

## Career Development of Young Physician–Scientists in the Cardiovascular Sciences

### Perspective and Advice From the Early Career Committee of the Cardiopulmonary, Critical Care, and Resuscitation Council of the American Heart Association

Sachin Agarwal, Edda Spiekerkoetter, Eric D. Austin, Vinicio de Jesus Perez, Cameron Dezfulian, Bradley A. Maron, John J. Ryan, Monique A. Starks, Paul B. Yu, Sebastien Bonnet, Sarah M. Perman

**B**ased on our collective early career experiences, we will provide the key elements in a road map for a successful physician–scientist. Discussion includes the importance of mentoring, establishing successful collaboration, time management, work–life balance, and submitting a successful grant.

The current climate is challenging to launch and sustain a physician–scientist career. The combination of budgetary cuts in funding, financial disincentives to academic careers, increased educational debt, and rising institutional administrative demands make it daunting to choose to enter a research career.<sup>1,2</sup>

According to National Institutes of Health (NIH) statistics (2000–2016), the success rate for first independent (R01) applications has plateaued in past 5 years (18%–20%) and continues to remain below the 30% levels seen 10 to 15 years ago while the number of new applications is on the rise. Perhaps, even more disconcerting is the recent attrition of NIH-funded physician–scientists. About 40% of M.D.s with a K08 (mentored clinical scientist development) award do not even apply for independent funding.<sup>3</sup> NIH data (1980–2016) also highlights the increase in the average age of funded clinician

investigators to 45 years of age. In addition, the number of women physician–scientists applying for K and R01 awards is strikingly low.<sup>4</sup> Given these factors, the biomedical sciences have noted a decline in physician–scientists; 95% enter into clinical residencies but only 81% take positions in academia or research.<sup>5</sup>

Numerous obstacles to becoming a successful physician–scientist exist. However, under the correct circumstances and with the right support, this career is attainable, rewarding, and enjoy a strong employment market. In this manuscript, we provide a road map to a successful physician–scientist career and provide practical advice based on experiences, struggles, and challenges that members of the Early Career Committee have faced and overcome.

#### Mentorship for the Early Career Investigator

Seeking effective, robust mentorship is strongly encouraged and valued by funding agencies as exhibited by the volume of dedicated funds for mentored career-development awards. Early career investigators should consider identifying multiple mentors to support a multifaceted career. They should have local as well as remote mentorship within areas of expertise that they hope to attain. Although individual mentorship is crucial, mentorship teams provide variable content expertise, institutional expertise, and varied personal experiences.

Effective mentoring is strongly associated with career satisfaction and higher proportion of research-oriented faculty staying on track.<sup>6</sup> Mentorship not only provides guidance but also resilience against the inevitable failures that come with academic careers.<sup>7</sup> Most junior faculty, particularly women, identify lack of work–life balance as a major issue, and mentors can help address how to integrate a demanding career into their equally demanding personal life. Mentees should not feel a need to select mentors based on similarities of sex or race, rather examples of what they wanted for their own life and career.<sup>8</sup>

A good mentor–mentee relationship should have mutual respect, shared goals, clear expectations, a good personal connection, and reciprocity.<sup>9</sup> Furthermore, accessibility is another crucial aspect of good mentoring. Mentees should actively set the agenda for meetings, providing goals and expectations, guiding the flow of information, and following up with the mentor about action items. A perception of competition with the mentor or personal issues, such as sexual harassment, verbal or

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

From the Neurocritical Care, Columbia University, New York (S.A.); Pulmonary and Critical Care Medicine, Stanford University, CA (E.S., V.d.J.P.); Department of Pediatrics, Vanderbilt University, Nashville, TN (E.D.A.); Department of Critical Care Medicine, University of Pittsburgh, PA (C.D.); Department of Cardiovascular Medicine, Brigham and Women's Hospital, Boston, MA (B.A.M., P.B.Y.); Department of Cardiovascular Medicine, University of Utah, Salt Lake City (J.J.R.); Department of Cardiovascular Medicine, Duke University, Durham, NC (M.A.S.); Department of Medicine, Laval University, Quebec, Canada (S.B.); and Department of Emergency Medicine, University of Colorado, Denver (S.M.P.).

