# Assessing the Effect of an Intensive 2-Week Surgical Training and Innovation Program for High-School Students

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**OBJECTIVE:** The summer surgery program (SSP) was founded in 2012 as an educational program for students at the critical juncture between high school and college to engender interest in medicine, science, and innovation. This program has a distinct emphasis on innovation and problem solving based on real-life operative challenges identified by students during surgical observation in the operating room. The effect of the SSP regarding postsecondary education and career goals was evaluated by participants using a follow-up questionnaire.

**DESIGN:** Retrospective cohort study using web-based survey administered to students at least 1 year after participation in the SSP. Associations between demographics and survey responses were made using Fisher's exact test and a Bonferonni correction was used to account for multiple comparisons.

**PARTICIPANTS:** Between July 2012 and August 2015, 119 students enrolled in the SSP. We sent a web-based questionnaire link to all participants who completed the program. The questionnaire contained 80 questions assessing the participant's interest in studying medicine or science in college, knowledge of health care, and their appreciation and understanding of innovation.

**SETTING:** UC Irvine Medical Center, Orange, CA; Institutional tertiary care center.

**RESULTS:** In total, 77 (64.7%) of 119 students who matriculated in the SSP completed the follow-up survey; the mean number of years after the program was 2.09 years. Nearly all students reported the program increased their interest in studying medicine or science in college (97.4%), led them to a better understanding of their own career goals (93.5%) and made them more confident in their ability to succeed in a career in health care (88.3%). The majority indicated the program led them to better understand the training and schooling required of doctors and surgeons (94.8%), and led them to better appreciate the roles of different medical specialties (96.1%). Overall 96% of students reported that the program led them to better understand the importance of innovation and 86% of the respondents noted they better understood the process of innovation. Participants in the SSP were confident they would be able to become a health professional ($p < 0.0001$). Of note, there was no drop off in the ratings for the program when comparing classes that were 1, 2, 3, or 4 years after their SSP experience.

**CONCLUSIONS:** The follow-up survey revealed that the 2 week SSP had a markedly, long lasting positive effect on participants in areas of academic, career, and innovation-related variables. (J Surg Ed ▮:▮▮▮-▮▮▮. ©2017 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

**KEY WORDS:** surgical education, innovation, program evaluation, high-school student feedback

**COMPETENCIES:** Patient Care, Medical Knowledge, Practice-Based Learning and Improvement

## INTRODUCTION

The interest and attitude of high-school students in the United States (U.S.) toward science and achievement appear to decline before their entry into college.[1] In addition, these same students have a lack of high-school science preparation compared with students in many other first world countries. The 2009 National Assessment of Educational Progress reported that only 21% of high-school seniors scored at or

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above proficiency in science education.[2] To address this concerning trend, there has been an increase in the number of health-related, nonschool-based biomedical pipeline programs for high-school students.[3] Summer biomedical pipeline programs incorporate an inquiry-based, interactive learning environment and have been shown to effectively promote critical reasoning skills and increase a student's interest in pursuing science-related careers.[4,5] University-affiliated programs hosted in large medical centers offer participants access to diverse clinical settings, mentoring by faculty and student role models, as well as access to research and clinical skills centers. This kind of exposure may increase a student's awareness of science- and health-related careers and thereby alter their subsequent professional path. Indeed, the success of programs of this nature has been manifested by high percentage of participants attending college, majoring in biological and physical sciences and pursuing medical or graduate school.[6]

When students search for summer medical experiences, they will largely choose between 2 well-defined prototypical biomedical pipeline program formats. In summer *research* programs, students are exposed to research and innovation through direct involvement in a biomedical research setting. Students assist in laboratory-based research and are often asked to share their research contributions in an end-of-program symposium. In contrast, summer *medical* programs facilitate health care experience by hosting lectures, teaching basic medical procedures, and offering operating room (OR) shadowing. The clinical focus of these programs allows for direct patient interaction and exposure to diverse health care settings.

The University of California, Irvine (UCI) Summer Surgery Program (SSP), founded in 2012 by the Department of Urology, is distinguished by its emphasis on both surgical exposure and innovation. The surgical program incorporates an intense in-depth curriculum focused on surgical anatomy, technical skills, an introduction to innovative techniques (i.e., laparoscopy, robotic surgery, and endoscopy) and mentorship. Participants shadow surgeons in the OR and receive hands-on surgical skill instruction in UCI's Surgical Skills Center. The program's innovation focus, centered within the innovator group project, requires that students, after identifying surgical challenges in the operating theater, develop innovative solutions, which in turn are presented to biotechnology experts at an end-of-program symposium. Projects are evaluated by experts based on feasibility, design, and marketability.

To our knowledge, the only other surgery-focused summer program in the USA is the Stanford cardiothoracic surgical skills program that primarily focuses on teaching surgical skills. Notably, the Stanford program and other summer medically focused programs do not incorporate innovation into their primary focus.[7,8]

The UCI-SSP was evaluated by its participants in a follow-up questionnaire targeted to those students completing the program during its initial 3 years. This study aims to assess the type of effect the program had on its participants as it relates to postsecondary education, career goals, and exposure to innovation in medicine.

## MATERIAL AND METHODS

### Program Background and Eligibility

The SSP was founded by the UCI Department of Urology in 2012 with the aim of providing students a comprehensive introduction to surgery with an emphasis on the importance surgical innovation. Two 2-week sessions with total enrollment of 40 to 50 students are hosted each summer. Competitive enrollment was based on the following: current matriculation in high school, age $\geq$16 years, a minimum 3.5 grade point average requirement, strength of 2 letters of recommendation, quality of responses to the application questions and a phone interview. On average, 100 applications are received and 48 students are accepted yearly. Four students each year were granted scholarships and the remainder paid tuition to attend the program as it is the normal practice for summer medical experience programs.

### Program Curriculum

Program days are comprised of a morning and an afternoon session (Appendix A). The morning sessions begin with "Pre-Rounds" lectures given by UCI surgical faculty on various surgical, clinical, and research-oriented topics. This is followed by an anatomy course comprised a 5-session fetal pig dissection with concordant human anatomy lectures. Two innovator groups combine and alternate between two 2-hour sessions in the Department of Urology Surgical Skills Center and the UC Irvine Douglas Hospital OR. In addition, students become certified in basic life skills training, complete an ultrasound curriculum and participate in various didactic sessions on innovation, radiology, and case discussions.

In the skills laboratory, students receive instruction from faculty mentors on surgical skills such as open knot tying and suturing along with instruction in laparoscopic, endoscopic, and robotic (Da Vinci, SI, Intuitive Surgical, Sunnyvale, CA) techniques. In the OR the students observe surgical procedures performed by faculty from multiple departments including general surgery, orthopedics, urology, and neurosurgery. OR shadowing varied from day-to-day and did not necessarily correspond with the daily didactics. The students have the opportunity to interact with the surgeons to discuss real-life applications of surgical skills and begin to develop an understanding of the role and limitations of contemporary technology in current surgical practice. The program concludes with a final examination including an anatomy practical, laparoscopic skills assessment, and written examination.