Outcomes of a Novel Training Program for Physician-Scientists: Integrating Graduate Degree Training With Specialty Fellowship

Mitchell D. Wong, MD, PhD
Lourdes Guerrero, EdD, MSW
Tamer Sallam, MD, PhD
Joy S. Frank, PhD
Alan M. Fogelman, MD
Linda L. Demer, MD, PhD

ABSTRACT

Background Although physician-scientists generally contribute to the scientific enterprise by providing a breadth of knowledge complementary to that of other scientists, it is a challenge to recruit, train, and retain physicians in a research career pathway.

Objective To assess the outcomes of a novel program that combines graduate coursework and research training with subspecialty fellowship.

Methods A retrospective analysis was conducted of career outcomes for 123 physicians who graduated from the program during its first 20 years (1993–2013). Using curricula vitae, direct contact, and online confirmation, data were compiled on physicians' subsequent activities and careers as of 2013. Study outcomes included employment in academic and nonacademic research, academic clinical or private practice positions, and research grant funding.

Results More than 80% of graduates were actively conducting research in academic, institutional, or industrial careers. The majority of graduates (71%) had academic appointments; a few (20%) were in private practice. Fifty percent had received career development awards, and 19% had received investigator-initiated National Institutes of Health (NIH) R01 or equivalent grants. Individuals who obtained a PhD during subspecialty training were significantly more likely to have major grant funding (NIH R series or equivalent) than those who obtained a Master of Science in Clinical Research. Trainees who obtained a PhD in a health services or health policy field were significantly more likely to have research appointments than those in basic science.

Conclusions Incorporation of graduate degree research, at the level of specialty or subspecialty clinical training, is a promising approach to training and retaining physician-scientists.

Introduction

Physician-scientists are important to the nation's biomedical research endeavor. The breadth of MD training provides a clinical perspective that complements PhD training, providing the foundation for a career making scientific discoveries that can be translated into clinical care. Since the 1970s, the predominant physician-scientist training model has been PhD research during medical school (eg, National Institutes of Health [NIH] funded medical scientist training programs). These graduates have more success with NIH funding than physicians without a PhD.[1] However, MD-PhD graduates typically face 7 or 8 more years of clinical training before applying for grants as faculty, at which point their PhD experience may be outdated or their career goals may have changed. In contrast, those who receive PhD training after medical school have more published papers, grant funding, and protected research time, as well as fewer clinical responsibilities, than those who obtained PhDs before or during medical school.[2]

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Editor's Note: The online version of the article contains features of graduates of the Specialty Training and Advanced Research Program (1994–2013).

Methods

In 1993, the Department of Medicine at the University of California, Los Angeles (UCLA) initiated the Specialty Training and Advanced Research (STAR) Program to fund protected time for trainees to pursue a graduate degree shortly before completing their specialty or subspecialty clinical training.[3] This report describes the 20-year outcomes of this novel training program designed to address the need to enhance the training of physician-scientists.

The application process, mentorship, interinstitutional partnerships, clinical departments, and tracks are detailed in TABLE 1. Almost all trainees applied to the program concurrently with applications to residency or fellowship programs through the National Resident Matching Program. Many completed 1 year

of clinical training prior to matriculating into the program. We assisted awardees in applying to a degree-granting department at UCLA (or a partner institution) and in choosing a research mentor. In the mid-1990s, the program added a postdoctoral track for trainees who had previously completed an MD-PhD program, and partnered with the California Institute of Technology to expand the pool of basic science mentors and laboratories. To complete the spectrum of translational science training, 2 further tracks were added: a PhD in Health Services research (1999) and a Master of Science degree in Clinical Research (MSCR) to bridge molecular medicine and patient-oriented research (2001). We also established a partnership with the Pardee RAND Graduate School, providing an even broader selection of programs and mentors in health policy–related fields.

What was known and gap

Physician scientists are key to the nation's biomedical research endeavor and the development of new knowledge and innovation.

What is new

An analysis of the career outcomes for 123 physicians who graduated from the University of California, Los Angeles physician scientist program between 1993 and 2013.

Limitations

Single institution study and retrospective format reduce generalizability.

Bottom line

Creating a system for trainees to incorporate a scientific graduate degree during their specialty or subspecialty training is beneficial to training and retaining physician scientists.

