ORIGINAL ARTICLE

The Integration of Pediatric Emergency Simulation in an Undergraduate Curriculum

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Abstract

integration of paediatric emergency simulation in undergraduate curriculum. A cross-sectional study was carried out at the Clinical Skills and Simulation Centre at King Abdulaziz University in Jeddah, Saudi Arabia during the academic year 2015-2019. The questionnaire was designed to evaluate students' simulation experience before integration in the academic year 2015-2016 curriculum and after integration in paediatric course in 2017-2018 and paediatric emergency course in 2019. A qualitative section was also included in the questionnaire for students' comments. The total valid responses to the questionnaire were 549. Number (Percentage) of responses to the first and second questionnaire were 32.7% and 67.3%, respectively). A statistical significant difference was found in students' perceptions of their simulation experiences between the questionnaire groups ($P < 0.001$), viz., before integration of simulation-based education, and after integration for both courses. The integration of simulation into the curriculum received favourable ratings, as measured by students' perceptions of the learning experience. The internal consistency of the first questionnaire was very good ($\alpha = 0.845$) and was excellent ($\alpha = 0.972$) for the second.

Keywords

Simulation; Simulation-based education; Paediatric emergency; Saudi Arabia, Clinical Skills and Simulation Centre

Introduction

Medical simulation is a technology used widely for teaching and assessing students' clinical skills. The use of health care simulation has resulted in increases in students' psychomotor skills, professional skills and confidence[1].

Over the last two decades, simulation-based education (SBE) has become a common component of undergraduate medical courses[2]. The benefits of SBE are well documented, in particular, its ability to provide medical students with repeated clinical experiences without exposing real patients to harm[3]. Current medical education and training for the preparation of students to provide clinical care, specifically, the taking of patients' history, physical examination, diagnoses and management, have been described as inadequate by students, even after graduation[4].

Many medical students struggle to bridge the theory-practice gap. The competent integration of classroom-taught skills with the skills necessary for

practice in the clinical setting is a challenge, especially in critical care areas, such as emergency departments, intensive care units, and surgical settings (involving anaesthesia)[5].

Simulation allows trainers to control the learning environment and optimize learning conditions for the skill being taught[6]. Educational programs of the Saudi Commission for Health Specialties (SCHS) are seeing rapid technical developments, especially in scientific areas related to evidence-based medicine. The Simulation Subcommittee and the Anaesthesia and Critical Care Scientific Board of the SCHS have held several meetings and workshops with the aim of providing a roadmap for integrating the use of simulation (which has been initiated in other medical specialties) in anaesthesia training, assessment and practice[7]. Their current recommendation is that medical schools should use simulation technology in educating undergraduate medical students[8].

Several studies have reported that high-fidelity paediatric simulation enhanced medical students' critical thinking, teamwork, behavioural and technical skills. It is likely that the confidence gained through simulation augmented the knowledge students were acquiring through actual patient encounters[2].

This study was conducted to assess the satisfaction of medical students with paediatric emergency simulation in the curriculum by comparing their perceptions before and after simulation was made mandatory in the curricula of various courses.

Methods

This cross-sectional study was conducted at the Clinical Skills and Simulation Centre (CSSC) at King Abdulaziz University in Jeddah, Saudi Arabia from September 2015 to March 2019. The CSSC is equipped with numerous simulators ranging from low to high fidelity. They are used by medical students for practice under the supervision of assigned instructors and for assessment purposes. Simulation sessions are conducted before students begin their training in the emergency department. The session begins with a PowerPoint presentation on how to approach a critically ill child, and during the briefing, the educator orients students to the manikin, monitors, and other equipment that can be used during the scenario.

