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Improving the Biomedical Pipeline: Long-term Outcomes of An Undergraduate Internship

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Abstract

Undergraduate science majors entering their final (senior) year face a critical decision: whether to pursue post-baccalaureate degrees and continue on the path to careers in biomedical, medical or public health fields. Large disparities in socioeconomic factors contribute to the high rate of attrition of under-represented minority (URM) students from historically excluded communities (HEC's) at this key decision point. Here, we present outcome data for six cohorts (2011-2016) of rising seniors (n=163) who participated in the Fred Hutchinson Cancer Center's Summer Undergraduate Research Program (SURP). The SURP recruited a diverse population of science majors for a nine-week intensive research internship during the summer between junior and senior year. The interns engaged in research experiences in Fred Hutch laboratories and research groups while participating in professional development workshops designed to enable them to be competitive for admission to top master's, doctoral, medical and dual degree programs. In spite of historically documented disparities in advancement of students from HEC's, we demonstrate that an intensive internship that combines realistic research and professional development components can increase the obtainment of advanced degrees (n=80, 51.6%) for all participants regardless of racial, ethnic or socioeconomical background.

Introduction

The biomedical research enterprise is critically dependent on recruitment, training and retention of the highest-quality researchers and practitioners (Eisen & Eaton, 2017). The United States (US) appears to have been quite successful in recruiting such researchers (Gibbs Jr, Basson, Xierali, & Broniatowski, 2016; Gibbs Jr, McGready, Bennett, & Griffin, 2014); however, little is known of the characteristics of undergraduate education that may motivate students to pursue advanced careers, especially biomedical careers. At issue for understanding the pipeline of recruitment and retention into advanced careers is the paucity of research on long-term outcomes of efforts to increase student movement into advanced careers (Eisen & Eaton, 2017; Howell, Wahl, Ryan, Gandour-Edwards, & Green, 2019; Liberman, Singh, Tan, & Gotian, 2023; Mervis, 2006; Teegarden et al., 2011; Thompson et al., 2019).

The National Center of Education Statistics (NCES) is a federal agency responsible for collecting and reporting

data on education in the US. It periodically reports data about educational attainment and subsequent employment of individuals who receive bachelor's degrees through its Baccalaureate and Beyond Longitudinal Studies (B&B). For example, B&B tracked students who received a bachelor's degree in 2007-2008, and followed them at various intervals, ending with a third follow-up at 10 years post-bachelor's degree to 2018 (Cominole, Thomsen, Henderson, Velez, & Cooney, 2021). Of the 2007-2008 cohort, some 43% had completed another degree or certificate program. Of all students graduating with a bachelor's degree, 27% received a master's degree, 6% received an undergraduate certificate, associate degree, or additional bachelor's degree, 5% received a professional doctoral degree (such as MD, PA, NP), 4% received a post-bachelor's or post-master's certificate, and 2% received an academic doctoral degree (Cominole et al., 2021).

Although the B&B has published data related to long-term educational accrual, it includes only limited variables, such as ethnicity, race, gender, age, major, and current employment status. Other critical individual characteristics such as financial well-being, receipt of financial aid, military status, first-in-college, and rural primary residence are not examined. The most recent B&B data currently being gathered includes some of these variables (financial well-being, financial aid received, military status, education of parents), but long-term data are not yet available (Henderson, Drummond, Thomsen, Yates, & Cooney, 2022).

Individual characteristics may be somewhat explanatory; however, the learning environment in which individuals are located may also affect advancement to graduate degrees. In an effort to increase the entry of undergraduate students into graduate and professional or academic degree programs, numerous colleges and universities now offer extra-curricular experiences that have been shown to stimulate such progress. Sample programs include undergraduate mentorship by scientists (Ford, 2016) undergraduate research experiences during the academic year (Follmer, Zappe, Gomez, & Kumar, 2017; Vincent-Ruz, Grabowski, & Schunn, 2018), and undergraduate summer internship programs (Gaida et al., 2021; Meadows et al., 2022; Thompson et al., 2019; Villarejo, Barlow, Kogan, Veazey, & Sweeney, 2008). The Fellowships in Research and Science Teaching (FIRST) program noted in a 17-year follow-up that cohort-driven community, developmental training, and ongoing mentorship were crucial to the success of the program (Eisen & Eaton, 2017). Others have noted that even short-term research experiences have demonstrated increases in openness to research collaboration, likelihood of pursuing graduate careers, gains in research skills, higher GPAs in STEM courses, gain in confidence, and insights in science (Anders et al., 2024; Baron, Brown, Cumming, & Mengeling, 2020; Chou, Hammon, & Akins, 2019; Follmer et al., 2017; Gaida et al., 2021; Gorbunov, Moreland, Tingle, & Deaton, 2022; Masunaga, Chun, & Vu, 2023; Vincent-Ruz et al., 2018).