The online-only Data Supplement is available with this article at <http://circres.ahajournals.org/lookup/suppl/doi:10.1161/CIRCRESAHA.118.312999/-/DC1>.

Correspondence to Sarah M. Perman, MD, MSCE, Department of Emergency Medicine, University of Colorado, School of Medicine, 12401 17th Ave, Suite 711, Aurora, CO 80045. E-mail [sarah.perman@ucdenver.edu](mailto:sarah.perman@ucdenver.edu)

(*Circ Res.* 2018;122:1330–1333.)

DOI: 10.1161/CIRCRESAHA.118.312999.

© 2018 American Heart Association, Inc.

*Circulation Research* is available at <http://circres.ahajournals.org>

DOI: 10.1161/CIRCRESAHA.118.312999

physical abuse, are major contributors to failed mentorship relationships.<sup>9</sup> Given the complexity and importance of the mentor–mentee relationship, identifying a mentor often requires more than a single meeting. In addition, the need for mentorship does not expire once one successfully transitions to independence but necessary for the duration of one’s academic career.

## Getting Research Funded

### Selecting a Content Area

It is important for the early investigator to select an area of content to pursue. Although it may be appealing to explore subjects that are currently being funded, it is challenging to build a research career around a topic that is not specifically of interest to the investigator. The authors think while blending your research and clinical interests may be ideal, having a strategic clinician partner could well serve this purpose.

### Timeline for a Competitive Proposal

Long-term planning is essential to formulate the most competitive proposals addressing significant yet unanswered questions in the field.

1. Establish the project topic with advice from the primary mentor: 12 to 24 months. Proposal writing: 6 to 12 months.
2. Solicit support letters from collaborators, references, departmental/divisional leadership: 2 months.
3. Mentor and experienced peer review: 1 month.

### Identifying Suitable Funding Mechanisms

Various grant mechanisms are available to help individuals transition to independent funding, but NIH-funded career awards have the most explicit and stringent evaluation criteria, serving as the most highly-regarded milestones for success as a junior investigator. For these reasons, this discussion will focus on factors that contribute to successful NIH K submissions.

There are several NIH Career-Development (K) Awards available for junior faculty (Online Table 1). Evaluations are based on 5 criteria: (1) candidate, (2) career-development plan, (3) research proposal, (4) mentor/consultants/collaborators, (5) environment and institutional commitment. Notably, the proposal itself is not the most important criterion for success, but if the proposed research and career-development plan enhances the candidate’s potential for a productive, independent research career.

### The Candidate

We recommend a strong publication record, likely the most important criterion while judging a candidate’s potential for independence. Publishing peer-reviewed science in high-impact journals validates several skill sets, including leadership, scholarship, efficiency, resilience, and the ability to communicate science.

1. Be a finisher: lead projects to completion and publication. Avoid significant publication gaps: aim to publish at least 1 first author manuscript per year.
2. Discuss publication strategy frequently with mentors.
3. Although first authorship manuscripts are important, collaborative work warrants multiple cofirst authors and middle authorships.

Delays in manuscript writing are often attributed to perfectionism, fear of criticism, imposter syndrome, time management problems, procrastination, and binge writing at deadlines.<sup>10</sup>

### Formulating a Career-Development Plan

The program should address deficits in experience or expertise for which additional training is necessary, such as didactic coursework, workshops, or specific skills training. It should clearly define a path toward developing scientific independence.

### Cultivating a Network of Mentors

Most career-development awards will require a mentoring team including a senior mentor and mentors with content or methodologic expertise.

1. Peer mentors: At a similar or slightly more advanced position. Share grant opportunities, success, and failure stories in funding, and most importantly, their previous funded grants as templates.
2. Senior mentors: Individuals with administrative leadership roles after having established successful research programs. Provide seasoned advice, broad perspectives, and networking/collaborative opportunities.
3. New mentorship and collaborative relationships: Via interactions at scientific meetings or by introductions from mentors, new relationships can be developed. Using a team-science approach, translational and interdisciplinary research projects are being aggressively promoted by institutions and funders. In earlier career stages, while striving to become established, a well-defined role in a subproject or section of a greater collaboration may be beneficial.<sup>11</sup>

### Institutional Support

Evidence of an institution’s investment in developing a candidate either through start-up funds, space, or research infrastructure is now heavily emphasized. The trainee should not make strategic decisions on their research idea based entirely on a perceived niche or need in the department but should not ignore the importance of contributing something unique or novel compared with other researchers.

