Review Article

Integration of simulation in postgraduate studies in Saudi Arabia: The current practice in anesthesia training program

ABSTRACT

The educational programs in the Saudi Commission for Health Specialties are developing rapidly in the fields of technical development. Such development is witnessed, particularly in the scientific areas related to what is commonly known as evidence-based medicine. This review highlights the critical need and importance of integrating simulation into anesthesia training and assessment. Furthermore, it describes the current utilization of simulation in anesthesia and critical care assessment process.

Key words: Anesthesia training; medical education; Saudi Arabia; simulation

Introduction

Simulation is an applicable and safe solution to overcome risk that could be encountered by both learners and teachers during training in the high-risk industries such as nuclear and aviation. It is considered as a core component of their training, certification, and maintenance of license for both institutions and individuals.[1] Adaptation of over 90 years' experience in other fields (military, aviation, astronauts, nuclear industry, etc.) proved simulation's value and has begun the adoption and adaptation by health care.[2]

Simulation-based medical education enables knowledge, skills, and attitudes to be acquired for all health-care professionals in a safe, educationally orientated, and efficient manner.[1] Postgraduate medical education for technical skills had been completely informal - until the introduction of simulation technologies and methodologies.[2] Simulation-based medical training programs traced back to the late 1960s and early 1970s, in the University of Miami where Harvey was developed. Harvey was the cardiology patient simulator, a hybrid between a sophisticated task trainer and computer-enhanced manikin simulator.[3]

A major challenge for medical undergraduates is the application of theoretical knowledge to the management of patients. Some medical schools in the Middle East have

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changed their curricula and adopted such educational strategies as problem-based learning. Furthermore, many medical schools have started to utilize clinical skills' laboratories for training. However, simulation-based learning is not yet well established in this region.[4] Worldwide, simulation has been widely used for the acquisition of specific clinical skill in specialties such as pediatrics, emergency medicine, intensive care medicine, obstetrics, anesthesia, radiology, and allied medical sciences.[5,6]

Simulation-based education (SBE) can help the current situation in at least two dimensions. First, SBE promotes the implementation of competency-based medical education principles by fostering performance of key needed skills for all members within teams. Second, SBE enables the integration of patient safety principles within the existing training and assessment domains of the current training program. Furthermore, it will aid reaching the needed cultural awareness to promote the application of safety-oriented practices upon graduation from the program.[7] Simulation provides many new advantages: objectively measuring both technical and nontechnical skills performance, setting proficiency "benchmarks" that insure a minimum standard is measured and achieved before patient care begins, and retraining when a physician has a prolonged absence or testing new devices before initial use on patients.[2]

In an era of patient safety and quality of care, accompanied by public pressure and extreme shortage of qualified anesthesiologists, our practice in Saudi Arabia calls for immediate reform to provide safer and better health care for patients.[8] The educational programs in the Saudi Commission for Health Specialties (SCFHS) are evolving and developing rapidly in the fields of technical development. Such development is witnessed, particularly in the scientific areas related to what is commonly known as evidence-based medicine. The Scientific Board for Anesthesia and Critical Care reviewed the applicable international experiences and guidelines in the field of simulation to develop a staged program that provides the optimal use of best practice for the local training and assessment. A program that can also foresee and incorporate these new technologies in the field of licensing and maintenance of certification for anesthesia practitioners.

In the last year, several meetings and workshops were hold by the simulation subcommittee at the SCFHS anesthesia and critical care scientific board with the aim to provide a roadmap for integrating the use of medical simulation in anesthesia training, assessment, and practice. It also aimed to transfer this experience as a contribution to other national medical specialties under the umbrella of the SCFHS. This work aimed to highlight the critical need and importance of integrating simulation into anesthesia training and assessment and to describe the current utilization of simulation in anesthesia and critical care assessment process.