Program Costs and Funding Sources

The average costs per fellow consisted of postgraduate year level salary, equal to that of clinical fellows, and $5,000 tuition per year. Infrastructure expenses included 1 coordinator, a faculty director stipend, and approximately $3,000 per year for some trainees to travel to conferences. Funding sources included extramural funds (eg, NIH T32 training grants and individual extramural grants obtained by the trainees) and intramural funds (such as clinical practice and philanthropic funds). The NIH T32 training grants awarded to individual specialty divisions provided at least partial support to 53% (65 of 123) of STAR graduates. Although conventional MD-PhD programs are eligible for direct NIH grants from the National Institute for General Medical Science, training at the fellowship level requires separate grant applications to individual NIH institutes since subspecialty trainees are linked to specific disease categories. Expenditures for the entire program averaged $2 million per year, with approximately half from extramural and half from intramural sources. Trainees were not required to contribute except for a nominal filing fee that is now covered by the program. Research mentors provided the research supplies and their time, as they do for other graduate students.

This was a retrospective study, using program level data, with Institutional Review Board exemption.

Methods of Evaluation

We had contact information for most of the 123 graduates, and obtained curricula vitae for all except for those in private practice. Supplemental information was obtained through university records and Internet searches, including PubMed and NIH Reporter. We identified each graduate's career outcomes immediately after graduation, as well as grant funding to date. Academic appointments were defined as faculty-level employment at a university. Research appointments were defined as appointments in universities, research institutes, or industry having research titles, or evidence of substantial active research publications. For graduates transitioning between career types, the position held in 2013 was used. For statistical analysis, we used Pearson χ^2 test to determine whether outcomes of research careers and grant funding were associated with individual characteristics at a significance, P level of $< .05$.

Results

Program Graduates

By 2013, 123 trainees had completed both their clinical and graduate degrees (detailed data are available as online supplemental information). Ten trainees started graduate degree training, but did not complete degree requirements (all completed their specialty or subspecialty training). Since these 10 trainees did not graduate from the program, they were not included in the analysis.

Research Training

Of this cohort, 67% of graduates (83 of 123) completed a PhD in basic science (including the postdoctoral track), 22 (18%) completed a PhD in a public health field (eg, health services research, health policy, or epidemiology), and 18 (15%) completed a

TABLE 1
Components and Characteristics of the Specialty Training and Advanced Research (STAR) Program

Components	Characteristics
Applications	▪ Trainees applied to the STAR program concurrently with the conventional NRMP application to clinical residency or fellowship ▪ Applicants were interviewed by scientists and clinicians from throughout the campus and were discussed and ranked by the STAR Selection Committee ▪ STAR awardees applied to the graduate training program of a degree-granting department at UCLA or a partner institution during the first year of training ▪ STAR awardees were paid at the level of postgraduate year of training ▪ Salaries, benefits, and tuition were borne by the trainee's sponsoring clinical department/division
Mentorship	▪ Trainees were assisted in choosing a funded research mentor ▪ Emphasis was placed on choosing a mentor outside the trainee's own clinical division, department, school, or university to enhance independence and reduce effects of "institutional inbreeding" ▪ This approach had the "incubator" effect of building novel collaborations
Interinstitutional partnerships	▪ California Institute of Technology (Caltech) provided an expanded selection of mentors and basic science laboratories ▪ Pardee RAND Graduate School provided mentors in health policy–related fields
Clinical departments	▪ Medicine, family medicine, neurology, obstetrics and gynecology, ophthalmology, pathology and laboratory medicine, pediatrics, and surgery ▪ Most awardees completed at least 1 year of core clinical specialty training before enrolling in the graduate degree program ▪ One department offered a faculty position to each physician who successfully completed the program
Program Tracks	**Characteristics**
Track 1: Physician-Scientist Basic Science	▪ Trainees obtained basic science PhDs from a UCLA or Caltech basic science department[a] ▪ Trainees typically took 3 to 4 years to complete the degree program
Track 2: Postdoctoral Track[b]	▪ Trainees were given 2 to 3 years of postgraduate-level salary and benefits for protected time in advanced research
Track 3: Master of Science in Clinical Research[c]	▪ Designed to train patient-oriented investigators to bridge molecular medicine and clinical research ▪ Degree requirements include a minimum of 48 units, including 32 units of required upper division and 8 elective graduate courses ▪ Instructors are faculty from the departments of biomathematics and biostatistics
Track 4: PhD in Health Services Research[d]	▪ Awardees obtained their degrees from the UCLA School of Public Health ▪ Degree requirements included a minimum of 48 units, and STAR awardees typically took 4 years to complete the degree program

Abbreviation: NRMP, National Resident Matching Program.

