

# Addressing Projected Healthcare and STEM Profession Needs Through a Regional Summer Pipeline Program

Kyeorda Kemp<sup>1</sup> Stephanie M. Swanberg<sup>2</sup> Suzan Kamel-ElSayed<sup>1</sup> James Grogan<sup>1</sup>  
Tiffany Williams<sup>3</sup> Caryn Reed-Hendon<sup>4</sup>

<sup>1</sup>Oakland University William Beaumont School of Medicine Department of Foundational Medical Studies

<sup>2</sup>Michigan School of Psychology

<sup>3</sup>Oakland University William Beaumont School of Medicine Office of Diversity & Inclusion <sup>4</sup>Lawrence Technological University

## Abstract

Pipeline programs in health and biomedical sciences have gained attention as students who engage in these programs are more likely to enter into associated fields. In 2012, to support the mission of Oakland University William Beaumont (OUWB) School of Medicine, the Future Physicians Summer Enrichment Program (FPSEP) was launched for regional high school students. Recently, a program review was performed to determine if the program was meeting its goals to: 1. increase diversity and inclusion in medicine, 2. serve the needs of the community, and 3. facilitate students entering the medical and biomedical sciences pipeline. Program structure, participant demographics, and analysis of surveys administered to past participants indicate that the program is meeting its goals and supporting the mission of the medical school. The results of this analysis, areas for improvement, strengths of the program, and solutions to refine the program are presented in this article. These lessons learned can help other institutions develop and refine their programs to increase diversity and inclusion and promote the entry of students into the pipeline.

**Keywords:** pipeline programs, high school students, medical schools, program evaluation

## Introduction

Pre-college pipeline programs are considered powerful tools to expose students to academics, provide a sense of belonging, and convey the importance of life-long learning (Afghani et al., 2013; Fritz et al., 2016; Houtz & Kosoko-Lasaki, 2006; Murray et al., 2009). In 2008, it was estimated that biomedical pipeline programs were offered by more than 70 medical schools, universities, research institutions, and hospitals across the United States (Office of Science Education, 2008). These numbers have undoubtedly increased. Such programs expand undergraduate enrollment by inspiring high school students to pursue science- and health-related careers. Indeed, studies reveal that these programs increase students' knowledge of health and biomedical science careers, enhanc-

ing their desire to pursue a career in medicine or STEM fields (Chang et al., 2016; Crump & Winkleby, 2015; Kaye et al., 2014; VanMeter-Adams et al., 2014; Winkleby et al., 2009). To meet future regional needs regarding health and biomedical careers and with the knowledge of the above, the Oakland University William Beaumont School of Medicine (OUWB) created the Future Physicians Summer Enrichment Program (FPSEP). This program aims to: 1. increase diversity and inclusion in medicine, 2. serve the needs of the community, and 3. facilitate students entering the medical and biomedical sciences pipeline. To ensure that the goals of the program were met, a program review was conducted.

## The Need for Pipeline Programs

Nationally, according to the Bureau of Labor Statistics (2020a), healthcare occupations are the most in-demand professions, with a projected 14% increase in growth from 2018 to 2028. This demand is due to several factors, including increased health care needs from an aging American population and those with chronic conditions, a projected large percentage of healthcare professionals retiring in the next decade, and the effects of anticipated health care reform measures (Buerhaus et al., 2017). However, the nation is facing a significant healthcare worker shortage across all major healthcare occupations, including an estimated 139,000 physician shortage by the year 2033 and 200,000 new nursing job openings annually (Association of American Medical Colleges [AAMC], 2020a; American Association of Colleges of Nursing [AACN], 2019a; Buerhaus et al., 2017; Bureau of Labor Statistics, 2020b).

Both healthcare and biomedical sciences are of vital importance at a national level and at a state level. According to the Michigan Bureau of Labor Market Information and Strategic Initiatives (n.d.), long-term employment projections for 2028 show similarly increased demand compared to national predictions for biomedical and healthcare-related fields in Michigan. For example, demand for medical scientists will increase by 3.7%, biochemists and biophysicists by 4.1%, health specialties educators by 17.6%, and healthcare practitioners and

allied health technical occupations by 4.8% (Michigan Bureau of Labor Market Information and Strategic Initiatives, n.d.).

In addition to addressing workforce shortages, increasing diversity in biomedical sciences and the health professions is a state and national priority (National Academies of Sciences, Engineering, and Medicine, 2016; National Academies of Sciences, Engineering, and Medicine, 2018). Having diversity in health fields improves innovation and research and, with regards to medicine, leads to improved patient health outcomes (AlShebli, 2018; Epstein, 2014; Gomez & Bernet, 2019; Laditka, 2004; Swartz, 2019). Furthermore, members of marginalized populations bring knowledge of the health and societal issues that non-majority individuals face. Surveys of medical residents across multiple institutions were contacted to measure their comfort in caring for underserved populations (Lopez et al., 2008; Marshall et al., 2017; Wieland et al., 2010). Specifically, both Lopez et al. (2008) and Wieland et al. (2010) found that respondents who identified as African-Americans scored highest in their knowledge of underserved populations regarding healthcare access, socioeconomic position, and topics pertaining to racial and ethnic health disparities. In addition, women scored higher than men regarding these measures (Wieland et al., 2010).

While gains have been made regarding increasing racial and ethnic diversity in STEM and medicine in the last few decades, gaps exist in degree attainment between underrepresented minorities (URMs) and White and Asian counterparts (National Science Foundation, 2019a). According to the United States Census Bureau (2019a), African Americans / Black Americans comprise 13.4%, Hispanics make up 18.5%, and Alaskan Natives / Native Americans represent 1.3% of the US population. Yet all are underrepresented in science and medicine (Table 1). Indeed, a recent National Science Foundation (2018) report on graduate education in science and engineering shows URMs represented 9% of all doctoral degrees awarded in 2015, the last year reported on the survey, up from 6% in 2000. The disparity is also present when we consider socioeconomic status and geographical distribution as well. The academic achievement gap between students

	US Population <sup>a</sup>	Civilian employed workforce <sup>b</sup>	US Physicians <sup>c</sup>	US Nurses <sup>d</sup>	Bachelor's degree in science or engineering <sup>b</sup>	Biomedical and Biological Doctorate Recipients in 2019 <sup>e</sup>
African American/Black	13.4%	11%	5%	6.2%	6.3%	4.3%
Hispanic	18.5%	15.8%	5.3%	5.3%	7%	9.4%
Native American	1.3%	NR	NR	0.4%	~1% <sup>^</sup>	0.2%

Note. <sup>a</sup>United States Census Bureau, 2019a. <sup>b</sup>Martinez & Gayfield, 2019. <sup>c</sup>AAMC, 2019. <sup>d</sup>AACN, 2019b. <sup>e</sup>National Science Foundation, 2019b.

