

## **Analysis of Scholar Outcomes for the NIGMS Postbaccalaureate Research Education Program**

Alison Hall, Jessica Mann, Michael Bender

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### Abstract

In 2000, NIGMS began the novel Postbaccalaureate Research Education Program (PREP), designed to enhance the diversity of the biomedical research workforce by supporting institutional programs that provide scholars with a scientific apprenticeship as well as academic and professional development activities. The specific objective of PREP is to prepare eligible individuals to successfully enter and complete rigorous Ph.D. training programs. The purpose of this analysis was to identify the subsequent educational and career outcomes of PREP scholars and to better understand the impact of PREP. This project focused on PREP awards between 2001 and 2014, and included 41 institutional programs. Educational and career outcomes described in competing renewals were confirmed or obtained from public sources, and the study included data validation approaches to manage the quality of self-reported information. Changes in the length of PREP training (from 2 years to 1 year) and in eligible PREP institutions (a restriction to research-intensive institutions) were made in the 2007 PREP funding announcement, and PREP scholars were separated into a pre-2007 cohort (n=501) and a post-2007 cohort (n=1,025) for review. Analysis of both competing renewal applications and student educational outcomes suggests that 65 percent of PREP scholars matriculate into Ph.D. programs. Among scholars who entered a Ph.D. program in the first cohort, about 63 percent completed the degree, while many in the second cohort were still in graduate training at the time of this analysis. Among Ph.D. earners (n=241) from the PREP program thus far, about half were still in postdoctoral training, and the remaining post-training scholars were in research or research-related careers.

### Introduction

PREP is an institutional R25 research education program ([PAR-14-076](#); Reference [1](#)) designed to develop recent baccalaureate graduates from groups underrepresented in biomedical science so that they have the necessary knowledge and skills to pursue Ph.D. degrees in biomedical science. The program is part of a larger effort at NIGMS to promote, support and sustain the development of a highly skilled, creative and diverse biomedical workforce ([2015 NIGMS Strategic Plan](#); Reference [2](#)). The objective of PREP is to prepare eligible individuals for both successful entry into, and completion of, rigorous Ph.D. training programs. NIGMS also anticipates that PREP awards will help awardee institutions achieve greater diversity in their doctoral training programs through institutional change fostered by experience with the PREP program and/or through recruitment of successful PREP participants to those training programs.

Current grantees are expected to design 1-year programs supporting five to 10 PREP scholars who spend 75 percent of their time as apprentice scientists in the lab, and 25 percent of their time in academic and professional development activities. PREP scholars receive a salary and benefits to pursue mentored research projects, and often work beside graduate students and postdoctoral fellows. While scholars are not degree-seeking, they often take graduate classes. Typical interventions in PREP include a program of study to enhance the student's academic record, a mentored discovery research project, activities to

encourage formation of productive peer groups, participation in scientific writing workshops and journal clubs, and access to graduate application information and assistance.

The current Funding Opportunity Announcement (FOA) sets institutional targets for Ph.D. matriculation and completion, although earlier announcements did not. A goal of 75 percent Ph.D. matriculation following PREP was set to allow programs to invest in promising students, as higher goals might lead to selection of candidates already sufficiently prepared for study. In addition, research suggests that PREP scholars have a variety of initial motivations and benefit from development (Reference 3). The FOA also sets a goal that once in a Ph.D. program, 75 percent will complete the degree. This level of Ph.D. completion, slightly higher than overall national life sciences Ph.D. completion rates (Reference 9), might reflect the coaching of students to select appropriate Ph.D. programs and to prepare strong applications, as well as student confidence and motivational factors.

Participant eligibility is determined by awardee institutions and conforms to [NIH's Interest in Diversity](#), although specific eligibility requirements may have changed over the history of these awards. Current eligibility focuses on individuals from groups underrepresented in biomedical sciences as defined by the National Science Foundation (References 4 and 5) and includes individuals from specific racial and ethnic groups and individuals with disabilities (Reference 6). To be eligible to apply to PREP, scholars must be within 36 months of earning a science baccalaureate.

NIGMS performed this retrospective analysis to better understand scholar outcomes and to inform any future modifications to PREP. This analysis addresses the common core metrics laid out for the NIH R25 mechanism such as 1.) aggregate number and demographic characteristics of participants; 2.) subsequent educational/career progress, including enrollment and completion of a research doctorate graduate program and subsequent participation or employment in a research field.

## Methods

*PREP Award Information.* Award and termination information for all funded PREP institutions were collected from the NIH IMPAC database. The six FOAs for PREP were [PAR-14-076](#), [PAR-13-085](#), [PAR-12-056](#), [PAR-07-432](#), [PAR-03-140](#) and [PAR-00-139](#).

