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AOA Critical Issues in Education

The Impact of a Virtual Orthopaedic Surgery Symposium on Medical Students: Increasing Awareness and Knowledge of the Field

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Background: Orthopaedic surgery has become an increasingly popular field of residency training for medical students. Many institutions offer elective time to explore areas of interest through clinical rotations and research; however, most of these opportunities are reserved for senior medical students. The purpose of this study was to evaluate the impact of a dedicated medical student orthopaedic surgery symposium to increase awareness about the field and to assess students' interest and knowledge of orthopaedic surgery before and after the symposium.

Methods: Medical students were invited to submit orthopaedic surgery-related research to a free, 1-day virtual symposium held in April 2022. Abstracts were reviewed and selected from 9 different orthopaedic surgery subspecialty categories. Survey assessments were sent to medical students to complete before and after the symposium. The surveys included questions related to participant demographics as well as interest and knowledge about the field of orthopaedic surgery. Statistical analyses were completed to compare the participants' responses before and after the symposium.

Results: In total, 962 medical students registered for the 4-hour symposium. Of these, 58.5% completed the pre-symposium survey and 48.0% completed the postsymposium survey. 13.3% of the respondents reported being "very knowledgeable" about the various orthopaedic surgery subspecialties before the symposium, which increased to 18.4% after the symposium. 46.9% of the participants stated that they were "knowledgeable" about the daily life of an orthopaedic surgery resident before the symposium, which increased to 67.3% after the symposium. Similarly, the percentage of respondents who reported that they were "very knowledgeable" about the residency match process increased from 12.2% presymposium to 22.4% postsymposium.

continued

*A list of the Medical Student Orthopedic Society members is provided in a Note at the end of the article.

This study was approved by the George Washington University Institutional Review Board under protocol NCR213801. It was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Disclosure: The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (<http://links.lww.com/JBJSOA/A429>).

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Conclusions: As interest in pursuing a career in orthopaedic surgery increases, medical students will continue to seek information, mentorship, and opportunities to present their research in preparation for residency applications. Our study demonstrated that a large-scale, national, virtual orthopaedic surgery symposium provided a platform to augment medical students' knowledge of the field, present their research, and interact with faculty members.

Level of Evidence: Level V.

Introduction

Securing an orthopaedic surgery residency position has become increasingly more difficult. In the most recent National Resident Matching Program Match cycle, there were 1,470 applicants for 875 available positions, resulting in an overall match rate of just 59.5%¹. Given the competitive nature of orthopaedic residency selection, medical students interested in the field have been more focused on obtaining early mentorship and advocacy from orthopaedic surgeons and conducting research within the field². Participation in research in orthopaedic surgery also helps medical students develop insight into study design, critical examination of the literature, data presentation, academic collaboration, and formation of innovative ideas for future studies. In addition, research participation provides students with an opportunity to learn more about the field of orthopaedic surgery, which is often underrepresented in the US medical school curriculum. Earlier introduction to the field of orthopaedic surgery could allow for a more diverse applicant pool because students may develop interest in a field previously less known to them.

In recent years, orthopaedic surgery has been one of the most competitive residency specialties, with applicants having some of the highest requirements among specialties for US Medical Licensing Examination (USMLE) Step 1 and Comprehensive Osteopathic Medical Licensing Examination (COMLEX) board score averages, clinical grades, and number of research publications³. As of January 2022, the USMLE Step 1 and COMLEX Level 1 switched to a pass/fail grading system. Historically, research was not as significant as Step scores or clinical grades in the orthopaedic surgery residency application process⁴. However, the transition of board examinations to the pass/fail grading system has now made research experience and mentor advocacy increasingly important components of residency applications⁵.

The first Medical Student Orthopaedic Symposium (MSOS) was held on April 10, 2022. This free, medical student-run, virtual symposium was created to provide interested students the opportunity to present their research and learn more about the field of orthopaedic surgery. The purpose of this study was to evaluate the impact of this symposium. We hypothesized that, after the inaugural MSOS, students would have a greater interest in and knowledge about research, the life of orthopaedic surgery residents, and the residency application process.

Materials and Methods

Symposium

A 1-day virtual medical student orthopaedic surgery symposium was held on April 10, 2022. The symposium

planning committee consisted of 11 orthopaedic surgery attending physicians, 2 orthopaedic surgery residents, and 8 medical students. The committee developed a website and social media accounts to promote the symposium. Electronic communication and social media were the main modes of promotion, with individual school orthopaedic surgery interest groups targeted for promotional distribution.

