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Exploring Surgeons' Perceptions of the Role of Simulation in Surgical Education: A Needs Assessment

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Abstract

Background: The last two decades have seen the adoption of simulation-based surgical education in various disciplines. The current study's goal was to perform a needs assessment using the results to inform future curricular planning and needs of surgeons and learners.

Methods: A survey was distributed to 26 surgeon educators and interviews were conducted with 8 of these surgeons. Analysis of survey results included reliability and descriptive statistics. Interviews were analyzed for thematic content with a constant comparison technique, developing coding and categorization of themes.

Results: The survey response rate was 81%. The inter-item reliability, according to Cronbach's alpha was 0.81 with strongest agreement for statements related to learning new skills, training new residents and the positive impact on patient safety and learning. There was less strong agreement for maintenance of skills, improving team functioning and reducing teaching in the operating room. Interview results confirmed those themes from the survey and highlighted inconsistencies for identified perceived barriers and a focus on acquisition of skills only. Interview responses specified concerns with integrating simulation into existing curricula and the need for more evaluation as a robust educational strategy.

Conclusion: The findings were summarized in four themes: 1) use of simulation, 2) integration into curriculum, 3) leadership, and 4) understanding gaps in simulation use. This study exemplifies a mixed-methods approach to planning a surgical simulation program through a general needs assessment.

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Introduction

Simulation is a well-established educational technique in medical education.[1-3] The last 15 -20 years has seen the adoption of simulation-based education in various disciplines, with the introduction of a range of simulation methods from the simple to the complex, from high to low fidelity and in a variety of domains from procedural skills to team communications and the assessment of professionalism.[2-5] Much of this implementation has occurred in specialties such as anesthesiology, emergency medicine and critical care medicine and has been led by enthusiasts and "early adopters".[4] The uptake of simulation-based education in the training of surgeons has been more variable. Some centres have forged ahead in the field and simulation curricula have emerged.[5-8] However, many institutions still train surgeons by the apprenticeship model in the clinical environment. Surgeons learn to assess, manage and operate on real patients in real time. For most surgical residents and practicing surgeons, new skills are learned by observing, assisting with, and then assuming graduated responsibility for operative procedures.

In Canada, a national curriculum in surgical simulation does not exist, nor is there consensus on how simulation should be integrated in Canadian surgical residencies. Therefore, despite the growth in acceptance of simulation as a key learning technique for surgical education no national strategy exists to support institutions with the appropriate integration of simulation into established surgical curricula. Furthermore, surgical educators require a clear understanding of how best to integrate simulation at the undergraduate, post-graduate and practicing professional levels.

It was in this context that we set out to systematically develop a curriculum in surgical simulation at the University of Alberta, Canada. At the initiation of this process, we designed a general needs assessment as the first step of the curriculum design cycle described by Kern,[9] to inform the development and implementation of a curriculum in surgical simulation.[8-10] This needs assessment was intended to identify current uses of surgical simulation in the learning environment; understand surgeons' perceptions of the role of simulation in the education of medical students, residents and practising surgeons; and explore surgeons' ideas about how simulation should be developed and implemented in our environment in the future.

The intent of this study was to understand the current use of simulation in our educational environment, a publicly funded institution, and to identify the factors that might influence the future adoption and integration of simulation technologies into our surgical education programs.

Methods

Study Setting

Our Department of Surgery consists of approximately 150 practising surgeons within 9 Divisions of Surgery. Approximately 125 surgical residents and 250 medical students are educated per year. This is distributed between 7 residency programs and 2 clerkships at a number of hospital sites in the City of Edmonton. The Divisions represented within the Department are: General Surgery, Orthopaedics, Urology, Otolaryngology/ Head and Neck Surgery, Vascular Surgery, Cardiac Surgery, Thoracic Surgery, Neurosurgery and Plastic Surgery. For the purposes of this study, participants were drawn from the pool of practising surgeons within these Divisions, and from the affiliated Departments of Obstetrics and Gynaecology and Ophthalmology.

