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Abstracts

01

The Queen Bee phenomenon in Canadian surgical subspecialties: an evaluation of gender biases in the resident training environment. *Lydia Goff, Helena Greene, Alexandra Munn, Andrew Furey, Nicholas Smith.* **From Memorial University.**

Background: The Queen Bee phenomenon describes the behavioural response that occurs when women achieve success in a male-dominated environment, and in this position of authority, treat their female subordinates more critically. This behavioural response has been demonstrated in fields such as business, academia, the military, and police force. The goal of this study was to determine whether the Queen Bee phenomenon occurs similarly in surgical specialties within medicine. We hypothesized that female surgeons, fellows, and senior surgical residents would be more critical in their assessment of junior female residents than of their male counterparts. **Methods:** A scenario-based survey was distributed to all Canadian surgical programs, guised as a survey-based study of patterns of interaction among surgical trainees and staff surgeons. Scenario questions were designed to assess either female or male learners. Respondents' average Likert score for female-based and male-based questions were calculated. The differences in scores were analyzed. Subgroup analyses were performed based on age, seniority, and surgical specialty. **Results:** We collected 716 survey responses, with 387 respondents identifying as male (54%) and 321 identifying as female (45%); the remaining 8 respondents did not report gender. This included 385 staff surgeons (54%), 66 fellows (9%), and 263 residents (37%); the remaining 2 respondents did not identify their group. The mean Likert scores for female respondents assessing female learners was significantly lower than when male learners were assessed ($p = 0.008$). During subgroup analysis, resident females scored female learners significantly less favourably than the staff and fellow groups ($p = 0.036$). Some subspecialties demonstrated significant scoring differences. Female orthopedic surgeons scored female learners more harshly than male learners ($p = 0.049$). **Conclusion:** The Queen Bee phenomenon was shown to be present among surgical specialties. Females assessed female learners more critically than their male counterparts. These findings highlight the importance of tackling organizational biases to create more equitable educational and work environments in surgery.

02

Barriers to surgical peer coaching — What have we learned, and where do we go from here? *Sofia Valanci Aroesty, Rhonda St. Croix, Susan Moffatt-Bruce, Guylaine Lefebvre.* **From The Royal College of Physicians and Surgeons of Canada (Valanci Aroesty, St. Croix, Moffatt-Bruce, Lefebvre); and University of Ottawa (Moffatt-Bruce)**

Background: Over the last 50 years, we have seen continuing professional development (CPD) evolve from purely didactic meetings to personalized workplace modalities. Peer coaching (PC) has gained attention and has been positively received in the surgical world as a modality that can advance workplace CPD and improve outcomes. This project aimed to address the barriers that limit safe and effective PC as a workplace CPD modality and develop a program that strives for excellence in coaching. **Methods:** Based on our previous studies and literature reviews, we identified perceived and true barriers keeping surgeons from engaging in PC. Qualitative and quantitative data from 2 studies evaluating the effect of coaching skills training and workplace practice were collected. Data were coded and classified into themes. Possible solutions to each barrier were grounded in adult learning theories. **Results:** Barriers were classified into logistical constraints, relationship dynamics, surgical culture, and perceived lack of need. We approached these barriers by designing a microlearning program on coaching skills with practice and habit change ensuring bilaterality, personalization and autonomy; motivating participants; creating a streamlined approach to credit claiming; and building awareness by championing early adopters and pilot programs. Final perception outcomes are not available, as the study is still ongoing. **Conclusion:** We highlight some considerations for developing a program that breaks down the barriers to surgical PC. Future programs should consider autonomy, intrinsic motivation, and a collaborative mindset approach to encourage surgeons to use coaching skills for growth and transformation in the learning continuum.

03

Shared decision-making and evidence-based medicine: Pivotal or trivial to patient care in orthopedic trauma? *Jenny W. Jing, Edward J. Harvey, Rudolph Reindl, Hamid Al Badi, Gregory K. Berry, Paul A. Martineau.* **From McGill University Faculty of Medicine and McGill University Health Centre.**

Background: Numerous aspects of quality of care in orthopedic trauma surgery are not adequately addressed by evidence-based medicine and shared-decision-making models. Importantly, it is unclear how much level-1 evidence exists and how its implications have influenced clinical practice. Thus, this exploratory study aimed to quantify the volume of clinical practice guidelines (CPGs) and level-1 evidence published in the last 10 years, based on preoperative diagnoses made in 1 day in an orthopedic trauma clinic. **Methods:** Unique preoperative diagnoses were collected during an 8-hour trauma clinic at a level-1 trauma centre. Using eponyms and descriptors of each diagnosis, advanced text-word searches were conducted in PubMed. Relevant American Academy of Orthopaedic Surgeons (AAOS) guidelines were identified through manual review. The number of pages of literature found per diagnosis was recorded. **Results:** Among 31 unique diagnoses made during 62 patient visits, a total of 29 667 pages of level-1 evidence and CPGs have been generated in the past 10 years. Among 22 published AAOS guidelines, 17.9% have been generated using level-1 evidence, while 41.7% have been generated using consensus and limited evidence. **Conclusion:** It is unclear how 29 667 pages of evidence has been incorporated into orthopedic practices. Numerous factors that affect the statistical power, and thus quality, of clinical studies do not apply to surgical interventions in orthopedic trauma. Often, surgeon experience and availability of hospital resources determine which surgical interventions are possible. The hierarchy of evidence should not necessarily change clinical practice in orthopedic trauma.

04

Immersive virtual reality and cadaveric bone are equally effective in skeletal anatomy education: a randomized crossover noninferiority trial. *Dario Ferri, Robert Koucheki, Johnathan R. Lex, Alexandra Morozova, Tyler M. Hauer, Sarah Mirzaie, Peter C. Ferguson, Barbara Ballyk.* **From Temerty Faculty of Medicine, University of Toronto (Ferri, Kouchei, Ferguson, Ballyk); Institute of Biomedical Engineering, University of Toronto (Koucheki, Lex, Hauer); Division of Orthopaedic Surgery, University of Toronto (Lex, Ferguson); Division of Anatomy, University of Toronto (Morozova, Ballyk); David Geffen School of Medicine, University of California Los Angeles (Mirzaie); and Department of Orthopaedic Surgery, Mount Sinai Hospital (Ferguson).**

Background: In this study, we aimed to compare the effectiveness of immersive virtual reality (IVR) with direct cadaveric bone models for teaching upper- and lower-limb skeletal anatomy. **Methods:** A randomized, double-blind crossover noninferiority trial was conducted. Participants were incoming first-year medical students who were recruited to utilize IVR technology and cadaveric bone models to study upper- and lower-limb anatomy. The primary end point of the study was change in performance from the pre- to postintervention knowledge tests. **Results:** Among all students, the average score on the preintervention knowledge test was 14.6% (standard deviation [SD] 18.2%) and 25.0% (SD 17%) for upper and lower limbs, respectively. Percentage increase in scores between the pre- and postintervention knowledge tests was 15.0% in the upper limb IVR group, and 16.7% for upper limb cadaveric bones ($p = 0.286$). For the lower limb, the score increase was 22.6% in the IVR and 22.5% in the cadaveric bone group ($p = 0.936$). Qualitative data revealed that participants were favourable toward utilization of IVR technology as a supplement to teach skeletal anatomy, and highly favourable toward combination use of traditional methods and IVR technology for learning skeletal anatomy. **Conclusion:** In this noninferiority crossover randomized controlled trial, there was no significant difference in knowledge after using IVR or cadaveric bones for skeletal anatomy education. IVR created an enjoyable learning experience for participants, and a combination of IVR and cadaveric teaching in their anatomy education was preferred. These findings have further implications for medical schools that face challenges in acquiring human cadavers and cadaveric parts.

05

Development of simulators for decentralized simulation-based education IO training using design thinking and Delphi — a novel approach. *Mithusa Sivanathan, Julia Micallef, Luz Yanguez Franco, Ian R. Drennan, Dale Button, Adam Dubrowski.* **From Ontario Tech University (Sivanathan, Micallef, Yanguez Franco, Dubrowski); University of Toronto (Drennan); and Durham College (Button).**

Background: Intraosseous (IO) infusion provides a quick alternative route to vascular circulation through the bone when intravenous access is compromised. Despite its potentially life-saving benefits, it is often an underutilized procedure in the adult population, partially owing to lack of training that stems from the unavailability of cost-effective, anatomically correct simulators. The aim of this study was to identify and integrate critical improvements to the existing simple and advanced adult proximal tibia IO simulators previously designed at Ontario Tech University. **Methods:** First, a design thinking (DT) process was conducted with 3 health care professionals to brainstorm a list of improvements. Then, these ideas were moved into a 2-round Delphi methodology with 7 health care professionals to clarify and consolidate potential updates. Finally, this set of short-listed items were discussed with 3 3D-printing designers to determine feasibility of the changes. **Results:** The DT process generated 6 and 8 ideas for the simple and advanced simulators, respectively. These were carried into the Delphi methodology, through which panellists collectively agreed on 2 upgrades to only the advanced simulator: to offer the ability to laterally expose the tibia and resistance to flow. The 3D-printing designers were able to integrate the features into the design of the advanced simulator. **Conclusion:** This study provided design details required to develop and manufacture an affordable, customizable, and realistic IO simulator. The revisions are intended to support the development of an effective decentralized simulation-based education model aimed at teaching health care professionals IO skills remotely.

