Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Virtual vascular surgery interest group during the coronavirus disease 2019 pandemic

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ABSTRACT

Objectives: Early exposure to vascular surgery at the medical student level positively influences one's decision to apply into an integrated vascular surgery residency program. Vascular surgery interest groups (VSIGs) are student-run and aim to facilitate such exposure, traditionally via in-person events. Social distancing during the coronavirus disease 2019 pandemic disrupted these interactions. This is a description of the virtual activities of a VSIG group during the 2020-2021 academic year and highlights their impact among medical students.

Methods: The virtual activities of the VSIG at the Yale School of Medicine were reviewed. Students received surveys prior and after activities to assess their impact. Preactivity and postactivity surveys using Likert scale (1 = completely disagree; 5 = completely agree) were administered and compared. Statistical significance was achieved with a P value of less than .05.

Results: A total of five virtual events were held: an Introductory Session (October 2020), a Simulation Session (November 2020), a Research Night (January 2021), a Journal Club (February 2021), and a National Match Panel (April 2021). The surveys of three events (Introductory Session, Simulation Session, and National Match Panel) were analyzed. Attendance at these events were 18, 55, and 103 respectively. The average presurvey response rate was 51.2% and the average post-survey response rate was 27.46%. Students agreed that the Introductory Session increased their knowledge about vascular surgery as a subspecialty (4.22 ± 0.67) and that the session was valuable to their time (4.33 ± 1.00). The Simulation Session increased student's comfort with knot tying from 1.73 ± 0.89 to 3.21 ± 1.25 ($P < .001$). Students reported an increased understanding of residency program selection (2.39 ± 1.10 vs 3.21 ± 1.12; $P = .018$), the Electronic Residency Application Service application (2.16 ± 1.01 vs 3.00 ± 0.88; $P = .007$), and letters of recommendation (2.45 ± 1.07 vs 3.14 ± 1.17; $P = .04$). Students particularly had a significant increase in the understanding of the logistics of residency interviews, which were held virtually that year for the first time (1.84 ± 0.96 vs 3.29 ± 1.20; $P < .001$).

Conclusions: Virtual VSIG activities were feasible and effective during the pandemic in promoting student engagement and interest in vascular surgery. Despite lifting social distancing measures, the virtual format could become a valuable tool to expand outreach efforts of the vascular surgery community to recruit talented medical students. (J Vasc Surg 2022;■:1-7.)

Keywords: Vascular surgery; Interest group; Virtual medical education; Surgical simulation

As the population of the United States ages and the prevalence of vascular disease increases, it is predicted that there will be a vascular surgeon shortage in the upcoming years.[1,2] Thus, the pipeline of future vascular surgeon trainees is crucial to sustain the continuity of vascular care for the population. Although there has been an increase in US applicants to integrated vascular surgery programs, early exposure to the subspecialty facilitates long-term interest and prevents attrition of candidates.[3-6] The creation of vascular surgery interest groups (VSIGs) in medical schools is key to those efforts.[6] Traditionally, interest groups have been shown to positively influence students' decisions to apply into smaller subspecialties, including vascular surgery, by providing clinical exposure, suturing and simulation workshops, case presentations, research projects, and mentoring opportunities.[7-11]

The coronavirus disease 2019 pandemic altered many aspects of medical education. Primarily, many traditional and critical in-person facets of medical education were shifted to a virtual format.[12-14] In a recent survey of VSIGs, it was reported that interest groups activities were halted in more than 60% medical schools during the pandemic.[15] In an effort to continue vascular surgery engagement with medical students, the Yale School of

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Medicine VSIG continued with virtual activities. Although there is no replacement for in-person learning, virtual events allowed students to continue engaging with vascular surgery throughout this unprecedented year. Described herein are the various activities held by that group during the 2020-2021 academic year and its impact on students.

METHODS

This descriptive report was deemed exempt by the institutional review board. The activities of the Yale VSIG between June 2020 and June 2021 were reviewed and summarized. The goal and content of each activity was described. Presurveys and postsurveys were conducted to obtain information on the demographics of the attendants as well as their level of knowledge pertinent to the content of the various activities. Specific questions were administered to assess the impact on the students using a Likert scale (1 = completely disagree; 5 = completely agree). Presurveys and postsurveys were administered following most sessions via Google Forms (Alphabet Inc. Mountainview, CA) (Supplementary Tables I-III, online only). Presurveys were open for responses for 1 week before the events and postsurveys were open for responses for 1 week after the events. All responses were deidentified.

