



Gauging the effects of COVID-related changes to the medical student surgical clerkship experience: a mixed-methods study

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Abstract

Purpose This study sought to understand the medical student experience on the restructured surgical clerkship during the COVID-era to provide guidance for future scenarios affecting student participation in clinical activities.

Methods Medical students completing an anonymous 70-question survey at the conclusion of their surgical clerkship from June 2019 to October 2020 were divided into 2 cohorts: students completing their clerkship prior to March 2020 and after June 2020. Quantitative assessment was performed to evaluate the clerkship performance and perceptions. Resulting findings were used to construct an interview guide and conduct semi-structured interviews.

Results Fifty-nine medical students rotated through the surgical clerkship prior to COVID and 23 during the COVID-era. No differences in perception of the surgical clerkship, participation in essential activities, or shelf examination scores were found. Students completing their clerkship during the COVID-era reported a lower perception of interaction and professional relationships with attending and resident surgeons ($p=0.03$). Qualitatively, students completing their clerkship during the COVID-era struggled to balance clinical experiences with personal wellness and noted that building relationships with faculty was substantially more difficult.

Conclusions There does not appear to be a difference in the level of participation in essential clerkship activities nor a diminished perception of learning between students completing their surgical clerkship before or during the pandemic. However, there does appear to be a difference in the relationships formed between students and attending surgeons. Altered didactic structures and apprenticeship-type rotations may help mitigate such effects.

Keywords Surgical clerkship · Apprentice model · Mixed methods

Introduction

During the peak of the COVID-19 pandemic, medical students were deemed ‘non-essential workers’ and largely excluded from the workforce. Most students experienced a temporary halt in clinical activities followed by virtual curricular supplementation to promote didactic learning [5, 7, 8].

Subsequent efforts to understand the effects of the COVID-19 pandemic on medical students has focused on considerations for accelerated licensing, the shift to virtual

learning environments required curricular changes across multiple clerkships that have been implemented across the US, and the risks of an altered clerkship cycle and its *potential* impact on residency application cycles and preparedness [1, 10, 11, 14, 15]. However, the effect of the COVID-19 restrictions on student performed activities on the surgical clerkship and the educational, professional, and relational impact from a student perspective is unknown. Without such assessment and concomitant understanding, little can be done to mitigate the impact on the affected students as well as plan for possible strategies to handle future environmental stressors that demand similar restrictions.

Albert Bandura’s theory on social learning, emphasizing the importance of the setting in which a learner observes, internalizes, and reproduces certain behaviors [2], provides a useful framework for considering the impact of changes to the surgical clerkship during the COVID pandemic.

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Previously, Bandura's theory has been used to assess how medical students are affected by clinical role models, noting that students reported more benefit from consistent, continuous, consistent observation of their clinical teachers and teachers reported the need for similar exposure to learners to provide formative feedback [12]. Given the documented impact of clinical role models on professional formation [16] and the notable changes in the surgical clerkship during the COVID pandemic which limited student interaction with potential role models, we aimed to gain insight into the perceived impact of personal and environmental factors on medical student learning on the surgical clerkship during the pandemic via a mixed-methods approach.

Methods

This was an explanatory sequential mixed-methods study involving medical students from a single medical school at a large, tertiary care academic medical center. From June 2019 to October 2020, at the conclusion of their surgical clerkship, medical students completed an anonymous 70-question survey, previously described by McKinley et al. and found in full form in Appendix C in Supplementary material [13]. The survey was designed to capture student demographics, perceptions of surgeons, surgical clerkship activities, and satisfaction with the clerkship. Retrospectively, students were divided into two cohorts: students completing their clerkship prior to March 2020, which marked the beginning of the local surge in COVID admissions with temporary dismissal of medical students from clinical responsibilities, and after June 2020, which marked the resumption of clerkship activities in an altered fashion. Quantitative assessment was performed to evaluate the frequency of specific clerkship activities, perceptions of the clerkship, and clerkship shelf examination scores. The perceptions and performance of pre-COVID-era students were compared to the perceptions and performance of COVID-era students. Descriptive statistics included frequencies by percent for categorical data and mean/median for continuous outcomes. The Mann–Whitney U test was used when comparing ordinal data. All tests were univariate two-sided and statistical significance was defined

as $p < 0.05$. Analysis was performed using RStudio (Version 1.3.1056, RStudio, PBC).