The symposium consisted of 305 research presentations and 2 panels. The research categories included hip and knee reconstruction, foot and ankle, shoulder and elbow, hand and wrist, spine, trauma, sports medicine, pediatrics, oncology, basic science, practice management, medical education, and health disparities. The first panel was "A Day in the Life of an Orthopaedic Surgery Resident," which included 6 resident panelists from different institutions. The second panel was "How to be a Competitive Residency Applicant," which included 6 orthopaedic surgery program directors.

Study Participants

The 962 medical students who registered for the symposium were invited to complete the anonymous surveys. These were students from US allopathic and osteopathic medical schools as well as international medical schools. Participation in the surveys was voluntary, and no compensation was provided for participation. This study was approved by the primary institution's Institutional Review Board.

Surveys

Survey assessments were given to the medical students before and after the symposium (Appendices 1 and 2, <http://links.lww.com/JBJSOA/A430>). The presymposium survey was provided to the students after initial symposium registration. The post-symposium survey was provided to the students within 24 hours after the conclusion of the symposium. The survey included questions related to demographics such as age, sex, race, year in medical school, and allopathic or osteopathic medical school education. In both the presymposium and postsymposium surveys, questions regarding the students' interest in orthopaedic surgery were asked, including how likely the student was to pursue a career in orthopaedic surgery. Students' knowledge of orthopaedic surgery was further ascertained through several questions focusing on their knowledge of the orthopaedic surgery subspecialties, the daily life of an orthopaedic surgery resident, and the residency match process.

In the presymposium survey, data collection included the number of research experiences, posters/presentations, and

publications as well as whether the student had a mentor. In the postsymposium survey, data collection included the determination of students' attendance, participation, and satisfaction with the various symposium sessions. Study data were collected and managed using Research Electronic Data Capture⁶.

Statistical Analysis

Descriptive analyses were used to calculate the frequency and percentage of each response to all questions in the survey. Summary statistics were reported for demographic data. Results for all participants who completed the presymposium and postsymposium surveys were independently recorded. The results were further analyzed for the subset of participants who completed both the presymposium and postsymposium surveys with the use of a unique identifier. Multivariate analyses were performed with results being reported as odds ratios with 95% confidence intervals. The Statistical Package for Social Sciences (SPSS; Version 28) software was used for all analyses in this study. A p-value of <0.05 was considered statistically significant.

Source of Funding

There was no source of funding for this study.

Results

Study Participants

Responses for the presymposium survey were received from 563 medical students (58.5%), and postsymposium surveys were received from 462 medical students (48.0%). Two hundred ninety-five students (52.4%) completed both the presymposium and postsymposium surveys. Most of the survey participants were male (64.1%) and between 25 and 29 years (57.0%) (Table I). Most of the participants were White (45.6%), followed by Asian (20.2%) and Black (11.2%). Most were third-year (31.6%) or second-year (30.7%) medical students. Respondents mainly attended US allopathic medical schools (74.8%) (Table I).

More than one-third of the participants had 5 or more research experiences in any field of medicine (35.5%), followed by 3 to 4 research experiences (27.2%) (Table II). Thirty-eight percent of the respondents had between 1 and 3 research posters or presentations accepted to conferences in any field of medicine while 21% did not have any accepted posters or presentations before the symposium (Table II). In addition, 39% of respondents had between 1 and 3 publications in peer-reviewed journals while 35% did not have any publications before the symposium (Table II). Although slightly more than half of the participants (58.4%) had a mentor in the field of orthopaedic surgery, many of the participants were looking for a mentor to provide advice and guidance about the match process and expand their network (Table III).

Presymposium Survey Analysis

Our results showed that as students progressed in medical school, they were more likely to have an orthopaedic surgery mentor (odds ratio [OR] OR 1.51; 95% confidence interval [CI] 1.14-2.00). There was also an association between the type of

TABLE I Participant Characteristics

Demographics	N (%)
Age (yrs)	
20-24	184 (32.7)
25-29	321 (57.0)
30-34	49 (8.7)
35-39	7 (1.2)
≥40	2 (0.4)
Year in medical school	
1st yr	107 (19.0)
2nd yr	173 (30.7)
3rd yr	178 (31.6)
4th yr	38 (6.7)
Research yr	50 (8.9)
Other	17 (3.0)
Type of medical school	
US Allopathic Medical School (MD)	421 (74.8)
US Osteopathic Medical School (DO)	97 (17.2)
International Medical Graduate	40 (7.1)
Other	5 (0.9)
Sex	
Male	361 (64.1)
Female	193 (34.3)
Transgender female	1 (0.2)
Transgender male	1 (0.2)
Sex nonconforming	1 (0.2)
Prefer not to answer	6 (1.1)
Race	
American Indian	6 (1.1)
Asian	114 (20.2)
Black or African American	65 (11.5)
Hispanic/Latino	56 (9.9)
Native Hawaiian or other Pacific Islander	6 (1.1)
White	257 (45.6)
Multiple races/ethnicities	36 (6.4)
Prefer not to answer	23 (4.1)

medical school and whether students had a mentor. US allopathic students were more likely to have a mentor compared with students who attended US osteopathic medical schools or international medical schools (OR 1.94; 95% CI 1.28-2.94). There was no association between sex and having a mentor ($p = 0.655$).