Demographic information was analyzed using descriptive statistics. Presurveys and postsession responses were analyzed using paired *t* tests via R Statistical Computing (The R Foundation for Statistical Computing, Vienna, Austria). For the Match Panel, presurvey and postsurvey responses were matched. A *P* value of less than .05 was deemed significant.

Events. Five events were held under the direct supervision of a resident liaison and faculty advisor: an Introductory Session (October 2020), a Simulation Session (November 2020), a Research Night (January 2021), a Journal Club (February 2021), and a National Match Panel (April 2021). All events were conducted via Zoom (Zoom Video Productions, Inc., San Jose, CA). The Introductory Session was open to all medical students at the institution. The event was held on October 1, and consisted of one 30-minute introductory lecture from the leaders of the VSIG, followed by two 10-minute interesting case presentations by the resident liaison, and concluded with a 10-minute interactive question and answer session with the vascular surgery faculty attending the session.

The Simulation Session took place on November 18, 2020. Before the event, suturing materials (Castroviejo needle holder, pick-ups, Penrose drains, 5-0 Prolene sutures, and silk sutures) were purchased from faculty donations and provided to medical students in a socially distant manner. Every student received a set of suturing materials to keep. A suturing video demonstrating the correct use of Castroviejos and one-handed and two-handed knot tying was created by the senior students in the group, reviewed by the faculty, and then distributed electronically to the students before the event. The event started with an orientation (10 minutes) followed by demonstration of an endovascular aneurysm repair simulation (20 minutes), using a Medtronic (Medtronic, Dublin, Ireland) simulator. Next, the group was split into alternating 15-minute, break-out sessions to participate in either knot tying or suturing in zoom rooms under the supervision of vascular surgery faculty or chief residents. Students and faculty were encouraged to use a multiscreen display or additional electronic devices to engage in the small group virtual chat rooms while simultaneously displaying their hands. Faculty were able to view multiple participants at once and give real-time, verbal feedback.

The Research Night was held on January 13, 2021 via Zoom. The session consisted of a short introduction to vascular surgery research, followed by a 10-minute presentation on funding opportunities. Afterward, attendings delivered 5-minute presentations regarding their research. This was followed by a question and answer session with medical students currently conducting vascular surgery research with various attendings. As part of a school-wide initiative for online events, food delivery vouchers were offered at this event.

The Journal Club was held on February 15, 2021. It consisted of a 30-minute presentation surrounding two recent papers in vascular surgery regarding paclitaxel-coated devices.[16-18] Notably, these presentations were given by medical students and open for discussion throughout. This was followed by 30 minutes of active discussion with attendings and students. Food delivery vouchers were also offered at this event.

The National Match Panel was held on April 1, 2021, approximately 2 weeks after the National Resident Matching Program's Match Day (March 19, 2021). The panel consisted of six incoming integrated vascular

ARTICLE HIGHLIGHTS

- **Type of Research:** Single-center descriptive report
- **Key Findings:** Five virtual events were held by a vascular surgery interest group during an academic year. After an introductory event, vascular surgery knowledge increased. After a simulation session, comfort in suturing and knot-tying increased. A virtual National Match Panel increased understanding of residency program and application, recommendation letters, factors to consider when exploring programs, and creating rank lists.
- **Take Home Message:** A virtual Vascular surgery interest group is feasible and effective in stimulating medical student interest in vascular surgery particularly during a pandemic.

Table I. Attendance data

	Signed up	Attendance	Pre-event survey	Postevent survey
Introductory session	28	18	14	11
Simulation session	79	55	64	25
Research panel	70	62	–	–
Journal club	66	51	–	–
National Match Panel	194	103	44	22

Values are number.

