Establishing valid procedural competency in virtual reality robotic simulation

Authors
Lisette Hvid Hovgaard, Copenhagen Academy for Medical Education and Simulation (CAMES), Copenhagen, Denmark
Steven Arild Wufts Andersen, Copenhagen Academy for Medical Education and Simulation (CAMES), Copenhagen, Denmark
Lars Konge, Copenhagen Academy for Medical Education and Simulation (CAMES), Copenhagen, Denmark
Torur Dalsgaard, Department of Gynaecology at Copenhagen University Hospital, Rigshospitalet-Glostrup, Copenhagen, Denmark
Christian Rifbjerg Larsen, Department of Gynaecology at Copenhagen University Hospital, Herlev-Gentofte, Copenhagen, Denmark

Background: The use of robotic surgery for minimally invasive procedures has increased considerably over the last decade. Robotic surgery has potential advantages compared to laparoscopic surgery but also requires new skills. Virtual reality (VR) simulation can be used to facilitate acquisition of these skills through proficiency-based training—and this is dependent on solid validity evidence. This study aims to systematically collect validity evidence according to Messick’s framework of validity for a simulation-based test for procedural competency in VR robotic simulation and establish a credible pass/fail standard for future mastery learning.

Method: Eleven novice gynaecological surgeons without prior robotic experience and 11 experienced gynaecological robotic surgeons were recruited. After familiarization with the VR simulator, participants completed six repetitions of the module ‘Guided Vaginal Cuff Closure’. Validity evidence was investigated for 18 preselected simulator metrics (e.g. time, path length and errors). Internal consistency was assessed using Cronbach’s alpha and a composite score from 0 to 100 was calculated based on the metrics with significant discriminative ability between the two groups. Finally, a pass/fail standard was established using the contrasting groups’ method.

Results: The experienced surgeons significantly outperformed the novice surgeons on 6/18 metrics. Internal consistency (Cronbach’s alpha) was 0.58. The experienced surgeons’ mean composite score for all six repetitions were significantly better than the novice surgeons’ (76.1 vs. 63.0, respectively, p<0.001). A pass/fail standard of 75/100 was established. Four novice surgeons passed this standard (false positives) and three experienced surgeons failed (false negatives).

Discussion & Conclusion: Only a minority of the built-in metrics could discriminate between novices and experienced surgeons, emphasising the need to collect validity evidence when setting standards in simulation-based skills training. The established pass/fail standard resulted in failing 3/11 experienced surgeons. However, it is important to use a representative sample of proficient robotic surgeons, otherwise the established standard could be either unachievable or too low. In conclusion, we have systematically gathered validity evidence for a simulation-based test for procedural robotic surgical competency and established a credible pass/fail standard for future proficiency-based training.

Take-home message: Validity evidence is important for standard setting in simulation-based skills training.

Validation and Transferability of the SIMULATE Ureterorenoscopy Training Curriculum: A Multicenter International Study

Authors
Abdullatif Aydin, MRC Centre for Transplantation, Guy’s Hospital, King’s College London, London, UK
Camran Ahmed, MRC Centre for Transplantation, Guy’s Hospital, King’s College London, London, UK
Nicholas Raison, MRC Centre for Transplantation, Guy’s Hospital, King’s College London, London, UK
Takashi Abe, Department of Urology, Hokkaido University Hospital, Sapporo, Japan
Muhammad Shamim Khan, MRC Centre for Transplantation, Guy’s Hospital, King’s College London, London, UK
Prokar Dasgupta, MRC Centre for Transplantation, Guy’s Hospital, King’s College London, London, UK

Background: There have been considerable developments and subsequent use of simulation models in urology. However, utilising different modalities within a curriculum is suggested to be much more effective. The international SIMULATE curriculum for ureterorenoscopy (URS) employs the most evidence-based validated training models, in a structured fashion. The aim of this study is to assess the validity and transferability of the SIMULATE URS training curriculum.

Method: Junior urology trainees with less than 10 URS experience (n=46) were invited for training using the curriculum on five separate occasions in Manchester (n=15), Salzburg (n=15), Hokkaido (n=5), Guangzhou (n=9) and London (n=4). Participants performed cases on the URO Mentor VR simulator (Simbionix) and also the UroScopic Trainer (Limbs & Things) and Advanced Scope Trainer (Mediskills) bench models. The first cohort were also given the opportunity to use fresh frozen cadavers with fluoroscopy. Performances were evaluated throughout the sessions using OSATS, by endourology and education specialists, all of whom were also invited for an evaluation survey following training. Construct validity was
assessed using a One-way ANOVA test to evaluate the level of progress throughout the curriculum. Trainees were followed up at their institutions and assessed for technical skills, using OSATS to evaluate transfer validity. Participants rated that the training significantly improved their skills (mean: 4.2/5) and that they gained transferrable skills (mean: 4.2/5). A One-way ANOVA test revealed significant improvement in both semi-rigid (p=0.0005) and flexible URS (p=0.0266) skills, with consecutive cases throughout the curriculum and the first OR performance (n=13). Furthermore, there was no difference in OR performance between the cadaveric (n=9) and non-cadaveric groups (n=12; p=0.6872). Of the used modalities, dry-lab models scored the highest with regards to instrument handling, laser stone fragmentation and stone extraction whilst C-arm control was the most highly rated aspect of fresh frozen cadavers (mean: 4.7/5).