**Table 1. Underrepresented Minorities in STEM and Medicine in the US**

with lower socioeconomic status and those with higher socioeconomic status has been well described (*American Psychological Association, n.d.; Palardy, 2007; Perry, 2010*). Economically disadvantaged students are less prepared for STEM fields and are less likely to enter into these fields (*Jury, 2017*). Students from a lower socioeconomic bracket are less likely to participate in optional summer STEM experiences before college, and positive experiences in high school can influence STEM persistence (*Liu, 2020; Maltese, 2011*). Moreover, they are less likely to participate in STEM courses after high school (*Cooper, 2020; Niu, 2017*). Therefore, it is vital that diverse populations are recruited to participate in biomedical programs.

Patterson and Carline (2006) have reviewed best practices for partnerships between health professional schools and K-12 partners who promote minority access to health careers. These practices include multidimensionality, strengthening skills in an academic environment, and developing self-esteem and cultural awareness. In addition, all successful programs appear to have in common strong administration, organizational support, knowledgeable faculty, and an enjoyable and engaging learning environment (*Afghani et al., 2013; Blank, 2015; Derck et al., 2016; Smith et al., 2009; Winkleby et al., 2009*). The OUWB Future Physicians Summer Enrichment Program (FPSEP) is a readiness initiative supporting these practices to increase diversity, equity, and inclusion in healthcare. In addition, the program attempts to guide students on how to apply to college and post-baccalaureate programs, navigate college, and create networks that will help them in their future endeavors (Appendix A).

## Program Description

### Future Physicians Summer Enrichment Program (FPSEP)

OUWB welcomed its charter class of medical students

in August 2011 with a mission of having a “collaborative, diverse, inclusive and technologically advanced learning community” (*Oakland University William Beaumont School of Medicine [OUWB], n.d.*). OUWB’s strategic goals focus on sustaining excellence in medical education and increasing inclusion and “serving the community through the faithful execution of the mission,” and meeting its needs (*OUWB, n.d.*). To this end, the medical school’s Office of Diversity & Inclusion sponsored its first cohort of high school students in FPSEP in 2012 and has continued to offer it annually. This two-week summer onsite program is designed to enhance opportunities for high school-age students to learn about topics in medicine in a curriculum designed to highlight the connections of scientific, humanistic, and clinical perspectives of medical practice. Several of the medical school’s faculty and medical students volunteer time to design and implement the curriculum. FPSEP has elements in common with programs previously described that aim to stimulate interests in healthcare careers (*Briskey et al., 2017; Chang et al., 2016; Winkleby et al., 2009*).

### A Brief Program History of FPSEP

FPSEP started in 2012 as a joint program with the OUWB Office of Diversity & Inclusion, the Chaldean Federation of America, and the Chaldean Chamber of Commerce. The program has grown from an initial cohort of ten students to forty students. The forty 10th–12th grade students represent diverse social-economic backgrounds from several southeast Michigan counties, including Wayne, Oakland, Genesee, and Macomb, in partnership with the Oakland University Office of Public School Academies (Table 2 and Figure 1). Students with a high potential for future success and an interest in medicine and health sciences are encouraged to apply (Appendix B).

When the initiative began in 2012, it initially launched

with a human anatomy and physiology-based focus. At the time, what made the program unique was the utilization of clinical and Foundational Medical Studies (FMS) faculty and hospital professionals with expertise in clinical care. As the program grew, it expanded to incorporate cell and molecular biology, medical ethics, behavioral health, and social determinants of health; invite medical students to serve as teaching assistants; and expose participants to allied health careers. In addition, a team research project opportunity was integrated into the curriculum to challenge the participants to learn more about medical topics and their impact. Students that complete FPSEP are also encouraged to participate in the Summer Research Opportunity Program (SROP), a six-week program designed to introduce senior high school or recently graduated students to the mechanics of medical research.

## Participant Recruitment and Selection

### Recruitment

Recruitment efforts rely heavily on sharing information about the program through several organizations and professional and personal networks. The program administration staff has cultivated relationships with school districts and charter schools in southeast Michigan. A collaboration with Oakland University (OU) Undergraduate Admissions allows students to be introduced to campus life and receive guidance on college readiness. In addition, social media announcements, mass email mailings, high school visits, website announcements, teacher and principal nominations of students, word of mouth, and most recently, communications with faith leaders have been used to share information. The outreach and marketing for the program start in December prior to the end of the semester and are sent monthly through the April application deadline.

## Application and Selection Process

All interested students must complete an application and submit two letters of recommendation, two essays, and official transcripts by the April deadline. The two essay questions were:

1. Why are you interested in this program and healthcare, and what unique characteristics do you bring to the program?
2. What events have helped shape your desire to learn more about medicine? Please describe.

The selection process is completed by a committee, including the FPSEP faculty curriculum coordinators, the Director of Diversity & Inclusion, the Diversity & Inclusion Program Coordinator, and colleagues in Oakland University Office of Public School Academies (OU/PSA). See the rubric and standards for acceptance for more information (Appendix B).

## Program Curriculum

Multidimensionality drives the curriculum of the FPSEP program, fostered by a faculty culture of innovative teaching in the undergraduate medical education program. In addition to hands-on learning in labs and clinics, students benefit from campus tours, an orientation to “college life,” and question and answer sessions led by faculty, staff, and medical students on career paths.

The enrichment program curriculum focuses on the basic biological sciences and the connection to medicine and medical discoveries. It is designed to encourage student collaboration in small groups of five to six students, with a total of 18 group sessions taught by FMS faculty and hospital-affiliated clinicians at Beaumont Health over two weeks during June (Sample Program Schedule in Appendix A). Sessions were held on the Oakland University

campus and at its affiliated Beaumont Health System hospital.

Interactive sessions accompany daily discipline-based lectures. A description of the main components follows:

- interactive sessions on medicine and medical school-related topics include: an introduction to medicine lecture; a tour of the medical school campus; hands-on activities in the anatomy lab and microbiology and cell biology lab; health and wellness overviews; nutrition, disease prevention, mindfulness, medical ethics, basic science, anatomy, and physiology lectures; question and answer periods with the medical faculty; and lunches and interaction times with medical students;
- career-focused presentations in the healthcare and biomedical sciences where faculty present their paths to biomedical and clinical science career success, and undergraduate medical students offer their unique stories illustrating ways to acceptance into medical school;
- tour of the Mocer Learning Center includes: an introduction to hospital care delivery systems, exploration of the hospital complex, demonstrations (ex: CPR, Heimlich Maneuver, etc.), simulation activities (ex: virtual reality, e-Learning, etc.), question and answer periods with medical practitioners, and lunch in the residents’ lounge with medical interns;
- guidance to students on small-team research projects (PowerPoint, infographic, or poster) on a topic of interest related to the concepts of the curriculum; and
- a final colloquium convened at the end of the program for teams to present their scholarship to the

community, including parents, medical students, teaching faculty, the Dean of OUWB, and the OU president. The Dean delivers the keynote address and awards certificates of completion to students, following each teams’ collaborative oral presentation of their completed projects.

