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Critical Review

SIMULATION EDUCATION – A REVIEW OF THE CURRENT STATUS

PRIMENA SIMULACIJE U EDUKACIJI – PREGLED DANAŠNJEG STATUSA

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Summary. Simulation education refers to the recreation of a real life task, event or experience with the aim of providing a safe learning environment for the acquisition of knowledge, skills, attitudes and behaviors of individuals or teams of personnel.

This kind of education connects life experiences and prior learning to new information. Learners are active participants and they are able to share experiences and practice a skill or apply knowledge.

Today simulation technologies include computer based gaming and virtual reality software, actors (portraying patients, family members or medical staff members) part task trainers (training devices designed for learning particular tasks and skills: endoscopy, laparoscopy, central line placement etc.); full body mannequins; standardized patients (an individuals who are trained to act as a real patients in order to simulate a set of symptoms or problems); fully immersive virtual reality systems and high-fidelity full-body human patient simulators.

High fidelity simulation (HFS) as a teaching modality consists of both hands-on experience with a lifelike manikin and a debriefing session. Debriefing is a planned session after the simulation, led by the instructor, during which learners assess their decisions, actions and communication.

Future research in this field is targeted to improve patient safety, clinical outcomes, non-technical skills as well as human factors, debriefing and cost effectiveness.

Sažetak. Korišćenje simulacije u edukaciji omogućava rekonstrukciju realnih događaja, iskustava ili zadataka sa ciljem stvaranja bezbedne sredine za sticanje znanja, veština i modela ponašanja kako po-jedinaca tako i medicinskog tima.

Ovaj način edukacije povezuje prethodno stečena iskustva i znanja sa novim informacijama. Učenici su aktivni učesnici i u mogućnosti su da razmenjuju iskustva, usavršavaju određenu veštinu ili primene znanje.

Današnja simulaciona tehnologija uključuje glumce koji glume pacijente, članove porodice ili članove medicinskog tima; sprave odnosno delove tela za vežbanje određenih procedura npr. endoskopije, laparoskopije ili plasiranja centralnog venskog kate-tera; manekene koji predstavljaju čitavo ljudsko telo; standardizovane pacijente koje predstavljaju osobe obučene da simuliraju određene simptome; sisteme za virtuelnu realnost i visoko sofisticirane simulatore ljudskog tela. Rad na ovim visoko sofisticiranim simulatorima obuhvata kako praktičan rad tako i jednako važan razgovor koji sledi nakon njega. Tokom ovog razgovora koji vodi posebno obučeni instruktor, polaznici analiziraju svoje postupke, razmišljanja, odluke, način komunikacije.

Istraživanja u ovoj oblasti usmerena su na stvaranje što veće bezbednosti za pacijenta tokom edukacije, usavršavanje veština kao i smanjivanje troškova koji predstavljaju ograničavajuću okolnost u primeni ove visoke tehnologije.

Key words: simulation, patient safety, experiential learning

Ključne reči: simulacija, bezbednost pacijenta, učenje kroz rad

Introduction

Definition of simulation education

"I hear and I forget. I see and I remember. I do and I understand."

Confucius

Simulation education refers to the recreation of a real life task, event or experience with the aim of providing a safe learning environment for the acquisition of knowledge, skills, attitudes and behaviors of individuals or teams of personnel.

The term Technology Enhanced Learning (TEL) is often used to describe the same training techniques.

This technology has a long history of application outside the field of medicine, including flight simulators for pilots and astronauts, war games and training exercises for the military and management games for business executives.¹

Over the last two decades a growing body of evidence has indicated that simulation technology provides a safe and effective mechanism to educate and evaluate medical professionals (Tekian et al., 1999; Issenberg et al., 1999; Gaba, 2000; Fincher & Lewis, 2002). Satava developed one of the first surgical simulators in 1993, which included a computer model of abdominal anatomy that was viewed in three dimensions and in 1995 Stredney developed an early epidural anaesthesia simulator.^{2,3}

Today simulation technologies include computer based gaming and virtual reality software, actors (portraying patients, family members or medical staff members) part task trainers (training devices designed for learning particular tasks and skills: endoscopy, laparoscopy, central line placement etc.); full body mannequins; standardized patients (an individuals who are trained to act as a real patients in order to simulate a set of symptoms or problems); fully immersive virtual reality systems and high-fidelity full-body human patient simulators (HPS). "High tech" HPS's can recreate a multitude of disease states and respond physiologically (based on computer algorithms) in real time to drug administration, procedural interventions and management strategies. The degree of realism is termed

fidelity (physical, physiological and psychological). Highly realistic training environments can be achieved by using HPS in-situ, that is in the place where individuals normally work, for example in theatre or in an intensive care unit or by the use of specially designed simulation training centres.

