Original Research Article

Exposure and reception of surgery live-streaming technology in undergraduate medical education

Hyeok-Yoon (Ashley) Kwon, Madison Campbell

Michael G. DeGroote School of Medicine, McMaster University, Hamilton, Canada

Abstract

Virtual education has undergone rapid development during and since the COVID-19 pandemic. Surgical live-streaming is one such virtual format that can provide invaluable learning, particularly when limited by distance or contact restrictions. This study aimed to explore the current exposure level and reception of surgical live-stream opportunities in undergraduate medical students. An invitation to participate in an anonymous survey was sent to the McMaster University undergraduate medical education program's class of 2026 (n = 221) of. The survey consisted of preliminary questions indicating the degree of exposure to livestreaming participation, and two different sets of questionnaires that were assigned depending on presence or absence of prior participation. 22 (10%) students participated in and completed the survey. 21 (95%) students indicated that they were unaware of any live streaming opportunities, and 22 (100%) students indicated absence of prior participation in virtual surgical livestreaming. Interest level in attending a live-stream event given the opportunity was "High" or "Very High" for 19 (86.4%) students. Such results show that while there currently is insufficient opportunity for medical students to participate in surgical live streaming, there is ample interest. Further, live streaming was preferred as an adjunct to, rather than a replacement for, in-person opportunities in 77.3% of students. We hope that the results of this study will be able to assist the educational planners and other stakeholders in medical education to consider the appropriate application of surgical live streaming in future curricula.

Keywords: Medical education, Surgery, Virtual learning, Streaming

Corresponding author: Ashley Kwon, ashley.kwon@medportal.ca

Introduction

Development of technology, and its integration within the medical school curricula, has allowed for advancements in surgical teaching and educational development. With each technological breakthrough, a discussion is necessary on the potential value, and proposed integration into medical school curricula. Surgical live streaming is an emerging technology that gives medical learners access to surgical procedures in real time, providing an innovative method to enhance their educational experiences (1). This technology can be modified to add on features of live communication between the surgical team and learners either through audio or chat function to address questions at appropriate times during an operation (2). Methods of virtual education, such as live-streaming, have undergone accelerated development during the past decade, particularly in light of the COVID-19 contact restrictions (3,4).

The COVID-19 pandemic necessitated a rapid period of innovation and gave rise to new solutions to non-contact learning (5). Live streaming of surgical procedures provided a lifeline for continued learning during the pandemic (6-8). Technological advancements of video quality and the interactive experience of surgical live streaming have propelled the evolution of live streaming as an effective learning methodology (9). Research underscores the crucial significance of affording abundant opportunities for engagement in surgical learning. Factors such as “mentorship, experience in surgery, stereotypes, timing of exposure, and personal factors are recognized to be major determinants in medical students' decisions to pursue surgery” (10). During COVID-19 opportunities of exposure and experience were restricted for safety reasons, limiting in-person surgical learning, and highlighting the innovative solution of surgical live streaming for noncontact learning (7,8). This initiative is not being proposed to replace the vital practical and clinical skills that are learned in person (3,11). However, it does provide novel opportunities for connections, learning, and research, all contributing to a more well-informed decision when pursuing a career in surgery (3,4,8). The extent of implementation of surgical live streaming in Canadian medical education is relatively limited in comparison to that in U.S.—yet there is emerging evidence that learners and educators alike found value in these opportunities. For instance, Schmidt et al. demonstrated positive surgeon feedback and desire to engage in more sessions in the future, as well as improved anatomy scores from learners (12). The discussion concerning virtual surgical opportunities continues, expanding beyond a pandemic necessary curriculum (6,12). Perhaps an emerging question now is whether surgical livestreaming remains pertinent in medical education as learners return to in-person learning.

Currently, no Ontario medical schools have formally included surgical live streaming as a part of their curriculum despite increasing research demonstrating the educational advantages (2,9,13). However, there are emerging efforts to develop specialized live-streaming platforms tailored to medical programs in Canada. VivoSurgery is one platform under such development; its CEO, Phillip Mohabir, offered insight to the approach they built in hoping to integrate itself in Ontario’s medical education. Vivosurgery has a vision of integration into the training programs for Canadian surgical residents and medical students (14). Although currently in the developmental stage, VivoSurgery aims to augment surgical education by using head-mounted

cameras, ambient cameras, and endoscopic cameras to live stream surgical procedures in high definition (HD) quality (14). As necessary for streaming platforms, the recorded content is then live streamed through a secure, cloud-based platform, ensuring both confidentiality and auditability (14).

