HHS Public Access

Author manuscript

J Cancer Educ. Author manuscript; available in PMC 2022 May 20.

Published in final edited form as:

J Cancer Educ. 2016 June ; 31(2): 228–235. doi:10.1007/s13187-015-0825-0.

Mentoring Strategies and Outcomes of Two Federally Funded Cancer Research Training Programs for Underrepresented Students in the Biomedical Sciences

Marvella E. Ford[1], **Latecia M. Abraham**[2], **Anita L. Harrison**[3], **Melanie S. Jefferson**[4], **Tonya R. Hazelton**[5], **Heidi Varner**[6], **Kimberly Cannady**[6], **Carla S. Frichtel**[7], **Omar Bagasra**[8], **Leroy Davis**[9], **David E. Rivers**[10], **Sabra C. Slaughter**[11], **Judith D. Salley**[12]

Marvella E. Ford: fordmar@musc.edu

[1]Cancer Disparities, Hollings Cancer Center, Department of Public Health Sciences, Medical University of South Carolina (MUSC), 86 Jonathan Lucas Street, Charleston, SC 29425, USA

[2]Public Information and Community Outreach, Department of Library Science and Informatics, MUSC, 171 Ashley Avenue, Suite 305, MSC 403, Charleston, SC 29425, USA

[3]Hollings Cancer Center, MUSC, 86 Jonathan Lucas St., Room HO124G, MSC 955, Charleston, SC 29425, USA

[4]Cancer Control, Hollings Cancer Center, Department of Psychiatry & Behavioral Sciences, 86 Jonathan Lucas Street, Hollings Cancer Center, MSC 955, Charleston, SC 29425, USA

[5]Heart & Vascular Center, MUSC, Ashley River Tower, 25 Courtenay Drive, Room # 3301, Charleston, SC 29425, USA

[6]Cancer Disparities, Hollings Cancer Center, Department of Public Health Sciences, MUSC, 86 Jonathan Lucas Street, MSC 955, Charleston, SC 29425, USA

[7]Research Development, Hollings Cancer Center, MUSC, 86 Jonathan Lucas St., Room HO124, MSC 955, Charleston, SC 29425, USA

[8]Department of Biology, SC Center for Biotechnology, Claflin University, 400 Magnolia Street, Orangeburg, SC 29115, USA

[9]Department of Biology, Voorhees College, P.O. Box 678, Denmark, SC 29042, USA

[10]Department of Library Science and Informatics, Public Information and Community Outreach, MUSC, 171 Ashley Avenue, Charleston, SC 29425, USA

[11]Department of Family Medicine, Southeastern Virtual Institute for Health Equity and Wellness (SE VIEW), MUSC, 179 Ashley Avenue, Charleston, SC 29425, USA

[12]Department of Biological & Physical Sciences, South Carolina State University, 300 College Street, Orangeburg, SC 29117, USA

Correspondence to: Marvella E. Ford, fordmar@musc.edu.

Electronic supplementary material The online version of this article (doi:10.1007/s13187-015-0825-0) contains supplementary material, which is available to authorized users.

Ethical Standards The manuscript does not contain clinical studies or patient data.

Conflict of Interest The authors declare that they have no conflict of interest.

Abstract

The US is experiencing a severe shortage of underrepresented biomedical researchers. The purpose of this paper is to present two case examples of cancer research mentoring programs for underrepresented biomedical sciences students. The first case example is a National Institutes of Health/National Cancer Institute (NIH/NCI) P20 grant titled “South Carolina Cancer Disparities Research Center (SC CaDRe)” Training Program, contributing to an increase in the number of underrepresented students applying to graduate school by employing a triple-level mentoring strategy. Since 2011, three undergraduate and four graduate students have participated in the P20 SC CaDRe program. One graduate student published a peer-reviewed scientific paper. Two graduate students (50 %) have completed their master’s degrees, and the other two graduate students will receive their degrees in spring 2015. Two undergraduate students (67 %) are enrolled in graduate or professional school (grad./prof. school), and the other graduate student is completing her final year of college. The second case example is a prostate cancer-focused Department of Defense grant titled “The SC Collaborative Undergraduate HBCU Student Summer Training Program,” providing 24 students training since 2009. Additionally, 47 students made scientific presentations, and two students have published peer-reviewed scientific papers. All 24 students took a GRE test preparation course; 15 (63 %) have applied to graduate school, and 11 of them (73 %) are enrolled in grad./prof. school. Thirteen remaining students (54 %) are applying to grad./prof. school. Leveraged funding provided research-training opportunities to an additional 201 National Conference on Health Disparities Student Forum participants and to 937 Ernest E. Just Research Symposium participants at the Medical University of South Carolina.