Postsymposium Survey Analysis

In the postsymposium survey, 83.5% of respondents reported that they planned to connect with other medical students, residents, and attending physicians who they met at the symposium (Table IV). More than 75% of the survey participants attended all the symposium sessions, with the greatest interest in the program director panel (87.2%) and resident panel

TABLE II Research Experience and Publications of Participants

Questions*	Presymposium Survey (N = 563)
Statement: how many research experiences have you had in any field of medicine?	
0	24 (4.3)
1	56 (9.9)
2	116 (20.6)
3-4	153 (27.2)
≥5	200 (35.5)
Statement: before this symposium, how many research posters or presentations have you had accepted to conferences in any field of medicine?	
0	119 (21.1)
1-3	212 (37.7)
4-6	104 (18.5)
7-9	48 (8.5)
≥10	66 (11.7)
Statement: how many publications in peer-reviewed journals in any field of medicine have you had accepted?	
0	195 (34.6)
1-3	217 (38.5)
4-6	78 (13.9)
7-9	27 (4.8)
≥10	32 (5.7)

*The values represent the number of participants, with the percentage indicated in parentheses.

(85.5%). Overall, most of the respondents were satisfied with the symposium, and 84% would recommend the symposium to others (Table IV).

Comparison of Presymposium and Postsymposium Knowledge

The self-reported levels of interest and knowledge of orthopaedic surgery were measured in both the presymposium and postsymposium surveys. The results for all participants who completed the presymposium and postsymposium surveys independently are provided in Appendix 3, <http://links.lww.com/JBJSOA/A430>. The results for respondents who completed *both* the presymposium and postsymposium surveys are given in Table V. There was no change in whether respondents wanted to pursue orthopaedic surgery as a career. Approximately 13.3% reported being “very knowledgeable” concerning the various orthopaedic surgery subspecialties before the symposium, which increased to 18.4% after the symposium. Most of the respondents (46.9%) stated that they were “knowledgeable” about the daily life of an orthopaedic surgery resident before the symposium, which increased to 67.3% after the symposium. Similarly, the percentage of respondents who reported being “very knowledgeable” about the residency match process increased from 12.2% presymposium to 22.4% post-

symposium (Table V). Similar results regarding the interest level and knowledge of orthopaedic surgery were found when participants were stratified by age (i.e., younger than 30 years), sex (i.e., male and female), year in medical school (i.e., first and second years, third and fourth years), and the type of medical school (i.e., US allopathic and osteopathic and international). The stratified results are summarized in Appendices 4-10, <http://links.lww.com/JBJSOA/A430>. In total, there was a 40% to 80% increase in the number of medical students who felt “very knowledgeable” about the various orthopaedic subspecialties, the daily life of an orthopaedic surgery resident, and the residency match process after the symposium.

Discussion

Introducing orthopaedic surgery attendings and residents, as well as orthopaedic research, to medical students earlier in their training can help increase their knowledge about the specialty. However, the curriculum of US medical schools provides little access to orthopaedic surgery until the clinical years, and even then, exposure is quite sparse relative to other clinical subspecialties. Consistent with our initial hypothesis, this novel, 1-day, virtual symposium provided medical students with exposure to orthopaedic surgery research and improved their knowledge of the field. After the symposium, the participants had a greater knowledge of orthopaedic surgery and planned to connect with symposium participants after the event.

Symposia are an effective method to expose trainees to a field in medicine⁷. Within the field of interventional radiology, several medical student symposia have been organized. These symposia included didactic lectures, hands-on simulation models, and networking with faculty members⁸⁻¹⁰. In line with our findings, these symposia improved medical students' interest and knowledge of the field, increased their understanding of the

TABLE III Mentorship of Participants

Questions*	Presymposium Survey (N = 563)
Statement: do you have a mentor in the field of orthopaedic surgery?	
Yes	329 (58.4)
No	218 (38.7)
Statement: what are you looking for a mentor to provide? (check all that apply)	
Advice regarding away rotations	434 (77.1)
Guidance about the orthopaedic surgery match process	484 (86.0)
Opportunities to network and meet other people in a specific orthopaedic surgery subspecialty	498 (88.5)
Provides research opportunities	460 (81.7)

*The values represent the number of participants, with the percentage indicated in parentheses.

