

Surgical education for the 21st century medical trainee: Evidence-based considerations to optimize quality in surgical workshops for pre-clerkship medical students

Neil D'Souza, MD, MHSc¹; Joel Davies, MD, MSc¹; Thomas Gregory, MD²; Vishaal Gupta, MD¹; Andrew Kapoor, MD, MSc³; Rushika Perera, MD, MSc⁴; Khaled Ramadan, MD¹; Caleb CJ Zavitz, MD, PhD^{1,5}; George Christakis, MD, MSc, FRCSC^{6,7}

¹Department of Postgraduate Medical Education, University of Toronto

²Department of Postgraduate Medical Education, Queen's University, Kingston, Ontario

³Department of Postgraduate Medical Education, McMaster University, Hamilton, Ontario

⁴Department of Postgraduate Medical Education, Western University, London, Ontario

⁵Department of Pathology and Molecular Medicine, McMaster University, Hamilton, Ontario

⁶Department of Cardiac Surgery, Sunnybrook Health Sciences Centre, Toronto, Ontario

⁷Department of Surgery, University of Toronto

Abstract

Background: Pre-clerkship medical students in Canada receive little formal exposure to surgery during their undergraduate medical education. Hands-on workshops and simulations may be key surgical education experiences for students addressing this lack of exposure. However, little evidence exists regarding which components provide the best hands-on experiences. The purpose of this study was to present a qualitative evaluation of a hands-on surgical experience intended for pre-clerkship medical students.

Methods: We used the workshop component of the Surgical Education and Discovery (SEAD) Program at the University of Toronto to conduct our evaluation. Twenty program participants were asked to complete surveys eliciting workshop feedback. Data was compiled and prevailing themes were drawn from survey responses.

Results: Nineteen surveys were completed (N=19). The overall impression of the SEAD Program was either "very good" or "good" (19/19). When asked about the favourite component of the SEAD Program, "workshops" was cited 16 times (16/19). The 3 most prevalent positive themes from the feedback were "the personnel present", "the types of skills taught", and "the hands-on experience provided". The 3 most prevalent negative themes were "inadequate time", "unmet equipment/resource needs", and "poor teaching/instruction".

Conclusion: This preliminary analysis identified key aspects contributing to the quality of a surgical education experience. Such aspects may be of value to surgeon educators creating similar experiences for pre-clerkship medical students. Further study is needed with larger participant numbers, long-term data, and CaRMS match results, to ascertain any impact the identified themes have on pre-clerkship students choosing a surgical career.

Introduction

Medical students in Canadian medical schools receive little formal exposure to surgical specialties prior to clerkship. Yet medical students often form their career choices either before or early within the pre-clinical training years.^{1,6} Positive encounters between first-year medical students and surgeons have been found to confer favorable perceptions towards a career in surgery.⁴ These early positive perceptions are particularly relevant considering the potential barriers to students pursuing careers in surgery, namely perceived poor life style, technical demand, and lack of mentorship opportunities.^{3,7} As such, surgical departments have an interest in, and actively pursue the creation of, opportunities for career exploration to attract potentially interested medical students. In 2012, the University of Toronto's Department of Surgery developed the inaugural Surgical Exploration and Discovery (SEAD) Program to provide comprehensive surgical exposure to pre-clerkship medical students through formal operating room (OR) observerships, organized informal career discussions with staff surgeons and residents, and hands-on workshops and simulations.⁸ This program also implemented the recommendations put forth by the American Surgical Association's "Blue Ribbon Committee Report on Surgical Education", which call for increased involvement of surgical departments in the educational activities of pre-clerkship students, exposure to surgical role models as early as possible, and greater utilization of surgical simulation tools in pre-clerkship education.⁹ Prior research has demonstrated the use of simulation-based learning can foster a positive attitude towards a career in surgery.^{10,12}

Given the importance of early surgical skill exposure to pre-clerkship medical students' interests in pursuing careers in surgery, the objective of this study was to determine the key components contributing to a quality workshop experience, as well as to provide an initial reference point to establish quality control and quality assurance. Specifically, our goal was to evaluate participants' perceptions of the positive

Corresponding Author:
Neil D'Souza
neil.dsouza@mail.utoronto.ca

and negative aspects of a comprehensive hands-on surgical simulation experience intended for pre-clerkship medical students, and to identify critical aspects surgical educators should consider when designing their own surgical exposure programs in the future.

