

Because the WSU evaluation activities are primarily focused on program improvement, we do not have a wealth of information related to long term program outcomes and effectiveness in college success. We are providing you with both the information we considered most relevant from our evaluation activities (presented in Part I) and round out the evidence supporting the program using published studies documenting the effectiveness of the program in producing six identified outcomes (Part II).

**Part I
Findings from the WSU C2 Program**

Afterschool program

Currently, there not much related data. Beginning with 2017-2018, we began tracking student awareness and interest in STEM/Health fields in a way that allows comparison of individual students’ pre- and post-participation responses.

The following data offer some support of the effectiveness of the summer program

Summer IPE

	2014		2015		2016		2017	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Understand what it is like to work in a health career*	4.40	5.04	4.36	5.13	4.15	4.74	3.76	4.17
Unsure about steps to becoming a health professional	3.16	2.44	3.04	2.75	3.62	2.92	3.4	3.34
Parents report improved impression of WSU	90%		82%		90%		87%	
Parents report improved impression of Detroit/Midtown	81%		73%		65%		78%	

* Statistically significant increases across all years of program.

- From 2014 to 2017:
 - Participants in the summer residential IPE consistently self-reported more understanding of what it is like to work in a health career after the camp. This finding was statistically significant across all years of program.
 - Participants also reported being less unsure about the steps to becoming a health professional.
 - The vast majority of their parents (over 80% each year) reported that the camp improved their impression of Wayne State; and
 - Each year, between 65% and 81% of the parents reported that it improved their impression of Detroit/Midtown.

Summer Day camps

	2014	2015	2016	2017
camp made me more interested in STEM/Health career	-	67%	71%	68%

- From 2015 to 2017, at least two-thirds of students in summer day camps reported that the camp made them more interested in STEM/Health careers.

C2 Pipeline Lab

Although the Center does not collect information regarding lab use, we offer the following list of data questions to guide thinking about how the C2 Pipeline Lab may be influential here.

- Who is using the lab?
 - Which schools, districts?
 - How many teachers (by district?)
 - How many students (by district?)
- How much professional development is being done?
- Does it raise profile C2 Pipeline? Of the university?
 - Reach of website? Facebook? Number of inquiries?
- How does this connect with Admissions? Is there any data on the trends on:
 - Number of applications/admissions/enrollments
 - From C2 Pipeline afterschool sites
 - Students participating in IPE
 - Schools who visit the Lab

Part II

Review of the Literature Supporting Pipeline Programs

We conducted a quick literature review to provide additional support for the value of programs like the C2 Pipeline program. Outreach events are important for STEM to help students understand what a future in STEM would look like but are difficult to evaluate effectiveness (Ritchey, 2016). Studies have documented that afterschool programs such as the WSU C2 Pipeline program as well as summer research programs have the following outcomes:

1. Increased interest in STEM and medical careers
2. Increased research skills and research self-efficacy
3. Increased diversity in STEM and health sciences professions
4. Increased matriculation, graduation rates
5. Increased entry to MD/PhD programs/ entry into health care workforce
6. Increased skills at teacher/mentor/level

Detailed Information

1. Increased interest in STEM and medical careers

- a. Tai, et al., 2017: data from AMA colleges college admissions questionnaire and student records from MCAT registrations: results indicated that high school research experience helps students decide if research suits them as a future goal; reinforces desire to enter life sciences research path
- b. Holden, et al (2014) focus groups: most don't think about careers till end of high school but those who decide early base it on experiences or exposure to someone from that field.
 - i. Health care is not popular choice due to: lack of experiences or negative experiences, lack of knowledge of variety of health care professions, health care lacks the status of athletics or entertainment

- ii. Parents can impact on career but often lack knowledge themselves on health professions- image it will be expensive and do not have time or resources to research financial assistance programs, internships.
 - iii. Teachers and schools lack resources to put together speakers, activities, internships to provide strong background in subject
- c. Goldsmith et al (2014)- hands on program with focus on **pharmacy** and PA lab skills- significant increase in understanding profession and interest in pharmacy career after program
- d. Awé et al (2010)- Pathways to **pharmacy** program- after completing 75% enrolled in college pre-pharmacy curriculum and planned to pursue career in pharmacy.
- e. Zhang et al (2016) Anatomy and Pathology Workshop, a cadaver-based outreach program that models medical education to large groups of high school students: study demonstrates that outreach programs provided by medical schools help young adults during their formative years by modeling professionalism, providing role models, enhancing learning, and encouraging many to consider opportunities in the health professions.

2. Increase research skills and research self-efficacy

- Salto et al (2014) Evaluation of summer research program at Loma Linda University- underrepresented high school and the undergraduate participants reported large, statistically significant gains in self-assessed research skills and research self-efficacy.
- Tai et al (2017) sites several studies to support secondary school students' confidence for doing science increases after participation in OST research programs and science-focused activities
- Rohrbaugh et al (2011)- Lack of opportunities to participate in research internships during high school makes it more difficult for URM students to take advantage of research opportunities available in college that would prepare them to follow careers in STEM disciplines.

