When virtual becomes reality: short term impressions of a two-week virtual urology sub-internship program

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WHILES BB, KOWALIK CG, MIRZA M, WYRE H, THURMON KL. When virtual becomes reality: short term impressions of a two-week virtual urology sub-internship program. *Can J Urol* 2021; 28(6):10907-10913.

Introduction: *The COVID-19 pandemic disrupted medical student education and posed a unique challenge for educators, especially for surgical clerkships. In response to COVID-19 rotation restrictions, we implemented a virtual urologic surgery sub-internship program and evaluated medical student impressions of the experience.*

Materials and methods: *A two-week urology curriculum was created with content delivered by interactive videoconferencing. The curriculum included synchronous and individual learning with live patient clinical experiences in the outpatient clinic and operating room, lectures, departmental conferences, a suture lab, self-reflective writing exercises, and an oral presentation. Student impressions were assessed with an exit survey. Descriptive statistics were utilized to evaluate the 5-point Likert scale responses.*

Results: *A total of 40 students applied, and 18 were selected for 1 of 5 two-week rotation blocks. All students successfully passed the rotation. Of the 18 students who participated, 16 (88.9%) completed the exit survey. The overall experience was rated as "strongly positive" by 14 of 16 (87.5%) students. The learning experience was rated as 4.75 (0.45) (average (SD)). The rotation positively impacted our virtual students' plan to apply to this residency program (mean 4.81 (0.54)). All students reported they would recommend this rotation to a fellow student, and feedback regarding the self-reflection activities was positive.*

Conclusions: *We successfully implemented a two-week virtual urology sub-internship rotation with a wide variety of clinical and educational experiences. The rotation was well received by our medical students. This is a unique experience in urology that can easily be implemented by other surgical sub-specialty programs in the future.*

Key Words: education, medical students, medical surgery, urology, rotation, COVID-19

Accepted for publication September 2021

Acknowledgements
Special thanks to our program coordinator, Deb DeConink, for her assistance and logistical expertise throughout the rotation. Thank you to the urology faculty members at both KU and our Children's hospital who actively participated in this experience.

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Introduction

The COVID-19 pandemic has resulted in a disruption and disturbance in medical education and the training of future physicians.[1] For many 4th-year medical students, this led to the cancellation of their visiting or away medical student sub-internship rotations for their desired specialty at potential programs of interest. Although such rotations are not required or typical in some specialties, away rotations are commonplace in many competitive surgical sub-specialties including urologic surgery. Approximately

95% of applicants participate in at least 1 away urology sub-internship rotation.[2] These experiences are considered imperative to familiarize medical students and residency programs with each other, to allow for student assessment in the form of recommendation letters, and to aid in the professional development of potential urology residents.

The practical and logistical limitations of the COVID-19 pandemic have posed a unique challenge for educators, especially in the surgical clerkship learning environment where a large proportion of teaching occurs in the operating room. This has required medical educators to become creative in their training efforts of future physicians in order to accommodate the implemented travel bans, the need for social distancing, and the preservation of personal protective equipment.[3-5] These changes prompted the development of a urology specific guide for virtual sub-internships by the Society of Academic Urologists.[6] Various programs across the United States implemented virtual urology rotations in response to this, including our institution. To date, there have been only two prior virtual urology rotations described in the literature.[7,8] Our program differs from both of these courses, as we only delivered live, synchronous content material to our students. Here, we describe the development, implementation, and medical student impressions of our immersive two-week virtual urology rotation, which is the first and largest described in the literature consisting of only synchronous course content including live patient care experiences both in outpatient clinic and in the operating room.

Materials and methods

With the inability to engage in-person with our visiting medical students, we adapted by developing a fully virtual two-week urological surgery rotation via two-way, interactive videoconferencing at the University of Kansas Hospital. Institutional Review Board approval was waived as this was deemed non-human subjects research.

Application process

Medical students across the United States were invited to apply to the virtual urology sub-internship at our institution through the Visiting Student Learning Opportunities Application. All applications and curricula vitae were reviewed; however, virtual rotation offers were extended on a first-come, first-serve basis for five two-week rotation blocks between August-October 2020 with a maximum of four students per rotation block. If a student's preferred block was unavailable, an alternative rotation block was offered to the student.