Despite such promising advancements in technology, there remains a deficiency in research examining the current perspectives of crucial stakeholders such as surgeons, medical education coordinators, residents, and medical students on virtual surgical livestreaming. Understanding relevant viewpoints, needs, and concerns is imperative for the successful implementation and acceptance of such groundbreaking advancements in the field of medical education. Even prior to implementation, it will assist in evaluating the utility of surgical livestreaming with the now resolving pandemic and a shift back to in-person medical education. Indeed, careful balancing of utility between virtual versus in-person learning opportunities will be crucial for effective resource allocation in the coming post-pandemic years.

This study aims to evaluate the existing comprehension and interest among medical students regarding surgical live streaming in order to gain essential insights from medical learners on the perceived value of surgical live streaming. We will further focus on the existing knowledge deficit regarding the success of these technologies, while also examining the importance that medical students attribute to the continuation of this unique learning opportunity.

Methods

An invitation to participate in an anonymous survey was sent to the McMaster University undergraduate medical education program's class of 2026 (n = 221). The inclusion criteria was any willing student in the class of 2026, regardless of prior experience in attending a surgical live-stream. The exclusion criteria was any incomplete survey input. The survey consisted of a preliminary questionnaire investigating the degree of exposure to livestreaming participation opportunities using a grading scale ranging from strongly disagree to strongly agree, as well as several binary questions (Appendix A). Following the preliminary survey, participants were given a different set of questionnaires depending on presence (Appendix B), or absence (Appendix C), of prior participation in virtual live streaming.

Results

22 (10%) students participated in and completed the survey. Answers to the preliminary questions are shown in Figure 1. While 15 (68.1%) of students indicated that they were open to surgical live streaming ("favor", "strongly favor"), 21 (95%) students indicated that they were unaware of any live streaming opportunities. 22 (100%) students indicated absence of prior participation in virtual surgical livestreaming. Answers to the questionnaire for those without prior experience are shown in Figure 2 and Figure 3. Interest level in attending a live-stream event given the opportunity was "High" or "Very High" for 19 (86.4%) students (Figure 2).

Preference between an in-person surgical observation and a live-stream opportunity was 17 (77.3%) and 1 (4.5%), respectively (Figure 3).