### Resilience and Feedback

When an application is not successful, it is important to seek feedback from trusted mentors so that one can objectively evaluate the strengths and weaknesses of the application and help interpret reviewer feedback. Persistence and the willingness to adapt to constructive criticism are the keys to eventual success.

### How to Secure Long-Term Success

Early success and positive feedback in a scientific career is a predictor of future success. To secure long-term success, combine long-term, higher risk projects with short-term, low-risk projects. Although these initial efforts might lead to middle-author rather than lead-author contributions, they document research productivity and can attract attention. Diversification of a research portfolio should be guided by thematic coherence.

**Table. Summary Recommendations for a Successful Physician–Scientist Career**

<b>Establishing a strong mentor–mentee relationship:</b>
Mutual respect: There must be shared respect between the 2 participants to foster a long-term relationship that will advance both careers
Shared goals/reciprocity: A clear common goal that will potentially benefit both parties. This benefit is not necessarily event but should have commonality to ensure that both parties are committed
Accessibility: One on one meetings are integral to career success. If the mentor does not have sufficient time for the mentee, then potentially, this is not a positive partnership to enter into for an early state investigator
Mentee driven: Research meetings should be driven by the mentee and frequent assessment of team progress is necessary to continue to advance in your science and your mentored relationship
<b>Getting research funded</b>
Choose a content area that is compelling to you and will afford strong mentorship and funding opportunities
Identify suitable funding mechanisms and contact program officers to ensure a good match between agency and your idea
Create an appropriate timeline to ensure sufficient lead in time for the ideas to develop and for potential changes in project design
Cultivate your study team as you cultivate your ideas. Ensure that you have the best team to conduct the work you propose
Be resilient and persistent. Most grants do not get funded on the first submission, prepare for the worse and celebrate the successes
<b>Protecting writing time<sup>10</sup></b>
Time: create a routine time for writing, schedule an optimal daily amount (short but consistent)
Space: find a comfortable, easy to get to, functional, with minimal distractions (cookie jars, telephone, television etc)
Getting started: Have a writing space stocked with necessary materials, recall times in the past when you wrote productively, establish, or re-establish a consistent habit and ritual of daily writing
Changing behavior: Make a chart of your daily writing process, make success unavoidable each day by having attainable goals, with modest expectations, make a list of your most common work-avoiding behaviors and develop strategies against them, do not reward yourself for not writing by engaging in pleasure-seeking activities during writing time, rather make a desired activity contingent on having done some writing
Thoughts and feelings: Notice your self-talk about writing, pay in particular attention to thoughts that are demoralizing and overwhelming, consciously replace unhelpful messages with positive, hopeful ones. An unreasonable harsh critic is common among blocked writers
People issues: Develop and use relationships with colleagues or other writers you can share your work with, and be specific about the kind of feedback you desire. Avoid isolation
<b>Work–life balance</b>
Time management. Clearly define your goals and ensure that those are being prioritized among all of the competing demands on your professional time
Learn to say no when the ask is not crucial to career advancement, not requested of you by potential collaborators/senior faculty, and when it potentially will side line you from your goal. But, keep in mind that some deviations can be career defining, so say no wisely
Protect time for personal wellness, including family and friends

**Time Management and Work–Life Balance**

Time management is a challenge uniformly encountered by physician–scientists. How to establish a research career while also meeting the requirements of an academic faculty appointment and one’s personal life is no easy feat. Although early career investigators often receive warnings not to become overcommitted to other career endeavors, caution must be applied as these tasks may become opportunities for career advancement, and professional as well as personal satisfaction.

**If Only There Were More Than 24 Hours in a Day**

To prioritize one’s time, strong self-reflection and clearly defining one’s goals for today, tomorrow, and future is paramount. Each commitment should inform either an immediate goal or build toward a future goal. Balancing both career and personal desires is essential to avoid conflict potentially leading to failure in one, or even both aspects of one’s life.

**Learn to Say No**

Saying no may be one of the most uniform struggles for early career investigators. The fear of disappointing mentors, chairs, and colleagues is daunting. What seems to be a small commitment can easily detract from focused work and become distractions from achieving one’s own goals.