## Program Evaluation

An initial evaluation of FPSEP was conducted to assess if the goals of the program were being met in supporting the mission of the medical school. Specifically, trends in program participation and the results of a follow-up evaluation survey sent to all past participants in 2019 were used to evaluate the program.

### Trends in Program Participation

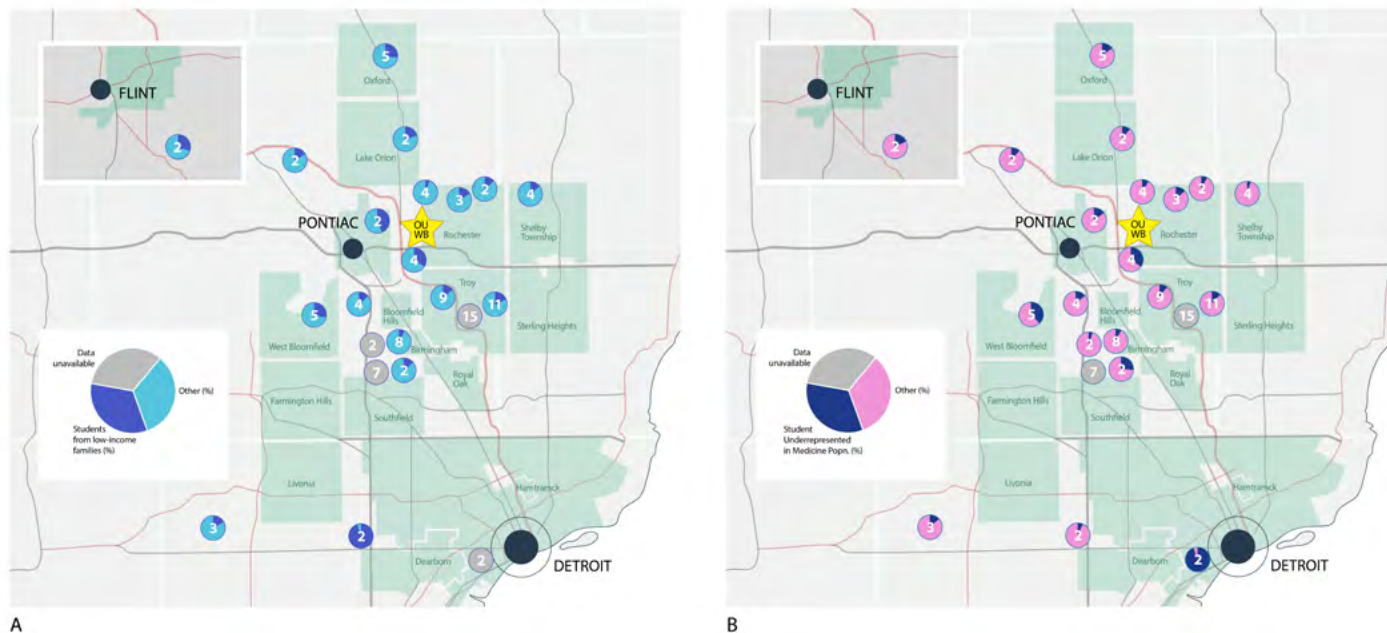
The program has been offered annually since 2012 with eight cohorts of student participants from local area high schools. A total of 214 students out of 344 applicants have been accepted into the program. The average number of participants per year was 27, with all student participants completing the program. The demographic make-up of the participants reflects a widely diverse mix of minority, cultural and ethnic-based backgrounds, including those of African American, Hispanic, Indian, Chaldean, and Middle East descent. Table 2 shows a breakdown of student participants by reported gender and race. As no students identified as Native American / Alaska Native or Native Hawaiian / Pacific Islander, they are not reported in the table.

The FPSEP program serves the community surrounding Oakland University’s Rochester campus. Figure 1 illustrates this region with notations indicating the num-

	2012 <i>n</i> (%) N=9	2013 <i>n</i> (%) N=17	2014 <i>n</i> (%) N=29	2015 <i>n</i> (%) N=30	2016 <i>n</i> (%) N=30	2017 <i>n</i> (%) N=29	2018 <i>n</i> (%) N=30	2019 <i>n</i> (%) N=40	Total <i>n</i> (%) N=214
<b>Gender</b>									
Female	4 (44.4)	16 (94.1)	17 (58.6)	18 (60.0)	21 (70.0)	24 (82.8)	23 (76.7)	34 (85.0)	157 (73.4)
Male	5 (55.6)	1 (5.9)	12 (41.4)	12 (40.0)	9 (30.0)	5 (17.3)	7 (23.3)	6 (15.0)	57 (26.6)
<b>Race</b>									
African/ Black American	0 (0.0)	6 (35.3)	5 (17.2)	1 (3.3)	4 (13.3)	2 (6.9)	5 (16.7)	4 (10.0)	28 (13.1)
Hispanic/Latino	0 (0.0)	0 (0.0)	1 (3.4)	2 (6.7)	1 (3.3)	4 (13.8)	1 (3.3)	1 (2.5)	10 (4.7)
Asian	0 (0.0)	0 (0.0)	6 (20.7)	16 (53.3)	15 (50.0)	7 (24.1)	11 (36.7)	18 (45.0)	73 (34.1)
Middle Eastern/ North African/Arab	8 (88.8)	11(64.7)	12 (41.4)	0 (0.0)	0 (0.0)	4 (13.8)	3 (10.0)	1 (2.5)	39 (18.2)
White	1 (11.1)	0 (0.0)	4 (13.8)	11 (36.7)	10 (33.3)	12 (41.4)	9 (30.0)	15 (37.5)	62 (29.0)
Biracial	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 <sup>a</sup> (3.3)	1 <sup>b</sup> (2.5)	2 (0.9)

Note. <sup>a</sup>In 2018, one student identified as Arab and Spanish. <sup>b</sup>In 2019, one student identified as African American and White.

Table 2. Demographics of FPSEP Participants, 2012 - 2019



Note. Map A (left) and Map B (right) identify the major cities and towns in the Southeast Michigan region, with the medical school identified by a yellow star. Each map includes circles representing the area high schools attended by the program participants and the number of students from those high schools from the 2016–2019 program years. The within-circle shading indicates additional information. Map A indicates the proportion of student participants in each school from low-income families with dark blue shading. Map B compares White students (pink shading) to students defined as underrepresented in medicine (dark blue shading) in each school.