Keywords

Triple-level mentoring strategy; Mentoring programs; Outcomes; Diversity; Underrepresented minority students; Biomedical sciences; Cancer research training programs; Education

Introduction

The US is currently experiencing a shortage of biomedical research scientists. This shortage is experienced most dramatically among diverse populations, where young adults are not entering science, technology, engineering, and mathematics (STEM) careers at significant rates. Diversity in this case refers to young adults who are racially and ethnically diverse, from rural areas, and from low socioeconomic-position backgrounds [1]. Since 2000, the percentage of underrepresented minorities receiving degrees in engineering and the physical sciences has been flat, and participation in mathematics has dropped [1, 2].

Compounding these problems, the demand for cancer prevention, screening, and treatment services will grow over the next two decades as the proportion of older adults in the USA increases, leading to an anticipated 45 % rise in the number of new cancer cases by 2030 [2]. To improve outcomes from the growing cancer problem, investigators must understand the science behind the disease.

Given the potential for dramatic workforce shortages due to the reasons mentioned above, it is imperative to leverage strategies to enhance the scope and diversity of the next

generation of cancer researchers and physician scientists. As noted by the Institute of Medicine [3], greater diversity among medical researchers and physicians leads to improved access to care among racially and ethnically diverse patients, greater patient choice and satisfaction, improved patient-provider communication, and better educational experiences for biomedical students during their training [4–6].

A landmark review [7] noted that African Americans are 10% less likely than European Americans to receive NIH R01 funding, a marker of independent investigator status, even after controlling for demographic characteristics, education and training, and research productivity, among other measures. Increasing the number of diverse investigators who are well-trained in the traditional methodological and analytic principles of research is a critical step toward successfully increasing capacity in cancer health equity research.

The purpose of this paper is to present two case examples of undergraduate student mentoring programs. The case examples are drawn from two federally funded cancer research training grants for underrepresented populations in the biomedical sciences. The first case example is a National Institutes of Health/National Cancer Institute (NIH/NCI) P20 grant titled “South Carolina Cancer Disparities Research Center (SC CaDRe).” The second case example is a prostate cancer-focused Department of Defense grant titled “The South Carolina Collaborative Undergraduate HBCU Student Summer Training Program.” The Student Fellows in the NIH/NCI P20 SC CaDRe and the DoD-funded summer research programs are all students who have racial/ethnic backgrounds that are underrepresented in biomedical and biobehavioral research. The design and outcomes of each program will be highlighted. The unintended consequence of leveraging funds through the programs will also be described.

Methods

Case Example 1. NIH/NCI P20 SC CaDRe Grant

Purpose—The South Carolina Cancer Disparities Research Center (SC CaDRe) is a formal collaboration between the Medical University of South Carolina (MUSC) and South Carolina State University (SCSU). The primary goal of SC CaDRe is to create a critical mass of well-trained faculty researchers between the two institutions who conduct disparity-focused feasibility studies and obtain preliminary data that leads to further extramural funding. A secondary goal of SC CaDRe is to enhance the racial and ethnic diversity of emerging scientists at all levels. The Student Fellows’ summer undergraduate research training program is part of the larger scope of activities that are conducted under the auspices of the NIH/NCI P20 SC CaDRe.

