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Review for Emergency Medicine using Simulation in Medical School Education

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ABSTRACT

Medical education is developing quickly. Simulation training has given educators a fresh approach to delivering medical education in the twenty-first century with the paradigm

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change to small-group didactic sessions and concentrate on clinically oriented case-based scenarios. The field is being incorporated into medical school clerkship education, particularly in emergency care, as its breadth and practise continue to grow (EM). It is commonly known that graduate medical education uses medical simulation. In this research, we will explore the use of simulation in EM medical student clerkships by doing a retrospective analysis of recent literature. Studies have shown that simulation is a useful tool for teaching fundamental scientific concepts as well as clinical expertise, procedural skills, teamwork, and communication abilities. More research is required to determine whether simulation training improves patient-related outcomes as it becomes more prominent in medical school curricula.

Keywords: Emergency medicine, retrospective analysis, pharmacology, simulation.

INTRODUCTION

The present trend of using simulation as a teaching tool for evaluating and preparing students is reflected in medical schools' curricula. Simulators are used to assess and train residents, faculty, and medical students in emergency medicine (EM), in particular. Despite the fact that simulation is frequently utilised in medical education, there are substantial differences between the modalities used at various schools and across various specialties. Insufficient study has also been done to investigate the prevalence and types of simulation employed in EM clerkships. In this research, we will explore the use of simulation in EM medical student clerkships by doing a retrospective analysis of recent literature. To give a succinct review of the literature, we conducted a methodical search of the literature for pertinent papers.

Types of Simulation

The simulators that are currently available for medical education are numerous and diverse, but the majority can be divided into the following categories: standardised patients, partial-task trainers, mannequins (highfidelity patient simulators), screen-based computer simulators, and virtual-reality simulators.

Standardized patients are actors who have undergone training to simulate a range of symptoms, provide medical histories, and exhibit a range of emotions during a physical exam. A particular kind of simulator known as a partial-task trainer is used to instruct in the

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placement of intravenous lines, central lines, endotracheal tubes, and other high-risk/low-prevalence procedures.

These trainers are categorised as low to high fidelity, depending on how closely they mimic the conditions in which the skill is commonly done, even though conventional criteria for differentiating between high- and low-fidelity simulators have not been clearly established.

The full-body robot mannequin is essentially a "man-made man": a very accurate simulator that imitates specific medical conditions by producing various indications and vitals created by a computer controlled by a person in the background.[3]

Students participate in screen-based simulations that display various clinical circumstances on a computer screen. In accordance with the curriculum, the student engages with the virtual patient and takes control of the physical examination before evaluating and managing the patient's case. General surgery, ear, nose, and throat surgery, and orthopaedic surgery are just a few surgical specialties where virtual reality is becoming a common and trusted means of training. This programme provides 3-dimensional illustrations of the organs and human anatomy to aid in training and preoperative preparation.

Support for Use of Simulation in Medical Education

According to studies to date, using simulation to train medical students and residents helps to improve students' knowledge and evaluate their performance. [4] Students value simulation-based learning because it gives them "the chance to learn new skills in a safe environment."[5] It has been demonstrated that using simulation at the very beginning of the undergraduate medical curriculum helps students better understand fundamental medical concepts like pharmacology and physiology. This is probably because these simulated experiences aid students in better understanding abstract concepts of fundamental science that are challenging to comprehend with regular discourse. [6–9]

Studies on the effectiveness of simulation in instructing residents and students in various medical specialties have been carried out. By heavily utilising mannequins and screen-based simulators for resident and faculty practise in endotracheal intubation, mask ventilation, and cricothyrotomy, anesthesiology has been a pioneer in adopting simulation. [10,11] Obstetric simulation has been used to teach trainees how to handle obstetric emergencies and how to identify and steer clear of traps when handling challenging deliveries. [12–14] The

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effectiveness of using virtual reality to train residents in operating room operations like cholecystectomy has been supported by a number of studies in the field of surgery. [15,16]

Although these studies were conducted in domains unrelated to emergency medicine, many of the taught and evaluated skills, such intubation, are also employed in EM. Additional evidence that may justify the expanded usage of simulation beyond its existing uses in EM would be provided by confirmatory research within EM that replicate the studies carried out in these other domains.

Simulation in Emergency Medicine

Although it is a young discipline, emergency medicine (EM) has been fast to follow its peers in embracing simulation technology. However, the majority of research that are currently accessible have focused on how simulation is used to train residents rather than medical students. The Society for Academic Emergency Medicine (SAEM) Simulation Task Force was founded in 2005 to raise awareness of advancements in this important technology in the field of emergency medicine.

There has been an increase in the usage of simulators for training residents, according to a 5-year study by Okuda et al17 (2003–2008) on the growth of simulation training in EM residency programmes. 122 (91%) of the 134 EM residency programmes that took part in the study used simulation equipment to instruct their residents. It's noteworthy that 58 (43%) programmes reported using more than 10 hours of simulation each resident. The programmes used simulation as a teaching and evaluation tool as well as to train the residents in professionalism (59%) and teamwork (75%). The academic and professional domains of residency education have both benefited from EM simulation. This type of simulation training in EM is also supported by a 2006 review by McFetrich18, who found that programmes using these techniques significantly improved emergency airway management and surgical airway management of pneumothorax, as well as significantly improved ethics application and team performance.

