FOCUS ON . . . HOSPEX

HOSPEX AND CONCEPTS OF SIMULATION

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Abstract

A conceptual three-level framework is presented for understanding the aims, scope and potential outcomes of simulation in healthcare contexts. At the first level, micro-simulation aims at honing basic technical skills of individual clinicians. At the second level, meso-simulation aims to train clinicians to work more effectively and efficiently as part of a clinical team. At the third level, macro-simulation aims to assess organisational fitness for purpose at large scale. We discuss HOSPEX as an exemplar macro-simulation and argue for needs- and evidence-based implementation of simulation-based training at micro, meso and macro levels.

Introduction

Simulation is a *"person, device, or set of conditions, which attempts to present evaluation problems authentically. The student or trainee is required to respond to the problems as he or she would under natural circumstances. Frequently, the trainee receives performance feedback as if he or she were in the real situation"* [1]. As the definition suggests, simulations can take a variety of guises. They can be focused on individual trainees or teams; they can be static or interactive; they can be more or less technology driven, for instance, with an Information and Communication Technology (ICT) interface with the user. It follows, that some simulations replicate the "real thing" (e.g., procedure, clinical environment) more accurately than others. Simulations can, therefore, be of lower or higher fidelity. Usually, higher fidelity implies higher complexity and thus increased costs.

Regardless of the specifications of the simulation, in recent years there has been a dramatic increase in simulation based learning and training modules for doctors. This development follows other high risk, high reliability industries, in which human errors are costly and can often be fatal, including commercial aviation, the military and the financial sector. Reasons underlying the increasing reliance on simulation based training in the medical and surgical domains include reduced training time (due, for instance to the European Working Time Directive), associated changes in the delivery of healthcare services (e.g., increased reliance on shift working) and ever expanding new technologies. Taken together, such developments have rendered the need to train within a safe, learning-friendly environment paramount [2]. Initial evidence suggests that simulations offer effective learning environments [1,3] and are welcome by both trainees and trainers [4].

This article aims to provide a conceptual framework for understanding the aims, scope and potential outcomes of simulation. Such a framework is currently lacking; possibly due to the fact that simulation has been driven by acute clinical need, whilst educational research has not quite kept up. As a result, there seems to be "little awareness of the substantive and methodological breadth and depth of educational science in this field" [3]. In the long run, this approach does not help maximise the output from simulation based training at best and may even compromise the quality of the training at worst. If simulation is to be formally integrated into any training curriculum, it must be evidence driven, effective (i.e., meeting learning objectives) and efficient (i.e., minimising cost and time taken to achieve proficiency [4]. Strategic planning is thus required and the framework that we are proposing here aims to offer a vehicle for such planning to occur.

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Conceptual Framework: Levels of Simulation

We propose a three level hierarchy of simulation, grounded on existing evidence, as shown in Figure 1. In the sections that follow, we elaborate on each one of these levels.

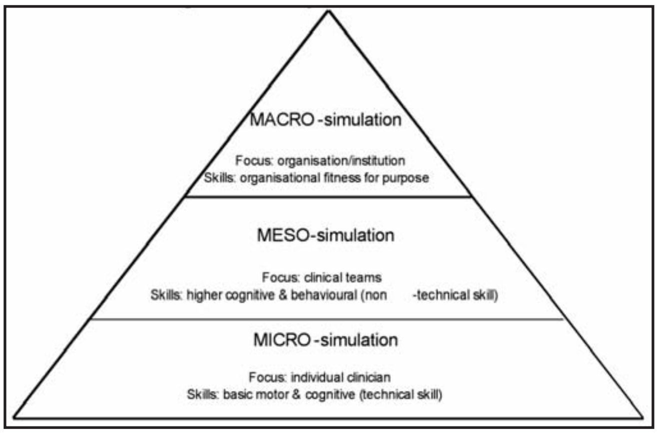

Figure 1. Hierachy of simulation levels.

Across medical specialties, interventional medicine has led the way in simulation based training. Surgery and anaesthesia are the two disciplines that have paved the way with most of the resulting evidence base on the efficacy and efficiency of simulation based training in healthcare coming from these specialties. Thus, we shall focus on evidence stemming from applications of simulation to anaesthetic and surgical training. Our conceptualisation, however, can be applied to any medical speciality.

