# Cultivating STEM/Health Identities and Talent in Historically Marginalized Populations Through Equity-Focused Place-Based Learning: The Rush Education and Career Hub (REACH) Model

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**ABSTRACT:** Students of color, first-generation, and residents of communities experiencing disinvestment—who aspire to obtain meaningful postsecondary degrees, career success, financial security, and social mobility—face tremendous challenges in navigating science, technology, engineering, math, and health science (STEM-H) education and career sectors. The Rush Education and Career Hub (REACH) utilizes a place-based workforce intermediary model that joins an academic medical center with academic institutions, community-based organizations, and employers to increase and broaden STEM-H participation. REACH provides innovative, hands-on learning for underrepresented youth cradle-to-career to increase postsecondary achievement and diversity in STEM-H professions through: (1) early and sustained access to high quality STEM-H education experiences, (2) paid work-based learning paired with professional development, (3) the ability to earn recognized industry credentials, (4) mentorship to facilitate participant engagement and promote program completion, and (5) OutREACH community engagement that provides information, resources and wraparound supports for students, their families, and the community. Preliminary findings suggest that this model inspires and prepares young people for success. REACH offers institutions an equity-centered community-engaged framework for cultivating education and workforce partnerships to foster opportunities, support, and the relationships necessary to thrive in STEM-H for those who have historically been denied.

## INTRODUCTION

Employment projections for the fields of science, technology, engineering, math, and health science (STEM-H) are growing, with some expanding more rapidly than others. According to the United States Department of Labor Bureau of Labor Statistics "In 2021, there were nearly 10 million workers in STEM occupations with this total projected to grow by almost 11% by 2031, over two times faster than the total for all occupations" (U.S. Bureau of Labor Statistics, 2022). Overall employment in healthcare occupations is projected to grow 13 percent from 2021 to 2031, with this increase expected to produce about 2 million new jobs over the decade (USBLS, 2022). As the healthcare industry continues to face pandemic-driven workforce challenges, about 1.9 million job openings each year, on average, are projected to come from both growth and replacement needs (USBLS, 2022), with a shortage of up to 124,000 physicians anticipated by 2034 (Association of American Medical Colleges, 2021), and projected 200,000 openings for Registered Nurses (RNs) through 2030 (USBLS, 2022). Critical shortages are also anticipated for various allied health professions, however, as STEM-H fields grow, inequality and underrepresentation of people from historically marginalized communities remains stubbornly persistent. Racial equity in STEM-H educational attainment and labor market outcomes have been topics of increasing national concern (Ghazzawi et al., 2021, 2023; Ro et al., 2021; McGee, 2020; Curvey Johnson et al., 2023). National data indicate that compared with the general population, "Black students earned 7% of STEM bach-

elor's degrees as of 2018, the most recent year available, below their share of all bachelor's degrees (10%) or their share of the adult population (12%). The share of Latinx college graduates with a STEM degree –12%– remains lower than that for all college graduates (15%) in 2018" (Fry et al., 2021). There is considerable consensus among scholars and practitioners about the need for STEM-H career exposure and academic preparation to increase the diversity of the workforce.

In the healthcare sector, racial and ethnic diversity enhances the quality of clinical care and research. From treatment recommendations (Hoffmann et al., 2016), to perceptions about pain (Schulman et al., 1999; Trawalter and Hoffman, 2015), to tests for kidney function (Vyas et al., 2020; Gaffney, 2021), the literature has consistently shown the impact of biased views about race-based differences on patient outcomes. Access to care (Mitchell et al., 2006; Jackson et al., 2014; Wilbur et al., 2020), patient trust (Rotenstein et al., 2021), workplace experiences and employee engagement (Downey et al., 2015) also benefit from a diverse workforce. While diversification of the workforce is viewed as a promising strategy for eliminating health disparities, racial and ethnic diversity in many health professions, albeit increasing, "has not kept pace with demographic changes in the general populations of the United States" (Hinton et al., 2010; Donini-Lenhoff et al., 2010; Wilbur et al., 2020). For instance, Salsberg (2021) analyzed nationally representative data from the American Community Survey and the Integrated Postsecondary Education Data System and concluded that "Black, Hispanic, and Native American people were underrepresented in 10 health care professions, and while the educational pipeline shows some limited improvement, underrepresentation of these groups persists" (Salsberg et al., 2021). Diversity at the highest levels of health care practice remains an elusive goal. Undoubtedly, the underrepresentation of historically marginalized populations reflects the long heritage of structural barriers that drive disparities in access to education, health care, high-quality jobs and housing. Increasing STEM-H programs for underrepresented students is one promising way to move toward health equity and improve rates of entrance into healthcare.

Expansion of a STEM-H capable workforce begins with investment in K-12 academic programs. Despite evidence indicating the many benefits of STEM learning for children, gaps in achievement persist. Challenges in accessing STEM learning opportunities have consistently been more acute for children in areas experiencing economic hardship, and for children from historically marginalized groups (Betancur et al., 2018). This gap continues to widen as children move through elementary, middle, and high school (National Academy of Sciences, Engineering and Medicine, 2011). The importance of encouraging and cultivating interest in STEM is well recognized. Several studies demonstrate

the value of summer programs in promoting diversity in STEM-H education (Kemp et al., 2021; Ashley et al., 2017; Tomasko et al., 2016; Wolfe and Riggs, 2017) but tend to concentrate efforts on one level of education, and not the full continuum. A growing body of literature investigates the numerous challenges that historically underrepresented groups experience at all levels of the STEM pipeline (Brown et al., 2016) however, the cradle-to-career approach remains a relatively underexplored topic. The current landscape of programs designed to address anticipated shortages of healthcare providers is also well documented (Smith et al., 2009; Bouye et al., 2016; Rocha et al., 2022), however, the literature fails to provide consensus for designing best practices in a healthcare-focused integrated STEM-H cradle-to-career place-based model. Place-based refers to general planning approach, which emphasizes the characteristics and meaning of places as a fundamental starting point for planning and development (Johnson et al., 2021). With place-based education, programs, services, and curriculum are inherently tailored to local realities. With these models, the community is viewed as a starting point. The culture, history, and assets serve as the basis for learning. This engagement with the local ecosystem is critical because it becomes the lens through which students make meaning of the world, cultivating agency, global thinking, and a sense of responsibility to their respective communities in co-creating the future. The drivers of STEM-H disparities require programmatic approaches and use of theoretical frameworks that consider the whole learner and produce outcomes that include and extend beyond content knowledge.

Research shows that early and continuous exposure produces promising results in closing disparities in STEM-H (Theobald et al., 2020). However, factors influencing students' decisions to choose a career in STEM-H fields are notably complex. Research identifies intrinsic factors, such as the desire to help others and a personal interest in health care as a key factor in influencing students to pursue these types of careers (Wu et al., 2015). Extrinsic factors including the cost of education, concerns about student debt, work-life balance and professional responsibilities can also be deeply influential in career decision making (Rosenblatt et al., 2005; Toretsky et al., 2018). Research has identified other factors, such as the limited exposure to health careers and the lack of mentors and role models as key barriers to enter and persist in these fields (Straus et al., 2006; Toretsky et al., 2018). Social-cognitive career theory (SCCT) (Lent et al., 2000) has emerged as a framework for understanding and evaluating career-related decisions across several sectors, including STEM-H fields. SCCT focuses on the interplay among a variety of person (e.g., race, ethnicity, gender), environmental (e.g., parental or peer influence), and socio-cognitive variables (e.g., sense self-efficacy) that are hypothesized to influence the processes through which people (a) develop

academic and career interests, (b) approach planning, and (c) achieve varied degrees of success in their pursuits—viewed through the lens of social cognitive theory (Bandura, 1997; Lent et al., 2000). An important feature of SCCT is the concept of self-efficacy—the notion that one's perceived ability to perform well in a specific task is in fact correlated with the person's decision to pursue and complete the task, which promotes continued learning. For example, middle-school students with higher mathematics self-efficacy tend to demonstrate increased knowledge in STEM careers and are more likely to choose careers in STEM fields, while students with lower mathematics self-efficacy are more likely to lose interest in STEM overall (Blotnicky et al., 2018). An emerging area of research focuses on how young people form an occupational identity—defined by the Equitable Futures project as "how young people envision their future selves in the workforce, what they like to do, what they believe they are skilled at, and where they feel they belong" (Equitable Futures, 2020). Occupational identity formation, then, can be understood within the SCCT framework affirming individual occupational choices as emanating from the multiple levels of influences, such as self-efficacy, outcome expectations, and interests; as well as learned experiences, barriers and supports in the environment, such as higher or lower levels of parental or teacher support.