[a] Biological chemistry, biomathematics, biomedical engineering, experimental pathology and laboratory medicine, human genetics, microbiology and immunology, molecular biology, molecular genetics, molecular and medical pharmacology, neuroscience, physiology, molecular, cellular, and integrative physiology.

[b] A postdoctoral track was added in 1995 for trainees who had previously completed an MD-PhD or Medical Scientist Training Program (MSTP) program.

[c] In 2001, an option was added for a new graduate program leading to a Master of Science degree in Clinical Research in the Department of Biomathematics under the umbrella of the UCLA Graduate Training Program in Translational Investigation (NIH K30 program).

[d] In 1999, a PhD track was added to provide training in health services and health policy research.

TABLE 2
Characteristics Associated With a Research Career and Major Research Funding (n = 123)[a]

Characteristics	N	Outcome			
		Research Career		Major Grant	
		n (%)	*P*	n (%)	*P*
Sex			.32		.68
Women	39	32 (82)		22 (56)	
Men	84	62 (73)		44 (52)	
Department			.13		.48
Medicine	97	72 (74)		51 (52)	
Other	25	22 (88)		15 (60)	
Specialty			.15		.78
Cardiology	24	19 (79)		12 (50)	
Dermatology	10	6 (60)		5 (50)	
Endocrine	2	2 (100)		2 (100)	
Gastroenterology	13	6 (46)		8 (61)	
General internal medicine	12	11 (92)		5 (41)	
Geriatrics	2	2 (100)		2 (100)	
Hematology oncology	14	10 (71)		8 (57)	
Infectious diseases	7	5 (71)		2 (28)	
Nephrology	2	1 (50)		1 (50)	
Pulmonary	7	7 (100)		4 (57)	
Rheumatology	4	4 (100)		3 (75)	
Other	26	21 (81)		14 (54)	
Year of Completion			.24		.93
1993–2003	48	34 (71)		26 (54)	
2004–2013	75	60 (80)		40 (53)	
Research Track			.01		.50
Postdoctoral	31	18 (58)		16 (52)	
Basic science	52	40 (77)		31 (60)	
Health services research	22	21 (95)		12 (55)	
Master of Science in Clinical Research	18	15 (83)		7 (39)	

[a] Major funding was provided by National Institutes of Health, Veterans' Affairs, foundation career development award, or an National Institute of Health R award or equivalent.

MSCR. Of those who pursued a PhD degree, 70% (52 of 74) were in basic science, and the remaining graduates were in health services or clinical research fields. Ninety-eight of 123 graduates (80%) completed clinical training in the department of (internal) medicine. Six graduates carried out their PhD training at partner institutions (3 at the California Institute of Technology and 3 at the Pardee RAND Graduate School). The remaining graduates received a PhD from the UCLA College of Letters and Sciences, with 2 in engineering, 15 in public health, and 1 in public affairs.

Career Outcomes

In 2013, 99 of 123 graduates (80%) were employed in academia or in industry research, and 24 of 123 (20%) were in private practice (graduate characteristics are provided as online supplemental material). At least 15 graduates transitioned between career types, with most having left academics for private practice or nonacademic research. Graduates of the public health PhD track were more likely to remain in research positions than other graduates (TABLE 2). No other characteristics were associated with maintaining a research career.

Grant Funding Received by Graduates

Sixty-one graduates (50%) received career development awards, including 44 from the NIH and 6 from Veterans' Affairs (VA). A total of 23 graduates received investigator-initiated NIH (R01) or equivalent grants. Altogether, STAR graduates served as the principal investigator or co-principal investigator on 57 NIH R grants, 16 U grants, and 175 other types of grants. There were no significant associations found between sample characteristics, receipt of major research grants, or number of grants received by MSCR graduates (TABLE 2).

Leadership Positions

Based on a review of the curricula vitae, several graduates were noted to hold high leadership positions. These included a department chair, vice chairs, an assistant vice chancellor, division chiefs, executive medical directors, a vice president for a health insurance company, a chief medical officer for a pharmaceutical firm, and a chief scientific officer at a university-affiliated research institute. The graduates also included several training program directors and government advisors.