Simulation-related Activities in Saudi Arabia

The International Conference on Advanced Clinical Simulation was held in Prince Sultan Military College of Health Sciences, Dhahran, KSA, in October 2014. The conference provided a forum for academicians, administrators, and health-care professionals to discuss the current and projected SBE practices. An expert panel discussion was held to identify considerations for establishing a state-of-art simulation center. These considerations were the planning stage, stakeholders' involvement, strategic planning, center design, partnership development, faculty development, curriculum development, and establishing a research strategy.[9] Later on, the Ministry of Health (MOH) sponsored the first Saudi Health Simulation Conference in Riyadh, June 9, 2015, to June 11, 2015. The SCFHS was among the sponsors of the conference, as both MOH and SCFHS are playing an active role in the introduction of simulation in postgraduate residents' training.[10] In addition, the academic institutions had the central role in introducing, developing, and applying new training modalities such as SBE to health care in Saudi Arabia.[11]

There are many studies conducted in Saudi Arabia regarding the usage of simulation in undergraduate medical curriculum. They aimed to describe the extent of its use, its efficacy in achieving the intended learning as well as satisfaction of both teacher and students with simulation.[12-15] On the other hand, scarce, if any, studies were conducted on the usage of simulation in postgraduate curricula. There was one meta-analysis Saudi study conducted on the use of simulators for teaching laparoscopic surgery skills among junior surgical residents. It showed a significant enhancement and improvement at a cognitive as well as psychomotor level.[16] More recently, a Saudi systematic review of the literature was conducted to evaluate simulation in training for arthroscopic knee surgery.[17]

Alghamdi in another Saudi study has presented the idea and design of an interactive simulation in radiological education.[18] A recent Saudi study conducted to assess the impact of acute stress on psychomotor bimanual performance during a simulated tumor resection task. It showed that acute stress initiated by simulated severe intraoperative bleeding significantly decreases bimanual psychomotor performance during the acute stressful episode.[19] These

researches conducted on the medical simulation in Saudi Arabia demonstrate a positive prompt response to the call for establishing a research strategy in simulation, one of the recommendations of the International Conference on Advanced Clinical Simulation held in Dhahran, KSA, 2014.[9]

Using Simulation in Anesthesiology

Anesthesiology is one of the hands-on specialties, in which the only way to master a skill is to practice it again and again.[20] Anesthesiology trainees relied, in the past, on the apprenticeship model and spontaneous exposure to patient cases to gain expertise in managing the high-stakes situations and life-threatening events. Academic anesthesiologists adopted the simulation-based training to supplement this experiential learning using full-body manikins[21] training models such as crisis resource management (CRM)[22] and assessment of nontechnical skills.[23] Rare conditions, such as difficult airway management and malignant hyperthermia, can be imitated to give trainees practice in patient management before encountering these challenges in a clinical context.[24] In other words, simulation provides a safe learning environment where anesthesiology residents and students can be taught, practice, and be evaluated on technical skills such as intubation and ventilation without ever putting a real patient at risk.[20]

Current Practice of Simulation in Anesthesia Residency Training Program

In the curriculum of Anesthesia Residency Training Program, task-training hands-on workshops and low- or moderate-to-high fidelity simulation are used during training. To ensure effective engagement of simulation in Anesthesia Residency Training Program, the minimal standards for simulation-based workshops were set. These standards included defining the minimal fidelity that is needed to run the workshop, the minimal workshop instructor qualification, and the minimal required competency in every workshop. These workshops are fully specified as seen in Table 1. The competencies set were according to what was described by Miller[25] and showed in Figure 1. All anesthesia residents are expected to participate and complete these workshops to successfully obtain their Final In-Training Evaluation Report.

Among the simulation-assisted courses and workshops included in the curriculum of Anesthesia Residency Training Program are difficult airway management and crisis management which represents the most widespread use of simulation in anesthesiology.[26] The effectiveness of using the high fidelity AirSim Bronchi airway simulator to teach residents how to manage lung isolation with double-lumen ETT and bronchial blockers was studied by Failor *et al*.[27]

Table 1: Simulation-assisted courses and workshops included in the curriculum of anesthesia residency training program

