Effect of cardiothoracic surgery mentorship on underrepresented high school students

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Lack of diversity among surgeons has remained a problem in the medical workforce. There is a paucity of underrepresented in medicine (URiM) and female candidates in the surgical subspecialties and in medicine more broadly. URiM candidates make up <6% percent of physicians and only 2% of cardiothoracic surgeons.1,2 Lack of representation in these fields can be attributed to lack of exposure during childhood educational experiences, trainees’ perceptions of inadequacy or insufficient talent to enter surgical fields, lack of URiM surgeon leadership and mentorship, and top-down inaccurate perceptions regarding candidates who are female or from a racial/ethnically diverse backgrounds.3-6

Studies have shown that structured mentoring programs involving URiM trainees are associated with promotion of these trainees to pursue surgical subspecialty fields as a career.7,8 Mentorship creates an avenue for trainees to see themselves in a certain career path and understand the realistic journey toward achieving that goal.

We developed a mentorship program through the Department of Surgery, led by a cardiothoracic surgeon, for local high school students to explore surgical subspecialties. Our goals were to understand the impact of a mentorship program for URiM students and to determine how to guide other cardiothoracic groups nationwide to adopt similar programs.

CENTRAL MESSAGE
Our division created a high school mentorship program in 2016. Since then, the number of participants has risen dramatically. We encourage cardiothoracic groups broadly to create similar programs.

METHODS
Creation of the Mentorship Program
The surgical mentorship program, created in November 2016, was designed as a multiphase plan. The program’s goals were to increase the high school graduation rate, to motivate students to attend college, and to encourage students to choose careers in medicine and/or surgery. The participating high schools included high percentages of students experiencing economic hardship (92%) and students from an ethnic/racially diverse background (98.8%), as determined by the US Department of Education. Economic hardship was defined as arising from a household with an annual income at or below 185% of the official federal poverty line; in 2023, that figure is $26,273. Ethnic/racially diverse backgrounds included students of black American, Hispanic, Pacific Islander or Native American background. College readiness was determined by the Department of Education and based on standardized test scores in mathematics and evidence-based reading and writing.

Design of the Mentorship Program
The mentorship program was completed in 3 phases. During phase 1, a cardiothoracic surgeon attended local high schools to give a presentation on the mentorship program and the path from high school to becoming a cardiothoracic surgeon. Students were presented with a free opportunity to meet role models in the surgical field and get exposed to life as a surgeon. During the visit, students were instructed on the discipline and work ethic.

To view the AATS Annual Meeting Webcast, see the URL next to the webcast thumbnail.

Word cloud generated from student summative essays after phase 3.

See Commentary on page XXX.
necessary for a successful career as a surgeon. Over time, additional surgeons participated in these phase 1 visits.

Following the high school visit, phase 2 was initiated. During phase 2, high school students were invited to the medical center and engaged in surgical simulation sessions. Each session during phase 2 occurred on a Saturday morning and lasted 4 hours. Students were given a survey before and after the visits designed to elicit their plans to go to college, their interest in becoming a surgeon, and their self-confidence. Survey questions were scored on a Likert scale ranging from 1 to 5. The Wilcoxon signed-rank test was used to compare the results of the survey before and after phase 2. Institutional Review Board approval was obtained prior to survey administration.

During the sessions, a diverse group of medical students and surgery residents discussed their experiences during training and the obstacles they faced. During these lectures, the medical students and residents provided specific information about the daily lives of trainees during their education and residency. These lectures also included practical advice on specific scholarship opportunities, combined baccalaureate-medical degree programs, and strategies for the standardized tests required for college applications. Thereafter, students participated in various activities, chosen based on what the mentors and program directors felt that high school students would be able to perform to increase their self-confidence, including:

- Simulation drills using the laparoscopic simulator and fundamentals of laparoscopic surgery modules
- Knot-tying and suturing
- Basic skills on the robotic simulator, including camera control and ring roller coaster
- Cadaver dissection in the microanatomy lab
- Tour of different parts of the medical center, including the operating room, intensive care unit, and the basic laboratory of one of the surgeons in the division.

During phase 3, students applied for a summer internship. Selected interns were paid a stipend of $1000 over the summer and paired with a professional. The funding was provided by the program creator during the first several years; thereafter, departmental funds and donations were secured for part of the funding. The pairings were based on the students’ career interests. During this time, the students also participated in multiple “bonding” events that were not medically inclined, including a baseball game and other local activities. All students who were currently in high school were eligible. The internship occurred over 7 weeks of the summer. The mentor and students created their schedules based on availability. At the end of the internship, the students were each asked to write a 2-page essay summarizing their experiences. Students were also encouraged to provide feedback about the mentorship program to help guide improvements. Free text responses from the participants were collected and analyzed for themes. Simple content and thematic analyses were used.