Recruitment Pool—Undergraduate students at a local historically black university (Student Fellows) are given financial support to participate in SC CaDRe. Minority status is not an eligibility criteria to become a SC CaDRe-supported Faculty and Student Fellow, but the SC CaDRe leadership give priority to minority applicants, based on the following input from the NIH Slavkin Report: [8]

> "While it is clear that a researcher need not come from a minority or disadvantaged background to contribute to the understanding and remediation of health disparities, it is reasonable to expect that such individuals as a group would possess greater motivation, persistence, familiarity, sensitivity, and insight into this problem. Therefore, effective recruiting efforts should tap into this talent pool and focus on bringing underrepresented groups into biomedical research."

Recruitment Strategies—At the beginning of each spring semester, the investigators identify a pool of potential undergraduates at the advanced undergraduate level (sophomores who have taken advanced science classes, juniors, and seniors). Potential Student Fellows are required to have at least a 3.0 grade point average (GPA). The investigators interview prospective students and select the top candidates based on the interviews, transcripts, letters from the students' academic advisors, and the candidates' interest or desire to conduct prostate or breast cancer research. Based on this process, two Student Fellows are selected per year. Upon acceptance into the P20 SC CaDRe, the Student Fellows are also accepted into a broader summer undergraduate research training program which is integrated with a SC CaDRe-specific training curriculum in prostate and breast cancer research.

Mentoring Strategy—Protected one-on-one time with a research mentor is a crucial aspect to research career growth and development. To identify potential mentors, the graduate faculty database is reviewed. All potential mentors are sent an e-mail message to publicize the opportunity to become a research mentor. The SC CaDRe's Student Fellows conduct mentored pilot research. Each mentoring team includes a senior cancer researcher from MUSC (individuals with existing NIH or other federal funding in breast and prostate cancer research), a junior faculty member from SCSU, a junior faculty member from MUSC (junior investigators with no NIH funding), graduate students from MUSC, and Student Fellows from SCSU. To optimize the research mentoring strategy, the SC CaDRe employs a *triple-level mentoring strategy* (as shown in Fig. 1) in which the senior cancer researchers mentor junior faculty, junior faculty mentor graduate students, and graduate students mentor the Student Fellows. To accomplish the goals of the SC CaDRe, the Center adopts/adapts a number of existing interactive research training efforts at both MUSC Hollings Cancer Center (HCC) and SCSU as well as developing new initiatives. All SC CaDRe-supported Student Fellows participated in these year-round activities. The SC CaDRe-supported Student Fellows each begin participating in the summer as part of the summer undergraduate research program and then continue through the fall and spring semesters by participating in the following activities:

- SC CaDRe Visiting Scholars—nationally renowned cancer disparities researchers spend a day at MUSC to give presentations and meet with Student Fellows.
- HCC Annual Spring Research Symposium—thematic research conferences are presented such as "Cancer Disparities: Scope of the Problem and Steps Toward the Solutions," and participants come from around the state, including SCSU.

- HCC Annual Research Retreat—each fall, the HCC hosts a center-wide research retreat where Student Fellows have showcased their research via poster presentations
- Perry V. Halushka Student Research Day—the Perry V. Halushka MUSC Student Research Day is held annually. The SC CaDRe Student Fellows participated in this event, many as oral presenters, an honor that is typically given to graduate students.
- Training in the Responsible Conduct of Research—Student Fellows were required to complete the MUSC Collaborative Institutional Review Board (IRB) Training Initiative (CITI) online program in the responsible conduct of science and ethics and a 4-day Biomedical Ethics class that meets for 2 h per day during the summer.

Case Example 2. Department of Defense-funded South Carolina Collaborative Undergraduate HBCU Student Summer Training Program

Purpose—The Medical University of South Carolina (MUSC) and three historically black colleges/universities (HBCUs)—Claflin University (CU), SCSU, and Voorhees College (VC)—are continuing to collaborate under the larger auspices of the South Carolina Cancer Health Equity Consortium (SC CHEC) on the Department of Defense Collaborative Undergraduate HBCU Student Summer Training Program in prostate cancer research. Since the grant's inception, 24 students ("Student Fellows," 4 each summer) have participated in a 10-week program of laboratory rotations and weekly research discussions. The Student Fellows also participate in a twice-weekly, 1-h Prostate Cancer Health Equity Research Course. The course lectures span the spectrum from basic science to clinical science to population sciences. The course includes an introduction to the Sea Island/Gullah population of South Carolina, which is a culturally distinct group of blacks, and one of the most genetically homogeneous in the USA. To date, the Student Fellows have given 47 scientific presentations, and two Student Fellows have written peer-reviewed publications, based on their summer research projects. The ultimate goal of the Training Program is to increase the diversity of emerging scientists who may choose prostate cancer research careers in the basic, clinical, and population sciences.

