The Role of Simulation in Medical Training and Assessment

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Purpose

An overview of the current use of simulation in medical training and assessment, reflecting on its advantages and disadvantages, as well as speculating on its future.

Content Organization

An overview to medical simulation has been provided. In the context of procedural interventional radiology training, we start with the definition and history of simulation, address its increasing importance in medicine reflect on its theoretical basis and current evidence and finally review its advantages/ limitations and prospects for the future.

Summary

There are a number of influences that have driven the development of simulation. Currently the visuo-spatial and manipulation skills required in interventional radiology are learnt in a traditional apprenticeship model. However Working Time Directives in the UK and Europe limit in-hospital work hours of trainees, reducing the time and case mix available to train. Other drives include the development of new technologies for diagnosis and management. Furthermore, there are now major ethical considerations with patient safety and medical errors being high on the medical and political agendas. Some animal and fixed models have also been used to reproduce some of the training objectives, but they are an imperfect substitute for the 'real patient' experience. They also have ethical limitations, are expensive and limited in number.

Simulation in clinical learning has been shown to provide excellent opportunities for safe and effective learning. Simulation is taken from the Latin word *simulare*, 'to copy, represent'. It can be regarded as a method to enable learning and training of individuals and teams by recreating 'real' clinical situations. This allows them to learn, practise and repeat procedures as often as necessary in order to correct mistakes, develop their professional competencies, fine tune their skills and ultimately improve patient outcomes. It also allows comparison of performance of groups of individuals at the same level, so that performance standards can be set. Tasks can also be staged according to experience level, enabling novices to practice core skills before attempting complex procedures.

The initial interest in simulation began in other 'high risk' industries such as aviation and the military. These industries share a highly complex and hazardous nature similar to healthcare, where training and testing in the 'real world' is considered too costly and dangerous to undertake.

A wide range of technologies and methods are currently utilised in medical simulation, including: basic models created using tissue mimics or rapid prototyping, often part-task trainers; animals; simulated patients; scenarios and computer-based systems. The latter may involve hybrid or augmented reality models, or immersive, 'high fidelity' virtual reality and integrated simulators. Kneebone et al (2008)

states that the use of simulated patients and simulated environments uses context to enhance realism, with added potential for skills to transfer to similar scenarios, and even to cross boundaries into different contexts.

The medical community has come under much criticism for adopting and implementing educational innovations without robust evidence for their efficacy. The field of simulation has also been subjected to intense scrutiny for the same reason. Bradley and Postlethwaite (2003) explain that the field itself is theory-rich, and that understanding of learning theories is relevant to, and underpins, the effective use of simulation in medical education. They go on to discuss the relevance of the various learning theories such as behaviourism, constructivism, reflective practice, situated learning and activity theory.

An important aspect of evidence-based simulation lies in its validity. Although this is new to surgery, validation has been well developed in psychology and behavioural sciences. A valid instrument measures what it is intended to measure and trains skills that transfer to procedures in patients in the clinical environment. There are subjective and objective approaches to the determination of validity which are divided into four types:

Face validity: extent to which the simulation appears to be a correct representation of the real world task.

Content validity: degree to which an expert judges the simulator as correctly replicating the physical processes of the real world task.

Construct validity: ability of the simulation to correctly replicate and measure key procedure steps: it indicates the simulation's ability to assess features that are important for correct performance of the target procedure.

Concurrent validity: ability of scores on a test on the simulator to predict actual performance in real life.

As can be seen there are many advantages that simulation will bring into the medical field. The risks to patients and learners are avoided, with reduction of undesired interference. Tasks can be created to meet the requirements of the training curriculum. Skills can then be practised repeatedly and training, tailored to individuals, with retention and accuracy being increased. Transfer of training from classroom to the real, clinical situation, and trainee performance evaluation, can also be enhanced. However, there are limitations of simulation that have to be recognised as well. The most important being the lack of robust, highly valid and experimental data on current high fidelity medical simulators. High fidelity simulators are also very expensive and require dedicated facilities, personnel and technological support.

The future of medical simulation is very optimistic with increased research going into the robust validation of simulators that use high fidelity where that has been identified as appropriate. A clear message needs to be sent out that research needs to be focused on higher level outcomes in order to provide convincing evidence across the whole spectrum of the efficacy and effectiveness of simulation-based education.