Curriculum development and technology utilization

A mentorship model was utilized and consisted of virtual clinical experiences with active participation in patient encounters. Figure 1 displays a representative two-week rotation schedule used for each rotation block. This rotation format was developed with assistance from the Medical Student Clerkship Director, Residency Program Director, Residency/Clerkship Coordinator, and other key faculty members within the Department of Urology. Approximately 40 hours of coordination work was required to develop this virtual course and curriculum including collaboration with our university's technology team in the operating room to streamline connectivity for the rotation. Live surgery simulcasting was utilized with direct input into the Da Vinci robot and Storz endoscopic video

Week 1	Monday	Tuesday	Wednesday	Thursday	Friday
Conference 7-8am	Research & Protocol	Indications			
Morning 8am – 12pm	Clinic – Infertility	OR – Endourology	OR – Oncology	OR – Robotics	Clinic – Female Recon.
Afternoon 1pm-5pm	Clinic – Male Recon.	OR – Endourology	Clinic – Stone	Clinic – Robotics	Clinic – Oncology
Faculty Lecture Variable times	Neurourology	Drug Development	Urotrauma		Anatomy and suture lab
Other	Virtual meet and greet with clerkship director Welcome happy hour		Resident inpatient rounds		
Week 2	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Conference 7-8am	Medical student Grand Rounds presentations	Patient Safety (M&M)			
Morning 8am – 12pm	OR – General Urology	OR – Robotics	Clinic – General Urology	Clinic – Oncology	Clinic – Oncology
Afternoon 1pm-5pm	OR – General Urology	OR – Male Recon.		Clinic – Oncology	Clinic – Female Recon.
Faculty Lecture Variable times	Office evaluation of male infertility	Residency program overview with Associate Program Director	Pediatric urology imaging conference		Diagnosis and management of localized prostate cancer
Other			Resident inpatient rounds	Mentoring meeting with Department Chair	Exit interview with clerkship director, program director and associate program director

Figure 1. Representative medical student virtual rotation schedule.

towers. Since students were enrolled in the course through our university, they were allowed and granted remote access to the hospital's electronic medical record system, Epic. This allowed for independent information gathering prior to planned outpatient visits or surgical procedures. This also enabled students to write notes after virtual clinic encounters with real patients.

The Zoom videoconferencing platform (Zoom Video Communications Inc., 2016) was utilized for delivery of all rotational material including didactics as well as for direct patient care both in the outpatient clinic setting and in the operating room. This allowed for our visiting medical students to have interactive Health Insurance Portability and Accountability (HIPAA) compliant synchronous communication with the urology residents, faculty, and patients as well as the other medical students on the rotation. This software provided encrypted transmission of audio, video, chat, as well as screen sharing data for these encounters. Students were sent Zoom meeting links via email for all clinical activities. For use in clinic as well as in the resident's work room, we obtained iPad devices mounted on portable wheels to allow for additional informal interactions with the urology team which also occurred via Zoom. No additional software or technology was required to be utilized by the medical students during this rotation.

In clinic, students were able to actively participate in patient care experiences. Students would join either the attending physician or urology resident before clinic in the virtual Zoom room. Looking at the electronic medical record together, patients were selected that would be appropriate for the medical student to interview during that day's clinic. The laptop or iPad was then brought into the patient's exam room where the student was introduced, and patient permission was obtained for medical student involvement in their encounter. The student was then tasked with obtaining the relevant history from the patient for both new and established patients. For sensitive exams, the device's camera was switched off, and the exam was completed by the in-person provider. After obtaining the relevant history, students were then involved in developing an assessment and plan. This was either completed in the room with the attending physician and patient or was discussed outside the patient's room with the urology resident before re-entering the room with the attending physician. The student input and completed the encounter documentation directly into the patient chart. Medical students were rarely able to assume a shadowing role in clinic, as active participation and involvement in the clinical encounter was expected. At the end of the clinic day, the attending physician and student had a debriefing session about the learning objectives from that day's clinic experience.

The Da Vinci robotic platform as well as the Storz endoscopic towers were connected to Zoom as well. The use of this technology during surgery allowed for the virtual students to see the same display screen as the surgery team in the operating room. To further emulate the face-to-face interaction between the medical student and surgeon typically seen in the operating room, the software also allowed for simultaneous audio conferencing while viewing the live surgical footage. The virtual medical students did not participate in any open surgical experiences.