Recruitment Pool—At the beginning of each spring semester, the Training Program Director and Associate Program Directors along with the HBCU Faculty Advisors identify a pool of potential Student Fellows at the advanced undergraduate level (sophomores who have taken advanced science classes, juniors, and seniors). During the past 5 years, the four collaborating institutions have worked closely to advertise inter-institutional research training opportunities. Student Fellows are recruited from the large population of enrolled students at CU, SCSU, and VC. The demographic characteristics of students from each institution for the 2013–2014 academic year who are enrolled in biomedical programs in science, technology, engineering, and mathematics (STEM programs) in each of the three collaborating HBCUs are listed in Table 1, which show the depth of the pool from which the Student Fellows are recruited. Only students who have completed their sophomore or junior year of college are eligible to participate in the Training Program.

Selection of Student Fellows—Eligibility criteria for the training program include the following: (1) a written statement of career goals related to biomedical research and interest in cancer research; (2) greater than or equal to a 3.0 GPA based on their official transcripts; and (3) two letters of recommendation from faculty at students' home institutions with at least one from a science course instructor. The program leaders evaluate each applicant, based on these review criteria to determine the top candidates. A scoring algorithm is used so that candidates can be ranked objectively. If an additional level of review is required, they conduct interviews to make the final selections. Priority is given to applicants with backgrounds that are underrepresented in the biomedical sciences. The denominator typically includes approximately 15–20 students. Based on this process, four Student Fellows are chosen each year (ideally, at least one per institution).

Recruitment Strategies—During the past 5 years, the four institutions have worked closely to advertise inter-institutional training opportunities, and there are standing protocols in place for advertising summer training opportunities at MUSC through list services, campus newspapers, class announcements, and available packets for each of the faculty advisors to distribute to promising candidates. As an additional recruitment strategy, former Student Fellows are asked to serve as a referral source for interested students, participate in the interview process, and become informal mentors for incoming Student Fellows.

Research Projects and Didactic Training—In the Prostate Cancer Health Equity Research Course, each Student Fellow engages in a short-term laboratory prostate cancer research project. This activity is based on the philosophy that a meaningful engagement, involving hands-on applied experiences in a laboratory or research setting with an accomplished cancer researcher will be the most critical catalyst in igniting students' commitment to a biomedical science career. Student Fellows spend up to 35 h per week, earning 15 credits toward graduation, in the laboratory or research offices of an MUSC-based Research Mentor. Guided by the interests expressed by students in their applications, the Leadership Group matches each selected Student Fellow with an appropriate Research Mentor. The Research Mentors shape the Student Fellows' summer experiences to ensure tangible outcomes—presentation of data results (preliminary or final) and submission of scientific abstracts and papers for peer review. Student Fellows are involved in laboratory techniques, data collection and analytic methods, interviewing techniques, data interpretation, and summarizations of results.

Four Student Fellows per year participate in an enriched 10-week summer course that includes an introduction to cancer disparities research, journal clubs, and take-home tests. The Training Program has also been broadened to encompass additional exposure to biomarker development, genetics, survivorship issues, and developmental therapeutics through shadowing experiences in the MUSC Hollings Cancer Center's (HCC's) clinics, shared resources/cores, and greater interaction with the Sea Island/Gullah population of South Carolina.