Study Design

This study was designed to explore the opinions of "key informants" within these Departments about the use of simulation in surgical education. Key informants are defined as "those individuals who possess special knowledge and have access to, or special information about the context that they participate in".[11] We developed a list of key informants who held educational and leadership roles focused on the development of surgical education, from all Divisions and Departments listed above. Our study design was conducted in two phases: phase 1 included an initial electronic survey of all key informants; phase 2 included in-depth recorded interviews with a purposefully sampled subset of key informants. Survey data were analyzed using quantitative methods. A qualitative approach based on grounded theory was used to analyse the interview transcripts. The University of Alberta's Health Research Ethics Board granted approval for this study.

Development of the Needs Assessment

The first step in the curriculum cycle, as described by Kern, is "problem identification and general needs assessment" which is further defined as "the identification and critical analysis of a health care or educational need",[9] requiring "an analysis of the current approach to the problem followed by the identification of the ideal approach, reflecting how the educators should be addressing the reported problem". Using this approach, we developed a needs assessment based on the three questions (themes), as informed by Kern et al..[9] These questions were intended to analyze the current use of simulation in our environment, and to explore how we might implement simulation techniques in surgical education. The three questions were: What is the current use of simulation in surgical education in our environment? What would be the ideal use of simulation in surgical education in our environment? What are the perceptions of key informants in regards to factors affecting the implementation of simulation in surgical education in our environment? The survey items were then developed after a literature review guided by the questions and validated with content experts in simulation in the Faculty of Medicine and Dentistry and Faculty of Education.

Key Informant Survey Design

Survey items were constructed according to the principles of survey design[12] after a review of recent literature on the topic of introduction of simulation activities[10,13-17] Content validity was ensured by having the survey reviewed and amended by the individuals (MLC, JW, MC) authors whom have expertise in survey design and surgical education. Testing for clarity and face validity was performed by having the survey reviewed by a sample of senior residents in surgery. The final survey consisted of a total of 25 questions: 18 statements to be rated using a 5 point Likert scale (from 1: strongly disagree to 5: strongly agree), 5 questions about participants' experiences of and beliefs about simulation and 2 open-ended questions about the use and development of simulation-based educational activities. Participants were asked in particular about their experience of the following types of simulation activities: cadaveric, models, simulated patients, computer-based (CD), high fidelity, role play, video, real-time OR, web review, and task-specific. The survey items are presented in Table 1.

Table 1a. Needs Assessment Survey Items Using Likert Scale with Mean Responses

Items rated using Likert scale (1= strongly disagree, 5= strongly agree)	Mean
1. Simulation activities are an essential part of training for residents.	4.45
2. Simulation activities are a good way to practice new surgical procedures.	4.43
3. Simulation activities are a good way to learn new motor skills.	4.33
4. Simulation activities in surgical training will improve patient safety.	4.29
5. Simulation activities in surgical training will help people learn skills faster.	4.24
6. Simulation activities are an essential part of training for medical students.	4.14
7. Trainees who use simulation will be better prepared for the operating room environment.	4.14
8. Simulation activities are a good way to learn new knowledge.	4.10
9. Simulation activities are an essential part of training for practicing surgeons.	3.95
10. Simulation activities in surgical training will help teams to function better.	3.90
11. Simulation activities are a good way to learn how an operating room functions.	3.67
12. Simulation activities allow practicing surgeons to maintain their skills.	3.48
13. The use of simulation activities for surgical trainees will reduce my teaching load in the operating room.	3.00
14. Simulation activities are not like real surgical practice.	2.81
15. There is not enough space to accommodate a simulation centre within the Department of Surgery.	2.38
16. Simulation activities are too expensive to use.	2.33
17. There is not enough time to use simulation activities to augment surgical education.	1.86
18. Simulation is not a useful way to learn.	1.57

Table 1b. Needs Assessment Survey - Open Response Items

Open response items
19. What simulation activities do you have personal experience of? *
20. What simulation activities are occurring in your Division currently? *
21. What simulation activities would you like to see occurring in your Division? *
22. What simulation activities do you think are useful for the following groups of learners: medical students, residents, surgeons? *
23. Where should simulation take place? **
24. Who should be using simulation?
25. Who is responsible for the development of simulation at your institution? (open-ended)

* Listed activities: cadaveric, models, simulated patients, computer-based (CD), high fidelity, role play, video, real-time OR, web review, task-specific, other.