All faculty lectures were delivered to students on the virtual rotation in a live didactic. This format was selected intentionally to allow didactic sessions to be more interactive and permit students to ask questions and engage in discussion with the staff and other medical students during the virtual educational experience.

Medical students also participated in our pre-existing urology resident conferences, the majority of which had already transitioned over to a virtual format. These included 1 hour-long lectures given twice weekly and were led by urology staff on pertinent board review topics as well as Radiology, Pre-operative Indications, and Patient Safety (Morbidity & Mortality). Once per week, students also participated virtually in the Imaging conference with our pediatric urology team at Children's Mercy Hospital in Kansas City, Missouri.

A 2-hour medical student only Anatomy and Suture lab was held with one of our faculty members who has special interest in and knowledge on this topic. Each student was sent an Ethicon (Ethicon, Inc. Johnson & Johnson) Wound Closure Kit with rubber suture board, Adson forceps, a needle driver, suture scissors, a disposable scalpel and various sutures via mail at the start of the rotation to be used during this educational activity. An Ethicon grant was obtained for the suture lab materials. A similar suture kit could be purchased and is available online for approximately $30-$35 USD per kit. During this virtual lab, students were taught about the relevant anatomy, suture materials, knot types, and closure techniques. The two-way video teleconferencing allowed for faculty supervision and personalized feedback during the suturing practice.

Other activities included a welcome happy hour on the first evening of the rotation, weekly resident rounds, presentation of a 15-minute Grand Rounds lecture to all residents and staff, mentorship meetings, and multiple self-reflective writing exercise. The topics

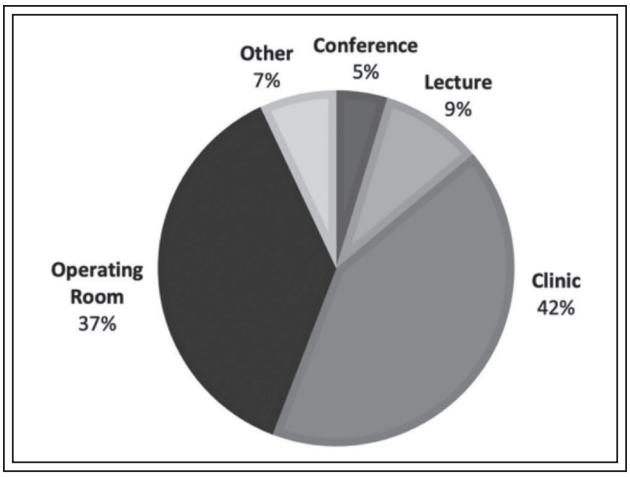

Figure 2. Breakdown of time spent on each educational activity.

for the self-reflective writing exercises included: the beginning of your hopes, physician know thyself, patient encounter self-reflection, dealing with stress, unconscious bias, critical self-reflection using the University of California San Francisco LEaP Guidelines for critical reflection, the art of patience, Life's driving force.[9] Mentoring meetings with the department chairman as well as other key faculty members were schedules for students. Figure 2 depicts the breakdown of educational activities during the two-week rotation.

Assessment and feedback

Formal assessment of the medical student performance on the rotation was completed. Medical students were assessed by the faculty members with whom they worked. Specifically, they were evaluated on their communication and professionalism skills, teamwork, teachability, technical aptitude, leadership potential, and knowledge base via a 4-point system (good, very good, outstanding, or exceptional) as found on the Standardized Letter of Recommendation form constructed by the Society of Academic Urologists.[6] Their final grade for the rotation was provided via a Pass/Fail system. Academic credit was available for the rotation if desired by the medical student and permitted by their home institution.

To obtain feedback about the rotation from the medical student rotators, we administered an exit-survey to assess their overall impression of the rotation. The de-identified survey was electronically administered via RedCap to all students between 2-8 weeks after their rotation, since it was delivered after the conclusion of all virtual rotation blocks for the academic year. All questions in the survey were voluntary. Overall impressions of the rotation were evaluated on a 5-point Likert Scale with 5 being "strongly positive" and 1 being "strongly negative". The virtual experience was also evaluated via a 5-point Likert Scale with 5 being "strongly agree" and 1 being "strongly disagree" to various statements about the rotation.

Data analysis

Descriptive statistics were utilized for evaluation of the medical student impressions and experiences on the rotation. The mean (standard deviation) is shown.