The efforts to recruit general undergraduate students into graduate careers has been equally, if not more widespread, than the attempt to recruit and train underrepresented students in an undergraduate setting. Despite a 40-year national effort to boost diversity in scientific fields, the proportions of underrepresented individuals in scientific careers are still far from the desired goals (Hue, Sales, Comeau, Lynn, & Eisen, 2010; Odedina et al., 2019). Well over 30% of the population of the US is non-majority (US Census bureau), yet only about 11% of the biomedical workforce self-identifies as underrepresented (National Science Foundation, 2023).

More alarming is the proportion of movement to advanced degrees that declines with each level of advanced education and training (National Science Foundation, 2023). In 2021, the rates of bachelor's degrees among Blacks, Hispanics, Asians, and non-Hispanic Whites were 28.1%, 20.6%, 61.0%, and 41.9% respectively showing much lower bachelor's degree rates for minority populations, with the exception of Asians, relative to non-Hispanic Whites (Bureau, 2022). Going on to examine minorities that had gained a bachelor's degree--Blacks, Hispanics, Asians, and others (e.g., non-Hispanic Whites)--the rates of total advanced degrees were 45.9%, 40.6%, 49%, and 47.8% respectively, indicating that with the exception of Hispanics, other minority groups exceeded non-Hispanic Whites in acquiring advanced education. However, it is worth noting that most of the advanced degrees for Blacks and Hispanics fell into undergraduate certificates and additional bachelor's or master's degrees, with few obtaining professional or academic doctoral degrees.

It is not clear why the minority disparity exists; however, many attribute it to institutional barriers in education (Gibbs Jr et al., 2016; Gibbs Jr et al., 2014; Griffin, 2019; Taff & Clifton, 2022). The current national emphasis on diversity, equity, and inclusion (DEI) recognizes that education has not been inclusive or equitable in more advanced educational institutions. Focusing on the environment within which students participate, DEI fosters changes that ensure all students, regardless of personal characteristics, have opportunities to excel (Estrada, Woodcock, Hernandez, & Schultz, 2011; Howell et al., 2019; Taff & Clifton, 2022).

Despite the long-term inequities in education, little is known about the long-term effects of inclusion programs; that is, are participants in research-based extra-curricular undergraduate experiences more likely to enter advanced education training programs? In part, the answers are difficult to determine in that few extra-curricular research programs engage in long-term follow-up of their participants. Even more challenging is the difficulty in collecting data on control groups to serve as valid comparators. A few exceptions were noted. The Meyerhoff Scholars Program at the University of Maryland, Baltimore County (Maton et al., 2016; Stolle-McAllister, Sto. Domingo, & Carrillo, 2011) is a comprehensive four-year program designed to prepare trainees for academic STEM careers and has demonstrated success. The Meyerhoff Scholars Program has served as a model for similar programs at major research universities (Sto. Domingo et al., 2019). The effectiveness of short-term mentorship, career development and research experience programs is less well documented.

Thompson et al. (2019) followed a group of underrepresented students participating in the Partnerships to Advance Cancer Health Equity (PACHE) program sponsored by the National Cancer Institute (NCI). Participants in any one of the undergraduate programs offered by the PACHE program were more likely to earn advanced degrees ranging from master's degrees, research doctoral degrees, other doctoral programs (such as MDs, PharmD, etc.) than their counterparts who were not in the PACHE program. The five-year advanced educational attainment rates for those graduating with a bachelor's degree were 79% (2002-2007) and 75.2 % (2007-2013) (Thompson et al., 2019). A study in the Meharry-Vanderbilt-Tennessee Partnership, also a PACHE program, indicated that 87% of participants, all of whom were of minority status, earning a bachelor's degree between 2011 and 2020 had enrolled in a graduate program by 2020 (Meadows et al., 2022). A short-term project noted that undergraduate research experiences were vital in STEM student persistence (Vincent-Ruz et al., 2018).

Here, we report on long-term educational attainment outcomes of participants in the Summer Undergraduate Research Program (SURP) at Fred Hutchinson Cancer Center. SURP is implemented with the goal of providing an intensive research experience that encourages all participants, including underrepresented participants to consider obtaining advanced degrees, increasing the likelihood of retaining them on the path to biomedical and public health research careers. SURP offers a nine-week internship that provides participants with lab experience, ongoing mentorship, professional and applied seminars, and training. The participants are provided with a stipend, roundtrip travel to Seattle, and additional funds for housing in cases of financial need. Training opportunities include seminars on the processes of applying to graduate and medical school, one-on-one mentoring with current graduate and medical students, and personal statement and resume writing workshops. A comprehensive follow-up protocol was implemented in 2009 to track participants for seven years post participation in the SURP. We report on the long-term rates of all participants and of underrepresented participants. We compare our results to the B&B studies data to note our findings in SURP to national patterns.