Numerous other studies show that simulation-based training increases the effectiveness of EM residents. 19 residents were taught about critical resuscitation techniques using simulators in a study by Langhan et al. There were two steps to the review process: the first occurred right after the 8 hours of simulation, and the second occurred after 3 months. The

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inhabitants began to improve right away and kept doing so even after the 3-month washout period. High-fidelity simulators are effective in both summative and formative resident evaluation, according to a 200820 study done with EM residents. Advanced cardiac life support has been taught to medical students, residents, and paramedics via simulation-based training. [21–24] High-fidelity simulation was utilised in a study by Small et al.25 to expose EM doctors to various patient scenarios. It has been demonstrated that this kind of simulation enhances teamwork, leadership, patient safety, and liability.

The corpus of research supporting simulation use in EM undergraduate medical education is far from strong, despite the fact that these and numerous other studies support the claim that simulation is an important tool in the training and evaluation of EM residents. The SAEM Simulation Task Force developed a research agenda in 2007 that included further investigation of the use of simulation in undergraduate medical education as one of many potential research topics.

Simulation in Emergency Medicine Undergraduate Education: Literature Review

More papers on the use of simulation in EM clerkships have been published in recent years, whether in response to this announced research objective or just out of academic EM physicians' common curiosity. The results of a PubMed literature search with the terms "education," "simulation," and either "clerkship, rotation, undergraduate education, or fourth-year medical students" in the "any field" search criteria revealed a consistent rise in the number of publications that had been published on this topic. The cumulative results revealed 2 articles from 1988 through 1990, 1 article from 1991 to 1995, 4 articles from 1996 to 2000, 8 articles from 2001 to 2005, and 31 articles from 2006 to 2010 after duplicate results had been eliminated but before the articles had been reviewed to ensure their relevance. A closer look revealed that several of these research either used nursing or pharmacy students in their investigations or included medical students as test subjects for simulation modalities, making them unsuitable for this analysis. The aforementioned search phrases, as well as "simulator" in lieu of "simulation," "emergency department" in place of "emergency medicine," and "medical students" in place of "fourth-year medical students," were used in subsequent searches on PubMed and Web of Science to find additional articles. The following discussion will focus on the papers discovered through these searches that are particularly related to medical student instruction or evaluation in EM clerkships.

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Students' opinions of a simulator's instructional value were surveyed in a number of recent studies into the use of simulation in EM clerkships after they received training in operating the simulator. Undergraduate medical students (n1495) in internal medicine, surgery, and EM clerkships volunteered to participate in a 2-hour session of simulation training in the management of several acute scenarios in a study by Takayesu et al27 in 2006. The pupils were then given the chance to evaluate the exercise's value qualitatively. The simulator exercise received a 94 percent "good" rating, and 91 percent of respondents advised making it a requirement for the curriculum.

In 2009, simulation was used to teach medical students how to handle resuscitation during severe shock and sepsis as part of a prospective cohort trial at Loma Linda University28. The teaching approach was well received by the students, who also stated that it increased their confidence in handling similar issues in the future. The participating medical students gave a positive reaction to a 2007 study that assessed the effectiveness of simulation training for undergraduate medical education29. For this exercise, 41 students participated in an interactive simulator training session in a simulator lab to learn the fundamentals of treating a thoracic injury in the emergency department. The students' knowledge level significantly increased (by around 14%) after a 30-minute training session, and they preferred simulation to conventional didactics.

In other research, the educational effectiveness of simulation has been assessed by contrasting student performance following simulation use with student performance following teaching using more conventional instructional approaches. An evaluation of the effectiveness of problem-based learning (PBL) and simulation in teaching fourth-year medical students how to care and evaluate critically ill patients was done at the University of California, Los Angeles30. This randomised control research with 31 participants revealed that the simulator-educated students transferred knowledge more effectively than the PBL students.

A study by Ten Eyck et al.31 demonstrated how improving medical students' performance and happiness may be accomplished by incorporating simulation into the EM curriculum. 91 fourth-year medical students were split into 2 groups for the randomised control study. After two weeks of exposure to simulated scenarios, the first group switched over to the second group to participate in discussions of sample cases. Both groups were examined for the

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number of questions correctly answered and evaluated for student satisfaction at the conclusion of the four-week period. Students from the simulation arm greatly outperformed those in the case-discussion-based instruction in terms of test scores. The simulation exercise was stressful for the students, but they preferred it over case discussions because they felt the method was safe and level-appropriate.

Franc-Law et al.32 compared didactic lecture plus catastrophe medical simulation to didactic lecture plus nondisaster simulation in their article that appeared in the Canadian Journal of Emergency Medicine. After the instruction, the 22 students were split into 2 groups and evaluated. Students in the intervention group performed noticeably better than those in the control (non-disaster scenario) group. The students then gave the simulation training a high rating for preparing them for disaster management (8 out of 10 on a Likert scale).