06

The impact of feedback on laparoscopic skills for surgical residents during COVID-19. *Chelsea Harris, Casey Thorburn, Claire Skanes, Robert Kennedy, Chris Smith.* **From Memorial University.**

Background: We sought to determine how real-time video feedback compares to delayed written feedback on junior resident performance of laparoscopic skills using at-home laparoscopic training boxes. **Methods:** Junior surgical residents from Memorial University were randomized into 3 groups: a control group (group A), a delayed feedback group (group B), and a live feedback group (group C). Data collection was 5 months in duration. Participants practised prescribed laparoscopic skills biweekly. Intervention groups (B and C) received either delayed or live feedback on weekly practice from an expert. Pre- and post-testing were completed. **Results:** Twelve residents were recruited; 1 was lost to follow-up. After the data collection period, the average number of pegs transferred correctly increased by 2.8 ± 1.7 for group A, 3.0 ± 2.6 for group B, and 2.0 ± 1.4 for group C. There was significant group variance ($F_{2,8} = 5.928$, $p = 0.026$). Post hoc testing resulted in group B outperforming groups A and C. For the intracorporeal knot tying task and number of throws completed, groups B and C both improved; no significant difference was noted between groups. Qualitative data showed an increase in confidence for all groups in completing the tasks and a preference for live compared with delayed feedback. **Conclusion:** Access to box trainers allowed residents to practise at home, leading to improved skill and confidence. Participants receiving delayed feedback showed a significant improvement in peg transfer. Further studies with larger sample sizes should be conducted on how feedback can affect resident outcomes in laparoscopic surgery skills.

07

The role of collaborative feedback and remote practice in the acquisition of suturing skills by medical students at Université de Montréal. *Florence Pelletier, Andrei Torres, Léamarie Meloche-Dumas, Natasha Guérard-Poirier, Ahmad Kaviani, Bill Kapralos, Frédéric Mercier, Adam Dubrowski, Erica Patocskai.* **From Université de Montréal (Pelletier, Meloche-Dumas, Guérard-Poirier, Kaviani, Mercier, Patocskai); and Ontario Tech University (Torres, Kapralos, Dubrowski).**

Background: Learning surgical skills remotely in a decentralized model requires an effective and economic way of providing feedback. Our objective was to test the effectiveness of various forms of feedback in the acquisition of surgical skills by medical students. **Methods:** This was a pilot randomized control trial, in which 45 volunteers were randomized among 4 experimental groups to acquire suturing skills remotely. These skills were practised on custom-developed take-home simulators under 4 feedback conditions. Acquisition was mediated through an experimental learning management system designed to provide interactive instructions and peer-to-peer/expert feedback. During a practice phase of 1 week, learners uploaded suture attempts to receive feedback: group 1 by peers and an expert using a checklist (CL); group 2 by peers using a CL; group 3 by peers using open-ended feedback (OEF); and group 4 by peers and an expert using OEF. Performance on day 1 (pretest) and day 9 (posttest) was assessed by a CL and using a Global Rating Score (GRS). **Results:** Analysis of CL and GRS revealed similar dynamics; significant improvement was seen between pre- and posttest scores for all groups. However, participants in group 2 had significantly lower GRS than the other 3 groups. **Conclusion:** The results suggest that learners can acquire surgical skills remotely and, more importantly, that peers providing feedback are just as effective as experts if they use OEF and not CL.

08

Efficacy testing of an affordable and realistic small bowel simulator for hand-sewn anastomosis. *Florence Bénard, Merieme Habti, Léamarie Meloche-Dumas, Simon Bérubé, Dominic Cadoret, Artur Arutiunian, Yasmina Papas, Andrei Torres, Bill Kapralos, Frédéric Mercier, Adam Dubrowski, Erica Patocskai.* **From Université de Montréal (Bénard, Habti, Meloche-Dumas, Bérubé, Cadoret, Papas, Mercier, Patocskai); and Ontario Tech University (Arutiunian, Torres, Kapralos, Dubrowski).**

Background: General surgery residents need to master the hand-sewn bowel anastomosis (HSBA) technique. However, practice opportunities outside of the operating room are rare, and commercial simulators are often costly. The objective of this study was to assess the efficacy of a new, affordable silicone small bowel simulator, made with a 3D-printed mould, as a training tool to learn this technique. **Methods:** This was a single-blinded pilot randomized controlled trial comparing 2 groups of 8 junior surgical residents. All participants completed a pretest using an inexpensive, custom-developed 3D-printed simulator. Next, participants randomized to the experimental group practised the HSBA skill at home (8 sessions), while those randomized to the control group did not receive any hands-on practice opportunities. A posttest was done using the same simulator used for the pretest and practice sessions, and the transfer test was performed on an anesthetized porcine model. Pre-, post- and transfer tests were filmed and graded by a blinded evaluator based on technical skills, procedural knowledge and quality of the final product. **Results:** The experimental group significantly improved after practising with the model ($p = 0.01$), while an equivalent improvement was not noted in the control group ($p = 0.07$). Moreover, the experimental group's performance remained stable between the posttest and the transfer test ($p = 0.95$). **Conclusion:** Our 3D-printed simulator is an affordable and efficacious tool to teach residents the HSBA technique. It allows development of surgical skills that are transferable to an in vivo model.

09

The LASER rating scale: a new teaching tool in otolaryngology. *Ève Sédillot-Daniel, Antoine Melkane, Carlos Chiesa, Nicolas Fakhry, Vyvy Young, Libby Smith, Jerome Lechien, Louis Guertin, Marie-Jo Olivier, Anastasios Maniakas, R. Jun Lin, Éric Bissada, Apostolos Christopoulos, Tareck Ayad, Andrée-Anne Leclerc.* **From Centre Hospitalier de l'Université de Montréal (Sédillot-Daniel, Guertin, Bissada, Christopoulos, Ayad, Leclerc); CIUSSS de l'Est-de-l'Île-de-Montréal (Sédillot-Daniel, Olivier, Ayad, Leclerc); Hotel Dieu de France (Melkane); Hospital Universitario Donostia (Chiesa); Centre Hospitalier Universitaire La Conception (Fakhry); University of California San Francisco Voice and Swallowing Center (Young); University of Pittsburgh Medical Center (Smith); University of Mons (Lechien); Centre Hospitalier Universitaire Saint Pierre (Lechien); Hopital Foch (Lechien); MD Anderson Cancer Center (Maniakas); and Unity Health Toronto, St. Michael's Hospital (Lin).**

Background: The CO_2 laser is frequently used during microlaryngeal surgery (MLS) for tumour resection and cordectomy or cure of laryngomalacia, laryngeal cleft, and laryngeal stenosis. Learning how to use it safely is part of the curriculum for every otolaryngology resident. However, owing to a limited surgical field and some safety concerns when using the CO_2 laser, assessment of laryngoscopy technical skills can be more difficult for supervisors, making it more difficult to provide feedback to learners. The Laser Acquirements in Surgical Evaluation for Residents (LASER) rating scale aims to facilitate the evaluation of residents' performance and provide constructive feedback. **Methods:** The initial evaluation grid was based on a thorough systematic review on CO_2 laser laryngoscopy (with an emphasis on technique, safety, efficacy, and indications) using Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia). The final version was produced after a 4-round Delphi process. **Results:** This project was the result of an international collaboration among 15 ear, nose and throat surgeons from either laryngology or head and neck surgery subspecialties. Panellists were based in Canada ($n = 8$), the United States ($n = 3$), Europe ($n = 3$) and Lebanon ($n = 1$). Main scale categories included global appreciation, anesthesia considerations, pre- and perioperative laser safety measures, and surgical technique. **Conclusion:** The LASER rating scale is a new teaching tool for MLS, aiming to

help surgeons give quality feedback on surgical skills and essential safety measures when using a CO_2 laser. The next step will be the validation process of the evaluation grid.

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Virtual patient case simulations: their role in undergraduate and postgraduate surgical training. *David Fleiszer, Nancy Posel, Alicia Rosenzveig.* **From McGill University (Fleiszer, Posel); and University of Ottawa (Rosenzveig).**

Background: At McGill University, accreditation and regulatory requirements for undergraduate and postgraduate surgical training mandated innovative approaches for trauma teaching. This led to the creation of 12 online virtual patients based on authentic clinical situations with extensive opportunities for learner interactivity, including individualized active decision-making aligned with diverse patient outcomes. **Methods:** Case simulations used a commercial application, established pedagogical and conceptual frameworks, and depicted clinical situations based on Advanced Trauma Life Support principles and Medical Council of Canada standardized objectives. The design was based on the use of a blended learning model, deliberate practice, and experiential learning to support the development of critical reasoning skills and clinical practice scripts and to target entrustable professional activities within competency-based medical education. **Results:** Initially available in undergraduate surgical clerkships, cases are now included in R1 postgraduate training. They provide objective and individualized data to learners and educators to help to determine current knowledge, encourage dialogue and support, and meet the unique needs of each school. Uniformly positive feedback has been received from the students. **Conclusion:** Growing use of technologies integrated within core curricula provide another option to synergize, enhance and enrich medical teaching and learning. Online provision of virtual case-based simulation provides additional teaching and assessment methodologies available to medical educators. Imagination as well as innovation can serve to augment curricula and meet the changing requirements of 21st-century learners. The potential utility of these cases continues to be explored.