After reviewing the quantitative differences in student perceptions in the post-clerkship survey, a semi-structured interview guide (Appendix A) was developed to attempt to uncover an explanation for these differences. The interview guide consisted of questions focused on the impact that COVID-era clerkship changes (see Appendix D for examples of these changes) had on student interactions with attending and resident surgeons. Approximately 4–6 weeks after the conclusion of the surgical clerkship and after final grades had been received, email invitations were sent to students who had completed their surgical clerkship during the COVID-era. Students were given a study fact sheet and the opportunity to participate in a 30-min interview regarding their surgical clerkship experience. Students who decided to participate arranged a time with a qualitative researcher (MH) and the interview was conducted virtually. The interviewer did not possess an evaluative role regarding medical students nor did he have any prior interactions with any of the students interviewed (see full description in COREQ checklist in Appendix B). Interviewees were not compensated. Interviews were transcribed and de-identified prior to thematic analysis. A codebook was developed from the themes in the clerkship exit survey and all de-identified interviews were deductively coded by two independent coders (TC, RS) using Dedoose (v8.3.41, University of California, Los Angeles). Interviews were conducted until thematic saturation was achieved. This study was approved by the Mass General Brigham Institutional Review Board and qualitative analysis followed COREQ guidelines (Appendix B).

Results

During the study time period, 59 medical students rotated through the surgical clerkship prior to COVID and 23 students during the COVID-era with a 61% and 91% survey response rate, respectively. There was no difference in shelf examination scores, Objective Structured Clinical Examination scores, or activity logs (Table 1). There were no significant differences in perception of learning in the operating room, participation in activities in the operating

Table 1 Comparison of pre-COVID and COVID-era cohorts

	Pre-COVID era	COVID era	<i>p</i> value
Number of clerkship students	59	23	–
Time spent on clerkship (weeks)	12	8	–
Number of exit surveys completed (%)	36 (61%)	21 (91%)	0.07
OSCE scores (out of 4)	3.74±0.40	3.82±0.52	0.63
NBME shelf scores (out of 100)	79.30±6.30	77.90±5.69	0.46

OSCE Objective Structured Clinical Examination; NBME National Board of Medical Examiners

room, perception of surgeons as role models, opportunities for interaction with surgical patients, or overall perception of the surgical clerkship as a meaningful experience ($p=NS$). However, students completing their clerkship during the COVID-era reported significantly lower perception of professional relationships with attending and resident surgeons ($p=0.03$), which was specifically noted to be due to a decreased perception of one-on-one interactions with attending surgeons ($p=0.02$) (Table 2).

Ten medical students who completed their surgical clerkship in the COVID-era (i.e., after June 2020) were interviewed. The average interview duration was approximately 30.8 min. Inter-coder agreement as measured by Cohen's kappa was 0.90 and analyses identified five major themes:

- (1) Structural changes to the surgical clerkship
- (2) COVID-era hospital policies affecting medical students
- (3) Emotional state during the clerkship
- (4) Interactions with surgical trainees (e.g., residents, fellows)
- (5) Interactions with surgical faculty

Detailed descriptions of individual themes and subthemes within each domain, along with additional representative quotes, are included in Table 3.

Structural changes to the surgical clerkship

Students reported that three major changes to the structure of the surgical clerkship affected their experience. First, the shortened nature of the clerkship (8 weeks from 12 weeks) forced increased focus on shelf exam studying and detracted from the time available to learn about patients on the service as well as prepare for upcoming operations.

"I had a shorter rotation and felt like I always had to be studying for my shelf [exam]. On medicine, for

example, I had three months and so I could spread out my studying, and that gave me the opportunity to read into my patient charts. Having a shortened rotation really forces you to do things on like an accelerated timeline." (0001)

In addition, the reduction in surgical elective time resulted in significant perception of lost understanding about the breadth of surgical fields. While students recognized the importance of prolonged engagement with a single team, most felt that the lack of opportunity to interact and engage with surgical subspecialties limited their ability to make career decisions and likely would require further shadowing or rotations in the future to correct such a deficit.