Methods and Materials

Study Background and Setting

The SEAD Program's major focus is on increasing participant exposure to practical surgical skills and procedures common to the surgical subspecialties. Medical students in their first year of studies at the University of Toronto spent approximately two weeks engaged in practical learning in the OR each morning, followed by didactic and practical training sessions each afternoon organized by each of seven divisions in the Department of Surgery (Cardiac, General, Neurosurgery, Orthopaedic, Plastic and Reconstructive, Urology, Vascular). Each division hosted a three-hour hands-on simulation workshop led by residents, fellows and staff surgeons. The primary purpose of these workshops was to introduce and teach basic surgical principles. Participants had an opportunity to work through one to four stations, each lasting between 45 to 180 minutes, and focused on skills which were relevant to each discipline (Table 1). Workshop topics were selected by the staff surgeons chosen to lead the workshop, in collaboration with a second-year medical student division coordinator.

Study Design and Recruitment

This was a prospective study involving SEAD Program participants, from which study recruitment was drawn. Participation in both the Program and the study were voluntary, and the decision to participate in the study did not impact their involvement in the Program.

Sample Size and Sampling Methods

Medical students in their first year of studies at the University of Toronto had the opportunity to apply to the pro-

gram on a competitive, voluntary basis outside the formal medical school curriculum. From this group of first year medical students, 52 written applications were received and a total of 20 students were ultimately accepted to the SEAD Program. These 20 students comprised the study sample, and were asked to complete questionnaires on a voluntary and anonymous basis.

Questionnaire

After each workshop, a brief questionnaire was provided to each participant. The questionnaire was developed by the SEAD Program Director and supervising SEAD faculty members. The questionnaire consisted of four questions (1-4) to be answered on a five-point Likert scale, and three questions (5-7) that solicited free-form responses, for a total of 7 questions. The following statements were posed to the participants:

1. I enjoyed the workshop.
2. I am now more interested in this sub-specialty.
3. I am now less interested in this sub-specialty.
4. This workshop should be continued next year.
5. Things that I liked.
6. Things that can be improved.
7. Other comments.

In addition, we also asked participants the following questions at the end of the Program:

- 1) What was your overall impression of the SEAD Program? (five-point Likert scale)
- 2) The SEAD program increased my interest in surgery. (five-point Likert scale)
- 3) What was the most favourite component of the SEAD Program? (free-form response)

Data Collection, Outcome Measures, and Analysis

The questionnaires were administered and collected without any participant-identifying data. Responses were entered manually into a Microsoft Excel database for analysis (Microsoft, Redmond, WA). Quantitative responses from

Table 1. Topics covered during hands-on simulation workshops by sub-specialty.

Station	General Surgery	Urology	Plastic Surgery	Neuro-Surgery	Orthopaedic Surgery	Cardiac Surgery	Vascular Surgery
1	Simple interrupted suturing	Laparoscopy simulator	Z-plasty	Neurotrauma seminar	Small bone fragment plating	Aortic valve replacement	Femoral anastomosis
2	Simple continuous suturing	Pelvi-trainer	Modified Kessler tendon repair	Neurotrauma simulator	Arthroscopy simulator		
3	One-handed knot tie	Virtual reality laparoscopic simulator	Microsuturing	Craniotomy and burr hole drilling			
4	Subcuticular suturing	Laparoscopic instrument review	Vertical and horizontal mattress suturing				

Likert scale questions were compiled into histograms in Excel, while free-form responses were analyzed by three independent and blinded researchers. Each researcher performed thematic analysis using Grounded Theory to uncover the major ideas that emerged in participants' responses. These themes were then compared to generate consensus key words. The frequency with which these key words or phrases were repeated in participants' answers was then examined using KWIC Concordance Version 5.1.0 (Satoru Tsukamoto, Tokyo, Japan). The phrases in which these key words were repeated most frequently were analyzed to explore the characteristics making the hands-on workshops effective. Upon completion of the analysis, the three independent researchers compared findings for triangulation, and consensus results were gathered.

Ethics Statement

Approval for this study was obtained through the University of Toronto Research Ethics Board. Participants received a briefing explaining the purpose of the study, that participation was voluntary and anonymous, and that participation would not impact their scholastic or SEAD Program opportunities. Participants consented implicitly by anonymously completing the questionnaires.