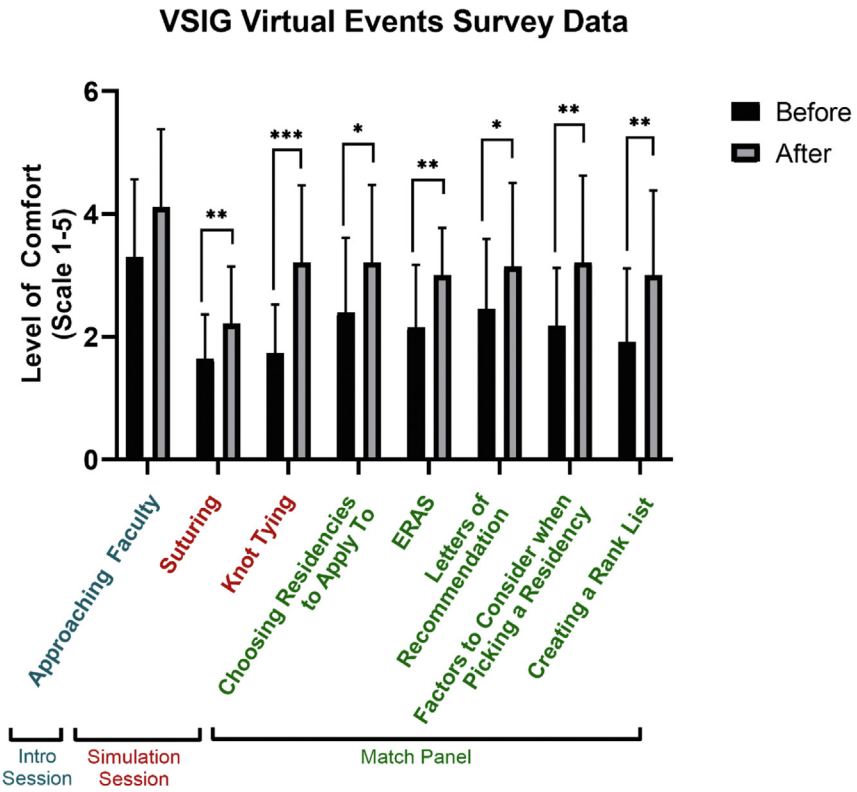

Fig. Survey data regarding students' comfort levels pre and post virtual activity session. *ERAS*, Electronic Residency Application Service; *VSIG*, vascular surgery interest group.

surgery residents, including five MD candidates and one DO candidate (four females, two males). Topics of discussion were based on a prior iteration of this event[19] and included pathways to becoming a vascular surgeon, medical school experiences for a successful match, information regarding subinternships and away rotations, the application process, letters of recommendation, program considerations, interview preparation, and creating a rank list.

RESULTS

Surveys. The average attendance across all 5 events was 58 students (Table I). The mean response rate for pre-event surveys was 51.2% and was higher than the post-event response rate, which was 27.4%.

Introductory session. There were 28 students registered, and 18 students attended the event, with the majority being first-year medical students (50%). Students had some familiarity with vascular surgery as a surgical subspecialty (2.93 ± 1.21). The students strongly agreed that the introductory session increased their knowledge about vascular surgery as a subspecialty (4.22 ± 0.67) and that the session was valuable to their time (4.33 ± 1.00). There was also a trend toward an increase in comfort with approaching the vascular surgery faculty after the event, although this did not reach significance (3.29 ± 1.27 vs 4.11 ± 1.27; $P = .07$; Fig).

Simulation session. A total of 79 students preregistered for the event; there were 55 in attendance. First- and second-year students comprised most attendees

Table II. Match Panel demographics data

Demographics	% (n = 44)
Year in medical school	
M1	18.2 (8)
M2	25.0 (11)
M3	38.6 (17)
M4	11.4 (5)
Other	6.8 (3)
DO	4.5 (2)
Female	54.5 (24)
Ethnicity	
White	47.7 (21)
Asian	25.0 (11)
Hispanic	15.9 (7)
African American	4.5 (2)
Other	6.8 (3)
Region of home institution	
Northeast	34.1 (15)
Midwest	25.0 (11)
South	22.7 (10)
West	6.8 (3)
International	11.4 (5)
VSIG at home institution	81.8 (36)
Home institution vascular program	
Integrated	15.9 (7)
Fellowship	27.3 (12)
Integrated and fellowship	29.5 (13)
Neither	13.6 (6)
Unsure	13.6 (6)
Is vascular surgery a required rotation?	
Yes	4.5 (2)
No	86.4 (38)
Unsure	9.1 (4)
Home institution COVID accommodations	
In person	4.5 (2)
Online	77.3 (34)
None or unsure	15.9 (7)
Participation in virtual clerkship/subinternship	2.3 (1)
Interest in virtual clerkship/subinternship	68.2 (30)
Applying to IVSR programs	
Very likely	56.8 (25)
Likely	6.8 (3)
Still deciding	34.1 (15)
Unlikely	2.3 (1)
Applying to general surgery residency programs	
Very likely	18.2 (8)
Likely	25.0 (11)
Still deciding	38.6 (17)
Unlikely	18.2 (8)
Applying to other residency programs	
Very likely	2.3 (1)
Likely	13.6 (6)
Still deciding	34.1 (15)
Unlikely	50.0 (22)

COVID, Coronavirus disease 2019; *IVSR*, integrated vascular surgery residency; *VSIG*, vascular surgery interest group.