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Evaluating the effectiveness of video-assisted informed consent in surgery: a systematic review. *Apoorva Bhandari, Peter Gariscsak, Laryssa Kemp, Faizal Haji.* **From Queen's University School of Medicine (Bhandari, Gariscsak, Kemp); and University of British Columbia (Haji).**

Background: Here we reviewed the impact of video-assisted informed consent (VAIC) on patient knowledge and experience, compared with traditional informed consent (IC), for surgical interventions. **Methods:** MEDLINE, Embase, CINAHL, EBM Reviews, and Google Scholar were searched for peer-reviewed studies published until May 21, 2022, that (i) were full-text randomized or nonrandomized controlled trials, and (ii) evaluated the effect of VAIC, compared with standard IC, on patient comprehension, recall and/or anxiety for surgical procedures. **Results:** Thirty-six studies were included, comprising a total of 3483 patients. Twenty-four studies (82.8%) demonstrated significant improvement in patient comprehension and 3 (75%) in recall with the implementation of the video adjunct. Patient anxiety was evaluated in 16 studies, 3 of which reported a significant improvement using VAIC. Overall satisfaction improved with the use of VAIC in 24 (96.0%) studies; however, this difference reached significance in only 9 (36.0%) studies. VAIC decreased consultation length compared with standard IC. **Conclusion:** Notwithstanding substantial heterogeneity among studies, most reported an improvement in patient knowledge, patient satisfaction, and clinical efficiency with VAIC. The paucity of data on the feasibility of developing video adjuncts and their acceptability to clinicians and patients makes it difficult to identify and subsequently address potential implementation barriers. Notably, most VAICs did not adequately address all 4 tenets of IC: procedure knowledge, risks, benefits, and alternatives; procedure knowledge and risks were the most consistently communicated. Further well-designed studies are required to develop a standardized framework for the development and validation of VAIC tools to optimize the IC process.

12

Communication patterns in the cardiac surgery operating room are affected by task difficulty: a simulation model. *Abigail White, Andrew Reid, Surita Sidhu, Michael Moon, Simon Turner, Bin Zheng.* **From University of Alberta.**

Background: Cardiac surgery is dependent on successful interaction between the surgeon, anesthesiologist and perfusionist to ensure a successful patient outcome. Despite this recognition, few multidisciplinary Non-Technical Skills for Surgeons training programs currently exist. We demonstrated a simulation model to evaluate communication patterns among operating room members. **Methods:** Four groups consisting of a surgeon, anesthesiologist and perfusionist underwent a high-fidelity porcine model cardiopulmonary bypass (CPB) simulation. Phase I was initiation of CPB and phase II was weaning from CPB (more difficult). Videos of the simulation sessions were transcribed for audio and analyzed for the following 5 communication patterns: question, response, give an order, acknowledge/rebuke, and show appreciation. We used χ^2 analysis to compare phase I to phase II, and a *p* value < 0.05 was considered statistically significant. **Results:** The main form of communication for the surgeon was to give an order during phase I and phase II. For the perfusionist it was to acknowledge, and for the anesthesiologist it was to respond. Overall, there was a statistically significant difference in number of communication events for team members during phase II compared with phase I (*p* = 0.01). During phase II there were more questions being asked (*p* = 0.02) and corresponding responses being given (*p* = 0.01). **Conclusion:** Our results demonstrate that communication patterns change as task complexity increases using a simulated model. While weaning from CPB, more questions are asked than orders given. Identifying where deficiencies in communication are in a simulated environment can help prepare trainees for the operating room. Ongoing study is being conducted on communication patterns in scenarios of crisis.

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Improving adherence to postcall departure guidelines in orthopedics: a quality-improvement initiative. *Ajay Shah, Jesse Isaac Wolfstadt, Jeremy Hall, Sarah Ward, Abdulrahman Jad, Nicholas Yee, Tayler Declan Ross, Peter Ferguson.* **From Division of Orthopaedic Surgery, Department of Surgery, University of Toronto.**

Background: Historically, surgical residents have adhered to the "hidden curriculum" of remaining in the hospital to complete clinical duties the day after being on call overnight. However, recent literature has suggested that this practice may be harmful to both patient and trainee well-being. In fact, a plethora of literature shows that physicians are more prone to make errors when sleep deprived. The goal of this study was to collect data on the time of departure from hospital postcall in a large Canadian orthopedic surgery program. **Methods:** A wellness survey was circulated to the resident body asking questions regarding their general postcall habits. This survey was constructed from a literature search identifying common negative sequelae that have been known to occur in sleep-deprived trainees. Then, a 6-week study period was carried out for data collection. This anonymous form asked residents to record their level of training, hospital site, time of departure postcall, assigned and unassigned duties postcall, and any factors that contributed to them staying or leaving postcall. Responses were collected and stored securely. Preliminary analysis included aggregation of results and analyses of variance to identify factors (e.g., rotating at a trauma hospital, year of training, weekday v. weekend call) that made residents more likely to stay at the hospital postcall). After identification of key factors associated with delayed postcall departure, the quality-improvement (QI) intervention was implemented. Another 6-week study period was conducted to collect data on postintervention departure times. **Results:** The preintervention survey consisted of 132 data points (call shifts). Only 33% of residents departed before the legally mandated 12 pm deadline. Factors associated with delayed departure included being assigned to clinic/operating room postcall until noon ($p < 0.0001$), being on a spine rotation/service ($p < 0.05$) and being a senior resident ($p < 0.05$). Pareto charts and Driver diagrams were created to identify solutions to this initiative. The intervention was to ensure that all residents were not "assigned" postcall. This was carried out by working with scheduling administrators at each site, messaging from the division chair at hospital staff meetings, and e-mails to the resident body. The changes were positively received by residents, despite barriers including institutional culture, the hidden curriculum, desire for more clinical exposure, and theoretical resident shortages. After the intervention, 86% of residents departed before the legally mandated 12 pm deadline. Only 12.5% of respondents felt that their learning was negatively affected by the changes. **Conclusion:** A QI initiative to improve adherence to legal postcall departure guidelines was successful. Key strategies included involving stakeholders at different levels within the program community, and having buy-in from senior residents at specific sites. Next steps for this research include analysis of burnout and depression, and prevalence of medical and surgical errors in the peri-interventional period.

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Increasing familiarity among team members helps to reduce laparoscopic procedure time. *Yao Zhang, Bin Zheng.* **From University of Alberta.**

Background: Surgical performance is a team effort. We measured team familiarity in laparoscopic surgery and examined its correlation to procedure time (PT). **Methods:** A team familiarity score (TFS) and an index of difficulty of surgery (IDS) were calculated from a total of 360 laparoscopic operations. Simple linear regression, multiple linear regression, and random forest regression analyses were performed to investigate their contribution to the procedure time. **Results:** Simple linear regression and multiple linear regression models reported linear relationships between variables, while the random forest regression model further revealed nonlinear relationships. Simple linear regression showed that for every 1% increase in TFS, PT decreased by about 0.24% ($p < 0.001$). About 7% of the variability of PT was explained by the change of TFS alone. Multiple linear regression showed that 49% of the model variability could be explained when considering IDS, team size, and TFS as influencing factors. The random forest regression model was able to explain 52% of the variability when taking TFS, team size, patient age, and IDS into consideration. The variable importance test showed that IDS was the most important feature. Team size, patient age, and TFS had similar importance according to the random forest regression model. **Conclusion:** Familiarity among team members significantly contributed to the reduction of PT. We believe that simulation-based team training provides an additional opportunity for surgical team members to work together. Team training outside the operating room would be valuable for strengthening surgical performance in the operating room.

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The effectiveness of a self-directed online learning module on trainee knowledge and confidence during plastic surgery clinical rotations. *Pedram Akbari, Chantal Valiquette, Shakira Brathwaite, Greg Hawley, Glykeria Martou, Michael Hendry.* **From Queen's University (Akbari, Martou, Hendry); and University of Toronto (Valiquette, Brathwaite, Hawley).**

Background: Our objective was to develop, implement, and evaluate the effectiveness of an interactive plastic surgery learning module for building knowledge and confidence in off-service residents and clinical clerks during their plastic surgery clinical rotations. **Methods:** An interactive module on rotation-specific objectives and key plastic surgery topics was created using text, images, and video recordings. Two cohorts were recruited — a control cohort ($n = 9$) who completed the rotation without use of the module, and an intervention cohort ($n = 14$) who completed the module during the rotation. A demographic survey, a 20-question multiple-choice knowledge test, and self-reported confidence as measured by Likert scale scores were completed by both cohorts at the end of their plastic surgery rotations. The intervention cohort also completed a module feedback survey. Performance on the knowledge test and confidence between

cohorts was compared using a 2-tailed nonparametric analysis (Mann–Whitney test). **Results:** Learners from the intervention cohort reported a 93% module completion rate, and all interventional cohort learners reported "very useful" on the Likert scale with respect to its utility during their clinical rotations. All but 1 learner in the interventional cohort indicated they "will definitely recommend" the module to others. The intervention cohort indicated that the module was used as an adjunct to other resources such as UpToDate, textbooks, and Toronto Notes, and provided a useful resource, particularly for consults. The intervention cohort produced significantly higher knowledge and confidence scores than the control cohort ($p = 0.012$ and $p = 0.080$, respectively). **Conclusion:** An accessible and concise module on core plastic surgery concepts enhances learner knowledge and confidence during plastic surgery clinical rotations.