Mentoring Program—MUSC faculty Research Mentors each commit to providing summer laboratory research training (up to 35 h/week) for 1–2 students each summer in this enhanced comprehensive prostate cancer research training program. This mentoring pool is

continuously deepening with ongoing faculty recruitment efforts, including current searches for endowed chair-level positions in prostate cancer research. Also, the MUSC HCC has developed formal workgroup meetings in prostate cancer, bringing together clinical, basic, and population sciences researchers. At the end of the 10-week summer research period, each student prepares a brief written paper (6–10 pages in length) and gives an oral presentation, describing the research project that he/she worked on and preliminary and/or final research results. Given the short-term nature of the Training Program, not all Student Fellows see a research project to completion and/or publication. However, the Research Mentors give each Student Fellow a discrete research project to complete during the summer program. The Mentors also include the Student Fellows in all laboratory activities such as laboratory-specific journal clubs, maintaining laboratory notebooks and standard operation procedure manuals, research-in-progress meetings, research seminars, community engagement meetings, etc.

In addition to working with their Research Mentors, Student Fellows will actively interact with junior faculty, postdoctoral fellows, pre-doctoral students, and other scientists within each laboratory/research office. Beyond the scope of the Training Program, MUSC Research Mentors contact Student Fellows during the academic year after their summer research experience, and Student Fellows are asked to identify a mentor at their home institution to continue to promote their journey toward graduate school admission.

Results

As part of the evaluation of the cancer education training program, summative and formative data are collected. The summative data include the number of students who apply to graduate or professional school, make scientific presentations, publish peer-reviewed scientific papers, and enroll in graduate or professional school. Formative data include the perceptions of the program, as indicated in the Student Fellows' testimonials that are included in the Appendix.

Outcomes from Case Example 1. NIH/NCI P20 SC CaDRe Grant

As shown in Table 2, the P20 SC CaDRe cancer research training grant has led to numerous scientific presentations by the students who have participated in this funding mechanism. In addition, 3 (100 %) of the undergraduate Student Fellows who have participated in this training mechanism have taken a grant-sponsored GRE test preparation course, and 2 (67 %) have successfully enrolled in graduate school.

In addition to the training outcomes related to the Student Fellows, to date, the SC CaDRe has facilitated the award of two research project grants—R21 CA176135: Glycation as a Mechanism Promoting Cancer Disparity and R01 MD005892: Improving Resection Rates among African Americans with NSCLC, as well as an NIH/NCI Diversity Supplement to support an underrepresented doctoral student: 3P20 CA157071-03S1 SC Cancer Disparities Research Center in Prostate and Breast Cancer (SC CaDRe) Diversity Supplement.

Outcomes from Case Example 2. DoD South Carolina Collaborative Undergraduate HBCU Student Summer Training Program

As shown in Table 3, the 24 undergraduate Student Fellows who have participated in the DoD SC Collaborative Undergraduate HBCU Student Summer Training Program in cancer research have made 47 scientific presentations. All 24 Student Fellows (100 %) took a grant-sponsored GRE test preparation course, 15 (63 %) applied to graduate school, and 11 of them (73 %) enrolled in graduate or professional school. The remaining 9 Student Fellows (38 %) are in the process of applying to graduate or professional school.

Unintended Consequences—Outcomes from Other Leveraged Funds

In addition to completing the work of the P20 SC CaDRe grant and the DoD South Carolina Collaborative Undergraduate HBCU Student Summer Training Program, since 2011, the investigators annually have led the coordination of the Student Research Forum of the National Conference on Health Disparities (NCHD). The all-day Forum includes a poster session, oral presentations, a luncheon keynote speaker, and a roundtable discussion. The Forum also includes an interactive learning module presented by a National Library of Medicine staff member. In 2011, 54 students participated in the Student Forum during the NCHD in Charleston, SC. In 2012, 60 students participated in the Student Forum during the NCHD in Little Rock, AR. In 2013, 87 students participated in the Student Forum during the NCHD in St. Thomas, US Virgin Islands. In 2014, 66 students participated in the Student Forum during the NCHD in Long Beach, CA.

In addition to the Student Forum, since 2011, the investigators have annually contributed to the coordination of the Ernest E. Just Symposium held at MUSC each spring. Dr. Just was an early twentieth century African American embryologist who devoted his career to studying the early development of marine invertebrates.

