



CSTAR

Canadian Surgical Technologies and Advanced Robotics  
London Health Sciences Centre

# CSTAR Annual Report 2019-2020

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WORKING TOGETHER TO SHAPE THE FUTURE OF  
HEALTHCARE

# Message From the Directors



Andrew Mes, CSTAR Director



Christopher Schlachta, CSTAR  
Medical Director

In 2019, CSTAR continued to make meaningful strides toward the LHSC vision of “Working together to shape the future of health” and CSTAR’s mission “to improve the quality and safety of patient care through interprofessional healthcare innovation including research, simulation and education.” As you read through these pages of our second annual report, you will appreciate that CSTAR continues to advance new discoveries and innovations that optimize the health and wellbeing of those we serve at LHSC and that we are growing in our capacity to educate the health-care providers of tomorrow.

CSTAR, now well established as an accredited simulation centre by both the American College of Surgeons and the Royal College of Physicians and Surgeons of Canada has further demonstrated our capabilities by being awarded the John G. Wade visiting professorship by the Royal College and by being selected as one of three participating centres in evaluating the Advanced Modular Manikin.

Our in situ simulation program continues to grow as a leading example of multispecialty and interdisciplinary simulation training. From neurosurgery boot camp to ultrasound, endoscopic, and laparoscopic workshops, the CSTAR model for hands-on simulation training leverages our outstanding, technologically advanced facility and continues to make us regional leaders with national and international outreach.

Our research and discovery program, supported by our Director of Engineering, Dr. Rajni Patel, is now leading or collaborating on over \$10 million of research grants focusing on technologies for improving patient care and enhancing training. Of particular interest is our venture into virtual reality, artificial intelligence and the possibility of automated surgical tasks. More to come on that front.

As always, CSTAR's ongoing success is derived from our outstanding staff and their commitment to excellence. The CSTAR team continues to receive regular accolades for their customer service and professionalism. It is a remarkable group with whom we have the pleasure of working. Through the next few pages we hope that you will share our enthusiasm and celebrate our accomplishments.

Andrew Mes, Director CSTAR  
Christopher Schlachta, Medical Director CSTAR

# CSTAR's Mission and Vision

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**Our Vision** is to be the leading, internationally recognized centre for advancement in surgical technology, research and education.

**Our Mission** is to improve the quality and safety of patient care through interprofessional healthcare innovation including research, simulation and education. As part of a teaching hospital, CSTAR collaborates with external and internal research and education partners to achieve this mission.

# Accreditation

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## Royal College of Physicians and Surgeons of Canada

### CSTAR awarded John G. Wade Visiting Professorship

CSTAR, in partnership with the Schulich School of Medicine and Dentistry and the Centre for Educational Research and Innovation (CERI), was awarded the John G. Wade Visiting Professorship by the Royal College of Physicians and Surgeons of Canada. This prestigious award provides support for us to bring a distinguished professor in simulation, Dr. Walter Eppich, MD, PhD, Associate Professor Pediatrics and Medical Education at Northwestern University Feinberg School of Medicine to London to share his experiences with us. Originally scheduled for May 2020, we have had to postpone the event due to Covid 19. Please check our website for more information.

### CSTAR achieves Limited CPD Provider Status

CSTAR was granted Limited CPD Provider Status with the Royal College which enables us to accredit our own courses for Section 1 and Section 3 Continuing Professional Development credits.



AMERICAN COLLEGE OF SURGEONS

*Inspiring Quality:  
Highest Standards, Better Outcomes*

100+years

## American College of Surgeons

### Advanced Modular Manikin Study

As an Accredited Education Institute with the American College of Surgeons, CSTAR had the opportunity to apply to be a host site for the Advanced Modular Manikin study. The purpose of the study was to evaluate the experience of using a new innovative human patient simulation platform developed by the University of Washington (UW) and the University of Minnesota (UMN) and funded by the Department of Defense.

CSTAR was selected as one of three host sites, the only one in Canada. Working in collaboration with representatives from the Departments of Surgery and Anesthesia, and local and military first responders, we obtained our ethics reviews and were ready to proceed with the study; however, in the end, the timeline for the ACS only allowed for one host site to participate. In keeping with the requirements of the agreement with the Department of Defense a military site was selected to move forward. Despite our disappointment at not being able to participate, we were proud to have been selected and feel that the experience we gained will position us well for future opportunities.