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Implementing an orientation handbook before a surgical rotation in urology. *Ioana Fugaru, Victoria Schouela, Mélanie Aubé-Peterkin.* **From McGill University.**

Background: In the competency-based approach, learners are at the centre of their own experience. At our institution, urology rotations are not mandatory. Most students rotating on our service have an interest in the field with limited exposure to basic urological skills in their medical curriculum. Teaching the basics of urology during short rotations is a challenge to educators. The COVID-19 pandemic has also limited clinical exposure. Our goal was to develop a rotation-specific electronic resource for students rotating in our division. **Methods:** An electronic handbook was developed based on the most frequent questions asked by medical students. We outlined the functioning of clinical rounds, basic departmental information and record keeping. We also highlighted essential urological topics to be mastered and provided students with targeted resources. Sample consultations, operating room notes, progress notes and frequently used medications were also provided. This tool was distributed from June 2022 to present. **Results:** Currently, there are no reports highlighting the value of developing orientation handbooks as a tool for improving medical student experience during surgical rotations. Initial feedback received from students performing an elective rotation with our service demonstrated increased comfort in performing consultations. The value of the handbook and its specific impact will be assessed with a detailed online survey. **Conclusion:** We are providing learners opting for an elective in urology with an adapted electronic resource. Initial feedback from students demonstrates that this tool fulfills a need. We aim to assess its specific impact on the learner experience with a detailed questionnaire.

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An examination of equity-related experiences of surgical trainees at academic centres across Ontario: design of a targeted needs assessment. *Ishita Aggarwal, Laryssa Kemp, Andrea Winthrop.* **From Queen's University.**

Background: Despite the known benefits of diverse health care teams, the historical lack of diversity in surgical special-ties is troubling. Although there have been efforts to increase representation of equity-deserving groups, there is limited research focusing on surgical trainee experiences relating to equity, diversity and inclusion (EDI) in Canada. We describe the design and implementation of a needs assessment as the first phase of a quality-improvement (QI) initiative focusing on these issues. **Methods:** A literature review was completed for the initial general needs assessment. This was used to identify gaps and inform the development of the survey used for the targeted needs assessment. The survey explores surgical trainees' experiences relating to 6 key EDI domains: gender, race and indigeneity, sexuality, religion, disability and accessibility, and allyship. The survey has a mixed-methods design, with planned analysis of both quantitative and qualitative responses. **Results:** The survey has been disseminated to 47 program directors and administrators, and the 880 surgical trainees in Ontario, representing all direct-entry surgical discipline programs in Ontario. This project is ongoing, with continuing survey responses still being collected at the time of this abstract submission. **Conclusion:** This QI initiative will help increase our understanding of the EDI-related experiences of surgical trainees in Ontario. We plan to share the findings with the EDI stakeholders within the surgical training programs to help inform policy and program development, which will aim to facilitate recruitment and improve the clinical training environment for equity-deserving surgical trainees.

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Viewing differences between experts and trainees: implication for surgical education. *Yao Zhang, Bin Zheng.* **From University of Alberta.**

Background: Videos have been used extensively in surgical education. Most teaching videos were created by experts, emphasizing what they believe to be important. However, what a trainee needs as a starter might be cropped from the perspective of the expert. In this study, we compared the visual searching strategies between experts and trainees under a virtual reality scenario. **Methods:** We created a 360° virtual scenario of the operating room; 4 experts and 4 trainees were invited to watch a laparoscopic procedure while having their eye movements tracked. In this preliminary report, we calculated the eye trajectories total length (ETTL) and compared it between experts and trainees using a t test. Following that, 8 fixation heat maps were generated for future analysis on gaze point patterns. **Results:** When watching the surgery in the virtual operating room, experts and trainees did not show significantly different ETTL (expert: 243.5 ± 60.3 mm; trainees: 220.4 ± 94.8 mm, $p = 0.768$). We noticed novices had a larger standard deviation. Viewing the fixation heat maps, we noticed that the focus points of the trainees were more diverse than those of the experts. Quantitative analysis is yet to be done. **Conclusion:** ETTL failed to reveal differences between experts and trainees when viewing a surgical procedure in the virtual operating room. We are planning to collect more data and perform analysis on the heat maps to further investigate the difference between experts and novices in watching a surgery. We aim to create teaching videos that better fit the needs of trainees.

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Assessment of medical student exposure to and satisfaction with surgical subspecialty education. *Morgan S. Gold, Sébastien Belliveau.* **From Faculty of Medicine and Health Sciences, McGill University.**

Background: Formal teaching constitutes an important part of student exposure to surgical subspecialties. We sought to assess students' exposure to and satisfaction with teaching on surgical subspecialties. **Methods:** We surveyed McGill medical students on formal surgical teaching and compared this to a course audit assessing the title and learning objectives of all structured teachings available on the online course platform. **Results:** Forty-three students responded to the survey, 30 of whom were clerks. Students received on average 3.1 times more teaching than recollected. Over 60% of students reported very little to no preclerkship teaching in neurosurgery, vascular, plastic and cardiac surgery. The same held true for clerkship, with the addition of ophthalmology and urology. Over 55% and 90% of students reported some or a lot of general surgery and obstetrics and gynecology exposure during preclerkship and clerkship, respectively. Over 60% of students reported having enough or too much preclerkship exposure to general surgery and ophthalmology, with over 85% reporting enough or too much general surgery and obstetrics and gynecology clerkship exposure. Over 60% of students reported not having enough or wanting more neurosurgery, vascular, plastic and cardiac surgery teaching in preclerkship, with the addition of ophthalmology, urology and orthopedic surgery in clerkship. Students preferred didactic lectures (30%), small group activities (26%), and case presentations (23%) for teaching. **Conclusion:** There are clear discrepancies between the student exposure to and satisfaction with surgical subspecialty teaching. These findings can be used to create a more equally distributed and satisfactory surgical education curriculum for medical students.

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Assessment of student exposure to climate impacts of surgical personal protective equipment in the undergraduate medical curriculum. *Sébastien Belliveau, Morgan Gold.* **From Faculty of Medicine and Health Sciences, McGill University.**

Background: Climate change is an urgent global issue. Health care, and particularly surgery given its resource-intensive nature, contributes significantly to greenhouse gas emissions, partially via single-use plastics, including personal protective equipment (PPE). **Methods:** We surveyed McGill medical students to assess perspectives on PPE and sustainability, as well as their recollection of teaching received on various sustainability domains. **Results:** Fifty-nine students responded to the survey. Students generally reported less formal teaching in clerkship than preclerkship: 2.3% v. 32.8% for health care sustainability, 2.3% v. 6.6% for nonoperative PPE, 4.5% v. 11.5% for operative PPE, 6.8% v. 23% for disposable v. reusable PPE, and 77.3% v. 45.9% reporting no formal teaching. However, clerks reported more informal teaching on these topics than preclerks: 14.7% v. 19.8% for health care sustainability, 11.8% v. 6.9%

for nonoperative PPE, 10.3% v. 2.3% for operative PPE, 14.7% v. 9.3% for disposable v. reusable PPE, and 27.9% v. 38.4% reporting no informal teaching. Students overwhelmingly reported having not received enough instruction on these topics, with only 1.6%–13.8% saying they had. A majority of students (52.7%–77.8%) reported these topics were important to their medical education and overwhelmingly expressed that health care systems are not doing enough to mitigate the climate impacts of these issues (78%–90%). **Conclusion:** These data highlight the discrepancies between student interest and expectations with respect to teaching on sustainable health care and current curricula. This is an important gap to address in the training of future surgeons to mitigate the environmental impact of their practice.

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Virtual reality simulation for the middle cranial fossa approach — a face, content and construct validation study. *Carolyn Lai, Justin T. Lui, Madeleine de Lotbiniere-Bassett, Joseph M. Chen, Vincent Y. Lin, Sumit K. Agrawal, Nikolas H. Blevins, Hanif M. Ladak, Farhad Pirouzmand.* **From University of Toronto (Lai, Chen, Lin, Pirouzmand); University of Calgary (Lui, de Lotbiniere-Bassett); Western University (Agrawal, Ladak); and Stanford University (Blevins).**

Background: Virtual reality (VR) simulation is gaining prominence as a valuable surgical rehearsal and educational tool performed in a safe environment. Validation is needed to determine the educational value these platforms can offer. The middle cranial fossa (MCF) is ideal for simulation, as an approach surgeons often have limited exposure to that can be fraught with complication due to relationships of neurovascular structures in this region of the skull base. It has multidisciplinary relevance to neurosurgery and otolaryngology. Our objective was to assess the face, content and construct validity of an MCF simulation. **Methods:** We developed a VR simulation from high-resolution volumetric data sets of human cadavers to generate a high-fidelity visual and haptic rendering of the MCF using CardinalSim Software. Trainees from neurosurgery and otolaryngology at 2 Canadian academic centres were recruited and randomized to 2 arms. One arm simulated a more real-life dissection, while the other arm used more VR features. A Likert scale was used to assess face and content validity. Construct validity was evaluated by examining differences between training level on performance of the simulation. **Results:** Twenty-two trainees were enrolled and completed the simulation: 3 fellows and 19 residents. Statistical analysis is currently under way. **Conclusion:** This simulation platform may enhance surgical education and understanding of anatomic relationships of critical neurovascular structures, suitable for surgical rehearsal across both neurosurgery and otolaryngology as a formative educational adjunct.

