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Knight Scholars Program: A Tiered Three-Year Mentored Training Program for Urban and Rural High School High School Students Increases Interest and Self-Efficacy in Interprofessional Cancer Research

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Abstract

Cancer research training programs build our future biomedical workforce. Training is often centered for students residing close to research institutions, making access more challenging for rural students. A cancer research training program was developed for high school students residing in five geographical regions across Oregon. Training was tiered in duration and intensity across the three years, including a one-week Introduction program and subsequent 10-week summer research training programs (Immersion and Intensive). A total of 60 students participated in in-person and/or virtual training, with Immersion students receiving mentored shadowing experiences in clinical care, public health, and outreach in their home communities. Laboratory rotations at a

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ASSOCIATED CONTENT

Supplemental material mentioned in this manuscript can be found uploaded to the same webpage as this the manuscript.

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research-intensive institution enabled students to sample research environments before selecting an area of interest for Intensive training the following summer. Aligning with Self-Determination Theory, the Knight Scholars Program aims to build competence, relatedness, and autonomy of its trainees in biomedical sciences. The program exposed students to a wide range of interprofessional careers and collaborative teams, enabling scholars to envision themselves in various paths. Results show strong gains in interest and research self-efficacy for both Introduction and Immersion scholars, with findings highlighting the importance of representation within mentoring and training efforts.

Keywords

Science Education; Historically Underrepresented; Health Inequities; Disparities; Biomedical; Training; Undergraduate; High School; Mentoring; Professional Development; Program Evaluation; Scholar Research; Cultural Diversity; Peer Group; Interpersonal Relations; Research Education; Students; Workforce Development

INTRODUCTION

Diversity in biomedical sciences can increase innovation (Hinton et al., 2020) needed to address the increasingly complex nature of biomedical research (Scientific Management Review Board, 2015). Students from historically underrepresented racial and ethnic groups, students with disabilities, and those from disadvantaged backgrounds are underrepresented in biomedical sciences (National Institutes of Health, 2019). Underrepresentation is observed within college fields of science, technology, engineering, and math (STEM) as well as STEM-related professions (Boekeloo et al., 2015; Duffus et al., 2014; Valentine and Collins, 2015). A lack of diversity is also seen in cancer-specific research (Henderson and Bell, 2021). For example, individuals from underrepresented racial and geographic groups experience a significantly higher risk of cancer (Hamel et al., 2016; Henley and Jemal, 2018), yet participation in clinical trials is dramatically lower for underrepresented racial/ethnic groups and rural populations compared to that of Whites or those from more urban locations (Hamel et al., 2016; Salmon et al., 2016). Further, there are significantly fewer cancer clinicians who are themselves underrepresented (Hamel et al., 2016). Comprehensive cancer centers are targeting efforts to reach underrepresented communities to mitigate health inequities in cancer (Paskett and Hiatt, 2018), as these populations face inequitable access to cancer care (El-Deiry and Giaccone, 2021). Representation matters within cancer clinical trials and biomedical research training, with underrepresented scientists well positioned to reach the underrepresented populations and communities that they themselves represent (Caldwell et al., 2021; Marriott et al., 2021).

Community research involves engagement in collaborative practices that improve well-being and build trust (Vaughn et al., 2018; Talo, 2018); diverse community stakeholders contribute to team efforts (Hall et al., 2018; Park et al., 2019). Teams that incorporate cancer research and community can have strong benefits for health equity (El-Deiry and Giaccone, 2021), while advancing science on research topics relevant to that region, including cancer catchment areas (Paskett and Hiatt, 2018). African American/Black scientists pursue community and population health fields at higher rates than White scientists, fields that have lower funding levels despite this research having higher publication impact (Hoppe et al., 2019). When explored across 1.2 million U.S. doctoral recipients, scientists from underrepresented backgrounds produced higher rates of innovation in their biomedical research than racial majority peers, though their novel contributions were often devalued and discounted, perpetuating underrepresentation in research and faculty positions (Hofstra et al., 2020). As community research is critical for advancing science and reaching communities inequitably impacted by cancer, training programs that serve underrepresented students should include community and population health research in their training approach.

Cancer teams are becoming increasingly collaborative and interprofessional (Savage et al., 2018; Puts et al, 2018; Salamone et al., 2018). Interprofessional education describes learning with, from, and about others from different disciplines (Health Professions Accreditors Collaborative, 2019) and is an increasingly common component of biomedical training programs (Averill et al., 2019; Marriott et al., 2021). Interprofessional training in biomedical research enables modeling and exploration of different professional degrees (e.g., M.D., R.N., M.S.E., Pharm.D.), research paths (Ph.D., M.D./Ph.D., M.S.), and career options (Marriott et al., 2021). Interprofessional training enables students across physical, biological, clinical, and social sciences to share their similar experiences and feelings about their professional identity development, which can help other students realize that they are not alone when questioning how they could become a scientist and what it means to be one (Marriott et al., 2021). Such approaches may support retention of historically underrepresented students in biomedical research training, which is critical for enhancing representation in the biomedical workforce (Duffus et al., 2014; Estrada et al., 2016; Huerta et al., 2022; Hinton et al., 2020; Valantine and Collins, 2015; Valantine et al., 2016).

Training programs can support mentored professional development of students in biomedical research by showing the range of topics and environments in which research occurs. This manuscript describes the development of an interprofessional, cancer research training program for historically underrepresented high school students across Oregon. Aligning with Self-Determination Theory (Ntoumanis et al., 2021; Ryan and Deci, 2020), the program aims to provide students with training that increases their competency, relatedness, and autonomy in cancer research. Competence describes a student's belief that they have the ability to influence certain outcomes (e.g., success in a STEM course), with felt competence highly predictive of student academic achievement and persistence in STEM (Jones et al., 2010; Lent et al., 2003). Relatedness describes an individual's feeling of having satisfying and supportive social relationships (e.g., with educators and peers within a STEM discipline (Chemers et al., 2011). Autonomy describes an individual's felt sense of control (Ryan and Deci, 2020). For example, an autonomous student would feel control over their cancer training trajectories whereas a student with controlled motives would feel little to no control over their trajectory. The Knight Scholars Program aims to give scholars exposure to a broad range of cancer research areas and professionals that supports scholars' agency when defining their cancer research interests and building skill sets for ongoing training. Training experiences are centered in the community, with shadowing and community research experiences facilitated by research/education liaisons in students' home region. Approaches and lessons learned for implementing an interprofessional cancer research training program with underrepresented high school students is described, highlighting an effective way for raising interest, offering meaningful mentoring experiences, and building statewide partnerships for health equity and sustainability.

METHODS

Setting.

