



Evaluation of a Multi-Site Cancer Health Disparities Research Training Program for Underrepresented Undergraduate and Medical Students

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Abstract

Diversifying the biomedical research workforce is crucial for eliminating cancer health disparities. To address this need, Moffitt Cancer Center and Louisiana State University Health Sciences formed the Southeast Partnership for Improving Research and Training in Cancer Health Disparities (SPIRIT-CHD). A key component of SPIRIT-CHD is the Cancer Research Education Program (CREP), designed to train underrepresented undergraduate and medical students in biomedical science research. The CREP featured an 8-week summer internship with a web-based curriculum, community outreach, and mentored research experiences. Three cohorts ($n = 39$) completed the CREP. Students were evaluated before and after the internship using the Goal Attainment Scale (GAS), Science Teaching Efficacy Belief Instrument (STEBI), and Research Appraisal Inventory (RAI), modified to assess CREP outcomes. These scales measured students’ intentions to pursue cancer research careers, self-efficacy in communicating scientific information, and perceived research abilities. Paired test results showed significant increases ($p < 0.001$) in scores across the scales (GAS, STEBI, RAI) pre- and post-training. Trainees reported heightened intentions to pursue cancer research careers (GAS; mean increase of 5.3, $p < 0.001$) and greater self-efficacy in relaying scientific information (STEBI; mean increase of 9.2, $p < 0.001$). They also showed increased self-confidence in conducting research (RAI; mean increase of 58.2, $p < 0.001$). These findings demonstrate the program’s success in fostering interest in cancer research careers and enhancing research confidence. Results support the development of programs like CREP to positively impact the academic and professional trajectories of underrepresented students, ultimately creating a more diverse and inclusive biomedical research workforce equipped to address health disparities.

Keywords Cancer disparities · Biobanking · Precision medicine · Cancer education program · Underrepresented trainees

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Introduction

Despite advances in cancer research, disparities in cancer incidence and mortality persist among individuals from underrepresented racial/ethnic groups. Black individuals carry the largest burden compared to other population groups, with 19% and 12% higher cancer mortality rates for men and women, respectively, than non-Hispanic White individuals [1]. Recent evidence suggests that shared identity, such as race and ethnicity, between patient and provider may help to mitigate cancer health disparities [2, 3]. Therefore, it is imperative to increase diversity in the biomedical and behavioral research workforce and improve racial-ethnic concordance between patients and providers to achieve health equity [4]. Cancer-focused mentored research training programs have been successfully implemented for undergraduate students, medical students,

and clinicians in different regions across the USA [5, 6]. However, more progress is needed to diversify the workforce in the southern USA, where cancer disparities are the greatest [1]. To meet this need, Moffitt Cancer Center (MCC), a National Cancer Institute (NCI) designated cancer center in Tampa, Florida, and Louisiana State University Health Sciences Center (LSUHSC) in New Orleans, an academic institution serving underrepresented populations (ISUPS) united to form the Southeast Partnership for Improving Research and Training in Cancer Health Disparities (SPIRIT-CHD) Program. A key imperative was to instill excitement about science and offer instrumental direction about the possibilities of cancer research careers for undergraduate and medical students from backgrounds often underrepresented in biomedical science.

SPIRIT-CHD was funded by the National Cancer Institute (NCI) Center to Reduce Cancer Health Disparities (CRCHD) via the development of a training program for translational research studying the biological mechanisms of cancer health disparities, focusing on biospecimen-based research and precision medicine. The program had two main objectives: (1) to plan and execute two collaborative pilot research projects with underrepresented Early-Stage Investigators (ESIs) and (2) to develop a cancer research education program (CREP) for underrepresented undergraduate and medical students. This paper reports on the second objective. Translational research teams from both institutions worked together to advance biospecimen-based research focusing on cancer health disparities research. The CREP comprised an 8-week summer internship program prioritizing the engagement of undergraduate and medical students from underrepresented groups. The CREP included a joint web-based didactic curriculum focused on health disparities, biobanking, and precision medicine in conjunction with community outreach and engagement experiences in medically underserved communities in the nearby catchment area. Since the inception of the CREP program in 2018, three cohorts of trainees, 39 students total, have successfully completed the program, including 25 undergraduate and 14 medical students. The purpose of this brief report is to present evaluation findings from the training program that included pre- and post-self-report assessments related to trainees' self-efficacy in relaying scientific information, perceived confidence in conducting clinical and behavioral research, and intentions to pursue a career in cancer health disparities, biobanking, and/or precision medicine research.