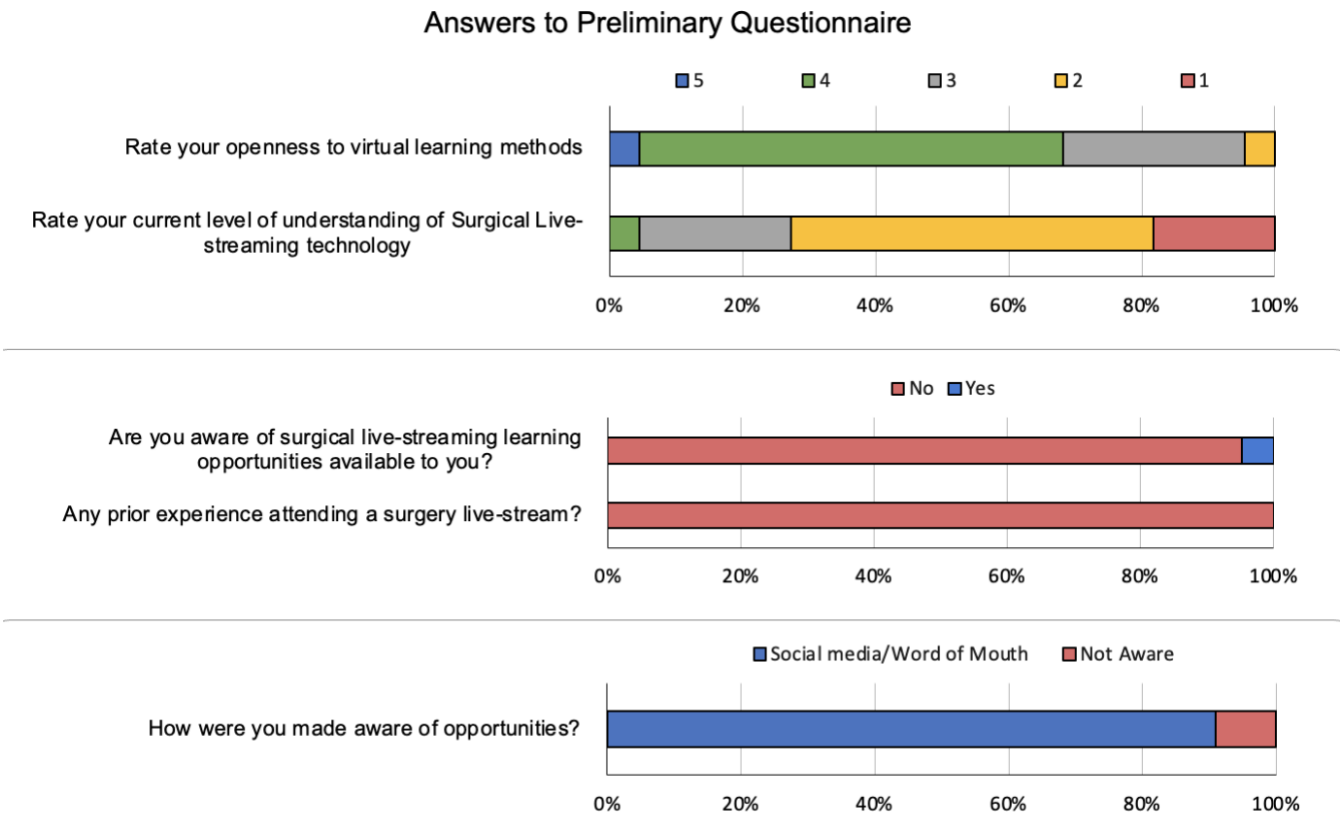

Figure 1. Answers to preliminary questionnaire

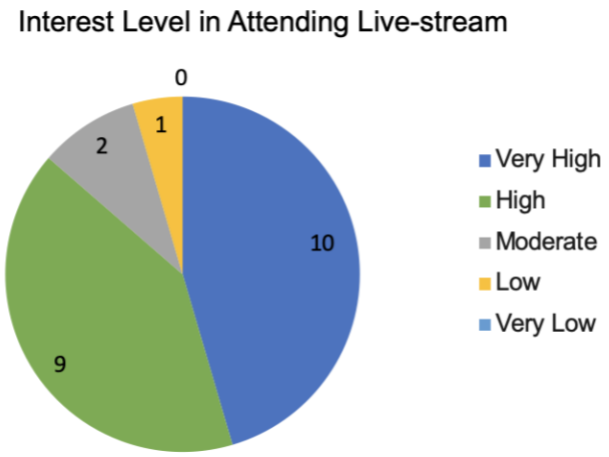

Figure 2. Interest level in attending a surgical livestream

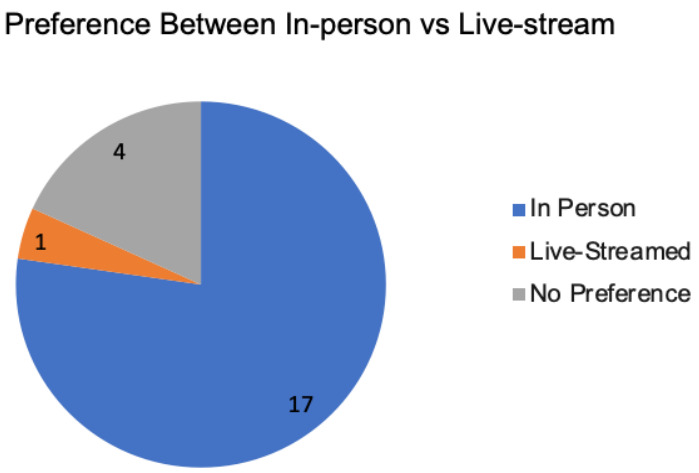

Figure 3. Preference between in-person or livestream opportunity

Discussion

All survey participants stated that they had not attended a surgical live streaming session. This data is surprising yet insightful; it illustrates the current lack of utilization of surgical live streaming in medical education. Two important figures to consider in relation to this information is that 93.3% of participants noted that they were unaware of these opportunities, and 54.5% of participants indicated they had a poor understanding of surgical live streaming technology. In contrast, 45.5% of participants, and 40.9% of participants had a very high and high interest level in attending a surgery live stream, respectively. This data allows a greater understanding about why virtual surgical opportunities were not attended. Our students expressed a clear interest, and thus perceived value, in the surgical live stream learning opportunities. Such results suggest that the lack of experience of survey participants is not necessarily from lack of interest but perhaps due to lack of exposure.