Figure 1. High School Demographics of FPSEP

ber of participants during the four most recent program implementations from 2016–2019, including the program participants' high school locations. As the program has grown, the goal of supporting qualified students with lower socioeconomic status and minorities underrepresented in medicine has come into sharper focus. The American Association of Medical Colleges (AAMC) (2004) defines underrepresented in medicine as “those racial and ethnic populations that are underrepresented in the medical profession relative to their numbers in the general population.” The majority of participants come from Oakland County. The program has a higher percentage of Asian American individuals when compared to the general population of the United States and Oakland County, Michigan, where the school is located (Tables 1 and 2). Specifically, the demographic make-up of Oakland County is 72.3% White (compared to 76.4% nationally), 13.6% African-American (13.4% nationally), 7.2% Asian (5.9% nationally), and 4.0% Hispanics-any race (18.5% nationally) (*Southeast Michigan Council of Governments, 2019; United States Census Bureau, 2019a*). The percentage of African-American participants in the program has remained similar to the general population for most years; however, the largest percentage of racial and ethnic minorities participating are Asian and Middle Eastern. Overall, the share of Hispanic / Latino students is on par with the county. Interestingly, the program is skewed toward higher participation of females compared to males. This may be explained by the increased interest of women in the biological sciences and clinical fields. Women are 58%

or more of graduate students in biological, clinical, and health science doctoral programs, excluding medical doctors (AAMC, 2020b).

Using data publicly available through GreatSchools (n.d.) and the CARES Engagement Network (n.d.), the socioeconomic and racial-ethnicity status of students was mapped onto the school locations of program participants (Figure 1). The majority of the high schools reside in mid-to higher-income areas and have less socioeconomic diversity. Moreover, there is an inverse relationship between socioeconomic status and underrepresented minorities in the school populations. Oakland County, Michigan, is the second wealthiest county in Michigan, with a median household income of \$79,698 in 2019 dollars (*Southeast Michigan Council of Governments, 2019*). This is compared to the national median household income of \$63,179 (*United States Census Bureau, 2019b*).

### Follow-Up Longitudinal Evaluation Survey

The OUWB Office of Diversity & Inclusion created a program-specific follow-up survey to reach past participants and gather evaluation data on all diversity summer programs, including FPSEP (Appendix C). The survey contained 18 questions, including those related to:

- survey participant demographics (gender, race, age, highest completed level of school, GPA);
- which university or college they attended or planned to attend;
- intended career and field of study, including the influence of the summer program on their desire

to pursue a healthcare field and become a physician;

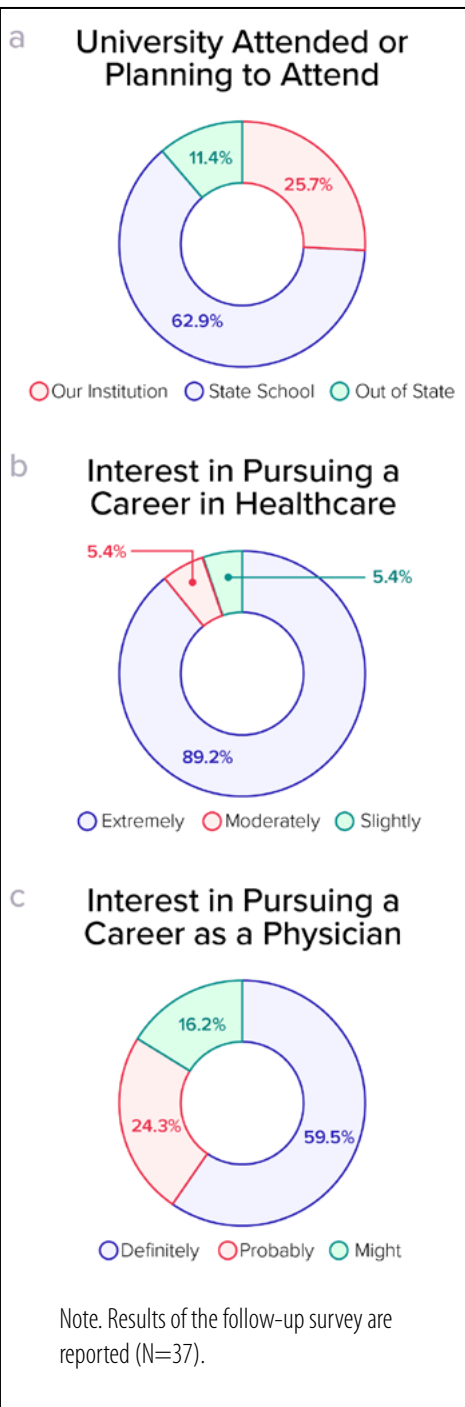
- satisfaction with the summer program;
- what inspired them to participate in the summer program; and
- if they would recommend the programs to a friend.

The survey was distributed in 2019 via email to all past program participants. A total of 37 individuals responded. Table 3 reports the demographics of the survey respondents (Appendix D). Below we outline our interpretations of the survey with regards to meeting our goals.

### Meeting the Community's Needs Regarding Learning about Career/Medical Paths

The opportunity to gain experience in health and biomedical sciences inspired student participation in the program. Several interests emerged, with most students stating that they wanted to learn about different fields and career paths in health and medicine. In addition, the program offered the opportunity to network with medical students and health professionals in the area, meet like-minded peers, gain knowledge, and get hands-on experiences before college. Individual students specifically commented:

My interest and curiosity to learn more about the medical field inspired me to participate in the OUWB Diversity and Inclusion Summer Pipeline Program. I really wanted to learn more about the different aspects of the medical field and various opportunities



**Figure 2. Participants Future/Current Plans**

and pathways I could consider and would be interested in. I was very excited to attend FPSEP because of its unique structure that made me feel like I was already in medical school. I liked that I was able to experience actual medical school courses taught by actual medical school professors. Last summer, I was looking for medicine related camps, and I came across FPSEP online. I am very glad that I attended the camp; it was a perfect fit for my interests.

At the time my inspiration was to gain further knowledge on the field of medicine because I did not know much at all.

### Increasing the Number of Students Entering the Medical and Biomedical Sciences Pipeline

In the follow-up survey, participants were asked a series of questions about their plans to attend university, career choices, and their satisfaction with the program. The results are summarized below and represented in Figure 2.

#### University Attended or Planning to Attend.

When asked which university they attended or hoped to attend following high school, 94.6% (n=35) of students elected to respond to this question and provided a free text response (Figure 2a). Of those, 25.7% (n=9) stated they attended or planned to attend Oakland University, with 88.5% (n=31) providing the name of a university in the state of Michigan. The remaining four students mentioned an out-of-state 4-year-institution.