The Symposium serves as a major vehicle to recruit underrepresented students to enroll in graduate studies at MUSC. The students receive a tour of MUSC while they are on campus for the Symposium and meet with MUSC faculty to discuss graduate research options. These faculty members could become their future research mentors. In 2011, 400 students participated in the Symposium, representing 17 different colleges and universities, participated in the Symposium. A total of 66 students from HBCUs in SC participated in the Symposium. In 2012, 297 students participated, representing 19 different colleges, and universities. A total of 91 students from HBCUs in SC participated in the Symposium. In 2013, 240 students participated, 67 of whom were from HBCUs in SC. In 2014, 394 students participated, 56 of whom were from HBCUs in SC.

Publication Outcomes from Case Example 1. NIH/NCI P20 SC CaDRe Grant and Case Example 2. DoD South Carolina Collaborative Undergraduate HBCU Student Summer Training Program

- Ford M, Wahlquist A, Blake R, Green C, Streets J, Fuller E, Johnson E, Jefferson M, Etheredge J, Varner H, Johnson S, Glover S, Turner D, Garrett-Mayer E. Assessing an intervention to improve clinical trial perceptions

among predominantly African-American communities in South Carolina. Prog Community Health Partnerships 2012;6:249–63.

- Ford ME, Wahlquist AE, Ridgeway C, Streets J, Mitchum KA, Harper RR Jr, Hamilton I, Etheredge JJ, Jefferson MS, Varner H, Campbell K, Garrett-Mayer E. Evaluating an intervention to increase cancer knowledge in racially diverse communities in South Carolina. Patient Education and Counseling 2011;83:256–60.
- Mack JT, Helke KL, Normand G, Green C, Townsend DM, Tew KD. ABCA2 transporter deficiency reduces incidence of TRAMP prostate tumor metastasis and cellular chemotactic migration. Cancer Lett;2010;300(2):154–61.
- Norell H, Martins da Palma T, Lesher A, Kaur N, Mehrotra M, Naga OS, Spivey N, Olafimihan S, Chakraborty NG, Voelkel-Johnson C, Nishimura MI, Mukherji B, Mehrotra S. Inhibition of superoxide generation upon T-cell receptor engagement rescues Mart-1(27–35)-reactive T cells from activation-induced cell death. Cancer Res. 2009 Aug 1;69(15):6282-9. Epub 2009 Jul 28.
- Norell H, Zhang Y, McCracken J, da Palma TM, Lesher A, Liu Y, Roszkowski JJ, Temple A, Callendar GG, Clay T, Orentas R, Guevara-Patino J, Nishimura MI. CD34-based enrichment of genetically engineered human T cells for clinical use results in dramatically enhanced tumor targeting. Cancer Immunol Immunother, online publication, December 2009.

Discussion

The percentage of older adults in the population is increasing commensurately with the projected 45 % increase in cancer incidence rates [2]. Therefore, it is imperative that undergraduate research training programs are implemented to increase the number of underrepresented cancer-focused biomedical research scientists in the STEM careers. This “next generation” of cancer researchers will lead the way in developing discoveries to better treat the anticipated rising number of cancer patients in the USA.

This paper described the results of two Training Programs for underrepresented students. The first Training Program is funded by an NIH/NCI P20 SC CaDRe grant. The second Training Program, funded by the Department of Defense, is titled HBCU Student Summer Training Program. During the NIH/NCI P20 SC CaDRe and DoD-funded summer research programs, the Student Fellows receive didactic, twice-weekly instruction in the etiology of breast and prostate cancer, the genetic basis of cancer, the anatomy and function of the breast and prostate, controversies in breast and prostate cancer screening, and biostatistical and epidemiologic issues in breast and prostate cancer research, among other topics. The Student Fellows also gain hands-on experience working in the research labs/offices of leading cancer researchers in the basic, clinical, and population sciences at the Medical University of South Carolina (MUSC). In addition, the Student Fellows gain scientific presentation skills, which are required when they make presentations at local and national scientific meetings. The NIH/NCI P20 SC CaDRe and the DoD-funded summer research programs are federally funded programs that are conducted with institutional support from

MUSC. This support allows the Student Fellows' mentors and the instructors in the didactic education components of the programs to participate at no charge to the grants. In this paper, case examples for each funding mechanism were presented.