One of the main advantages for the integration of surgical live streaming is accessibility. It allows students access to invaluable learning that is often best obtained by observing surgical procedures, while eliminating the need for travel or use of space in operating rooms (1,2). It thereby enabled medical learners to make connections with professionals in diverse fields in ways unavailable before, especially within the limits of the COVID-19 pandemic (2). However, as indicated by our survey participants, it seems that learners currently undergoing undergraduate medical training at McMaster University were not informed of these new technological opportunities, and therefore it was not sufficiently accessible to this student population. This highlights not only a deficit of knowledge and advocacy for this innovative new learning platform, but also the importance of discussion about surgical live streaming opportunities for interested learners. Although our participants had not attended a surgical live streaming opportunity, they were still able to provide insight into the perceived value of these platforms.

We hope that this information will assist educators and curricula developers in achieving a better understanding of how students would benefit from these opportunities, and their interest in accessing them.

As stated previously, the virtual learning opportunities discussed in this study do not aim to replace traditional in person learning methods, as in person opportunities provide clinical experiences that cannot be easily replicated virtually. Of our participants 73.3% stated that they would prefer an in-person surgery observation, rather than a live stream surgery observation opportunity. Nevertheless, 63.3% of participants expressed a favorable attitude towards embracing virtual learning methods. Interpretation of this data allows us to better understand the place of surgical live streaming in the medical curricula moving forward. These virtual opportunities are not perceived to outweigh the traditional methods that are well established within our curricula. However, they can be informative and vital learning experiences for the medical student population. In person discussions, conversations, and practical skill development cannot be exactly replicated in this platform (3,11). However, the accessibility of various surgical specialties, interesting cases, and access to a community of peers within the medical community can provide a unique learning experience for educational and professional development (3,4,8).

One limitation of this study is the assessment of how surgical live streaming is able to affect academic learning, and career exploration. Although we aimed to answer this question, 100% of participants had not participated in any surgical live streaming opportunities. While we can infer the perceived value of these opportunities from the discussed data points above, we are unable to explicitly state or delineate the value found in this technology due to this deficit.

Another limitation is restricted sample size, and thus the limited statistical analysis within this study. Larger-scale studies that encompass more diverse demographics and allow statistical analysis could provide a more comprehensive understanding of perspectives regarding live streaming surgery. For instance, a study involving higher level learners that have experience in both in person and virtual opportunities may yield results that better compare available options. A study of larger sample size and demographic span would allow for a more robust evaluation of the proposed questions, mainly on the utility of live streaming surgery and whether it holds value at all within Canadian medical education.

Future research may explore effective strategies for advertising and implementing surgical live streaming technologies, ensuring accessibility and affording students the chance to engage with this novel opportunity. Furthermore, in depth research and discussions around how these technologies can fit within the current medical school curricula, in tandem with in-person components, is a compelling field to continue to understand. Various factors, including the necessary regulations, ethical considerations, specific educational objectives, cost versus available resources, and technological capabilities must all be considered to determine if live streaming surgery for medical education is a priority for resource allocation. As evident in this study, medical students find unique value in each mechanism of learning, and the role surgical

livestreaming has in consolidation of learning and career exploration poses potential for future exploration.

Conclusion

The results of this study show that while there is insufficient opportunity for medical students to participate in surgical live streaming opportunities, there is ample interest in participation. Further, live streaming was preferred as an adjunct to, rather than a replacement for, in-person opportunities. Surgical live streaming is a field still in development and holds potential to augment surgical education for Canadian medical students and residents. Even as contact restrictions are beginning to lessen, it may hold some utility in allowing opportunities for mentorship or research involvement, particularly for those limited by distance. We hope that the results of this study will be able to assist the educational planners and other stakeholders in medical education to consider the appropriate application of surgical live streaming in future curricula.

References

1. Jack MM, Gattozzi DA, Camarata PJ, Shah KJ. Live-streaming surgery for medical student education-educational solutions in neurosurgery during the COVID-19 pandemic. Journal of surgical education. 2021 Jan 1;78(1):99-103.

2. Van Bonn SM, Grajek JS, Schneider A, Oberhoffner T, Mlynski R, Weiss NM. Interactive live-stream surgery contributes to surgical education in the context of contact restrictions. European Archives of Oto-Rhino-Laryngology. 2022 Jun;279(6):2865-71.

3. Chao TN, Frost AS, Brody RM, Byrnes YM, Cannady SB, Luu NN, Rajasekaran K, Shanti RM, Silberthau KR, Triantafillou V, Newman JG. Creation of an interactive virtual surgical rotation for undergraduate medical education during the COVID-19 pandemic. Journal of Surgical Education. 2021 Jan 1;78(1):346-50.

