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Medical Simulation in Obstetrics and Gynaecology: The Way Forward to Develop, Maintain and Assess Operative Skills?

Olukunle Adegboye Ajayi*

Harrogate District Hospital, United Kingdom

Abstract

Medical simulation mimics clinical care, allowing individual health professionals and teams to develop and maintain skills necessary for safe and effective clinical care. It enables trainee surgeon practice remotely from patients thereby gaining confidence and becoming more efficient. One of the earliest examples of simulation is the construction of the game of chess in the sixth century for military training. In the last 10 years, technological advances have allowed for a wider availability and greater realism of simulation, and this has encouraged a great expansion in its use. The Experiential Learning Theory (ELT) developed by David Kolb (1982) 'comes alive' and explains well how simulation translates to deep learning. For operative gynaecology to fully take advantage of the advantages offered by the explosion of endoscopic surgery in recent years, simulation based training should be fully integrated and funded within training programmes for clinician at all stages. Simulation based training needs to be valued and adequately resourced by healthcare organisations. A skilled faculty of expert clinical facilitators should be developed to deliver high-quality simulation training. The importance of human factors training to safe care should be widely communicated.

Introduction

Medical simulation mimics clinical care, allowing individual health professionals and teams to develop and maintain skills necessary for safe and effective clinical care. It enables trainee surgeon practice remotely from patients thereby gaining confidence and becoming more efficient [1]. One of the earliest examples of simulation is the construction of the game of chess in the sixth century for military training. Medical simulation was has also been in practice long ago. In 1748, Madame du Coudray, the King of France's midwife, developed a life-size mannequin from leather and bone to teach the management of childbirth. She trained local doctors who, in turn, trained local women. In this way, du Coudray disseminated practical training, enabling hundreds of women in France to experience safer childbirth [2]. However, over the following 250 years, there appeared to have been little progress in medical simulation. In the 1900s, aviation and the military systematically developed simulation; Edward Link, seeing the fatal accidents in aviation in its early days invented the first flight simulator. He believed that there must be an easier, safer, and less expensive way to learn how to fly. He opened his flight school in 1930 to demonstrate the educational value of his trainer. In 1934, after several catastrophic and fatal accidents due to poor visibility, the Army purchased Link trainers to improve training. The military accounted for 80% of all modelling and simulation work before the 1990s [3]. In the last 10 years, technological advances have allowed for a wider availability and greater realism of simulation, and this has encouraged a great expansion in its use. In addition, the military was a major impetus in the transfer of modelling and simulation technology to medicine [4]. The same reasons expounded by Edward Link are the core advantages of medical simulation in medicine today: easier, safer and less expensive way to learn especially when safety of lives is concerned.

Initial Learning of and Maintenance of Surgical or Psychomotor Skills

The traditional method of surgical training was through apprenticeship, especially in the theatre. Both laparoscopic and open surgery training methods include the use of live animal, human, cadaver and manikins for several decades. With increasing uptake of laparoscopic surgery and improvements in optics came the development of high fidelity manikins, box-trainer (also called video trainer), and virtual reality training (training using computer simulation). Box trainers, for instance, have been shown to be superior to standard surgical training. Virtual reality training has been reported to improve the learning outcomes in different surgical procedures. It also offers an ethical way of assessing the competency of a surgeon in performing a procedure without risk to the patient [5].

With the pressure of high standard of medical service, improvement in quality of healthcare services rendered, service throughput and reduced training times for surgical trainees, there is increasingly limited training opportunities for postgraduate trainees [6]. Medical training needed to consider other models of training, assessment and skills maintenance in contrast to the apprenticeship model. Although an effective way to learn, apprenticeship does expose the patients to the risk of harm even though learners are initially supervised. Simulation allows learners to practise new hands-on skills in an environment that puts patients at less risk. When the learner knows that a mistake will hurt no one, they may be more likely to act quickly and learn from mistakes. Furthermore, unlike clinical situations, a simulation session can be paused, stopped or restarted, repeated to trainee's content, to correct mistakes and make teaching points. In addition, as many procedures are performed awake, thanks to progress in anaesthesiology, it becomes obvious to patients when a learner is being taught the basics of how to perform a procedure. Moving the initial teaching of new procedures therefore from the bedside to the simulator suite can provide comfort to all involved [7]. Hand–eye coordination is paramount in operative gynaecology and skills to use ventouse and forceps are essential in obstetric practice. How does one teach and ensure appropriate traction or trajectory is employed during delivery? High fidelity simulators that allows the trajectory of the application of forceps blades to be tracked using spatial censors and use of visual feedback and the isometric

***Corresponding author:** Olukunle Adegboye Ajayi, Consultant, Obstetrician and Gynaecologist, Harrogate District Hospital, HG2 7SX, United Kingdom, Tel: 01423 885959; E-mail: gboyefolu@yahoo.com

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strength testing unit are now possible as simulation based education is embraced in obstetrics and gynaecology [8,9]. A virtual reality study of repetitions of ultrasound measurements (femur length) has shown that the performance of junior trainees improves to near expert level in just five repetitions [1]. Furthermore, a recent cochrane review by Nagendran et al. 2013 concluded that virtual reality training appears to decrease the operating time and improve the operative performance of surgical trainees with limited laparoscopic experience when compared with no training or with box-trainer training. However, the impact of this decreased operating time and improvement in operative performance on patients and healthcare funders in terms of improved outcomes or decreased costs is not known [5].

