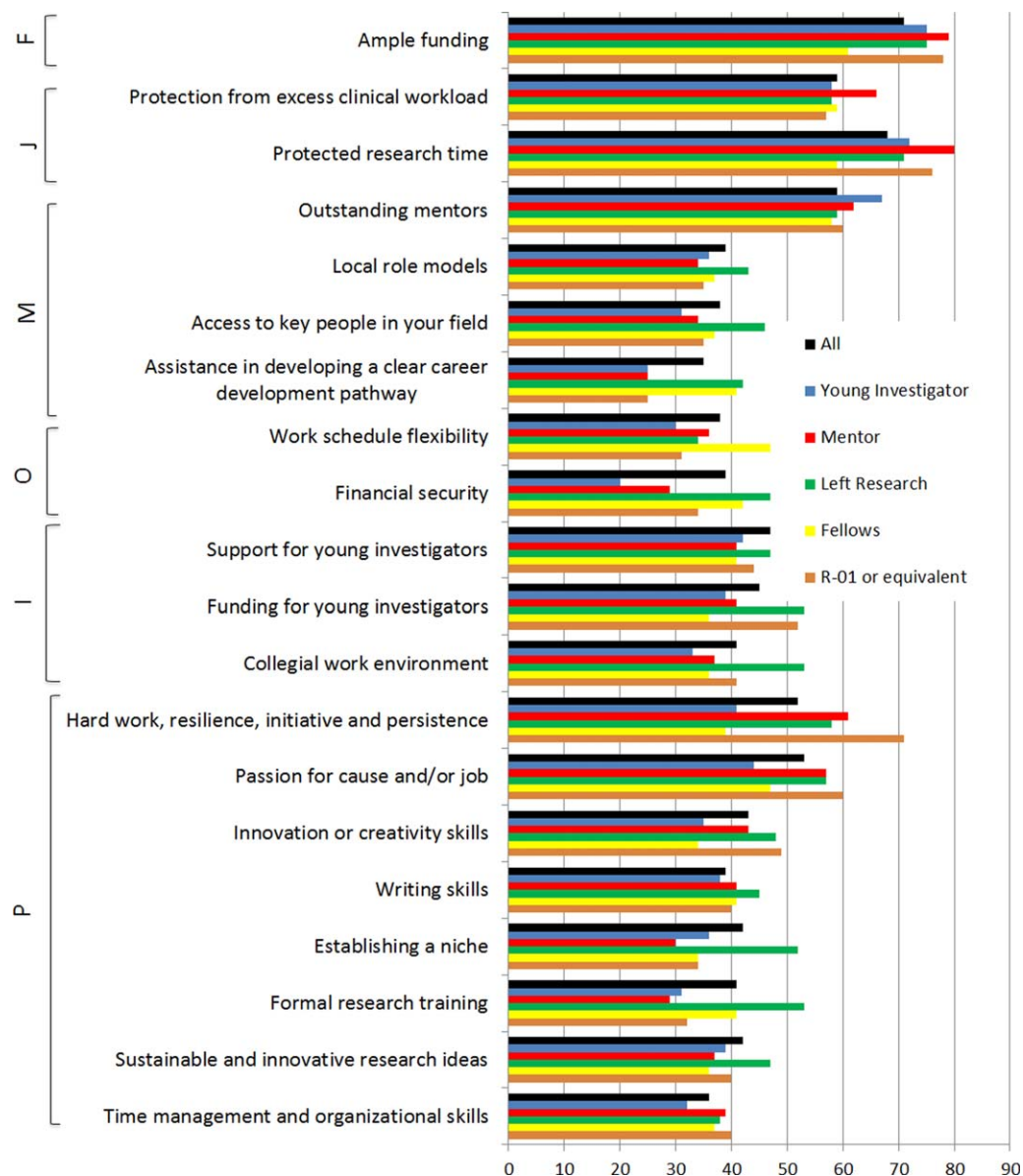
“When I was a fellow, male fellows were offered academic positions with several-year contracts, but female fellows were offered only 1-year contracts.”