The Knight Scholars Program was developed at Oregon Health and Science University (OHSU; Portland, Oregon) to train Oregon high school students from underrepresented backgrounds in cancer research using approaches that align with the National Cancer Institute's Youth Enjoy Science initiative (National Institutes of Health, 2016). The Knight Scholars Program was reviewed by OHSU's Institutional Review Board (#18720). The program is hosted by the Knight Cancer Institute, the only comprehensive cancer center located between Seattle, WA and Sacramento, CA. The Knight Scholars Program leverages partnerships between the Knight Cancer Institute, the Oregon Clinical and Translational Research Institute's (OHSU's Clinical and Translational Science Award (CTSA) site, the OHSU-PSU School of Public Health, and OHSU's Department of Academic and Student Affairs, all of whom facilitate reach to scientists, health professionals, community partners, educators, and students around the state.

Program Overview.

The Knight Scholars Program is a tiered program that increases in duration and intensity over a three-year period (Figure 1). The first year is a weeklong program (i.e., Introduction) designed to increase comfort of participants and their families with the program and its content. Interested scholars who complete the Introduction program are eligible to apply to the second year, a 10-week Immersion program where they receive shadowing experiences in their home communities, including in clinical care, public health and outreach. Immersion students also complete research rotations at OHSU and community research projects, demonstrating the varied settings in which cancer care and research can occur. These Immersion experiences hone scholars' interests for deeper study in the third summer's 10-week Intensive program, which continues research training in an area of scholars' choosing. Community research and engagement are emphasized throughout the program.

Educational and Training Context.

The Knight Scholars Program was designed by program faculty and staff to align with Next Generation Science Standards (NGSS Lead States, 2013) applied to cancer research training. The program's educational context and pedagogical alignment are described in Appendix A. Lenses of content, context, and process were overlaid to support scholars' experiential learning in areas beyond science content alone, using best practices learned from our prior NIH-funded teacher professional development program, the Teacher Institute for the Experience of Science (R25RR020443). Goals and activities aligned with Self-Determination Theory (Ryan and Deci, 2020) to build students' competence, relatedness, and autonomy in cancer research over the three-year program.

Site Selection.

Oregon's rural and frontier regions are home to over a third of Oregon's population (35%; Oregon Office of Rural Health, 2021) who face unique challenges due to their geographic isolation and historically low economic status (Oregon Office of Rural Health, 2016). As a result, students residing in these areas may have fewer research-based extracurricular educational opportunities. Oregon is home to nine federally recognized northwest American Indian tribes and ranks 11th in the U.S. in the number of American Indian and Alaska Native (AI/AN) residents per 2010 U.S. Census (U.S. Census Bureau, 2010). Many of these tribes are located in some of Oregon's most rural counties, with cancer being the second leading cause of death for AI/ANs both nationwide and in Oregon (Northwest Tribal Cancer Coalition, 2011). American Indian and Alaskan Native students were highlighted as an important group for program inclusion. Other demographic groups identified as underrepresented in biomedical sciences and who face cancer inequities include students from Black/African American, Native Hawaiian/Pacific Islander, and Hispanic and Latino backgrounds (De-Santis et al., 2019; Liu et al., 2019; National Institutes of Health, 2019).

The project's partnerships with OHSU's Community Outreach, Research and Engagement group (CORE; co-funded through OHSU's Knight Cancer Institute and CTSA) and On Track OHSU! (Provost initiative through Academic and Student Affairs) employed research and STEM educational liaisons, respectively. These liaisons live and work in the communities they serve. Regions for this project were selected based on the presence of a research liaison or a STEM education liaison in that community. Five regions were included, which comprise seven community sites that include 13 eligible high schools (Table 1). Our Eastern Oregon region, added in cohort 2, had not hired a community research liaison when students participated in the summer program and used interim program staff to fill this role. Geographical definitions from the Oregon Office of Rural Health (2019) were used to categorize sites, with rural defined "as any geographic areas in Oregon ten or more miles from the centroid of a population center of 40,000 people or more." Frontier defined "as any county with six or fewer people per square mile". Ten of Oregon's 36 counties are designated as frontier (Oregon Office of Rural Health, 2019).

Participant Recruitment and Admissions.

Each site (Table 1) was allocated five scholar placements. Research and STEM educational liaisons identified partner or target schools in their catchment region and reached out to teachers and administrators to recruit students in 9th and 10th grade. Liaisons recruited students to apply to the Knight Scholars Program via an online application (Qualtrics). In the first year, essays were used for admissions criteria and submitted with demographics, grade point averages (GPAs), students' unofficial transcripts, and a letter of recommendation. Appendix B describes application scoring criteria and rubrics across program tiers. After the first year, transcripts were removed from application requests and GPAs were no longer factored into admissions decisions, though GPA was still asked of applicants. One letter of reference was requested of applicants, with recommenders using an open letter submitted online for 2019 applications and moving to an online scoring system for subsequent application cycles, which asked recommenders to rate students on 13 attributes using a five point Likert Scale with a 'Not observed' option available: Creativity/innovation, Problemsolving ability, Initiative, Ability to work independently, Motivation, Intellectual ability, Written communication, Oral communication, Cooperativeness, Reliability, Self-discipline, Perseverance, and Leadership. Recommenders could provide more detail using open-field prompts. Each application was assigned two reviewers, including the applicant's regional liaison, to score applications in Excel according to a rubric (Appendix B). Disparate scores (i.e., >15-point difference) prompted review by a third reviewer. Average scores were used to rank applicants with final selection prioritizing applicants from NIH-defined underrepresented backgrounds (National Institutes of Health, 2018, 2019). Acceptance letters reiterated university and program conditions, with students and their guardians providing consent for program participation and longitudinal student evaluation.

Student demographics were obtained from program applications. Underrepresented students in biomedical sciences were defined using NIH definitions (National Institutes of Health, 2018, 2019), including (a) racial/ethnic backgrounds of Black/African American, Native Hawaiian/Pacific Islander, Native American/Alaskan Native, and Hispanic/Latino; (b) students with a disability; and (c) students with a disadvantaged background (National Institutes of Health, 2019). The 2019 Introduction program used 2018 NIH criteria for defining underrepresented groups (National Institutes of Health, 2018), while subsequent programs used 2019 criteria (National Institutes of Health, 2019), which defined disadvantaged background as meeting two or more criteria including (a) houselessness experience; (b) foster care experience; (c) Federal Free and Reduced Lunch eligibility; (d) first-generation college student defined by no parents or legal guardians who completed a bachelor's degree; (e) need-based financial aid (e.g., Pell grant eligibility); (f) Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) eligibility; or (g) grew up in a rural area defined by the Health Resources and Services Administration (HRSA) Rural Health Grants Eligibility Analyzer (by address) or a Centers for Medicare and Medicaid Services-designated Low-Income and Health Professional Shortage Areas (HPSA) (the latter presents eligible PY2020 zip codes in an Excel file). Applicants were selected based on available funded placements with others placed on a wait-list (Appendix B). Applicants not selected for the program were eligible for the Knight Scholar Program's comparison group and received a small financial incentive ($15 gift card) for completing pre-/post-program surveys.