3. Increase diversity in STEM and health sciences professions

- a. Patel et al (2015) mentoring pipeline program specifically targeted to high school students from lower SES, ethnic or racially underrepresented populations- students reported more likely to apply to medical school immediately following program and when contacted 2-3 years later- as sophomores or juniors in college all reported on pre-healthcare track
- b. Inglehart et al (2010) 15 Saturday classes on dental professions- lectures, hands-on, patient-related events (health fairs and shadowing): created positive experiences and opportunity to explore dental careers and for dental students to engage in teaching
- c. Other Material of Note: Office of Minority Health, Bureau of Health Professions, Health Resources and Services Administration. Pipeline programs to improve racial and ethnic diversity in the health professions: an inventory of federal programs, assessment of evaluation approaches, and critical review of the research literature. Washington, DC: 2009. accessed at <http://www.aapcho.org/wp/wp-content/uploads/2012/11/PipelineToImproveDiversityInHealthProfessions.pdf>

4. Increase matriculation, graduation rates

- a. Salto et al (2014) 67% of minority, unrepresented students graduated from college

- b. Winkleby et al (2007) biomedical pipeline program for low income high school students; 100% graduated from high school, 99% admitted to college, 81% of them earned a 4 year degree in biology and physical sciences.
 - i. Among 4 year college grads 52% were attending or graduated from medical or graduate school; 44% were becoming/became health professionals
 - c. Rohrbaugh et al (2011)- RISE program all but 1 continued to 4-year college and 61% enrolled in science-related major. 28% continued to be engaged in scientific research as undergraduates
- 5. increase entry to MD/PhD programs/ entry into health care workforce**
- a. Tai et al (2017) those reporting both high school and college summer lab research apprenticeships were 4 times more likely to matriculate to MD/PhD programs than peers
 - b. Winkleby et al (2007) see above
 - c. Phillips et al (1981): summer experience to expose high school students to variety of health careers associated with increased rates of participants entering work in health professions
- 6. Increased skills at teacher/mentee level**
- a. Laursen et al. (2007): K-12 students were engaged in hands-on life science activities by graduate student presenters. Positive outcomes were identified via interviews with students' teachers and presenter, including for students (interest/engagement and new views of science/scientists, understanding science + its relevance), teachers (more up to date on science, respite), and graduate student presenters (improved teaching skills and personal and career gains and greater understanding of education and diversity issues).

References

- Awé C, Bauman J. Theoretical and Conceptual Framework for a High School Pathways to Pharmacy Program. *American Journal of Pharmaceutical Education*. 2010;74(8):149.
- Goldsmith, C, Tran T, Tran, L. (2014) An Educational Program for Underserved Middle School Students to Encourage Pursuit of Pharmacy and Other Health Science Careers. *American Journal of Pharmaceutical Education* 2014; 78 (9) Article 167.
- Holden L, Rumala B, Carson P, Siegel E. Promoting careers in health care for urban youth: What students, parents and educators can teach us. *Information services & use*. 2014;34(3-4):355-366. doi:10.3233/ISU-140761.
- Inglehart MR, Stefanac SJ, Johnson KP, Gwozdek AE, May KB, Piskorowski W, Woolfolk MW. Recruiting underrepresented minority and low-income high school students into dentistry while educating dental and dental hygiene students about academic careers. *J Dent Educ*. 2014 Mar;78(3):423-36.
- Laursen S., Liston C., Thiry H., Graf J. What good is a scientist in the classroom? Participant outcomes and program design features for a short-duration science outreach intervention in K-12 classrooms. *CBE Life Sci. Educ*. 2007;6:49-64. <http://www.lifescied.org/content/6/1/49.short>
- Patel SI, Rodríguez P, Gonzales RJ. The Implementation of an Innovative High School Mentoring Program Designed to Enhance Diversity and Provide a Pathway for Future Careers in Healthcare Related Fields *J Racial Ethn Health Disparities*. 2015 Sep;2(3):395-402. doi: 10.1007/s40615-015-0086-y. Epub 2015 Mar 12.
- Philips, BU, JM Mahan, and RR Perry. 1981. "Minority Recruitment to the Health Professions: A Matched Comparison 6-Year Follow-up." *Journal of Medical Education* 56(9 pt 1):742-747.
- Rohrbaugh MC, Corces VG. Opening Pathways for Underrepresented High School Students to Biomedical Research Careers: The Emory University RISE Program. Pukkila PJ, ed. *Genetics*. 2011;189(4):1135-1143. doi:10.1534/genetics.111.132126.
- Salto LM, Riggs ML, Delgado De Leon D, Casiano CA, De Leon M (2014) Underrepresented Minority High School and College Students Report STEM-Pipeline Sustaining Gains After Participating in the Loma Linda University Summer Health Disparities Research Program. *PLoS ONE* 9(9): e108497. doi:10.1371/ journal.pone.0108497.
- Tai R, Kong X, Mitchell CE, Dabney KP, Read DM, Jeffe DP Andriole DA, Wathington HD (2017) Examining Summer Laboratory Research Apprenticeships for High School Students as a Factor in Entry to MD/PhD Programs at Matriculation. *Life Sciences Education* 16:ar37, 1-8, Summer.
- Winkleby M. (2007) The Stanford Medical Youth Science Program: 18 Years of a Biomedical Program for Low-Income High School Students. *Acad Med*. 2007; 82:139–145.
- Zhang G, Fenderson BA, Veloski JJ, Livesey M, Wojdon-Smith T. Medical School Anatomy and Pathology Workshops for High School Students Enhance Learning and Provide Inspiration for Careers in Medicine. *Academic Pathology*. 2016;3:2374289516685323. doi:10.1177/2374289516685323.