Workshop title	Description	Minimal required fidelity	Minimal required competency level	Instructor (course organizer)
Communication Skills	This 1-day workshop includes many nonverbal communication skills needed for the competent anesthetist to be effective communicator at personal and professional levels	Low to high (role play, standardized patient (SP-based)	3	Certified in Advanced Train the Trainer
Difficult Airway Management	This 1-day workshop covers handling the difficult airway which is a critical part of the anesthesia residency training program	Low to high	3	Certified in Advanced Train the Trainer
Basics of Ultrasound and Regional Anesthesia	1-day introductory workshop covers the basics of anatomy, ultrasound physics, and needle probe handling techniques	Low	2	Certified in Regional Anesthesia
Crisis Resource Management – (Critical Care or Anesthesia II)	1-day simulation-based workshop considered a cornerstone to manage critical event in a safe learning environment	Low to high	3	Certified in Simulation Medicine Certified in Advanced Train the Trainer
Thoracic Anesthesia	1-day workshop covers many intraoperative skills related to thoracic anesthesia and different other tasks related to decision-making and applying different management strategies	Low	3	Certified in Thoracic Anesthesia
Obstetric Analgesia and Anesthesia	1-day workshop focuses on crises management in obstetric anesthesia in addition to other skills such as counseling patients for labor analgesia and/or anesthesia, anesthesia modality selection, and handling difficult pregnant airway	Low to high	3	Certified in Obstetric Anesthesia
Advanced Regional Anesthesia	1-day workshop covers the scanning, handling, and needling techniques for different levels of blocks. In addition to simulating the skills on phantoms, animals, and/or volunteers	Low to high	3	Certified in Regional Anesthesia

SP: Standardized patient

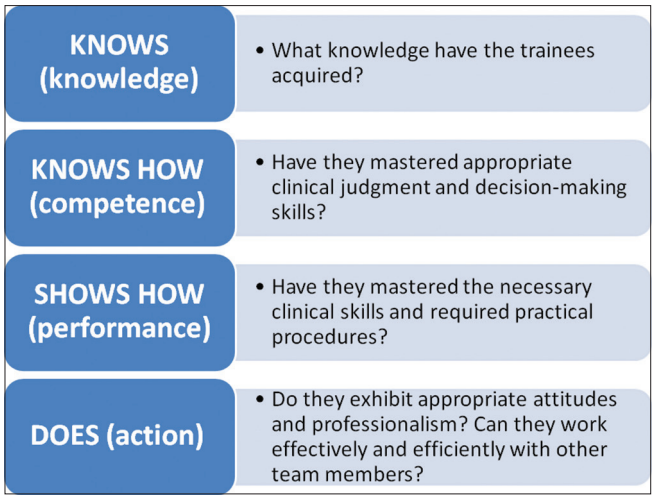

Figure 1: Level of competencies to be acquired by the trainee according to Miller 1990

They reported that resident confidence scores for each lung isolation technique improved after the simulation training, with the median gain ranging from 0.5 to 1.5. The largest improvement occurred with the bronchial blockers.

When it came to the fidelity of the simulation, low to high fidelity simulation was in the simulation-assisted courses and workshops included in the curriculum of Anesthesia Residency Training Program. A recent meta-analysis of 14 studies looking at the benefit of using high fidelity model for advanced life support training showed no significant improvement over low fidelity models with regard to either the skills or the knowledge.[28] Although it is often assumed that the high fidelity simulator gives a richer training experience. However, this might not always be true. This also depends on a large part of the objective the educators are trying to achieve.[29] The key is to use the appropriate fidelity model based on the expected educational and learning objectives.[30] In a recent meta-analysis of advanced airway management simulation training, Kennedy *et al*., 2014, reported an increase in learner satisfaction, improved skills, and patient outcomes but not knowledge in simulation compared with nonsimulation interventions.[31]

Before enrolling in the simulation-based training programs, the residents should successfully complete, with adequate competency, the life support courses as appropriate according to the pertaining regulations. These courses include basic life support, advanced cardiac life support, pediatric advanced life support, neonatal resuscitation program, advanced trauma life support, and fundamental critical care courses seen in Figure 2.