Results

A total of 40 medical students applied for the two-week virtual rotation, 20 students were selected for participation in one of the five available rotation blocks, and 18 students ultimately participated in the rotation. Two students withdrew from the virtual rotation close to their proposed start date due to personal scheduling conflicts with their home medical school, resulting in the inability to backfill those available spots by other applicants. Of the 18 students who participated in the rotation, 8 (44.4%) were women and 10 (55.6%) were men with an average age of 26.8 (2.5) years. Ethnicity was reported as Caucasian in 10, Other in 5 and African American in 1, and was unknown in 2 students. The students were from 15 different medical institutions in the United States, including multiple regions of the country, with 6 (33.3%) from the Midwest, 8 (44.4%) from the Southeast, 3 (16.7%) from the Southwest, and 1 (5.6%) from the Northeast.

All 18 students successfully completed the rotation and participated in all virtual activities that were assigned. All students received a grade of Pass on the rotation. Letters of recommendation were requested by 15 of the 18 (83.0%) virtual medical students. The letter format was standardized according to the Society of Academic Urologists guidelines.[6]

Of the 18 students who participated in the virtual rotation, 16 (88.9%) completed the RedCap rotation exit survey. A total of 13 (83.3%) students had a urology residency program at their home medical school. All students except one (93.8%) received academic credit for their virtual rotation. Ten (62.5%) students participated in other virtual urology rotations either before (6 students) or after (4 students) their rotation at our institution. When students were asked how much they spent to participate in the virtual rotation on items such as a web camera, lighting apparatus, or creation of an aesthetic background, 3 students did not spend any money, 2 students spent < $50, 10 students spent $50-$99, and 1 student spent between $100-$500 USD.

TABLE 1. **Medical student impressions of virtual urology rotation**

	Average score*	
Overall experience on sub-internship	4.81	(0.54)
Overall learning experience on rotation	4.75	(0.45)
Interactions with urology attendings	4.75	(0.58)
Interactions with urology residents	4.25	(0.86)
Impact of rotation experience on plans to apply to this residency program	4.81	(0.54)

*range 1-5; values expressed as mean (SD)

The reported medical student impressions of the virtual urology experience are described in Table 1. The overall experience was rated as "strongly positive" by 14 of 16 (87.5%) students who completed the survey. Their overall experience on the rotation is summarized in Table 2. The question with the most negative responses was in response to "During the rotation, I felt like an important member of the urology team" with 2 students strongly disagreeing and 3 students disagreeing with that statement. No other statements had any negative responses of "disagree" or "strongly disagree", except for 1 student who responded "disagree" to the statement regarding positive interactions with the urology residents.

All students reported they would recommend the rotation to a fellow student applying to urology, with 11 (68.8%) reporting "strongly agree" and 5 (31.2%) reporting "agree". When asked if it the virtual rotation should be continued, 6 students (37.5%) reported "yes, even if in person rotations return", 9 students (56.3%) reported "yes, but only if unable to do in person rotation", and 1 student (6.3%) reported "maybe".

Students were asked if they would have applied for an in-person rotation with our program if a virtual rotation were unavailable and an away rotation was allowed by both their home program and our hospital. A total of 8 students replied "definitely yes", 2 reported "likely", 5 "would have considered it", and 1 "unlikely". Students reported increased likelihood of planning to apply to our residency program after participation in the virtual rotation, Table 2.

A total of 15 of 16 survey respondents made at least one comment to the open-ended question in the electronic survey about the self-reflection journaling activities. The most frequently mentioned descriptive terms about this activity were "enjoyed" (5 students, 33.3%) and "helpful" (3 students, 20.0%). "Appreciated", "learning opportunity", and "goals" were also reported by 2 students (13.3%) for each statement. All students endorsed positive impressions of the self-journaling activity, with no negative or neutral reviews about

TABLE 2. **Medical student experience on virtual urology rotation**

	Average score*	
This experience greatly exceeded my expectations	4.50	(0.73)
I am more likely to seek a residency position at this program after my virtual rotation	4.75	(0.58)
The technology was easy to use	4.69	(0.60)
I felt connected with the other sub-intern students	4.63	(0.72)
I felt connected with the urology attendings	4.75	(0.45)
I felt like an important member of the urology team	3.50	(1.55)
I was comfortable asking questions to the staff and residents	4.63	(0.62)
The urology attendings I worked with were knowledgeable	4.94	(0.25)

*range 1-5; values expressed as mean (SD)

this activity. The journaling activity regarding implicit biases was mentioned by multiple students as their favorite journaling activity. One student stated that the self-reflection exercises were their favorite activity in the entire rotation. Another mentioned that they have continued journaling after the conclusion of this rotation, after first being introduced to it on this virtual sub-internship.