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Evaluating the Canadian Orthopaedic Surgery Medical Education Course (COSMEC). *Anser Daud, Tyler Hauer, Jesse Wolfstadt, Peter Ferguson.* **From Division of Orthopaedic Surgery, University of Toronto.**

Background: Medical students in Canada have limited exposure to applied musculoskeletal education and orthopedic surgery in their mandatory medical school curricula, with recent studies highlighting this knowledge gap. The Canadian Orthopaedic Surgery Medical Education Course (COSMEC) is designed to enhance the education of medical students around orthopedic surgery. **Methods:** Canadian medical students were invited to participate in COSMEC, which consists of 6 live, virtual teaching sessions and 1 in-person skills session led by orthopedic faculty and senior residents over a 12-week period. Teaching objectives were guided by musculoskeletal objectives of the Medical Council of Canada Qualifying Examination I. Voluntary pre- and postcourse surveys were administered to assess outcomes related to participant knowledge, participant-reported confidence, and participant interest in orthopedic surgery. **Results:** A total 84 paired pre- and postcourse surveys were received. Of the respondents, 42 (50%), 22 (26.1%), 17 (20.2%) and 4 (4.8%) were preclerkship, clerkship, elective and postgraduate medical students, respectively. Knowledge quiz scores out of 14 improved from 7.92 ± 2.6 before participation in COSMEC, to 9.7 ± 2.0 after participation ($p < 0.05$). There were also significant improvements in participant-reported confidence related to various learning objectives. **Conclusion:** COSMEC is an effective learning resource for medical students that can enhance knowledge and confidence in orthopedic and musculoskeletal topics. It can play a useful role in augmenting core medical school curricula for medical students interested in a variety of specialties. Further studies to determine if participation in COSMEC leads to improved performance in clinical rotations and licensing examinations would be of value.

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Subpial resection in a novel ex vivo calf brain epilepsy simulation model. *Nour Abou Hamdan, Abdulrahman Almansouri, Recai Yilmaz, Mohammadreza Eskandari, Trisha Tee, Chinyelum Agu, Puja Pachchigar, Bianca Giglio, Neevya Balasubramaniam, Houssem-Eddine Gueziri, Rolando Del Maestro.* **From Neurosurgical Simulation and Artificial Intelligence Learning Centre (Abou Hamdan, Almansouri, Yilmaz, Tee, Agu, Pachchigar, Giglio, Balasubramniam, Del Maestro), Department of Neurology and Neurosurgery (Almansouri, Del Maestro), and Neuro Imaging and Surgical Technologies Laboratory (Eskandari, Gueziri), Montreal Neurological Institute, McGill University.**

Background: Epilepsy surgery or subpial resection involves surgical removal of cortical tissue lesions. This resection technique is a critical bimanual task that is often mastered by trainees during live patient operations. Given the challenges faced during the pandemic, which impeded regular access to operating rooms, we sought to assess the educational potential of an ex vivo calf brain model for acquiring subpial resection skills. **Methods:** A pilot study was carried out in which neurosurgical fellows and residents were asked to perform a subpial corticectomy resection of 3 distinct cortical areas in an ex vivo calf brain model. The corticectomies were carried out using micro-scissors, a bipolar, and an ultrasonic aspirator while using an operating microscope. The educational potential of the model was assessed via questionnaires using a 7-point Likert scale.

Results: A total of 10 participants were included: 2 neurosurgical fellows, 5 senior residents, and 3 junior residents. A median score ≥ 6.0 was achieved in rating the realism of the preoperative setup, the sensory and tactile realism of the brain and the pia, and the use of the 3 surgical instruments. Participants found the task to be moderately difficult (median score 4.0) and outlined that they would use this simulation setup to practise their subpial resection skills if the model were available in their program (median score 7.0). **Conclusion:** In this pilot study, the ex vivo calf brain epilepsy model demonstrated educational potential. Face, content, and construct validation studies are proceeding to further outline the utility of this model in epilepsy bimanual psychomotor skills training.

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Effectiveness of the Eyesi augmented reality simulator for ophthalmology trainees: a systematic review and meta-analysis. *Lauren Carr, Tyler McKechnie, Amin Hatamnejad, Jenny Chan, Anne Beattie.* **From McMaster University.**

Background: Eyesi is the most commonly used ophthalmic virtual reality surgical simulator. Previously published data demonstrate improved ophthalmology trainee technical skill acquisition with simulation-based training, but a systematic review evaluating Eyesi specifically has yet to be conducted. The aim of this study was to meta-analyze studies comparing Eyesi to other technical skills teaching methods for ophthalmology trainees. **Methods:** Medline, Embase, and CENTRAL were systematically searched. Articles were included if they compared Eyesi with alternative methods of training ophthalmologic technical skills for medical students and/or ophthalmology residents. A pairwise meta-analysis using inverse variance random effects was performed. Standardized mean differences (SMDs) were used as the primary outcome measure to account for differences in objective surgical skill evaluation tools. **Results:** From 207 citations, 8 studies with 108 learners using Eyesi and 123 learners not using Eyesi were included. Improvements in objective technical skill scores were significantly greater with Eyesi use (3 studies; SMD 2.02, 95% confidence interval [CI] 1.47 to 2.57, $p < 0.001$, $I^2 = 0\%$). There was a significant reduction in posttraining technical errors in the Eyesi group (5 studies; odds ratio [OR] 0.43, 95% CI 0.20 to 0.90, $p = 0.03$, $I^2 = 30\%$). There were no significant differences in posttraining time-to-task completion between groups (3 studies; SMD 1.96, 95% CI −1.96 to 5.88, $p = 0.33$, $I^2 = 97\%$). **Conclusion:** It is possible the Eyesi simulator can improve objective ophthalmic technical skills in ophthalmology trainees and reduce technical errors for tasks such as capsulorhexis and cataract excision. This study was limited by sample size and heterogeneity among included studies. Further prospective study evaluating specific Eyesi modules with standardized scoring systems is warranted.

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Learning beyond the objectives: an evidence-based analysis of AI-selected competencies in surgical simulation training. *Ali M. Fazlollahi, Recai Yilmaz, Ahmad Alsayegh, Mohamad Bakhaidar, Rolando F. Del Maestro.* **From Neurosurgical Simulation and Artificial Intelligence Learning Centre, Montreal Neurological Institute, McGill University.**

Background: Recreating the operating environment in virtual simulation provides opportunities for repetitive practice and enables recording vast amounts of data from the computer. Artificial intelligence (AI) has been demonstrated to be an effective method to improve medical students' performance in virtual reality simulation, but the extent of this effect requires further investigation. **Methods:** To assess the pedagogical value of AI-selected competencies, we explored their extended effect on other performance criteria and investigated how this changed students' competency compared with that of experts. A previously collected data set from a randomized clinical trial was used to compare medical students' performance, with ($n = 23$) or without feedback ($n = 23$), on AI-selected metrics with the performance of expert neurosurgeons ($n = 14$). **Results:** Among medical students, feedback on AI-selected movement competencies of the nondominant hand had a significant extended effect on the movement metrics of the dominant hand. Students receiving feedback on reducing the acceleration of their nondominant hand demonstrated significant changes in extrinsic movement competencies of their dominant hand compared with the control group (acceleration: mean difference –0.02, 95% confidence interval [CI] –0.031 to –0.007, $p < 0.001$; velocity: mean difference –0.13, 95% CI –0.18 to –0.08, $p < 0.001$) upon completion of training. However, some of these changes diverged medical students' metric scores away from the experts' benchmark. **Conclusion:** This study shows that following a curriculum with AI-selected learning objectives has the benefit of adjusting multiple competencies based on a few metrics. Similar to other curricula, incorporating AI in course design requires ongoing assessment to maintain transparency and foster evidence-based learning objectives.

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Virtual compared with in-person surgical grand rounds: participants' perceptions, preferences and directions for the future. *Giuseppe Retrosi, Nafisa Dharamsi.* **From University of Manitoba.**

Background: The COVID-19 pandemic prompted the transformation of our departmental grand rounds (GRs) from in-person to virtual. Our purpose was to report survey data providing participant-reported perceptions of virtual compared with in-person GRs. **Methods:** Once in-person meetings were discontinued because of the COVID-19 pandemic, we switched to virtual GRs using Zoom. At the conclusion of the 2021–22 academic year, we sent a 19-item online survey to all residents and faculty to assess their perspective and to obtain directions for the future. A 5-point Likert scale from 1 to 5, with 5 being extremely effective, was used. **Results:** The response rate was 74 of 190 (39%). Respondents found no difference between virtual and in-person GRs for providing updates in patient management, diagnosis, and research. However, virtual GRs were considered more convenient to attend, and to obtain continuing medical education (CME) credits. The virtual format was considered better than in-person for delivery of content, learning of content, and overall satisfaction. In-person GRs were considered better for social collegiality and networking. Zoom fatigue level was low for 47% of participants. We asked which format they will prefer for our future meetings. The answers were as follows:

7% in-person, 44% virtual, 49% hybrid. **Conclusion:** Our participants found virtual GRs convenient to attend and to obtain CME credits. However, they recognized the merits of in-person GRs for promoting social collegiality and networking. Nearly half of the respondents recommended adoption of a hybrid format for our future GRs.