Information on the appointment and termination of individual scholars at each PREP institution was obtained from xTrain (eRA Commons) for scholars appointed 2009-present, and competing renewals were reviewed to obtain the names and appointment dates of individual scholars throughout the duration of the program. There was significant variation in reporting, particularly in cohort 1, with institutions indicating funding but not naming a scholar, or inconsistently reporting numbers between reports. Some programs also appointed additional scholars; but for the purposes of this analysis, institutionally-funded participants were excluded. Institutional reports (comprising 1,657 participants) were examined and a list of only those paid by the PREP (1,600 participants) was identified. From this list, a small number had withdrawn or were dismissed from PREP, or were deceased and were also excluded from further analysis (n=42). Those with a PREP term length of less than 6 months were also excluded (n=32), leaving a group of 1,526 PREP scholars appointed between 2001 and 2014 for analysis.

*Outcome Measures.* Key core metrics outlined in the announcement and included in this analysis were the 1.) aggregate number and demographic characteristics of participants; 2.) subsequent educational/career progress measures, including matriculation and completion of a graduate program and year and subsequent participation or employment in a research field, including job title

and career sector.

In this report, we calculate a Ph.D. matriculation rate for PREP (the fraction of PREP scholars who matriculate into a Ph.D. program) and a Ph.D. completion rate for PREP (the fraction of PREP scholars who enter a Ph.D. program and then complete the Ph.D.). For comparison to national rates of Ph.D. attainment for all baccalaureate students in STEM fields, we also calculate an overall PREP Ph.D. attainment rate (the fraction of PREP scholars that complete the Ph.D.).

*Public Information Data Mining Approach and Limitations.* The approach was to probe public sources for information on the awardees, using general information from the PREP competing renewal/progress report on the individuals' names and educational history if provided (for example, the awardee earned a baccalaureate degree at institution X, and was a PREP scholar at institution Y, during the specified years of the award). A number of sources were probed for educational and professional information, including Google, Linked In, Scopus, Ph.D. Tree, NIH Reporter, Intellius, patent information and institutional links with information about alumni. These public sources are widely considered networks for professional interactions; by contrast, Facebook was deliberately avoided, as it is often used for personal networks.

Matriculation in a rigorous research doctorate Ph.D. (or M.D.-Ph.D.) program is an important proximal measure of PREP success. To estimate Ph.D. matriculation, reports were collected from competing renewal PREP applications received in 2012 (12 applications), 2013 (4 applications) and 2014 (9 applications). The aggregate data represent 25 PREP programs.

Institution names were compared with Carnegie Basic Classification (Reference [7](#)) as well as lists of institutions that enroll significant numbers of underrepresented students. In cases in which a university had multiple campuses and a specific campus was not indicated, the main campus affiliation was used.

Two common R25 core metrics outlined in the FOA were not collected in this analysis. The first was to measure if scholars had “subsequent participation in a formal research training or career development program in a STEM field,” and the second was whether they had “subsequent authorship of scientific publications in a STEM field.” These data may be collected in the future by using NRSA tables for PREP reporting, through inclusion of external identifier information, such as ORCID for PREP scholars, or with other approaches, but these data are not currently available in a systematic fashion for PREP scholars, and most scholars have not yet reached a career stage of postdoc or beyond.

It is important to note that public searches by definition provide self-reported information, and that poses distinct challenges both for data quality and data structure. Individuals or institutions may provide information that is inaccurate in small (incorrect year of degree award) or large ways (did not earn a degree at all). In an attempt to account for such inconsistencies, data confirmed from multiple sources were preferred over single entries, and some sources were considered higher quality than others (for example, an electronic dissertation was higher quality than an alumni website). In some cases, no educational or career information was available in public media, and these “unknowns” are indicated for each measure.

One step in the data collection process was to confirm subsequent educational outcomes. In general, only where there were both a degree and a year awarded was the educational outcome included. A very small number of Ph.D.s (fewer than 11) was also included without a degree date because other qualifying data (like a named postdoctoral fellowship) were present. The strict criterion (degree plus

date) likely results in an under-report of earned Ph.D. degrees. By contrast, because the FOA indicates that participants must have been awarded a science baccalaureate prior to PREP, all scholars were reported with a baccalaureate even in cases where there was no subsequent educational information from public media (190 scholars).

A last concern is that some of the information reported or collected might not be current. Because public media information often lacks a timestamp indicating the posting date by individuals and institutions, some data, including the current position, are subject to this caveat. Thus the data presented represent a moment in time for a scholar.