At the time of application, participants in both Introduction and Immersion programs ranked their interest in various cancer topics and research environments (Appendix A). Interests support placement of Immersion scholars in research rotations, with items asked each year to understand change over time as scholars pursue cancer research.

Program Format.

The 2019 Introduction program (one week) was held in-person with all program students hosted in nearby dormitories at Portland State University. The 2020 programs were canceled due to COVID-19, with 2021 summer programs (e.g., one week Introduction and ten week Immersion) held virtually due to university COVID-19 restrictions. A technology survey was sent to scholars in advance of 2021 programs (i.e., May) to understand technological needs for participation in the program (e.g., computer, internet accessibility and speed) and whether loaner materials (e.g., computers or personal hotspots) were needed. Scholars were also asked to complete an online Zoom Fatigue Scale (Fauville et al., 2021) via Qualtrics, scored on a five-point Likert scale to understand fatigue from virtual classroom environments toward the end of the school year. All Oregon schools were entirely virtual leading up to summer 2021.

Peer Mentors.

Peer mentors were recruited through a local NIH BUILD program (Valantine et al., 2016), which trains underrepresented undergraduates in mentored biomedical research over a three-year period. A Knight Scholars Program faculty member works with BUILD EXITO trainees and is recruited for the summer opportunity using announcements. After 2019, BUILD trainees were directed to a Google site to learn more about the opportunity (Knight Scholars Program, 2021a). An online application system (Qualtrics) was used to screen peer mentor applicants using essays and interviews with scoring rubrics (Huerta et al., 2022). The 2019 program funded six peer mentor positions to serve as resident advisors and chaperones in the dormitories as well as mentor students. The 2021 programs funded five peer mentor positions to facilitate conversations and debriefs with students in the virtual environment. In 2021, peer mentors were paid $15/hour with up to 400 hours available. Peer mentors supplemented other program mentorship (i.e., community liaisons, scientist partners, community partners, and program staff).

Scientist and Community Partner Recruitment.

The Introduction program recruited speakers to introduce cancer to scholars in engaging ways while the Immersion program recruited speakers and shadowing sites across clinical care, public health, outreach, and research environments. Each liaison networked in their region to source partners from local clinic and hospital facilities, non-profit organizations and local or regional public health. Research partners were recruited through email using Knight Cancer Institute and OHSU scientist listservs. Partners were directed to a public-facing Google site to learn more about the program (Knight Scholars Program, 2021b), such as program goals, educational context, examples of training experiences, and learning objectives (Appendix A). Partners applied these principles to develop experiences in their own training area.

Scholar Evaluation.

Program impact was evaluated for scholars participating in the Knight Scholars Program (i.e., intervention group) as well as for a comparison group of students matched for program eligibility but not selected for the program. Both groups completed pre-post program surveys. Knight scholars also participated in post-program focus groups and daily feedback surveys. Evaluation was guided by a logic model and analysis plan (Appendix C). The program’s external evaluator (OHSU Evaluation Core) implemented pre/post surveys and focus groups.

Pre-post Program Surveys.—The OHSU Evaluation Core implemented online pre-/post-surveys with students (REDCap) and managed resulting data. Students in the intervention and comparison groups completed surveys before (within one week) and after (within two weeks) the Introduction and Immersion programs. Evaluation instruments and timelines are described in Appendix C and include measures of STEM interest (Byars-Winston et al, 2010; Lent et al., 2003), grit (Duckworth and Quinn, 2009), impulsivity (Steinberg et al., 2013), science self-efficacy (Marriott et al., 2019; Usher and Parajes, 2009), mindset (Paunesku et al., 2015), motivation and self-determination theory (adapted scale from Deci et al., 2001 for science), biomedical research attitudes (Cameron, 2005), and research self-efficacy (Weston and Laursen, 2015), with the latter reported in this manuscript. Research self-efficacy was measured post-program using the Undergraduate Research Student Self-Assessment (URSSA; Weston and Laursen, 2015) which presents five questions on a five-point Likert scale (0=No Gains; 4=Great Gain; Appendix C). A summary score from item totals was used to compare intervention and comparison students in the Introduction and Immersion programs.

Individual Reflections.—Daily feedback surveys were used to estimate what experiences were impactful for scholars and enabled rapid program adjustments, if necessary. Paper-based reflections were used in 2019; an online survey approach (Qualtrics) was used in summer 2021. Scholars rated each activity that day (e.g., speaker, session, panel, tour, etc.). Individual presenters/sessions were rated on a five-point Likert scale (1=low; 5=high) for Overall quality, Clarity, Relatability as a person, and Interest level in the topic. Scholars could add comments in open field responses. Scholars in the virtual program were asked five additional prompts daily to understand program satisfaction, which were scored on a five point Likert scale and included: “I am feeling interested”, “I am feeling supported”, “I liked today’s schedule”, “Online time was reasonable”, and “I’m excited for more”, with higher scores denoting more satisfaction. Open-ended prompts asked scholars about the best part of their day, the most important thing they learned that day, and areas for program improvement.

On the last day of each week, trainees could nominate professionals for Most Inspirational, Best Teaching, Best Role Model, Science Pathfinder (someone whose science was most interesting to trainee), Best Community Work, Most Relatable, and Most Engaging. Tallies were summed to determine Introduction program winners. For the 10-week immersion program, scholars reflected on a list of all submitted nominees on the last week of the program (Appendix A) to determine those most impactful to their experience in that category. Nominees and winners are shared publicly to honor cancer professionals and serve as awards that could be cited in their professional portfolios. Nominee lists were used to spotlight participants for future inclusion (i.e., re-invite). .

Post-program Group Reflection.—The OHSU Evaluation Core facilitated post-program focus groups with scholars on the last day of each program (i.e., Introduction and Immersion) without the presence of any program staff. Projected number of focus groups, facilitator details, and scripts are detailed in Appendix D. Post-program reflections of peer mentors was also captured, with scripts and findings described elsewhere (Huerta et al., 2022).

Scientist Evaluation.

Feedback from research learning communities, including the laboratory principal investigators and research staff involved with hosting Immersion scholars, was solicited at the end of each of the four two-day placements. An online survey (Qualtrics) asked scientists about their scholar hosting experience (e.g., preparation, time involved, impact of virtual setting, involvement of peer mentors, and likelihood of continued participation), with prompts described in Appendix C.

Data Analysis.

URSSA Likert scale responses from five items were converted to numbers and summed to produce a summary score (Appendix C). If one or more of the five variables was missing, then the record was removed from analysis. Shapiro-Wilk normality tests were applied to determine if parametric or non-parametric statistical tests were used (i.e., t test or Wilcoxon rank sum test, respectively).