"One of the most significant ways that I was affected was the limited opportunity to explore additional specialties within surgery. I only had one week of elective time and there were other subspecialties within surgery that I would have been interested in exploring or having some exposure to but I didn't have the chance to." (0003)

"We lost a lot of elective time. I only got to do one week on thoracic surgery, which was super helpful, because I needed to decide if that was a path I wanted to take after doing a lot of research in undergrad. It turned out it wasn't for me, which was helpful to know. But I definitely have a lot of classmates who are doing more surgical electives this spring, like a friend who's doing three of them back to back, which is super demanding and not something that I think she would have done had we gotten that elective time." (0004)

Similarly, students almost unanimously agreed that the newly implemented virtual didactics, while well intentioned, resulted in significantly less interaction with faculty and less student engagement. Since much of the curriculum was delivered outside of normal clinical hours, the virtual didactics

Table 2 Comparison of survey results between pre-COVID and COVID-era cohorts by survey domain

	<i>p</i> value	Effect size
Perception of the surgical clerkship as a meaningful experience	0.37	0.12
Perception of surgeons as physicians, leaders, and colleagues	0.20	0.17
Perception of the operating room as a positive learning environment	0.55	0.08
Participation in essential activities of the operating room	0.77	0.04
Opportunities for one-on-one interaction with surgeons ^a	0.03	0.29
Opportunities for meaningful interactions with surgical patients	0.58	0.07
Perception of attending surgeons as role models	0.37	0.12
Perception of resident surgeons as role models	0.70	0.05
Opportunities to perform a surgical consultation (ER or inpatient)	0.42	0.11

^aStudents completing their clerkship in the COVID-era reported significantly lower one-on-one interactions with attending/resident surgeons as compared to students completing their clerkship prior to COVID

Bold signifies statistically significant or effect size of moderate/large

Table 3 Codebook themes, definitions, and additional quotations

Theme	Definition	Additional representative quote(s)
Structural changes to the surgical clerkship	Students estimate the impact of alterations in the format of the surgical clerkship such as length, adjustment of subspecialty electives, and virtual format of didactics	“Unfortunately you're sort of setting yourself up to not really sleep, which is really hard when you're trying to be on full rotation. I think the timing was challenging for us, like when you do evening [lectures]. You need to decompress a little bit and not be able to work during that time.” 0006
COVID-era hospital policies affecting medical students	Students estimate the impact of system-wide changes regarding 'non-essential' personnel and engagement with patients, staff, and physical restrictions on space usage	“I felt like I was getting a good sense of what people actually do a day to day basis in a non-pandemic setting and they gave me a lot of opportunity to not interact with COVID patients, which I thought was great.” 0001
Emotional state during the clerkship	Students' perception of the influence of the psychosocial and emotional environment on their ability to learn and participate in the clerkship	“It's just stressful to think about family that might be affected and the uncertainty around whether you're going to catch it or not, you know. Yeah, those are the main things that were on my mind outside of the rotation.” 0002
Interactions with surgical trainees	Students consider how COVID restrictions affected their interactions with surgical trainees during the clerkship	“I feel like the residents were at a lower point. They had been worked really hard, and they probably weren't getting as much community.” 0005 My intern and resident were great. I feel like I can text them now if I had questions and wanted advice about something. They were very interested in helping me improve in the ways that I wanted. All the feedback they gave me was really formative and stuff that I could actually utilize it.” 0004
Interactions with surgical faculty	Students consider how COVID restrictions affected their interactions with surgical faculty during the clerkship	“The opportunity to naturally dialogue with [the faculty] and the opportunity to interact and ask questions was much more limited.” 0003 “The only time I really interacted with an attending was in the operating room, and depending on the nature of the surgery sometimes there was no interaction at all. Usually the residents go to the attendings and present the patients and the med students get to meet [the attendings], but, during COVID, [the residents] did that over the phone. The only time I really interacted with the attendings was in the operating room.” 0007

were perceived to detract from more productive use of time outside the hospital.

“It was difficult because surgery is busy during the day so you have to coordinate, leaving and making it home in time for the didactics but, also you have to squeeze that in with any preparation for cases the next day.” 0002

COVID-era hospital policies affecting medical students

Despite significant changes in hospital-wide policy to limit unnecessary exposures, students on the surgical clerkship did not believe that their overall experience with patients was diminished. In fact, most reported that they experienced enormous support from their resident-led teams to be as engaged with patient-level care as they deemed appropriate given their risk tolerance and family situation.