Students of color, and/or those who are first-generation, and/or from low-income communities—who aspire to obtain meaningful postsecondary degrees, career success, financial security, and social mobility—face tremendous challenges. Local systems and institutions are not adequately designed to address or sufficiently eliminate long-standing structural barriers for those navigating our STEM-H education and career sectors today. The Rush Education and Career Hub (REACH) utilizes a unique workforce intermediary model that joins an academic medical center with local elementary and high schools, community-based organizations, higher education institutions, and employers to increase and broaden STEM-H participation. REACH provides innovative, hands-on learning for underrepresented youth cradle-to-career to increase postsecondary achievement and diversity in STEM-H professions through: (1) early and sustained access to high quality STEM-H education experiences, (2) paid work-based learning paired with professional development, (3) the ability to earn recognized industry credentials, (4) mentorship to facilitate participant engagement and promote program completion, and (5) OutREACH community engagement that provides information, resources and wrap-around supports for students, their families, and the community (Figure 1).

**The Rush Education and Career Hub: A Brief History.** First launched in 1990 as the Science and Math Excellence (SAME) Network, REACH is a strategic education and
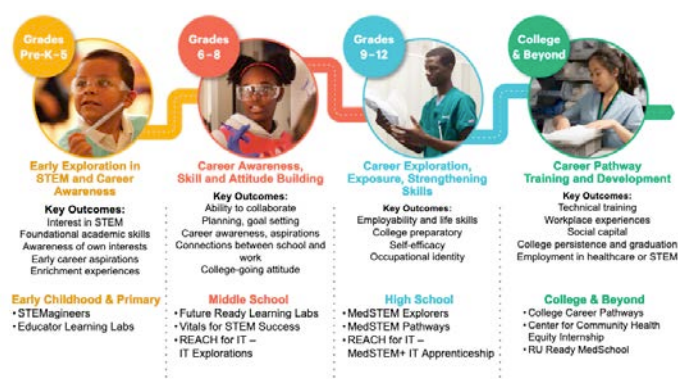


**Figure 1**. Rush Education and Career Hub Cradle-to-Career Conceptual Framework.

workforce initiative of Rush University Medical Center (Rush), one of Chicago's longest standing healthcare institutions (Rush University Medical Center [RUSH], 2022) one of the largest non-governmental employers on the Near West Side of Chicago and 20th largest private sector employer in Chicago (Marotti, 2015). Set in the Illinois Medical District, the nation's largest urban medical district (Illinois Medical District, 2022), Rush University Medical Center is part of a hub of leading-edge patient care, research, and education. In 1990, Reginald "Hats" Adams, who led Rush's Department of Community Affairs, developed the SAME Network in response to the low science, math and reading test scores in public schools surrounding Rush on the West and Southwest sides of the city. Formed as a cooperative effort among Rush, Chicago Public Schools, businesses, corporations and the Chicago Area Project, a social-service organization serving young people, the mission of the SAME Network was to give students in these neighborhoods access to the same academic opportunities—particularly in math and science—as peers in more affluent areas. The SAME Network offered programs for students from preschool through college. The preschool program introduced preschoolers (3- to 5-year-olds) to science and math. The Hands-on Math Laboratories were equipped with games, instruments and other materials for children in kindergarten through 8th grade to develop critical thinking and problem-solving skills. The Scholars' Program gave students the chance to use science equipment. The Church-Based Math and Reading Program was a weeknight resource for children who need tutoring in math and reading. The College Preparatory Enrichment Program provided a select number of students entering the 7th and 8th grades the chance to experience college life while taking classes in science, math and technology. The Internship Program provided paid internships to high school students. The College Program identified opportunities for students to work in an area related to their career choice at Rush, and the annual SAME Network Recognition Banquet honored students for their outstanding achievements in science and math (Mills, 2004).

In 2017, the SAME Network transformed into REACH

as part of Rush's broader strategy for health equity (Ansell et al., 2021). REACH updates these offerings and integrates them into a cradle-to-career workforce intermediary model that serves the educational, training and career development needs of a broad range of participants while proactively addressing workforce needs through consideration of both employer and future job seekers. As defined by the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), "Workforce intermediaries and collaboratives are a community-based model of education, job training and economic development that has become commonplace in local and regional labor markets" (American Federation of Labor and Congress of Industrial Organizations, 2022). Defined by sector-based labor market demand, intermediaries bring together a consortium of education/training partners in the workforce system to address issues like anticipated workforce shortages through the development of career pathway and training programs (Urban Institute, 2022). Despite the promise of these programs, there are relatively few models described in the literature focused on youth development for STEM-H that emphasize a community-engaged equity-centered approach. This manuscript aims to illustrate the potential of the REACH model.

## PROGRAM DESCRIPTION

**Logic Model and Theory of Change**. REACH seeks to increase and broaden STEM participation for underrepresented youth cradle-to-career by: (a) describing a structured set of learning experiences that include providing professional development to teachers, (b) engaging families/stakeholders, (c) creating, modeling, and supporting a comprehensive culturally responsive curriculum, and (d) supporting enrichment and career learning experiences both in and outside of school. The SCCT framework referenced above contributes to our understanding of how a cradle-to-career program can promote interest in STEM-H pathways among learners. The REACH logic model and pathway trajectory (Figure 2) illustrates the continuum of support and intention-

al focus cradle-to-career. The model describes the process and the mechanisms through which the REACH program is thought to work and the participant outcomes it intends to affect. This model demonstrates the causal process through which change is expected to occur as a result of the REACH program's intervention;

> *If a student participates in a REACH program that provides STEM-H exposure, hands on learning, holistic student support and pathways to postsecondary education, those industry aligned learning experiences will provide the opportunities necessary to develop interest in, pursue, and attain jobs in the healthcare field.*

**Purpose**. REACH connects with students, parents, educators, and staff to spark and catalyze STEM learning in and outside the classroom to address challenges and design solutions in the local community and beyond. The REACH Learner profile (Appendix 5) translates the long-term, holistic vision of REACH into a set of learning outcomes expected of each program participant.

**Setting**. REACH serves the nine west side communities of Rush's primary service area. Within the city of Chicago, Rush's defined community includes the areas of the Near West Side, Lower West Side, West Town, East Garfield Park, West Garfield Park, North Lawndale, South Lawndale, Humboldt Park, Archer Heights, Brighton Park, Belmont Cragin, and Austin (Rush University Medical Center (Rush), 2022). This service area widely consists of working-class Black and Latinx communities, most heavily impacted by poverty, systemic racism, lack of educational opportunities and other social determinants of health (Appendix 2).

**Participants and Recruitment**. REACH recruitment efforts rely heavily on sharing information about programs through several organizations and professional networks. REACH has cultivated relationships with the Chicago Public School (CPS) district, City Colleges of Chicago, academic institutions, community-based organizations, employers and industry partners all serving the greater Chicagoland area. There are currently 16 CPS schools identified as partners for REACH. A collaboration with After School Matters (ASM), "a non-profit organization that provides life-changing after-school and summer program opportunities to nearly 19,000 Chicago high school teens each year" (After School Matters, 2022) allows REACH the opportunity to further build STEM-H opportunities for local students by maximizing recruitment through ASM's extensive network of public-private partners. In addition, email newsletters, school site visits, field trips to Rush, community workshops, career fairs, website announcements, social media posts, word of
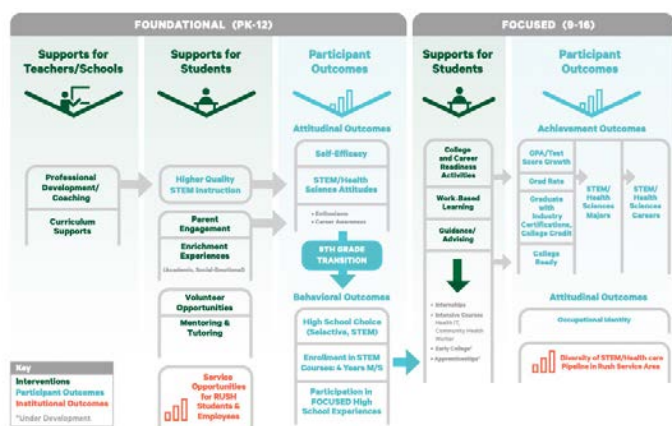
**Figure 2**. REACH Logic Model.