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Quality of narrative feedback for entrustable professional activities assessed in the operating room: analysis of 4 years of assessments in the surgical foundations curriculum at Queen's University. *Rosephine Del Fernandes, Ingrid de Vries, Steve Mann, Laura McEwen, Timothy Phillips, Boris Zevin.* **From Queen's University.**

Background: Competency-based medical education requires ongoing formative assessments and feedback on learners' performance. The frequency and quality of narrative feedback documented for procedural entrustable professional activities (EPAs) performed in the operating room (OR) is currently unknown. **Methods:** We collected assessments of EPAs performed in the OR by residents in the surgical foundations (SF) curriculum at Queen's University from July 2017 to June 2021. We collected variables pertaining to the assessor, resident, and assessment. Two raters independently evaluated narrative quality using the Quality of Assessment of Learning (QuAL) Score. **Results:** We had a total of 630 assessments of EPAs in the OR completed by 409 (65.8%) attendings, 45 (7.2%) allied health, 165 (26.5%) residents/fellows, and 3 (0.5%) medical students. Most assessments were triggered by residents (531 of 630, 84.3%,) with 84 of 630 (13.3%) by programs and only 15 of 630 (2.4%) by attendings. About 51% (322 of 630) of assessments had narrative feedback documented, with a mean QuAL score of 2.1 ± 1.4. Of these, 228 of 322 (70.8%) provided evidence about the resident's performance, 130 of 322 (40.3%) provided suggestions for improvement, and 55 of 322 (17.1%) connected suggestions to the evidence. The quality of feedback provided by the attendings was equivalent to feedback provided by others ($p = 0.309$). The quality of narrative feedback was significantly higher if the resident was not on an EPA (2.46 ± 1.62 v. 2.08 ± 1.08, $p = 0.046$) and had an inverse correlation with time between resident encounter and assessment completion ($p < 0.001$, $r = –0.201$). **Conclusion:** The frequency and quality of narrative feedback for EPA assessments in the OR was fair. Results from this study can facilitate future faculty development.

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SimOscopy: an accessible 3D-printed and laser-cut laparoscopic surgical simulator developed for a mobile device. *Stephanie Roberts, Andrew Robart, Hannah Brennan, Joshua Conway, Christopher Patey.* **From Memorial University.**

Background: Owing to safety and liability concerns, medical students are commonly expected to select a medical specialty without first completing the foundational procedures of a discipline. For medical specialties that value laparoscopic surgical skills, the learning curve is steep. Operating room time constraints, trainee level, preceptor comfort, and case complexity all

limit laparoscopic surgical training. In addition, portable and affordable laparoscopic simulators for medical students are challenging to access. Simulation provides a safe, standardized environment to develop laparoscopic skills while receiving immediate feedback. The goal of this study was to investigate how the use of a laparoscopic simulator affected specialty interest, self-reported confidence, and anatomy knowledge retention. **Methods:** With the advent of laser cutting and 3D printing, researchers developed a low-cost laparoscopic surgical simulator (SimOscopy) compatible with a mobile device. We intend for undergraduate medical students to complete a presession assessment of basic laparoscopic skills, as well as a survey with open-ended and Likert-style questions. This will be followed by an educational skills session, a 30-minute device free-use session, and a postsession skills assessment and survey. Given the lack of opportunities to provide students with simulated laparoscopic surgical training, we anticipate that SimOscopy will improve students' ability to confidently assist with procedures, identify anatomy, and positively influence their decision to pursue a surgical specialty. **Results:** Pending. **Conclusion:** Students currently lack resources and opportunities that they need to make informed career choices. We foresee that SimOscopy will aid decision making and improve laparoscopic surgical training in medical schools across Canada.

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A debriefing tool to acquire nontechnical skills in trauma courses. *Fabio Botelho, Jason Harley, Dan Poenaru.* **From McGill University.**

Background: Surgical programs tend to overlook nontechnical skills teaching, limiting opportunities to identify the best way to teach them. The present work reports our use of a nominal group technique (NGT) to evaluate the Promoting Excellence and Reflective Learning in Simulation (PEARLS) debriefing tool to foster nontechnical skills in trauma simulation courses. **Methods:** An NGT was used to evaluate the main strategies in PEARLS — self-assessment, focused facilitation, and provision of information. Seven experts had the opportunity to share their opinions in a survey and subsequent meeting. A descriptive analysis of experts' answers to the survey and during the meeting is reported. **Results:** Based on the online survey results, the self-assessment debriefing strategy was rated 4.83 out of 5 in relevance, the focused facilitation was rated 5 out of 5, and the provision of information was 4.5 out of 5. Experts agreed that PEARLS is sufficient and appropriate for fostering nontechnical skills and that all the debriefing strategies contained in PEARLS are valid and should be used. Further, experts agreed that the cards should be given to the instructors to help them conduct structured formal debriefings. A specific debriefing card for trauma scenarios was designed after these conclusions. The card has examples for questions and comments for a better debriefing, helping the instructor to use all PEARLS strategies. **Conclusion:** A nominal group of experts in education, simulation, and trauma support PEARLS strategies for nontechnical skills training in trauma courses. Therefore, we encourage the use of structured debriefing tools to unlock trainees' nontechnical skills in pediatric trauma courses.

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Capacity building using a hub-and-spokes model to produce customizable simulators for surgical education. *Julia Micallef, Mithusa Sivanathan, Krystina Clarke, Merieme Habti, Marie-Ève Roy, Stephane Bedwani, Érica Patocskai, Adam Dubrowski.* **From Ontario Tech University (Micallef, Sivanathan, Clarke, Dubrowski); Université de Montréal (Habti, Roy); and Centre hospitalier de l'Université de Montréal (Bedwani, Patocskai).**

Background: Additive manufacturing enables simulation centres to produce customized simulators to fit curricular needs. However, human resources and lack of digital design skills are a gap. A solution is a "hub-and-spokes" (HAS) model where the "hub" is a digital design centre, and "spokes" are simulation centres. The test case reported here aimed to assess the feasibility of HAS and test the quality of the simulators produced. **Methods:** The "hub" — maxSIMhealth laboratory (MSH) — co-designed 2 simulators to train deep suturing and bile duct anastomosis skills. The "spoke" — Centre Hospitalier de l'Université de Montréal (CHUM) — provided clinical expertise and 3D-printing resources. The simulators were assessed for anatomic accuracy and educational quality using modified Michigan Standard Simulation Experience Scales. Simulators were designed at MSH, components printed at CHUM, and they were published as technical reports and made available at GitHub.com/maxSIMhealth. Simulators were assembled at CHUM during a 3-hour workshop attended by 9 CHUM and 3 MSH trainees. **Results:** All participants were satisfied with the HAS model and the workshop's quality. Assessments showed that the bile duct was anatomically accurate (5 out of 5), and a good training tool (4.5 out of 5), while the deep suture pad was moderately accurate (2.75 out of 5), but still a good training tool (4.5 out of 5). **Conclusion:** The HAS model is feasible in producing simulators of high anatomic and educational quality. Its strengths were human resources, time savings, and provision of a sharable platform. With more "spokes" added, this approach may reduce development costs and improve design quality.

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Exploring skin tone diversity in a plastic surgery resident education curriculum. *Raahulan Rathagirishnan, Chantal Valiquette, Jane Zhu, Alexander Adibfar, Laura Snell.* **From Queen's University (*Rathagirishnan*); and University of Toronto (*Valiquette, Zhu, Adibfar, Snell*).**

Background: Plastic surgery education is highly visual and relies on images for teaching its residents. Currently, there are deficits in photographic representation of skin tone diversity. It is important to provide residents with the necessary exposure to skin tones that are often less represented to treat a diverse population. Our study aimed to assess the variety of skin tone representation in a resident plastic surgery curriculum, and resident and faculty perception of diversity in the curriculum. **Methods:** A photogrammetric analysis was performed of all recorded seminars from the University of Toronto plastic surgery education curricula from May 2020 to August 2021. The Fitzpatrick scale was used to guide codification of skin tones by

independent reviewers, and interrater reliability was controlled for in a multivariate analysis. A survey of program lecturers and residents was done to explore perceptions of the curricula. **Results:** In total, 1296 images were included for analysis: 1096 (84.6%) were Fitzpatrick type I-III, 115 (12.0%) were Fitzpatrick type IV-V, and 45 (3.5%) were Fitzpatrick type VI. Interrater reliability was 0.52. About 74% (14 of 19) of faculty respondents believed they include enough diversity in their photographs; however, 57% (4 of 7) of resident respondents reported wanting to see more diversity in lecturers' photographs. Resident belief that there should be opportunities to learn about equity, diversity, and inclusion was significantly higher than that of faculty, *p* = 0.037. **Conclusion:** Our study highlights a poor representation of Fitzpatrick type IV-VI skin tones in comparison to lighter skin tones in educational images. Residents are open to more diversity in their curriculum.

