Medical Science Educator (2019) 29:643–646
https://doi.org/10.1007/s40670-019-00771-9

SHORT COMMUNICATION

Clinical Skills Simulation Complementing Core Content: Development of the Simulation Lab Integrated Curriculum Experience (SLICE)

Drew Cutshaw[1] · Thomas O'Gorman[1] · Gary L. Beck Dallaghan[1] · Anita Swiman[1] · Benny L. Joyner Jr[1] · Kurt Gilliland[1] · Paul Shea[1]

Published online: 9 July 2019

Abstract
Simulation is emerging as an essential component of the medical school curriculum. Simulation Lab Integrated Curriculum Experience (SLICE) is a student-organized program at the University of North Carolina School of Medicine (UNC SOM) for medical students that provides skills-based training sessions to augment didactic learning experiences. During its pilot year, SLICE conducted five events with respondents completing pre-and post-surveys evaluating participants' level of comfort with procedures. There was a significant increase in self-reported confidence after each session, with students providing overwhelmingly positive feedback regarding SLICE's ability to contextualize material presented in traditional lectures.

Keywords Medical student · Simulation · Clinical skills · Basic science

Background

Over the past several years, medical schools have restructured their curricula to emphasize self-directed learning [1], team-based learning [2], and other educational modalities that were more student-centric [3]. These delivery methods reflect the growing call for competency-based medical education [4] and are designed to increase knowledge acquisition and retention by actively engaging students.

Although lectures are an acceptable instructional method to convey core material, medical students may not find this modality particularly useful [5]. In fact, a recent study asked first-year medical students to rank their preferences among eight instructional methods, team-based learning and simulation had the highest mean ratings [6]. However, lectures still ranked in the top five for the first-year students, indicating that team-based learning and simulation in isolation are not sufficient modalities to teach medical students.

✉ Gary L. Beck Dallaghan
gary_beck_dallaghan@med.unc.edu

1 University of North Carolina School of Medicine, 311 Berryhill Hall, CB 7321, Chapel Hill, NC 27599, USA

In 2011, the Association of American Medical Colleges (AAMC) surveyed 93 medical schools from across the country regarding their opinions and implementations of simulation experiences. Nearly 100% of medical schools surveyed indicated that they used simulation to teach medical knowledge, patient care, and interpersonal communication skills. Interestingly, however, most medical schools also indicated that they desired to use simulation to teach professionalism, critical thinking, decision-making, and psychomotor tasks [7].

Simulation in medical education has predominantly focused on beginning doctoring courses. These simulations involve standardized patient encounters to develop history-taking and physical examination skills. Although the simulated sessions may incorporate material first introduced in a didactic format, the emphasis is on developing specific clinical skills to better prepare students for clerkship experiences [8, 9]. Inclusion of simulation exercises as a means of complementing basic science instruction has not been explored extensively. One study used clinical case scenarios with high-fidelity mannequins to enhance students' understanding of pathophysiology, demonstrating increased engagement, stimulation, perception, and expectation without compromising knowledge acquisition [10]. Other studies have also employed simulation to complement clinical and diagnostic skills [11–13]. Few studies reported focusing on understanding basic science principles underlying the need for certain procedures as part of the simulated exercise.

In 2014, the University of North Carolina School of Medicine (UNC SOM) transitioned from the traditional 2-year preclinical/2-year clinical education model to the Translational Education at Carolina (TEC) curriculum. In TEC, students spend the first year and a half in the preclinical Foundation Phase, where they are taught basic science content in 13 organ system blocks to prepare them for their clinical rotations. Relevant physiology, histology, radiology, and pathology for a particular organ were taught in a self-contained block (e.g., cardiology, pulmonary or urinary blocks).

Simulation Lab Integrated Curriculum Experience (SLICE) is a student-organized program at the UNC SOM for medical students during the Foundation Phase, complementing classroom learning with basic clinical skills education. The objective for developing SLICE was to enhance retention of lecture material by augmenting and contextualizing the core material via reproducible and cost-conscious simulations. Secondary objectives for this program included increasing familiarity and comfort with clinical skills medical students may encounter on clinical rotations and increasing involvement of educators and advanced medical students to contribute to medical education. We describe the development of SLICE and report student perceptions from the pilot year.

Methods

During the pilot year from March 2017 to February 2018 in select organ system blocks in UNC SOM's Foundation Phase, SLICE offered simulation training sessions relevant to the material presented in lecture. For most events, students were instructed to watch a preparatory video or read a *New England Journal of Medicine* article describing the selected procedure and its indications prior to the session. All enrolled first- and second-year medical students completing the system block were invited to participate in the simulations. The number of participants varied per session and were scheduled based on instructor and equipment availability. Students could sign up on a first come, first served basis using an emailed form.