**Table 1.** *Self-reported demographics of REACH participants 2019-2022.*

| | Number | % |
|---|---|---|
| **Gender** | | |
| Male | 230 | 27% |
| Female | 614 | 72% |
| **Race/Ethnicity***  | | |
| African American or Black | 422 | 55% |
| American Indian or Alaska Native | 15 | 2% |
| Asian American or Asian Indian | 162 | 21% |
| Middle Eastern or North African | 2 | 0% |
| Pacific Islander | 2 | 0% |
| White | 90 | 12% |
| Ethnicity = Hispanic, Latino/a/x, or Spanish | 279 | 35% |
| **Area of Residence** | | |
| Primary residence in Rush's service area | 434 | 58% |

Gender, Race/Ethnicity n = 854, Area of Residence n = 750
*Categories are not mutually exclusive in relation to unit of analysis, participants are listed in each racial/ethnic category that they reported.

mouth, and more recently, education and workforce consortiums are used to share information. The outreach and marketing for programs varies across the academic year.

Enrollment in early childhood, elementary and middle school programs occurs at the school-level as an elective embedded in the day or participant-level through a parent or guardian for out-of-school time programs. Programs at the high school and postsecondary level use an admissions process. Applicants complete an online application, which includes short essays with emphasis on STEM-H career interests, leadership qualities, community involvement and extracurricular activities. Applications are reviewed by REACH faculty and program leadership; GPAs, school attendance record, transcripts, and teacher recommendations are most strongly considered. While open to all students across the city, preference is given for students enrolled at a REACH partner school, and/or residence (assessed via zip code) in Rush's primary service area. Parent occupation and education level are also considered. Competitive students are chosen for individual interviews. On average, 90% of the applicants with completed applications are invited to interview. Of those who interview, 40%, excluding returners, are selected for program participation each year. See Table 1 for additional sociodemographic characteristics.

**Early Exploration in STEM and Career Awareness: Early Childhood/Primary**.

*STEMagineers*. STEMagineers serves children, teachers, and families, focusing on preschool through 2nd grade. The goal of the work is to deliver age-appropriate, interactive STEM-H learning experiences. There are five distinct components to the curriculum, (1) professional development workshops offer partner schools progressive, evidence-based, high-quality training and educational materials that reflect the guidance of state and national learning standards, (2)

education outreach sessions invite teachers and students to engage in interactive experiences in their classrooms with the goal of enhancing themes and studies through authentic exposure and equipment, (3) parent involvement events such as open house, family night and parent workshops create opportunities for the children and families to build knowledge together (4) resources and loan kits provide participants the tools they will need to implement the new learned strategies enhancing learning in the classroom and at home. (5) community partnership development engages external partners such as public schools, parochial schools, after school programs, and social service agencies in a process that addresses alignment, specific needs, and interests. The STEMagineers curriculum is not a universal strategy, each external partner has a distinct culture, so programmatic offerings are adapted to each learning environment. The menu of services is presented to external partners and is then catered to meet the individual needs of each program. The primary focus of the STEMagineers program is to collaborate, experiment, and discover the most impactful method of reaching educators, children, and families in the community. Table 2 provides an overview of REACH programs.

*Educator Learning Labs.* Learning Labs for teachers provide professional development sessions in the effort to engage educators in learning about and trying out STEM-H focused instructional activities in their classrooms. This school-embedded model consists of workshops delivered quarterly and are designed as a space for educators to come together and build knowledge together about how kids learn, preferred activities, and how to structure classroom instruction so that activities produce the intended outcome of generating interest in STEM-H. Learning Labs are half-day sessions embedded within the school day at the school building. Workshops begin with collective learning around a STEM-H topic, for example: "The Importance of Exercise to Health and Well-Being". With this example, REACH would bring in a certified fitness professional from Rush to lead the workshop, provide equipment, supplies, and resources that a school may not have at its fingertips, and with the educator practice a lesson where participants are encouraged to anticipate student thinking, consider the benefits and challenges of the lesson, and develop shared goals for the experience. Throughout the school year, the primary goal of the program is to work collaboratively with the educator to implement high-quality STEM-H lessons within their classroom. The co-teaching partnerships over time have shown to have significant impact on motivating teachers to build confidence to implement more science experiences for students. Teachers get the chance to listen and observe instruction on concepts like cooperative learning, establishing a climate of problem solving and nudging thinking. We want our educator partners to leave with the tools they will need to implement the new learned strategies.

**Table 2.** *Characteristics of REACH Programs.*

| **Early Exploration in STEM and Career Awareness: Early Childhood/Primary** | | | | | |
|---|---|---|---|---|---|
| | **Number Served*** | **Program Type** | **Number of Sites** | **Dosage** | **Occurrence** |
| STEMagineers | 1950 | Classroom Enrichment | Multiple sites | 2 hours, 2 days a week | During the Academic Year |
| Educator Learning Labs | 125 | Teacher Professional Development | Multiple sites | Half-day session every quarter | During the Academic Year |
| **Career Awareness, Skill and Attitude Building: Middle School** | | | | | |
| | **Number Served*** | **Program Type** | **Number of Sites** | **Dosage** | **Occurrence** |
| Future Ready Learning Lab | 100 | School day Elective | 7 | 1 hour, 2 days a week | During the Academic Year |
| VITALS for STEM Success | 30 | Afterschool Program | 7 | 1-2 hour, 1-2 days a week | During the Academic Year |
| REACH for IT - IT Explorations | 850 | School day Elective, Enrichment, After-school Program | Multiple | 1-2 hour, 1-2 days a week | During the Academic Year, Summer Camp |
| **Career Exploration, Exposure and Strengthening Skills: High School** | | | | | |
| | **Number Served*** | **Program Type** | **Number of Sites** | **Dosage** | **Occurrence** |
| REACH for IT MedSTEM+ IT Apprenticeship | 25 | Apprenticeship | On-site at Rush | 8 months, 160 hours total | Year-Round |
| MedSTEM Program | 175 | Pre-Internship and Internship | On-site at Rush | 6 weeks, 120 hours total | Spring, Summer |
| Bridges Mentoring (to Medicine, Nursing, Allied Health) | 60 | Enrichment + Mentoring | On-site at Rush | 8 months | During the Academic Year |
| **Career Pathway Training and Development: College & Beyond** | | | | | |
| | **Number Served*** | **Program Type** | **Number of Sites** | **Dosage** | **Occurrence** |
| College Career Pathways | 35 | Internship | On-site at Rush | 8 weeks, 256 hours total | Summer, (Winter Optional) |
| Center for Community Health Equity Internship | 4 | Research Internship | On-site at Rush | 8 weeks, 320 hours total | Summer |
| RU Ready MedSchool | 20 | Enrichment | On-site at Rush | 2 years | Year-Round |
| **OutREACH Community Engagement** | | | | | |
| | **Number Served*** | **Program Type** | **Number of Sites** | **Dosage** | **Occurrence** |
| Community Workshops, School Visits, Career Fairs, Resources, and Wraparound supports | 7500 | Community Engagement | Multiple sites | varies | Year-Round |

*\*Approximate number served annually*

## Career Awareness, Skill and Attitude Building: Middle School.

*Future Ready Learning Lab (FRLL)*. FRLL is a one-hour, two-days-a-week enrichment elective that is integrated into the school day. As necessary, FRLL also provides equity-based instructional strategies to further support science curriculum in schools that do not have access to a science teacher during the academic day. Students who participate in this program are exposed to science enrichment, career exploration, social emotional learning, and strategic planning for high school and college. Students gain knowledge about a variety of health care careers. A fundamental component is exposing students to the wide variety of career paths in the healthcare field. Students engage in research-based activity in which they choose a healthcare career that they have never heard of and investigate it, including salary, educational requirements, and specific roles. Students then present their findings via a poster presentation. Additionally, students learn about each of their body's main systems and compare their knowledge to that of animals with similar characteristics, culminating in a dissection activity to see the precise system that they are studying. Students take field excursions to local museums to expand on their knowledge and have Career Day workshops in the final weeks to learn more from industry experts. Curriculum aligned to science standards enable FRLL students to go deeper in their exploration of future careers, advancing their knowledge of science and sparking a strong interest in STEM-H.