Advantages of Simulation

There are a number of advantages of simulation compared to traditional teaching. During simulation the simulator is a patient, negating any risk to actual patients and for the learner also. With appropriate guidance or facilitation from an experienced colleague or instructor a learner can explore, discover and develop the appropriate clinical strategies in a highly realistic environment for common and rare clinical situations. The aim is to create a learning environment where individuals or teams feel safe to perform as they would normally with actual patients, without the fear of embarrassment or negative outcomes. One can practice highly realistic procedural interventions with flexibility and reproducibility, with the ability to freeze situation, gain expert advice and give immediate feedback. Learners can develop the ability to reflect on their actions, improve self-confidence and ultimately translate this to improved patient care. Simulation also provides an ideal environment to learn and reflect upon non-technical skills (also termed human factors) including leadership, followership, decision making, communication, situational awareness and error recognition.

Non-technical skills are described as anaesthetists' attitudes and behaviours in the operating theatre environment not directly related to the use of medical expertise, drugs or equipment and they encompass those social and cognitive skills that underpin good and effective clinical and technical practice and have been shown to be important for patient safety.⁴

These skills have a vital role in anaesthetic practice but have not traditionally been addressed in anaesthetic training.⁵

Realization of the need to train and assess these skills is growing, but these activities must

be based on validated measurement tools. The Anaesthetist Non-Technical Skills (ANTS) system comprises four key categories (which consist of a number of more specific skill elements) and a set of associated behavioural markers showing examples of good and poor practice for each element. The four skill categories are: task management, team working, situation awareness and decision making.⁶

Components of simulation education

Seven common components have been identified and adapted below⁷:

1. Pre-briefed learners
2. Facilitator with appropriate debriefing knowledge and skills
3. The simulated experience
4. Debrief techniques relevant to adult learners and emotionally engaging
5. Recollection - clear and factual
6. Reporting - normally verbal, but can be written (other media)
7. Timing

In terms of human patient simulators anaesthetic or intensive care educational sessions, it is normal to commence with a pre-brief. The objective is twofold: to create the bubble of safety in order to promote reflective learning and to highlight the expectations in terms of the performance of learners relating to the key learning outcomes for the session. The key learning outcomes are normally mapped to an educational curricula, one example of this is the international Managing Emergencies in Paediatric Anaesthesia (MEPA), a collaborative course based upon the Royal College of Anaesthetist of UK curriculum.⁸ MEPA aims to give all anaesthetic trainees in the UK the opportunity to develop management strategies for emergencies in paediatric anaesthesia using high fidelity simulation.

The pre-brief allows familiarization with the human patient simulators (Image 1), monitoring, equipment, interventions (for example intubation) and limitations. Currently wireless human patient simulators have advanced such that they talk, have pupils responsive to light, become cyanosed or have seizures in addition to previous cardio-respiratory responses, but as yet capillary refill time, skin color and touch temperature is not available. Immediately prior to commencing the simulation education session the learners are given the appropriate

information pertaining to the clinical situation they are about to find themselves in.

Image 1: Human patient simulator (HPS).



Prof Ralph James MacKinnon teaching at the University Children's Hospital, Belgrade. May 2012.

Currently there is considerable focus upon facilitator faculty development, to increase capacity of simulator education provision in many countries, particularly with respect to appropriate debriefing knowledge and skills. There is a strong world-wide drive towards collaborative, evidence based, peer reviewed simulation scenarios targeted to key patient care outcomes.

After-action review or debriefing is a crucial component of the learning experience during simulation⁹. Debriefing is defined a "facilitator-led participant discussion of events, reflection and assimilation of activities into their cognitions producing long lasting learning".¹⁰ This is a structured session after completion of simulated scenario, guided by the facilitator, who provides the learners with the time to assess their decisions, actions, communication and ability to deal with the unexpected (Decker, 2007). Most debriefing processes and methods used in health care have been adapted from a host of high risk industries, including aviation, military, nuclear power and high performance sports.¹¹

Although there are several models of debriefing techniques, debriefing is generally considered to be a time for the participants to reflect on the event, discuss it with others, learn and modify behavior

as a result (Decker, 2007; Fanning and Gaba, 2007). Debriefing encourages reflective learning which allows the participants to link theory to practice and research, think critically and discuss how to intervene professionally in complex situations (Jeffrees 2010). This kind of post experience analysis is a way of bridging the gap between experiencing an event and making sense of it.