Results

Of the 20 participants, 19 completed questionnaires. Overall results showed all 19 respondents indicating a "very good" or "good" overall impression of the SEAD Program (Figure 1), and a total of 17 participants "strongly agreed" or "agreed" that the Program increased their interest in surgery (Figure 2). When asked "What was the most favourite component of the SEAD Program?", free-form responses showed the word "workshops" appearing 16 times out of a total of 19 responses.

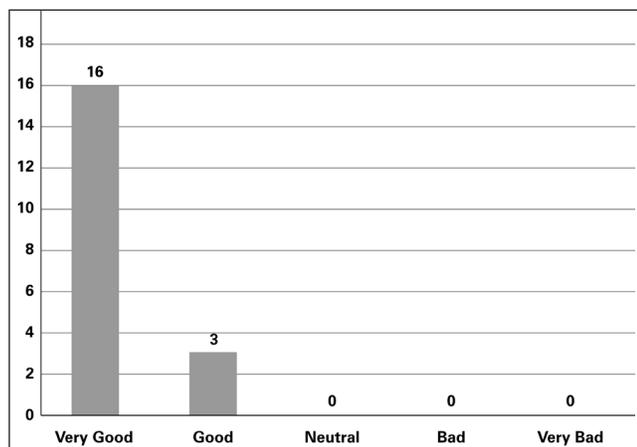


Figure 1. Overall impression of the SEAD Program (N=19)

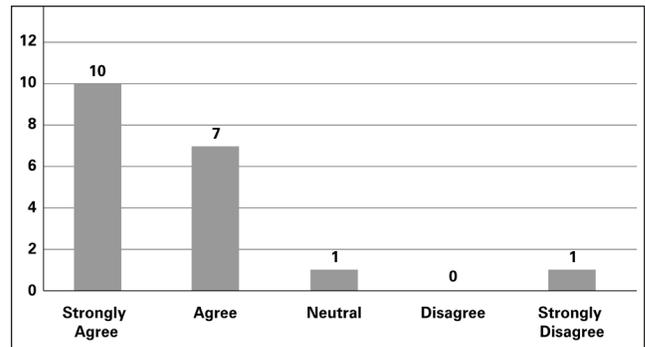


Figure 2. Responses to "The SEAD Program increased my interest in a career in surgery" (N=19)

Workshop Questionnaire Results

Thematic analysis uncovered three positive and three negative themes. Positive themes were those which students associated with the success of the program, or those which they felt should be sustained in future iterations of the SEAD program. On the other hand, negative themes were those which participants identified as areas for improvement, or which they thought decreased the effectiveness of the program. The most commonly cited positive and negative themes are listed in Table 2.

Table 2. Summary of Themes

Positive Themes	Negative Themes
Staff/residents	Time
Type of skills	Equipment/resources
Hands-on experience	Quality of teaching/instruction

Positive Themes

The most commonly identified words associated with positive participant feedback were "residents" (13 occurrences), "skills" (8 occurrences), and "hands" (7 occurrences). These corresponded to the themes of "the personnel present", "the types of skills taught", and "the hands-on experience provided".

Negative Themes

The most commonly identified words associated with negative participant feedback were "more" (14 occurrences), "time" (5 occurrences), and "instructions" (3 occurrences). These corresponded to the themes of "inadequate time", "unmet equipment/resource needs", and "poor teaching/instruction".

Discussion

Hands-on surgical experience has been shown to have a positive influence on medical students choosing to pursue a surgical career. Using the University of Toronto's SEAD Program as the means to carry out the study, our purpose

was to ascertain the aspects of surgical simulation activities contributing to a quality experience for pre-clerkship medical students. The results from our thematic analysis suggest participants enjoyed the hands-on experience, the variety of skills taught, and the informal teaching from staff and residents. Areas where participants desired improvement include an inadequate amount of allotted time, poor instruction from some workshop teachers, and poor quality of some of the workshop materials.

The access to hands-on skills training was crucial to the success of the program, as most students particularly enjoyed the workshops. The benefits of hands-on experience through simulation-based learning has been shown to foster a positive attitude towards, and increased interest in, a career in surgery – a trend further supported in this study. Hands-on sessions allowed participants to learn by active participation, in contrast to the majority of their didactic lecture-based curriculum during the pre-clerkship years.^{2,10-12} The immediate feedback given by staff and residents provided an opportunity to improve students' skills, and familiarized them with the learning process inherent in surgical and procedural education. Consequently, students gained insight into their own preferences towards kinesthetic learning and the immediate gratification associated with physical interventions such as surgical procedures. This connection between kinesthetic learning and immediate gratification is important in surgical training. As such, educational components of surgical programs could benefit from the inclusion of introductory simulation for their undergraduate medical students.