TABLE IV Satisfaction of Participants and Attendance in the Various Symposium Sessions

Questions*	Postsymposium Survey (N = 462)
Statement: which barriers, if any, have you faced to presenting any orthopaedic-related research this year? (check all that apply)	
COVID-19 pandemic	189 (40.9)
Project submissions rejected	148 (32.0)
Other	51 (11.0)
None	144 (31.2)
Statement: do you plan to connect with medical students, residents, or attending physicians that you met at this symposium (ex: follow on social media, send an email, etc)?	
Yes	386 (83.5)
No	32 (6.9)
Statement: what sessions did you attend? (check all that apply)	
Opening remarks	349 (75.5)
Award-winning presentations	362 (78.4)
Breakout sessions	375 (81.2)
Resident panel	395 (85.5)
Program director panel	403 (87.2)
Closing remarks	362 (78.4)
Statement: how satisfied were you with the breakout room sessions?	
Very satisfied	285 (61.7)
Somewhat satisfied	87 (18.8)
Not satisfied	12 (2.6)
Did not attend	34 (7.4)
Statement: how satisfied were you with the resident and program director panels?	
Very satisfied	372 (80.5)
Somewhat satisfied	34 (7.4)
Not satisfied	2 (0.4)
Did not attend	10 (2.2)
Statement: how likely are you to recommend this symposium to someone else?	
Very likely	386 (83.5)
Somewhat likely	29 (6.3)
Not likely	1 (0.2)
Not at all	0 (0.0)
Not sure	2 (0.4)
*The values represent the number of participants, with the percentage indicated in parentheses.	

training pathways, and motivated students to seek out further opportunities within the field⁸⁻¹⁰. Similar symposia have also been developed in surgical fields. Roch et al. demonstrated that

after a medical student symposium for minimally invasive surgery (MIS), the students' interests in MIS and surgery in general increased, with many of the students enjoying the laparoscopic hands-on experience¹¹. Symposia have also been used to educate attendees on specific topics. To train future physicians to recognize and respond to trauma, Chokshi et al. developed a 4-hour symposium for medical students on trauma-informed care¹². After the symposium, students' knowledge and understanding of trauma care improved and attendees said that they would be comfortable applying trauma-informed care in clinical practice¹².

Conducting research and presenting main findings teaches medical students how to present data and communicate effectively and how to collaborate with others. Prior research has shown that participation in research early in medical school facilitates the development of physician-scientists and competent clinicians¹³. For example, Young et al. found that one-third of medical students complete medical school without significant exposure to research¹⁴. However, the authors further stated that research not only exposes students to scientific methodology and academic writing but also teaches students how to multitask, communicate, and analyze the scientific literature¹⁴. Along these same lines, the MSOS provided a platform for students to highlight their research and learn how to effectively communicate study findings. Furthermore, the symposium allows another opportunity for medical students to gain exposure to the field. Of note, approximately 20% of our attendees were from osteopathic and international medical schools. Interestingly, our study found that, compared with U.S. allopathic medical students, osteopathic and international medical school students were less likely to have a mentor in the field of orthopaedic surgery. Our symposium provided an opportunity for these students to connect with potential mentors because many may not have orthopaedic surgery departments at their home institution.

The demographics of the student participants and presenters were also more diverse than those applying to orthopaedic surgery. In 2019, the total percentage of female orthopaedic applicants was 19.3%¹⁵. In our symposium, the percentage of female medical student participants was nearly double this percentage at 34.3%. Regarding race, in 2019, the distribution of applicants who were White, Asian American, African American, Hispanic or Latino, or other was 64.2%, 14.7%, 6.2%, 3.8%, and 11.1%, respectively¹⁵. The participants of our symposium were more diverse than the pool of orthopaedic surgery applicants with the percentage of students being White, Asian American, African American or Black, Hispanic or Latino, or other being 45.6%, 31.7%, 11.5%, 9.9%, and 7.5%, respectively. Although this study is unable to assess a correlative relationship of the impact of this symposium on orthopaedic surgery applicants, the diversity of the participants at this event is encouraging for the future of orthopaedic surgery. We speculate that the diversity of our attendees is a testament to the work that other groups, such as Perry Initiative, Nth Dimensions, the Ruth Jackson Orthopaedic Society, the J Robert Gladden Orthopaedic Society, Pride Ortho, and #SpeakUpOrtho, have been doing in increasing interest and diminishing potential barriers for URiMs in orthopaedics. These groups have been instrumental in