4. Shah HP, Kafle S, Lee JY, Cardella J, Alperovich M, Lee YH. Livestream surgeries enhance preclinical medical students' exposure to surgical specialties. The American Journal of Surgery. 2023 Feb 1;225(2):432-5.

5. Gandsas A, Dorey T, Park A. Immersive Live Streaming of Surgery Using 360-Degree Video to Head-Mounted Virtual Reality Devices: A New Paradigm in Surgical Education. Surgical Innovation. 2023 Mar 29:15533506231165828.

6. Abu-Rmaileh M, Osborn T, Gonzalez SR, Yuen JC. The use of live streaming technologies in surgery: a review of the literature. Annals of Plastic Surgery. 2022 Jan 1;88(1):122-7.

7. Ruthberg JS, Quereshy HA, Ahmadmehrabi S, Trudeau S, Chaudry E, Hair B, Kominsky A, Otteson TD, Bryson PC, Mowry SE. A multimodal multi-institutional solution to remote medical student education for otolaryngology during COVID-19. Otolaryngology–Head and Neck Surgery. 2020 Oct;163(4):707-9.

8. Ottinger ME, Farley LJ, Harding JP, Harry LA, Cardella JA, Shukla AJ. Virtual medical student education and recruitment during the COVID-19 pandemic. InSeminars in Vascular Surgery 2021 Sep 1 (Vol. 34, No. 3, pp. 132-138). WB Saunders.

9. Gandsas A, Dorey T, Park A. Immersive Live Streaming of Surgery Using 360-Degree Video to Head-Mounted Virtual Reality Devices: A New Paradigm in Surgical Education. Surgical Innovation. 2023 Mar 29:15533506231165828.

10. Mehta V, Oppenheim R, Wooster M. Distance learning in surgical education. Current Surgery Reports. 2021 Aug 9;9(9):23.

11. Ebrahim S, Dorsamy E, Phillip JL, Naidoo R, Van Wyk JM. A Scoping Review of Online Teaching in Undergraduate Surgical Training. Indian Journal of Surgery. 2023 Oct 25:1-0.

12. Schmidt LE, Cooper CA, Guo WA. Factors influencing US medical students' decision to pursue surgery. Journal of Surgical Research. 2016 Jun 1;203(1):64-74.

13. Abu-Rmaileh M, Osborn T, Gonzalez SR, Yuen JC. The use of live streaming technologies in surgery: a review of the literature. Annals of Plastic Surgery. 2022 Jan 1;88(1):122-7.

14. Phillip Mohabir. Development and Prospective Utility of VivoSurgery in Canadian Medical Education [Personal Interview, 8 June]. Virtual; 2023 (unpublished).

Appendix A

1. How open are you to virtual learning methods? (1:Strongly oppose - 5: Strongly favor)
2. What is your current level of understanding of surgical live streaming technology? (1:Poor - 5: Excellent)
3. Are you aware of surgical live streaming learning opportunities available to you?
    a. Yes
    b. No
4. If yes, how were you made aware of these opportunities?
    a. School administration
    b. Student led initiatives
    c. Social media/word of mouth
    d. Personal research
    e. I was not made aware
    f. Other: please specify
5. Have you had any prior experience attending a surgery livestream?
    a. Yes
    b. No

Appendix B

1. Please specify the number of opportunities attended & platform used:
    a. Number of attendances: _____
    b. Platform
2. Do you feel the surgical live-streaming opportunity aided in your academic learning
    a. Yes b. No
3. Do you feel the surgical live-streaming opportunity aided in your career exploration
    a. Yes b. No
4. If you responded yes to question 6, please specify in which way your experience benefited career exploration:
    a. Gained a better perspective of a career I was already interested in
    b. Exposure to new careers
    c. Allowed me to rule out career options after exposure
    d. Allowed me to form new connections in a career of interest
    e. N/A
    f. Additional comments:
5. As more in-person surgery opportunities are becoming available, do you feel these surgical live streaming pathways remain beneficial?
    a. Yes b. No
6. If given the choice, would you prefer an in person or live-streaming surgery opportunity
    a. I prefer a virtual opportunity
    b. I prefer an in-person opportunity
    c. I have no preference
    d. Additional comments: _____

Appendix C

1. What would be your interest level in an opportunity to attend a surgery livestream? (1: Very low - 5: very high)
    a. Additional comments:_____
2. If given the choice, would you prefer an in-person or live streaming surgery opportunity?
    a. I prefer a virtual opportunity
    b. I prefer an in-person opportunity
    c. I have no preference