## Results and Discussion

A total of 41 different institutions have participated in PREP since the program inception ([Figure 1](#)). The first FOA was released in September 2000, and the first PREP scholars were appointed to awarded programs in 2001. The number of programs increased slowly in the first few years, and in the last decade there have been about 25 active programs each year. Only one program has been continuously funded through the entire period. There is a noticeable “gap” in active programs in 2007-2008, when there was a pause in the release of the FOA. There are several groups of institutions that have had PREP awards, including 1.) 8 programs active in cohort 1 that did not renew or persist, 2.) 15 programs active in cohort 2 (or “new” programs), and 3.) 16 programs that have been active in both cohort periods, but often with significant gaps in award periods.

Information on the appointment and termination of individual scholars at each institution was obtained from xTrain for scholars appointed 2009-present, and competing renewals were reviewed to obtain names of individual scholars throughout the duration of the program. This resulted in a list of 1,526 scholars appointed to the program in 2000-2014 who completed the PREP. The 2007 PREP FOA changed several aspects of the program. In particular, the length of PREP training was changed from 2 years to 1 year, and PREP institutional eligibility was restricted to research-intensive institutions. PREP scholars were therefore separated into a pre-2007 cohort and a post-2007 cohort for analysis. At this writing in 2015, the pre-2007 cohort has had sufficient time to complete graduate, and in some cases, post-graduate training and therefore offers a view of downstream career outcomes.

*Undergraduate Origins of PREP Scholars.* PREP programs recruit scholars within 3 years of their earned science baccalaureate. To learn more about the origins of PREP scholars, characteristics of the undergraduate institutions were collected ([Figure 2](#)). Overall, the 1,526 scholars came from 397 different undergraduate institutions (note that for universities with multiple campuses, if the name was not specified, the main campus was assumed). The largest group of scholars came from research-intensive institutions (42 percent); with another 25 percent from colleges and universities that award a master’s degree, and 16 percent from primarily baccalaureate institutions. Institutions that enrolled substantial numbers of underrepresented students were the origin of about half the scholars, with Hispanic Serving Institutions (HSI, 22 percent), Historically Black Colleges and Universities (HBCU, 16 percent) and Asian American Native American Pacific Islander Serving Institutions (AANAPISI, 9 percent) accounting for many students (note that some institutions may have more than one designation; [Reference 8](#)). The undergraduate institutions that individually contributed the most PREP scholars reflect the robust participation of large public institutions, as well as smaller institutions with a historical commitment to diversity.

PREP appointment periods often reflect the academic calendar. Scholars may begin PREP in the summer

after college graduation (for example, in July) and terminate as they transition to Ph.D. programs (often in June for a July doctoral program start). This example (July-June) leads to a 12 month PREP duration, and indeed, there were strong peaks around 12 and 24 months duration ([Figure 3](#)). Relatively few PREP scholars had durations shorter than 10 months, but it was not clear how many months represented full participation in PREP. Each program has specific interventions for scholars, and a short PREP duration likely results in incomplete interventions and reduced benefit to the scholar. Because it seemed unlikely that short term participation could have significant benefit, 32 scholars with PREP experiences less than 6 months were excluded from further outcome analysis, leaving a group of 1,526 scholars for whom subsequent educational and career outcomes was sought.

*Ph.D. Matriculation Rate.* It is important to distinguish the proportion of 1.) PREP scholars who matriculate into a Ph.D. program (the Ph.D. matriculation rate); 2.) PREP scholars who entered a Ph.D. program, who then complete the Ph.D. (the Ph.D. completion rate); and 3.) initial PREP scholars who both matriculated and completed a Ph.D. (the Ph.D. attainment rate), as these have different comparison groups.

The matriculation of individual students into Ph.D. programs is not nationally reported, however, this information forms a key outcome for PREP. In a first step to understand the Ph.D. matriculation rate, PREP outcome reports were collected from competing renewal applications received in 2012-2014 (25 programs; [Figure 4](#)). Competing renewal applications were selected for analysis because the quality and detail of the outcome data were better than in annual progress reports. Care was taken to review applications to collect “Ph.D. program matriculation” where reported, rather than “graduate program matriculation.” From these competing renewals, there were 801 PREP scholars who had completed the PREP from 853 initial scholars, such that the PREP attrition was about 6 percent. Of those who completed PREP, 512 had enrolled in a Ph.D. program, reflecting a 64 percent Ph.D. matriculation rate. In a second approach, to estimate Ph.D. matriculation, the number of scholars in cohort 1 with a M.S. or Ph.D., or now in graduate school were summed (n=304, of total 501), and represent a Ph.D. matriculation rate of about 60 percent (note this estimate does not account for any graduate school attrition). In a third approach, the number of students in cohort 2 reported as “in graduate training” or having earned a Ph.D. was summed (omitting any current PREP scholars who could not have matriculated), and again, this approach confirmed that at least 64 percent of scholars matriculated in a Ph.D. program after PREP. One study of PREP scholars reports that “more than 80 percent” of PREP scholars have begun Ph.D. or M.D.-Ph.D. training ([Reference 3](#)) although no data were provided. Thus, several data sources suggest the current PREP matriculation rate into Ph.D. programs is about 65 percent.