# CSTAR Education Advisory Committee

The Committee provides strategic oversight to CSTAR simulation and CME programs and services, while upholding a focus on the promotion of quality, patient safety and inter-professional education. By bringing varied perspectives to the table, CSTAR benefits from a range of expertise, experiences and skills.

Dr. Christopher Schlachta, Medical Director, CSTAR, Consultant, General Surgery

Dr. Richard Cherry, Associate Dean, Learning with Technology & Simulation, Consultant, Anesthesia

Dr. Jeff Yu, Consultant, General Internal Medicine

Ana Malbrecht, Educational Coordinator Medicine

Dr. Robert Leeper, Consultant, Critical Care and General Surgery, In situ

Dr. Mary Fotheringham, Simulation Director, Consultant, Emergency Medicine

Dr. Marie Eve Lebel, Simulation Lead, Consultant, Orthopedic Surgery

Dr. Brent Lanting, Consultant, Orthopedic Surgery

Terri MacDougall, Education Coordinator Surgery

Dr. Julie Ann VanKoughnett, Program Director, Consultant, General Surgery

Stacey Wanlin, Research Manager, Fowler Kennedy Sports Medicine Clinic

Belinda Gougoulas, Coordinator Respiratory Therapy

Donna McAnallen, Manager Nursing Professional Practice

Rob Blanchette, Manager, Patient Safety and Accreditation

Andrew Mes, Director CSTAR

Tara Oke, Coordinator CSTAR

Stephanie Ayres, Simulation Consultant CSTAR

Maria Quiroz, Learning Assistant CSTAR

Dr. Christopher Schlachta, Medical Director

Andrew Mes, Director

Tara Oke, Coordinator

Stephanie Ayres, Simulation Consultant

Rachel Daniels, Surgical Suite Associate

Maria Quiroz, Learning Assistant

Meghan Lightfoot, Administrative Assistant

Karen Siroen, Surgical Suite Associate

Scott Sumpter, Simulation Tech Consultant

## The CSTAR Team

At CSTAR, we have an outstanding staff to facilitate your learning experience, providing you with support at every step of your educational event, from planning to execution, including post-event evaluation and debriefing.

Contact us at [cstarinfo@lhsc.ca](mailto:cstarinfo@lhsc.ca) for more information

# Bringing Simulation to the Front Line

According to the Society for Simulation in Healthcare in situ simulation is defined as “taking place in the actual patient care setting/environment in an effort to achieve a high level of fidelity and realism”

Over the past year, the team at CSTAR has been working hard to expand in situ simulation offerings at LHSC. In partnership with Dr. Sonja Payne, Anesthesiologist and Elizabeth McGowan, Nursing Educator, we implemented a new in situ program in the Post Anesthetic Care Unit. We also collaborated with physicians in the Cardiac Care Unit and Emergency Departments to provide resources and expertise to expand their existing in situ programs; and partnered with the Resuscitation Team to conduct simulated Code Blue sessions across both sites.

Scenarios are based on real, experienced events designed to provide staff an opportunity to practice skills that may be used less often and to test the system to ensure the resources and environment are optimized for safety and reliability. Every in situ event concludes with a debrief where learners are encouraged to reflect on performance, discuss challenges they may have encountered and make recommendations for the future. Feedback on performance is provided by the facilitators. Issues with equipment, access to supplies, role clarity and gaps in process or education are identified and brought forward to area leadership for follow-up.





To increase the realism and performance feedback of in situ simulations we implemented three new pieces of equipment, two of which were designed and built in-house by our Simulation Technician Scott Sumpter:

- In situ cart complete with patient monitors, a sound system, and recording devices, that is compatible with our SimMan3G mannequins or can be run in Simulated Patient mode.
- Ultrasound simulator that is compatible with our mannequins where images can be uploaded specific to the scenario.
- Resusci Anne QCPR provides in the moment feedback on the quality of CPR, including compression depth, rate and release; ventilation; and hands-on time. The mannequin can be intubated and shocked; tracks the timing of significant events during a code blue scenario; and is easily transportable allowing us to offer simulated arrests to other sites.