A fear of failure or lack of confidence in abilities was also reported by 2 participants. Lack of institutional infrastructure for research and lack of knowledge about the needs of young investigators on the part of both the division chiefs and fellowship directors were cited as barriers.

Numerous participants indicated that clinical workload and administrative duties are a significant burden to researchers:

“Why does everyone in academia have to do everything (teach, research, write, see patients)? Academia needs to re-examine the way things have ‘always’ been done.”

“Keeping junior faculty researchers productive despite the ever-increasing demands that clinical work places on part-



**Figure 2.** Facilitators of a career in research. Among all survey participants, the most commonly cited facilitators are shown for all participants and then subgroups of participants. The x-axis shows the percentage of participants ranking each item as important (defined as ranking the item as 1, 2, or 3 of 10). The facilitators are split into the following categories: F = funding; J = job duties; M = mentoring and networking; O = outside influences; I = institution; P = personal skills and characteristics. Additional facilitators and P values for differences between groups are shown in Supplementary Table 1 (available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22569/abstract>).

time clinical faculty, including administrative duties required for CME [Continuing Medical Education], compliance, ICD-10 [International Statistical Classification of Diseases and Related Health Problems, Tenth Revision] training, MOC [maintenance of certification], etc., is a significant burden.”

Some participants noted that the environment for careers in research is changing:

“The landscape has changed dramatically over my career. Most importantly, it has become harder to obtain funding, but almost as important, commitment to family has grown, in part because the majority of our trainees and young faculty are women, but also because this has become more important

to men. Thus, while there used to be an issue of balancing time for research with time for clinical care and teaching, there is now a greater issue of balancing time for family. I think that this is a good thing, but it is nonetheless an issue.”

With regard to facilitators, several participants noted that successful researchers require all or many of the facilitators listed:

“A successful young investigator needs to have ALL of the things listed above. If a young investigator is missing ANY of them (funding, time, mentorship, work ethic/passion, family support), then they will fail.”

**Supporting young investigators and improving the research environment.** Participants were asked to give a free-text answer to the question, “How can the ACR best support young investigators?” and a free-text space was available for additional open comments. A total of 632 comments from the 2 items were reviewed. Content analysis revealed numerous themes related to improving the research career landscape for young investigators, many of which were directed at efforts the ACR could pursue to improve support for young investigators (Table 3). These responses were categorized as follows: funding, mentoring, career development and skill building, increase interest in and sustainability of research as a career, improve the research environment for young investigators, and miscellaneous. Overall, participants were supportive of the ACR’s current endeavors:

“Continue the strong funding support options available through the Rheumatology Research Foundation – these are critical with the shrinking NIH portfolio.”

The most commonly reported theme was the need for increased funding, particularly for young investigators, but also increased pilot funding from the ACR extended to diseases other than inflammatory arthritis and bridge funding with attention to the K-to-R transition. Participants also suggested increasing the salary support from grants, including federally funded grants:

“\$75K for a K award is not sufficient to support a salary and institutions do not provide money to support the gap. Thus, K award holders spread themselves thin to get more grants to provide salary support rather than spending the 75% protected time on the specific K award research project. Thus, allowing for overlapping funds is important.”

Participants encouraged continuation and expansion of advocacy efforts to increase NIH funding directed toward rheumatic diseases:

“Advocacy for arthritis research funding at NIH.”

“Continued federal lobby[ing] to interest lawmakers in medical research – we are really not considered in any political budget discussions.”

“...Highlight the potential benefits to be derived from research...and the importance...in ultimately furthering the field. The public needs to know, and perhaps become energized to help push for research dollars and support.”

The need for mentoring was the second most commonly reported theme. Participants suggested developing a structured, cross-institutional mentoring program for interested researchers and similarly to increase networking for young investigators with experienced investigators. Furthermore, many participants also noted that support for mentors is also important for the development of young investigators.

“My primary concern is not direct support for the trainees but rather the available pool of mentors – ever shrinking with limited funding and the exodus of talented rheumatology

researchers away from academic medicine. So to me, in order to adequately support trainees we need to make big steps to facilitate the ability of ‘veteran’ researchers to remain intact.”