Not everyone can analyse and evaluate learning experiences on their own; it is particularly difficult to do so if you are involved in highly dynamic team based activities. The debriefing or feedback stage is considered by many as the key element in simulation leading to translation of learning from the simulated environment to clinical practice. Debriefs generally last the same or longer time periods than the actual simulated scenario and should be viewed as a social practice where participants can freely engage and interact with each other and their surroundings and even enjoy the process.¹²

Effective debriefing gives an opportunity to concentrate on key learning objectives, have an open discussion and employ strategies and ideas for improvement on individual or team performance.¹⁰ Emotion is a key element of the debriefing process, participants must be fully at ease and trusting of their environment before they are able to express their thoughts freely.¹⁰ It usually occurs immediately after the simulated scenario so participants thoughts and emotions are present. The debrief setting ideally is confidential, private, non-threatening, comfortable area with circle arrangement of seating with all participants and facilitator at same eye level, not time limited or disturbed.¹³ The responsibility of the facilitator is to maintain this bubble of safety, as discussed above, in which learners feel confident to express any of their deep-rooted thoughts or be able to ask any questions. This bubble of safety is not always easy to achieve, debriefing is as much an art as it is a science. The key is to ask the right questions to promote reflective learning. Effective debriefers are neither harshly judgmental nor falsely “non judgmental”.¹³ To assist in the creation of a bubble of safety and optimise debriefing it is important to highlight briefly some key points of adult learning theory.

As adults we learn optimally when actively engaged and when we experience concrete real events in a cognitive fashion, termed experiential learning. The experiential learning model has four stages, active experimentation, subsequent analysis, reflection

on the experience and incorporation into practice.¹⁴ As adults about to enter a simulation, we arrive with different previous life experiences or “frames”.¹³ A frame is the perception, knowledge, assumptions, feelings, training, clinical experience and ingrained personality traits that a participant arrives to a simulation with. Many of us can be naturally untrusting, have a dislike of this form of learning and can be hostile to it. The debrief leads to new frames and changes later action, the role of the debrief facilitator is as a ‘cognitive detective’; they try to figure out frames through a stance of curiosity and their skills are paramount.¹³

Debriefing strategies

A number of different strategies and debrief tools are available. One generic structure describes three phases of debriefing.¹⁵

The description phase, in which participants are guided to reconstruct what happened during the scenario from respective perspectives.

The analysis phase is a phase where the thought processing underpinning the learner’s actions during the simulation is explored, understood and linked to the key learning objectives of the session. This can lead to emotional aspects of the event.¹⁶

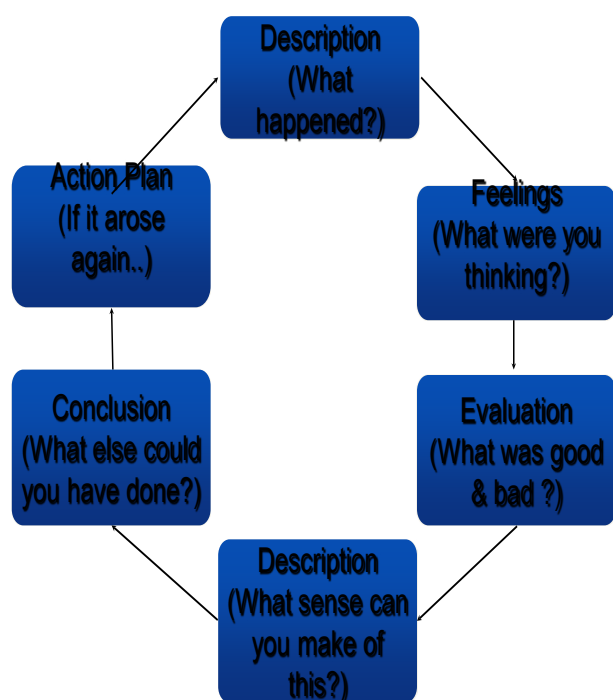
An interesting question is how much learning and change of mental models can address issues beyond cognition, like emotions or bodily sensations when considering learning.⁹ The participants explore why they were successful or not during the scenario and learn to avoid weaknesses and mistakes next time.