RESULTS

Participants

The program expanded over time. In the first year of the program, only 1 high school was visited, but by 2022, 16 high schools were involved in phase 1. The number of student participants in phase 2 (Figure 1) and phase 3 (Figure 2) rose dramatically; by 2022, the number of phase 3 applicants had risen from 11 to 438. The number of selected interns increased from 4 in 2016-2017 to 34 in 2021-2022. Owing to the Coronavirus disease 2019 pandemic, the program was suspended from April 2020 to October 2021. No phase 3 program was offered in the summer of 2020 or the summer of 2021, as institutional pandemic policies barred high school students from campus for shadowing or observation.

Students’ Self-Perception

Survey results from phase 2 are shown in Table 1. The data show a statistically significant increases in students’ desire to choose a career in medicine, confidence in their level of preparation for college, and self-confidence in their ability to become a surgeon.
Students selected for phase 3 overwhelmingly had a positive experience during their summer internship over the years. A word cloud generator used to analyze the summative essays of the students (Figure 3) found that the most-used words were “opportunities” and “experience.” Representative student comments about their internship included the following:

“I really appreciate the program for choosing me. I probably never would have gotten this opportunity.”

“This internship helped me realize that I have the ability to create a lot of change in the world and make a difference.”

“This internship has given me many opportunities I would have never had before. It has taught me to shoot my shot even if I am unsure.”

“Did you find any surprises or limitations in the program?”

“It was important to see people that look like me doing the job that I wanted to do.”

“I am usually a loner. The program stressed how important networking is.”

**DISCUSSION**

Our division began this program in 2016 and has learned many lessons since then. We began this program with the idea that many URI students have never envisioned a career in surgery. Our idea arose from the common aphorism “If you can see it, you can be it.” Because younger generations tend to be more visual learners, we believe that surgeons have particular advantages that make them favorable mentors. This generation also reacts favorably to hands-on experiences, like simulations. Many surgery

**TABLE 1. Survey results before and after phase 2 (mean)**

<table>
<thead>
<tr>
<th>Survey question</th>
<th>Before</th>
<th>After</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I plan on going to college after high school.”</td>
<td>4.66</td>
<td>4.69</td>
<td>.66</td>
</tr>
<tr>
<td>“I am interested in pursuing a career in medicine.”</td>
<td>4.25</td>
<td>4.47</td>
<td>.03</td>
</tr>
<tr>
<td>“I know what subjects I want to study in college.”</td>
<td>4.25</td>
<td>4.59</td>
<td>.03</td>
</tr>
<tr>
<td>“I am interested in pursuing a career in medicine.”</td>
<td>3.91</td>
<td>4.19</td>
<td>.02</td>
</tr>
<tr>
<td>“I am interested in pursuing a career as a surgeon.”</td>
<td>3.06</td>
<td>3.72</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>“I am prepared for the academic obligations of college.”</td>
<td>3.97</td>
<td>4.44</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>“I am confident that I will accomplish my career goals.”</td>
<td>4.63</td>
<td>4.78</td>
<td>.02</td>
</tr>
<tr>
<td>“I have the dexterity and physical ability required to become a surgeon one day.”</td>
<td>3.53</td>
<td>4.03</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Survey questions were scored on a Likert scale ranging from 1 to 5.
programs have the advantage of accessible simulation centers and experience with equipment in these centers. Our high school students have been very enthusiastic about this part of the program in particular. In addition, many of the students are incredibly gifted despite their young age. They have been using electronic devices and developing hand-eye coordination since their preadolescent years.\textsuperscript{12,13}

We saw that students developed an increased level of self-confidence following phase 2 activities. One of the most important reasons for this trend is that students realized how skilled they were with technical drills and surgical simulation.

We exposed high school students to a racial/ethnically diverse array of medical students, surgery residents, and attending surgeons during their participation. The majority of high school students were URiM students, but we believe that there is value in diversity of mentors. When selecting mentors to participate in phases 1 and 2, we intentionally tried to include different races, genders, religions, and ages. Although our focus is on surgery, we feel that it is crucial for high school students to see that a diverse group of professionals can interact well with each other and come together for a common purpose. Another benefit of a diversity of mentors is that it allows high school students to be exposed to younger trainees. In our experience, the medical students and surgery residents were able to provide a different perspective than that provided by the older attending surgeons. Although the high school students did respond well to the attending surgeons, it seemed that they were able to relate to the trainees on a different level. Having trainees closer in age to the high school students was invaluable, and we would recommend this strategy for other institutions planning a mentorship program.