“If there are lapses in funding, then an entire career in academic medicine is lost, as institutions force faculty to either leave or drop research altogether. Those of us who are still standing are absolutely overwhelmed with mentoring responsibilities, even as junior faculty, since there is a huge gap in mid-level faculty who have left for practice or industry. We are happy to do our research and mentor those after us, but not if a single year of lapsed funding results in job loss.”

Other common themes included the need for development of grant writing skills through workshops, webinars, and mentorship; development of a community for young investigators to provide peer mentoring; encouragement for formal research training; development of standards for research training in fellowship or a core research curriculum; continued support for career development workshops; collaboration among institutions; support for protected time; and better compensation for investigators. Participants also suggested development of a loan repayment program, early research exposure for medical students and residents, and more comprehensive research exposure early in fellowship. Finally, participants suggested that the ACR should work with institutions to educate department chairs, division chiefs, and fellowship directors about the needs of young investigators and how to best support them and provide support for young investigators from institutions without strong research enterprises.

When asked which formats are best for presentation of career development programs, workshops or seminars, sessions at the ACR/ARHP Annual Meeting, mentoring programs, and networking opportunities were selected by more than one-half of the participants (Figure 3).

## DISCUSSION

In this mixed-methods study, we report the perceived barriers to and facilitators of a career in rheumatology research among young investigators, fellows, mentors, established investigators, and those who have left a career in research. Our qualitative and quantitative results confirmed previous findings that research funding is a major concern for investigators, particularly given increased competition for dwindling NIH funding (2). However, protected research time, protection from clinical duties, and mentorship frequently ranked as important barriers and/or facilitators. Examination of reasons rheumatologists left research also revealed the importance of institutional support.

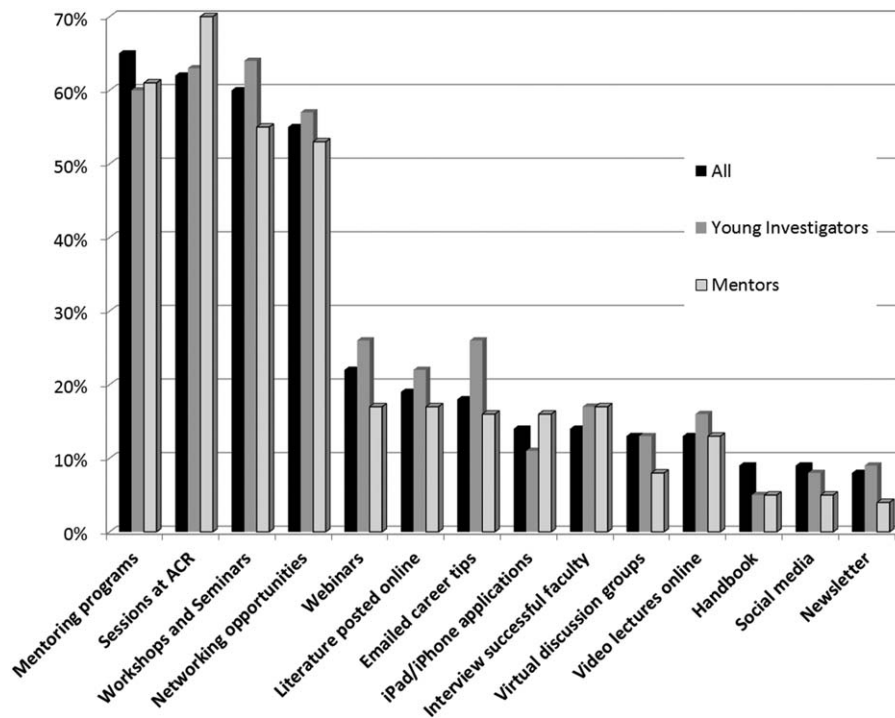
To our knowledge, this is the first study to examine barriers to and facilitators of a career as a physician-scientist in the US from the perspectives of diverse constituencies, including young investigators, mentors, fellows, and those who decided to leave a career in research. Additionally, this is the first study to examine reasons for leaving a career in rheumatology research. Strengths of this study include the development of survey items using the Delphi technique and the relatively large number of responders