Daily survey ratings were descriptively analyzed for averages and standard deviations. Survey feedback (i.e., open-ended comments from trainees about reactions to day's activities; post-rotation scientist feedback) was exported from Qualtrics into Microsoft Excel to analyze counts and themes. Qualitative data coding occurred in Excel using columns to permit co-coding of themes, as necessary. Coded themes were summarized into matrices for reporting. Program staff performed the analyses above while external evaluators (OHSU Evaluation Core) performed statistical analyses of quantitative pre-/post-program survey data (Appendix C) and thematic analysis of focus group qualitative data using Dedoose and Taguette qualitative coding software (Appendix D). KSP program staff supported qualitative coding of 2021 student focus groups using themes previously identified by OHSU Evaluation Core in 2019 transcripts.

RESULTS

Study Participants.

The Knight Scholars Program trained 60 scholars across Oregon and recruited 73 into its comparison group. Average age of scholars was 16 years old when beginning the Introduction program (range 14–17 years). Students were typically in 10th grade when beginning the program (range 9–11th grade). Admission rates for the two Introduction cohorts averaged 24% (Table 2) with 90% of scholars indicating intent to return for further training at the end of the first summer. Approximately 77% of initially accepted students were retained and applied for Immersion training, with 43% of eligible scholars who completed the Immersion program applying for Intensive training (Table 2). COVID-19 impacted participation rates between 2019 and 2021 programs, with continued impacts projected for 2022 training programs. Scholars represented a broad range of demographic backgrounds in program applications (Table 3), with 85% underrepresented in biomedical sciences using NIH definitions. Approximately 70% of Knight Scholars were females, 15% reported a disability, and 77% reported a disadvantaged background. Approximately a third of Knight Scholars (32%) are multi-lingual. The program prioritized selection of historically underrepresented students among qualified applicants. As such, the experimental group had more underrepresented students than in the comparison group.

Disadvantaged background variables were likely underreported in our sample, as we found eligibility to be higher when verifying self-report. For example, approximately 45% of students identified as first-generation college when asked by self-report, but significantly increased when verified against parent/guardian education (55%; $p<0.02$). Likewise, many students underreported their rural eligibility for both HRSA and HPSA metrics on their admissions applications. For example, 29% of students completing program surveys (38/133; Table 3) self-identified as rural using NIH disadvantaged background definitions (National Institutes of Health, 2019). However, when address information from admissions applications were verified (address for HRSA; zip code for HPSA), over 96% (227/236) of students qualified for rural eligibility; 54% were HRSA eligible (125/231) and 96% were HPSA eligible (226/235).

Exposure to Biomedical Professionals.

The first Introduction program (in-person, 2019) engaged approximately 40 scientists, health professionals, and community partners. The summer 2021 virtual programs engaged a total of 153 scientists, health professionals, and community partners – including 21 for the virtual one-week program and 143 for the virtual Immersion program (some professionals participated in both programs). Eleven undergraduate peer mentors (NIH-funded BUILD EXITO program trainees or alums) supported the program across the two cohorts as well as 6 K-12 science teachers (including 1 teacher liaison for the 2021 programs), 5 community research and educational liaisons, and 3 program staff who offered instruction to scholars in cancer research.

Program Activities.

Introduction programs were designed for early high school students (ages 14–16) to safely develop interest and background training before becoming eligible to enter laboratories at age 16. Introduction programs focused on exposure to health professionals over a five-day sequence: 1) Oregon’s cancer landscape (population health); 2) clinical care, 3) cancer detection and precision oncology, 4) translational and basic research; 5) community research (schedules and topics in Appendix A). Morning huddles with staff oriented scholars to the day’s topics, which included content and topical talks, networking sessions (e.g., meet the scientist informal chats; panel discussions, expert roundtables), and experiential sessions/tours. An afternoon debrief with staff concluded online activities with virtual scholars at 1:45, with offline independent reflection time in afternoons. In contrast, in-person scholars (2019) stayed in dormitories and had post-program downtime with peer mentors (e.g., going to gym, playing soccer, dancing) before having networking dinners (e.g., with scientists, undergraduate researchers, college admissions representatives). Scholars had additional group bonding time after dinner (e.g., games, university exploration) before bedtime. Peer mentors supervised dormitory activities and talked informally with scholars in the mornings before sessions as well as after sessions and into the evenings.

Immersion scholars experienced cancer research training through shadowing experiences in their home communities (clinical, public health, outreach, totaling five weeks) as well as through research rotations (two weeks) and skills training at the university (three weeks). Learning objectives for shadowing experiences, examples and schedules from the 2021 virtual program are described in Appendix A. Research training was delivered by the program team as part of research orientation in week 1 (e.g., research ethics, literature skills; photovoice, informational interviewing), community research project development in week 5 (e.g., framing research questions, sourcing data, data visualization), and week 10 culminating presentations (Appendix A). Optional office hours with peer mentors were added in week 7 to support community research project development.

Cohort 1 Immersion scholars were entirely virtual for the 10-week training program due to COVID-19, therefore hours spent online were compressed to 9–1:45 pm based on the recommendations of site teachers and program faculty. Sessions were recommended to not exceed an hour between breaks. To enhance interaction during the virtual Immersion program, an explicit focus on simulation was woven throughout the program. It was facilitated by School of Medicine's clinical education team, who modeled cancer diagnosis procedures (e.g., ultrasound, imaging), advances in imaging research (e.g., microbubbles for treatment); and interprofessional teamwork for patient communication using actors. Simulations for high school students mirrored activities used to train health professionals.

Evaluation of Knight Scholars Program.

Pre-/post- Program Surveys.—The program was successful in recruiting intervention and comparison group students to take pre-/post-surveys that enable measurement of individual-level student impact (Table 4). All intervention students (100%) completed pre-/post-surveys. Statistical analysis of survey data is in progress by the external evaluation team, with preliminary results showing strong gains in research self-efficacy for trainees in both Introduction and Immersion programs. Intervention students in the one week Introduction program showed significantly greater gains in research self-efficacy (URSSA) compared to comparison students ($W=766$; $p<1.7e-10$), $N=132$, reflecting Introduction experimental ($n=60$) and comparison groups ($n=72$). Likewise, trainees in the 10-week Immersion program (held virtually) showed significant gains in research self-efficacy compared to comparison students ($W=51.5$, $p<0.003$, $N=34$, reflecting Immersion experimental ($n=14$) and comparison groups ($n=20$)). Wilcoxon rank sum tests were used because data were not normally distributed ($p<0.05$) for all groups except Immersion comparison students when analyzed using the Shapiro-Wilk normality test.