A questionnaire was designed for students to evaluate their simulation experience using a 5-point Likert Scale: (1) Strongly disagree; (2) Partially disagree; (3) Neutral; (4) Agree; and (5) Strongly agree. The scale was designed for 5th year undergraduate students of paediatric course during the academic year 2015-2016, when simulation was not integrated into the curriculum. When simulation was integrated in the paediatric course in 2017-2018 and paediatric emergency course in 2019 (when it was integrated into the curriculum), the questionnaire was modified to assess students' perceptions of the course facilities and their pre-simulation, simulation, and post-simulation experiences. Therefore, the medical students were practicing paediatric emergency simulation in two different courses (the paediatrics and emergency courses). In the modified questionnaire, students were instructed to rate their level of agreement with statements about the simulation on a 7-point Likert Scale: (1) Strongly disagree; (2) Disagree; (3) Somewhat disagree; (4) Neutral; (5) Somewhat agree; (6) Agree; and (7) strongly agree. The modified questionnaire also included a qualitative section, which provided space for students to write comments in their own words about various aspects of the program and how they thought it would affect their clinical practice. Verbal consent was obtained from all participants prior to administration of the questionnaires. Students were guaranteed the confidentiality of the information they provided. The questionnaire was reviewed by a senior researcher, a biostatistician, and a physician involved in the simulation. The reliability of the questionnaire was ascertained. The Faculty of Medicine Research Ethics Committee approved the study. Data cleaning and assignments of codes were completed before the students' responses to the questionnaires (*i.e.,* those with complete data) were analysed. IBM SPSS Statistics for Windows, Version 25 (IBM Corp, Armonk, NY USA) was used for the statistical analyses.

Results

The total number of valid responses to the questionnaire (n = 549) are presented in Table 1. The gender wise responses to the simulation experience before and after implementation was 52.4% for females and 47.6% for males. The total responses to the first (administered when simulation was not implemented in the curriculum) and second (after simulation was implemented in the curriculum) questionnaire was

Table 1. Percentages of responses to the simulation experience questionnaires and their reliability before and after implementation in the curriculum

Groups		%	α	No. of Items
Gender	Females (n=288)	52.4		
	Males (n=261)	47.6		
Simulation	Not integrated into the curriculum (n=179)	32.7		
	Integrated into the paediatric course (n=255)	46.5		
	Integrated into paediatric emergency course (n=115)	20.8		
Cronbach's alpha	Before curriculum implementation		0.845	9
	After curriculum implementation		0.972	25

32.7% and 67.3% respectively. The reliability of both the questionnaires was examined statistically. The internal consistency of the first questionnaire was very good ($\alpha = 0.845$), and it was excellent ($\alpha = 0.972$) for the second questionnaire. The analysis of normality of the distributions of participants' responses showed the data were not normal and therefore required the use of non-parametric tests.

Table 2A shows the percentages of responses of 5th year students to the 9-item questionnaire with a 5-point Likert Scale before integration of simulation into curriculum and Table 2B lists the percentages of responses of 6th year students to the 25-item questionnaire with a 7-point Likert Scale after integration of simulation into the curriculum. The mean scores for the students' perceptions of their experiences ranged from 1 to 5 and 1 to 7, respectively, with 1 = strongly disagree and 7 = strongly agree. The majority of students agreed with the statements regarding the simulation on the questionnaire and rated highly. The students gave positive comments on the realism of the simulation procedures. Among all 5th year students, 76% of identified simulation scenario as realistic to real patient treatment and felt that they understand better how to approach paediatric patients in ER (Table 2A). 56.0% of the students agreed simulation as a valuable learning experience and 84% felt that it must be part of the undergraduate curriculum. Further 62% responses were positive about the use of simulation experiences in emergency room.

After the integration of simulation-based education in paediatric course and paediatric emergency course, the satisfaction level of 6th year students are improved. Eighty-eight percent of the students agreed that the simulation objectives were clearly stated, and the briefing was adequately offered before the simulation activity. More than 88% of the students felt that their overall learning benefits were satisfactory (Table 2B). Students commented positively on hands-on practice and 86.5% of them had a chance to practice actively during simulation. They recognized that simulation program helped them in applying knowledge and skills to clinical practice. Most (84.6%) of the students felt that the assessment tool was a reflection of their ability to practice medicine.

The Kruskal-Wallis test was used (see Table 3) to compare the participants' scores on the two questionnaires. A statistical significant difference was found in students' perceptions of their simulation

Table 2A. Percentages and mean scores of students to the simulation experience questionnaire (paediatric course) when simulation was not yet part of the curriculum (5th Year – 2015-2016)

		Mean ± SD
Question 1	I found it easy to treat the manikin as a simulated human	3.37 ± 1.0226
Question 2	The briefing (orientation to simulator) made it easier to deal with the manikin	3.83 ± 0.985
Question 3	The scenario was realistic like I was treating a real patient	3.94 ± 0.992
Question 4	The simulation helped increase my understanding of "approach to paediatric patients in ER"	4.10 ± 0.924
Question 5	I experienced nervousness during the simulation	3.73 ± 1.103
Question 6	Because of this simulation I will be less nervous dealing with paediatric patients with similar disease in ER	3.74 ± 0.987
Question 7	This simulation session was a valuable learning experience	4.04 ± 0.952
Question 8	This simulation can substitute for clinical experience in ER	3.82 ± 1.127
Question 9	Simulation must be part of our undergraduate curriculum	4.35 ± 0.915