The SIMULATE URS curriculum revealed face, content, construct and transfer validity. Participants are currently being followed up in the operating room for 25 URS procedures and will compared to an arm with no simulation experience, as part of the ongoing SIMULATE randomised controlled trial.

8G3 (243)
Diving In Hands First – A New Approach to Training in Undergraduate Medical Education

Authors
Rajiv Shah
Alexandra Davidson
Michael Arnason
Anita Shah
Nicolette Caccia
Eliane M. Shore

Presenter:
Rajiv Shah, University of Toronto, Canada

Background: Clerkship students do not currently benefit from formalized hands-on training during their OB/GYN rotation at University of Toronto; however, they participate in multiple procedures. It has been suggested that incorporating technical skills practice into teaching sessions is not only superior to traditional lectures for delivering the material, but can also improve patient care and safety at the bedside. As a result, we aimed to introduce a perineal repair (PR) workshop with instruction on instrument and hand knot-tying into our curriculum. We piloted a PR workshop for clinical clerks in order to demonstrate perineal anatomy, laceration repair as well as suturing and knot-tying. Prior to the workshop, students’ (n=82) baseline knowledge was assessed with a pre-test and their knot-tying speeds were recorded. Students were then given a tutorial on perineal anatomy and laceration repair as well as knot-tying. Following a small group demonstration, students practiced their skills on an inexpensive perineal model (that we created) and were provided with individualized instruction and feedback. Knowledge and knot-tying speeds were then reassessed. There were statistically significant improvements in both knowledge of perineal anatomy, lacerations and repair techniques (51.0%, 71.0%, p<0.05) as well as technical skills with respect to knot-tying speeds (259s, 197s, p<0.05) after the workshop. Importantly, 94% of students agreed or strongly agreed that this method of learning was more enjoyable than and superior to traditional methods of teaching.

Results & Discussion: Increased need for practical skills and hands-on training has led to a movement towards incorporating simulation into undergraduate medical education. Patients have also been shown to be significantly more accepting of medical students performing procedures on them if the students have had previous practice with simulation. Our results support that hands-on practice in a simulated environment may bridge the gap between formalized teaching and clinical practice.

Conclusion: This highly reproducible and inexpensive teaching model ensures that the workshop is feasible for other health professionals (ie. Midwifery, family practice). It can be easily duplicated and incorporated into teaching curricula locally and internationally for the purposes of education and ultimately improved patient safety.

8G4 (404)
Breaking professional barriers - simulation based teamwork training for professional OR teams

Authors
Cecilia Escher, Center for Advanced Medical Simulation and Training, Karolinska University Hospital, Stockholm, Sweden
Hans Rystedt, Dept. of Education, Communication and Learning, University of Gothenburg, Gothenburg, Sweden
Johan Creutzfeldt, Center for Advanced Medical Simulation and Training, Karolinska University Hospital, Stockholm, Sweden
Lisbet Meurling, Center for Advanced Medical Simulation and Training, Karolinska University Hospital, Stockholm, Sweden
Anne-Kaj Kjellin, Center for Advanced Medical Simulation and Training, Karolinska University Hospital, Stockholm, Sweden
Li Fellander-Tsai, Center for Advanced Medical Simulation and Training, Karolinska University Hospital, Stockholm, Sweden

Presenter:
Cecilia Escher, Center for Advanced Medical Simulation and Training, Karolinska University Hospital, Stockholm, Sweden

Background: Increasing task complexity demanding more specialized staff and advanced equipment is a challenge to teamwork in multi professional operating room (OR) teams. Studies have pointed at non-proficient non-technical skills as a cause of adverse events and simulation based teamwork training as a possibility for improvement. The aim of this study was to find out how OR staff perceived a simulation based teamwork-training course and explore possibilities for transfer of learning from the training to the OR.

Method: In a prospective qualitative intervention study 32 experienced OR staff including 5 professions (surgeons, anaesthetists, OR nurses, nurse anaesthetists and nurse assistants) took part in a full day simulation based teamwork-training course with non-technical skills training goals. Data was collected during 5 focus group interviews
that were recorded. Transcripts were analyzed with thematic analysis.

**Results:** The screen between the sterile field and anesthesia was related to as physical barrier and a metaphor for a divided OR team. Non-technical skills taught during the training were mentioned as a possibility to reduce this barrier.

“It seems like a time-out is a very good method to reduce the barrier between anesthesia and surgery” (nurse anesthetist).