The synthesis phase explores different views held by all participants and how they apply on a larger scale.¹⁷ Participants are encouraged to reflect on this experience relative to real-life experiences.⁷ Discussion is facilitated as to how the information gained from the simulation can be employed to potential future situations or applications.¹⁸

The Gibbs reflective cycle (Figure1) provides a framework to potentially achieve these goals.¹⁹

In terms of using the debrief as a formative assessment tool to provide individually tailored feedback to learners on their performance and to master complex clinical, social and logistical challenges in clinical practice, the Closing the Performance Gap model has been proposed.²⁰ This intuitive model has four steps:

1. note salient performance gaps related to

Figure 1: Gibbs reflective Cycle¹⁹

Graham Gibbs 1984

predetermined objectives,

2. provide feedback describing the gap,
3. investigate the basis for the gap by exploring the frames and emotions,
4. help close the performance gap through discussion or targeted instruction about principles and skills relevant to performance.

It is proposed that the model can also be applied to bedside teaching in the emergency department and other clinical settings.

There are also assessment tools available aimed at improving the performance of debrief facilitators, including the Debriefing Assessment for Simulation in Healthcare (DASH) and The Observational Structured Assessment of debriefing tool (OSAD). DASH is a behaviourally anchored rating scale and it describes and reflects the behaviours needed to execute an effective debriefing.²¹ OSAD is based on a systematic review of the literature as well as expert opinion of clinical debriefers across three continents and includes eight core elements of a high quality performance debrief: approach, learning, environment, learner engagement, reaction, reflection, analysis, diagnosis, application.^{22,23}

Research and the evidence base for simulation education

A notable evolution of simulation education has been observed over the last two decades.

After the establishment of simulation with the recognition of the above advantages to complement traditional clinical teaching, there has been much debate as to the paucity of an evidence base for direct impact of simulation on patient care, particularly with reference to the high cost of purchasing simulators. This has continued throughout a phase, where assessment metrics have been developed and simulation education programs/courses have been qualitatively evaluated and widely published.²⁴

At present there is considerable research in simulation education aiming to address the evidence base question. Current research themes in terms of the exploration of translation of simulation education to the clinical domain have extended beyond crisis management and resuscitation, to focus upon non-technical skills, targeting key patient safety and clinical outcomes or cost effectiveness.

To achieve this there has been much focus on outcome measures including the Kirkpatrick system.²⁵

A recent modification of the Kirkpatrick Model (Table 1) has been developed to assess the impact of structured resuscitation training (SRT) programs on healthcare practitioners, patients and services as a Best Evidence in Medical Education systematic review.²⁶ This is the first systematic review of the literature that has described and analyzed the evidence available for the efficacy of SRT on acquisition of knowledge and skills, their retention and the effect of SRT on patient care and outcome.

The systematic review yielded “overwhelming evidence from the reported studies that the introduction of SRT within an institution has a direct positive impact on mortality and also on clinical management”.²⁶ It was reported that the majority of SRTs included both lectures and simulations. Interestingly however no studies were found relating to the transfer of behavioural changes in the simulated setting to the ‘real-life’ clinical domain.²⁶

Conclusion and future directions

Many changes have occurred in the medical educational environment in recent years. There are growing demands for safe care, quality care and

Table 1: Modification of the Kirkpatrick Model of outcomes²⁶

Kirkpatrick Level 1 Reaction to learning experience Evidence of learners' views on the overall learning experience and its inter-professional nature including the training programme, rather than any specific learning outcomes.
Kirkpatrick Level 2a Modification of attitudes and perceptions Evidence of documented changes in reciprocal attitudes or perceptions between participant groups and possible changes in perception or attitude towards the value and/or use of team approaches to caring for a specific client group.
Kirkpatrick Level 2b Acquisition of knowledge and skills Evidence of knowledge and skills acquisition immediately following completion of a SRT.
Kirkpatrick Level 2c Evidence of the retention of knowledge and/or skills over a period of time after the SRT.
Kirkpatrick Level 3 Behavioural change Evidence of transfer of learning to clinical practice.
Kirkpatrick Level 4a Change in organisational practice Evidence of changes within the organisational practice and delivery of care after the SRT.
Kirkpatrick Level 4b Benefits to patients/clients, families and communities Evidence of documented impacts in the health or well being of patients/clients, families and communities after the SRT.

demonstration of competency by the individuals and facilities that provide care. Patients are increasingly reluctant to participate in clinical education so that physicians in training can learn their craft, particularly junior learners.²⁷

The health care community can gain significantly from using simulation-based training to reduce errors and improve patient safety when it is designed and delivered appropriately.

Simulation education connects life experiences and prior learning to new information, learners are active participants and they are able to share experiences and practice a skill or apply knowledge.²⁸

Organisation of Simulation Networks and collaborations open the door to interdisciplinary activity and afford not only the possibility of meeting capacity needs for anaesthesiologists but also provide a venue for training, setting standards and bringing academic and non-academic practices together.²⁹

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