In March we were contacted by the Anesthesia department with a request to support essential in-situ simulation training for personal protective equipment technique and safe airway management in the patient with suspected/confirmed COVID-19. With limited notice, we were able to support development and delivery of multidisciplinary perioperative in-situ simulations. Over 100 perioperative nurses and Anesthesiologists were trained over 4 days. Feedback from the Anesthesia education lead at University Hospital for COVID preparations, Dr. Sonja Payne, highlighted our team's commitment to collaborate and the excellent quality of service provided to facilitate delivery of this fundamental training.

Our goals for the upcoming year include expansion of this in-situ framework to other departments, complete with training and resources for instructors to increase their confidence in leading and facilitating in-situ simulation.



# Celebrating Our Successes – New Courses

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## Sepsis Escape Room

CSTAR partnered with Professional Practice to design an escape room focused on educating nurses and front line staff about early detection and treatment of sepsis. Participants have to work through nine activities to “save” their patient Annie Escape. The escape room is designed to be mobile so that we are able to offer sessions outside of CSTAR and make it accessible to staff from both sites. The learning objectives focus on the need to perform a thorough assessment of the patient; recognize the SIRS criteria; communicate relevant concerning findings with the health care team; and identify prioritized medical interventions for the septic patient.

Based on feedback from our pilot with the Critical Care Outreach Team, we made changes and added extra “clues” to improve the experience for learners, and stay within our desired timeline for completion. We also created pre-briefing and debriefing tools to ensure that key learning points are reinforced with each group.

Between October 2019 and March 2020, 314 nurses and respiratory therapists participated in the escape room challenge. While not all groups escaped during the allotted time, each group was able to work through the clues and participate in a debrief to instill the key learning points. We are working with the Clinical Educators to continue to include the escape room in orientations and skills fairs to help increase awareness of sepsis across the organization.



# Celebrating Our Successes – New Courses

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## Canadian Neurosurgery Rookie Camp

The Canadian Neurosurgery Rookie Camp, launched in 2012, has the primary objective of supporting new trainees with their transition from medical school to residency and helps to prepare them for a future career in Neurosurgery. Developed by Dalhousie University's Division of Neurosurgery in collaboration with the Neurosurgery Specialty Committee of the Royal College of Physicians and Surgeons of Canada and with support from the Canadian Neurosurgical Society, the training is offered annually at rotating sites across the country.

In 2019, the camp was hosted by the Department of Clinical Neurological Sciences (CNS), Schulich School of Medicine & Dentistry, Western University at CSTAR for the first time. The program was directed by Drs. Mel Boulton and Sandrine de Ribaupierre. Over the course of two days, attendees had the opportunity to participate in basic neurosurgical skills training and simulated cases that provide trainees the knowledge necessary to manage the clinical scenarios they will face in their early neurosurgical rotations. Trainees had the opportunity to learn from instructors who travelled across Canada to participate in this valuable experience.

The Department of CNS looks forward to working with CSTAR in the future to host the upcoming 2021 event.



**“I felt that this strongly helped in solidifying knowledge in a readily applicable manner for starting residency.”**

**“Fantastic two days. Thank you so much.”**

# Celebrating Our Successes - Milestones

## Canadian Resuscitative Ultrasound Course (CRUS) – 10 Years Strong!

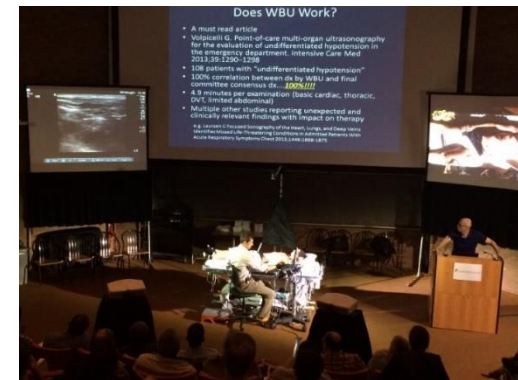
On July 30th, 2019, the Canadian Resuscitative Ultrasound Course (CRUS) celebrated its 10th annual course at CSTAR. This course started as a local effort, lead by then resident Dr. Rob Arntfield, in 2009 to introduce the concepts of bedside ultrasound to a small group of motivated faculty and residents. By its 10th instantiation, CRUS has evolved in to the largest and most comprehensive course of its kind offered in Canada. CRUS focuses on the core skill set required to begin the road to competency in point of care ultrasound from image acquisition and interpretation to clinical integration in cases with cardiac and respiratory failure and vascular access.