*VITALS for STEM Success (Vitals)*. Vitals is a 1-2 hour, 1-2 days a week after school program for highly motivated students who are interested in STEM or health care careers. Over the course of 10-weeks Vitals students participate in tutoring, labs, mentoring and more including field trips and

participation in online science and engineering competitions Vitals exposes students to different career paths in the field of healthcare, through structured activities and visits from professionals in the field helping them understand the different tracks available and what it takes to get started. Students work together to solve real-world challenges from the healthcare field. Past topics included forensic reconstruction to identify bodies and brainstorming an approach for fighting a disease epidemic.

*REACH for IT - IT Explorations.* IT Explorations is a program within the REACH for IT catalog, that aims at exposing, engaging, and encouraging students to participate in college and career STEM opportunities. The program serves as an outreach initiative that empowers 5th- 12th grade students with in-class and extracurricular enrichment opportunities ranging in subjects focused on STEM, Cybersecurity, Artificial Intelligence (AI), and Health IT. The curriculum also places a heavy emphasis on predictions of the future job market, career pathways, career readiness and executive functioning principles. Enrolled students are exposed to various subjects relating to Information Technologies (IT) and Computer Science (CS) fundamentals. Participants are then equipped with tools, resources and instructions to engage with and reinforce their education in a hands-on place-based learning environment. More importantly, students are encouraged throughout their participation in the program to pursue careers within the healthcare system and STEM industries through direct exposure to current professionals across the field. The IT Exploration Program delivers its offerings in various program models such as classroom instruction and out-of-school time (OST) activities. It also currently offers students the opportunity to participate in ongoing competitions, camps, clubs and workshops that are developed to further guide students through the career exploration process. IT Explorations tailors its offerings to partner school's needs to ensure equity and successful outcomes for participants; however, our program offerings are aligned to International Society for Technology in Education (ISTE) standards and supports requirements enforced by the Illinois State Board of Education's (ISBE) House Bill 2170 to expand computer science curriculum in school districts. By serving as a cradle-to-career program, REACH for IT can continue measuring success by aligning the program framework to career readiness competencies such as a critical thinking, effective communication, creation through collaboration, career management, intercultural fluency, and more that will aid our alumni in their future career and entrepreneurial endeavors.

**Career Exploration, Exposure and Strengthening Skills: High School.**
*REACH for IT - MedSTEM+ IT Apprenticeship*. Another subprogram of REACH for IT is the MedSTEM+ IT Apprenticeship. The program was created to help community members prepare for and get connected to high-paying career opportunities, while also diversifying the Healthcare and IT fields. It is a multiyear career development initiative that provides participants with the opportunity to engage in classroom instruction, job shadowing/networking experiences, project-based internships, mentorship, and receive technical certifications in IT Support, Cybersecurity, Artificial Intelligence (AI), and Health IT focus areas. This program supports intergenerational cohorts and is accessible to three key populations of Black and Latinx learners: Secondary, Postsecondary, and Adult Learners within our target communities. The 8-month paid IT Apprenticeship provides an opportunity for both youth and adults to gain knowledge, additional skill sets, and industry-recognized credentials that will help advance them across the Information Technology (IT) and Computer Science (CS) fields. In addition to their on-the-job training, students also engage in place-based learning to strengthen communication, teamwork, critical thinking, and problem-solving skills. By integrating technical knowledge and social-emotional learning, MedSTEM+ IT apprentices leverage experiential learning for self-efficacy, job readiness, and leadership in the STEM/healthcare fields. The program model aligns with defining principles (Career-Oriented, Equitable, Portable, Adaptable, and Accountable) originally set by New America's Partnership for Advancing Youth Apprenticeship network and is on track to be established as a Registered Apprenticeship Program (RAP).

*MedSTEM Program*. The MedSTEM Program is an intensive academic enrichment program designed to introduce teens to a variety of STEM and healthcare careers, strengthen academic preparation, and develop leadership skills. Students engage in hands-on learning to strengthen communication, teamwork, critical thinking, and problem-solving skills, and have opportunities to earn industry-recognized credentials. The program offers two options, MedSTEM Explorers and MedSTEM Pathways. MedSTEM Explorers is a paid, six-week pre-internship program for rising high school sophomores and juniors interested in exploring various STEM-H careers, developing workforce skills, and researching real-world issues that affect their Chicago communities. The Explorers curriculum consists of 5 classes: (1) Healthcare Skills, (2) Introduction to Community Health, (3) College and Career Writing, (4) Capstone, and (5) RU Ready Workshops. Classes are held two days a week between June and August. The healthcare skills and community health classes allow students to explore potential health and medical fields and learn the specific requirements necessary to succeed. The writing class helps students improve and master new techniques for strong essay writing. Through the RU Ready

Workshop students learn valuable professional skills necessary to succeed in post-secondary and/or employment opportunities and receive mentorship throughout the year. The Explorers experience culminates in the capstone class where students work in groups to investigate and offer solutions to a current real-world health challenge that's happening in Chicago. Each group selects a community area and a disease/health condition. Students conduct a mini health assessment reviewing the factors impacting health and design a new program, intervention, or health campaign that will help address the identified needs of their community. The teams present their findings to the broader Rush community during the Capstone poster fair. Explorers are also prepared to earn a CPR certification at the conclusion of the program. Students successfully completing the Explorers program are strongly encouraged to return for the Pathways program. MedSTEM Pathways is an intensive paid internship program designed for high school juniors and seniors to experience a variety of STEM/healthcare careers and environments, strengthen academic preparation, and develop leadership skills. The program provides internship opportunities combined with mentorship for those actively interested in healthcare and/or STEM-related fields. During each session, students spend up to 120 hours gaining work-based learning experience in designated departments like Labor and Delivery, Radiology and Diagnostics, Clinical Engineering, Emergency Room, Biomedical Research, and more. Programming is primarily held during the summer, with some participants taking part in internships offered during the academic year. For the summer session, the internship experience is coupled with classroom learning related to certifications and/or their career interests. Current pathways include: (1) Nursing, (2) Pre-Clinical, for those interested in medicine, veterinary science, or other clinical careers (3) Allied Health, which includes careers like patient care tech, EKG tech and Phlebotomist and (4) Health Innovation and Entrepreneurship, spanning the areas of engineering, business and law, and (5) Health IT. Based on their pathway, at the conclusion of the program students are potentially eligible for certification in ECG/EKG, Phlebotomy, a variety of IT certifications or other industry-recognized credentials. The Pathways program also includes a capstone/writing course where students are encouraged to identify an issue of local, national, or global significance that warrants urgent action by the scientific/medical community. Students describe the issue and who the key stakeholders are, then provide recommendations via a 5-10 minute "TEDTalk" style video presentation for how the issue they've selected might be addressed.