The NIH/NCI P20 SC CaDRe and the DoD-funded programs are offered during the summer only. During the academic year, the Student Fellows are invited to participate in scientific research forums at MUSC. The funding to support the students' travel to MUSC to present their research is provided through the grants. Funds to support the students' travel to local and national meetings to present their research is generally provided by their home academic institutions. In addition, during the fall and spring semesters, many of the summer mentors work with their students on conference presentations and manuscript submissions. Much of this work is completed via email and teleconference.

The P20 SC CaDRe Training Program has contributed to an increase in students applying to graduate school by fostering an environment that employs the *triple-level mentoring strategy*. The triple-level mentoring strategy instills the value of keeping the pipeline alive. A major strategy in increasing the underrepresented researchers is to re-emphasize that minority researchers are expected to help aspiring student researchers to fulfill their purpose. The P20 SC CaDRe Training Program provides an opportunity for students to access mentors one-on-one and conduct cancer research. The one-on-one mentoring allows the Student Fellows to ask seasoned cancer researchers questions that they might be apprehensive of asking in front of other peers and the freedom to ask pertinent questions regarding graduate application and research tips can only benefit Student Fellows' progress. In addition, Student Fellows have the opportunity to feature the results at the HCC Annual Spring Research Symposium, Perry Halushka Student Research Day, and the Student Research Forum for the National Conference on Health Disparities. The Student Fellows' participation in symposiums allows them to interact with senior cancer researchers and their student peers and provides an opportunity to gain additional mentors, which could lead to future internships and/or research/grant-writing collaborations.

The Department of Defense HBCU Student Summer Training Program has provided underrepresented students with the opportunity to conduct prostate cancer research, gain laboratory experience, participate in journal clubs, interact with the Sea Island/Gullah SC population, and gain invaluable mentors. This experience will help minority Student Fellows realize the relevance of conducting research within underrepresented populations.

Although the two training programs that have been described in this paper may prove beneficial to academic institutions by demonstrating ways to increase the number of underrepresented cancer researchers, the data from the training programs present some limitations. For example, due to the relatively small number of summer training program participants, statistical analyses of the data were not conducted. However, the measurable outcomes collected from the DoD SC Undergraduate HBCU Student Summer Training Program track the number of Student Fellows who took the GRE, applied to graduate school, completed scientific presentations and publications, and convey that the majority of Student Fellows who participated in these mentoring, research programs are enrolled in

undergraduate or graduate programs. These measurable outcomes will assist MUSC and the HBCUs in applying for additional funding to maintain the summer research programs.

A second limitation is that both of the case studies that are described in this paper are federally funded cancer research training grants for underrepresented populations from HBCUs in South Carolina. Data from only one state were included in the analyses, and the Student Fellows are minority students from colleges and/or universities with a minority European American population. This could potentially limit the generalizability of the findings.

Despite some limitations, the training programs have laid the foundation for other programs to provide training to underrepresented students, with the ultimate goal of increasing the diversity of the biomedical workforce. For example, the investigators recently submitted a NIH/NCI R25E grant which aims to create an innovative, inter-institutional, 14-week cancer health equity course that will be combined with hands-on laboratory research training activities and career mentoring, provided by senior mentors. This new initiative is a collaboration of an academic medical university and three HBCUs in South Carolina. Promoting interest, career development, and commitment from the Millennial Generation (those born in the 1990s) to cancer biomedical research is a critical step to attaining health equity and improved health outcomes in SC and beyond. Additional funding initiatives will be needed to significantly enhance the biomedical workforce over the next several decades.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors would like to acknowledge the following funding sources: NIH/NCI P30: 1P30CA138313-06, DOD SE VIEW II: W81XWH-11-2-0164, NIH/NCI P20 SC CaDRe: 5P20CA157066-02, and DOD HBCU: PC110451.