Furthermore, the variety of skills taught from each of the surgical programs were viewed positively. The SEAD Program workshops followed a design of progressive skill attainment and complexity – advancing from basic suturing to laparoscopy, z-plasty, and microsuturing, before transitioning to specialty-specific skills such as arterial anastomosis. This facilitated the involvement of relatively inexperienced students in the more advanced workshop skill sessions. Furthermore, access to a state-of-the-art surgical simulation centre used by the Department of Surgery at the University of Toronto provided a high-quality experience with activities that are rarely, if ever, available to students in their pre-clerkship years (e.g. laparoscopy, robotic simulations, artificial valve replacement). Overall, students gained exposure to the basic skill set relevant to various surgical subspecialties. This enabled students to self-select the complement of skills they most enjoyed, and may have provided some insight into which surgical subspecialties they might be interested in. This is concordant with studies that investigated medical student focused educational programs in vascular surgery, which exposed participants to endovascular simulator train-

ing.^{11,12} These studies conclude that mentored exposure to simulated procedures in specific skill sets positively impact the long-term attitudes and interest of medical students towards vascular surgery. Thus, simulation variety, useful models, and quality of facilities and materials are important for a positive workshop experience.

In addition, effective staff and resident teachers were imperative to the success of a simulation pre-clerkship surgical program. Career talks, which were integrated in the workshops preceding the skills sessions, were viewed as an informative overview of each surgical specialty. All instructors were recruited on a volunteer basis, and thus those who participated were greatly motivated. Accordingly, their strong advocacy for – as well as honest critiques of – their respective programs was well received by the participants. Students also expressed positive feedback with regards to the teacher-to-student ratio. The one-on-one time with staff and residents in an informal environment gave the opportunity for personal and career questions to be discussed.

Participants expressed constructive feedback regarding several aspects of the program, namely time constraints, resource needs, and variability in the quality of instruction. While many stations seemed to provide students with an introduction to the skill, some did not necessarily allow sufficient time for a full experience or skill acquisition. Students described frustration with having only a few attempts to try a skill before having to move on. There will inevitably be a compromise between the quantity of time spent at each station and the number of stations that the program can accommodate. In the future, exploring the possibility of expanding the timeframe of the program may remedy this issue.

Another negative aspect identified by students was some stations having a high learner-to-simulator ratio, preventing them from receiving sufficient hands-on time and adequate immersion. Additionally, some concerns were raised regarding the quality of some training materials made available by the simulation center. These materials, which had been previously used by senior medical students in their own training, were described as being in poor condition, thus impeding learning. A significant resource investment is required to build and maintain a high-quality experience that meets the learning needs of all 20 participants. Thus, expansion and quality control of seminar materials is required and may be an issue to focus upon for subsequent years.

Finally, with regards to the workshop instruction quality, several factors may have been responsible for the negative feedback from some students. The workshop activities were adapted from resident surgical training programs, and may have been too advanced for first year medical trainees. Yet we feel it is still valuable to provide early experience to

some of these skills at a lower level. In addition, while workshops were designed to cover similar topics, the program did not have a formal curriculum with objectives to ensure consistency of each workshop iteration. Therefore, clearly outlined goals and objectives for each session would be helpful. Similarly, a combination of structured and unstructured time with the equipment may yield a good balance, and achieve maximal results. Overall, there may be a need for a formal mini-curriculum to help guide consistent quality instruction and teaching of these skills, while being adapted at a more appropriate level.

All students had a favourable impression of the Program, and the majority stated that it increased their interest in a surgical career. Though not the focus of this study, this feedback is promising as it demonstrates an overall positive impact of the Program on pre-clerkship medical students. Furthermore, only a select number of students could participate due to resource limitations. As our colleagues Gawad et al. identify, additional resources to allow running multiple iterations of the program could remedy this issues.⁸ Going forward, awareness of the positive and negative themes borne from this study would be helpful in the creation of quality surgical simulation workshops for pre-clerkship medical students.