SLICE events included a brief informational session presented by a physician, nurse, paramedic, or trained simulation specialist on the indications, risks, benefits, and technique for the selected procedure. The instructor demonstrated the clinical skill of interest on a high-fidelity task trainer (Table 1), followed by students practicing under direct supervision. If more than one task trainer was available, students rotated between trainers. Instructors circulated the room, providing teaching moments and real-time feedback during the session. This model facilitated multiple attempts per student, feedback from instructors, and time for questions.

Five simulations occurred with corresponding blocks (Table 1). Pre- and post-session surveys were collected from students immediately before and after the event to gauge student understanding, perceived competence, and comfort with the procedure. Students rated themselves from 1 to 5 (least to most) on several questions with an additional free response question to elicit more direct feedback. Narrative comments were reviewed to identify common themes from the evaluation questions: What was your motivation for attending this session? and What was your impression of this experience?

Student leaders did not participate in the training events or surveys. This project was submitted to the UNC IRB and determined not to require IRB approval as a voluntary medical education project. Descriptive statistics were used to compare pre- and post-surveys. Mann-Whitney U tests were used to compare responses using IBM SPSS version 25.

Results and Discussion

SLICE provided a productive venue for undergraduate medical students to augment lecture-based classroom learning with low-pressure, high-fidelity simulations that increased perceived competence and confidence before entering clinical rotations. The primary objective of SLICE was to contextualize and augment material presented in the core curriculum through traditional didactics. Pre-and post-survey results indicated students experienced increased confidence and competence for each simulation (Table 2). Qualitative responses were overwhelmingly positive and indicated that students were able to use simulation as a means to understand and practice material presented in lectures. Our data suggests that SLICE successfully achieved its primary and secondary objectives.

For this pilot project, the number of students attending a simulation session varied from as few as 10 to 26 (Table 2). More resource-intensive events like the lumbar puncture simulation had fewer slots available. Other events, like IV placement and blood draw simulation, were less constrained by resources and instructor availability and therefore had a higher number of participants. In total, 5 to 15% of the class took advantage of these sessions, and some students participated in multiple events.

Pre- and post-surveys included common questions across all simulations to gauge confidence and perceived competence in a student's ability to perform the select simulation and teach the skill to a colleague. There was a statistically significant increase in perceived confidence and competence in each clinical skill after each respective simulation session (Table 2).

Narrative comments indicated students responded positively to the experiences provided. For many students, these were novel experiences and they felt they had a better

Table 1 Blocks and associated simulation exercises

Select organ system blocks	SLICE event	Number of sessions offered	Maximum number of students per session	Preparatory materials	Simulator used
Hematology/Oncology	Peripheral blood draws	4	8	NEJM video [14]	Adult venipuncture arm task trainer
Cardiology	DC cardioversion	4	5		Defibrillator in training mode and adult high-fidelity mannequin
Neurology	Lumbar punctures	2	10	NEJM video [15]	Adult and infant lumbar puncture task trainer
Obstetrics/Gynecology	Normal labor & delivery and cervical dilation status	2	10		Automated birthing simulator and cervical dilation & effacement module
Multi-organ synthesis	Central lines and tunneled catheters	2	5	NEJM video [16]	Subclavian vein central line task trainer

understanding of the clinical necessity for the procedures after the experience. Students reported the sessions provided "great hands on experience and a good way to get the jitters out." Through SLICE events, participants were "able to connect… knowledge of the principle behind treatment and how [the treatment] works." In addition to finding the actual procedural skill training helpful, students noted that these sessions helped to solidify their understanding of the basic science material they were learning in class. This was particularly noted during the direct current cardioversion simulation in the cardiovascular block, where a student commented, "This is the single most helpful thing I've had the opportunity to do to solidify [cardiology] material." The most frequent complaints logged in the narrative comments were that students wanted more individual time with each task trainer and more instructors to give directed feedback.

Table 2 Pre- and post-questionnaire results

Simulation	*n*	Pre	Post	*z*	*p*
Blood draws	26				
How comfortable do you feel describing how to perform on an adult and pediatric patient?		2.14	3.50	−4.90	< .001
How comfortable do you feel performing on an adult and pediatric patient		1.21	2.27	−4.49	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric patient?		1.50	2.69	−4.00	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric simulator?		2.68	3.73	−3.34	.001
DC cardioversion	17				
How comfortable do you feel describing how to perform on an adult and pediatric patient?		1.59	4.06	−5.18	< .001
How comfortable do you feel performing on an adult and pediatric patient		1.06	3.29	−5.25	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric patient?		1.18	3.71	−5.22	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric simulator?		1.47	4.65	−5.160	< .001
Lumbar punctures	19				
How comfortable do you feel describing how to perform on an adult and pediatric patient?		2.32	4.11	−4.66	< .001
How comfortable do you feel performing on an adult and pediatric patient?		1.26	3.42	−5.21	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric patient?		1.63	3.58	−4.50	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric simulator?		3.37	4.53	−3.64	< .001
Normal labor & delivery and cervical dilation status	18				
How comfortable do you feel describing how to perform on an adult and pediatric patient?		1.50	3.44	−4.77	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric patient?		1.44	3.28	−4.77	< .001
Central lines	10				
How comfortable do you feel describing how to perform on an adult and pediatric patient?		1.30	3.80	−3.86	< .001
How comfortable do you feel performing on an adult and pediatric patient		1.10	3.00	−4.07	< .001
How comfortable do you feel instructing a peer on how to perform the procedure on an adult and pediatric patient?		1.10	3.40	−3.97	< .001

Comparisons were significant with $p < .05$

A limitation of our study was the inability to identify participants to determine if participation influenced their block examinations.