Qualitative Findings.—The external evaluation team ran eight focus groups with scholars, including six with Introduction scholars (3 focus groups per cohort) and two with Immersion scholars, which captured scholar perceptions upon completion of their respective programs. Full summaries for each program are described in Appendix D. Results are separated into three sections: core learning from the program (Table 5), intent to pursue research as a result of the program (Table 6), and areas of growth for the program (Table 7). Themes were consistently observed across Introduction in-person and virtual programs unless specified otherwise.

In terms of core learning (Table 5), Introduction and Immersion training programs enhanced scholars' exposure to researchers and professionals, which was an essential component of the program. Professionals and peer mentors enabled modeling of careers and paths, including representation of diversity for scholars (Appendix D). The connections with professionals surpassed scientific content to include prior challenges faced and strategies used to navigate failure and barriers, which helped scholars envision themselves in various paths even if not successful at first. Scholars reported professional growth in educational interests, skills development, and communication as they learned about the breadth of research topics and environments. Team science was visible to scholars as were challenges experienced by scientists. Scholars emphasized learning the importance of networking, mentorship, keeping an open mind, and perseverance in the face of challenge.

Scholars cited the program as a unique opportunity that enabled self-reflection and meeting others. As a result of program participation (Table 6), scholars described a spark in interest or a deeper interest in research than when they began. They also cited how their educational trajectories were impacted, such as including more research and consideration of advanced degrees in their fields of interest.

When asked for recommendations to improve the program (Appendix D), scholars cited approaches for improved transparency (e.g., instructions, expectations), communication (e.g., language level, materials in advance), interaction (e.g., hands-on; informal group time), as well as ways to individualize the program to their interests. Representation of diverse backgrounds was improved over time, though continued improvement in this area remains a need (i.e., Muslim, LGBTQ+, African American, Hispanic and Latino, disability, and low-income representation). Some scholars reported concerns about not feeling accepted if they pursued research due to their racial/ethnic background; others reported feeling like research paths were inaccessible due to the financial concerns associated with schooling for advanced degrees (i.e., master's degrees in public health for scholars interested in health inequities research). Financial considerations were particularly impactful for scholars who were unsure if they would maintain interest in a field sufficiently to justify the expense. Scholars also reported self-doubt and burnout concerns.

The virtual environment introduced challenges and opportunities (Table 7). While it enabled engagement of distant scholars during a pandemic that limited in-person attendance, not all scholars had equitable internet connections or home environments, which magnified disparities of scholars. After a year of online school preceding the 2021 program, both Introduction and Immersion scholars reported the virtual program felt like school and that they were often distracted. Some reported experiencing headaches as a result of their online screen time. Other students reported more hesitancy to participate and engage with others in the virtual environment (e.g., unmuting, finding the right time to interject), particularly in larger group settings.

Partnerships.

This project extended partnerships with health and service organizations across the state of Oregon. Research and educational liaisons facilitated connections with clinical care organizations, public health agencies, tribal organizations, and outreach groups. The program facilitated connections to Oregon community partnership grantees with funded community projects in cancer. Public health departments were focused on the pandemic, though they still participated despite scaling back time commitments. In one case, a public health agency from another county supported training efforts, even though there were no students from their county participating in the program.

Peer Mentors.

Eleven peer mentors supported the program, including 6 in 2019 and 5 in 2021. Using demographic data from peer mentor surveys recorded in January, 2022 (Huerta et al., 2022), peer mentors' average age was 24 years with all (10 of 10 responding; 100%) qualifying as underrepresented in biomedical sciences based on 2019 NIH definitions (Table 3). Peer mentor focus group themes centered around peer mentors' professional development, invigorated or solidified career interests, and enhanced interest in further mentoring (Huerta et al., 2022). Peer mentors described that their relatability to trainees helped guide scholars in cancer research (Huerta et al., 2022).

Scientists and Research Learning Communities.

Nine rotations were available for Immersion scholars in 2021, representing areas of basic science, translational science, and community research. Topics included pancreatic cancer, exercise survivorship, tumor microenvironment, genetic risk for cancer, nanomaterials for drug delivery, community research, biostatistics, and computational biology. Immersion scholars were placed in four rotations based on their indicated interests using application data, each for 2 days from 9:00–1:15 (Appendix A). Thirteen feedback responses were submitted by scientists, representing eight unique users who completed the online survey. All labs agreed or strongly agreed with the statement that "I would host scholars again in the future" (4.6±0.5; mean+SD), "I would recommend this experience to other labs" (4.3±0.6) and "the shadowing duration was reasonable" (4.2±0.8) Labs also agreed with statements about the "Knight Scholars Program helped me to understand what to talk about with scholars (3.9±1.0), "I felt prepared to host scholars in the lab" (3.8±0.8), and the virtual setting worked fine for describing our work" (3.5±1.1). Labs disagreed with the statement that "the amount of time needed to prepare was too much" (2.7+0.9). Almost a quarter of responding scientists (23%) described benefits of the partner website for preparation around understanding guidelines and training examples. More than half (62%) offered feedback for improving training efforts, including providing labs with phonetic spellings of scholar names, description of scholar interests, and more about their assigned peer mentor. Almost a third (31%) described challenges with the virtual training environment for translating their work and sustaining engagement with scholars. About 38% of scientists reported challenges with scholar engagement (e.g., cameras on, challenges with asking questions) during rotations, with one scientist reporting four hour blocks of lab training is too long in a virtual setting. When asked about the ideal number of scholars placed in their lab, responses ranged from 2–6 scholars for virtual training (median=4, with one responding "any number") and 1–6 scholars for in-person training (median response= "2–4, depending on activity"). All scientists agreed that the program should continue having a peer mentor in sessions (with 8 of 9 responding "definitely keep" and one responding "likely keep"). Peer mentor roles and outcomes are described in Huerta et al., 2022.

DISCUSSION

The Knight Scholars Program is an interprofessional cancer research training program for high school students that emphasizes community-based experiences, using clinical care, public health, and outreach shadowing in scholars' home communities. Community experiences were supplemented by research rotations at a research-intensive university that showcase the continuum of cancer care (Taplin et al., 2012), allowing scholars to experience different cancer topic areas and research environments in a tiered setting before committing to an area for Intensive training. Our program shows that a one-week training can effectively stimulate interest in cancer research and research self-efficacy for Oregon high school students, with comparable results across in-person and virtual training programs.

High school trainees envisioned themselves in various paths modeled by over 150 professionals in the virtual training program. Path exploration and relatability of professionals were favorites of scholars, particularly when diversity and representation were included. The virtual program was particularly effective for training students geographically distant from a research-intensive site, including younger students (<16 years) who may not yet be permitted to enter laboratory settings due to age. Scholars were generally in 10th grade at the start of the program, though the pandemic paused training in 2020 and some scholars will complete the three-year program as undergraduates. Grade did not influence participation of students, who had a wide range of coursework and experiences upon entering. One fifth of returning Immersion scholars (n=3) reported concerns about their skills (e.g., "*How hard it will be to understand the subject matter*"; "*Not being as good as the others and falling behind*") when asked about their thoughts on returning. However, the range of grades in the program seemed to support students learning from each other. The first and second years of the program introduce scholars to cancer and cancer careers, respectively, so scholars are not placed in deep research settings where advanced knowledge is necessary. Both one-week formats supported early interest development and research preparation.