Discussion

With the successful implementation of a two-week virtual urology sub-internship rotation, we were able to provide a unique educational experience in urologic surgery to medical students in lieu of in-person rotations. The experience included live, direct patient care opportunities in the clinic and operating room and immersion into the urology team with participation in live lectures. Overall, all participating students felt this was a positive learning experience. To our knowledge, prior to the COVID-19 pandemic, no fully virtual surgical experiences involving direct patient care and involvement in live surgical cases existed.

With the pandemic, there has been an exponential increase in the number of available virtual rotations for medical students. Although the exact number of virtual urology rotations offered this year is unknown, it is estimated from the Society of Academic Urologists website to be approximately 20 rotation sites.

Williams et al reported their experience with a virtual urology rotation that included 75 hours of educational instruction, of which 15 (20%) were synchronous, non-pre-recorded content.[7] The majority of content delivered as part of their rotation was pre-recorded, asynchronous material, and of the 20% non-pre-recorded content, none involved direct patient care or experiences in the operating room. Similarly, the four-week urology rotation described by Margolin et al included approximately 5 hours per week of asynchronous course material.[8] In contrast, our rotation only included live didactic material. Our rotation also differed from those previously described by including a hands-on suture lab. These live, additional educational opportunities with this rotation are one of the major strengths of our program.

Our virtual urology rotation format is similar to that described by Margolin et al with both rotations including clinic and operating room experiences with live patients.[8] Similarly, we both report high satisfaction from medical student participants from either rotation. Course length is one of the major differences though between our two curriculums (4 weeks versus 2 weeks). Our study demonstrates that a shorter virtual rotation of two weeks still provides an educational opportunity that is well received by medical students. This shorter rotation format may be beneficial in increasing the number of students who can be exposed to a specific urologic program as well as allowing for applicants to participate in multiple virtual courses. As part of two rotation blocks, their rotation enabled participation by only 8 medical students. Our two-week rotation format is able to accommodate double the number of medical students during the same timeframe while still maintaining a positive learning experience for our students. This two-week format may be beneficial for other programs if COVID travel and rotation restrictions continue without the implementation of additional virtual rotations at other institutions across the United States. A higher demand than supply for these virtual rotations is noted from our 40 applications and ability to only accommodate less than half of those students in our own virtual rotation.

Chao et al described their virtual surgical rotation in Otolaryngology, Head and Neck Surgery with successful immersion in operative experiences similar to ours.[10] A major difference between theirs and any of the rotations described in the field of urology is that they also included open surgical experiences during their rotation via a Go Pro forehead mounted video camera device for two-way interactive streaming during open surgical cases. The addition of open surgical cases to the virtual surgical experience is a great educational opportunity for students and may be incorporated into our own and other urology specific curriculums in the future.

Our virtual rotation was unanimously well received by the medical student rotators. Positive feedback was obtained both formally by the exit survey as well as informally during the virtual Zoom exit interview. Use of a single videoconferencing platform with Zoom allowed for students to become easily comfortable with the technology and required little capital investment from the department or university. This same technology could easily be utilized at other institutions to implement their own virtual surgical rotation anywhere across the globe.

Potential modifications to this rotation in the future could include changes to the application and selection process. We utilized a first come first serve model at our institution. A different ranking process or interview for future virtual sub-internship rotations may be beneficial since we had twice as many applicants as available spots (40 applications for only 20 potential rotators). This may be beneficial as we anticipate continued interest and utilization of virtual rotations in the future.

Furthermore, based on student feedback, it would be our goal to integrate them more as members of the Urology team and increase exposure to the Urology residents by having them "shadow" a resident for 1-2 full days during the rotation. This would include having the rotators virtually round on postoperative patients for which they observed their surgery and conducting interviews on inpatient consults.