Data collected during the first year of SLICE were self-reported measures and do not serve as an assessment of clinical competence for a given skill. SLICE was designed to reinforce key principles and concepts being taught in the systems blocks. Furthermore, students who consider themselves primarily "hands-on learners" or who face challenges with traditional lecture formats may particularly benefit from programs like SLICE.

Unfortunately, due to availability of simulation lab staff and resources, only 15% of the first-year class participated in SLICE during its inaugural year despite a large interest in the program. This was a notable limitation of the scope of the program, and we are working to integrate SLICE into the formal curriculum. Given the positive reception to the program, expanding access of the program to the entire student body is an important future goal of SLICE.

Conclusions

SLICE is the first known student-organized program augmenting the curriculum using state-of-the-art simulation facilities. The pilot year of the program successfully provided high-yield and engaging experiences that helped to solidify key content presented to students in didactic sessions. Follow-up studies are planned to determine if SLICE participation influences preclinical course examinations and if student performance during the clinical rotations is improved. Students, faculty, and educators are excited for the future of SLICE and the continued integration of simulation into the core curriculum.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest to declare.

Ethical Approval This study was deemed to be program evaluation.

Informed Consent Not applicable.

Previous Presentations Not applicable.

References

1. Knowles MS. Self-directed learning. New York: Association Press; 1975.
2. Burgess A, Bleasel J, Haq I, Roberts C, Garssia R, Robertson T, et al. Team-based learning (TBL) in the medical curriculum: Better than PBL? BMC Med Ed. 2017;17:243. https://doi.org/10.1186/s12909-017-1068-z.
3. Spencer JA, Jordan RK. Learner centered approaches in medical education. BMJ. 1999;318(7193):1280–3.
4. Hautz SC, Hautz WE, Feufel MA, Spies CD. Comparability of outcome frameworks in medical education: Implications for framework development. Med Teach. 2015;37(11):1051–9.
5. Talmon GA, Beck Dallaghan GL. Mind the gap: generational differences in medical education. North Syracuse: Gegensatz Press; 2017.
6. Zinski A, Panizzi KTC, Blackwell PW, Belue FM, Brooks WS. Is lecture dead? A preliminary study of medical students' evaluation of teaching methods in the preclinical curriculum. Internatl J Med Ed. 2017;8:326–33.
7. Passiment M, Sacks H, Huang G. Medical simulation in medical education: results of an AAMC Survey. AAMC. 2011.
8. Alluri RK, Tsing P, Lee E, Napolitano J. A randomized controlled trial of high-fidelity simulation versus lecture-based education in preclinical medical students. Med Teach. 2016;38(4):404–9.
9. Angarita FA, Price B, Castelo M, Tawil M, Ayala JC, Torregrossa L. Improving the competency of medical students in clinical breast examination through a standardized simulation and multimedia-based curriculum. Breast Cancer Res Treat. 2018. https://doi.org/10.1007/s10549-018-4993-6.
10. Chen H, Kelly M, Hayes C, van Reyk D, Herok G. The use of simulation as a novel experiential learning module in undergraduate science pathophysiology education. Adv Physiol Educ. 2016;40:335–41.
11. Courteille O, Fahlstedt M, Ho J, Hedman L, Fors U, Von Holst H, et al. Learning through a virtual patient vs. recorded lecture: A comparison of knowledge retention in a trauma case. Internatl J Med Educ. 2018;9:86–92.
12. Gonzalves A, Verhaeghe C, Bouet PE, Gillard P, Descamps P, Legendre G. Effect of the use of a video tutorial in addition to simulation in learning the maneuvers for shoulder dystocia. J Gynecol Obstet Hum Reprod. 2018;47:151–5.
13. Solymos O, O'Kelly P, Walshe CM. Pilot study comparing simulation-based and didactic lecture-based critical care teaching for final-year medical students. BMC Anesthsiology. 2015;15:153. https://doi.org/10.1186/s12871-015-0109-6.
14. Ortega R, Sekhar P, Song M, Hansen CJ, Peterson L. Peripheral Intravenous Cannulation. New Engl J Med. 2008;359:e26.
15. Ellenby MS, Tegtmeyer K, Lai S, Braner DAV. Lumbar Puncture. New Engl J Med. 2006;355(13):e12.
16. Grahm AS, Ozment C, Tegtmeyer K, Lai S, Braner DAV. Central venous catheterization. New Engl J Med. 2007;356:e21.