In academia, there is more to the global mission than the research agenda: contributing to overall departmental goals is emphasized. Try to ally administrative duties within one’s interest to fuel personal career satisfaction. These duties might even lead to future collaboration or research. Keeping lecture requirements within one’s content area is beneficial.

**Fuel Your Soul**

Missing family events and late night grant writing are part of physician–scientists life; however, if you focus on a topic you are passionate about, it will make these challenging times more tolerable. If an opportunity arises that could potentially meet a personal or career goal, consult with mentors and most importantly your family and friends to make the best decision. Be sure to make their needs a priority: career success is better celebrated with loved ones; and bad days are often forgotten when one can spend time with those who fuel one’s soul.

Although building a physician–scientist career might seem daunting, we hope that we have conveyed that it is an attainable and gratifying career goal. We have provided a roadmap (Table) that summarizes our recommendations to excel as a physician–scientist in translational research.

**Acknowledgments**

American Heart Association Cardiopulmonary, Critical Care and Resuscitation Early Career Committee Members: Harm Bogaard, Evan Brittain, Stephen Chan, Hyung Chun, Michael Cocchi, Jonathan Elmer, Christophe Guignabert, Bryn Mumma, Roxane Paulin, Sudarshan Rajagopal, Brian Roberts, Kurt Ruetzler, Thenappan Thenappan, Corey Ventetuolo, Mark Gladwin.

**Sources of Funding**

Dr Cameron Dezfulian is supported by American Heart Association (AHA) Grant (17UFEL23750003); Dr Bradley Maron is supported by AHA Grant (15GRNT25080016). The remaining authors have no sources of funding directly associated with this work.

Downloaded from <http://circres.ahajournals.org/> by guest on May 22, 2018

## Disclosures

None.

## References

- Rosenberg LE. The physician-scientist: an essential—and fragile—link in the medical research chain. *J Clin Invest*. 1999;103:1621–1626. doi: 10.1172/JCI7304.
- Zemlo TR, Garrison HH, Partridge NC, Ley TJ. The physician-scientist: career issues and challenges at the year 2000. *FASEB J*. 2000;14:221–230.
- Dickler HB, Fang D, Heinig SJ, Johnson E, Korn D. New physician-investigators receiving National Institutes of Health research project grants: a historical perspective on the “endangered species”. *JAMA*. 2007;297:2496–2501. doi: 10.1001/jama.297.22.2496.
- Ley TJ, Hamilton BH. Sociology. The gender gap in NIH grant applications. *Science*. 2008;322:1472–1474. doi: 10.1126/science.1165878.
- Brass LF, Akabas MH, Burnley LD, Engman DM, Wiley CA, Andersen OS. Are MD-PhD programs meeting their goals? An analysis of career choices made by graduates of 24 MD-PhD programs. *Acad Med*. 2010;85:692–701. doi: 10.1097/ACM.0b013e3181d3ca17.
- DeCastro R, Griffith KA, Ubel PA, Stewart A, Jagsi R. Mentoring and the career satisfaction of male and female academic medical faculty. *Acad Med*. 2014;89:301–311. doi: 10.1097/ACM.000000000000109.
- Weinert CR, Billings J, Ryan R, Ingbar DH. Academic and career development of pulmonary and critical care physician-scientists. *Am J Respir Crit Care Med*. 2006;173:23–31. doi: 10.1164/rccm.200503-325OC.
- Dimitriadis K, von der Borch P, Störmann S, Meinel FG, Moder S, Reincke M, Fischer MR. Characteristics of mentoring relationships formed by medical students and faculty. *Med Educ Online*. 2012;17:17242.
- Straus SE, Johnson MO, Marquez C, Feldman MD. Characteristics of successful and failed mentoring relationships: a qualitative study across two academic health centers. *Acad Med*. 2013;88:82–89. doi: 10.1097/ACM.0b013e31827647a0.
- Rasch D. *The Blocked Writer's Book of the Dead: Bring Your Writing Back to Life*. CreateSpace Publishing; 2005.
- Zucker D. Developing your career in an age of team science. *J Investig Med*. 2012;60:779–784. doi: 10.2310/JIM.0b013e3182508317.

