Welcome

Welcome to the fifth Simulation Publications Update bulletin, a service brought to you by CSMEN in partnership with NES Knowledge Services.

The focus for this July Simulation Bulletin is on surgery and technology. These may be of interest or relevance to your current role in NHS Scotland. The articles may also be of use in your research. These articles are from those journals we currently subscribe to. If there are any articles or journals that you would like us to add/consider please let us know.

Until now we have tried to provide approximately 30 links to articles on all aspects of simulation. However there does appear to be an increase in publications related to process and outcomes of simulation in different specialty areas such as surgery.

If you would like to suggest a focus topic or become a reviewer please also let me know. Jean.ker@nes.scot.nhs.uk

The plan is to run this service for a series of six bulletins and to monitor its use and effectiveness so feedback would be much appreciated.

This bulletin has been developed by Jean Ker, Clinical Lead CSMEN, in partnership with Alan Gillies from NES Knowledge Services.

Access to journals

Different journals have different processes for login so please follow the instructions for accessing the full text of the articles through the links provided.

On your behalf, NES Knowledge Services subscribes to some journals direct and others via aggregators (i.e. journal collections or full text databases). We use something called a ‘link resolver’ to link you via the best route, using your NHS Scotland OpenAthens password.

Some journals can detect that you’re logging in from NHS premises, so won’t ask for the OpenAthens password, but if you’re accessing from home you may have to login.

None of the links should require you to set up a separate login – where there are login boxes for personal accounts, look for an OpenAthens or ‘institutional login’ option as well, which will accept your OpenAthens password.
Focus: The Topol Review


Although the independent Topol Review was commissioned by Health Education England (2019) it has important messages about the impact of healthcare technologies on the challenges facing the workforce over the next 20 years. The review defines healthcare technologies as genomics, digital medicine, artificial intelligence and robotics. Having taken expert opinion Topol has identified that within 20 years 90% of all jobs in the NHS will require some digital skills including genomics literacy.

This skills gap could be addressed by evidence-based simulation education. (See page 16 -17). He also states that there is a need for ethical frameworks and governance to be in place to enhance the efficiency of service delivery without dehumanising care.

Topol also identifies new roles for the future digital NHS such as data scientists and robotic engineers and the need to embrace a learning culture that enables the workforce to incorporate technological solutions into their work practises. His recommendations relate to three broad areas the citizen and patient, the workforce and the health system. Definitely worth a read.

Professor Jean Ker

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Recent articles on simulation in training for healthcare professionals in relation to Surgery, Technology and Virtual Reality

With the growth of telehealth, simulation personnel will be called upon to support training that integrates these new technologies and processes. This study sought to integrate remote telehealth electronic intensive care unit (eICU) personnel into in situ simulations with rural emergency department (ED) care teams. Scenario development included experts in sepsis, telehealth, and emergency medicine. The authors describe the operational systems challenges, alternatives considered, and solutions used. Participants completed surveys on self-confidence pre-simulation/post-simulation in using telehealth and in managing patients with sepsis. The post-simulation mean ratings of confidence in using telehealth and in managing patients with sepsis increased.

High-tech simulators are gaining popularity in surgical training programs because of their potential for improving clinical outcomes. However, most simulators are static in nature and only represent a single anatomical patient configuration. The Dynamic Haptic Robotic Training (DHRT) system was developed to simulate these diverse patient anatomies during Central Venous Catheterization (CVC) training. This article explores the use of the DHRT system to evaluate objective metrics for CVC insertion by comparing the performance of experts and novices.

Fewer open surgical procedures are performed, and thus a need to learn open surgical techniques outside the operating room has emerged. Simulation training offers the possibility to train in a safe environment before operating on patients. The purpose of this study was to evaluate the effect of a simulation-based course in basic open surgical skills and to describe its pedagogical foundation, content and organisation. The study found that the course significantly increased the participants' surgical abilities and meets requirements for a well-structured simulation course.