*Ph.D. Degree Completion and Attainment.* In light of the lengthy training period typical in the sciences to prepare for a biomedical research career, many recent PREP appointees in cohort 2 were in graduate training at the time of this analysis ([Figure 5](#)). Scholars can anticipate 1 to 2 years of PREP followed by a Ph.D. of 6 years, on average, and this time period may be extended with employment or a master’s degree. While we present this interim analysis of PREP in mid-2015, it is important to understand that the majority of PREP scholars have not had enough time to complete PREP and a research doctorate by this time.

About a third of all PREP scholars (n=501) participated in the first cohort and many have completed Ph.D. or M.S. degrees. To begin to understand a Ph.D. completion rate, we estimated those who had initially matriculated into the Ph.D. to include all those who subsequently earned a Ph.D., as well as those who eventually earned a master’s, and those who are now in graduate school (n=304). Of those

who started a Ph.D., there was about 63 percent Ph.D. completion (191 earned Ph.D./304 Ph.D. matriculants) in cohort 1. For comparison, in life sciences fields, the Ph.D. completion rate of graduate students who began the doctorate varies by discipline, but ranges between 59 and 69 percent (Reference [9](#)). NIH-wide Ph.D. completion by trainees supported by the predoctoral NRSA programs is 80 percent (Reference [10](#)). A recent report from Council of Graduate Schools (Reference [11](#)) indicates that students from underrepresented groups had Ph.D. completion rates of about 50-58 percent in the life sciences.

The current FOA sets targets for an institutional PREP (at 75 percent Ph.D. matriculation and 75 percent Ph.D. completion) that, if met by all funded institutional programs, would result in a 56 percent overall Ph.D. attainment rate. At this writing, two-thirds of PREP scholars are currently in graduate training as expected for their career stages, but some insight into overall PREP Ph.D. attainment rates might be gained from scholar outcomes from the first cohort of PREP. In cohort 1, at least 38 percent had earned a Ph.D. (191 earned Ph.D./501 total PREP), at least 15.6 percent had earned an M.S., 12 percent earned an M.D., and 6.8 percent were still in graduate training; for 27 percent no further degree beyond the bachelors could be confirmed. For comparison, a [recent outcomes analysis of the NIGMS Diversity Supplement Program](#) showed that at least 16 percent of undergraduates supported by this program had earned a Ph.D. (Reference [12](#)).

*Where the Ph.D. Is Earned.* The PREP FOA calls for rigorous Ph.D. training in high quality programs, but Ph.D. program quality is generally difficult to assess. The 241 PREP scholars from both cohorts who have completed the Ph.D. earned their degrees from about 100 graduate institutions. Of these, 51 institutions each had one graduate from PREP, and the top 10 Ph.D. institutions (defined by number of PREP students) had 78 PREP Ph.D.s among them. The vast majority of PREP Ph.D.s are earned at research-intensive universities and medical schools ([Figure 6](#)). Indeed, most biological sciences Ph.D.s in the U.S. are earned at research-intensive institutions. For comparison, for U.S. biological sciences Ph.D.s, 85 percent were earned at research universities and 13 percent at medical schools (Reference [13](#)). Most of the Ph.D. institutions attended by PREP participants were not those that enroll a substantial number of students from underrepresented groups. It is important to recognize that the Carnegie research class of the entire university is a very limited measure of the rigor or quality of a Ph.D. program. The quality of particular research doctorate programs in the United States has been assessed with common measures in particular fields (Reference [14](#)). However, in many cases, the particular Ph.D. program or topic area was not systematically reported by PREP Ph.D. graduates themselves.

Another way to estimate the quality of a Ph.D. program is to assess research products and research careers of its graduates. Among PREP scholars who have earned a Ph.D. or equivalent, about half remain in postdoctoral training at this time ([Figure 7](#)). For the rest, careers of PREP scholars post-training included research (43 percent), science related non-research (36 percent), with few in non-science careers or unemployed (see NIH Advisory Committee to the Director, Biomedical Research Workforce Working Group Report for career sectors, Reference [13](#)). It is important to note that at least some “unknowns” may still be in training, since 12 of the 19 scholars in this category earned the Ph.D. in the last 3 years (2013-2015).

One goal of PREP is to diversify awardee institutions’ graduate programs. This might be done by a school matriculating scholars from its own PREP program, recruiting PREP scholars from other institutions or by gaining experience with effective practices with diverse candidates and undergraduate campuses to broadly diversify their graduate programs. The diversity of Ph.D. programs before and after the PREP is often described in competing renewals, but data about the level of change are variable. These reports

suggest that about 11 percent of the Ph.D. enrollment at PREP institutions is composed of individuals from underrepresented racial and ethnic groups (range 6-16 percent; 2011-2012). These limited data also suggest that diverse enrollments are variable year-to-year due to small numbers of graduate matriculants in programs overall. Among the top 10 Ph.D. origin institutions for PREP scholars, 9 have, or had, a PREP. It may be that for PREP Ph.D. applicants, the presence of PREP at the institution is a welcome signal that the institution is working to enhance diversity. Thus, PREP serves as one source for diverse graduate candidates.