KEY WORDS: budgets ■ mentors ■ research personnel ■ time management ■ work-life balance

# Circulation Research

JOURNAL OF THE AMERICAN HEART ASSOCIATION



## **Career Development of Young Physician–Scientists in the Cardiovascular Sciences: Perspective and Advice From the Early Career Committee of the Cardiopulmonary, Critical Care, and Resuscitation Council of the American Heart Association**

Sachin Agarwal, Edda Spiekerkoetter, Eric D. Austin, Vinicio de Jesus Perez, Cameron Dezfulian, Bradley A. Maron, John J. Ryan, Monique A. Starks, Paul B. Yu, Sebastien Bonnet and Sarah M. Perman

*Circ Res.* 2018;122:1330-1333

doi: 10.1161/CIRCRESAHA.118.312999

*Circulation Research* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Copyright © 2018 American Heart Association, Inc. All rights reserved.

Print ISSN: 0009-7330. Online ISSN: 1524-4571

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://circres.ahajournals.org/content/122/10/1330>

Data Supplement (unedited) at:

<http://circres.ahajournals.org/content/suppl/2018/04/30/CIRCRESAHA.118.312999.DC1>

**Permissions:** Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Circulation Research* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the [Permissions and Rights Question and Answer](#) document.

**Reprints:** Information about reprints can be found online at:  
<http://www.lww.com/reprints>

**Subscriptions:** Information about subscribing to *Circulation Research* is online at:  
<http://circres.ahajournals.org/subscriptions/>

## Supplementary Table 1. National Institute of Health – Early Career Awards

<b>K01</b>	<p><b>Mentored Research Scientist Career Development Award</b>  <i>For support of a postdoctoral or early career research scientists committed to research, in need of both advanced research training and additional experience.</i></p>
<b>K02</b>	<p><b>Independent Research Scientist Development Award</b>  <i>For support of an early to mid-career research scientists with research funding, in need additional protected time committed to research</i></p>
<b>K07</b>	<p><b>Academic Career Development Award</b>  <i>To support either a mentored or independent investigator to develop or enhance curricula, foster academic career development of promising young teacher-investigators, and to strengthen existing teaching programs</i></p>
<b>K08</b>	<p><b>Mentored Clinical Scientist Research Career Development Award</b>  <i>To provide the opportunity for promising clinician scientists with demonstrated aptitude to develop into independent investigators, or for faculty members to pursue research, and aid in filling the academic faculty gap in health profession's institutions.</i></p>
<b>K22</b>	<p><b>Career Transition Award</b>  <i>To provide support to outstanding newly trained basic or clinical investigators to develop their independent research skills through a two-phase program; an initial mentored research experience, followed by a period of independent research.</i></p>
<b>K23</b>	<p><b>Mentored Patient-Oriented Research Career Development Award</b>  <i>To provide support for the career development of clinically trained professionals who have made a commitment to patient-oriented research, and who have the potential to develop into productive, clinical investigators.</i></p>
<b>K25</b>	<p><b>Mentored Quantitative Research Career Development Award</b>  <i>To support the career development of investigators with quantitative scientific and engineering backgrounds outside of biology or medicine who have made a commitment to focus their research endeavors on basic or clinical biomedical research.</i></p>
<b>K99/00</b>	<p><b>Pathway to Independence Award</b>  <i>To support both an initial mentored research experience (K99) followed by independent research (R00) for highly qualified, postdoctoral researchers, to secure an independent research position. Award recipients are expected to compete successfully for independent R01 support during the R00 phase.</i></p>
<b>K43</b>	<p><b>Emerging Global Leader Award</b>  <i>To provide research support and protected time to a junior scientist with a faculty position at an LMIC institution leading to an independently funded research career</i></p>
<b>K76</b>	<p><b>Emerging Leaders Career Development Award</b>  <i>To advance the development of physician-scientists prepared to take an active role in addressing present and future challenges of a global biomedical research enterprise</i></p>
<b>DP2</b>	<p><b>NIH Director's New Innovator Award</b>  <i>To support highly innovative research projects by early stage investigators in all areas of biomedical and behavioral research</i></p>

\*click on links provided for more details <https://researchtraining.nih.gov/programs/career-development>  
<https://researchtraining.nih.gov/career/early-career>