(89.1%). In the presurvey, 50.9% and 52.7% had prior suturing and knot-tying experience, respectively. The proportion of students that had previously attended an in-person simulation session prior was 43.6%. Students reported a significant increase in comfort with knot tying from 1.73 ± 0.89 to 3.21 ± 1.25 ($P < .001$) and suturing from 1.64 ± 0.85 to 2.21 ± 0.93 ($P = .009$; Fig).

Match Panel. The Match Panel was open to medical students from other institutions and publicized on social media and societal forums. There were 194 students registered for the National Match Panel (Table II). There were 103 attendees. Of those who filled out the pre-survey, approximately one-half were female (54.5%). Most students were second- and third-year medical students (25.0% and 38.6%). Most students reported having VSIGs at their home institution (81.8%). Participant demographics are shown in Table II.

Students reported that they became more informed about deciding which residency programs to apply to (2.39 ± 1.10 vs 3.21 ± 1.12; $P = .018$). Knowledge in writing personal statements and put in the Electronic Residency Application Service application increased on a Likert scale from 2.16 ± 1.01 to 3.00 ± 0.88 ($P = .007$). Knowledge regarding letters of recommendation, such as how many to get them, from whom, and timelines, increased (2.45 ± 1.07 vs 3.14 ± 1.17; $P = .04$). Students also reported an increased understanding of important factors to consider when exploring residency programs (2.18 ± 0.97 vs 3.21 ± 1.19; $P = .002$) and creating a rank list (1.91 ± 1.10 vs 3.00 ± 1.18; $P = .002$). Additionally, there was a greater understanding about how to prepare for residency interviews (2.02 ± 1.00 vs 3.00 ± 1.24; $P = .004$) and about the logistics of virtual residency interviews, including differing formats, technical aspects, and follow-up communication (1.84 ± 0.96 vs 3.29 ± 1.20; $P < .0001$).

DISCUSSION

Virtual VSIG events are feasible and effective. Such events may increase awareness of vascular surgery among first- and second-year medical students and allow them to form meaningful connections with faculty. Other traditionally in-person events, such as simulation

events, may also be effective in the virtual format to increase confidence in suturing and knot tying. Last, a multi-institutional Match Panel, held virtually, can reach many medical students and be beneficial in all domains of preparation of application to an integrated vascular surgery program.

Since the coronavirus disease 2019 pandemic began, within vascular surgery, a multitude of studies have been published regarding pandemic-related stressors at the resident level, and changes in perceptions and logistics of the Match process for graduating medical students.[20-22] There are few reports within the subspecialty describing virtual experiences for medical students specifically, particularly those in their early years of training. Several reports have assessed virtual subinternship experiences among medical students applying into vascular surgery; these experiences have been shown to positively influence one's application decisions, although data remain limited.[20] This agenda of activities, which consisted of interactive online training modules, increased new interest among those who accessed the online content. Although virtual events cannot fully replace in-person events, such studies demonstrate that delivering high-quality content online is feasible. As in-person events gradually return, virtual events may continue to be particularly relevant to aspiring vascular surgeons from institutions where there is no home vascular surgery program. Additionally, virtual events allow for increased flexibility from both students and attendings, perhaps allowing for increased mentorship opportunities and engagement. Virtual VSIGs held at the regional or national level, perhaps sponsored by national societies, may further play important roles moving forward by increasing accessibility for students everywhere.