The feasibility of integrating remote presence technology within a simulation scenario for psychiatric-mental health nursing (PMHN) students to develop telehealth competencies was evaluated. A wireless, audio-visual robot from Double Robotics, manoeuvrable by smartphone or tablet computer, was used to simulate the facilitation of students' patient assessment and treatment decisions from a distant location for 32 weeks (total hours of robotic simulation = 32). Overall, students participating in the telehealth-enabled simulations reported moderate to strong value for the use of telemedicine within the simulation. These results illustrate the feasibility of using a remote presence robot in an educational simulation environment.
**Virtual reality objects improve learning efficiency and retention of diagnostic ability in fetal ultrasound.** Ebert, J. & Tutschek, B., Ultrasound in Obstetrics & Gynecology, 525-528. 2019. Virtual reality (VR) objects of foetal ultrasound volumes have been proposed for teaching and learning diagnostic ultrasound. The aim of this study was to determine if VR objects improve learning efficiency and retention of diagnostic ability in fetal ultrasound. Participants taught using VR objects answered significantly more questions correctly and solved the tests quicker than those taught using conventional methods only, both 1 and 4 months after teaching.

**Outlier experienced surgeon's performances impact on benchmark for technical surgical skills training.** Gallagher, A.G., et al, ANZ Journal of Surgery, E412-E417. 2018. A proficiency-based progression outcome approach to training relies on a quantitative estimation of experienced operator performance. We aimed to develop a method for dealing with atypical expert performances in the quantitative definition of surgical proficiency. In study one, 100 experienced laparoscopic surgeons' performances on virtual reality and box-trainer simulators were assessed for two similar laparoscopic tasks. In study two, 15 experienced surgeons and 16 trainee colorectal surgeons performed one simulated hand-assisted laparoscopic colorectal procedure. Performance scores of experienced surgeons in both studies were standardized (Z-scores) using the mean and standard deviations. Objectively assessed atypical expert performances were few. Z-score standardization identified them and produced a more robust quantitative definition of proficiency.

**Examining validity evidence for a simulation-based assessment tool for basic robotic surgical skills.** Havemann M.C., et al, Journal of Robotic Surgery, Vol 13, 1, 99-106. 2019. Increasing focus on patient safety makes it important to ensure surgical competency among surgeons before operating on patients. This study describes validity evidence for a virtual-reality simulator for basic robotic surgical skills, which can be used for assessment of basic competency and as a training tool. However, more validity evidence is needed before it can be used for certification or high-stakes assessment.

**Eye gaze of endoscopists during simulated colonoscopy.** He W., et al, Journal of Robotic Surgery, 2019. Regaining orientation during an endoscopic procedure is critical. We investigated how endoscopists maintain orientation based on video and eye gaze analysis. Novices and experts performed a simulated colonoscopy procedure. When disorientation happened, novices brought the view to the edge more frequently than the centre. However, experts were able to bring it back to the centre directly. Eye tracking showed that the rate of saccades in experts increased when the bowel lumen moved away from the central view, such a behaviour was not observed in novices. Maintaining a cantered view of the bowel lumen is a strategy used by expert endoscopists. Video and eye tracking analysis revealed a key difference in eye gaze behaviour when regaining orientation between novice and experienced endoscopists.

**A systematic review of the educational effectiveness of simulation used in open surgery.** Heskin L., et al, Simulation in Healthcare, Vol 14, 1, 51-58. 2019. This systematic review synthesizes the evidence with respect to the educational effectiveness of simulators used in open surgical training. Six randomized controlled trials were included from the 9934 studies found. The methodological quality of the included studies was variable. Overall, the use of the simulators was more educationally effective compared with standard teaching of the skill without a simulator (P < 0.05). Two studies showed that the simulator was
as good as an animal model of much higher fidelity. Further studies are needed to secure higher evidence for the educational value, validity, and transferability of the skills to the hospital setting for all simulators.

The influence of visual-spatial discordance during training on laparoscopic skills is poorly understood. It has been proposed that training in visual-spatial discordant situations can improve performance in the forward alignment. This study's aim was to explore the impact of simulated training in visual-spatial discordant situations on forward alignment performance. Its findings suggest that training in visual-spatial discordant conditions does not lead to the development of forward alignment laparoscopic skills. This could have important implications when developing future laparoscopic skills training curriculums. To the authors’ knowledge, this is the largest study to date assessing the impacts of training in visual-spatial discordance situations on performance in the forward alignment.