***Bridges Mentoring (to Medicine, Nursing, Allied Health).*** The Bridges Mentoring program is an 8-month mentorship program for high school students interested in careers in healthcare. Comprised of three tracks, Bridges to Medicine,

Bridge to Nursing and Bridges to Allied Health, students can learn about a wide variety of careers. Students are matched with a mentor and have the opportunity to attend workshops lead by current nursing, medical and health science professionals. The overarching objectives of the program are to: (1) expand participant knowledge and awareness on becoming part of the healthcare field, (2) support those underrepresented in healthcare in achieving their milestones, (3) expose students to the application process for graduate and professional school, (4) build networks and connections with faculty members, medical students, and healthcare professionals, (5) educate students on the health disparities in the current medical system, (6) provide college and career readiness workshops, (7) engage with the community through service, and (8) have all students realize that they do belong and will attain careers in healthcare, if that is what they desire.

## Career Pathway Training and Development: College and Beyond.

***College Career Pathways (CCP)***. CCP is an eight-week paid, summer internship program for highly motivated undergraduates who have a strong interest in health care careers. Participants are on site at Rush University Medical Center or partner organizations for 32 hours per week. There are 5 core elements of the CCP program, students: (1) work at the medical center — alongside medical students, nurses, doctors and support staff in a wide range of departments — or at a Rush partner organization, gaining hands-on experience in real-life situations, (2) connect with STEM-H career mentors for advice on networking, finding a full-time job and further development of workplace skills, (3) earn stackable, industry-recognized certifications such as certified nursing assistant (CNA) and phlebotomist, (4) get involved in Rush's community engagement work through community visits and event planning, (5) are provided learning experiences to understand the history of structural inequities that affect health outcomes in Chicago, particularly in west side communities.

***Center for Community Health Equity Internship (CCHE).*** The CCHE research internship offers an eight-week, 40-hour per week immersive experience in research, health disparities, and community relations for highly motivated college juniors or seniors interested in careers in research and the health sciences. During the internship, CCHE students learn about the history of structural inequities that affect health outcomes in Chicago communities, with a focus on the West Side. For example, a team of CCHE Scholars presented a poster on their research into factors for successful educational attainment by Black high school and college students living in a westside neighborhood at a local conference and are preparing their findings for publication. Through the CCHE

research curriculum students learn how to conduct research in a major research institution through weekly educational sessions, forums, discussion groups, workshops and field observations and use those skills to develop a team-based research project centered on how families from a West Side community attain educational success. The project is supervised by Rush University faculty members and culminates in a final oral presentation. Additionally, students experience community engagement in research through community visits and event planning and attain the writing skills necessary to submit a working research paper for review.

*RU Ready MedSchool*. RU Ready MedSchool is a 2-year program that prepares Black, Latinx, and other underrepresented students for applying to and completing medical school. It consists of two primary parts: (1) DiscoverMed, exploratory workshops for students entering college who are interested in pursuing a medical degree to learn more about activities that will best prepare them to be competitive, and (2) MedSchool Bootcamp, intensive guidance and support for the pre-med journey and application process for med school. It includes support on everything from volunteer experiences through MCAT preparation (free resources) and letters of recommendation to personal statement workshops, shadowing, and more.

**OutREACH Community Engagement.**
*Community Events*. REACH hosts regular community workshops for students, parents and community members on a range of topics such as financial aid, mental health and college readiness. These workshops take place at Rush University Medical Center and are open to anyone from the community who is interested in learning more about the featured topic. Each semester, REACH hosts a few Chicago schools for full-day field trips to Rush University Medical Center. Visits include a STEM/health care-related activity, a tour of the hospital and a career panel with a range of health care professionals. REACH provides all materials, bus transportation between the school and Rush and lunch for all students and chaperones. REACH also host biannual career fairs for middle and high school CPS students where participants explore careers and opportunities in STEM and Healthcare.

*REACH Wraparound Supports*. The COVID-19 pandemic fundamentally shifted the mode of teaching globally. Depending on the institution, the expansion of, or transition to virtual learning environments brought renewed focus to questions on equity and access across historically marginalized populations. As use of online learning expanded in response to this global health emergency, emerging findings revealed substantial challenges in ensuring equitable access to and delivery of high-quality instruction. It became increasingly important to investigate the social implications

and structural consequences of the moment on both students and their families. REACH realized the need to supplement our programming with wraparound support for students and their families, many of whom live in communities that were hit hardest by the pandemic. In 2020, REACH launched the Health Equity Assessment Tool (HEAT) (Appendix 1) designed to identify health and wellness needs for REACH high school and college participants. In partnership with the Rush Community Health Worker Hub, REACH provided support to students who completed the assessment and needed assistance with anything from healthy food and transportation to technology and health care. All students who participate in the REACH program are now screened for social determinant need.

## EVALUATION

The conceptual framework above suggests that REACH can function as a powerful contextual factor according to the SCCT model and thereby influence STEM-H attitudes, beliefs, and occupational identity formation among its participants. We conceptualize REACH as a cradle-to-career learning experience through which participants build science self-efficacy and gain knowledge. Evaluation efforts seek to establish whether there is evidence of such a transformation, guided by the following questions:

1. How do students view the REACH program they are participating in?

2. How does a REACH program experience influence students' knowledge about and self-efficacy in STEM-H, especially students from historically marginalized populations?

3. To what extent does REACH influence students' occupational identity formation and STEM-H trajectory, especially students from historically marginalized populations?

**Methodology.** Assessment instruments were developed and are used to capture data on student satisfaction, progress and activities for each REACH program. (Examples of REACH program surveys are included as Appendix 3 and 4). Students complete surveys prior to program start and again at program completion for most programs. Survey items were selected and adapted from existing research (Friday Institute for Educational Innovation, 2012) and supplemented with items written specifically for that program based on focus, structure and educational level being served. The pre- and post-tests combine quantitative assessment (e.g., Likert-scale responses) and qualitative assessment (i.e., short-answer responses). Process measures include participant demographics, and perception of the quality of the program's components.

The created surveys gauge participants' attitudes toward: (1) STEM, (2) academic performance and self-efficacy, (3) healthcare as a profession, and (4) commitment to healthcare as a career. For middle school participants, intermediate outcome measures include an assessment of students' intention to take advanced math and science in the future. For high school participants, intermediate outcome measures include an assessment of students' knowledge and understanding of the college admissions process. For postsecondary participants, intermediate outcome measures include deeper and sustained engagement with REACH, increased labor market success and/or further postsecondary enrollment.

Qualitative data is acquired through free-text spaces in each evaluation tool. These spaces allow participants to identify what facilitated or hindered learning, how content was understood, and what impacted the participants' experience and STEM-H career trajectory. Through inductive and deductive content analysis, one author independently reviews all submitted evaluations, coding key phrases, terms, and written observations. Analytic patterns are further distilled into specific themes found across evaluations to detail the participants' experiences. Data is collected and managed using REDCap electronic data capture tools. Most of the data used in evaluation are aggregate data where the participants have been de-identified. In instances where data is not aggregated, a unique identifier is used to de-identify. As a result, the work described was determined exempt as human subjects research by the Rush University Medical Center Institutional Review Board. Data from programs that use a pre-post survey are collected and analyzed to track fidelity and assess progress towards program- and organization-level goals. Key findings from REACH's evaluations 2019 - current are highlighted below.

## RESULTS

**Demographics**. Demographic information demonstrates that the majority of REACH participants have been from racial and ethnic groups underrepresented in STEM-H (Table 1), with the two largest groups being African American/Black at 55% and Hispanic/Latinx American at 35% of participants. Further, these demographics also reflect that 58% of students served reside in Rush's primary service area. These data result from the intentional recruitment of participants from underrepresented groups in STEM-H and reflect the fulfillment of the main goal of the REACH program to inspire and empower young people of color to see their potential and their place in health care, beginning in preschool and continuing through college and graduate study.