**Table 3. Themes derived from content analysis of free-text comments\***

	No. (%)
Funding	299 (70)
Early career and young investigator grants	62 (14)
Bridge funding (before K award, between K award and R01, or between R01s)	32 (7)
Pilot grants and smaller project funding	19 (4)
ACR should advocate for more federal funding	18 (4)
Need more federal funding	17 (4)
Loan repayment programs	14 (3)
Midcareer funding	13 (3)
Funds for research assistant or startup funds	11 (3)
Funding for non-US citizens	6 (1)
Increase salary support in grants	5 (1)
Partner with other organizations	5 (1)
Promote the success of rheumatology research (both ACR and NIAMS funded)	4 (1)
Find more donors	3 (1)
Career reentry awards	2 (0.5)
Mentoring	135 (31)
Develop structured mentoring networks	48 (11)
Fund and support mentors	16 (4)
Mentor training	6 (1)
Career development and skill building	211 (49)
Increase opportunities for networking	57 (13)
Grant writing support and/or workshops	44 (10)
Host programs and workshops for career development	41 (10)
Disseminate information about resources for young investigators, including funding opportunities, job opportunities, research initiatives, research needs in the field using the website, and interactive media, including webinars, online forums, and e-mail distribution lists	21 (5)
Assist investigators with the K to R transition	20 (5)
Help young investigators develop their research focus and ideas	17 (4)
Support formal research training (e.g., masters programs)	16 (4)
Training in career skills such as presentation skills, leadership development, and negotiation	14 (3)
Provide example career paths and assist in assessing career path	14 (3)
Create a community for young investigators	14 (3)
Specific training in research skills such as basic biostatistics, clinical trials training, navigation of the research environment (e.g., IRBs, MTA), and research professionalism (e.g., guidelines for authorship)	12 (3)
Support research fellowships and/or time in another laboratory	8 (2)
Encourage early participation in the ACR	8 (2)
Help individuals assess their own skills	5 (1)
Provide access to resources such as statistical support, data, etc.	3 (1)
Increase interest in and sustainability of research as a career	117 (27)
Increase research training in fellowship starting at the beginning of fellowship	31 (7)
More protected time	31 (7)
Better compensation	21 (5)
Provide early research experience for undergraduates, medical students, residents, and fellows	20 (5)
Encourage cross-institutional collaboration	16 (4)
Salary security	15 (4)
Foster the development of the next generation of rheumatologists (both clinical and research)	12 (3)
Nontraditional career paths to keep investigators in academics and research (e.g., part time for parents with young children)	2 (1)
Improve the research environment for young investigators	71 (17)
Support clinicians who in turn can help support research	25 (6)
Support young investigators from institutions without solid research infrastructure and mentors	14 (3)
Educate division chiefs and fellowship directors about how best to support young investigators	10 (2)
Provide advice or mediation for young investigators in conflict situations	4 (1)
Improve study sections at NIH	4 (1)

\* ACR = American College of Rheumatology; NIAMS = National Institute of Arthritis and Musculoskeletal and Skin Diseases; IRB = institutional review board; MTA = Material Transfer Agreement; NIH = National Institutes of Health.



**Figure 3.** Formats most useful for presentation of career development and research training initiatives. Participants were asked to select formats for presentation of information relevant to career development and research training for young investigators. Young investigators and mentors identified similar formats as being useful, except that young investigators more often selected web-based formats compared to mentors. ACR = American College of Rheumatology.

(albeit a small proportion of the ACR), many of which provided very detailed and specific comments.

The Early Career Section of the American College of Cardiology recently conducted a similar survey of early career academicians in their field and found very similar results to those presented in our study, including insufficient funding, clinical workload, and lack of institutional commitment as major barriers to a career in research (5). A handful of other studies have indicated funding (5–7), mentoring (5,6,8,9), clinical workload and focus on clinical productivity (5,7,10), lack of protected time (5,11), economic disadvantage to a career in research (5,10,11), lack of institutional support and resources (5,6,10), organizational problems (7), lack of availability of collaborators (5), lack of support for women (7), personal attributes (6), and concerns about career sustainability (9) are influential in pursuing or maintaining research careers.