“If I said that I did not feel comfortable for whatever reason going into a room, the attendings and the residents, and all the rest of the surgical team staffs were very good about not putting pressure on me, which was something that on other rotations, they kind of would [do]. But they never did [that] on this rotation, especially if you offered to help in a different way. They never had problem with it.” 0008

Student emotional state during the clerkship

Even though medical students did not directly contribute to patient care during the surge at this institution, many still expressed the psychological and emotional toll that the pandemic had on their health and learning environment during this period. Specifically, students commonly noted the effects of pandemic stressors on their personal lives as well as their student colleagues.

“As a medical student I have a lot of reserve but when I was coming home I was dealing with a roommate who like didn't let anyone else in the apartment and I also [couldn't] visit family. So I had like a very low reserve, and I was dealing with so much.” 0005

Student interactions with surgical trainees

When it came to interactions with surgical trainees (residents, fellows), students felt the residents in particular were potentially overworked and equally as exhausted by the toll of the pandemic both in and outside the hospital.

“Surgical residents being redeployed or redistributed to work on non-surgical services was a major stressor and I think the cognitive load that that requires introduced ongoing stress into their lives.” 0003

Even so, students suspected that potentially, given the hold on elective cases, trainees had more available time, which they used productively to teach the students. This changed the opinion of students regarding the personality of surgeons in a positive manner.

“I had closer interactions with residents. I think that's just because they're like more accessible. And I think a lot of the things I came in like worried about in surgery like ‘oh, surgeons are all super arrogant’ or ‘they're all like in the frat bro culture’ and things like that. None of that was true and I think that actually changed my perceptions positively.” 0007

“I think the amount of mentorship I got was greater just because people had more time.” 0001

The most effective technique by residents seeking to clarify student role amidst the complex environment of COVID was explicit expectation setting. Students reported that this enabled learning even amidst a complex and constantly changing environment.

“I found it incredibly helpful the residents who took the time to, like, sit down on the first day to walk through the expectations of both like, what was expected for me as a medical student, on day two, as well as like what were the goals and setting explicit goals so that I could have worked towards those over the course of the month. And then, and then not only setting those goals but checking in on the open using those as a benchmark along the way to see that I was progressing or see that I was having a harder time in certain areas.” 0003

Student interactions with surgical faculty

Finally, students' experiences with faculty members were mixed based on the structure of their rotation. Students who spent a full month with the same attending surgeon in an apprentice-type model felt that faculty surgeons were available and good mentors.

“It was definitely better on the longer [rotation] because I was able to scrub in with the same attending [multiple] times over the course of the month. On the shorter ones I think I probably scrubbed in with like a different attending every day. I'd just say ‘hi, I'm the med student’ and they probably forgot my name and then the interaction would be over.” 0007

Conversely, students who spent their month on a team with multiple faculty surgeons typically felt like they only developed superficial interactions with faculty members.

“Attending schedules were crazy so I was never with the same person for more than like three days.” 0004

“There is a certain level of exposure and interaction with somebody before they realize that [the student is] going to be around or they should dig more into knowing who they are as a student and what their goals are. I think the attendings are very busy and so it takes a certain number of times to be exposed to students before they have kind of tested across that threshold to know that.” 0003

“The only time I really interacted with an attending was in the operating room, and depending on the nature of the surgery sometimes there was no interaction at all. Usually the residents go to the attendings and present the patients and the med students get to meet [the attendings], but, during COVID, [the residents] did that over the phone. The only time I really interacted with the attendings was in the operating room.” 0007

This same superficiality persisted on shortened subspecialty rotations and was exacerbated by the limited interactions allowed by virtual didactics.

“The opportunity to naturally dialogue with [the faculty] and the opportunity to interact and ask questions was much more limited.” 0003

“I imagined myself just dropping by the office of an attending and chatting with them for a second if I had a question or wanted to ask more about their specialty, but I felt like I couldn't do that because of COVID. So the networking that you get out of the clerkship was missing just because with didactics being virtual it was harder to connect.” 0007

Discussion

This study compared the experience of medical students partaking in the surgical clerkship during the COVID-era with those from the pre-COVID-era. Utilizing responses from an exit survey, students from the COVID-era did not demonstrate significant differences in clerkship activities or academic performance, but did report significantly decreased interactions with attending surgeons. To explain these findings, semi-structured interviews with a sample of students who completed their surgical clerkship during the COVID era were conducted which revealed frustration with virtual didactics, significant emotional stress, and lost opportunities for faculty surgeon-student relationship development while

relationships with trainees seemed largely preserved. Collectively, these results have the potential to enable productive immediate change, as well as help educators prepare for future situations in which significant clerkship changes are necessary.