Micro-simulation

Micro-simulation refers to simulation training that is delivered to individual clinicians, typically at early stages of their training.

The key focus of the training is the development of core clinical competencies, grounded in the training and development of basic motor and cognitive skills, such as tissue dissection and suturing, tissue handling, instrument selection and surgical knot tying. Simulation based training of such skills typically involves a trainer demonstrating the task, usually split into constituent steps and trainee clinicians using bench-top models to hone their skill. Depending on the level of skill that is being trained, the level of complexity and sophistication of the simulation varies. The bench-top model of choice may consist of synthetic or animal tissue, or it may be a virtual, ICT mediated simulator, such as the anaesthetic simulators and laparoscopic simulators for minimally invasive procedures that are currently available. The complexity is mirrored in the assessment of performance and the feedback that is provided to the trainee. At simple enough tasks, feedback is the self-evident success/failure of the trainee to complete the task (e.g., knot-tying). In more complex simulators, feedback is provided via global measures of skill that the trainer completes via observation, like the Objective Structured Assessment of Technical Skill (OSATS) [6]. More advanced tools currently being researched include feedback by means of analysis of the economy of motion, eye tracking and others [7,8]. Initial evidence suggests that micro-simulation improves performance at real procedures by shortening the length of time taken to complete a procedure, fewer errors and decreased patient discomfort [9-11], although more research is needed regarding the robustness of skill transfer from simulated to real procedures.

Meso-simulation

Meso-simulation refers to simulation training that is delivered to teams in their entirety (Figure 1). Such teams typically include clinicians who have mastered basic clinical skills and are at higher levels of their training than those who undergo micro-simulations. Although technical skills inevitably feature at this level as well, the key aim here is to bring people together and improve the way they work together. Meso-simulation typically occurs within purpose built surgical skills centres, thus overcoming some of the practical issues of space, faculty and funding resources. The major goal of this type of simulation-based team-training is to improve the safety and quality of care that is provided to patients. This is particularly important because studies of adverse events in the USA and the UK in the late 1990's and relevant major publications by the Institute of Medicine [12] and the Department of Health [13] suggested that key failures in patient care are not attributable to lack of individual technical skill, but rather to lack of accurate and timely communication among members of clinical teams, lack of leadership when required, and compromised crisis management. These reports also urged hospitals and medical schools to look into the development and training of a new generation of clinicians, who would be technically proficient, but also able to work with their colleagues in the most effective and efficient manner. Anaesthetic training was the first domain of application of such principles. Anaesthetists emulated crisis management training that was developed in the context of commercial aviation in the late 1970's and has become known as Crew Resource Management (CRM). This work led to the development of Anaesthetic CRM training (ACRM) modules. Surgical training has followed – with studies in real operating theatres [14,15] furnishing relevant evidence to be fed into simulation-based, crisis management training modules [16-18]. A number of assessment tools are currently being developed and evaluated to measure such higher-level cognitive and behavioural skills (e.g., communication, leadership, decision-making). These include the Observational Teamwork Assessment for Surgery (OTAS) [14,19], the NOn-TECHnical Skill scale (NOTECHS) [17,18,20,21], the Anaesthetic Non-Technical Skill scale (ANTS) [22] and the Non-Technical Skill for Surgeons (NOTSS) [23].

Figure 1. The Surgical team in action.

Macro-simulation

Macro-simulation refers to simulations that involve a whole hospital or network of hospitals or other institutions, in which healthcare is delivered (Figure 2). Such simulations typically involve experts from a range of medical and surgical specialties. They can also involve experts with no medical training, but likely to be involved in the simulated situation such as policemen, firemen and others. A key aim of the simulation is to prepare for events that are rare or require cross institutional coordination. Another aim of the simulation is forecasting the impact of future occurrences on the home institution and preparing effective and efficient responses. Due to their nature, these simulations transcend both individual skill and the (comparatively compact) clinical teams and they pose a significant challenge to trainers. There are at least two ways that such simulations can be carried out. The first is to carry out the simulation in situ. Given the scale of the event, such simulations are usually undertaken at full scale at national level. An example of such simulations in the UK are those that have been carried out by the Centre for Emergency Preparedness and Response of the Health Protection Agency, aiming to simulate building evacuation, first aid provision, and transfer to hospital in the case of a terrorist attack in London. The second way to carry out such simulation is by an ICT modulated environment, i.e., through computer modelling. A computer 'runs' a simulation based upon entered factors and the subsequent impact on organisational processes and outcomes are observed. Such simulations have been carried out in Great Ormond Street Hospital for Children, to assess the relative impact of a number of factors on the safety of surgery [24]. Although there is no single measure to assess these simulations, it follows from their aim that the ultimate question that they are meant to answer is whether the organisation is fit for purpose; and if not, what needs to be done to improve.