### What is the Impact of PREP?

The goal of PREP is to support the development of a highly skilled, creative and diverse biomedical research workforce. The specific objective of PREP is to prepare eligible individuals to successfully enter and complete rigorous Ph.D. training programs. NIGMS also anticipates that institutional PREP awards will help awardee institutions to achieve greater diversity in their doctoral training programs, either through institutional change fostered by experience with PREP and/or through recruitment of successful PREP participants into those training programs. The approach has been to support institutional postbaccalaureate research education programs that provide intensive research experiences and courses for skills development to recent science baccalaureate earners, who are individuals from underrepresented groups.

The core evaluation metrics for this R25 research education program outlined in the current FOA focus on subsequent educational and career outcomes including:

1. Aggregate number and demographic characteristics of participants.
2. Subsequent educational/career progress, including:
  - Enrollment in an advanced degree program in a STEM field.
  - Successful completion of a STEM graduate program.
  - Subsequent participation in research.
  - Subsequent employment in a research or research-related field.
  - Subsequent participation in a formal research training or career development program in a STEM field.
  - Subsequent authorship of scientific publications in a STEM field.

Progress toward these goals is described in this analysis, with a few exceptions. Data reporting over the 15 years and 6 FOAs was quite variable, particularly for the last two measures—participation in formal research training programs and authorship of scientific publications. Indeed, these elements do not form proximal outputs of PREP, but ones dependent on the effectiveness of subsequent graduate training, often at another institution. A second limitation in this analysis is that PREP programs are not set up as controlled experiments, so there is no control group for PREP that could be similarly tracked. Instead, we relied upon data about similar groups of individuals at similar career stages for comparison.

The rates for Ph.D. matriculation (about 65 percent) and Ph.D. completion (about 63 percent for cohort 1) observed for PREP scholars overall are highly dependent upon appropriate preparation for the Ph.D. by PREP, and further support by research doctorate programs once scholars enter those programs. The preparation of strong applications to particular Ph.D. programs is an important part of PREP developmental activities. Scholar matriculation in research intensive schools promises outstanding research opportunities and potentially good financial support, but these may not be sufficient for retention through the earned degree. The rate of Ph.D. attainment (the fraction of PREP scholars who

have completed PREP and then attain the Ph.D.) is 38 percent for cohort 1. For comparison, a simple model using WebCASPAR biology degree data suggests that about 7.7-8.7 percent of all U.S. baccalaureates in a particular year earn a Ph.D. in biology by 10 years later (this rate is 5.7 percent for individuals from underrepresented racial and ethnic groups). This database does not trace individual students, and does not correct for the proportion of all baccalaureates with an interest in or aptitude for Ph.D. matriculation and completion. Thus, PREP scholars in cohort 1 had completed the Ph.D. at about a six-fold higher rate than underrepresented biology baccalaureates at the time of this analysis.

Could this Ph.D. attainment rate reflect self- or program-selection of students already prepared to succeed? Scholars do self-select to apply for PREP, and must describe aspirations for a research doctorate career, but there also appear to be benefits from the PREP program interventions. One study on scholars explored the motivations and decisions by scholars in PREP (Gazley et al., Reference [3](#)). The research identified several goals among these scholars, summarized as Credential Seekers, PI Aspirants, Path Builders, Discipline Changers and Interest Testers. A major conclusion from this study is that PREP programs effectively address important scientist “identity work” that facilitates preparation for graduate work beyond credentials and skills.

The Gazley study also points out that scholars who begin PREP may not initially be sufficiently prepared for graduate study and need to build those credentials and skills. The authors argue that because a higher fraction of individuals from underrepresented racial and ethnic groups come from economically and educationally disadvantaged backgrounds, scholars may already be playing catch-up both academically and experientially throughout college and beyond. Among the sample of 49 PREP scholars, the average self-reported undergraduate GPA was 3.38/4.0, and few had substantial research experiences. This background does not place scholars in the strongest pool of candidates for a highly-competitive research doctoral program as they begin PREP (see, for example, Reference [16](#)). The resultant high rate of Ph.D. matriculation, completion and attainment observed among PREP scholars demonstrates the benefits of participation in PREP.