Limitations of the student impressions include two students not responding to the exit survey. Additionally, although the survey was anonymous, students may have felt compelled to respond positively to the questions. Future studies could evaluate long term or post-residency match impressions of the virtual rotation as these were not assessed in our study.

This study is one of the first in the literature to describe the virtual surgical rotation experience, including the medical students' perception and experience of the rotation. Our educational format can be modeled and easily implemented by other surgical programs and emphasizes that even a shortened two-week rotation provides a well-received educational opportunity to our students. The Association of American Medical Colleges requires a minimal standard of 8 weeks of surgical clerkship experience for graduation. Although we reserved the current iteration of this urology rotation for 4th year medical students interested in applying to urology residency, this format could easily be adapted and utilized for 3rd year medical students to fulfill their graduation requirements from a surgical education standpoint. It can also be modeled by other programs and institutions for use in not just urologic surgery, but also other surgical sub-specialities for sub-internship rotations. Although the time required to develop, coordinate, and set up this rotation at our institution for the first time was substantial, it is likely to take much less time in the future if the rotation were repeated or if our rotation format and curriculum were utilized for implementation at a different institution. By eliminating the logistics and costs of travel and lodging, the virtual experience is available to a wider range of interested medical students. There could also be a role for a virtual medical student experience as a substitution to in-person rotations for those students who desire to learn more about a specific program, but do not have 4 weeks available in their school schedule. This format could also be utilized for international medical students seeking additional experience in a specific surgical sub-speciality. Further studies are needed to compare this virtual rotation to our typical in-person rotation including perceptions about the program, the faculty and staff, the overall educational experience, and the impact on potential career choices and residency program selection.

Conclusions

Despite the many restrictions and changes resulting from the COVID-19 pandemic, the development and implementation of virtual surgical rotations may be one beneficial adaptation that may have a role in the future, even once in-person rotations are permitted. Not adapting would be a disservice to all learners including our medical students and residents. Virtual rotations provide an easily implementable modification to the current educational curriculum, even in surgical fields as this rotation model could be replicated in any other surgical sub-speciality. Two-week virtual surgical rotations are a well-received educational tool for our medical students. Further studies are needed to investigate their impact on the long-term educational outcomes and career choices of medical students.

Funding

This work was supported by an Ethicon supplies and material grant which was utilized for the suture lab. No other funding was obtained for this project. □

References

1. Rose S. Medical student education in the time of COVID-19. *JAMA* 2020;323(21):2131-2132.
2. Nikonow TN, Lyon TD, Jackman SV, Averch TD. Survey of applicant experience and cost in the urology match: opportunities for reform. *J Urol* 2015;194(4):1063-1067.
3. Dedeilia A, Sotiropoulos MG, Hanrahan JG et al. Medical and surgical education challenges and innovations in the COVID-19 era: a systematic review. *In Vivo* 2020;34(3 Suppl):1603-1611.
4. Ehrlich H, McKenney M, Elkbuli A. We asked the experts: virtual learning in surgical education during the COVID-19 pandemic-shaping the future of surgical education and training. *World J Surg* 2020;44(7):2053-2055.
5. Newman NA, Lattouf OM. Coalition for medical education-a call to action: a proposition to adapt clinical medical education to meet the needs of students and other healthcare learners during COVID-19. *J Card Surg* 2020;35(6):1174-1175.
6. Richstone L, Atiemo H, Averch T et al. Society for Academic Urology: virtual sub-internship in urology guide. https://sauweb.org/getmedia/b7e0de1e-7f3c-4761-b416-71225e3fb0f4/vSIU-Guidebook-June-2.aspx. Last Accessed October 30, 2020.
7. Williams C, Familusi OO, Ziemba J et al. Adapting to the educational challenges of a pandemic: development of a novel virtual urology sub-internship during the time of COVID-19. *Urology* 2021;148:70-76.
8. Margolin EJ, Gordon RJ, Anderson CB, Badalato GM. Reimagining the away rotation: a 4-week virtual sub-internship in urology. *J Surg Educ* 2021;S1931-7204(21)00008-8. Epub ahead of print.
9. Aronson L, Kruidering M, Niehaus B et al. UCSF LEaP (Learning from your Experiences as a Professional): guidelines for critical reflection. MedEdPORTAL 2012 Jan 1.
10. Undergraduate Medical Education During the COVID-19 Pandemic. *J Surg Educ* 2020;1:S1931-7204(20)30232-30234.