Almost half of Immersion students (6 of 15; 40%) cited reservations about the virtual program, describing "*I'm concerned about the program being virtual and spending so much time online. My school has been virtual the majority of the school year and it's tough to get quality learning and understanding.*" The pandemic spurred tremendous innovation for supporting students in cancer research training. The program moved immediately to developing scholar-facing websites for sharing information in graphic and engaging ways. Sessions were kept short, recognizing that programmatic settings were not equivalent for trainees. The challenges of chaperoning students and arranging evening activities for students from the 2019 program were eliminated in the virtual setting; however, we found challenges remained in the consistent engagement of scholars. Some scholars would show up late and many preferred cameras off, much to the frustration of some program staff and guests. However, social determinants of health describe how the conditions in which students live, work, and learn impact their health (Viner et al., 2012). Some of our scholars worked nights and were tired in the mornings. Many of our scholars reported having no private space to participate away from family members or noise. Many lacked reliable internet connectivity. Some lacked air conditioning, which became a challenge in attic rooms during the summer or when wildfire smoke made local air quality unhealthy. We found those conditions influenced scholars' participation and engagement more than science background. By focusing more broadly rather than deeply during initial cancer research training, the program bridged potential lack of content knowledge with broad exploration of cancer research careers that spurred interest in areas worthy of further study.

Scholars highly valued time with each other and peer mentors, which enabled them to informally discuss their program experiences and build identities that integrated their personal and professional selves, consistent with prior findings (Kasperiuniene and Zydziunaite, 2019; Marriott et al., 2021). Many scholars reported interest in helping their communities, though their desired approach varied (e.g., clinical care, biostatistical analysis of health inequities). As schooling decisions involve financial considerations, informal time within the program enabled scholars to discuss college readiness plans, including how to get the most from classes/credit hours, and opportunities that could advance their training. Our findings support results from BUILD EXITO, which documented that giving underrepresented undergraduates the time and support to plan feasible paths and make informed decisions about their schooling may help increase the percentage who complete advanced degrees (Marriott et al., 2021). Our findings with high school students underscore benefits of discussing hidden and implicit curricula as part of biomedical research training (Hinton et al., 2020; Marriott et al., 2021; Merolla and Serpe, 2013; Rubio et al., 2019; Toven-Lindsey et al., 2015).

The program offered several on/off ramps to scholars pursuing cancer research. First, we use a large pool of Introduction trainees from which to recruit for ongoing training. Second, we modified our Immersion application from a two-year commitment to a one-year commitment, which increased applications and helped scholars ensure interest before committing. Scholars who completed the Introduction program were eligible to continue at any time in the future during the grant period, not just the subsequent summer. Given that the pandemic has resulted in inequitable impacts on historically underrepresented populations (Fortuna et al., 2020), the program recognizes that some scholars may have faced illness/death of family members, financial burdens, or mental health challenges. It is important for programs to remember that the lack of scholar interest in ongoing training at the moment is not necessarily indicative of overall interest in the future. Many Immersion scholars offered that they were tired of online engagement after a school year of virtual school, but would participate if the program was run in-person or if their college schedules permitted participation. Likewise, peer mentors wanted to continue work with the program but questioned how to integrate schedules. Finding ways to be supportive of overlapping STEM and research training schedules would be expected to increase workforce development, as trainees learn to integrate knowledge and skills across training sources and implement professional communication about boundaries. Work-life balance within science was an important discussion point for scholars; work is a social determinant of health that can intersect with structural level factors to enhance inequities (Wipfli et al., 2021). Therefore, understanding biomedical training environments for research careers is no exception. Biomedical sciences encompass a wide range of career options with many skills transferable; programs like ours show many ways of contributing to cancer research.

Our peer mentors were essential for bridging connection between scholars, staff, and scientists. They identified areas for program improvement and helped scholars contextualize their experience. Peer mentors' interprofessional research backgrounds were not cancer-related, though many identified a subsequent interest in cancer, research, or mentoring (Huerta et al., 2022). They helped to lead community research projects and photovoice activities with scholars. Their professionalism helped our younger scholars navigate research environments, understand what to expect, and feel more comfortable asking questions. Peer mentors shared similar demographic backgrounds as scholars, reinforcing representation within biomedical research.

Our program documents strong benefits for interprofessional exploration of cancer research careers and settings, aligning with practices with Estrada and colleagues (2016) for improving student persistence in STEM for underrepresented students. We describe factors for engaging and retaining underrepresented students in cancer research training programs. These efforts enhance professional development of trainees pursuing cancer research and support enhanced representation of historically underrepresented groups in the biomedical workforce (Duffus et al., 2014; Estrada et al., 2016; Hinton et al., 2020; Valantine and Collins, 2015; Valantine et al., 2016).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS

AN	Alaska Native
AI	American Indian
CORE	Community Outreach, Research and Engagement
CTSA	Clinical and Translational Science Award
HPSA	Health Professional Shortage Area(s)
HRSA	Health Resources and Services Administration
NGSS	Next Generation Science Standards
NIH	National Institutes of Health
OHSU	Oregon Health and Science University
STEM	Science, Technology, Engineering, and Math
URSSA	Undergraduate Research Student Self-Assessment
WIC	Women, Infants, and Children

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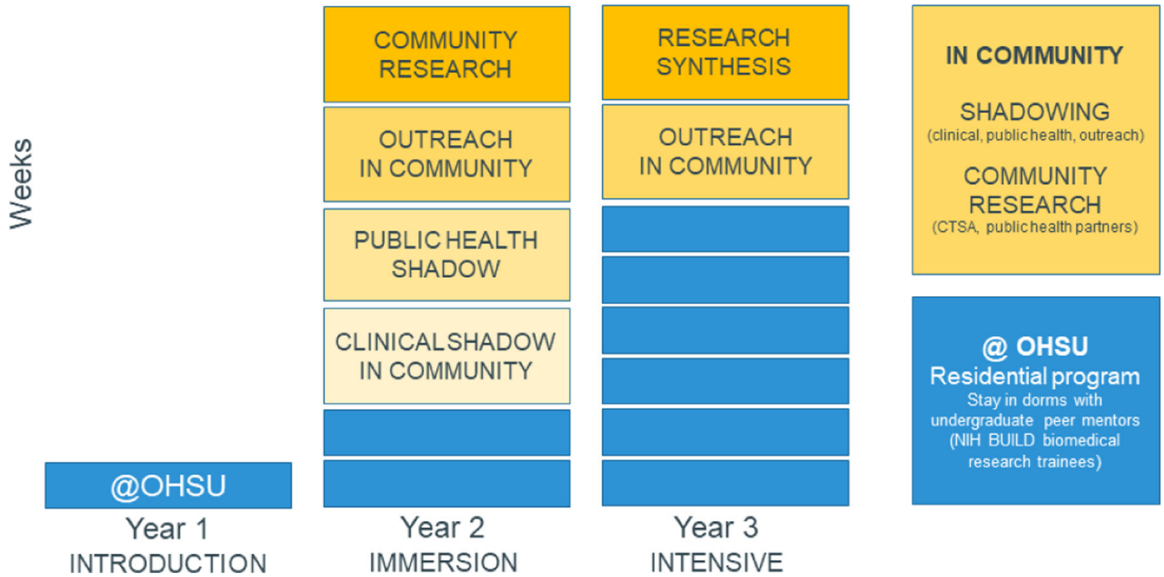