**STEM Attitudes, Self-Efficacy and Academic Performance.** Responses are provided on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). Attitudes toward STEM are assessed with items, such as, "*I like science*" or "*I am good at math.*" Given the reciprocity of the STEM self-efficacy—attitude—performance relationship (Bandura, 1997), measures where students assess their belief and capabilities are also included and tailored by program/grade level. For example, middle school students are asked, "*I am sure I could do advanced work in math,*" "*I know I can do well in science,*" or "*I am sure of myself when I do science.*" Questions for middle school students cover attitudes on science, math, tech and engineering broadly to gauge general interests. Beginning at the high school level, questions on engineering and technology are removed and substituted with healthcare specific questions, for example, "I am knowledgeable about the skills I need for a career in Health or Medicine." Table 3 examines patterns of pre-post attitudinal changes across four years (2019 through 2022) for the middle and high school programs. Empty spaces give the appearance of gaps in data collection in Table 3. The REACH for IT MedSTEM Apprenticeship and Bridges Mentoring programs are newer additions to our portfolio, launched at the beginning of the 22-23 academic year. Post-program data were not available at the time of publication. Additionally, rather than ask if a student "likes" or "is good at" health/medicine, questions are phrased as "*I am knowledgeable...*" and "*I would consider a career*" to better gauge occupational identity formation for high school participants.

**Healthcare as a Profession and Commitment to Healthcare as a Career.** Several questions on the survey inquire about participants' planned area of study and career path. At the high school level, 85% (n=519) of students participating in the MedSTEM summer program from 2019 - current said the program "made them more committed to work in a health or STEM field," while 89% indicated the MedSTEM program "gave them a clearer idea of the next steps for a health or STEM career." For the most recent cohort, 81% (n=121) stated they were "very likely" to pursue a career in STEM/healthcare. At the postsecondary level, 95% (n=82) of students indicated that the College Career Pathways program 2019 - current "furthered their commitment to working in STEM/healthcare and provided clarity around next steps for their career." Students reported access and exposure to STEM-related fields as being among the biggest strengths of the program. Students also praised the development of communication and technical skills specific to medicine and science-related fields especially those that led to certifications (e.g., taking blood pressure, EKG, CPR). They saw these credentials as strategic assets for future college/career opportunities (Figure 3). Upon entering, students already had ideas about the careers they wished to pursue. A large majority expressed interest in a career in healthcare. After participation, most of the students still expressed such interest. This finding indicates that participation worked to

**Table 3.** *Response frequencies and percentages for attitudinal items from REACH pre-post surveys, middle and high school 2019 - current.*

| | Middle School | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Science, N (%)** | | **Math, N (%)** | | **Engineering & Tech, N (%)** | |
| | **PRE** | **POST** | **PRE** | **POST** | **PRE** | **POST** |
| *I am good at […]* | | | | | | |
| VITALS for STEM Success | 11 (73%) | 11 (100%) | 7 (47%) | 4 (36%) | 6 (40%) | 6 (55%) |
| Future Ready Learning Lab | 7 (24%) | 12 (36%) | 19 (66%) | 18 (54%) | 11 (37%) | 19 (58%) |
| *I am the type of student to do well in […]* | | | | | | |
| VITALS for STEM Success | 10 (67%) | 10 (91%) | 6 (40%) | 6 (55%) | 8 (53%) | 6 (55%) |
| Future Ready Learning Lab | 9 (31%) | 16 (48%) | 16 (55%) | 18 (54%) | 15 (51%) | 18 (54%) |
| *I'm sure I could do advanced work in […]* | | | | | | |
| VITALS for STEM Success | 4 (27%) | 8 (73%) | 3 (20%) | 5 (45%) | 5 (33%) | 5 (45%) |
| Future Ready Learning Lab | 3 (10%) | 10 (30%) | 14 (48%) | 15 (45%) | 12 (41%) | 16 (48%) |
| *I would consider choosing a career that uses […]* | | | | | | |
| VITALS for STEM Success | 5 (33%) | 4 (36%) | 3 (20%) | 4 (36%) | 4 (27%) | 4 (36%) |
| Future Ready Learning Lab | 5 (17%) | 9 (27%) | 9 (31%) | 11 (33%) | 6 (20%) | 14 (42%) |
| | High School | | | | | |
| **Item** | **Science, N (%)** | | **Math, N (%)** | | **Health or Medicine, N (%)** | |
| | **PRE** | **POST** | **PRE** | **POST** | **PRE** | **POST** |
| *I like […]* | | | | | | |
| MedSTEM Program | 205 (67%) | 181 (75%) | 158 (52%) | 155 (64%) | – | – |
| REACH for IT MedSTEM+ IT Apprenticeship | 12 (85%) | – | 9 (64%) | – | – | – |
| Bridges Mentoring | 34 (77%) | – | 23 (52%) | – | – | – |
| *I am good at […]* | | | | | | |
| MedSTEM Program | 181 (59%) | 161 (67%) | 168 (55%) | 156 (65%) | – | – |
| REACH for IT MedSTEM+ IT Apprenticeship | 9 (64%) | – | 8 (57%) | – | – | – |
| Bridges Mentoring | 30 (68%) | – | 27 (61%) | – | – | – |
| *I am knowledgeable about the skills I need for a career in […]* | | | | | | |
| MedSTEM Program | 175 (57%) | 178 (74%) | 175 (57%) | 178 (74%) | 173 (56%) | 179 (74%) |
| REACH for IT MedSTEM+ IT Apprenticeship | 8 (57%) | – | 8 (57%) | – | 3 (21%) | – |
| Bridges Mentoring | – | – | – | – | 32 (73%) | – |
| *I would consider choosing a career in […]* | | | | | | |
| MedSTEM Program | 207 (68%) | 176 (73%) | 207 (68%) | 176 (73%) | 211 (69%) | 177 (74%) |
| REACH for IT MedSTEM+ IT Apprenticeship | 11 (78%) | – | 11 (78%) | – | 2 (14%) | – |
| Bridges Mentoring | 33 (75%) | – | 33 (75%) | – | 41 (93%) | – |

*Note: Responses are aggregate of "Agree" and "Strongly Agree." REACH for IT, and Bridges to Mentoring programs launched in 2022, post-survey scores not available at time of publication.*

support student development toward STEM-H for those who expressed interest.

**Satisfaction with REACH Program**. Overall, students who participated in a REACH program had a high degree of satisfaction. At the high school level, 65% (n=97) students participating in the summer 2022 MedSTEM program indicated intention to return the following summer, and 79% (n=119) reported that they would recommend the program to a friend. At the postsecondary level, 91% (n=28) students participating in the summer 2022 College Career Pathways program indicated intention to return with 95% stating they would recommend it to a friend. Narrative results are thematically summarized and represented in Table 4. Data collection efforts post-program completion indicate that the REACH program has a positive influence on students' fu-

ture career decisions, including which degrees they choose to pursue and whether they seek a career in a STEM-H field. Data indicates that 100% of REACH high school graduates enrolled in college and 95% indicated intent to major in STEM-H field, for the most recent academic year 2021-22. The biggest strength of the program mentioned by students was access and exposure. For some students, the strength was access and exposure to a field in which they were interested; for others, the strength was access and exposure to a field they never knew existed. Still, for others it was the hands-on learning and exposure the program provided, which they would not have experienced elsewhere. This was corroborated by the quantitative and qualitative data and suggests that the program is working to provide access and exposure for students, who recognize and value these elements. Taken together, this suggests that REACH provides
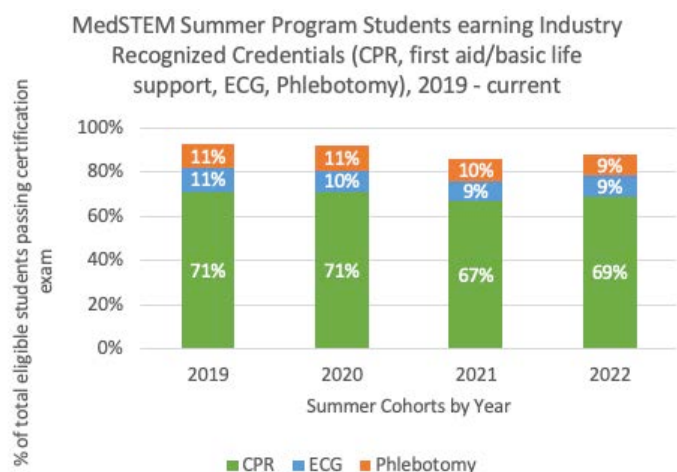
**Figure 3.** % Of MedSTEM students earning industry recognized credentials (CPR, first aid/basic life support, ECG, Phlebotomy), 2019 – 2022.

access to STEM-H experiences for URM students. As these preliminary findings suggest, the REACH mission is being met; however, there is opportunity for growth.