Video-based teaching is considered highly effective in debriefing, especially in minimally invasive surgeries. In this study, the benefits of using a new integrated video recording system, were investigated and compared to those of the standard basic skills robotic training procedure. Participants were randomized into 2 groups: a natural self-training group without a trainer, and a self-training group assisted by an integrated video recording system during training. After each session, the practice video recorded for group B was transferred to the residents’ smartphones for self-debriefing. The study concludes that the use of an integrated video recording system makes the self-manipulated protocol with own smartphone feasible to improve training efficiency and overcome the skill decay during robotic surgical training.

**A newly designed 3D printer-based gastric hemostasis simulator with two modules for endoscopic trainees (with video).** Lee D.S., et al, Gut and Liver. 2019.
The authors used three-dimensional (3D) printing technology to create a new hemostasis simulator for the stomach and investigated its efficacy and realism in endoscopic hemostasis training. Twenty-one endoscopists, including 11 first-year fellows (beginner group) and 10 faculty members (expert group), tested the performance of the simulator. The study concluded that the 3D-printed hemostasis simulator is capable of hemostasis training and can very effectively train beginners before they perform the procedure in patients with gastrointestinal bleeding.

While it is often claimed that virtual reality (VR) training system can offer self-directed and mentor-free skill learning using the system’s performance metrics (PM), no studies have yet provided evidence-based confirmation. This experimental study investigated the extent to which trainees achieved their self-learning with a current VR simulator and whether additional mentoring improved skill learning, skill transfer and cognitive workloads in robotic surgery simulation training. The study concluded that the current VR simulator offered limited self-skill
learning and additional mentoring still played an important role in improving the robotic surgery simulation training.


Surgical simulation is an important aspect of competency-based training. Recent trends in paediatric surgical simulations have migrated towards high-fidelity simulation with advanced technology resulting in models which are expensive and largely inaccessible in low- and middle-income countries. This article describes four wet simulation models of common surgical procedures in paediatric population created with animal tissue from local abattoir. The models created in the wet laboratory are neonatal bowel anastomosis, duodenoduodenostomy for discrepancy anastomosis, gastrostomy and pyeloplasty. These models provide locally accessible material for sustainable training programmes which are fundamental in developing safe and affordable surgical care worldwide.


The advanced laparoscopic skills (ALS) curriculum was created to address the need for improved laparoscopic training for senior surgical trainees. It focuses on the domain of laparoscopic suturing and consists of 6 tasks with established proficiency benchmarks. Tasks are performed using a standard laparoscopic box trainer. This study examined whether practicing on the ALS curriculum could translate to improved clinical suturing. Dedicated practice on the six ALS tasks led to decreased suturing time and fewer errors when completing both Gj and Nissen suturing in a porcine model. Further studies will be undertaken to determine the optimal application of the ALS task set in advanced laparoscopic training.


A longitudinal curriculum was developed in conjunction with anaesthesiologists, otolaryngologists, emergency physicians and experts in medical simulation and education. Residents participated in four different simulation-based training modules using animal models, cadavers, task trainers, and crisis scenarios using high fidelity manikins. Scenarios were based on various clinical settings (emergency room, operating room) and were followed by video-assisted structured debriefings. Residents reported simulation training significantly improved technical skills such as tracheostomy, cricothyroidotomy and paediatric intubation. Non-technical skills were significantly improved. 90% of participants found the modules of the curriculum to be useful and would recommend them to others.


The purpose of this study was to evaluate the effectiveness of a simulation-based communication-training program developed for general surgery and obstetrics and gynaecology residents. Following a group lecture on diagnostic laparoscopy, 34 residents independently completed a laparoscopy case on a patient simulator followed by a structured debrief that targeted team-based communication skills. Integrated into the case were 2 events (bradycardia and OR fire) that provided additional opportunities for the resident to communicate with his/her team. Overall, residents had a positive reaction to the training program and participation in the
program improved their ability to use effective communication techniques during the bradycardia and OR fire events.