Study Limitations

Due to inherent resource limitations, there was a small participant size (20 students) and in turn, a small sample size (N=19). As the SEAD Program is the first of its kind in Canadian undergraduate medical education, there is a lack of generalizability. In addition, the nature of recruitment for the program may have led to a selection bias of participants, with those already having an interest in surgery likely self-selecting to be involved in the program. However, this degree of homogeneity amongst the study cohort does allow for comparison of responses.

As mentioned previously, there was a lack of formal educational objectives, which may have prevented evaluation of whether students met specific objectives. Finally, data collection involved only a short survey, while more rigorous tools such as focus groups or interviews may have yielded greater findings. Also, data triangulation was performed between only three co-investigators, limiting the depth of the analysis. Overall, the study results would have greater generalizability and applicability had there been a greater sample size, more variability in participants (e.g. inclusion of more students not initially interested in surgery), tracking surgical interest over time with several iterations of the program, and comparing data with CaRMS match results.

Conclusion

Given the importance of hands-on involvement on increasing interest in and exposure to surgery, optimizing the quality of surgical education experiences among pre-clerkship medical students is an essential consideration. In this preliminary analysis, we identified three positive themes (high-quality instructors, type of skills, and hands-on experience), and three negative themes (minimizing time limitations, resource limitations, and poor instructors) worth considering to help improve the quality of simulation activities. Further study is needed to include larger and more varied sample sizes, coupled with long-term and CaRMS match data to support the quality factors we have identified as being important to introductory surgical simulation experiences.

Acknowledgements

The authors of this paper would like to thank the Department of Surgery at the University of Toronto and its staff, fellows and residents, the Mt. Sinai Surgical Skill Centre, and the St. Michael's Hospital Simulation Centre for their continued support of the SEAD Program. The authors would particularly like to thank Drs. Rutka, Christakis, and Kodama for their support, encouragement, and guidance. We would also like to recognize Nada Gawad (SEAD Program Founder and Inaugural Director, Class of 1T4) for her tremendous efforts and continued support of the program.

References

- 1 Minor S, Poenaru D, Park J. A study of career choice patterns among Canadian medical students. *Am J Surg* 2003;186(2):182-188.
- 2 Azizzadeh A, McCollum CH, Miller CC, Holliday KM, Shilstone HC, Lucci A. Factors influencing career choice among medical students interested in surgery. *Curr Surg* 2003;60(2):210-213.
- 3 Brundage SI, Lucci A, Miller CC, Azizzadeh A, Spain DA, Kozar RA. Potential targets to encourage a surgical career. *J Am Coll Surg* 2005;200(6):946-953.
- 4 Kozar RA, Lucci A, Miller CC, Azizzadeh A, Cacanour CS, Potts JR, et al. Brief intervention by surgeons can influence students towards a career in surgery. *J Surg Res* 2003;111(1):166-169.
- 5 Zeldow PB, Prestone RC, Daugherty SR. The decision to enter a medical specialty: time and stability. *Med Educ* 1992;26(4):327-332.
- 6 Scott I, Gowans M, Wright B, Brenneis F. Stability of medical student career interest: a prospective study. *Acad Med* 2012;87(9):1260-1267.
- 7 Erzurum VZ, Obermeyer RJ, Fecher A, Thyagarajan P, Tan P, Koler AK, et al. What influences medical students' choice of surgical careers. *Surgery* 2000;128(2):253-256.
- 8 Gawad N, Moussa F, Christakis GT, Rutka JT. Planting the "SEAD": early comprehensive exposure to surgery for medical students. *J Surg* 2013;70:487-494.
- 9 Debas HT, Bass BL, Brennan MF. American surgical association Blue Ribbon Committee report on surgical education: 2004. *Ann Surg* 2005;241(1):1-8.
- 10 Cloyd J, Hotzman D, O'Sullivan P, Samman A, Tendick F, Ascher N. Operating room assist: surgical mentorship and operating room experience for pre-clerkship medical students. *J Surg Educ* 2008;65(4):257-282.
- 11 Lee JT, Qui M, Teshome M, Raghavan SS, Tedesco MM, Dalman RL. The utility of endovascular simulation to improve technical performance and stimulate continued interest of preclinical medical students in vascular surgery. *J Surg Educ* 2009;66(6):367-73.
- 12 Markovic J, Peyser C, Cavoeres T, Fletcher E, Peterson D, Shortell C. Impact of endovascular simulator training on vascular surgery as a career choice in medical students. *J Vasc Surg* 2012;55(5):1515-1521.