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Video-based assessments of thoracic surgery trainees' operative skills as adjuncts in competency-based medical education. *Nicole Stachura, Rahul Nayak, Richard Malthaner, Dalilah Fortin, Richard Inculet, Mehdi Qiabi.* **From Western University (Stachura, Nayak, Malthaner, Fortin, Inculet, Qiabi); and Division of Thoracic Surgery, Department of Surgery, London Health Sciences Centre (Nayak, Malthaner, Fortin, Inculet, Qiabi).**

Background: Video-based assessments (VBA) of thoracic surgery trainees' operative skills may alleviate barriers faced with live assessments. The purpose of this study was to determine whether VBA by external consultants are in agreement with real-time assessment of the trainee by the operating surgeon (gold standard). **Methods:** Video-assisted thoracic surgery (VATS) procedures were video-recorded without sound (unedited). After surgery, the surgeon and trainee completed the VATS lobectomy Assessment Tool (VATSAT) and a modified Thoracic Competency Assessment Tool (mTCAT). External consultants completed VBA as well. Agreement was assessed using weighted κ. Differences in trainee self-assessment scores (linearized from 0 to 100) after video review were calculated using paired *t* test. Strength of association between VATSAT and mTCAT was calculated using the Pearson correlation coefficient. **Results:** Forty-five assessments per tool were done (13 surgeries). Slight agreement was found between live and VBA consultants for VATSAT (weighted κ = 0.176) and mTCAT (weighted κ = 0.135). Linearized scores were similar between live assessments and VBA for both tools (VATSAT: 76.6 v. 75.5, *p* = 0.851; mTCAT: 80.8 v. 80.1, *p* = 0.862). Trainees' scores did not significantly change after video review (64 v. 63.5, *p* = 0.871). VATSAT and mTCAT were found to strongly correlate (*r* = 0.87, *p* < 0.001). Video review took 21 minutes, on average. The rate of agreement on trainees' performance (below/meets/above expectations) between live and VBA consultants was 87.5%. **Conclusion:** Although direct observation remains the gold standard for summative appraisal of surgical skills, this study showed that VBA can be used to assess trainees' performance in thoracic surgery and could improve objectivity in their technical skills' assessment.

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How do you feel? An examination of team leaders' and members' emotions in surgical simulations. *Keerat Grewal, Sayed Azher, Matthew Moreno, Lucia Patino Melo, Reinhard Pekrun, Jeffrey Wiseman, Gerald M. Fried, Susanne Lajoie, Ryan Brydges, Allyson Hadwin, Ning-Zi Sun, Elene Khalil, Jason M. Harley.* **From McGill University (Grewal, Azher, Moreno, Patino Melo, Wiseman, Fried, Lajoie, Sun, Harley); University of Essex (Pekrun); Ludwig Maximilian University of Munich (Pekrun); Australian Catholic University (Pekrun); University of Toronto (Brydges); University of Victoria (Hadwin); McGill University Health Centre for Interprofessional Simulation (Khalil); and Research Institute of the McGill University Health Centre (Harley).**

Background: Team-based surgical simulations are safe, immersive environments that replicate challenging situations encountered in practice. As emotions can affect learning and performance, it is imperative to know which emotions are experienced during simulations. We sought to examine emotions experienced by leaders and team members in surgical simulations. **Methods:** A pre/post survey study recruited 45 residents enrolled in team-based surgical simulations. Residents reported their emotions before and after each simulation. Emotions were later characterized as positive activating, positive deactivating, negative activating, and negative deactivating based on the control-value theory of achievement emotions. **Results:** When not considering role, residents' presimulation positive activating emotion levels were reported as higher than all other presimulation emotions (*p* < 0.01). Residents' self-reported postsimulation positive emotions were higher than postsimulation negative emotions (*p* < 0.01). Residents' reported postsimulation emotions (emotion categories combined) were higher than presimulation emotions (*p* < 0.01). Team leaders' reported postsimulation emotions (emotion categories combined) were found to be higher than their presimulation emotions (*p* < 0.01). Team members' emotion levels analyses were nonsignificant. **Conclusion:** Though previous surgical simulation research tends to focus on negative emotions, our findings reveal that positive emotions are reported by learners and warrant further analysis. As emotions are reported at higher levels after a simulation, especially for leaders, results suggest that leaders may be more immersed during the simulation than team members. Overall, these findings provide valuable insight that could shed light on residents' emotional well-being and areas to improve residents' training so they can better navigate leading a surgical team through a challenging situation.

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Comparing the efficacy of a real-time intelligent coaching system to human expert instruction in surgical technical skills training: randomized controlled trial. *Recai Yilmaz, Mohamad Bakhaidar, Ahmad Alsayegh, Nour Abou Hamdan, Ali M. Fazlollahi, Chinyelum Agu, Puja Pachchigar, Rolando Del Maestro.* **From Neurosurgical Simulation and Artificial Intelligence Learning Centre, McGill University (Yilmaz, Bakhaidar, Alsayegh, Hamdan, Fazlollahi, Agu, Pachchigar, Del Maestro); and King Abdulaziz University (Bakhaidar, Alsayegh).**

Background: Artificial intelligence–powered surgical technical skill tutoring systems provide risk-free training on realistically simulated patient cases and objective assessment. This study compared the efficacy of a real-time intelligent tutoring system in technical skills learning with human instructor–mediated training. **Methods:** Ninety-eight medical students performed a virtually simulated brain tumour resection 5 times. Participants were randomly allocated into 3 feedback groups: (1) no-real time feedback, (2) real-time intelligent instruction, (3) in-person human instruction. All students performed the first repetition without receiving feedback (baseline). Group 1 received visual feedback only after each procedure based on expert benchmarks. Group 2 was instructed by the intelligent system in real time. After each task, the students were shown their error video clips generated by this system alongside the expert level demonstrations relating each error. Group 3 was instructed by human instructors during the tasks. After each task, instructors summarized the areas of improvement and demonstrated correction techniques. All participant data were scored by the intelligent system. The performance score was compared from the first to the last repetition of the task within and between groups to assess learning. **Results:** Compared with the baseline performance, group 2 and group 3 significantly improved in the performance score by the third and second repetition, respectively ($p < 0.01$ and $p = 0.01$). The between-groups comparison demonstrated that group 2 achieved significantly higher scores than group 3 in the fifth repetition ($p < 0.01$). **Conclusion:** Intelligent systems may facilitate trainee learning by providing more efficient learning than human instruction. These systems may aid in the development of competency-based standardized curricula in surgical training.

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Empowering women to pursue surgery: launching a pilot gender-congruent mentorship program for medical students. *Sheharzad Mahmood, Sarah Almas, Joanna Ryan, Blaire Anderson.* **From University of Alberta.**

Background: Gender-congruent mentorship is a positive predictor for women medical students pursuing surgical training. Therefore, facilitating mentorship programs, focusing on women mentors, represents an actionable initiative to increase exposure and support for women trainees interested in surgery. **Methods:** A 1-on-1 mentorship program was established through the University of Alberta chapter of the Association of Women Surgeons (AWS), pairing medical students self-identifying as women or allies (mentees) with women surgical residents and staff surgeons (mentors) from a variety of surgical specialties over a 6-month period. At the completion of the program, anonymous surveys will be distributed to all participants and semistructured interviews will be conducted with a subset of students, residents, and staff. This study is currently ongoing. Twenty-seven mentee–mentor pairs have enrolled. Thematic analysis will be conducted on the data from the survey responses and interview transcripts according to the following themes: 1) access and barriers to mentorship in surgery, 2) perceived benefit of mentorship program, 3) qualities valued in a mentor/mentee, and 4) impact of gender identity and other intersectional identity components in mentorship. This will evaluate the program from both mentor and mentee perspectives with a unique lens focusing on gender identity.

Results: Pending. **Conclusion:** The results of this study will not only allow for improvements of this mentorship program, which may serve as a model at other institutions, but also influence advocacy for other initiatives to support and empower women trainees in surgery.

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Affective and cognitive responses to a virtual reality spine simulator. *Trisha Tee, Puja Pachchigar, Bilal Tarabay, Recai Yilmaz, Rolando Del Maestro.* **From Neurosurgical Simulation and Artificial Intelligence Learning Centre (Tee, Pachchigar, Yilmaz, Tarabay, Del Maestro); McGill University (Tee, Pachchigar, Yilmaz, Del Maestro); and Montreal Neurological Institute (Tarabay).**

Background: Lumbar laminectomy and pedicle screw insertion are standard neurosurgical and orthopedic procedures with steep learning curves. Virtual reality simulators may be effective training tools. Affective emotions and cognition play critical roles in learning outcomes. Therefore, this pilot study aimed to assess affective and cognitive responses to a virtual reality spine simulator. **Methods:** Neurosurgical–orthopedic fellows and residents performed a lumbar laminectomy followed by pedicle screw insertion using a virtual reality spine simulator (TSYM, SymgeryTM). Participants completed the Medical Emotions Scale and the Leppink's Cognitive Load Index questionnaires on 7-point Likert scales before, during, and after the trial. Affective responses were categorized as positive activating (enjoyment, proud, curious), positive deactivating (relaxed, relieved), negative activating (anxious, frustrated, confused), and negative deactivating (hopeless, disappointment) emotions. **Results:** Seven participants were included in the study. The spine simulator's potential as a training tool (cognitive load) was rated as median 6.0 (range 5–7), and procedural complexity, techniques and concepts were rated as median 5.0 (range 4–7). For affective responses before, during and after the trial, the mean score remained in the range of 4.90–5.04 for positive activating emotions, 3.71–4.28 for positive deactivating, 2.04–2.52 for negative activating and 1.21–1.42 for negative deactivating emotions. **Conclusion:** Participants found that the simulator was an effective training tool and procedure complexity was moderate, along with experiencing greater positive activating emotions while using the virtual reality spine simulator. The simulator's potential as an education tool is also being assessed, using artificial intelligence–driven classification to measure performance objectively.

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Immersive virtual reality for patient-specific preoperative planning: a systematic review. *Reva Qiu, Lucy Lan, Randi Mao, Jeffrey Kay, Darren de SA.* **From McMaster University.**

Background: Immersive virtual reality (iVR) facilitates surgical decision-making by enabling surgeons to interact with complex anatomic structures in realistic 3D environments. With applications in clinical, research, and teaching settings, its effects on patient- and surgeon-specific outcomes should be clarified.