Attracting rheumatology fellows into a career in research is also important. A study by the ACR Young Investigators Committee in 2009 examined rheumatology fellows' perceptions of a career in research and demonstrated the fellows view a research career path as "high risk" (12). Fellows noted barriers to an academic rheumatology career path focused on funding issues, including decreased federal funding for research, increasing competition for foundation funding, and tightening budgets at academic institutions, but also concerns about the incompatibility of family life and academia. The latter concern about incompatibility with family life is a particular concern given the increasing number of women in rheumatology (3,13). Previous studies

have suggested that effective mentorship is particularly important for the career development of women (14).

Limitations of our study include potential responder bias, low response rate, bias in item selection, and misinterpretation of survey questions. As with all surveys, there may be responder bias, particularly in this case, as more investigators than clinicians and more academicians than non-academic rheumatologists responded. It may be that those who responded were more likely to have strong opinions. Similarly, some participants could have participated more than once and, given the anonymity of participants, we may have missed some duplicates. We excluded responses in which the demographics were identical and the comments were nearly identical. Next, in building the items for the survey, we performed a Delphi exercise among the Early Career Investigator Subcommittee, all of whom are assistant professors devoting the majority of their time to research. This may have biased the results obtained. Additionally, question order or grouping may have influenced answer selection. We addressed these risks by seeking additional comments.

Participants noted several potential solutions to the mentioned barriers, including 1) development of a formal cross-institutional mentoring network; 2) lobbying for increased NIH funding; 3) working with institutions to educate division chiefs and fellowship directors on the needs of young investigators; 4) providing more career development training, including topics such as grant writing, how to be a mentee, providing example career paths and assistance in developing career development plans,

balancing clinical duties and research activities, developing collaborations, time management, and skill-based training; and 5) creation of a list serve or community for young investigators to network and share common experiences and advice. Additional solutions suggested by other studies include potential changes to NIH funding mechanisms such as reinstatement of a specific R award for K awardees attempting to achieve R funding for the first time (15), institutional support in the way of childcare services and mentoring for individuals struggling with work–life balance (13), creating and seeking new funding mechanisms through partnerships with industry and non-profit organizations (5), and increasing research opportunities during fellowship (5).

In summary, in order to attract young investigators into rheumatology research and sustain their careers, knowledge of the obstacles faced and the elements that facilitate career persistence are critical. This study revealed that funding and mentoring are the two greatest resources for young investigators, but that numerous other factors play a role in the development and sustenance of an investigator. Protection from excessive clinical and administrative duties is also important particularly early in the investigator's career, when he or she is gaining the necessary skills to facilitate success. Many of the barriers and facilitators identified are dependent on institution-specific resources and personal characteristics and situations. However, informing young investigators about how to locate and leverage such resources and how to find support for individual circumstances may improve the landscape for young investigators. Improved and more wide-reaching mentoring could potentially have a large impact on some of the barriers noted. In partnership with the Childhood Arthritis and Rheumatology Research Alliance (CARRA), the ACR developed the ACR/CARRA Mentoring Interest Group (AMIGO), a novel program aimed at matching pediatric rheumatology fellows and junior faculty with mentors of similar interests at other institutions (16). This model has been successful and could potentially be expanded to include adult rheumatologists. With that being said, participants recognized that mentors need protected time, funding, and recognition for their efforts (17).

As the American medical system continues to evolve in the next decade, the challenges facing young investigators will likewise evolve. The ACR has made support for young investigators a significant part of their mission. A continued effort to address and meet the needs of young investigators and established investigators who serve as their mentors is critical to maintaining the physician-scientist workforce in rheumatology and supporting advancements in our understanding of the etiology and optimal treatment of the rheumatic diseases.

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## AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be published. Dr. Ogdie had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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