## DISCUSSION

To successfully guide youth and young adults from underrepresented groups into STEM-H careers, programs must do much more than provide STEM-H content. Participants must see a place for themselves as healthcare professionals and feel that their voice is critical in finding solutions to the problems they observe in their own communities. STEM-H cradle-to-career programs must be intentional in both content and process to ensure that youth not only get STEM-H knowledge but receive it in a way that is relevant to their own lives and has more potential to change their trajectories.

One underexplored area for research and practice are interventions aimed at influencing occupational identity, or how a person envisions their future selves in the workforce, informed by what their preferences are, what they believe they are skilled at, and where they feel they belong. How young people see their future selves potentially shapes a multitude of decisions about their work, education, and careers. Preliminary findings suggest that, while overall participation in REACH programs did not appear to be associated with large increases in interests and self-efficacy, when the program managed to increase participants' interest in math and science, this appeared to lead to increases in both self-efficacy and increased career interest. Perhaps, due to self-selection at the high school and postsecondary level, many participants enter the REACH program with an existing high sense of self-efficacy. While their sense of confidence in STEM may not be completely attributable to their REACH experience, the program may contribute to building their sense of efficacy even more, as they challenge themselves in new settings. Hands-on learning experiences may

**Table 4.** *Illustrative quotes from MedSTEM and College Career Pathways program participants, 2019 - current.*

| Theme | Select Quotations |
|---|---|
| Work-Based Learning Experiences | "My favorite experience was being able to work in the Rush Oak Park Emergency Room and put my EKG skills to good use. In addition to that, I was able to interact with patients and help them move around, transport them to different places, help them change their clothes, take their vital signs, and much more. Being able to interact with patients, listen to their problems, and just being able to see what it was like to work in healthcare was truly amazing." |
| Understanding How to Improve the Health of Their Communities | "This program does an excellent job of creating a space for us to talk about social issues both within and outside of healthcare which is something I truly enjoyed." |
| | "Honestly, my favorite experience was the Community Health class. Before this I would have never said that, but it honestly opened my eyes to the real world. I never really thought I would care much about a subject such as health equity, but it gave me a completely different outlook on what people need in life." |
| Curriculum | "My favorite experiences in the program this summer we're taking a CPR class and learning basic skills in anatomy. These skills will not only help in real world situations, but they help with my career path." |
| | "Working with others and improving my leadership skills was great." |
| | "My favorite experience was during the writing class. I was taught how to write in a more professional setting for interviews and other things and had really helpful tips when there's writing/research projects." |
| Industry-Recognized Credentials | "My favorite experience from participating in this program over this summer is for sure the CPR certification, knowing how to do effective CPR is a life changer." |
| | "My most favorite experiences from participating in the program this summer was probably the CPR certification course. I am a really hands-on person, therefore I really liked being able to practice performing CPR on mannequins. It was great being able to get my CPR certification" |
| | "Being able to learn so much in-depth information about the heart and how to interpret ECGs. It was fun to perform ECGs among my classmates, and it was really cool to see what my heart looked like from an ECG." |
| College and Career Readiness | "This program is really helping me become a smarter and more responsible adult. I am obtaining more knowledge from this program and exploring my options for future careers." |
| | "This program really made me understand the steps and hard work it takes to become what you want and what you need to do to choose your career. I now know the steps to becoming a great student in and out of college." |
| | "This program has given me the confidence within myself to say, 'I can, and I will.' succeed on my road to become a nurse practitioner." |

*EKG/ECG, Electrocardiogram; CPR Cardiopulmonary resuscitation.*

further reinforce their perceptions of their ability to persist.

Previous research has generally demonstrated how crucial a sense of belonging or alignment with the community of practice is among URM health professionals (Brown et al., 2016). Due to structural inequities experienced by URM students, it is important for programs like REACH to support positive self-perception (King et al., 2013), and self-efficacy (Lane and Id-Deen, 2020). Lane and Id-Deen found that students' self-efficacy from urban contexts influenced their STEM abilities. In addition King et al. (2013) revealed the importance of connecting students with STEM profes-

sionals and providing them opportunities that allow them to engage with the field. Instruction from those engaged in professional practice was an important factor for REACH participants at the high school level, as evidenced by themes that emerged in student responses:

> *What distinguishes medicine from other fields of service is the commitment to see people through recovery. I have seen qualities in nurses, doctors and therapists that I can see in myself. I visualize myself working as a doctor because it fits with my calling directly serving people.* – REACH Alum, Future Physician

Current STEM-H professionals play a critical role in helping students see themselves as future STEM-H professionals. REACH incorporates an intentional and sustained approach to recruiting and retaining faculty and staff of color. Other researchers have found that interventions that address mentor racial/ethnic concordance and promote culturally sensitive mentorship may improve URM student recruitment in medicine (Penaloza et al., 2023), we hypothesize that racial and ethnic concordance between participants and instructors, preceptors, mentors, etc. also has the capacity to mitigate any sense of being alone or isolated, and prove inspirational, encouraging students to engage and persist in STEM-H. A sense of community and a positive STEM-H identity are also fostered in the classroom by authentic, supportive, learning environments that encourage near peer interactions (Singer et al., 2020).

Another relevant issue is the conceptualization of the pipeline. As Skrentny and Lewis (2021) note, "the "STEM pipeline" carries implicit assumptions regarding length (i.e., that it "starts" and "stops" at specific stages in one's education or career), contents (i.e., that some occupational fields are "in" the pipeline while others are not), and perceived purpose (i.e., that "leakage," or leaving STEM, constitutes failure)." The pipeline metaphor can also neglect the multitude of external factors impacting students as they move through school. A diverse pipeline is needed and important, but that is not the same as broadly promoting practices that enhance, reinforce, and embrace equity, as well as focus on relevance and use. The straightforward progression of the pipeline model also fails to reflect the full range of career opportunities available to students in healthcare and the many factors that influence career choices over a lifetime. A "pathways model" like the one REACH employs better represents the breadth of credentials, degrees, and jobs in the sector so students can explore and understand how to stack credentials and navigate career paths into clinical, non-clinical, or even non-healthcare jobs, over the course of their working lives (Figure 4). This approach also recognizes that employers can create workforce paths to draw on diverse individuals with disparate educational backgrounds and expertise. It is not simply a matter of changing who is involved in the work, but the intent and the work itself. REACH's model consists of a set of core values paired with core practices:

- Empower through education. We help our students see education as fuel for a fulfilling, impactful career, and teach them the skills, resilience and accountability

| REACH Career Pathways (2 -4yrs) | Industry Credentials provided by REACH & Partners | Entry-Level Job (Based on Certifications earned + HS) | Postsecondary Degrees (2 or 4 year) | Typical Jobs |
|---|---|---|---|---|
| Medicine/ Pre- Professional | CPR, First Aid BLS, Phlebotomy, EKG Tech | EKG Tech Phlebotomist | Bachelor's Degree Graduate/ Professional | Family Physician Pediatrician Anesthesiologist Surgeon |
| Nursing | CPR, First Aid BLS Phlebotomy EKG Tech Certified Nursing Asst., | Nursing Asst. Medical Asst. Phlebotomist EKG Tech Patient Care Tech | Registered Nurse (AAS) Registered Nurse (Bachelor's) | Licensed Practical Nurse Registered Nurse Nurse Practitioner |
| Allied Health | CPR, First Aid BLS, Phlebotomy, EKG Tech, Community Health | Phlebotomist EKG Tech Patient Care Tech | Respiratory Therapy (AAS) Medical/ Radiology Tech (AAS) Pharmacy | Respiratory Therapist Physical Therapist Pharmacist |
| IT/ Health IT | CPR, Apple Swift, CompTIA+, CompTIA IT Fundamentals+ CompTIA Security+, EPIC (Healthcare Software) | IT Tech Support Analyst EPIC Trainer | Applied Computer Science (AAS) Computer Science (AS) Web Development (AS) (Bachelor's Degree) | Software Developer User Support Specialist Security Analyst |
| Health Administration & Innovation | CPR, Medical Office Assistant, Microsoft Office Specialist, Community Health Worker Certificate | Medical Office Asst. Community Health Research Coordinator | Associate's Degree Public Health, Health Sciences, Finance, STEM (Bachelor's Degree) | Health Services Manager Health Administrator |

**Figure 4.** REACH Career Pathways: Healthcare & STEM Focus.

they need to turn their dreams into reality.