** Listed locations: hospital, academic institution, private office.

Key Informant Interview Design

After review of the survey data, questions were developed to probe further into the views of the leadership of the Department of Surgery. Semi-structured interviews were conducted with a subset of the key informants identified by purposeful sampling. The interviews were conducted by one researcher (MC) familiar with interview techniques and the content area. The five structured questions employed are shown in Table 2.

Table 2. Questions Used in the Structured Interview

Interview questions
1. What is your impression of simulation in general?
2. What do you perceive that simulation is good for?
3. Can you tell me about simulation in your department or division?
4. What simulation activities would you like to see developed in Edmonton for the future?
5. What are the barriers, if any, for developing simulation type programs or activities that you know of?

Each interview was approximately 30 minutes and was digitally recorded and transcribed verbatim for analysis. The transcripts were initially analyzed by a single investigator (MC) who selected key words and phrases to describe the concepts expressed by the interview subjects. A coding scheme was then developed to describe the relationships between the ideas expressed. Using a constant comparison technique, the cycle of reading-analysis-coding was repeated on further transcripts until no new concepts were derived, and data saturation was achieved. A second investigator (JW) then reviewed the transcripts and categorization to offer additional insight and refinement of the coding scheme. Data saturation was achieved after six interviews were analyzed, comprising 45 pages of single spaced transcript.

Results

Analysis of Survey Data

There were 21 of 26 surveys completed (80.8%); the internal consistency estimate of reliability was 0.81 (Cronbach's alpha).[18] Participant responses and means to the first 18 items are summarized in Table 1. The strongest agreement (mean Likert response > 4.0: agree/strongly agree) was observed with statements relating to the use of simulation in learning new procedures and new motor skills and in the training of surgical residents. There was also agreement with statements relating to simulation's impact on patient safety, the use of simulation for preparing for the operating room, and the use of simulation in medical student education. There was moderate agreement (mean Likert response 3.0 - 4.0: no opinion/agree) with statements pertaining to simulation use in training and skills maintenance for practicing surgeons, in improving team function and in learning how an operating room functions.

Participants were divided on whether simulation would reduce the amount of teaching done in the operating room (mean Likert response 3.00: no opinion). Participants disagreed (mean Likert response < 3.0: disagree/strongly disagree) with a number of items which were intended to probe their opinion on the usefulness of simulation as an educational technique and on their perception of barriers to the implementation of simulation in surgical education: they considered simulation to be realistic, and that time, space and resources should be found to implement simulation-based educational activities. The strongest disagreement was noted to the statement: "simulation is not a useful way to learn" (mean Likert response: 1.57).

Regarding their own previous personal exposure to simulation-based educational techniques, participants reported having used lower fidelity simulators the most (cadaveric, –computer-based, models, >70% of participants), and real time operating room experiences the least (<30%). Current simulation activities most often reported were cadaveric and models (>50%), with less reporting of real time operating room, role playing, high fidelity computerized models and web based reviews. Participants expressed a desire for all of the simulation activities listed to be developed in our environment, but demand was highest for high fidelity simulation (>50%). The responses obtained suggested that, while participants believed that all learner groups would benefit from simulation-based education, different activities would be useful for different learners. Responses suggested that simulation activities for medical students should focus on computer-based learning and standardized patients (>60%), while activities for residents should focus mainly on cadaveric training, task-specific trainers, anatomic models

and high-fidelity simulation (all >70%). They stated that simulation activities for themselves as practising surgeons should include real-time operating room simulations, high-fidelity simulation, cadaveric models, and web review (>50%).

Regarding the physical location for delivery of simulation-based education, responses suggested that simulation activities such as simulated patients and real time operating room experiences should occur in a hospital environment, while university settings should house cadaveric, model and video activities. Private offices were considered the best setting for computer programs, CD based activities and web reviews. Lastly, participants suggested that the responsibility for development of simulation-based educational activities should be directed by academic and clinical leadership, using a collaborative, centralized approach.

Analysis of Interview Data

Analysis of interview data provided another method of understanding key informants' beliefs about the role of simulation in surgical education. These data confirmed many of the observations noted in the survey data and provided an interesting comparison between the opinions of those identified as surgical leaders and of the larger group of key informants[11] who completed the electronic survey. The coding structure developed is presented in Figure 1.