Methods

Setting

Fred Hutchinson Cancer Center (Fred Hutch) was established in 1975 as an independent cancer research and treatment cancer. Currently, it is composed of six divisions representing basic and population science as well as translational and clinical research fields in cancer, immunology, and infectious disease. It has been a National Cancer Institute (NCI)-designated Comprehensive Cancer Center since 1976. Fred Hutch is affiliated with the University of Washington (UW). Graduate students from several UW departments as well as co-administered umbrella graduate program have the option to conduct thesis research in Fred Hutch laboratories and research groups.

The Summer Undergraduate Research Program (SURP)

Recruitment

The SURP curriculum is tailored to undergraduate STEM students between junior and senior year of study. This enables SURP to capitalize on the timepoint when students are making decisions about next steps after obtaining their undergraduate degree and provide professional development to help students succeed in their chosen career path. The program recruits through a variety of forums that provide internship information to college undergraduates including students from HECs. SURP presents at annual meetings of the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS),

Annual Biomedical Research Conference for Minoritized Scientists (ABRCMS) and American Indian Science and Engineering Society (AISES) as well as distributing information packets to Historically Black Colleges and Universities (HBCUs) and other Institutions serving Underserved Health Disparity Populations and Underrepresented Students (ISUPS). Information is also distributed to colleges and universities that have successfully placed interns in SURP in previous years. Several academic institutions provide financial support for their students who participate in SURP.

Admissions

SURP receives 300 to 400 applications annually. Applications consist of a personal statement describing the applicant's previous research experience and motivation to participate in SURP, the applicant's choice of three research laboratories at Fred Hutch in which they wish to participate, a current transcript, and up to two letters of recommendation. A committee composed of Fred Hutch faculty, students, and staff reviews the applications seeking to identify applicants who express a strong commitment to obtaining advanced degrees, including Doctor of Philosophy (Ph.D.) in life sciences or public health, doctor of medicine (M.D.), or combined dual degree (M.D./Ph.D.) programs including Medical Scientist Training Program (MSTP). Additional review criteria include strength of letters of recommendation and previous research experience. Priority is given to applicants who have not had research experiences at major academic or biomedical research institutions. URM applicants from HECs, socioeconomically disadvantaged groups, or first-in-family college students are also given priority. The program typically selects a cohort of 25-30 interns representing a variety of backgrounds and home institutions.

Placement

Prior to receiving offers of admission to SURP, applicants are placed in research groups or laboratories that align with the applicant's stated research interests, and when a research group is confirmed, applicants are contacted with offers of admission. Typically, >90% of accepted applicants confirm participation. Placement prior to admission notification is thought to be responsible for the high percentage of admitted applicants confirming participation. A "hands on" mentor in the home laboratory is identified for each incoming intern. The mentor role *in situ* is to initiate contact with the intern prior to start of the program, provide background information including relevant literature, and to serve as the day-to-day contact once the intern begins. The role of the laboratory's principal investigator (PI) is to provide high level scientific discussion and career guidance for the intern.

Program Schedule

Each week of the internship has a professional development workshop in which specific career advancement skills are taught and practiced. Scientific presentations by Fred Hutch faculty spanning the gamut of disciplines from basic science to translational and public health research are also presented weekly. Faculty giving the scientific presentations are encouraged to describe their professional journey with an emphasis on identifying key decisions and factors influencing them in selecting their chosen fields and careers. Cohort building and social activities include a group outing to a professional baseball game, a ferry trip to a destination in Puget Sound, a tour of a local chocolate factory, and other social events. The program culminates in a competitive scientific poster session on the last day of the internship; the session summarizes the interns' work.

Tracking the Students

Student tracking is specific and extensive; SURP staff administer a robust follow-up and evaluation surveys to measure the impact of the biomedical research education curriculum and the quality of mentorship among program

participants. To assess whether the program had a relationship with students' career goals and motivations to attend graduate, medical, or professional school, as well as how the program can be improved in future years, students are asked to complete a pre- and post-survey via SurveyMonkey at the start (week one) and conclusion (week nine) of the program. Participation in both surveys is voluntary; however, most interns complete them.