The 2-day course is structured in a flipped classroom format with lectures provided prior to the course, so that time spent in CSTAR's state of the art facilities is dedicated to hands-on sessions with a 2:1 student to faculty ratio.

Annually, this course brings together clinicians involved in resuscitation such as intensivists, emergency physicians, anesthesiologists, and internists. It also draws renowned faculty such as Dr. Drew Thompson, Dr. Behzad Hassani, Dr. Heather Hames, Dr. Fran Myslik, and Dr. Ahmed Hegazy.

Particularly interested in resuscitative ultrasound, CRUS course director, Dr. Rob Arntfield, has co-authored the textbook: Point-of-Care Ultrasound and elevated the course to one of national eminence. For the first time since its beginnings at CSTAR, this two-day course was held at 2 sites: CSTAR in London Ontario and in Edmonton, Alberta.

*“Over the 10 years of this course, many changes have occurred in the curriculum and in the culture of what is now known as “point-of-care ultrasound”. We have enjoyed tremendous success in building our local presence as a leader in this field and this is in no small part due to the talented staff and vision of CSTAR.” Rob Arntfield*



**“Fantastic course for all level of physician learners. Well worth the investment.”**

**“The balance of hands on training for image generation and the image interpretation sessions demonstrating actual pathology and potential pitfalls maximized learning”**

# Celebrating Our Successes - Milestones

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## Course for Residents in Advanced Therapeutic Endoscopy (CREATE) Celebrates 5th Year

Residents have limited exposure to advanced endoscopic therapeutic maneuvers in their core training, yet are expected to be experts upon entering practice. This course provides an opportunity for trainees to practice essential skills relevant to all gastroenterologists, such as polypectomy and hemostasis, and allows exposure to advanced techniques which they may not have experienced in their home programs.

Multiple instructors are engaged in the delivery of this one-day course with a combination of lecture and hands-on practice. Residents have attended from all 5 Gastroenterology Training Programs across Ontario. This course has been very popular; however, registration is limited each year to maintain a 2:1 ratio of participants to instructors.

Each year participants complete a comprehensive evaluation of lectures and hands on stations to determine which components were valuable to include in future courses. In addition, residents are asked to suggest any other techniques not provided which would be beneficial for future courses. Annual course development, is then based on input from trainees from prior years' evaluations and the experience of the expert faculty on the ever-changing techniques of modern endoscopy. Course directors also include the local junior trainees who will be attending the upcoming course to understand needs from their perspective. This was the 5th year of offering the course at CSTAR - participating trainees have consistently evaluated the course as extremely helpful and have voiced their appreciation for the opportunity to participate and the time spent by instructors in organizing and delivering the content. For 2020, input from GI Training program directors and their respective chief residents will also be solicited in the form of a needs survey to help optimize CREATE.



**“Amazing experience. Hands on is outstanding experience.”**

**“Should be mandatory for all GI fellows.”  
“Should be available for more fellows to attend.”**

# Celebrating Our Successes - Milestones

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## 500 Trainee Milestone for SAGES Resident Workshops at CSTAR

In 2019, CSTAR achieved a new milestone for Canadian Surgical trainees attending SAGES Resident Workshops in Minimally Invasive Surgery. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) is the premier, global society for gastrointestinal endoscopic surgery and surgical innovation. Since 2008, CSTAR has been welcoming Canadian General Surgery junior and senior residents from across Canada, along with international faculty, for SAGES sponsored, two-day workshops in Basic Laparoscopy and Endoscopy, Advanced Upper GI and Bariatric surgery and Advanced Colorectal surgery.