This initial assessment of scholar educational and career outcomes from PREP provides several important observations, and points to future work. First, attrition from PREP is low (about 5-6 percent), indicating effective efforts by institutional PREP programs in identifying and retaining PREP scholars. Second, Ph.D. matriculation (about 65 percent) is strong and PREP scholars pursue the Ph.D. at a range of research universities and medical schools that mirrors national STEM Ph.D. statistics. These results indicate that PREP programs are preparing scholars to compete effectively for entry into rigorous Ph.D. training programs throughout the United States. Third, PREP Ph.D. completion rates calculated for cohort 1 (about 63 percent) are strong. This completion rate can be compared to that reported for students from underrepresented groups completing a Ph.D. in the life sciences (50-58 percent, Reference [11](#)) and the Ph.D. completion rate reported for all students in the life sciences (59-69 percent, Reference [9](#)). Finally PREP scholars who have now completed their doctoral and postdoctoral training are predominantly entering the research workforce (43 percent) and science-related non-research (36 percent) categories. Thus, PREP appears to be achieving its intended outcomes and contributing effectively to a larger effort at NIGMS to promote, support and sustain the development of a highly skilled, creative and diverse workforce.

One goal of this assessment was to clearly articulate program goals and to identify how to measure educational and career outcomes. Much information on PREP for cohort 1 was collected in appointment forms that have since been replaced by the xTRAIN electronic system for cohort 2. However, key educational and career outcome measures for individuals in the program are still collected in



recommended tables that are not “structured” electronically and do not lend themselves to simple reporting. Public websites prove a rich source of information on individual matriculation into doctoral programs and completion of the Ph.D., as well as career outcomes, although additional structured tables or training databases would facilitate program analysis.

At this writing, two-thirds of PREP scholars are currently in graduate training, as expected for their career stage. Future analysis using similar approaches is needed to assess the bulk of PREP scholars currently in Ph.D. training. This analysis will be facilitated by the methodologies developed in this study. The rate of matriculation and Ph.D. completion demonstrated in the first phase of PREP, while strong, may have improved along with FOA changes made in 2007.

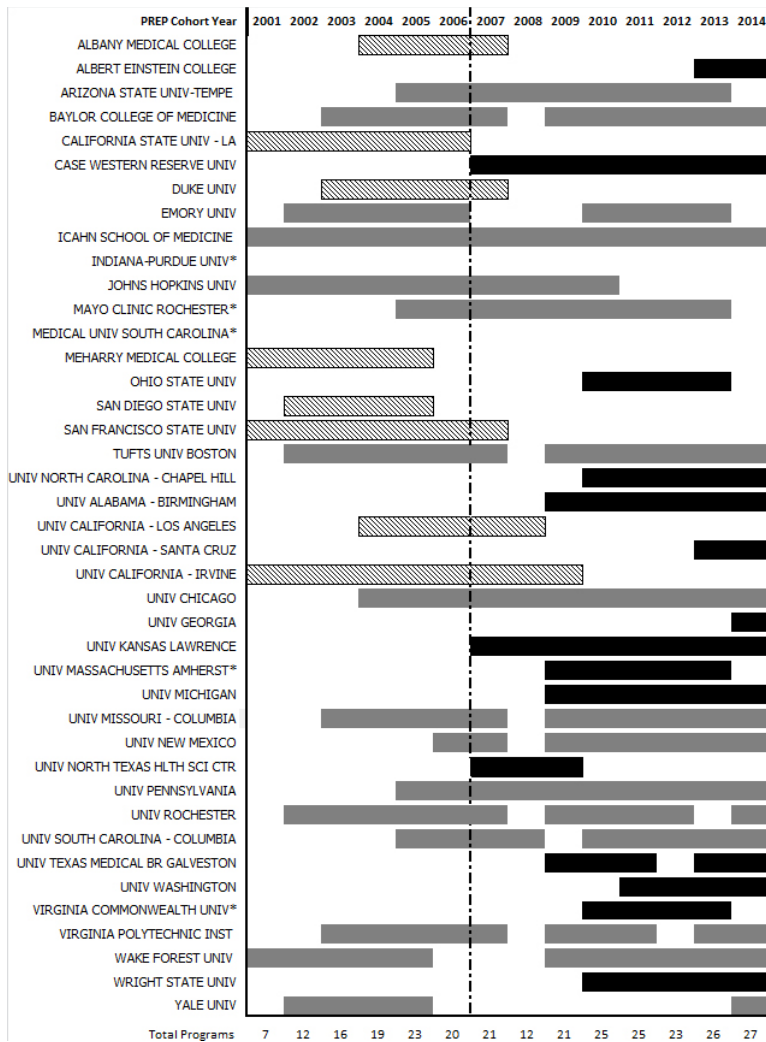
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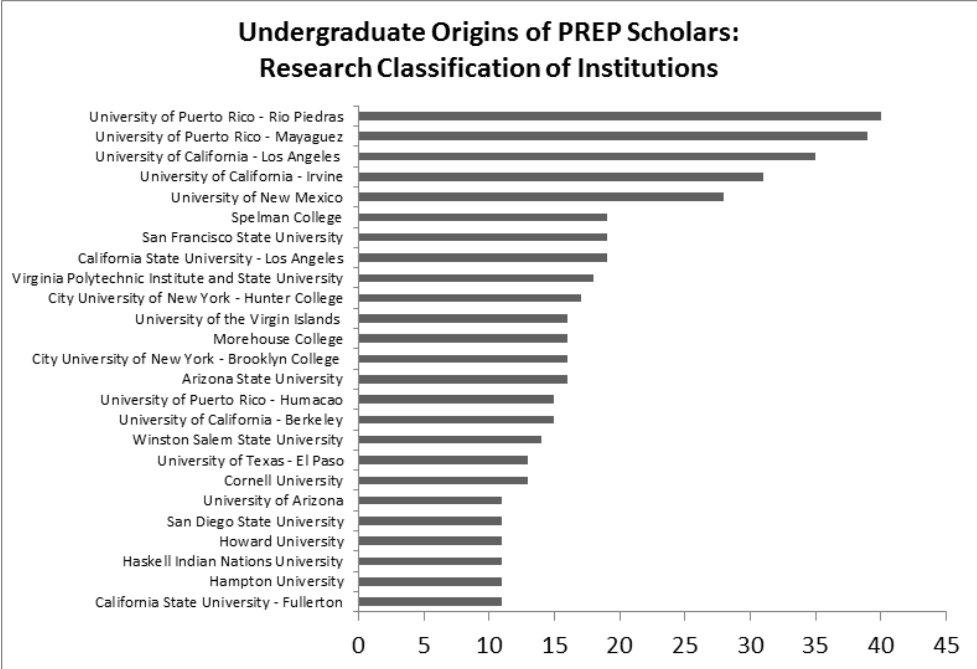
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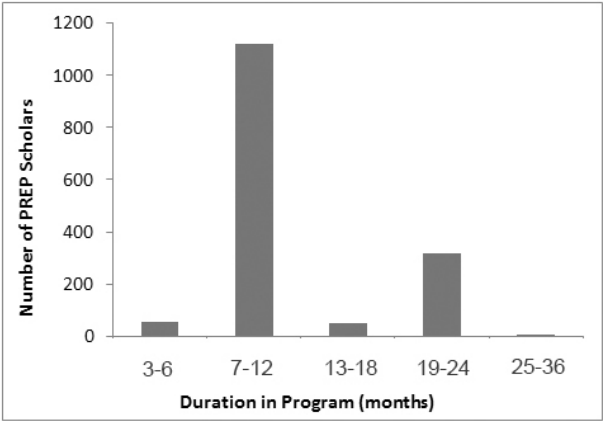