To assess the efficacy of SURP, staff need to learn about students' educational and career activities following their participation in the program. Specifically, we are interested in learning why some students who participated in the program: (1) entered graduate, medical, or professional school; (2) chose not to pursue or complete advanced degrees; and/or (3) pursued careers in cancer-related research or medical care. Upon acceptance to the SURP, students are asked to consent to participate in the Annual Training Program Follow-up. Once consent is obtained, students are contacted via email annually over the course of the next seven years with an invitation to respond to the follow-up survey via SurveyMonkey. Non-respondents receive two reminder emails. Staff then use the student-given emergency contact as a means to get in touch with non-respondents. If this effort fails, staff then use LinkedIn or other social media to ascertain current work, education and employment status.

Measurement of Students

The instruments for evaluating SURP activities are outlined below in Table 1. As can be seen, the instrumentation is relatively brief with a pre- and post-survey, an anonymized survey on various components of the program, and an annual survey to report on students' current activities.

Table 1. SURP Tracking and Evaluation Strategies

Pre-survey: This 18-item questionnaire is administered via SurveyMonkey® prior to participants' arrival to SURP and is designed to ascertain students' goals and motivations to attend graduate, medical, or professional school. Responses help staff identify how we can best support individual students' academic and career endeavors.
Post-survey: This 22-item questionnaire is administered via SurveyMonkey® at the conclusion of the 9-week program and designed to measure any changes in students' goals and motivations to attend graduate, medical, or professional school, assess quality of scientific advising received, frequency of interaction with science advisor(s), and gauge the program's influence on career choice.
Program evaluation by students: This comprehensive questionnaire is completed in 'real time' via a Word document to capture participants' immediate reflection following each curricular activity. The anonymous evaluation is submitted at the conclusion of the program. Students are encouraged to offer candid, detailed feedback. Responses are transferred into a table and analyzed in aggregate form to maintain confidentiality and identify primary themes.
Annual Training Program Tracking Survey: This 11-item questionnaire is administered via SurveyMonkey® (among students who consent to participate in Training Program Tracking) annually in April and designed to identify participants' current status, ways in which program participation informed or supported their academic/professional goals, and tangible accomplishments post-program, i.e. scholarships or grants received, publications, presentations, etc.

Analysis

We used the data from the measures described above to evaluate (1) the demographic characteristics of SURP interns, (2) the number of overall and URM interns participating in SURP over time, and (3) the highest degree attained by year of participation, URM status, first-generation status, and economic disadvantage status. We also assessed the level of self-efficacy, perception of graduate school, and perception of SURP PI reported by URM and non-URM interns and by degree attained. Finally, we compared the percent of SURP interns receiving an advanced degree (beyond a bachelor's degree) between URM vs. non-URM interns, first-generation vs. non-first-generation interns, and economically disadvantaged vs. not economically disadvantaged interns.

Results

Response Rates

Of the 163 students who participated in the years 2011 to 2016, 163 (100%) consented to participate in the pre-survey, 163 (100%) in the post-survey, and 163 (100%) participated in at least one year of the annual training program tracking survey. For the annual survey, there was some fall-off by year since program completion. Additional searches of professional databases (e.g. LinkedIn®) were able to determine the most recent degree for 155 (95.1%) interns. Almost half of the cohort (47.9%) consisted of interns who self-identified as URM. Many of the URM interns were also first-generation college students (45.2%) and/or economically disadvantaged (85.9%). Not surprisingly, many URM interns self-identified in more than one URM category.

Characteristics of the Students

Table 2 summarizes the students' characteristics at entry into SURP. As can be seen from the table, the majority were female, more than half were white and 21.3% were Hispanic, with a similar proportion (21.8%) being first generation college students. Almost half (44.3%) were economically disadvantaged. A few students selected "prefer not to answer" to specific questions and these were treated as missing data.

Table 2. Characteristics of Interns (N=163)

Characteristic	N (%)
Women	102 (63.8%)
N missing	3
Race	
Black	12 (7.9%)
American Indian/Alaska Native	4 (2.6%)
Asian American	16 (10.5%)
Mixed race	9 (5.9%)
White	111 (73.0%)
N missing	11
Hispanic or Latino	32 (21.3%)

Characteristic	N (%)
N missing	13
First generation college student	33 (21.9%)
N missing	12
Economically disadvantaged	66 (44.3%)
N missing	14

Figure 1 shows the total number of rising senior students over the six-year period as well as the number of underrepresented (URM) students. With the exception of years 2014 and 2015, the total number of students varied from 25 to 30 except for 2014 (23 students) and 2015 (24 students). URM students ranged from about half in 2011 and 2012 to about a third in 2013 and 2014 but increased to half again in 2015 and two-thirds in 2016. The upward trend in 2015 and 2016 was associated with a concerted emphasis on recruiting URM students.