The simulation trainer, instructor/facilitator of the simulation-based workshops, should be attended at least

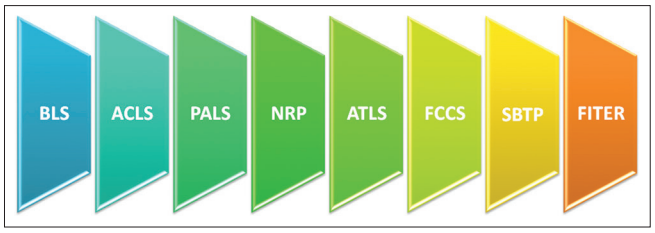

Figure 2: Sequence of Anesthesia Residency Training Program. FITER: Final In-Training Evaluation Report, BLS: Basic life support, ACLS: Advanced cardiac life support, PALS: Pediatric advanced life support, NRP: Neonatal resuscitation program, ATLS: Advanced trauma life support, FCCS: Fundamental critical care courses, SBTP: Simulation-based training programs

three courses under the supervision of an expert facilitator and should be evaluated for their knowledge, skills, and attitude by trainees and facilitators using both checklist and observation. On the other hand, renewal of certificate of the trainers in simulation required either running two full simulation courses/year or repeat the train the trainer or advanced course each 3 years.

Simulation-based Assessment

Simulation is the artificial recreation of a clinical environment or circumstance for the purpose of allowing a learner to undertake a specific task in a controlled manner that presents no risk to patients. Simulation can recreate many clinical settings with a degree of realism, allowing educators to observe how individuals and teams may perform in the "real world." It is particularly useful in assessing learner performance of a complete procedure, or in crisis situations that might not commonly be encountered or managed independently during a finite residency.[32]

There are several studies assessing the reliability and validity of simulation-based assessment. Most of these studies showed positive results regarding the reliability and validity of simulation-based assessment when compared to traditional assessment methods.[33-35] On the other hand, few studies showed some variability in reliability, especially on evaluating the behavioral aspects. The validity of simulation-based assessments to differentiate a large group of trainees based on clinical experience or training was confirmed in a previous study.[36] Hence, during the coming years, the role of simulation as a training and evaluation tool in anesthesiology is expected to grow.

The currently used types of simulation techniques included standardized patients, virtual simulation, computer-based simulation, full-body manikins high fidelity simulation, and hybrid simulation. Recently, simulation plays an essential role in the assessment process. Simulation-based assessment

tools utilized to assess the different technical skills included log book, direct observation with or without criteria, global rating scales (GRSs), and direct observation procedural skills. Best approaches are to combine a checklist with GRS to be able to identify strengths and weakness during the performance of any procedure.[37]

On the other hand, the nontechnical skills: the cognitive, social, and personal skills that complement the technical skills and contribute to safe and efficient task performance should be also assessed.[38]

These nontechnical skills are recognized as crucial to good anesthetic practice.[39] Good nontechnical skills (e.g., vigilance, anticipation, clear communication, and team coordination) can reduce the likelihood of error and consequently of accidents.[23] A taxonomy of nontechnical skills was developed under the umbrella of NHS Education Scotland in 1999. A team of anesthetists and psychologists was assembled to design an anesthetists' nontechnical skills (ANTS) system using series of task analyses based on a literature review, observations, interviews, surveys, and incident analysis.[25]

Examples of some tools that measure such skill are CRM and ANTS assessment.[23] The later measures performance in four areas: situational awareness, task management including fatigue and stress, decision-making and leadership, and communication. The ANTS assessment also needs a comprehensive training for the faculty and to familiarize the trainee with it before its introduction.[23,40] The Scottish Clinical Simulation Centre develops courses that focus on the development of the nontechnical skills which are directly relevant to anesthetic practice. The emphasis is on the use of nontechnical skills in routine practice to avoid errors and adverse events, but the courses also illustrate the importance of such skills in the management of emergency situations.[23]

The ANTS system was introduced to the UK after the members of the Educational Strategy Group of the Royal College of Anesthetists agreed to apply the system to a whole School of Anesthesia in 2003.[41] There has been considerable interest in the use of ANTS by anesthetists in other countries including India, the USA, German Canada, Spain, Sweden, the Netherlands, Australia, Italy, and Denmark.[42-44]

A 5-year plan aiming to integrate simulation-based station into the MOCK/Final OSCE was prepared to be implemented between 2014 and 2018 [Table 2]. It included also the aimed type of simulation as well as the appropriate assessment tool. Throughout the time frame, both candidates and examiners will be prepared for the final assessment

Application of Simulation in Anesthesia Licensing and Maintenance of Certification