**Figure 1. NIGMS PREP institutions, 2001-2014.** Since the program’s inception, 6 FOAs have been published, resulting in PREP awards to a total of 41 institutions. There have been about 25 active programs per year, with several gaps when there were no active FOAs. The institutions that have had PREP awards include 1.) 8 programs active in cohort 1 that did not renew or persist (striped bars), 2.) 15 programs active in cohort 2 (or “new” programs, black bars), and 3.) 16 programs that have been active in both cohort periods, but often with significant gaps in award periods (gray bars). An asterisk (\*) indicates institutions with an active program in 2014, but with no trainees in xTrain. The dashed line reflects the programs with scholars in cohort 1 (2000-2006) and cohort 2 (2007-2014).



Carnegie Research Classifications	# Students	Institution Type	% Students
Research Universities	638	HSI	22%
Doctoral/Research Universities	119	HBCU	16%
Master's	378	AANAPISI	9%
Baccalaureate	240	AIANSI	4%
Other/Foreign	20	PBI	*
Tribal Colleges	11	TCU	*
Not Reported	120	Other	49%
<b>Total</b>	<b>1526</b>	<b>Total %</b>	<b>100%</b>

Figure 2. Undergraduate origins of PREP scholars. From 2001-2014, 1,526 scholars had earned baccalaureates from 397 institutions. Undergraduate institutions that have produced 11 or more PREP scholars over the history of the program are shown. About 42 percent of students attended research-intensive universities (Carnegie RU/H and RU/VH, and including 8 students at medical schools), another 25 percent attended masters’ colleges and universities, and 16 percent attended primarily baccalaureate institutions. About half the scholars attended an institution with substantial enrollment of students from underrepresented groups, including a Historically Black College and University (HBCU), a Tribal College and University (TCU), an American Indian Alaska Native Serving Institution (AIANSI), a Hispanic Serving Institution (HSI), an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI) and a Predominantly Black Institution (PBI). Institutions may have multiple designations, Reference 8. \* indicates fewer than 1 percent



**Figure 3. Length of PREP scholar participation.** The number of scholars who had various durations of PREP participation are shown, grouped by months. Most scholars begin PREP during the summer and terminate the summer before beginning a research doctorate, and indeed, there were strong peaks at appointments for 12 and 24 months.