Participants appreciated training in their own professional roles in a full authentic team. They expressed that team skills learned during the course would be possible to transfer to their workplace. Barriers to transfer of learning included organizational factors at the OR department and the fact that not all staff participated.

**Discussion:** The results indicate that OR staff perceive OR teams as divided into sub-teams which is in line both with Makary’s findings of diverse views on quality of collaboration by the OR professions and an ongoing discussion about the adverse effects of the prevailing professional silos in healthcare organizations and training.

**Conclusion:** A divided team can imply inferior conditions for good teamwork and a risk to patient safety. Experienced OR staff describe the screen between the sterile field and anesthesia as a communication barrier indicating a possible risk to patient safety. Simulation based teamwork training offers a possibility to reduce the barrier.

8G6 (546)
**Sustainable Open inguinal hernia repair simulation model: from residency training to global surgery – a 10 year learning curve**

**Authors**
Parvathi Balachandran, Mayo Clinic, Rochester, USA
Mohammad Zeb, Mayo Clinic, Rochester, USA
Nicholas J. Prabhakar, Mayo Clinic, Rochester, USA
David R. Farley, Mayo Clinic, Rochester, USA

**Presenter:**
Parvathi Balachandran, Mayo Clinic, Rochester, USA

**Background:** The cost of simulation models available for practicing open inguinal hernia repair (IHR) is ~$500. The technical and economic sustainability of IHR models is very low in training surgery residents. We built a cost and resource-efficient open IHR model and introduced it into our education curriculum.

**Method:** We used low-cost fabric, yarn, and tubing to build anatomically accurate, reusable open IHR models. An instructor-led session of open IHR using the models with 30 surgical interns was conducted early on in each academic year. Thereafter, the models were available to trainees for practice. We biannually assessed the residents’ knowledge of groin anatomy and surgical skills to accurately complete an open IHR. With proven benefits from this pilot project, we used the model to help train surgeons in Ghana, Africa.

**Discussion:** The materials cost less than $3 per model and took 20 minutes to create. On serial assessments, residents showed significant improvement in groin anatomy knowledge (mean change 18%, p<0.01) and open IHR skills (42%, p=0.04). We used this model in 2017 in a comprehensive workshop to effectively assist 35 surgeons in Ghana learning the Lichtenstein IHR.

**Conclusion:** Inguinal hernia is a global health problem; it is crucial for all surgery trainees to be proficient in repairing inguinal herniae. A sustainable, reusable, low-cost model is essential for hands-on training and practice. We propose our model of IHR for surgical education programs, especially those with low resource availability.

**Take-home messages:** Simulation groin models allow trainees to improve their knowledge and skills in open IHR. Low-cost simulation models can assist worldwide surgical training for IHR.

8G6 (923)
**Teaching in the robotic environment: Use of alternative approaches to guide operative instruction**

**Authors**
Courtney A. Green
Simon Chu
Emily Huang
Hueylan Chern
Patricia O’Sullivan

**Presenter:**
Courtney Green, University of California San Francisco, USA

**Background:** The rapid growth of robotic-assisted surgery has prompted surgical residency programs to develop appropriate curricula. However, the unique learning environment in robotic operating rooms challenges educators to determine the most appropriate ways to instruct surgical residents. As a needs assessment for faculty development, we observed attending surgeons’ instructional language and behaviors as they guided residents through robotic dissection of live tissue.

**Method:** In June 2017, six senior surgical residents participated in a four-hour operative session using live porcine tissue and the da Vinci Surgical System (Intuitive Surgical, Sunnyvale CA). Academic robotic surgeons provided instruction and were restricted to teaching without manipulating the operative console. Three observers documented the language, gestures and behaviors occurring at three different stations, and at a fourth station, obtained video and audio recordings of the instructional interaction. Afterwards, instructors and residents met in separate focus groups. We used qualitative content analysis to summarize the type and frequency of teaching behaviors. Focus group information helped to clarify this analysis. We compared these results to an existing taxonomy of 16 operative teaching behaviors in open and laparoscopic surgery.

**Results:** The instructors came from four different specialties with up to eight years of experience. They used 11 of the 16 open and laparoscopic teaching behaviors. These 11 behaviors did not vary by surgical specialty or experience, but frequency of use differed due to both relevance and need to expand use of behaviors than observed in laparoscopic and open surgical instruction. Additionally, robotic-specific behaviors were identified
that involved disengaging the resident from the operative console for either onscreen direction or for gesturing with verbal instruction. These unique disengaging behaviors were highlighted by the focus groups as essential for guiding operative performance with the robot.

**Conclusion:** Robotic instruction uses a different set of instructional approaches compared to open and laparoscopic surgery, relying extensively on verbalization to address a learner at a console. In this study, additional behaviors emerged impelled by the physical separation of the robotic environment. Future faculty development in this area will need to emphasize specific verbal and physical instruction.