The results of this study are aligned with the small amount of literature available regarding the medical student experience with COVID imposed restrictions and provide an important roadmap for future events that require clerkship modification. First, despite early concerns that decreased patient exposure and a virtual lecture format would affect knowledge and technical skill acquisition, quantitative assessment via the post-clerkship National Board of Medical Examiners (NBME) shelf exam as well as the institutional Objective Structured Clinical Exam did not demonstrate such a difference. This was corroborated by exit survey results showing no perceived differences in the clerkship as a meaningful academic experience. Similarly, Prigoff and colleagues demonstrated that COVID-interrupted surgical clerkship students scored slightly higher on a clinical skills exam and the NBME exam as compared to students on the same clerkship from the 2 years prior [17]. While virtual didactics resulted in similar academic performance, it is important to note the negative impact that this format had on natural interactions between students and attending surgeons. Educators might consider creating more avenue for students to interact with attending surgeons either with informal office hours or ‘virtual lectern’ spaces in which additional unstructured course time is allocated for students to have the option to approach faculty about topics such as personal research opportunities, career decisions, etc.

In addition, the shortening of the clerkship resulted in significant perception of lost exposure to the breadth of surgical subspecialties. Frequent reports of limited exposure to surgical subspecialties may result in poor readiness for evaluating and selecting potential medical careers [1, 4]. Medical schools could potentially mitigate some of these losses by increasing curricular time available for exploration on elective services for those most affected by COVID-era restrictions. If the clerkship must be shortened for future pandemic precautions, supplemental exposure to electives will require creative solutions, such as meet and greets with residents and attendings or optional exploratory sessions about different surgical subspecialties.

Regarding psychological stress and its impact on the learning, the findings in this study match the personal or cognitive factors construct of Bandura’s social learning theory and have been similarly reported by other medical students during the pandemic, especially those in urban areas (similar to the students in this study) and with relatives or acquaintances infected with COVID-19 [6]. Others have also corroborated the significant need for social support

structures for the wellbeing of medical students and transparency as an evolving situation, especially as it relates to major changes to academic programming [9, 19].

This study may help inform educators seeking to improve the surgical clerkship, especially when environmental factors require substantial changes to the normal structure of the clerkship. Most notably, the decreased student-faculty interactions are concerning because of potential implications for mentorship, career selection, and residency preparedness. Students in the COVID-era cohort who were assigned to an apprenticeship model with a single attending surgeon qualitatively reported positive experiences and opportunities to engage with patients, the surgical team, and in the operating room. This is similar to what was found by two previous studies, one of which specifically compared the apprenticeship model to a traditional clerkship model and found that apprenticeship students were more likely to participate in the OR, in patient management, and view surgeons positively, especially as role models [18] and the other, which demonstrated that surgical mentorship was a significant predictor of career decision making [3]. In planning for the future, educators might consider options for apprenticeship-like models when circumstances place students at risk for decreased interaction with attending surgeons.

There are several limitations to this study. First, it was a relatively small study performed at a single institution. The clerkship exit survey is limited by the response options, which utilize numerical anchors for the ‘frequency of activity’ (e.g., suturing in the operating room) performed. Such limited response options could potentially result in a type II error. Lastly, as with all research containing a qualitative component, the perception and biases of the researchers must be noted as a limitation. In this instance, while the individual conducting the interviews (MH) had no prior interaction nor future evaluative role for these students, both coders (RS, TC) are surgical residents and have interacted with numerous medical students on the surgical clerkship.

Conclusion

Though significant restructuring changes were made to the surgical clerkship due to the COVID-19 pandemic, there does not appear to be a difference in the level of participation in essential clerkship activities nor a diminished perception of learning between students completing their surgical clerkship before or during the pandemic. However, a difference was noted in the relationships formed between students and attending surgeons, which was seemingly explained by the reduced interactions between students and faculty members in clerkship activities, especially virtual lectures. Further investigation into the long-term impact of structural

clerkship changes will help corroborate these findings and guide future clerkship redesign efforts as undergraduate medical education evolves.