TABLE V Interest and Knowledge in Orthopaedic Surgery for Matched Participants

Questions*	Presymposium Survey (N = 295)	Postsymposium Survey (N = 295)
Statement: how likely are you to pursue a career in orthopaedic surgery?		
Very certain	185 (62.7)	184 (62.4)
Most likely	87 (29.5)	87 (29.5)
Not likely	6 (2.0)	7 (2.4)
Not at all	1 (0.3)	1 (0.3)
Not sure	16 (5.4)	16 (5.4)
Statement: how familiar are you with all the orthopaedic surgery subspecialties?		
Very knowledgeable	39 (13.3)	54 (18.4)
Knowledgeable	188 (63.6)	191 (64.6)
Neutral	47 (16.0)	38 (12.9)
Little knowledge	19 (6.5)	12 (4.1)
No knowledge	2 (0.7)	0 (0.0)
Statement: how knowledgeable are you about the daily life of an orthopaedic surgery resident?		
Very knowledgeable	26 (8.8)	49 (16.7)
Knowledgeable	139 (46.9)	199 (67.3)
Neutral	93 (31.6)	39 (13.3)
Little knowledge	35 (11.9)	8 (2.7)
No knowledge	2 (0.7)	0 (0.0)
Statement: how knowledgeable are you about the orthopaedic surgery residency match process?		
Very knowledgeable	36 (12.2)	66 (22.4)
Knowledgeable	153 (51.7)	188 (63.6)
Neutral	76 (25.9)	34 (11.6)
Little knowledge	25 (8.5)	6 (2.0)
No knowledge	5 (1.7)	1 (0.3)

*The values represent the number of participants, with the percentage indicated in parentheses.

“demystifying” and replacing the anecdotal, stereotypical orthopaedic surgeon. Diversity among medical students interested in orthopaedics is likely because of these groups in large part. Regarding our symposium, many of these societies directly promoted our event to their listserv of students, permitting dissemination about the symposium to a diverse population of medical students. Anecdotally, those involved with our society have noted that their interest in orthopaedics has been largely influenced by the work done by these groups.


The findings of this study should be viewed in the context of its limitations. Chiefly, our results and analyses are based on surveys of one symposium. Consequently, future longitudinal studies should be performed to investigate follow-up data, which would provide greater insight into whether the symposium affects future attitudes, application strategies, and diversity. Future analyses for this symposium can observe students' personal assessments of their presentation skills and the impact of the symposium on

improving these skills. Furthermore, our symposium focused mainly on the research aspect of orthopaedic surgery and panels on the orthopaedic surgery residency and match process. Future symposia could also incorporate a greater clinical component such as a virtual suture clinic to teach clinical skills. Finally, future analyses can seek to understand why students attended the symposium. Regarding the 2 panels, the study showed that participants were highly interested in the content discussed, gaining useful advice from the panelists. However, neither of the panels was recorded to facilitate an honest discussion. Thus, we are unable to provide a transcript of the discussion for nonparticipants.

In conclusion, as interest in pursuing a career in orthopaedic surgery increases, medical students will continue to seek information, mentorship, and opportunities to present their research in preparation for residency applications. Our study demonstrated that a large-scale virtual national orthopaedic surgery symposium provided a platform to augment medical

students' knowledge of the field, present their research, and interact with faculty members.

Appendix

 Supporting material provided by the authors is posted with the online version of this article as a data supplement at [jbjs.org \(http://links.lww.com/JBJSOA/A430\)](http://links.lww.com/JBJSOA/A430). This content was not copyedited or verified by JBJS. ■

NOTE: On behalf of the Medical Student Orthopedic Society: Michael P. Ast, MD; Sophie Bernstein, BA; Joshua Campbell, MD; Cara A. Cipriano, MD; Avilash Das, MD; Marvin E. Dingle, MD; Teresa Doerre, MD; Samuel I. Fuller, BS; Tara Harmon; Grant Hogue, MD; Ivan Z. Liu, BA; Daniel London, MD; Mary K. Mulcahey, MD; Rachel Ranson, DO; Dustin Schuett, DO; Dhruv Sharma, BS; Uma-suthan Sriksumar, MD; Sean A. Tabaie, MD; Omar H. Tarawneh, MS; Savyasachi C. Thakkar, MD; BS; Amy Zhao, BA.

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