Trainee Recruitment, Assessment, Appraisal, Certification & Revalidation and Team Building

History taking from patient actors, pelvic examination using anatomical models or hybrid patients and carrying out procedures such as demonstrating forceps or ventouse delivery increasingly feature in the recruitment of doctors into obstetrics and gynaecology. Simulation based exercise to select doctors with good hand–eye–coordination will be useful in selecting for laparoscopic surgeons. Fox et al. advocated that data collated from individual performance in simulation could be made available for feedback to individual trainees to guide their own improvement. Simulated laparoscopic surgeries could be recorded so that the video is reviewed with the trainees as a form of feedback. The use of such formatively in work place based assessments to inform of ergonomics of movement in simulated laparoscopic surgery, peer feedback or individual reflection on performance could prove to be a powerful tool in enhancing individual learning, team building and interprofessional education [1].

The growth of laparoscopic surgery and its widespread acceptance into the mainstream of gynaecological practice have been faced with many challenges and pessimism. There was a great deal of opposition and pessimism of adopting laparoscopy at the inception which some antagonist termed "Foreveroscopy" because it took longer to perform than open surgery [10]. The learning curve for laparoscopic surgery has however been shown to have similar structure for senior surgeons and resident trainees. Although learning curve is influenced by several factors, increased practice offered by simulation improves skills. Thus, simulation training holds the greatest potential to be used as an adjunct to traditional training methods to equip the next generation of robotic surgeons with the skills required to operate safely [11,12]. As research continues into better ways of assessing individual doctors performance continues, simulation is likely to play more roles in professional development in the future and certainly in the development of expertise in new procedures, to brush up skills after extended leave, practise skills for very rare conditions [1].

Educational Theories Underpinning Simulation

The Experiential Learning Theory (ELT) developed by David Kolb (1982) 'comes alive' and explains well how simulation translates to deep learning. It provides a mechanism for how experience is transformed into knowledge, skills and attitudes. Learning is initiated with experience which is transformed into abstract conceptualisation by a process of reflective observation and active experimentation. The cycle goes on with repetition of simulation and practice [13]. Bandura described in his Social Cognitive Theory, individual's symbolising capability (remarkable ability to use symbols to transform their experience so that it can be stored and used as a guide to future actions) and the vicarious capability (that allow them to learn from observing the actions of others). These are engaged during simulation and deployed at work [14].

Furthermore, Knowles described four elements important to adult learning:

- Adults are autonomic and want independence in their learning
- Adults use their past experience
- Adult are goal oriented
- Adults tend to be problem based learner

Simulation enables clear objectives pitched at the level of the participants who could use their day to day experiences to maximise their learning [13]. Mayer describes in the 'cognitive theory of multimedia learning' that people receive and process new information via two separate but independent pathways: verbal and visual. These are additive such that both images and words provided together as in virtual simulation are better learned than information provided through either pathway alone. Virtual simulations training and serious gaming provide both input and are often exceptional ways of learning [15].

Conclusion

The importance and benefits of simulation has been demonstrated in the military and aviation. Air safety has improved greatly because of the skills of pilots in dealing with crises and the ability of the team to work together is regularly reinforced through simulator based-training and assessment. Giant strides in teaching and assessment of surgical skills over the past decades have been made. A century ago, a single trainer would sign off the trainee after the period of apprenticeship. Then came the era when more objective measures with proven validity and reliability such as Objective Structured Clinical Examination (OSCE) were introduced to assess surgical competence. The adoption of formative approach to assessment with the work place based assessment such as the Objective Structured Assessments of Technical Skills (OSATS) has further introduced more objectivity surgical skills assessment. With most laparoscopic surgeries having facilities for recording the entire procedure, the stage is set for review of recorded surgeries as a basis of examination of surgical competence in the near future [16].

For operative gynaecology to fully take advantage of the advantages offered by the explosion of endoscopic surgery in recent years, simulation based training should be fully integrated and funded within training programmes for clinician at all stages. Simulation based training needs to be valued and adequately resourced by healthcare organisations. A skilled faculty of expert clinical facilitators should be developed to deliver high-quality simulation training. The importance of human factors training to safe care should be widely communicated [17].

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