Data availability statement

The datasets generated during and/or analyzed during the current study are not publicly available due the personal and potentially sensitive information (test scores, interview transcripts, etc.) but are available from the corresponding author on reasonable request.

Appendix A: COVID-Era PCE Experience: Semi-Structured Interview Guide

Introduction

Thank you so much for agreeing to answer some questions about your surgical clerkship during the COVID-era:

Just to review:

- This interview is confidential.
- None of your responses will be shared with others, either in our department or elsewhere. All will be transcribed without personal identification. Once transcribed, the audio files will be destroyed.
- If you do happen to use someone’s name, we will remove any names that you mention.
- This interview is being audio recorded.
- You may stop at any time.
- The purpose of this interview is to understand the surgical clerkship experience during the COVID-era.
- For verbal consent, please confirm that you have received the study fact sheet and you consent to be in this study

Do you have any questions before we begin?

****Please note that not all questions will be asked of all participants depending on the content of participant answers to individual questions and the flow of the interview. It is possible that when asked one particular question, the participant will continue their answer and go on to answer other questions without being prompted. If this is the case, there is no need to ask all questions and solicit redundant answers.****

Possible questions

How do you believe the COVID restrictions (i.e. shortened length of the clerkship, decreased number of surgical procedures performed, virtual nature of didactic conferences, decreased patient face time, etc.) affected your experience on the surgery clerkship?

- Probe: How were your interactions with the residents and/or fellows affected?
- Probe: How were your interactions with the attendings affected?

How did the virtual didactic sessions impact your experience?

How did the converted format of the activities of the surgical department (i.e. decreased presence of attending surgeons in the hospital, increased virtual visits with patients, altered protocols resulting in admission of medical patients to the surgical services, etc.) impact your experience?

Do you think that the COVID restrictions affected the level of observation or mentorship you were able to receive?

- Probe: If yes, can you please explain how this relates to the level of observation or mentorship you were able to receive from residents and or/ fellows.
- Probe: If yes, can you please explain how this relates to the level of observation or mentorship you were able to receive from attending physicians.
- Probe: If no, can you please explain why.

Do you think that the COVID restrictions affected your view of surgeons as professionals?

- Probe: Can you please explain why your view was affected.
- Probe: Can you please explain why your view was unaffected.

Do you think that the COVID restrictions affected your view of surgery as a practice?

- Probe: Can you please explain why your view was affected.
- Probe: Can you please explain why your view was affected.

Appendix B COREQ Checklist

No	Item	Guide questions/ description
Domain 1: Research team and reflexivity		
Personal characteristics		
1	Interviewer/facilitator	Which author/s conducted the interview or focus group? Michael Healy, EdD conducted the interviews
2	Credentials	What were the researcher's credentials? <i>E.g. PhD, MD EdD</i>
3	Occupation	What was their occupation at the time of the study? Dr. Healy is currently employed as a researcher by Massachusetts General Hospital
4	Gender	Was the researcher male or female? Male
5	Experience and training	What experience or training did the researcher have? Dr. Healy conducted qualitative research for his dissertation
Relationship with participants		

No	Item	Guide questions/ description	No	Item	Guide questions/ description
6	Relationship established	Was a relationship established prior to study commencement? No, the interviewer possessed no relationship to interviewees prior to study commencement. The interviewer, who had no prior relationship with the students and has no evaluative capacity in the surgical clerkship, was thought to be an objective interviewer. Specifically, this interviewer, a non-clinician, is a health professions education researcher at Massachusetts General Hospital and has training in qualitative research. In addition, at the beginning of the interview, the interviewer detailed the confidential nature of the interview and that he had no role in evaluating their performance in the surgical clerkship. All students were asked for consent and expressed understanding that the purpose of this interview was to obtain formative feedback for future iterations of the clerkship. Lastly, all interviews were conducted after the surgical clerkship had concluded and grades had been provided in order to ensure students that this work could not alter their clerkship performance	7	Participant knowledge of the interviewer	What did the participants know about the researcher? Participants only knew the information provided by Dr. Healy regarding the purpose of the study, which was provided during the consent process
			8	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? Dr. Healy reported the purpose of the research study and that his involvement had no reflection on the grading process for the students
			Domain 2: study design		
			Theoretical framework		
			9	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? Phenomenology
			Participant selection		
			10	Sampling	How were participants selected? Convenience sampling was used. Medical students who agreed to offer qualitative feedback about the clerkship experience were interviewed
			11	Method of approach	How were participants approached? Participants were approached via email
			12	Sample size	How many participants were in the study? 10 medical students were interviewed