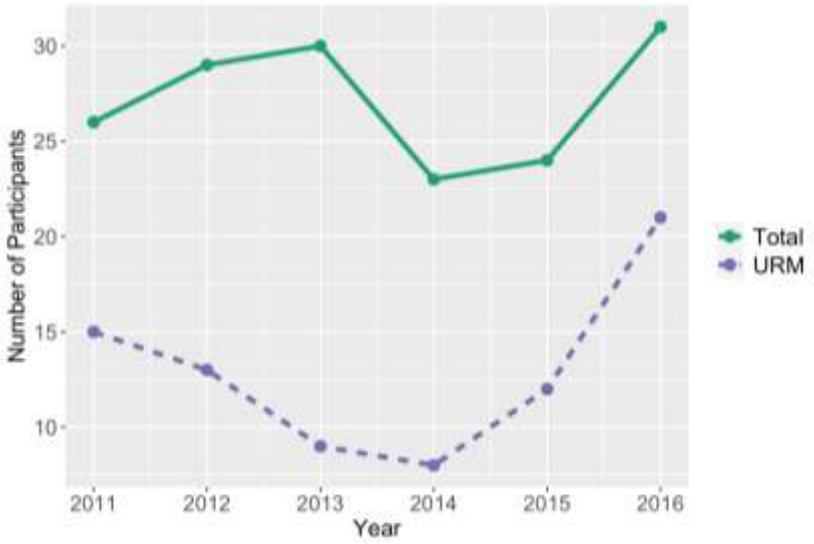

Figure 1. SURP URM Students and Total Students

Figures 2-5 show the highest degree attained by program year. Figure 2 is the overall attainment during the seven years and demonstrates that 43.5% of interns achieved higher than a baccalaureate degree. All interns for whom we were able to obtain information during the seven years post-program completion graduated from college. In Figure 3, advanced degrees were attained by 50.7% of URM interns compared to 37.3% of non-URM interns. Figure 4 shows a similar pattern for first-generation students, and Figure 5 demonstrates roughly the same for economically disadvantaged interns. In a comparison of all years beyond the internship (up to 12 years), we noted that URM students attained advanced degrees at rates similar to non-URM students (see Figure 6). A notable difference between URM and non-URM interns is that 7-year follow up based on surveys shows that a higher proportion of non-URM to URM (55.4% versus 44.9%) interns obtained advanced degrees, however, this difference is erased in longer-term follow-up with LinkedIn® data (78.8% versus 80.8%). Since the LinkedIn follow-up ranges from 7 years for the 2016 cohort to 12 years for the 2011 cohort, the longer follow-up results in a higher percentage of SURP alumni obtaining advanced degrees regardless of URM status (see Figure 7).

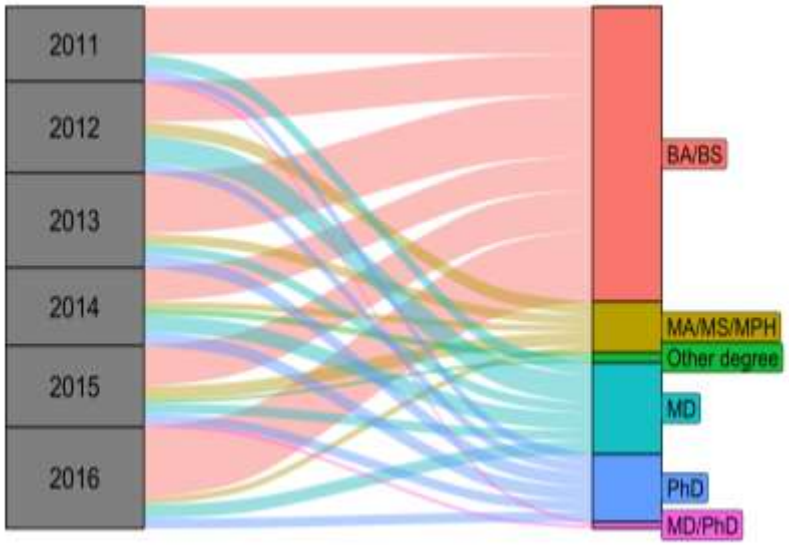

Figure 2. Highest Degree Attained by Program Year (Seven-Year Follow-Up)