Methods

Cancer Research Education Program (CREP)

The CREP focused on training undergraduates and medical school students from underrepresented backgrounds at LSUHSC and MCC, focusing on health disparities,

biobanking, and precision medicine [7]. The CREP was designed to be an innovative, collaborative training program with an immersive 8-week summer research internship program augmented by a web-based didactic curriculum and community outreach and engagement experiences. A description of each component is as follows:

1. **Research experiences.** Trainees accepted for the summer internship program were paired with a faculty mentor at MCC or LSUHSC based on their research interests. They became immersed in their mentors' labs to work on cancer or cancer health disparities-focused research projects. Projects spanned a variety of research fields, including genetic diagnostics, drug development, immunology, bioinformatics, epidemiology, cancer prevention, and community and behavioral health.
2. **Web-based didactic curriculum.** The CREP leadership teams from LSUHSC and MCC worked together to create an engaging web-based didactic curriculum with modules focused on cancer health disparities, biobanking, and precision medicine. Each week, students from LSUHSC and MCC met via virtual sharing platforms (e.g., WebEx, Zoom) facilitated by faculty members.
3. **Community outreach and engagement experiences.** Throughout the 8-week summer internship program, trainees at LSUHSC and MCC participated in the planning and facilitating of community outreach and engagement experiences in medically underserved communities. For example, trainees at Moffitt collaborated with the Tampa Bay Community Cancer Network, an established community-academic network, to organize a community conversation about the meaning of precision medicine and the importance of mixed-race stem cell donation for the treatment and cure of blood cancers in underrepresented populations [8].

Trainee Selection

Trainees were recruited using several outreach strategies. The summer research program was open to students nationally, but recruitment efforts focused on underrepresented students at academic institutions in Florida and Louisiana, including but not limited to Historically Black Colleges And Universities and Hispanic-Serving Institutions. Undergraduate and medical students with or without prior research experience were welcomed to apply. Based on their location, students selected for the summer internship program completed their internship at LSUHSC or MCC. The recruitment strategy aimed to identify underrepresented students from various institutions who would benefit from an enriching learning environment with various perspectives and experiences in cancer research and health disparities. CREP leadership teams at LSUHSC and MCC visited local colleges and

universities to give brief presentations about the summer research opportunity to underrepresented student-serving organizations and health and research-related student organizations.

Interested applicants submitted an electronic application packet that included demographic information, research interests (e.g., wet lab or dry lab), an essay regarding their interests in cancer and/or cancer health disparities research, transcripts (for undergraduate students only), and a recommendation letter from an academic advisor or mentor. Three cohorts of undergraduate and medical students were trained for 8 weeks each year during the summers of 2018–2021; due to the impact of the COVID-19 pandemic, the 2020 cohort was postponed until the following year.

Measures

Pre- and Post-Internship Questionnaires

Trainees were evaluated using formative (process) and summative (impact/outcome) evaluation metrics. On the first day of the summer internship program, trainees completed a Pre-internship Questionnaire, which included information about their current academic and research interests and expected academic and professional trajectories. After the summer internship program (8 weeks post), trainees completed the Post-internship Questionnaire, which included the same measures. A description of the assessments is provided below.