No	Item	Guide questions/ description	No	Item	Guide questions/ description
13	Non-participation	How many people refused to participate or dropped out? Reasons? Of the 23 students who were eligible for interview, 11 students were non-responders to the request for interview. 2 students reported that they did not have adequate time to participate due to involvement in other rotations	18	Repeat interviews	Were repeat interviews carried out? If yes, how many? No repeat interviews were carried out
			19	Audio/visual recording	Did the research use audio or visual recording to collect the data? The Zoom (Zoom Communications, Inc) platform recording software was used to capture audio recordings of the interviews and generate transcripts
Setting					
14	Setting of data collection	Where was the data collected? The data collection was performed virtually with the interviewees participating from their own home	20	Field notes	Were field notes made during and/or after the interview or focus group? While preparing the codebook, the authors listened to all the interviews and took notes
15	Presence of non-participants	Was anyone else present besides the participants and researchers? No other individuals were present for the interviews	21	Duration	What was the duration of the interviews or focus group? The interviews lasted, on average 30.8 min
16	Description of sample	What are the important characteristics of the sample? Medical students who participated were third year students at Harvard Medical School. Six interviewees were female. No further demographic data was collected in order to preserve anonymity	22	Data saturation	Was data saturation discussed? Data saturation was discussed at 8 interviews, and the decision was made to conduct two more interviews for confirmation. No new themes were identified in subsequent interviews and code definitions remained stable
Data collection					
17	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested? The interview guide was developed based on review of the exit survey findings and reviewed by surgical clerkship directors. The interview guide was pilot tested once prior to use with students	23	Transcripts returned	Were transcripts returned to participants for comment and/or correction? Transcripts were not returned to participants for review

No	Item	Guide questions/ description	No	Item	Guide questions/ description
Domain 3: analysis and findings					
Data analysis					
24	Number of data coders	How many data coders coded the data? Two coders (TC, RS) coded all the data	30	Data and findings consistent	Was there consistency between the data presented and the findings? Consistency was found between the quantitative results obtained from the exit survey and the results of the interviews. Findings discussed in the manuscript are internally consistent
25	Description of the coding tree	Did authors provide a description of the coding tree? Table 3 provides the codebook and associated definitions			
26	Derivation of themes	Were themes identified in advance or derived from the data? Themes were identified in advance based on review of the surgical clerkship exit survey. Sub-themes were allowed to emerge during analysis	31	Clarity of major themes	Were major themes clearly presented in the findings? The themes are clearly defined and presented with representative quotations
27	Software	What software, if applicable, was used to manage the data? Dedoose was the software utilized for data management and coding	32	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes? Minor themes are discussed as part of the results section
28	Participant checking	Did participants provide feedback on the findings? Participants were not engaged to provide feedback on the findings			
Reporting					
29	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? Quotations are provided for each theme and attributed to each interviewee			

Appendix D: Examples of Clerkship Changes

The following list enumerates some of the changes that occurred during the surgical clerkship. Given that two separate cohorts of students rotated through the clerkship during the COVID-era included in this study, not all students experienced all of these changes, hence the discrepancies in some students reporting various changes which impacted their surgical clerkship experience.

Examples of transient changes:

1. Shortening of the length of the core rotations
2. Elimination of sub-specialty rotations

3. Temporary restriction on students entering COVID + patient rooms
4. Virtual didactic sessions for students
5. Virtual grand rounds and morbidity/mortality conference
6. Virtual didactic sessions for residents
7. Virtual tumor board meetings
8. Evening student lecture series (virtual via national student curriculum)
9. Temporary elimination of overnight call shifts
10. Temporary removal of students from ER consultations
11. Temporary removal of students from induction and extubation processes due to aerosol generating nature of procedures

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