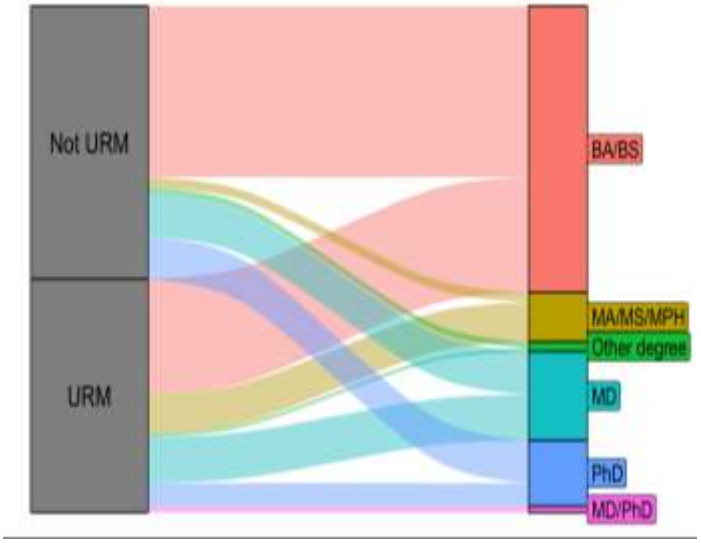

Figure 3. Highest Degree Attained by URM Status (Seven-Year Follow-Up)

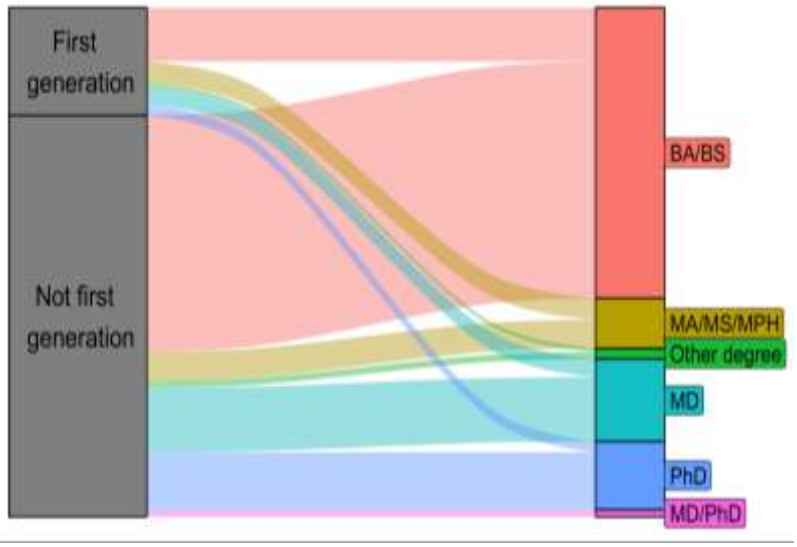

Figure 4. Highest Degree Attained by First-Generation Status (Seven-Year Follow-Up)

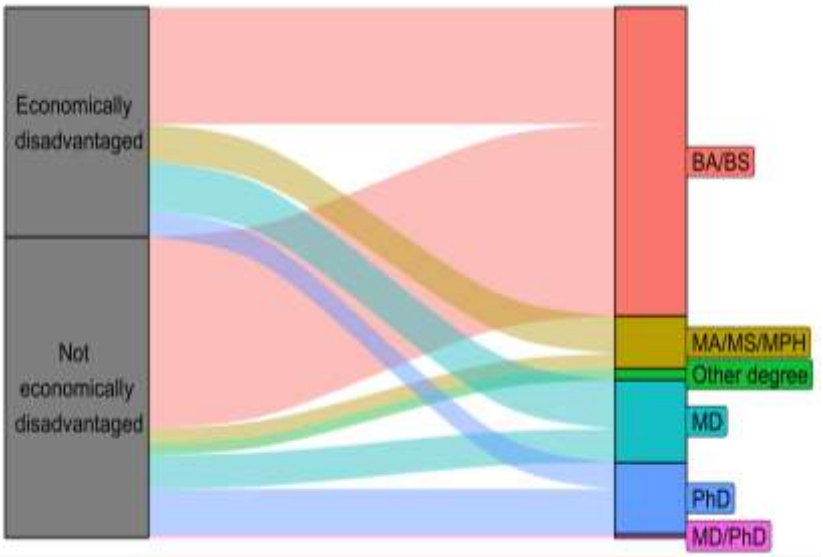

Figure 5. Highest Degree Attained by Economic Advantage (Seven-Year Follow-Up)