#### Intended Career Path in Healthcare Fields.

Several questions on the survey asked about the participant's intended field of study and career path. When asked how likely they were to pursue a career in a health sciences field after attending the summer program, 89.2% (n=33) stated they were "extremely likely," with 10.8% (n=4) expressing moderately likely or slightly likely (Figure 2b). In addition, participants were explicitly asked about becoming a physician, and 59.5% (n=22) stated they "definitely will," 24.3% (n=9) "probably will," and 16.2% (n=6) "might or might not" (Figure 2c). The specialties students reported interest in included emergency medicine, internal medicine, neurology, OB/GYN, pediatrics, psychiatry, and surgery. Other students cited a STEM or allied health science field as a potential career choice, including engineering, biological research, and physical therapy.

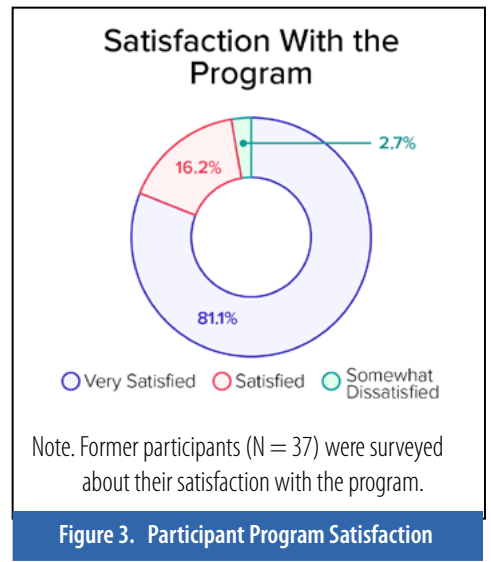
Narrative feedback from the students indicates that this experience helped reinforce their desire to continue in a health-related field. Three students specifically commented:

My interest in medicine initially inspired me to participate in the OUWB Diversity & Inclusion FPSEP program. Although I thought the program would simply be educational, after reflecting on my time during the program, I've also realized that I want to truly pursue medicine for the rest of my life.

FPSEP was truly a great experience that helped me learn more about the career paths I am interested in pursuing and how I can further my knowledge of the medical field.

The Medical Student Panel Discussion helped me understand the life of medical school students and provided me motivational advice on pursuing your dreams to help others and enjoy interests in medicine.

**Satisfaction with Summer Program.** Students who participated in the program had a high degree of satisfaction. Nearly all, 97.3% (n=36), of the students were either "very satisfied" or "satisfied" with the program,



with 81.1% (n=30) reporting "very satisfied" (Figure 3). In addition, 86.5% of students reported that they would recommend the program to a friend. Moreover, 43.2% went on to participate in local, national, and international STEM programs. A student wrote:

I greatly enjoy the spirit of Oakland University and desired to learn about the medical programs Oakland University offered. This program allowed me to explore and pursue my future academic goals and help me prepare for upcoming challenges of college life in terms of self-discipline, maturity, responsibility, motivation, communication, and confidence skills. It prepared me to proactively handle challenges and manage college and external stress. Moreover, this program provided an opportunity to meet other students who share similar interests as me; I was able to share my experiences with them, gain perspectives about their experiences, and develop professional connections while working on team-based projects.

### Lessons Learned

The follow-up longitudinal evaluation survey results indicate that the FPSEP program has a positive influence on students' future career decisions, including which degrees they choose to pursue and whether they seek a career in a health or biomedical sciences field. In addition, preliminary analysis suggests that the program's mission is being met; however, there is the opportunity for continuous improvement. Below, the strengths, areas for improvement, and future directions are described.

#### Strengths

##### Meeting the Institutional Mission

This program attempts to meet the mission of Oakland University to "cultivate[s] the full potential of a diverse and inclusive community" and meet its strategic goal of diversity and inclusion to "Become a campus of choice for students, administrators, faculty and staff from underrep-

resented minorities and underrepresented groups" (Oakland University, n.d.). These institutional goals are linked to the greater education priorities for the State of Michigan related to access to technology, education, and resources.

In 2006, the State Board of Education released the State of Michigan Educational Technology Plan in which one of the eight objectives stated: "Every Michigan educator and learner will have equitable and sustained access, through statewide coordination and support, to resources necessary to transform teaching and learning through educational technology" (Michigan State Board of Education, 2006, p. iii). The plan focused on a projected statewide objective for access. This plan was updated and presented as an educational technology roadmap to the State Board of Education by Brian Whiston, the State Superintendent of the Michigan Department of Education, in 2017 and reiterated:

Michigan students cannot wait for incremental changes in teaching practices to impact their learning. Each year, approximately 100,000 students graduate from public high schools across the state (source: www.mischooldata.org). Some possess skills to be successful in a global economy, while others do not. The zip code of each student must not be the determining factor in the learning experiences, curricula, technology, and teacher expertise available. (Michigan Department of Education, 2017, p. 10).

Oakland University is located in one of the wealthiest counties in the nation, and the areas surrounding Oakland University are segregated by race/ethnicity and social class (Figure 1) (CARES Engagement Network, n.d.; Southeast Michigan Council of Governments, 2019). Moreover, the metropolitan area of Detroit is one of the most segregated urban areas in the United States, and individuals in these communities have reduced opportunities to interact. Individuals living in the wealthy-majority White suburbs have increased access to educational opportunities not found in less-affluent areas (Darden et al., 2010; Farley, 2018; Massey & Tannen, 2015). This program is uniquely positioned to not only increase diversity in the healthcare and biomedical science pipeline, but to allow students who would not normally have the opportunity to interact to come together, learn, and exchange ideas.

### **Sponsorship and Collaboration**

FPSEP's continued growth and success are due to support within the medical school. First, the Office of Diversity & Inclusion is responsible for managing the summer pipeline programs and is a separate administrative entity from the academic departments of the medical school. The program receives dedicated financial support from the medical school administration. The Office of Diversity & Inclusion manages program logistics, including marketing, recruitment, participant selection, transportation, room reservations, catering, and participant

communication. Second, the Office of Diversity & Inclusion has established effective professional partnerships with several stakeholder groups in planning and offering several programs that include faculty, medical students, physicians, and medical librarians. Faculty lead the design and implementation of the daily sessions in the FPSEP curriculum in consultation with the Office of Diversity & Inclusion. In addition, medical students have been an essential resource to the success of FPSEP. They share their journeys to medical school with the student participants, often changing student perspectives on medicine.