When asked about simulation in general, participants focused on its role in promoting patient safety, describing it as "a safe way to learn and practice", as a technique by which "safe mistakes" could be made. They also described simulation as a means of maintaining existing skills and learning new skills. Participants then discussed two further aspects of their perceptions about simulation, which had not clearly emerged from the survey. The first of these we categorized as "Limitations/Unknowns" and the second we described as "Barriers".

Under the category "Limitations/Unknowns", participants appeared to temper their enthusiasm for simulation in general with concerns about how simulation would be implemented in practice in existing curricula and learning environments. They admitted that they did not really know what type of simulation would be best at facilitating, wondering whether it could enhance the acquisition of knowledge as well as skills, and whether it would be effective in helping people to learn how to work as teams, how to work in new environments and how to communicate. Participants also suggested that simulation might be useful for all learners (undergraduate to CPL), and they may benefit from simulation in different ways. This concept was further developed in the discussion about the level of fidelity required, suggesting that while novices might benefit from low-fidelity simulation, experts (such as the participants) would benefit most from high-fidelity, real-time simulation. There was also some consideration given to the cost of such high-fidelity simulation relative to the perceived learning need and anticipated benefit. Lastly, participants pondered how simulation could be integrated into existing curricula for maximum effect, and how it might be used as an assessment tool, for instance as something to be mastered before graduating to operating on real patients.

Under the category 'Barriers', participants elucidated the factors that they anticipated would have to be overcome, if simulation were to be implemented in our curriculum. The factors listed were time, physical space, access to resources, finances and "buy-in" from program directors and practicing surgeons.

In the final section of the interviews, participants considered how they would like to see a program of simulation developing in their own environment. There were two main themes raised: firstly, that they would like to see more evaluation of simulation as an educational method, addressing some of the concerns raised under "Limitations/Unknowns", and secondly that they would like to see senior academic leadership take action to overcome the identified barriers to implementation and to define how simulation-based education should be integrated to enhance existing programs.

Discussion

This study is an in depth curricular needs assessment that explores the views of practising surgeons, who are seen as leaders in surgical education, relating to simulation and how they envisage it can be employed to improve surgical

education at our institution. Understanding these influential leaders' perceptions in relation to simulation education will impact the integration of appropriate simulation strategies into established surgical curricula. The key findings are summarized in four themes. The first theme relates to the use of simulation with a focus on learners' needs, with higher levels of fidelity for higher levels of learning. The second theme relates to integrating simulation into the curricula finding that the surgeons were keen to see simulation activities added to the curriculum, but were unclear how to achieve this goal. The third theme identifies the leadership challenges anticipated. Ideally, simulation activities and programs should be led by academic centres with a shared coordination of efforts to reduce duplications. The fourth theme describes the gap in understanding the potential benefit and scope of simulation; which is broad with a focus on technical (skill acquisition) rather than non-technical skills.

Theme one – The use of simulation. Responses about the use of simulation in the training of medical students and residents reveal much about surgeons' conceptions of learning in these groups. Our results are consistent with the idea that surgeons perceive medical students as "learning the basics" and that high-fidelity simulation is not required at this stage. Simulated patients and computer-based simulation should suffice for this level of training, presumably because most students are not expected to master surgical procedures. Surgical residents, on the other hand, are being trained to perform procedures and surgeons suggested that they should focus on anatomical models and task-specific simulation, perhaps graduating later to high-fidelity simulation, presumably as an introduction to performing procedures on real patients. This suggests that surgeons see simulation as one way of ensuring patient safety while trainees are on the "learning curve" for procedures, allowing trainees "permission to fail" in a safe, simulated environment.[10, 20-22] Surgeons suggested that more resource-intensive simulation activities such as real-time OR and high-fidelity simulation should not be provided to medical students, but should be reserved mainly for surgeons in practice. Despite these surgeons' enthusiasm for simulation as a learning tool for residents, they did not seem to believe that simulation would lighten their own "teaching load" in the operating room. This may be because surgeons do not have a clear idea of how simulation activities would be integrated into the surgical curriculum, nor how simulation might change how residents learn to perform procedures and are assessed.