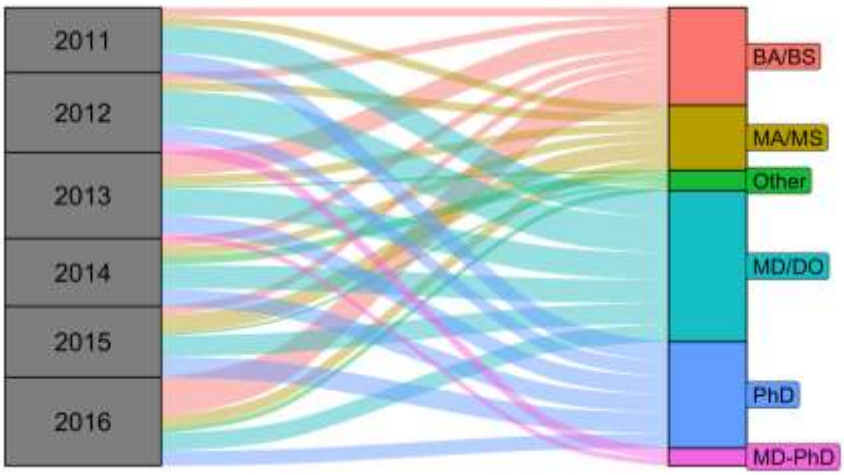

Figure 6. Highest Degree Attained by Program Year (12-Year Follow-Up)

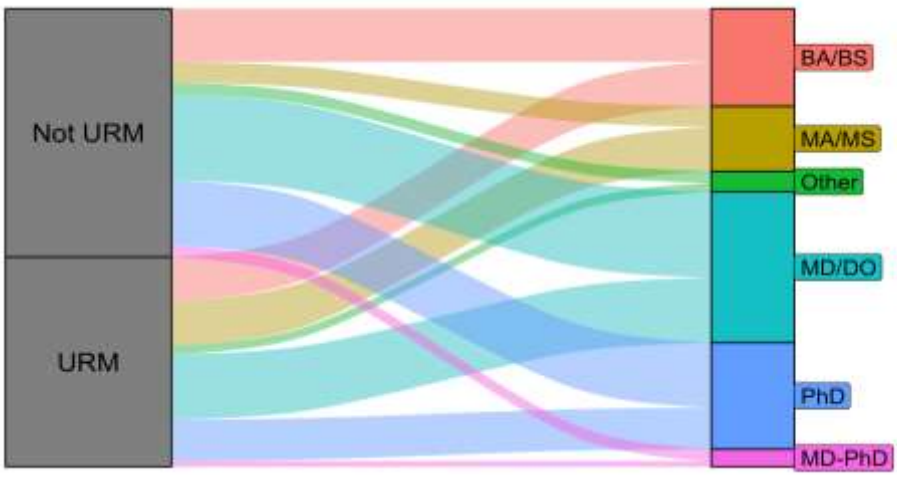

Figure 7. Highest Degree Attained by URM Status (12-Year Follow-Up)

Self-efficacy assessed the students' self-perception of the highest degree they hoped to attain and as shown in Table 3, there was no difference in mean self-efficacy between non-URM and URM students (4.8 for each on a 5-point scale). Also shown was their concern about their academic preparedness for graduate school; the mean preparedness was similar for both URM and non-URM students (2.97 on a 5-point scale for URM and 3.0 for the non-URM). In terms of their perception of PI/mentors, URM students had a slightly higher, or better, mean perception of the encouragement given by their mentors (3.6 on a 5-point scale) than non-URM students (3.4 on a 5 point scale), but again the differences are not substantial.

Table 3. Cross-tabulation of Constructs* by URM and Not-URM

Construct	URM	Non-URM
Self-efficacy (n missing = 19)	4.80	4.80
Perception of graduate school (n missing = 10)	2.97	3.00
Perceptions of PI/Mentor (n missing = 10)	3.55	3.44

*Based on a 5-point scale, where 5 is high

Discussion

In this examination of advanced degree training by participating interns in the Fred Hutch Summer Undergraduate Research Program (SURP), we found that, based on up to 12 years of follow-up, the majority of interns went on to pursue advanced academic careers. Initially, underrepresented students (URM) were less likely to pursue higher education than non-URM students; however, an examination of over a longer timeframe since baccalaureate degree indicated that URM interns attained advanced degrees at a nearly equal rate to non-URM students. This suggests that URM students may need more time to complete an advanced degree. It is not clear why this is the case, but it may be due to financial constraints, the need to work before proceeding to advanced education, gap years, or other matters of personal concern. Regardless, the percentages of URM and non-URM students who achieved advanced degrees are nearly equal over a longer time span.