### **Program Curriculum**

Diverse teaching methods, such as problem-based learning and completion of research projects in small groups, add to the experience by introducing new learning processes for students to engage. Student feedback has been captured on this multidimensional program structure through the follow-up longitudinal evaluation survey. One student stated, "...the bioethics session taught me how patients value certain treatments and the moral rights associated between the patient and doctor." In addition:

I was very excited to attend FPSEP because of its unique structure that made me feel like I was already in medical school. I liked that I was able to experience actual medical school courses taught by actual medical school professors.

I really enjoyed the immunology [session] and seeing how doctors have to piece together information like [a] puzzle in order to determine a disease. The session on college was also very useful as seeing what to do later this summer once I start applying.

Also, tours at the hospital and the medical school clinical skills training center provided them with knowledge of how the medical students practice their patient skills in a realistic, welcoming environment. Moreover, the team project provided students with an opportunity to improve their communication and collaboration skills. Each team had a chance to present their project on the last day of the program. An additional benefit of working in groups is that it allowed an opportunity to network with like-minded students. One participant commented:

Moreover, this program provided an opportunity to meet other students who share similar interests as me; I was able to share my experiences with them, gain perspectives about their experiences, and develop professional connections while working on team-based projects.

### **Student Satisfaction & Influence on Career Interests**

Another strength of the program is that it is well received by student participants. Student participants who completed the survey reported a high degree of satisfac-

tion, and a large percentage of participants indicated they would recommend this program to others. The follow-up longitudinal evaluation survey may have encountered selection bias in that the more satisfied a student was with the program, the more likely they were to respond to the survey. In addition, the population demographics of the survey differed from that of the program, with 40% of respondents being White (Appendix D). This led to a review of the narrative comments received on the end-of-program survey given to students on the last day of the program in 2018 and 2019. Students stated they enjoyed the program not only for exploring careers in medicine but also for gaining life skills. One student stated:

I greatly enjoy the spirit of Oakland University and desired to learn about the medical programs Oakland University offered. This program allowed me to explore and pursue my future academic goals and help me prepare for upcoming challenges of college life in terms of self-discipline, maturity, responsibility, motivation, communication, and confidence skills. It prepared me to proactively handle challenges and manage college and external stress.

In addition, students specifically reported liking the diversity. A student stated:

Most of the programs closer to my home were very expensive and short. It was great having a mix of people from different races, gender, and schools. It allowed all of us to engage in a very diverse experience.

Many students spoke about the friendships they were able to forge, learning about the medical field, and recommending the program to others. The following feedback can further illustrate student feelings regarding the program:

This program has opened up so much for me, mainly made me more interested in medicine, helped me understand the complexity of it more, gave me experiences I wouldn't have received elsewhere, and created lifelong friendships with some of the nicest people I have met. I am very appreciative of all the time and effort [the director] put into this program, and I will most certainly be suggesting the program to fellow classmates and friends.

Overall, the student participant feedback expressed appreciation for the program's many aspects, including the wide variety of learning experiences, meeting medical students and learning from experts from different medical disciplines, and the opportunity to interact and develop relationships in a professional team environment. The literature demonstrates that creating medical pipeline programs with academic rigor and additional individual extended support for high school students reinforces their interest in medicine and research post-high school, prompting their continued interest in medicine as a career (Bedaike et al., 1996; Winkleby, 2007). In addition, bio-

medical and medical pipeline programs focused on improving diversity in health careers enhance the recruitment of underrepresented minorities into the pipeline (Duffus et al., 2014). This was observed in the current program where the majority of students exiting the program indicated that they were majoring or planning to major in biomedical sciences and enter into a career in medicine or biomedical sciences, including those that are URM or a member of an ethnic minority (Figure 2a-c and Table 3 in Appendix D).

### Areas for Improvement

In reflecting on the strengths of the FPSEP program, there are also opportunities for growth and continuous improvement for future years.

### Socioeconomic and Geographic Diversity

While the program has consistently included a racially and ethnically diverse participant population, it lacks socioeconomic and geographic diversity. Program participants have primarily been from the affluent communities immediately surrounding Oakland University. One contributing factor to this remaining challenge is a lack of transportation. The program runs from 9 am to 5 pm for two weeks in the summer. Many students in less affluent areas lack a car to drive to campus, or their parents cannot take time off of work to shuttle them to and from the program every day. In contrast, students from wealthier areas often can find a friend or family member or have a car that they can use. There have even been instances when parents have arranged for their children to stay in the area. For example, one student applied and was accepted into the program from Northern Michigan whose parents paid for them to stay in a local hotel during the duration of the program. However, qualified students from less affluent areas have withdrawn from the program due to a lack of transportation. The planning group recently received a small grant to pay for transportation for students to attend the program. In addition, enhancing relationships with community partners can further the program's visibility and expand interest among applicants in diverse communities. One way to do this is to prioritize recruitment efforts and identify champions in school districts with higher numbers of economically disadvantaged students (Figure 1). It is anticipated that these changes will help increase geographic and socioeconomic diversity in future program years.

### Sustainability

As with many community outreach programs, ensuring sustainability is a challenge. Maintaining and continuing to improve the FPSEP program has addressed two challenges: sponsorship and resources. As mentioned above, much of the program's stability is due to being managed and overseen by the Office of Diversity & Inclusion. The Office of Diversity & Inclusion's goal for increasing interest in health and biomedical sciences by students underrepresented in medicine directly aligns with the

medical school's mission of inclusiveness and community engagement. The Office of Diversity & Inclusion budget is dependent on the medical school. While the budget has been maintained and outreach programming is supported, there is always the possibility of school priorities shifting. In addition to sponsorship, the program depends on the volunteer faculty who design and deliver the schedule and curricula. The Office of Diversity & Inclusion organizes regular community educational programs with faculty throughout the year and has strong support from teaching faculty in return. A robust and authentic faculty commitment to the school mission also contributes to a succession of committed teaching faculty, an invaluable resource to maintain and improve the course content. However, challenges to maintaining the commitment of teaching faculty can occur during periods in which significant curriculum changes, accreditation preparation, and major faculty research efforts become priorities. In addition, unforeseen challenges to sustainability can occur. In particular, the recent pandemic prompted discussions of how to continue the momentum and engage potential participants without an in-person program and resulted in the development of a shortened biomedical program delivered entirely online. Faculty and administration saw particular merit in this resource-neutral approach to offering educational opportunities to local students when on-site access for the program was interrupted.

### Limitations

A limitation of this program review is the low response rate (17.3%) to the follow-up longitudinal survey. As such, there is a possibility of sampling bias, as individuals who responded may have a higher level of satisfaction with the program. However, an analysis of students' comments from the program evaluations received in 2018 and 2019 also indicates a high level of satisfaction similar to the follow-up longitudinal survey results (see above). Another limitation is that the longitudinal survey was distributed via email, leading us to miss the opinions of students with limited internet access. Additional methods of contacting participants once they complete the program will be investigated. One potential strategy is mailing paper surveys or surveying students over the phone or via text in addition to sending an email survey. Also, parent / guardian emails are now being collected in case student contact information becomes out of date.