Figure 2. The resuscitation room in action.

Where does HOSPEX sit?

HOSPEX sits at the top of the pyramid: it is an exemplar macro-simulation. The aim of HOSPEX is to simulate a hospital in the battlefield in its entirety, including the available equipment and layout of the hospital, the in-hospital clinical, administration and discharge processes, the type of cases that the participants are likely to encounter, the type of decisions that they are likely to make and other aspects of the clinical reality in the field that are different from those in an average acute NHS Trust. Given these aims, HOSPEX participants are senior SpRs and Consultants, qualified Nurses, Allied Health Professionals (AHP) and healthcare managers (medical commanders). This implies adequate level of technical skills of the type that micro-simulation nurtures. Participants are also likely to have been involved in crisis in the context of their work, although at the current state of medical or surgical training it is likely that not all participants would have undergone crisis management training that meso-simulation would aim to deliver. That is not to say, however, that they have no crisis management skills at all. Personally experienced crises and those in which the participants may have been called in to assist colleagues are likely to have occurred in the professional lives of HOSPEX participants, thereby enabling them to develop their own approach to crisis handling (idiosyncratic perhaps, but potentially effective). In addition, the HOSPEX experience itself allows further honing of crisis management skills via the scenarios that the participants practice during the exercise. More importantly, HOSPEX offers the integration of teams in pre-hospital, through-hospital and post-hospital (transfer) care, thus allowing simulation of the entire care pathway (Figure 3). In that, HOSPEX does allow for a cross-over between meso- and macro-levels of simulation based training.

Figure 1. RAF CCAST team practice the transfer of a critically ill patient on the helicopter mock up.

Discussion

It is evident from what we have discussed so far that not all simulations are (or should be) meant to achieve the same goals, or are of the same scope. At the bottom of the pyramid of Figure 1, trainers aim to offer micro-simulation to as many people as possible, ideally everyone, aiming to hone individual motor and cognitive skills. Expert clinicians act as trainers. Moving one level up, trainers design meso-simulation aiming to train teams who have mastered reasonable expertise in basic skills, usually via a combination of micro-simulation and real-life on-the-job training. Although desirable, in reality not all clinicians undergo such training at present. The level of complexity and requirements to carry out such simulations is higher. Trainers aim to offer understanding of behavioural issues around crisis management and concrete recommendations, often algorithms, that will help the team mitigate the crisis and achieve safe care provision. Trainers here are expert clinicians once they have been trained themselves and psychologists or human factors scientists. Such simulations are more likely to be offered by larger simulation centres that have facilities (e.g., mannequins, simulated operating theatres) and expert non-clinical staff. At the top of the pyramid, macro-simulation is a sophisticated, expensive tool that aims to assess risk in a cumulative manner and to evaluate organisational response and outcome. Attempts to rehearse macro-simulation through 'wargaming' and 'desk-top' exercises help teams to prepare at low cost before being exposed to more expensive full panoply of HOSPEX macro-simulation. These levels of simulation are inter-related: unless training at lower levels has occurred, there is little point moving upwards. The possibility, however, exists that some cross-over will be observed between levels (e.g., meso to macro, as discussed above in relation to HOSPEX). Nevertheless, whilst the specific focal points across the three levels are different, micro, meso, and macro-simulation are linked by the overarching goal of contributing towards safe, high quality, efficient care provision though training.

Conclusions

Strategic planning is required to assess what simulation is appropriate for what level of training need. The proposed conceptual framework facilitates (i) good understanding of what different types of simulation should be expected to achieve and (ii) effective planning of simulation-based training at individual, team, and organisational level.

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