When 28 fourth-year medical students were trained using either a human patient simulator (SIM) or a PowerPoint lecture for the management of myocardial infarction (MI) and anaphylaxis, their performance was assessed in a randomised crossover research by McCoy et al33 in 2007. (LEC). The students switched learning modules for training on anaphylaxis after learning about MIs via LEC and SIM, respectively, for half of the class. In comparison to the LEC teaching, 27 out of the 28 individuals showed improved assessment and management abilities after receiving SIM education.

The claim that simulation training is more effective for undergraduate medical education is not supported by all of the existing evidence. Using either a Human Patient Simulator (HPS) or Case-Based Learning (CBL) modules, Schwartz et al34 evaluated the performance of fourth-year medical students following a month of training during their obligatory EM clerkship. The students were divided into two groups at random: CBL (n1452) and HPS (n1450), and each group received instruction from a curriculum designed to cause chest pain. All of the students took the same test to gauge their knowledge at the end of the month. The groups' gender, age, and preferred specialties were examined, and it was found that there were no appreciable disparities between them. There was no discernible difference in student performance on the test between the HPS and EBL groups, according to a multivariate analysis of variance.

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Gordon et al.35 conducted a randomised control research in which pretest and posttest evaluations of undergraduate medical students were used to examine the educational efficacy of didactic lecture and simulation. Either a MI simulation was followed by a lecture on reactive airway disease (RAD) or a RAD simulation was followed by a MI lecture was given to 38 third-year medical students.

Despite the fact that the students' performance increased from the pretest to the posttest, no discernible variations in performance were discovered between the groups of students receiving didactic teaching and those receiving simulation-based education.

According to Graber et al's36 investigation of how undergraduate medical students' simulator training might influence patient perceptions, simulation may enhance how patients view students doing procedures during their EM clerkships. In order to determine whether patients would consent to a student's first procedure after they had mastered the skill on simulator training for the following procedures: venipuncture, placement of an intravenous line, suturing the face or arm, performing a lumbar puncture, placement of a central line, placement of a nasogastric tube, intubation, and cardioversion, this study surveyed patients (n 14 151) after they had been seen in an ED at After that, the findings were contrasted with those of an earlier study that looked at patients' willingness to undergo a student's first procedure without simulation training. Comparing the results of the two surveys revealed that, with the exception of intubating and suturing, more patients said that they would consent to undergo a student's first procedure if they knew the student had mastered it in simulation.

DISCUSSION

One of the most crucial teaching tools for medical curricula, simulation has completely changed how students are taught medical-science ideas. [5] To find the most efficient method, however, it is still necessary to conduct randomised controlled trials that compare the present instructional modalities with simulation training in undergraduate medical education because the evidence on value is still insufficient. The studies that have been done so far on the use of simulation for teaching undergraduate medical students in EM clerkships either evaluate student acceptance, contrast the educational efficacy of simulation versus didactic lecture, or, as demonstrated by Graber et al.[36], explore advantages like patient satisfaction. Numerous small-scale studies have demonstrated that simulation is more

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effective than other teaching methods, such as didactic lectures or problem-based learning, for the instruction of medical students. However, other studies of a similar nature have not supported this conclusion, despite demonstrating simulation's equal value. Maybe simulation offers superior instruction for some things, like professionalism and technical abilities, whereas didactic or problem-based learning does a better job of teaching patient assessment and treatment algorithms. The value of simulation for the education of particular tasks could be clarified by categorising the simulation efficacy studies based on the task the simulator is designed to teach or measure. Future simulation designs and the creation of incredibly effective curriculum for undergraduate medical education would both benefit greatly from this insight. Until more studies are conducted to broaden the body of literature, strengthen the evidence, and enable a stratification of the studies, decisions regarding the application of simulator modalities for education in EM clerkships will continue to be based on scant evidence, anecdotal support, and speculation.

The literature search clearly demonstrates that over the past ten years, there has been a significant surge in academic study regarding the usefulness and acceptance of simulation in EM clerkships. Documentation of the state of simulation utilisation in EM clerkships across the country is still required, though. Researchers may use this information to design studies that will be most useful to EM clerkship directors and other educators by identifying the frequency of simulation use in EM clerkships, the types of simulators used, and the specific purposes the simulators serve in educating or evaluating the students. We need study into the impact of simulation on patient care, safety, and satisfaction as we embrace simulation-based medical education as a useful tool for training and evaluating medical students and residents. Only a few encouraging studies have shown improvements in patient-care outcomes. [37,38] We cannot completely support the wider integration of simulation into medical curriculum and endorse it for instructional purposes until we have thoroughly examined its effects on patient care.

CONCLUSION

With the help of simulation, student knowledge, management abilities, self-assurance, and contentment with the rotation have all significantly improved throughout EM clerkships. Future research is required to ascertain the impact of this training on patient care as well as the effectiveness of simulation training in medical student education as compared to more

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conventional methods. Based on this assessment, it seems appropriate to provide some resources and include some level of medical simulation, even though different schools will have varied resources to apply to undergraduate medical student instruction.

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