SD: Standard deviation; ER: Emergency Room

Table 2B. Percentages and mean scores of students' responses to the simulation experience questionnaire (paediatric course and paediatric emergency course) after implementation of paediatric emergency simulation in the curriculum (6th Year – 2017-2018 and 2019)

		Mean ± SD
Question 1	Staff designated at the front desk were helpful	6.39 ± 964
Question 2	Space provided in the classroom was appropriate	6.32 ± 1.06
Question 3	All teaching aids needed were available	6.44 ± 0.873
Question 4	All teaching aids needed were in good working condition	6.40 ± 0.989
Question 5	CSSC provided an effective learning environment	6.47 ± 0.875
Question 6	CSSC employees showed professionalism	6.44 ± 0.955
Question 7	Orientation to the simulation environment was appropriate	6.35 ± 1.00
Question 8	The simulation objectives were clearly stated	6.36 ± 1.03
Question 9	I had a chance to practice actively during the simulation	6.41 ± 0.882
Question 10	The instructor showed competency in the simulation	6.47 ± 0.827
Question 11	The session objectives have been achieved	6.42 ± 0.899
Question 12	The program helped me apply knowledge and skills needed for clinical practice	6.43 ± 0.909
Question 13	The simulation environment was appropriate	6.47 ± 0.769
Question 14	The simulation equipment was appropriate	6.42 ± 0.927
Question 15	The simulation technology used was appropriate	6.44 ± 0.903
Question 16	Actively participated in debriefing sessions	6.39 ± 0.959
Question 17	Debriefing helped me recognize appropriate interventions	6.45 ± 0.844
Question 18	Debriefing encouraged sharing ideas and thoughts regarding the situation	6.46 ± 0.777
Question 19	Session objectives were achieved	6.41 ± 0.893
Question 20	I would recommend this program to a colleague	6.52 ± 0.804
Question 21	The instructor was well prepared	6.48 ± 0.814
Question 22	The program was well organized	6.49 ± 0.804
Question 23	Overall learning benefits were satisfactory	6.45 ± 0.842
Question 24	I feel like I was assessed fairly by the instructor	6.42 ± 0.896
Question 25	I feel like the assessment tool was a reflection of my ability to practice medicine	6.38 ± 0.967

SD: Standard deviation; CSSC: Clinical Skills and Simulation Centre

Table 3. Comparisons between the groups after implementation of the simulation in the curriculum

	N		Mean ± SD	*p*-value
Kruskal Wallis Test	549		4.34 ± 0.638	<0.001*
Mann-Whitney Test		Not integrated into the curriculum *vs.* Integrated into the paediatric course	4.34 ± 0.638	<0.001†
		Integrated into the paediatric course *vs.* Integrated into the paediatric emergency course		0.092
		Not integrated into the curriculum *vs.* Integrated into the paediatric emergency course		<0.001†

**Kruskal Wallis test was statistically significant ($p < 0.001$)*
†Mann-Whitney test was statistically significant ($p < 0.001$)

experience between the questionnaire groups ($p < 0.001$). Within-group comparisons using the Mann-Whitney test that showed a statistically significant difference in the satisfaction with the simulation experience when it was not integrated into the curriculum, when it was integrated into the paediatric course, and when it was integrated into the paediatric emergency course ($p < 0.001$).

Discussion

The study evaluated simulation experiences among medical undergraduate students. As feedback is imperative for effective learning in simulation, planned and intentional, participants' feedback was taken on their perceptions of simulation-based education[9]. The simulation session was conducted with 5th and 6th year medical students during their rotation in the paediatric emergency unit through their paediatric course to minimise the effect of the gap between the theoretical and practical components of the learning experience[10]. The simulation sessions received favourable ratings from the students, indicating higher levels of satisfaction when simulation was integrated in the curriculum, compared to the first time of simulation sessions in their 5th year in medical school.