Goal Attainment Scale (GAS)

The GAS was used to measure trainees' career goals related to pursuing a career in cancer health disparities research (e.g., "I am interested in pursuing cancer health disparities research in my career") [9] as well as biobanking and precision medicine. Each goal was rated on a 5-point Likert scale, with the degree of attainment captured for each goal area ranging from 5—strongly agree to 1—strongly disagree. In our sample, Cronbach's alpha (α) for the GAS was 0.82.

Science Teaching Efficacy Belief Instrument (STEBI)

The STEBI was used to measure the trainees' self-efficacy and outcome expectancies related to their efficacy in communicating scientific information to lay communities [10]. (e.g., "I understand research concepts well enough to be effective at teaching in underrepresented minority communities.") This instrument uses Likert scales that range from 1 to 5 (from strongly disagree to strongly agree). A modified version of the STEBI was administered and included 12 items to assess students' self-efficacy in relaying scientific information to lay audiences, including individuals from

underserved communities. The STEBI is a reliable and valid measure used in various teaching settings with a reliability coefficient 0.78 [11, 12]. In our sample, the Cronbach's α for the STEBI was 0.82.

Research Appraisal Inventory (RAI)

The RAI assessed trainees' self-confidence in conceptualizing, designing, and analyzing a research study [13]. This tool used a Likert scale from 0 to 10 with 0=no confidence and 10=total confidence to measure CREP students' self-confidence in their ability to successfully conduct research, including behavioral and biomedical research projects. The questions were divided into subsections, including conceptualizing, designing, and collaborating on a study and planning and interpreting data. The RAI has been tested for internal reliability and validity in various studies and has strong psychometric properties [13–15]. The original instrument showed strong internal consistency (0.96) [13]. In our sample, Cronbach's α for the RAI was 0.78, above the minimum expected level of 0.70.

Data Analysis

Data were summarized using descriptive statistics, including median and quartile 25th and 75th percentiles for continuous measures and proportions and frequencies for categorical measures. The Wilcoxon paired test was applied to evaluate the difference in scores between pre- and post-intervention among combined cohorts (cohorts 1, 2, and 3). The total analyzed sample was 39 participants. Two participants did not complete the post-program survey, and two additional participants could not be matched on pre/post assessments. Cronbach α was calculated to assess the internal consistency of the scales, and all statistical analyses were performed using the R v4.2.0 software for Windows (R Foundation for Statistical Computing Vienna, Austria) [16]. The Institutional Review Boards of MCC and LSUHSC reviewed, approved, and deemed this project exempt.

Results

Trainee Demographics

Table 1 presents the combined demographic data for the three CREP cohorts. Most trainees were female across cohorts 1–3 ($n=31$, 79.5%). Regarding race/ethnicity, 56.3% of participants self-identified as Black ($n=22$), and 17.9% identified as Hispanic and/or Latinx ($n=7$). In addition, 74.4% reported their sexual orientation as straight, 7.7% as bisexual, 5.13% as gay/lesbian, and 12.8% as other.

Table 1 CREP trainee demographics for cohorts 1–3

Variables	<i>N</i> =39
Age	21.0 (19.5, 23)
Gender	
Female	31 (79.5%)
Male	6 (15.5%)
Non-binary	1 (2.5%)
Prefer not to answer	1 (2.5%)
Race	
Black	22 (56.3%)
White	12 (30.8%)
Other	5 (12.9%)
Ethnicity	
Not Hispanic/Latino(a)	32 (82.1%)
Hispanic/Latino(a)	7 (17.9%)
Sexual orientation	
Straight	29 (74.4%)
Gay or lesbian	2 (5.13%)
Bisexual	3 (7.69%)
Other	5 (12.8%)

Pre- and Post-Questionnaires

A total of 39 trainees in the combined sample completed both the pre-test and post-test questionnaires. Of these, 64.1% were undergraduate students, and 35.9% were medical students. Results from the pre- and post-test evaluation measures can be found in Table 2, which shows the paired test results of the combined cohort with statistically significant difference scores ($p < 0.05$) between pre- and post-training for the three nationally validated scales, the GAS, STEBI, and RAI, modified for the CREP. Trainees' interest in pursuing a career in cancer research increased from pre to post, with a mean difference of 5.3. In addition, perceived self-efficacy to explain cancer-related research topics increased from a pre- to post-mean difference score of 9.2, and reported self-confidence to conduct and manage a research study increased from pre to post, with a mean differential of 51.1.