Although a nine-week internship cannot take sole credit for success that may take many years to obtain, it can claim to provide support and continued mentorship that helps to prevent life sciences college graduates from leaving the biomedical workforce. The nearly equal success of URM trainees to that of their non-URM peers documented here demonstrates that a concerted effort to provide tools and skills needed to succeed in graduate programs can to some extent overcome disadvantages experienced by URM students. Several factors contribute to this: SURP interns participate between junior and senior year of college; many take gap years or participate in post-baccalaureate programs after graduation, and; average time to doctoral, medical and dual degree times to graduation ranging from 6 to 8 years.

Interestingly, there was no difference in mean self-efficacy when URM and non-URM students entered the program and both groups attained advanced degrees at a higher rate than national averages. This may be because the selection process used for the program was sufficiently stringent that students had to demonstrate their ability and motivation to attend graduate school to be admitted. This ability and motivation in itself is founded on

experiences prior to the internship putting URM and non-URM students on an more equal footing than the general student population. This does not imply that systemic differences that make it more difficult for URM students to remain and advance toward advanced degrees are eliminated; the time difference required to obtain an advanced degree demonstrates this. However, these results suggest that it is possible for URM and non-URM interns to benefit to the same extent from research experiences and mentoring in pursuit of advanced degrees.

URM students had a more favorable impression of their PI/mentors compared to non-URM students. Non-URM students are more likely to have had social support and possibly mentor feedback in their academic careers while URM students were more likely to lack that type of support. Toward that end, attention from the principal investigators/mentors may have been more meaningful to URM students who had less social support than non-URM students. The literature supports this lack of social support among URM students (Daniels et al., 2016; Estrada et al., 2011; Schultz et al., 2011).

The rate of higher academic achievement was higher than that for the B&B cohort where 43% of graduates went on for advanced degrees (Cominole et al., 2021; National Science Foundation, 2023). It should be noted that many students who participate in the SURP already possess a strong motivation to pursue graduate studies, making it difficult to attribute the higher rate of advanced degree attainment solely to the program. Without a control group for comparison, it is challenging to isolate the program's impact on academic achievement. The SURP interns all achieved a baccalaureate degree making them comparable to the B & B data which examines educational advancement after baccalaureate graduation.

Limitations

This study has some limitations. We had no control group with which to compare our interns; however, the URM versus non-URM comparison remains valid. Likewise, SURP selects STEM majors who express an interest in biomedical or public health research careers prior to the internship. Although the percentage of STEM majors who go on to research careers is significantly higher than the percentage of all majors who pursue these careers, disparities based on race, ethnicity or socioeconomic status among this group still exist. The seven years of follow-up are too short to account for individuals who go on to doctoral programs or MD/PhD programs. However, the extended (up to 12 years) follow-up noted that 27.8 percent of interns had achieved those degrees. Although the numbers of interns are relatively small, it is noteworthy that we were able to determine the most recent degree reported on LinkedIn® for 95% of them yielding confidence in our results. However, reliance on LinkedIn® data could potentially confound these results; if URM students were more likely to have LinkedIn profiles or report their degree information, the advanced degree attainment rates reported here may be skewed. Finally, the very process of applying to the SURP requires high self-efficacy, making this population different from the overall population of rising seniors.

Conclusions

The biomedical research enterprise needs to recruit, train, and retain a diverse workforce in order to accomplish

its goals of advancing knowledge and curing diseases. A variety of training programs recruit qualified high school and college students from diverse backgrounds to participate in curricula designed to introduce them to biomedical science while providing experiences that enable them to succeed at the next level of education, thereby seeking to retain them in the biomedical research workforce. Students from racially or ethnically under-represented backgrounds, economically disadvantaged, as well as first generation college students have been documented to have a progressively diminishing presence along the undergraduate to graduate to post-graduate trajectory (Cominole et al., 2021; National Science Foundation, 2023; Schultz et al., 2011). The disparity is exacerbated by a high degree of overlap between these groupings, with many students falling into two or all three categories. The goal of many training programs, therefore, is to provide trainees from these groups with skills and support to pursue research careers with the same confidence and ambitions as their more privileged classmates.

The SURP at Fred Hutch has, since 1995, provided internships to rising college seniors from diverse backgrounds and since 2011 tracked their post-baccalaureate progress. SURP places interns in individual laboratories and research groups to carry out intensive nine-week long research projects. Faculty members recruited to host and mentor the interns provide scientific direction and professional guidance. The interns also interact with graduate students, post-doctoral and clinical fellows, and staff scientists daily and receive a realistic introduction to what the life of a scientist requires but also offers. Throughout the internship, they participate in professional development workshops designed to enable them to compete for admission to top doctoral, medical, and dual degree programs. The interns also receive personal mentoring in scientific writing and presentation skills. The program works.

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