Anesthesia specialty worldwide is currently facing two major challenges included: increased public awareness of anesthesia-related complications as well as the heterogeneous training and practice which possess a continuous threat on patient safety. These changes might persist in the future. The American Board of Anesthesiology had developed a solution to face such challenges by introducing simulation-based Maintenance of Certification in Anesthesiology program.[45]

Currently, in Saudi Arabia, participation of simulation-based continuous medical education activity is encouraged to be licensed or recertified as anesthetist, but it is still optional. Encouragement could be enhanced by doubling of accredited CME hours for simulation-based session

Accreditation of Simulation Centers

Simulation is becoming an integral part of the accreditation process in several medical disciplines.[46,47] Accreditation process of the simulation centers in Saudi Arabia, and the trainer licensing in each center is a crucial step after the introduction of simulation into training, assessment, and licensing. This process will be the responsibility of the SCFHS. Currently, the

Table 2: Integration of simulation-based stations into the assessment process

Simulation integration	2014	2015	2016	2017	2018
Training examiners and preparing candidates MOCK OSCE	4 task trainer OSCE stations MOCK	6 stations of OSCE, 2 stations of them ACRM simulation in MOCK	6 stations of OSCE, 2 stations of them ACRM simulation in MOCK	8 stations of OSCE, 2 stations of them ACRM simulation in MOCK	8 station of OSCE, 2 stations of them ACRM simulation in MOCK
Assessment tool	GRS + grading Checklist	GRS + grading Checklist	GRS + grading Checklist ANTS (MOCK only)	GRS + grading Checklist ANTS	GRS + grading Checklist ANTS
Summative assessment	None	3 stations of OSCE, 1 station of them ACRM simulation in final oral	3 stations of OSCE, 1 station of them ACRM simulation in final oral	4 stations of OSCE, 2 stations of them ACRM simulation in final oral	4 stations of OSCE, 2 stations of them ACRM simulation in final oral

ACRM: Anaesthesia Crisis Resources Management; GRS: Global Rating Scales; OSCE: Objective Structured Clinical Evaluation; ANTS: Anesthetist's nontechnical skills

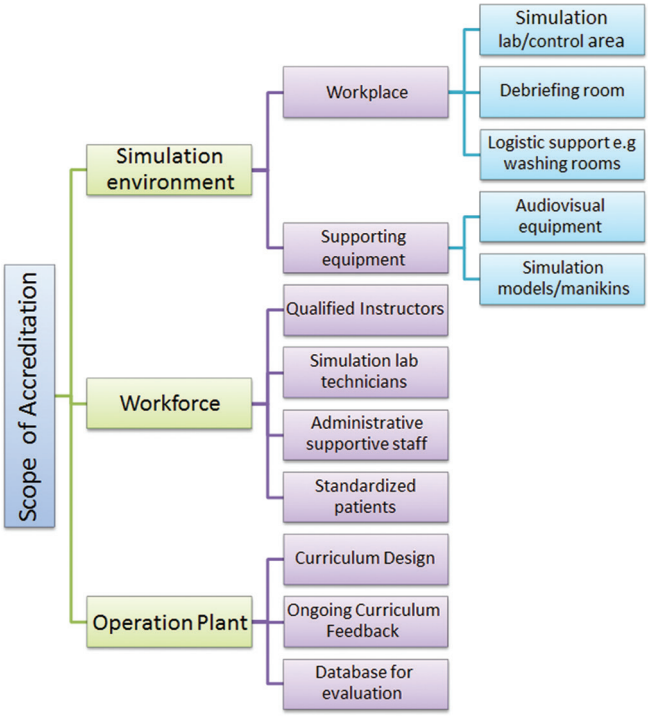

Figure 3: Scope of accreditation process of the simulation centers set by the Saudi Commission for Health Specialties

scope of accreditations included three main domains simulation environment, workforce, and operation plan [Figure 3].

Conclusion

A roadmap for integrating the use of medical simulation in anesthesia training, assessment, and practice was effectively prepared by the SCFHS. Many steps of this roadmap were taken, and many steps are pending. Many efforts are needed to complete this fruitful journey.

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Conflicts of interest

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