On November 21, 2019 the sixteen attendees from the University of Calgary, Dalhousie, Manitoba, McGill, McMaster, Memorial, Saskatchewan and Western included the 500th trainee to attend these special hands-on workshops that have been generously, continuously, supported by Ethicon.



# CSTAR's Expanding Learning Platforms

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After years of dedication and vision, the \$4 million-dollar project to equip LHSC with a cardiac hybrid operating room is now a reality. This OR brings together surgical facilities and the resources of a cardiac catheterization lab; enabling health teams to perform concurrent interventional and surgical procedures using fluoroscopy and minimally invasive procedures. As part of the project, the new OR was connected to CSTAR, allowing future learners to observe procedures and learn life-saving procedures and techniques without necessitating access to the prized OR floor.

To celebrate the completion of the project, donors who made the project a reality were invited to witness the inaugural surgery from CSTAR's own Multi Media Theatre on March 3rd, 2020. Dr. Chu performed a transcatheter aortic valve implantation in the OR, while the audience at CSTAR watched in real time. The attendees were able to observe every part of the surgery, including real time ultrasound and fluoroscopy imaging, live video, and audio feed.

Remote surgical education is now added to CSTAR's vast learning platforms!



# Promoting Interprofessional Education

"Interprofessional education occurs when students from two or more professions learn about, from and with each other to enable effective collaboration and improve health outcomes"

- World Health Organization, 2010

Participants in interprofessional education programs benefit from an increased understanding of the roles and skills of other professions; building of interprofessional networks; improved communication; and potentially a 'shared language'. Working collaboratively in a safe learning environment encourages students to broaden their perspectives and helps to build respect amongst teammates. The majority of our in situ simulations involve interprofessional learning and the benefits of improved communication, consistent understanding of practices and role clarity are evident during the debriefing sessions.

Despite the recognized benefits, most professions continue to learn in silos, and it is our goal to continually increase the amount of interprofessional learning that occurs at CSTAR. In the past year we assisted with bringing together new nurses and personal support workers to participate in a collaborative orientation process. According to Jonathan Lao, Clinical Educator with the PSW Resource Team, nurses and personal support workers appreciate the opportunity to learn about the similarities and differences between their roles and many have expressed that it sheds clarity around how the two roles can work together effectively to care for patients in a complex and evolving healthcare environment. Learning how to collaborate through training in CSTAR allows for a positive transition to the floors, which also sets an example for existing staff.

We will continue to seek out opportunities for increasing interprofessional education in the coming year and are looking to establish a working group to guide this work.

**"Understanding "what's mine", "what's yours", and "what's ours" is clearer after combined orientation. I am happy to have met my peers before I start working on the floor."**



In September, CSTAR celebrated Healthcare Simulation Week. From Monday to Wednesday, CSTAR had a display available outside of the cafeteria at University Hospital where people could practice their CPR skills with feedback available to them on the depth and rate of compressions; or attempt an intubation on one of our task trainers.

CSTAR also partnered with the Resuscitation Team to conduct simulated Code Blue sessions, in situ, in the University Hospital cafeteria. The goal of these sessions was to promote the use of simulation as a teaching tool; and to introduce staff to the concept of mock code exercises, delivered in the clinical environment, which will be rolled out across both sites as a means for identifying educational needs for staff, and environmental and systems issues that need to be improved upon.

Plans are already underway for adding more events next year to continue to celebrate and promote the use of simulation as an education tool.