An additional limitation of the program is the ability to directly correlate student participation with their decision to pursue a medical or biomedical career. Students who apply to the program may already have an inherent interest in medicine, STEM, or research fields. Therefore, the program may further foster their interest but may not be why they enter the pipeline. In the future, the program evaluation survey will be altered to explicitly ask how participation in the program affects their likelihood of continuing on the medical and biomedical sciences path.

## Conclusion

In conclusion, evaluation of the FPSEP program indicates that it is successfully meeting the institution's goals by increasing diversity and inclusion in medicine, serving the community's needs, and increasing the number of students interested in the medical and biomedical sciences fields. However, while the program has seen a diverse cohort of students, future program improvements need to focus on including students from a lower socioeconomic background and increasing geographic diversity. In supporting these improvements, the next steps include applying for external, longitudinal funding opportunities to address transportation issues and increase access to the program. In addition, discussions regarding plans for the program's sustainability will further help assess the overall impact of this initiative on the local community and contribute to the impending shortage of healthcare professionals.

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**Kyeorda Kemp, Ph.D.** is an Assistant Professor of Foundational Medical Studies at Oakland University William Beaumont School of Medicine. She teaches topics in immunology to preclinical medical students. Dr. Kemp's current scholarly interest focuses on Increasing Diversity, Inclusion, and Equity in medicine through community outreach and engagement and promoting collaborative and self-regulated learners in science and medicine. Dr. Kemp received her Ph.D. from Northwestern University in 2010.



**Stephanie Swanberg, MSI, AHIP** is the User Services Librarian at the Michigan School of Psychology where she primarily teaches information literacy skills in searching, evaluation, and management to students and faculty. She previously served as an Associate Professor and Information Literacy and eLearning Librarian at Oakland University William Beaumont School of Medicine where her passion for community engagement led the library to be actively engaged and integrated into these activities. She earned her Master of Science in Information (MSI) degree from The University of Michigan in 2011 and is a senior member in the Association of Health Information Professionals (AHIP).



**Suzan Kamel-ElSayed, DVM, Ph.D.** is an Associate Professor in the Department of Foundational Medical Studies at Oakland University William Beaumont School of Medicine. She teaches Human Physiology for M1/M2 students in organ system integrated-based curriculum and Pathophysiology in case-based learning clerkship sessions. She is also a co-director of the Cardiovascular Organ System. Her current research is focused on medical education and DEI.



**James Grogan, Ph.D.** is a Professor in the Department of Foundational Medical Studies at Oakland University William Beaumont School of Medicine. He teaches topics in biochemistry to preclinical medical students. He has recently served as a course director of the Promotion and Maintenance of Health courses and initiated a service-learning program to engage students with community partners. Professor Grogan served as a co-director for pipeline program curricula supported by the Office of Diversity and Inclusion at OUWB. He earned his Ph.D. in biochemistry and molecular biology from the University of California at Santa Barbara in 1990.



**Tiffany Williams, Ph.D.** is the Director of Diversity & Inclusion at OUWB. She oversees the outreach programs that include pipeline and outreach initiatives, as well as diversity and inclusion hosted school-wide events for students, staff and faculty. She obtained her Master's in Educational Leadership and Policy Administration from the University at Buffalo, SUNY, and a post-Master's Graduate Certification in Higher Education from Oakland University. Dr. Williams received her Ph.D. in Organizational Leadership from Oakland University with a specific focus in higher education leadership and access in 2020.



**Caryn Reed-Hendon, Ph.D.** is the Director of Diversity, Equity & Inclusion at Lawrence Technological University (LTU). At LTU, she is responsible for the daily operations of the Office for Diversity & Inclusion, in support of the President's office, the Dean of Students office, and University Human Resources. She has over twenty years of higher education experience specifically in the area of Student Services. Dr. Reed-Hendon obtained her Ph.D. in Educational Leadership from Oakland University in 2013.



## Appendix A.

### Sample Program Schedule

Time\Day	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
9:00 AM	Welcome/Agenda / Icebreaker	Housekeeping	Housekeeping	Housekeeping	Housekeeping	Housekeeping	Housekeeping	Housekeeping	Housekeeping	Independent Presentation Preparation
9:15 AM	Campus Tour	Biochemistry	Embryology	Anatomy Lab	Nutrition and Physiology	Genetics	Project Guidance Time with Library	Project Guidance with Library and Instructional Design	My Journey to Medical School Student Panel	
9:30 AM										
9:45 AM	Program Orientation/	Break	Break	Break	Break	Break	Problem-Based Learning - Obesity II	BioEthics		
10:00 AM	Break									
10:15 AM	Final Project Overview	Microbiology	Social Determinants of Health	Hospital Community	Lunch	Lunch	Lunch	Lunch		
10:30 AM										
10:45 AM										
11:00 AM										
11:15 AM	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch		
11:30 AM										
11:45 AM	Histology	Immunology	Neuroscience	Wellness	Problem-Based Learning - Obesity I	Clinical Skills Learning Center at Hospital	Problem-Based Learning - Research Student Presentations	Poster Work Time		
12:00 PM										
12:15 PM	Break	Break	Break	Break	Break	Break	Break	Final Project Work Time and Rehearsals		
12:30 PM										
12:45 PM	Final Project Set up	Immunology	Final Project Work Time	Final Project Work Time	Final Project Work Time	Travel Back to Campus	Pharmacology	Final Presentation Work Time		
1:00 PM										
1:15 PM	Evaluation Time	Evaluation	Evaluation	Evaluation	Evaluation	Evaluation Time	Evaluation	Evaluation		
1:30 PM										
1:45 PM	Final Project Set up	Immunology	Final Project Work Time	Final Project Work Time	Final Project Work Time	Travel Back to Campus	Pharmacology	Final Presentation Work Time		
2:00 PM										
2:15 PM	Break	Break	Break	Break	Break	Break	Break	Final Project Work Time and Rehearsals		
2:30 PM										
2:45 PM	Final Project Set up	Immunology	Final Project Work Time	Final Project Work Time	Final Project Work Time	Travel Back to Campus	Pharmacology	Final Presentation Work Time		
3:00 PM										
3:15 PM	Evaluation Time	Evaluation	Evaluation	Evaluation	Evaluation	Evaluation Time	Evaluation	Evaluation		
3:30 PM										
3:30 PM	Final Project Set up	Immunology	Final Project Work Time	Final Project Work Time	Final Project Work Time	Travel Back to Campus	Pharmacology	Final Presentation Work Time		
3:45 PM										
4:00 PM	Evaluation Time	Evaluation	Evaluation	Evaluation	Evaluation	Evaluation Time	Evaluation	Evaluation		
4:15 PM										
4:30 PM	Final Project Set up	Immunology	Final Project Work Time	Final Project Work Time	Final Project Work Time	Travel Back to Campus	Pharmacology	Final Presentation Work Time		
4:45 PM										
4:45 PM	Evaluation Time	Evaluation	Evaluation	Evaluation	Evaluation	Evaluation Time	Evaluation	Evaluation		
5:00 PM										