**Video analysis in basic skills training: A way to expand the value and use of BlackBox training?**


Basic skills training in laparoscopic high-fidelity simulators (LHFS) improves laparoscopic skills. However, since LHFS are expensive, their availability is limited. The aim of this study was to assess whether automated video analysis of low-cost BlackBox laparoscopic training could provide an alternative to LHFS in basic skills training.


Supermicrosurgery (SM) involves operating on vessels with calibres from 0.3-0.8 mm. SM requires skills beyond those of conventional microsurgery. Current microsurgery courses do not prepare a junior surgeon for such a challenge. This systematic literature review summarizes the existing SM simulation models, and their likely impact on microsurgery training for small-calibre vessel-based procedures is assessed. Thirty-six articles were included in the reviewing process, and 15 SM simulation training models were identified. The simulation models were classified as nonbiological or biological and as ex vivo or in vivo. None of these models demonstrated validity. However, critical analysis of the full-text articles established the clinical correlation of each model along with the specific skill demonstrated. A novel ladder-based curriculum was established.


Participants were trainees from departments of surgery, gynaecology and urology who were recruited while taking part in a laparoscopic training course. The intervention consisted of added access to a mobile box trainer allowing participants to train at home. Trainees who had access to training at home did not pass a test earlier or achieve a higher score at the end of a course than trainees who had no such access. Improved access to training at home allowed for shorter and more frequent sessions; however, testing and mandatory training requirements apparently determine training patterns. Trainees were able to reliably rate their own performance.


The study aimed to determine whether computerized feedback in simulated colonoscopy would improve performance, optimize time spent practicing, and optimize the pattern of training. The findings revealed that an automatic, computerized score of progression during simulated colonoscopy motivates the novices to improve performance, optimizes time spent practicing, and optimizes their pattern of training.

**The development and application of virtual reality animation simulation technology: Taking gastroscopy simulation system as an example.** Wang, Q., et al, Pathology Oncology Research, 2019.

Taking gastroscopy simulation system as an example, this paper discusses the development and
application of VR animation technology, its performance and current research status in surgery, scientific research, training and education.

**Stereoscopic versus monoscopic displays: Learning fine manual dexterity skills using a microsurgical task simulator.** Wehr F. & Held, J., Applied Ergonomics, Vol 77, 40-49. 2019. This study investigated the learning of fine manual dexterity with a microsurgical instrument and a new simulator in a context of microsurgery. 30 subjects were divided into two groups. One (3D group) interacted with a stereoscopic and the other (2D group) with a monoscopic display. It found that the initial learning process for hand-eye coordination is easier with a 3D display, and that performance persists at a higher level of proficiency than with the 2D display option. Thus stereoscopic displays can be especially beneficial for novices, for those learning new procedures, or for providing orientation to operators facing a new or altered spatial situation.

**A surgical team simulation to improve teamwork and communication across two continents:** ViSIOT proof-of-concept study. Weldon, S.M., et al, Journal of Surgical Education, 2019. Team communication in operating rooms is problematic worldwide, and can negatively impact patient safety. Video-based social science methods have contributed to the study of communication in UK ORs through actual observations of surgical teams in practice. Drawing on this, the authors have developed a surgical team simulation-training model [Video-Supported Simulation of Interactions in the Operating Theatre (ViSIOT)]. A proof-of-concept study was conducted in the UK and USA to assess if the ViSIOT simulation-training has applicability and acceptability beyond the UK. ViSIOT training was conducted at two simulation centres in the UK and USA over a 10-month period. There was strong agreement from all participants in terms of their perception of the course across all sub-sections measured.

**Introducing off-the-job training to cardiovascular surgical residency training: A new era of developing competent cardiovascular surgeons,** Yokoyama, H., Surgery Today, 300-310. 2019. This review summarizes the recent progress made in understanding the skill acquisition process of achieving expert status in various fields that require fine motor skills. We discuss the attempts to apply this progress to develop competent surgeons. The common element of practice to develop top-ranking experts in various fields is deliberate practice. Long-term repetitive practice is supported by the individual’s mental attitude: guts, resilience, initiative, tenancy (GRIT). GRIT can be imparted using a teaching method that supports a “growth mindset”.