Score Differences by Trainee Type

There were no statistically significant findings between undergraduate and medical students on the GAS ($p = 0.43$) and STEBI ($p = 0.15$) measures. However, the total RAI score

($p = 0.02$) differed between undergraduate and medical students. Specifically, on the RAI, undergraduate students scored higher than medical students on confidence in their conceptualization ($p = 0.04$), interpretation ($p = 0.05$), and planning ($p = 0.03$) of a research study (Table 3).

Discussion

The SPIRIT-CHD brought together two translational research teams at MCC and LSUHSC to build trainees' self-efficacy in relaying scientific information, comfort in conducting research, including biomedical and behavioral research in diverse communities, and future intentions to pursue a career in cancer health disparities, biobanking, and/or precision medicine. The overall results of our pre- and post-program surveys demonstrated significant increases in CREP participants' self-efficacy in relaying scientific information, their confidence in conducting research, and plans to pursue a career in cancer health disparities, biobanking, and precision medicine research, demonstrating our training program success.

The CREP program builds upon other successful training programs established nationally to identify and motivate students from diverse backgrounds (including underrepresented individuals) to enter the biomedical/behavioral workforce [3, 17]. Cancer educational programs based at academic institutions and cancer centers have identified that immersions in clinical trial operation, biobanking, drug development, and community engagement were instrumental in "socializing and acculturating participants into the habits of scientific thinking" [3, 18]. A strength of our evaluation approach for the CREP was utilizing nationally validated scales such as the GAS, STEBI, and RAI, which were tailored to address our objectives.

Goal setting and attainment within training programs have frequently been examined across multiple settings [19]. Achieving goals places trainees at the forefront, with mentors playing a crucial role in facilitating and supporting their interests while identifying and addressing barriers to their career development. Assessing goal attainment is especially important for trainees. In the context of the CREP, goal attainment was operationalized through innovative pedagogical approaches, such as the flipped classroom model, which enhanced student engagement via near-peer mentoring and increased interaction with faculty mentors. In this study, we assessed individualized goals

Table 2 Paired test results for survey questionnaires in the combined cohort (*N*=39)

Variables	Pre-mean	Post-mean	Difference (95% CI)	<i>p</i> value
Goal Attainment Scale (total)	13.9	18.2	5.3 (3.1, 7.5)	<0.001
Science Teaching Efficacy Belief Instrument (total)	32.7	41.9	9.2 (7.0, 11.4)	<0.001
Research Appraisal Inventory (total)	238.5	289.6	51.1 (28.4, 73.7)	<0.001

Four unfinished participants were excluded from the combined cohort

Table 3 Score differences by trainee type in the combined cohort ($N=39$)

Variables	Difference (95% CI)		
	Medical student $N=14$	Undergraduate $N=25$	p value
Goal Attainment Scale	3.0 (3.0, 3.0)	6.0 (3.0, 8.0)	0.43
Science Teaching Efficacy Belief Instrument	7.5 (3.5, 10.0)	9.50 (6.75, 14.0)	0.15
RAI collaborating with others	0.0 (−3.00, 3.8)	2.00 (0.0, 7.0)	0.06
RAI conceptualizing a study	10.0 (3.5, 20.2)	21.5 (13.8, 25.2)	0.04
RAI analyzing data	6.0 (2.0, 10.5)	10.0 (8.8, 14.2)	0.08
RAI designing a study	11.0 (5.0, 13.0)	14.0 (8.0, 25.8)	0.24
RAI interpreting data	4.5 (−0.8, 7.8)	6.00 (4.5, 13.5)	0.05
RAI planning a study	0.50 (−2.0, 2.0)	2.00 (0.0, 5.0)	0.03
RAI presenting a study	−5.00 (−10.3, 1.3)	−4.00 (−6.3, −0.5)	0.47
RAI reporting a study	8.00 (2.00, 14.0)	10.0 (6.8, 21.0)	0.21
RAI total difference	22.0 (1.50, 52.5)	66.0 (44.8, 102.0)	0.02