The Introductory Session served as an overview of vascular surgery as a surgical subspecialty. Similar to prior research, the questionnaires demonstrated that medical students lacked extensive exposure to vascular surgery before the session.[23,24] Vascular surgery is often not a required rotation during medical school clerkship rotations, but those who do rotate on vascular surgery services have an increased awareness of the specialty and report positive experiences.[24] Although it is unknown whether or not the attendees will definitively apply into an integrated vascular surgery program in the future, it is notable that early exposure to vascular surgery may influence one's decision to apply.[25]

In regard to the simulation session, there is undoubtedly no substitution for practicing surgical skills than real-life experience. During the pandemic, many leaders of surgical subspecialties found alternative methods of teaching practical skills to medical students[4,26]; this account uniquely reports a virtual, vascular surgery-specific agenda targeted toward attracting medical students. Although not a permanent substitute for in-person training, the virtual Simulation Session was a convenient means for faculty, residents, and medical students to gather from their homes or offices. Despite social distancing measures, the barrier of entry remained low and merely involved procuring and distributing suturing materials. Students were also encouraged to use materials easily procured at home; previous techniques for creating inexpensive suturing models relevant to vascular surgery have been described extensively.[27-29] Given that time and a lack of a faculty or student leaders to organize such events may deter the formation of in-person events,[7] a virtual event makes cross-institution collaboration easily feasible and may alleviate time demands while providing diverse teaching. It has been suggested that one key point to a successful vascular surgery simulation is a high faculty-to-attendee ratio and ample simulation sessions for attendees.[30] This simulation session was guided by six faculty members and two residents for high faculty-to-attendee ratio.

Last, the National Match Panel was an iteration of a previously described event.[19] The Match Panel described offered candid, peer-to-peer conversations regarding the application process specifically during the 2020-2021 application cycle. In contrast with the previous year, this year's panelist further included representation from osteopathic schools and more female-identifying speakers. A virtual format is particularly conducive to this, given that there are often few students applying into vascular surgery at any institution; a virtual format allows more experiences to be shared. As previously shown, those that attended this virtual Match Panel reported an increased understanding of various aspects of the integrated vascular surgery residency application. Although a variety of topics were discussed during the panel, a recent study demonstrated that both male and female applicants weighed culture, geographic location, mentorship, and program prestige as important factors that impact rank lists; in addition, females further place heavier weight on personal relationships in cities and female representation at programs.[21] Because this information is not always conveyed through program information sessions and open houses, a medium for frank conversation such as the Match Panel offers a candid and open platform without any faculty interference or monitoring.

This report has several limitations. Given low response rates, there is risk for response bias, and these results should be viewed more as results of a feasibility assessment than as a definitive representation of all medical schools. Likewise, although statistical significance may provide quantitative information about perceptions, the authors note that educational significance may not always be quantifiable and is highly dependent on multiple, individualized factors for a single student. Second, the anonymity of all responses leads to challenges in validating responses; however, this was necessary to encourage truthful responses from attendees. Owing to the virtual nature of the activities, attendance may not

be accurately recorded because it cannot be accurately taken online. For example, it is commonly acknowledged that in the Zoom era, attendees may not always be fully present during the session; similarly, there may be multiple people participating on one user's account. However, these are unavoidable effects in the virtual realm and the attendance data collected still characterizes the reach of the group and suggests some dedication and interest to login. Additionally, except for the National Match Panel, we posit that the large faculty to student ratio enhanced student engagement during activities. Last, given that this experience took place over an unprecedented year, results may not be entirely generalizable to all vascular surgery education. Nonetheless, one can view the results and discussion as accessible and effective examples for future learning models, however that may look in the future.

This experience revealed various lessons learned that may be applicable to future virtual interest group events. The most important factor in virtual VSIG events is attendance and participation. Generally, there is great interest, particularly among first-year medical students, in the beginning of the academic year. It was also important to time events to avoid overlap with examinations or holidays. Most events were planned for the evenings, when attendings, residents, and students were more available. Persistent advertising, especially on social media, e-mail chains, and group chats, was also critical in increasing attendance. It is noted that one pitfall of virtual events is that attendance does not always equal meaningful participation. As an incentive for attending the VSIG activities, food vouchers for students were offered for some of the events. Although this factor could have contributed to a relatively high number of students signing up and attending the Journal Club and Research Night, some students may not have had the same level of participation. Additionally, highly specialized events, including the Journal Club and Research Night, had historically fewer in-person attendees because those events likely catered to students who were already more involved with vascular surgery. Future virtual VSIGs may consider creating targeted events consisting of early versus advanced tracks, tailored to students' familiarity with the subspecialty.