## Appendix B.

### Applicant Review Rubric

Applicant Name:|  
 High School:  
 Current GPA:  
 Research Interests (if any):

	<b>Exceptional 5</b>	<b>Good 4</b>	<b>Acceptable 3</b>	<b>Fair 2</b>	<b>Poor 1</b>	<b>Score</b>
<b>Personal Essays</b>						
Communication of meaningful and relevant content						
Ability to express thoughts clearly						
Motivation and perseverance toward goals						
<b>Recommendation Letters</b>						
Confidence and esteem for student						
Description of character and accomplishment						
Inclusion of specific examples						
Three Categories on the Application (one point for each checked box): <input type="checkbox"/> Disadvantaged Background <input type="checkbox"/> Underrepresented in Medicine <input type="checkbox"/> Disability <div style="text-align: right;">_____</div>						

Total Points: \_\_\_\_\_

Maximum number of points possible: 33

Minimum number of points possible: 9

26-34 Points - Admitted into Program

16-25 Points - Debate (Only if group has not been filled)

15 Points and Lower - Denied Admission

## Appendix C.

### Program Evaluation Survey

Please enter your name:

- First Name:
- Last Name:

What is your email address?

What is the best telephone number to reach you?

What is your gender?

- Male
- Female

What is your year of birth?

Are you Spanish, Hispanic, or Latino or none of these (select all that apply):

- Spanish
- Hispanic
- Latino
- None of these

Choose one or more races that you consider yourself to be:

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander
- Other (specify)

What is the highest grade or level of school that you have completed?

- Sophomore (Grade 10)
- Junior (Grade 11)
- Senior (Grade 12)
- High School Graduate
- Some College

- Graduated 2-year College
- Graduated 4-year College
- Post Graduate
- Prefer not to answer

Please tell us your current/desired programs of study:

- Current/Desired Major [free text]
- Current/Desired Minor [free text]

What is your current GPA (4.0 Scale)? [free text]

What year were you a part of the OUWB Diversity & Inclusion Summer Pipeline Programs? If you attended more than one program, please select years.

- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018

Which programs did you attend? If more than one, please select programs.

- Future Physicians Summer Enrichment Program
- Beaumont Future Medical Scholars
- DAPCEP Medical Explorers
- Bioengineering and Biomedical Sciences Summer Program
- Summer Research Opportunity Program

After completing the program(s), and you already graduated from high school, what college or university did you choose to attend? [free text]

After completing the program(s) and are currently in middle school or high school, what college or university do you hope to attend? [free text]

After your participation in the OUWB Diversity & Inclusion Summer Pipeline Programs, did you participate in any other STEM or medically-related educational opportunities?

- Yes
- No

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If yes, please list the names/years of the programs attended. [free text]

Based on your experiences in the OUWB Diversity & Inclusion Summer Pipeline Programs, are you more likely or less likely to pursue a career/education in the health fields?

- Extremely likely
- Moderately likely
- Slightly likely
- Neither likely nor unlikely
- Slightly unlikely
- Moderately unlikely
- Extremely unlikely

Based on your participation in the OUWB Diversity & Inclusion Summer Pipeline Programs, what are your chances of you going into a career specific to becoming a physician?

- Definitely will
- Probably will
- Might or might no
- Probably will not
- Definitely will not

If you know that you are going into a career specific to becoming a physician, please share what specialty you are interested in. [free text]

If you are no longer interested in a career in the health field, what career are you currently considering? [free text]

Overall, how satisfied or dissatisfied were you with your experience in the OUWB Diversity & Inclusion Summer Pipeline Programs?

- Very Dissatisfied
- Dissatisfied
- Somewhat Dissatisfied
- Neutral
- Somewhat Satisfied
- Satisfied
- Very Satisfied

How likely are you to recommend this pipeline program to friends or colleagues? [0 - 10 scale with 0=Not at all likely to 10=Extremely Likely]

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If yes, please list the names/years of the programs attended. [free text]

Based on your experiences in the OUWB Diversity & Inclusion Summer Pipeline Programs, are you more likely or less likely to pursue a career/education in the health fields?

- Extremely likely
- Moderately likely
- Slightly likely
- Neither likely nor unlikely
- Slightly unlikely
- Moderately unlikely
- Extremely unlikely

Based on your participation in the OUWB Diversity & Inclusion Summer Pipeline Programs, what are your chances of you going into a career specific to becoming a physician?

- Definitely will
- Probably will
- Might or might no
- Probably will not
- Definitely will not

If you know that you are going into a career specific to becoming a physician, please share what specialty you are interested in. [free text]

If you are no longer interested in a career in the health field, what career are you currently considering? [free text]

Overall, how satisfied or dissatisfied were you with your experience in the OUWB Diversity & Inclusion Summer Pipeline Programs?

- Very Dissatisfied
- Dissatisfied
- Somewhat Dissatisfied
- Neutral
- Somewhat Satisfied
- Satisfied
- Very Satisfied

How likely are you to recommend this pipeline program to friends or colleagues? [0 - 10 scale with 0=Not at all likely to 10=Extremely Likely]



What inspired you to participate in the OUWB Diversity & Inclusion Summer Pipeline Programs? [free text]

## Appendix D.

Table 3

*Demographics of survey respondents by gender, race, and highest completed education (N=37)*

	<i>n</i>	(%)
<b>Gender</b>		
Female	29	(76.3)
Male	9	(23.7)
<b>Race</b>		
Black or African American	3	(8.1)
Asian	11	(29.7)
Middle Eastern/North African/Arab	5	(13.5)
White	15	(40.5)
Biracial*	3	(8.1)
<b>Highest Grade level completed</b>		
Grade 10	11	(28.2)
Grade 11	6	(15.4)
Grade 12	6	(15.4)
Some college	11	(28.2)
Graduated from a 2-year college	1	(2.6)
Graduated from a 4-year college	2	(5.1)
Post-graduate	2	(5.1)

Participants were asked to choose all races or ethnicities to which they identified. \*One student identified as White and Chaldean, and two students identified as Hispanic/Latino and White.