Medical students who participated in simulation sessions included recommendations for the incorporation of simulation in the undergraduate curriculum and exposure to more simulation scenarios. Most of the medical students' recommended incorporation of simulation scenario in each topic of the curriculum. The simulation sessions after its implementations in curriculum has proved to be effective, as an alternative teaching strategy to enhance students' skills in paediatric emergency. From the student's perceptions it became clear that medical undergraduate students highly value simulation-based education.

Simulation-based education is an established method for the training and education of healthcare professionals in both technical and nontechnical skills prior to working with real patients. It has even been shown that simulation can help to improve not only psychomotor but also cognitive skills[11]. Simulation may lead to more in-depth learning and increased student satisfaction, and it may be appropriate for different learning approaches[12]. We used high-fidelity simulation in paediatric emergency setting as opposed to an acute care setting, in which it is difficult to teach larger student groups, and faculty have limited time to simply observe training in emergency medicine[13]. Simulation experience is pivotal for high severity situations in paediatric emergency[14]. The realistic attributes of simulation system were rated highly in the present study. Most of the 6th year students opined that simulation-based education enabled them in applying their knowledge and skills to practice. They felt that simulation serves as an essential tool for assessment of clinical competencies. The findings corroborate with one of the similar studies on integration of high-fidelity simulation in paediatrics clerkship[15].

With an objective of achieving professional competencies, paediatric emergency scenario was integrated as part of the curriculum in paediatric and emergency course, conducted at the Clinical Skills and Simulation Centre at King Abdulaziz University (CSSC-KAU) in Jeddah.

Since deliberate repetitive training for acquiring skills is optimally feasible in the simulation-based education mode, it must be a required part of the overall curriculum for specific skills requiring repetitive practice, because optional curriculum sections do not attract the learner[16].

These results will help the author advance to the second stage of this inquiry, to evaluate students' knowledge before and after the simulation intervention based on Kirkpatrick's learning and evaluation theory.

Study Limitations

The results of this study have been rated as a high level of student satisfaction with simulation-based education. However, there are certain limitations such as high financial cost, desired learning outcomes and logistic accommodation with all the clinical settings for a large undergraduate students group. These challenges need to be addressed through systematic approach.

Conclusion

The integration of simulation in the curriculum received a positive response from medical students, as measured by their perceptions of the learning experience. These experiences are essential for enhancing medical students' performance in managing medical emergencies. With the simulation experiences medical procedures may be successfully implemented with minimal patients' distress. In the near future, continuous assessments shall be conducted using Kirkpatrick's learning and evaluation theory with a goal to design better simulation program.

Conflict of Interest

The author declared that there is no conflict of interest that is related to this study and this article.

Disclosure

The author did not receive any type of commercial support either in the form of compensation or financial support for this case report. The author has no financial interest in any of the products, devices, or drugs mentioned in this article.

Ethical Approval

The study was approved by the Ethics Committee of the KAUH in Jeddah, Kingdom of Saudi Arabia, also known as the Institutional Review Board of Hospitals.

References

[1] Gamble AS. Simulation in undergraduate paediatric nursing curriculum: Evaluation of a complex 'ward for a day' education program. Nurse Educ Pract 2017; 23: 40-47.

[2] Okuda Y, Bryson EO, DeMaria S Jr., Jacobson L, Quinones J, Shen B, ***et al.*** The utility of simulation in medical education: What is the evidence? Mt Sinai J Med 2009; 76(4): 330-343.

[3] Ziv A, Wolpe PR, Small SD, Glick S. Simulation-based medical education: An ethical imperative. Simul Healthc 2006; 1(4): 252-256.

[4] Joseph N, Nelliyanil M, Jindal S, Utkarsha, Abraham AE, Alok Y, Srivastava N, Lankeshwar S. Perception of simulation-based learning among medical students in South India. Ann Med Health Sci Res 2015; 5(4): 247-252.

[5] Morris MC, Conroy P. Development of a simulation-based sub-module in undergraduate medical education. Ir J Med Sci 2020; 189(1): 389-394.

[6] Beaubien JM, Baker DP. The use of simulation for training teamwork skills in health care: how low can you go? Qual Saf Health Care 2004; 13 Suppl 1 (Suppl 1): i51–i56.

[7] Arab A, Alatassi A, Alattas E, Alzoraigi U, AlZaher Z, Ahmad A, Albabtain H, Boker A. Integration of simulation in postgraduate studies in Saudi Arabia: The current practice in anesthesia training program. Saudi J Anaesth 2017; 11 (2): 208-214.