RAI, Research Appraisal Inventory subscales

Values in bold indicate statistically significant differences ($p < 0.05$)

using the GAS to calculate the extent to which our trainees plan to pursue a career in cancer health disparities, biobanking, and precision medicine research. Trainees demonstrated significantly greater plans to consider a career in cancer health disparities, biobanking, and/or precision medicine research. A structured and intentional research training program, like the CREP program, which includes integration of an enriching menu of educational and research career development activities, cross-institutional networking opportunities, multi-tiers of mentoring, and local community engagement, is especially crucial to expose students to the multiple aspects of biomedical/behavioral research and health careers. Further programs like CREP facilitate socializing students into academic disciplines and advancing and enhancing their career trajectories as potential health professionals and scientists.

Our CREP program differed from the other cancer training programs reported in the literature by emphasizing building trainees' efficacy in relaying scientific information and their confidence in conducting and carrying out a research project. Additionally, including undergraduate and medical students in the same cohort helped to facilitate near-peer mentoring between the two groups. Undergraduate students reported significantly greater increases in self-efficacy for conceptualizing, planning, and interpreting research studies using the self-reported RAI scale than medical students. One possible explanation for this finding is the near-peer mentor model in which formalized relationships between medical undergraduate students can positively impact the undergraduate students' career trajectory in medicine. Near-peer teaching can be an innovative approach to increase student engagement, and over recent years, it has been incorporated into the medical curricula [20]. In a recent meta-analysis of the effectiveness of near-peer tutoring compared to faculty/expert teaching in health science undergraduate students, no significant differences were found in knowledge and skill scores

between the near-peer and expert teaching groups [21]. Training programs can benefit students from underrepresented groups by allowing near-peer mentors of a similar culture to consolidate their learning while helping undergraduate students. Additional studies are needed to examine the impact of increased self-efficacy and near-peer teaching in other cancer education training programs and with larger nationwide samples. Furthermore, long-term follow-up is needed to assess the durability of career intentions and actualization of career goals.

Limitations

The CREP program included a modest sample of undergraduate and medical students, primarily from Florida and Louisiana, which may limit the generalizability of the results. Due to the small sample size, we could not assess differences by demographic factors or report individual trajectories using inferential statistics. Quantitative surveys alone provide limited insights into the students' experiences. Future research using mixed methods would likely enhance understanding of these experiences. Our findings indicate that students' career goals and confidence in biomedical/behavioral sciences were strengthened by the CREP program, offering valuable direction for careers in science and cancer research.

Conclusion

The SPIRIT-CHD included an innovative 8-week cancer research education program (CREP) for underrepresented undergraduate and medical students. Participants engaged in hands-on research, multi-tiered mentoring, and community outreach. CREP exemplifies effective collaboration between

academic institutions and healthcare organizations to boost minority representation in biomedical research. Further multi-institutional programs and long-term data are needed to enhance workforce diversity. Programs like CREP foster enthusiasm and curiosity in science, which is essential for retaining underrepresented students and promoting careers in cancer health disparities. Ultimately, such initiatives are pivotal in reducing cancer disparities in disproportionately affected communities.

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Data Availability None.

Declarations

Ethical Approval Ethical approval for this research has been exempted from Institutional Review Board (IRB) oversight. This research was approved for exemption on January 11, 2018, IRB #00000790.

Competing Interests The authors declare no competing interests.

Disclaimer None.

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