- Strive for excellence. We push ourselves and our students to see more, do more and be more. We take accountability for our actions through research and practical application, and we ask the same of our students so they can take what they learn into real-time experiences that make a difference.

- Lead with equity. Students of color are highly underrepresented in STEM and health care fields. We must actively interrogate our roles in perpetuating inequitable systems and work together to develop better practices, systems and structures within education and workforce development.

- Commit to community. The more organized and connected we are, the greater our impact on our students. That means leveraging the expertise, resources and contributions of our partners rather than reinventing the wheel. We work collaboratively and take the time to listen to each other, to our partners and to the communities we serve.

- Center the student. While the outcomes of our work have a meaningful impact on Chicago's economy, at the center of it all are young people with unique aspirations and challenges. What we do directly affects their lives, and we never lose sight of that.

Over the past six years, REACH has evolved considerably. Some of these changes were intentional and were made as a result of regular program monitoring and in response to needs of the community and/or labor market forecasting. Other changes were prompted by unforeseen developments—most notably, the COVID-19 pandemic. In what follows, lessons learned in REACH's trajectory across the program's six-year history are discussed. Cradle-to-career programs are continually seeking answers to long-term and complex questions; *what practices best accelerate student learning? What resources will be needed in the next five years? Ten years? What are the indicators (past and present) that a student is at risk of not graduating? What influences career choice over the lifecourse? What will the future of the US healthcare labor market look like — at national, state and county levels, and how can STEM-H programs better prepare students to fill those jobs?* Questions like these generate across the spectrum of our education and workforce systems and require programs to have a robust data infrastructure, however, designing and implementing data systems remains a challenge. One factor that may have affected our quantitative results is methodological, regarding the timing and method of data collection. It is often challenging to motivate students to participate as enthusiastically in the data collection aspects of a program as in the program activities.

The principal challenge of our current evaluation work are response rates, potentially limiting the generalizability of results. Although high response rates are ideal, we also recognize that as survey fatigue arises, and/or students' attention draws elsewhere, absolute thresholds representing adequate response rates may be less achievable in that moment. We also place our approach in the context of the survey research literature in which other researchers analyzed response rates and nonresponse bias and concluded "results from low response-rate surveys are considered on their merits, as they may accurately represent attitudes of the population…low response rates are not cited as reasons to dismiss results as uninformative and using rates alone to dismiss results may be unwarranted" (Meterko et al., 2015).

To address the response rates, we have begun to incorporate a number of strategies to improve survey completion and integrate data collection into the natural flow of programming. We communicate to the students why it is important to get their feedback. Program staff tell them directly that student feedback is being collected and we value and use their responses. When appropriate we share with them how we have incorporated past feedback into program development and quality improvement. We emphasize that understanding their perspectives on what we provide is of great importance to us. Additionally, obtaining data is a social interaction involving participants, program staff, and an array of intervening barriers and incentives. To this end, we have shifted survey delivery methods so that initial contact is from a recognized and respected staff member as opposed to a system generated email from a global email address to elicit a positive response. The most important characteristic of a cradle-to-career data system is the ability to connect and see participant-level data over time and to use this data to spot trends that can be used to identify at-risk students and potential intervention points to improve student success. In addition to using data to ensure appropriate curricular recommendations, data is a valuable tool for identifying retention and time-to-degree hurdles often experienced by URM students. Additionally, robust data practices facilitate identification of highly successful programs and highlight opportunities for improvement, including emerging equity considerations. The next iteration of REACH's evaluative work will launch a data infrastructure with the capacity to integrate existing systems and scale as the organization grows, while generating, synthesizing, and translating evidence effectively.

The success of many programs like REACH comes down to partnerships and relationships. Partnership internally across REACH programs and externally with community, education and employer partners are a key determinant of success. Strategic partnerships are a powerful way to build program capacity, however, those partnerships hinge on the clarity of mission, vision, and value statements and cohesion

between your organization and the potential partner organization. Namely, alignment on core values is essential in preserving culture, and for fostering collaboration and employee participation in the relationship. There is no shortage of energy around these types of solutions. A growing number of organizations nationwide are working in communities to address challenges like the ones identified here– a much needed movement, but a limited and potentially chaotic one if organizations aren't intentional in partnering. Over the years, REACH has identified a set of conditions that we feel characterize successful partnerships and ensure mutual success. These can be summarized as (a) a clear identification of what is important in this work and why (b) a comprehensive approach to develop, implement, and scale, and (c) an intervention that is tailored to local needs and context. A key element in the work is arriving at a common understanding, of who we are, what we are doing, how power and privilege have and continue to operate in these spaces, and how in some cases institutions have perpetrated harm to the same communities that they are looking to collaborate with. It requires organizations to be intentional in understanding the barriers that may have prevented organizations from working together in the past and how that may continue to influence the work today. Finally, several challenges to development and implementation success arise out of unique cultural and social norms that can impact program or intervention success and ability to scale. By implementing an equity-focused approach to engaging in partnership, organizations have a unifying principle to measure progress, hold teams accountable, and commit to ongoing optimization of their stated initiatives. Organizations can also create positive, inclusive experiences that deeply impact education and workforce systems. In light of the above-mentioned, and considering a series of perspectives expressed by REACH instructors, staff, and students, we present the following key aspects for consideration in developing a community-engaged place-based program:

- A stakeholder champion in a position of leadership can lead to the identification of potential resources and organizational buy-in.
- Meaningful, transparent, and empowering engagement of youth during their time in the program is likely to lead to deeper and sustained engagement post program completion.Different engagement strategies are required for different communities—must be tailored to community needs and context.
- Organizational commitment and support (including resources) leads to effective and efficient implementation.
- Capitalize on subject matter expertise and diversity of collaborators where possible.Leverage evidence-based interventions to avoid recreating the wheel.
- Find a way to articulate the value of the work.
- Active bi-directional communication builds trust between partners.
- Encourage and elevate youth voice.
- Center students and families as key partners in learning.

## CONCLUSION

It is evident that current practices have not achieved the STEM-H workforce diversity sought. Amidst challenging realities for our healthcare and public health sectors, REACH has a clear vision for the future: being a nationally recognized model for diversifying the health workforce that serves all students, provides a path to economic and social mobility, and values their identity and potential. REACH intends to prioritize growth in the coming years through inclusion of new educational opportunities, deepening of investment in current programs, and strengthening of community partnerships. REACH remains committed to its role as a workforce intermediary and national leader in career exploration, academic enrichment, and youth workforce development. By embracing the complexities of the modern workforce and STEM-H talent ecosystem, structured cradle-to-career programs as described here have the potential to empower minds and create opportunities for populations that have historically been denied.

## ASSOCIATED CONTENT

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

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The manuscript was written through contributions of all authors. All authors have given approval to the final version of the manuscript.

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## ABBREVIATIONS

AFL-CIO: American Federation of Labor and Congress of Industrial Organizations; AI: Artificial Intelligence; ASM: After School Matters; CCHE: Center for Community Health Equity Internship; CCP: College Career Pathways; CNA: Certified Nursing Assistant; CPS: Chicago Public School; CS: Computer Science; FRLL: Future Ready Learning Lab; HEAT: Health Equity Assessment Tool; ISBE: Illinois State Board of Education; ISTE: International Society for Technology in Education; IT: Information Technologies; JFF: Jobs for the Future; OST: Out-of-School Time; RAP: Registered Apprenticeship Program; REACH: Rush Education and Career Hub; RN: Registered Nurses; SAME: Science and Math Excellence; SCCT: Social-Cognitive Career Theory; STEM-H: Science, Technology, Engineering, Mathematics, and Health Science

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