This systematic review examined the current literature on iVR for patient-specific preoperative planning. **Methods:** A literature search was performed on MEDLINE, Embase, CENTRAL, Web of Science, and Scopus for relevant publications from Jan. 1, 2000, through Mar. 21, 2021. Two reviewers independently screened titles, abstracts, and full texts, extracted data, and assessed quality using the Quality Assessment Tool for Studies with Diverse Designs (QATSDD). Results were qualitatively synthesized, and descriptive statistics were calculated. **Results:** The systematic search yielded 2555 studies in total, with 24 full-texts subsequently included for qualitative synthesis, representing 264 medical personnel and 460 patients. Neurosurgery was the most frequently represented discipline (10 of 24; 42%). Preoperative iVR did not significantly improve patient-specific outcomes of operative time, blood loss, complications, and length of stay, but may decrease fluoroscopy time. In contrast, the impact of iVR on surgeon-specific outcomes of surgical strategy, anatomy visualization, and confidence was statistically significant. Validity, reliability, and feasibility of patient-specific iVR models were assessed as well. The mean QATSDD score of included studies was 32.9%. **Conclusion:** iVR improves surgeon experiences of preoperative planning, with minimal evidence for impact on short-term patient outcomes. Future work should focus on large, high-quality studies investigating long-term patient outcomes, and utility of preoperative iVR for trainees.

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The categorization of surgical problems by junior and senior medical students. *Mathew N. Hindi, Geoffrey Blair.* **From University of British Columbia.**

Background: Previous work has suggested that novice learners tend to categorize and classify problems in a manner different from experts. Through a surgical problem categorization exercise we explore how medical students conceptualize surgery. **Methods:** Thirty-two preclinical and 30 postsurgical clerkship students were enrolled in our study. They completed a survey asking for their categorization of 30 surgical scenarios through short answer responses. Responses were sorted by the participants' stage of training and were designated at least 1 theme using inductive thematic analysis: anatomic, specialty, urgency, pathophysiologic, management, diagnosis, etiology, or other. A Student t test was used to compare the proportion of responses across each group, with $p < 0.10$ being considered statistically significant. **Results:** Both preclinical and postclerkship students classified scenarios according to etiology of the problem most of the time (50% v. 60%, $p = 0.22$). While preclinical students classified problems more by urgency (37.5% v. 16.7%, $p = 0.04$), postclerkship students classified more often by the underlying pathophysiology (20% v. 6.3%, $p = 0.06$). There was a trend toward postclerkship students classifying more by surgical specialty (43.3% v. 28.1%, $p = 0.11$) and using more than 1 term to classify problems (80% v. 68.8%, $p = 0.16$). Similar proportions of preclinical and postclerkship students classified by anatomic (21.9% v. 16.7%, $p = 0.30$), diagnostic (12.5% v. 13.3%, $p = 0.46$) and a management (25% v. 30%, $p = 0.33$) approach. **Conclusion:** Seven themes of classification emerged. Notions of pathophysiology were more evident from postclerkship students, whereas notions of urgency were more common in the preclerkship responses. How medical students conceptualize surgical problems should inform surgical educational methods.

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The application of microlearning modules in surgical education to enhance procedural skills and surgical training. *Basmah AlTinawi, Alborz Noorani, Sama Noorani, Megan Mak, George Ibrahim, Mojgan Hodaie.* **From Department of Surgery, Division of Neurosurgery, University of Toronto (Hodaie, Ibrahim); Division of Brain, Imaging & Behaviour, Krembil Research Institute, Toronto Western Hospital, University Health Network (Hodaie, Ibrahim, AlTinawi, Mak); University of Toronto (Hodaie, A. Noorani, Ibrahim); Institute of Medical Science, University of Toronto (Hodaie, A. Noorani, Ibrahim); Cognitive Science in Education, Department of Human Development, Teacher's College, Columbia University (Mak); and Elmspace (Hodaie, Ibrahim, A. Noorani, S. Noorani).**

Background: Coaching and reinforcement are integral concepts in Competence By Design (CBD), but have had limited integration in current surgical education evaluation models. We address this limitation through the implementation of microlearning (MLM): a novel eLearning technology. MLMs are mobile-based, bite-sized, procedural modules constructed based on CBD entrusted professional activities (EPA). MLMs allow learners to focus on knowledge and technical requirements that reinforce CBD criteria for competence. The Department of Surgery at the University of Toronto has embarked on a pilot project implementing MLM in surgical education, specifically designed based on CBD criteria of competence. **Methods:** Our platform consists of an artificial intelligence (AI)-powered mobile-based app (ELMSpace), developed for surgical trainees. Each module focuses on an EPA, with 3 main components. The first is knowledge primer and assessment, reinforcing key EPA concepts. The AI engine then assesses the learner's level of preparation and knowledge mastery. The second is procedural primer, which visually reviews key aspects of the procedures. The third is knowledge reflection, where learners reflect on their performance and gauge their journey toward competence and mastery. Through the above steps, the AI engine augments the learning experience by tracking the learner's engagement and competency, identifying gaps, and forecasting the trajectory for completion of objectives. **Results:** Quantitative and qualitative evaluation tools will assess the effectiveness of MLMs through assessment of progress and EPA completion, EPA performance, learner reflections, and the Ottawa Surgical Competency Operating Room Evaluation (O-SCORE). **Conclusion:** MLMs complement coaching and reinforcement learning, allowing greater resident participation in CBD.

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Authorship gender disparity and trends in female authorship in 5 high-impact orthopedic journals from 2002 to 2022. *Reva Qiu, Katie van Kampen, Emily Domerchie, Patricia Farrugia.* **From McMaster University.**

Background: While gender equality in medicine is improving, it unfortunately continues to lag in orthopedic surgery. From 2001 to 2019, the number of female orthopedic surgeons in Canada increased only from 5.5% to 13%. Several factors may play a role in this discrepancy; however, this is still poorly defined. As such, we aim to further characterize trends of women authorship in orthopedic surgery research. **Methods:** A bibliometric analysis was undertaken to identify all female authors of articles (January, April, July, October) published quarterly in 5 high-impact orthopedic journals (*Journal of Bone and Joint Surgery*, *Clinical Orthopedics and Related Research*, *Journal of Orthopedic Research*, *Journal of Hand Surgery*, and *Arthroplasty*) at 5 time points from 2002 to 2022 (2002, 2007, 2012, 2017, 2022). Three independent reviewers collected characteristics of articles (topic, type, country) and authors (gender, degree). Gender was identified using Genderize. Ambiguous names were manually searched. **Results:** Preliminary data reveal that from 2002 to 2022, total female authorship increased from 10.4% (195 of 1879) to 20.8% (423 of 2034) across 5 high-impact orthopedic journals. Further data analysis will compare female authorship trends with growth of practising female orthopedic surgeons, orthopedic residents, and medical students. **Conclusion:** Although women make up more than half of medical students, they account for only 26% of orthopedic surgery residents and 11.9% of faculty positions. Female authorship in orthopedic research is no exception and prior studies show that women continue to publish less than men, despite growth in the number of practising women orthopedic surgeons and residents.

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The landscape of Canadian academic surgery: analysis of gender representation, academic rank, and research productivity. *Stuti M. Tanya, Maxine Joly-Chevrier, Anne Xuan-Lan Nguyen, Daiana Roxana Pur, Rebecca J. Power, Sanjay Sharma, Fiona Costello, Femida Kherani.* **From Department of Ophthalmology & Visual Sciences, McGill University (Tanya); Faculty of Medicine, Université de Montréal, (Joly-Chevrier);**

Faculty of Medicine and Health Sciences, McGill University (Nguyen); Schulich School of Medicine and Dentistry, Western University (Pur); Department of Urology, Dalhousie University (Power); Department of Ophthalmology, Queen's University (Sharma); Departments of Clinical Neurosciences and Surgery, University of Calgary (Costello); and Department of Surgery, Section of Ophthalmology, University of Calgary (Kherani).

Background: Gender disparity in academic surgery is well documented; however, there are no studies comparing surgical specialties in Canada. Our study assesses the association between gender and research productivity among Canadian academic surgeons. **Methods:** Surgical residency programs, academic rank, and gender were identified using publicly available sources. The h index, number of publications, and number of years active were collected using Scopus. Data were described using descriptive and basic statistics. The m quotient was determined by dividing h index by the number of years active. The effect of gender based on these criteria was assessed using a 2-sample Wilcoxon rank-sum (Mann–Whitney) test. **Results:** Among all surgical specialties, men occupied 82% of full professorship (780 men, 175 women) and 73% of overall faculty positions (3853 men, 1666 women). Men had significantly more publications, number of active years, and higher h index in ophthalmology, otolaryngology, urology, general surgery, and orthopedic surgery, with no statistically significant gender difference in m quotient. Men had significantly more publications, number of years active, higher h index, and higher m quotient in obstetrics and gynecology. There was no statistically significant gender difference for number of publications, h index, and m quotient in plastic surgery and vascular surgery, although the number of active years was higher for men. There was no statistically significant gender difference for number of publications, number of active years, h index, and m quotient in cardiac surgery and neurosurgery. **Conclusion:** Gender disparities were observed in all surgical specialties. Further research is needed to assess longitudinal association.