[8] Beal MD, Kinnear J, Anderson CR, Martin TD, Wamboldt R, Hooper L. The effectiveness of medical simulation in teaching medical students critical care medicine: a systematic review and meta-analysis. Simul Healthc 2017; 12(2): 104-116.

[9] Motola I, Devine LA, Chung HS, Sullivan JE, Issenberg SB. Simulation in healthcare education: a best evidence practical guide. AMEE Guide No. 82. Med Teach 2013; 35(10): e1511–e1530.

[10] Reime MH, Johnsgaard T, Kvam FI, Aarflot M, Engeberg JM, Breivik M, Brattebø G. Learning by viewing versus learning by doing: A comparative study of observer and participant experiences during an interprofessional simulation training. J Interprof Care 2017; 31(1): 51-58.

[11] Bland AJ, Topping A, Wood B. A concept analysis of simulation as learning strategy in the education of undergraduate nursing students. Nurse Educ Today 2011; 31(7): 664-670.

[12] Piryani RM, Piryani S, Shrestha U, Acharya A, Kanskar S, Shahi M, Kayastha J, Chaulagain A, Agarwal JP, Bajracharya SR. Simulation-based education workshop: perceptions of participants. Adv Med Educ Pract 2019; 10: 547-554.

[13] Arab AA. Role of academic anaesthesiology department in introducing patient safety module into medical school curriculum: 5 years-experience at King Abdulaziz University, Saudi Arabia. Saudi J Anaesth 2019; 13(2): 112-118.

[14] Amorim PG, Morcillo AM, Fraga AM, Brandao MB, Belluomini F, Baracat EC. Realistic simulation in pediatric emergency: Evaluation of strategy as a teaching tool for medical students. Arch Emerg Med Crit Care 2018; 3(1): 1036.

[15] Ortiz N, Pedrogo Y, Bonet N. Integration of high-fidelity simulator in third-year paediatrics clerkship. Clin Teach 2011; 8(2): 105-108.

[15] Chacko TV. Simulation-based medical education: Using best practices and curriculum mapping to maximize educational benefits in the context of shift toward competency-based medical education. Arch Med Health Sci 2017; 5(1): 9-15.

دمج المحاكاة الطبية في منهج طب طوارئ الاطفال

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المستخلص. أجريت الدراسة لتقييم مستوى الرضا لطلبة الطب وتوقعاتهم في دمج المحاكاة الطبية لمادة طوارئ الأطفال في المناهج الدراسية .لقد تم تنفيذ دراسة مقارنة في مركز المهارات والمحاكاة السريرية في جامعة الملك عبدالعزيز في جدة / المملكة العربية السعودية /خلال السنوات الاكاديمية ٢٠١٥-٢٠١٩م. تم تصميم الاستبيان (الدراسة) لتقييم تجربة الطلبة قبل ادماج المحاكاة الطبية في المناهج للعام الاكاديمي ٢٠١٦-٢٠١٧م وبعد دمج المحاكاة الطبية في مناهج طب الأطفال في العام الاكاديمي ٢٠١٧-٢٠١٨م ومناهج ودورات طب طوارئ للأطفال في ٢٠١٩م تم ادراج جزء يخص التوعية في الاستبيان وإعطاء المجال للطلبة لإبداء الرأي المفتوح وبلغ عدد الاستجابات المقبولة على الاستبيان ٥٤٩. عدد الاستجابات على الاستبيان الأول والثاني ٣٢,٧٪ و ٦٧,٣٪على التوالي .فرق التباين الاحصائي تم ايجاده بمعدل إدراك الطلبة للتصميم باستخدام المحاكاة للمجموعتين. كانت قيم الاحتمال اقل من ٠,٠٠١ قبل دمج المحاكاة في المناهج وبعد دمج المحاكاة في مناهج طب الأطفال وطب طوارئ الأطفال . دمج المحاكاة الطبية في المناهج لقي استحسان الطلبة وادراكهم للتجربة التعليمية. قيمة الترابط للاستبيان الأول كان جيد جدا وبلغ (٠,٨٤٥)، أما الاستبيان الثاني فكان ممتازاً بقيمة (٠,٩٧٢).

كلمات مفتاحية: محاكاة؛ التعليم القائم على المحاكاة ؛ طوارئ الأطفال المملكة العربية السعودية ، مركز المهارات والمحاكاة السريرية