Figure 1.
Knight Scholars Program’s tiered cancer research training

Table 1.

Oregon regions served by the Knight Scholars Program.

Region	Designation	Sites	Scholar Placements	Eligible High Schools	Liaison Type	
					Community Research	STEM Education
Portland Metro *	Urban	1	10	2 *	X	X
Willamette Valley	Rural	1	5	1		X
Central Oregon	Rural	2	10	2	X	X
Southern Oregon	Rural	1 ^	5	4	X	X
Eastern Oregon *	Rural/Frontier	1 ^	5	4	2021 *	
		7	**35**	**13**	**4**	**1** #

* Two sites (i.e., Eastern Oregon and one Portland metropolitan) were added in 2021 due to supplemental external funding from the Kuni Foundation. Program staff temporarily served as research liaison while the position was filled.

^ Multiple high schools were eligible to participate from these regions.

One STEM educational liaison was staff on this project and facilitated partnerships with On Track OHSU! sites.

Table 2.

Application and retention rates of program participants.

	Cohort 1	Cohort 2	Total (Average to date)
Year 1: Introduction Program (1 week)	2019; in-person	2021; online	
Introduction Program Applications [*]	82; 5 sites	163; 6 sites [*]	245
Admitted	25/82 (30%)	35/163 (21%)	60/245 (24%)
Matriculated (i.e., began program)	25/25 (100%)	35/35 (100%)	60/60 (100%)
Completed program	25/25 (100%)	35/35 (100%)	60/60 (100%)
Intention to Continue to Immersion [#]	22/25 (88%) [^]	30/33 (91%)	52/58 (90%)
Year 2: Immersion Program (10 weeks) [*]			
Immersion Program Applications	23/25 (92%) [&]	23/35 (66%) [C]	46/60 (77%)
Admitted [*]	16/23 (70%) [*]	23/23 (100%) [*]	39/46 (85%)
Matriculated (i.e., began program)	15/16 (94%) [^C]	Summer 2022	15/16 (94%)
Completed program	14/15 (93%)	Summer 2022	14/15 (93%)
Intention to Continue to Intensive [#]	2/9 (22%) [C]	Summer 2022	2/9 (22%)
Year 3: Intensive Program (10 weeks)			
Intensive Program Applications	6/14 (43%) [C]	Fall 2022	6/14 (43%)

[*] Additional grant funding was secured in 2020 that permitted us to add 10 new Introduction scholars (i.e., five from one existing urban site and five from a new rural site.) It also permitted us to increase Immersion placements from 16 to 23 spots). For the 2020 summer application cycle, 82 applications were submitted for five sites (NIH-funded) and 81 applications for two sites (Kuni-funded).

[^] Scholars who declined to continue cited a need to ranch to fund college (rural male scholar) and intention to join army (rural female scholar).

[&] One scholar declined to apply due to moving away for college; another scholar was unresponsive to multiple calls/emails.

[C] COVID-19 impacted participation, with many scholars reporting that they needed a break after a year of online school (statewide implementation).

[#] Intention to continue denoted by scholars rating a 4 or 5 in summative focus groups (Appendix D). Scholars who completed the prior year's program are eligible to continue.

Table 3.

Demographics of Knight Scholars Program evaluation groups reported in pre-/post-program surveys.

Demographic Category	Intervention Group			Comparison Group				
	Cohort 1 (n=25)	Cohort 2 (n=35)	Total (n=60)	Cohort 1 (n=24)	Cohort 2 (n=49)	Total (n=73)	Total Students (n=133)	Peer Mentors (n=11)
Gender								
Male	5 (20%)	12 (34%)	17 (28%)	3 (13%)	5 (10%)	8 (11%)	25 (19%)	4/11 (36%)
Female	20 (80%)	22 (63%)	42 (70%)	20 (83%)	43 (88%)	63 (87%)	105 (79%)	5/11 (45%)
Non-binary, Two-spirit ^	0 (0%)	1 (3%)	1 (2%)	1 (4%)	1 (2%)	2 (3%)	3 (2%)	2/11 (18%)
Age (Average, SD)	15.6, 0.5	16.4, .8	16.1, 0.8	15.8, 0.6	16.2, 0.8	16.1,0.8	16.1, 0.8	24.6, 4.3 ^
Underrepresented in Biomedical Sciences *								
Overall	19 (76%)	32 (91%)	51 (85%)	13 (54%)	33 (67%)	46 (63%)	97 (73%)	11/11 (100%)
Underrepresented Racial/Ethnic Group	17 (68%)	27 (77%)	44 (73%)	12 (50%)	24 (49%)	36 (49%)	80 (60%)	8/11 (73%)
Disability	0 (0%)	9 (26%)	9 (15%)	1 (4%)	13 (27%)	14 (19%)	23 (17%)	3/11 (27%)
Disadvantaged background	14 (56%)	32 (91%)	46 (77%)	0 (0%)	23 (47%)	23 (32%)	69 (52%)	11/11 (100%)
Race/Ethnicity *								
American Indian or Alaska Native	3 (12%)	6 (17%)	9 (15%)	1 (4%)	1 (2%)	2 (3%)	11 (8%)	0/11 (0%)
Asian	0 (0%)	9 (26%)	9 (15%)	1 (4%)	13 (27%)	14 (19%)	23 (17%)	2/11 (18%)
Black or African American	7 (28%)	10 (29%)	17 (28%)	4 (17%)	14 (29%)	18 (25%)	35 (26%)	2/11 (18%)
Native Hawaiian or Other Pacific Islander	0 (0%)	2 (6%)	2 (3%)	1 (4%)	2 (4%)	3 (4%)	5 (4%)	2/11 (18%)
Hispanic of any race	9 (36%)	11 (31%)	20 (33%)	7 (29%)	10 (20%)	17 (23%)	37 (28%)	5/11 (45%)
White	8 (32%)	10 (29%)	18 (30%)	12 (50%)	23 (47%)	35 (48%)	53 (40%)	4/11 (36%)
Prefer not to answer	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (4%)	2 (3%)	2 (2%)	0/11 (0%)
NIH Disadvantaged Background Categories								
Houselessness experience	0 (0%)	2 (6%)	2 (3%)	0 (0%)	2 (4%)	2 (3%)	4 (3%)	5/11 (45%)
Foster care experience	1 (4%)	3 (9%)	4 (7%)	0 (0%)	3 (6%)	3 (4%)	7 (5%)	0/11 (0%)
Federal Free and Reduced Lunch eligibility	11 (44%)	27 (77%)	38 (63%)	0 (0%)	24 (49%)	24 (33%)	62 (47%)	9/9 (100%)
First-Generation College (Self-report)	10 (40%)	17 (49%)	27 (45%)	7 (30%)	15 (31%)	22 (30%)	49 (37%)	9/11 (82%)