CONCLUSIONS

Virtual VSIG activities are feasible, engaging, and effective in increasing student knowledge about vascular surgery as a specialty. As medical education continues to evolve, this article provides the elements of a virtual program that extracurricular surgical groups can use to provide continuous, accessible, and impactful learning during a pandemic. Additionally, professional societies can adopt it to widen their reach to medical students beyond geographical constraints.

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AUTHOR CONTRIBUTIONS

Conception and design: SMC, MG, AB, CIOC
Analysis and interpretation: SMC, MG, CIOC
Data collection: SMC, MG, KS, AB, EA, DS, JC, CIOC
Writing the article: SMC, CIOC
Critical revision of the article: SMC, MG, KS, AB, EA, DS, JC, CIOC
Final approval of the article: SMC, MG, KS, AB, EA, DS, JC, CIOC
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SMC and MG contributed equally to this article and share co-first authorship.

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Additional material for this article may be found online at www.jvsvenous.org.

Supplementary Table I (online only). Pre-survey questions for introductory session

Presurvey
School
Gender
Year
Program
What specialties are you currently considering?
Had you heard about vascular surgery before starting medical school?
How would you rate your familiarity with vascular surgery as a specialty, on a scale of 1-5 (1 = not familiar at all; 5 = very familiar)
How comfortable would you feel reaching out to vascular surgery attendings or residents? (1 = not comfortable at all, 5 = very comfortable)
Postsurvey
How much has this session increased your knowledge about vascular surgery as a specialty? (1= not at all; 5 = by a lot)
How comfortable would you feel reaching out to vascular surgery attendings or residents? (1 = not comfortable at all, 5 = very comfortable)
How valuable was this session to you in general? (1 = not valuable at all; 5 = very valuable)
General feedback? How can we make future sessions better? What did you like / didn't like?

Supplementary Table II (online only). Pre-survey questions for simulation session

Presurvey
What year are you?
Have you ever sutured before (in a simulation session or in the operating room)?
How comfortable do you feel about suturing? (1 = not comfortable at all; 5 = very comfortable)
Have you ever tied surgical knots before (in a simulation session or in the operating room)?
How comfortable do you feel about knot tying? (1 = not comfortable at all; 5 = very comfortable)
Have you ever attended an in-person simulation session?
Have you ever attended a virtual simulation session?
What specialties are you interested in currently?
Please indicate your interest in vascular surgery (1 = not interested at all, 5 = very interested)
When will you be picking up your supplies? We won't have materials until late afternoon Saturday, November 14.
Postsurvey
After this session, how comfortable do you feel about suturing? (1 = not comfortable at all; 5 = very comfortable)
After this session, how comfortable do you feel about knot tying? (1 = not comfortable at all; 5 = very comfortable)
After this session, please indicate your interest in vascular surgery (1 = not interested at all, 5 = very interested)

COVID, Coronavirus disease 2019; *ERAS*, Electronic Residency Application Service.

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Supplementary Table III (online only). Pre-survey questions for Match panel session

Presurvey
Year in medical school
Type of medical program
Region of medical school
Sex
Ethnicity
Type of vascular surgery program at home institution
Is there an active VSIG at your home institution?
Is vascular surgery a required clinical rotation?
How likely will you be applying into an integrated vascular surgery residency?
How likely will you be applying into general surgery residency?
How likely will you be applying into another residency program?
How has your school accommodated the vascular surgery experience during the COVID-19 pandemic? (Select all that apply.)
Did you participate in a virtual subinternship or virtual clerkship this past year?
Would you be interested in participating in a virtual subinternship or virtual clerkship this upcoming year?
Please indicate your understanding in the following (1 = very unfamiliar, 2 = unfamiliar, 3 = neutral, 4 = well-informed, 5 = very well-informed)
Different pathways to becoming a vascular surgeon
Medical school experiences to use for a successful match
Vascular surgery subinternships
Away rotations
Deciding which residency programs to apply to
Personal statement and ERAS application
Requesting letters of recommendation
Important features of program to consider
Preparing for residency interviews
Logistics of residency interviews (scheduling, traveling, finances, Zoom set up)
Creating a rank list
Postsurvey
Please indicate your understanding in the following (1 = very unfamiliar, 2 = unfamiliar, 3 = neutral, 4 = well-informed, 5 = very well-informed)
Different pathways to becoming a vascular surgeon
Medical school experiences to use for a successful match
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COVID, Coronavirus disease 2019; *ERAS*, Electronic Residency Application Service; *VSIG*, vascular surgery interest group.