Cardiothoracic surgery departments interested in starting a mentorship program for underrepresented youth may face the dilemma of a lack of underrepresented faculty in their department. Although there is value in the diversity of mentors, departments can overcome this obstacle in several ways. Cardiothoracic groups can partner with other departments in surgery or medicine for joint efforts to increase the number of underrepresented mentors. Cardiothoracic departments also can engage underrepresented medical students and residents, as the diversity is slightly greater among trainees than among cardiothoracic attending surgeons. Finally, outside speakers who specialize in career development of youth can be hired for mentorship programs. Our mentorship program has drawn on each of these strategies to increase the number of underrepresented mentors for the students.

When selecting students for the phase 3 summer internship, initially one surgeon and the program creator chose the students. This approach was not ideal, especially as the number of applicants topped 400. To be more equitable and just, we decided to create a committee, a diverse group that included some members from outside the division and comprised a wide array of ethnicities, genders, and ages. We included nonphysicians in the committee as well. As the number of applicants increased, our committee had

\begin{figure}
\centering
\includegraphics[width=\textwidth]{word_cloud.png}
\caption{Word cloud generated from phase 3 student summative essays.}
\end{figure}
thought-provoking discussions about the selection criteria. The application included metrics such as grade point average, previous work experience, and career interests. Our dilemma concerned the students who would reap the largest benefit from being chosen. The high-achieving student is likely to do very well anyway, but being chosen may elevate their college application to an elite level. As such, our program may not benefit that particular student, while it would have benefited a higher-achieving student more. Having a committee involved has helped make these very difficult choices. Our approach has been to have a combination of high-achieving and lower-achieving students selected for phase 3. We have seen that there is benefit in the interactions among the high school students from various backgrounds.

As the program has grown, we have needed more mentors. Finding enough surgeons to participate as mentors can be difficult. Most altruistic work or projects related to diversity and equity are not compensated. Surgeons already have very challenging daily schedules. They must meet a clinical work target, publish manuscripts, secure extramural funding, and train students and residents. This set of demands has led to a high burnout rate among surgeons. Many surgeons who are interested in being mentors may simply not have enough time to participate. To overcome this obstacle, it will be helpful to meet with division/department or institutional leadership. If there is a way to use discretionary funds or provide “altruistic” relative value units, it may be easier to recruit mentors.

As we have progressed, we have also realized that our evaluations of the students and program can become more robust. Going forward, we have partnered with qualitative research investigators to change our evaluation surveys during phase 2 and our interpretation of the summative essays during phase 3. We are also implementing suggestions received in feedback from students, for example, a request from multiple students for more group activities to allow for thought-provoking discussions about the selection criteria. The application included metrics such as grade point average, previous work experience, and career interests. Our dilemma concerned the students who would reap the largest benefit from being chosen. The high-achieving student is likely to do very well anyway, but being chosen may elevate their college application to an elite level. As such, our program may not benefit that particular student, while it would have benefited a higher-achieving student more. Having a committee involved has helped make these very difficult choices. Our approach has been to have a combination of high-achieving and lower-achieving students selected for phase 3. We have seen that there is benefit in the interactions among the high school students from various backgrounds.

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Given the low percentage of URiM cardiothoracic surgeons, we encourage other cardiothoracic programs to create similar mentorship programs. Our profession already has a shortage of surgeons, and this problem is expected to worsen over the next decade. Engaging the young generation in their high school years is important to motivate these students to enter a career in cardiothoracic surgery. Our hope is that cardiothoracic groups across the country create similar programs. We present our approach and results as a general guide. We understand that our center is located in the middle of a large urban area, and that another medical center in a very dissimilar area will likely have different logistical considerations. Regardless, we believe that all cardiothoracic groups can provide meaningful mentorship, and that these programs will ultimately aid our profession.

Webcast

You can watch a Webcast of this AATS meeting presentation by going to: https://www.aats.org/resources/effect-of-cardiothoracic-surgery-mentorship-on-underrepresented-high-school-students.

Conflict of Interest Statement

The authors reported no conflicts of interest.

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References


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