Enroll PREP	Complete PREP	PREP Attrition %	Enroll Ph.D.	Enrolled Ph.D. %	Ph.D. Good Standing	Complete Ph.D.	Ph.D. Attrition %
853	801	6%	512	64%	387	92	6%

Figure 4. Ph.D. Matriculation Rate. PREP participant outcome data were collected from competing renewal applications received in 2012-2014 for 25 programs. From 853 initial PREP scholars, there were 801 who completed PREP, such that PREP attrition was about 6 percent. Of those who completed PREP, 512 had enrolled in a Ph.D. program, reflecting a 64 percent Ph.D. matriculation rate. At the time of report, the majority are in good standing and attrition from the Ph.D. program was low.

		2001-2006 Cohort 1	2007-Present Cohort 2
Total PREP scholars		501	1,025
Earned Degree	Current Program		
Ph.D. equivalent <sup>#</sup>		191	50
Master's <sup>&amp;</sup>		79	71
	Master's, now current graduate student	13	23
Bachelor's <sup>^</sup>		134	218
	Bachelor's, now current graduate student	21	468
	Postbac (including PREP)		181
Medical <sup>+</sup>		63	14

Figure 5. PREP Scholar Educational Outcomes. Scholars appointed to PREP were grouped into cohorts pre-2007 (n=501) and post-2007 (n=1025) and educational outcomes were assessed. To learn the Ph.D. matriculation rate in cohort 1, the numbers of scholars who had earned an M.S. or Ph.D. or who were in graduate school were summed (n=304, of total 501), and represent a Ph.D. matriculation rate of about 60 percent. The numbers of students in cohort 2 who had earned a Ph.D. or were current graduate students were summed (and any current PREP scholars who could not have matriculated were omitted), and again, at least 64 percent of scholars matriculated in a Ph.D. program after PREP. The numbers of PREP scholars who earned various terminal degrees are shown. Multiple degrees are included in each degree type, as follows: Ph.D. equivalent<sup>#</sup> Ph.D., M.D.-Ph.D., Pharm.D. ; Master's<sup>&</sup> including M.S., M.A., M.P.H., M.B.A., M.P.T.; Bachelor's<sup>^</sup> including B.S., B.A., B.S.E.E. and Medical<sup>+</sup> including M.D., D.O., D.D.S., D.V.M., O.D.

Research Classifications	# Students	% Students
Research Universities	167	69.3%
Medical Schools	45	18.7%
Other	15	6.2%
Not Classified	14	5.8%
Total	241	100%

Institution Type	% Students
AANAPISI	9%
HBCU	5%
HSI	5%
Other	81%
Total	100%

Figure 6. Institutions where Ph.D. was earned. The institutions at which 241 PREP scholars earned a research doctorate were collected. The vast majority of scholars earned their doctorate degrees at research-intensive institutions (Carnegie categories: Research Universities Very High and High Research Activities = 69 percent) while degrees earned at Medical Schools or Other (masters' colleges and universities, baccalaureate colleges, doctoral research universities and other health profession schools) were relatively infrequent. Some institutions are not classified in the 2010 Carnegie list. Some institutions with substantial enrollment of underrepresented students are also codified as in [Figure 2](#).



<b>Current Career Positions</b>	<b>PREP scholars with Ph.D.</b>	
PREP Ph.D. graduates, total	241	
PREP Ph.D. grads now in postdoctoral training	106	
PREP Ph.D. grads now in medical training	12	
Post-Training PREP Ph.D. graduates	123	
<b>Post Training Career Sector</b>	<b>PREP scholars</b>	<b>% in sector</b>
<b>RESEARCH</b>	<b>53</b>	<b>43%</b>
Academic research or teaching	27	22%
Industrial research	15	12%
Government research	11	9%
<b>SCIENCE RELATED NON RESEARCH</b>	<b>44</b>	<b>36%</b>
<b>NON SCIENCE/UNEMPLOYED/ UNKNOWN</b>	<b>26</b>	<b>21%</b>
		2000-2015 N = 123

Figure 7. Post-Training Career Sectors for PREP Scholars. Among PREP scholars who have earned a Ph.D. equivalent, about half are currently in postdoctoral training. Careers of PREP scholars post-training included research (43 percent), science related non-research (36 percent), non-science, unemployed and unknown careers (21 percent; aggregated to avoid identification). It is important to note that the “unknowns” may not all be post-training as 12 of the 19 PREP scholars in this category earned the Ph.D. in the last 3 years (2013-2015).