References

1. Baine, C. Women and Minorities in STEM careers: advancing our world. STEM;
2. Oncology ASOC. The State of cancer care in America, 2014: a report by the American Society of Clinical Oncology. ASCO; 2014.
3. Institute of Medicine. In the Nation’s Compelling Interest: Ensuring Diversity in Health-Care Workforce. Washington, DC: 2004.
4. Ashton CM, Haidet P, Paterniti DA, et al. 2003; Racial and ethnic disparities in the use of health services: bias, preferences, or poor communication? J Gen Intern Med. 18 (2) 146–152. [PubMed: 12542590]
5. Levine CA, Ambady N. 2013; The role of non-verbal behavior in racial disparities in health care: implications and solutions. Med Educ. 47: 867–876. [PubMed: 23931536]
6. Alexandraki I, Mooradian AD. 2013; Redesigning medical education to improve health care delivery and outcomes. Health Care Manag. 32 (1) 37–42.
7. Ginther DK, Schaffer WT, Schnell J, et al. 2011; Race, ethnicity, and NIH research awards. Science. 333 (6045) 1015–1019. [PubMed: 21852498]
8. Slavkin H, NIH. 1999. Working Group. Report and recommendations of the committee for recruitment of a diverse workforce in medical research February.

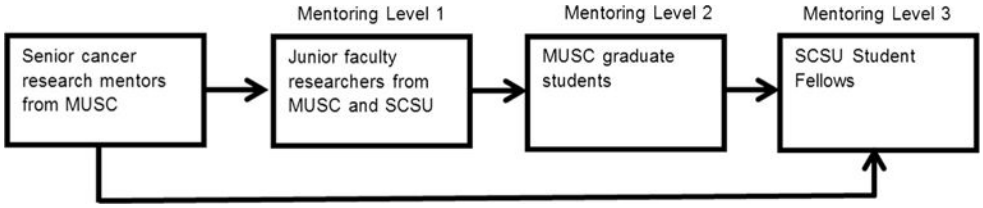

Fig. 1.
P20 SC CaDRe Triple-Level Research Mentoring Strategy

Table 1

Demographic characteristics of Biomedical Sciences STEM students in the three collaborating HBCUs

Institution	No. of undergraduates	No. of undergraduates declaring STEM majors	Demographic characteristics of STEM students in the 2013–2014 academic year					
			Gender		Race/ethnicity			
			Male	Female	AA	Hisp./Latino	EA	Other
CU	1886	396	37 %	63 %	96 %	1 %	2 %	1 %
SCSU	3195	909	53 %	47 %	91 %	2 %	5 %	2 %
VC	533	38	44 %	56 %	100 %	0 %	0 %	0 %

Table 2

Academic outcomes of the NIH/NCI P20 SC CaDRe Grant

	2012		2013		2014		Total
	Undergrad (*N*=1)	Grad (*N*=1)	Undergrad (*N*=1)	Grad (*N*=1)	Undergrad (*N*=1)	Grad (*N*=2)	7
No. of scientific presentations given by Student Fellows	1	0	4	3	4	3	15
No. of publications by Student Fellows	0	0	0	0	0	1	1
No. of students who took the GRE test preparation course	1	0	1	0	1	0	3
No. of students who applied/applying to Graduate School	0	0	1	0	1	0	2
No. of students who enrolled in Graduate School	0	0	1	0	1	0	2
No. of students who applied/applying to Professional School	0	0	0	1	0	1	2
No. of students who enrolled in Professional School	0	0	0	0	0	1	1

Table 3

Academic outcomes of the DoD SC Collaborative Undergraduate HBCU Summer Training Program Grant

	2009 Undergrad (*N*=4)	**2010 Undergrad (*N*=4)**	**2011 Undergrad (*N*=4)**	**2012 Undergrad (*N*=4)**	**2013 Undergrad (*N*=4)**	**2014 Undergrad (*N*=4)**	**Total 24**
No. of scientific presentations given by Student Fellows	4	5	6	7	4	4	30
No. of publications by Student Fellows	1	1	0	0	0	0	2
No. of students who took the GRE test preparation course	4	4	4	4	4	4	24
No. of students who applied/applying to Graduate School	3	3	4	2	3	0	15
No. of students who enrolled in Graduate School	3	2	3	2	0	0	10
No. of students who applied/applying to Professional School	1	1	1	0	1	0	4
No. of students who enrolled in Professional School	1	0	0	0	0	0	1