Theme two – The integration of simulation into curricula. Interviewed surgeons were enthusiastic to see simulation activities added to the curriculum, but were unclear how to achieve this goal. They expressed the need to monitor and evaluate the introduction of simulation to make sure that it was having the intended positive effect on learning. This idea is interesting when it is considered that it comes from a group of surgeons trained "in the traditional way", largely without the benefit of simulation, who can be assumed to have learned their craft by operating on real patients under the supervision of other more experienced surgeons. This group can be assumed to be highly invested in maintaining the quality of resident education, and to want to ensure that the introduction of simulation in a controlled way to ensure that the standard of education in procedural skills is at least maintained, if not improved. Clearly, these surgeons would like to see simulation used to improve surgical education, although they do not currently seem to have a clear understanding of precisely how this will be achieved.

With respect to surgeons' perceptions of the appropriate uses of simulation for practicing surgeons, medical students and residents, the respondents were positive about the potential of simulation. They described it as a good way of learning, a way to enhance patient safety during learning and a way to develop and maintain surgical skills. However, surgeons seemed to perceive simulation principally as a way to learn new procedural skills as opposed to other domains of learning such as knowledge or communication skills, a finding which is not in keeping with recent literature on the use of simulation to teach, practise and assess non-technical skills.[1,5,19] It is not surprising that physicians engaged in a procedural speciality such as surgery would perceive simulation activities as being "all about the motor skills", and struggle with other conceptions and applications of simulation techniques. In the data from the survey and interviews, surgeons clearly viewed simulation as a

way of facilitating the acquisition of new procedural manoeuvres while working at a high skill level. Simulation for practising surgeons seemed to focus on learning new skills rather than ensuring patient safety or skills maintenance. Surgeons wanted simulation accessible to them in their hospital environment (high-fidelity and real-time OR) and also in the office (computer/web based), targeted to their needs. These results imply that surgeons do not see simulation making much difference for them in procedures they have mastered and practice regularly; probably because they believe that they maintain their skills through regular performance of the procedure in practice.

Theme three – Leadership and responsibility for integration into established curricula. These surgeons expressed the view that the introduction of simulation activities into surgical education should be overseen by academic leadership, using a coordinated approach to drive the integration of simulation into existing curricula, to evaluate the impact and effects of simulation, to overcome barriers of time, money and space, and to avoid duplication of effort. There was an interesting contrast between the opinions of the larger group of key informants and the subset of surgical leaders invited for interview. While the survey responses of the larger group suggested that space, money and time in the curriculum should be devoted to simulation, the leadership group tempered their enthusiasm for simulation with concerns about limitations in current educational resources. This presumably reflects the difference in opinion between those who wish to see simulation developed in principle, and those responsible for its actual implementation in practice. Surgeons also see "buy-in" from older surgeons and others as a potential barrier. Surgery is by its nature a rather conservative field, and these surgeons anticipated that some of their colleagues might be less convinced about the benefits offered by simulation – this is another area in which academic leadership needs to play a role if simulation is to be successfully introduced.

Theme four – The "understanding gap". While surgeons are enthusiastic about simulation in principle, and are passionate about maintaining the quality of surgical education, there is a potential "understanding gap" among surgeons about modern concepts of simulation, particularly in relation to the use of simulation to enhance non-technical skills. We plan to address this by developing innovative ways to demonstrate to our faculty that the use of simulation in education is not solely about the development of motor skills and for learning new procedures in high-fidelity environment, but can also be applied to areas such as team functioning, communication and situational awareness.[1,3,6,8,23,24] We also need to educate our faculty about the full spectrum of simulation techniques which can be applied in surgical education, including novel applications of low-fidelity simulation in clinical environments.[4,25]

Conclusion

This study provides valuable information, that will be of use as we employ the next steps of Kern's , model[9] to develop a local curriculum in surgical education. This study showed that surgeons view simulation as an effective way to learn new procedures and are enthusiastic about the potential for simulation to enhance surgical education, but are unsure about how simulation should be integrated into existing surgical curricula. These results also constitute a challenge to leaders in the field of surgical education in Canada to provide a clear vision of how simulation is to be integrated into existing surgical curricula, and of how the advantages of simulation-based education can be demonstrated to the wider community of surgeons. It is our belief that an effective curriculum in surgical simulation can only be developed by informing surgical teachers about the advantages of simulation as an educational technique, and engaging them in the development, implementation and evaluation of the use of simulation-based surgical education.

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Figure 1. Coding Structure for Interview Data.