Retention at UCLA

Altogether, 45% of the graduates (55 of 123) continued their careers at UCLA after completion of the program. All transitioned to faculty status, including 4 at the affiliated VA Medical Center and 1 at the Harbor-UCLA Medical Center, except for 1 who opted to pursue a more advanced fellowship (neurological surgery). Eighty percent of graduates (98 of 123) completed their clinical training in internal medicine or subspecialties of internal medicine.

Publications

Based on a review of the curricula vitae, graduates collectively have published at least 1981 publications, including 1705 peer-reviewed manuscripts, 142 book chapters, and 134 review articles.

Early Versus Recent Graduates

Graduates from the first decade of the program had characteristics and outcomes similar to those who graduated in the second decade, except that the MSCR track was not available until the second decade, and more of the graduates from the first 10 years had obtained grant support by 2013.

Discussion

Overall, the outcomes for this 20-year period suggest that incorporating graduate degree research at the level of specialty or subspecialty clinical training is a feasible and successful pathway to training and retaining physician-scientists. We observed that having trainees complete their graduate training in departments outside their home clinical divisions resulted in more successful careers. They also had novel and long-term, interdisciplinary collaborations, reducing the isolation of university departments. Graduates completing PhDs in public health and health policy fields more often had academic positions at the 20-year time point. Those who graduated with a PhD were more likely than graduates from a MSCR track to receive a career development award (NIH K series) or an investigator-initiated grant (NIH R series or equivalent). As evidence for their positive view of this training approach, most of our graduates recommend it enthusiastically to more junior trainees.

In the 1980s, only 25% of graduates of conventional MD-PhD programs submitted NIH grant applications.[4] A more recent survey of directors of selected MD-PhD programs suggested that 81% of MD-PhD graduates who had completed all phases of postgraduate training were employed in academic centers or research institutions, 16% were in private practice, and 66% were in academic research positions.[5] Although those findings are limited by self-reporting and possible selection bias, the outcome is similar to our findings. Our results also show a somewhat lower attrition rate (7.5%) than that of conventional MD-PhD programs (10%–27%).[1,5]

Advanced degree research at the clinical fellowship level may have advantages over conventional fellowships. Although a degree is not essential for success, the formal graduate programs have the advantages of rigorous structure, expertise, and established curricula. Having chosen a subspecialty allows the trainee to focus research on a complementary area. Trainees also reach peak research skills, with command of the literature and knowledge of state-of-the-art techniques, at precisely the time they apply for grants and faculty positions. When a group of institutions provided 1 year of basic science training to 747 junior faculty between 1990 and 2011, 80% submitted at least 1 NIH grant application, and 2 of 3 received at least 1 grant, with a funding success rate of 55%.[6]

Our data results are from a single institution; therefore, our outcomes may not be generalizable. For

the success of a physician-scientist training program, the proximity of the teaching hospital with graduate colleges and research laboratories may be a critical element. Some of our data may also be subject to error, as curricula vitae are, to some extent, self-reported. Next steps will include prospective comparisons with conventional MD-PhD programs, as well as longer-term assessment of the outcomes.

Conclusion

The outcomes for the UCLA STAR program over the previous 20 years suggest that incorporating graduate degree research at the level of specialty or subspecialty clinical training is feasible and is an effective way to prepare trainees for lasting careers as physician-scientists.

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All authors are at the David Geffen School of Medicine, University of California, Los Angeles. **Mitchell D. Wong, MD, PhD,** is Professor of Medicine and Executive Co-Director, Specialty Training and Advanced Research (STAR) Program; **Lourdes Guerrero, EdD, MSW,** is Assistant Professor of Medicine, Department of Medicine; **Tamer Sallam, MD, PhD,** is Clinical Instructor, Department of Medicine; **Joy S. Frank, PhD,** is Professor Emeritus of Medicine and Physiology, Departments of Medicine and Physiology; **Alan M. Fogelman, MD,** is Professor of Medicine and Executive Chair, Department of Medicine; and **Linda L. Demer, MD, PhD,** is Professor of Medicine, Physiology and Bioengineering, Executive Vice Chair, Department of Medicine, and Executive Director, STAR Program.

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Corresponding author: Linda L. Demer, MD, PhD, University of California, Los Angeles, Department of Medicine, 10833 LeConte Avenue, Los Angeles, CA 90095-1679, 310.206.2677, ldemer@mednet.ucla.edu

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