Demographic Category	Intervention Group Cohort 1 (n=25)	Intervention Group Cohort 2 (n=35)	Intervention Group Total (n=60)	Comparison Group Cohort 1 (n=24)	Comparison Group Cohort 2 (n=49)	Comparison Group Total (n=73)	Total Students (n=133)	Peer Mentors (n=11)
First-Generation College (Verified)	11 (44%)	22 (63%)	33 (55%)	10 (42%)	26 (53%)	36 (49%)	69 (52%)	10/11 (91%)
Pell grant eligibility	7 (28%)	16 (46%)	23 (38%)	0 (0%)	7 (14%)	7 (10%)	30 (23%)	9/10 (90%)
WIC eligibility	6 (24%)	13 (37%)	19 (32%)	0 (0%)	16 (33%)	16 (22%)	35 (26%)	9/11 (82%)
Rural (HRSA or HPSA)	11 (44%)	17 (49%)	28 (47%)	0 (0%)	10 (20%)	10 (14%)	38 (29%)	6/11 (55%)
Other Demographic-Related Variables								
Multi-lingual	8 (32%)	11 (31%)	19 (32%)	6 (25%)	12 (24%)	18 (25%)	37 (28%)	8/11 (73%)

^ Two-spirit and non-binary gender options coded from open-ended prompts (Hunt, 2016; Morrison, Dinno, and Salmon, 2021).

* Participants could select multiple racial/ethnic categories with totals exceeding participant numbers. NIH Underrepresented backgrounds determined using criteria defined by National Institutes of Health (2019). WIC denotes Special Supplemental Nutrition Program for Women, Infants, and Children. Peer mentor data reported in Huerta et al., 2022 with nine of the eleven peer mentors reporting demographics; ages reported at the time of follow-up.

Table 4.

Response rates of study groups.

Time Point	Summative Evaluation Survey Response Rate returned/sent (%)			
	Intervention Group		Comparison Group	
	Cohort 1	Cohort 2	Cohort 1	Cohort 2
Introduction Program				
Pre-Survey	25/25 (100%)	35/35 (100%)	n/a	n/a
Post-Survey	25/25 (100%)	35/35 (100%)	24/54 (44%)	49/73 (67%)
Follow-up *	17/25 (68%)	n/a	16/44 (30%)	n/a
Immersion Program				
Pre-Survey	15/15 (100%)	Summer 2022	0	Summer 2022
Post-Survey	14/14 (100%) ^	Summer 2022	0	Summer 2022

* Follow-up surveys were given at the end of the following summer (August), due to the 2020 program being cancelled due to COVID-19.

^ One student withdrew mid-program to start own business.

Table 5.

Themes observed around scholars' core learnings from the program.

Prompt	Introduction Program	Immersion Program
Program components liked most	Meeting researchers and professionals; Meeting other scholars/peer mentors; Exposure to STEM areas/careers; Tours and facilities (only in-person; not virtual)	Meeting Researchers; Peer Mentors; Diversity; Public Health Weeks; Research Rotations; Clinical Week
Uniqueness compared to other STEM-focused activities	Beyond math anda science; Few other opportunities; Hands-on nature; More inclusive	Connections with researchers; Going to university; Stipend
Favorite thing learned during the program	Learning about researchers' career trajectories and challenges they faced in getting to where they are today; Variety of cancer research career options; Specific topics covered by presenters; Motivation for future	Learning about careers; Personal/professional growth; Meeting researchers; Increased public health/cancer knowledge; Tribal Health Program
Plan to use information learned in their life	Education and career path guidance	Professional Growth; Education Planning; Research Skills; Careers not interested in pursuing; Personal Growth
Impact on research attitudes and understanding	Beyond patient care; Beyond bench science; Personable nature of research; Collaborative nature of research	More likely to do research; Increased understanding of research; Difficulty of research
Advice for future students interested in research	Look for opportunities; Network/find mentors; Stay committed; Keep an open mind	Opportunities like Knight Scholars Program; Do your research

Table 6.

Themes observed related to intended pursuance of research as a result of program.

Prompt	Introduction Program	Immersion Program
Interest in returning for subsequent training	What students are looking forward to (experiences, deeper understanding); Concerns (time; representation)	Want in-person; Unsure if have time (college); Don't want to be away
Impact on pursuing research	Sparked interest in research; Deepened interest in research; Education impact	More attainable; Found fields they are interested in; Want patient focus; Better idea for major
Likelihood of recommending program to a friend	Unique opportunity; Paid (not described in cohort 1); General (i.e., meeting others)	Great opportunity; Paid opportunity; Self-Reflection

Table 7.

Themes describing areas for growth for improving cancer research training programs like Knight Scholars Program.

Prompt	Introduction Program	Immersion Program
Recommendations for improving program	More instructions/guidance; Program Structure; More time (for questions and with great people); Group Bonding (more informal time to get to know each other (virtual made this more challenging than in-person); More opportunity to individualize program	Ensure appropriate level of language; Provide information on presentation to scholars ahead of time; Set expectations of scholars early on; Protect break time; More interactive; Shorter sessions (noted for virtual)
Representation of different backgrounds and perspectives	Good diversity of backgrounds and perspectives; Saw themselves represented; Missing or underrepresented backgrounds	Good diversity of backgrounds and perspectives; Saw themselves represented; Missing or underrepresented backgrounds
Concerns about pursuing research	Time commitment; Financial concerns; Overcoming doubt; Fear of losing interest; Sacrifices/compromises	Not being accepted; Burn out; Financial concerns
Impact of virtual on engagement	Felt like school; Made personal connections more challenging; Increased hesitation to participate; More distracting; Connection issues	Cameras on was challenging; Felt like school; More easily distracted; Headaches from being online all day; Connectivity limitations