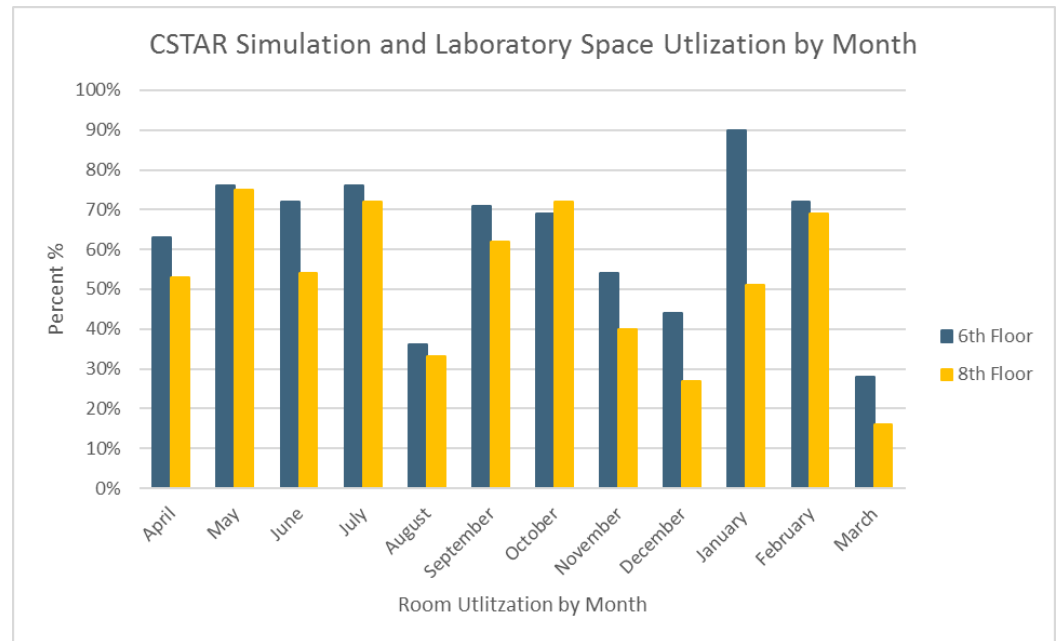
# CSTAR Celebrates Healthcare Simulation Week

Healthcare Simulation Week, sponsored by the Society for Simulation in Healthcare, recognizes professionals who use healthcare simulation to improve the safety, effectiveness, and efficiency of healthcare delivery

# CSTAR Facility Utilization

Located on three floors within the Lindros Legacy Research building at University Hospital, CSTAR is a 22,500 square-foot facility with world-class facilities and equipment.

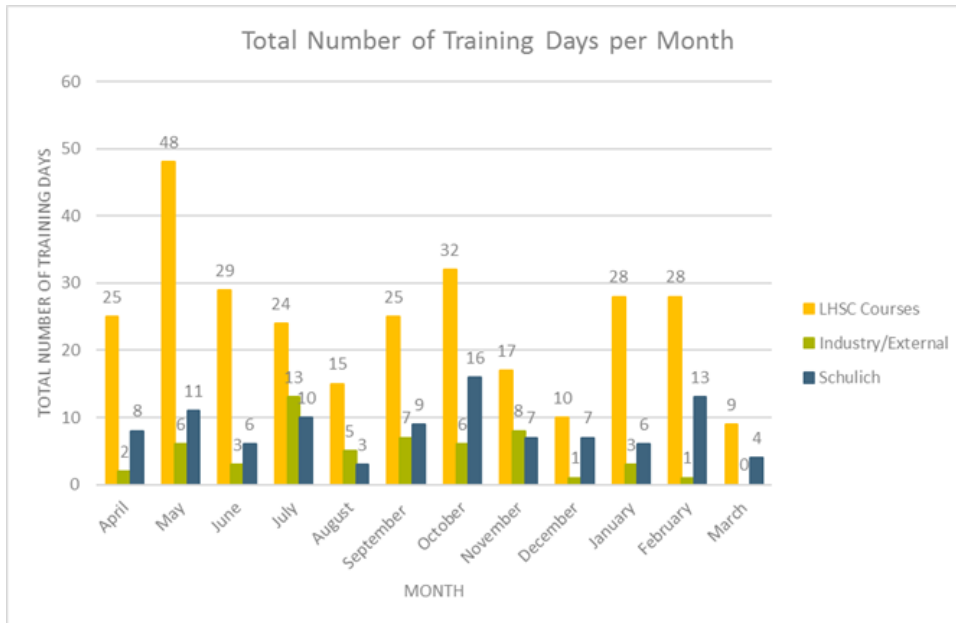
To book a room contact [cstarinfo@lhsc.on.ca](mailto:cstarinfo@lhsc.on.ca)



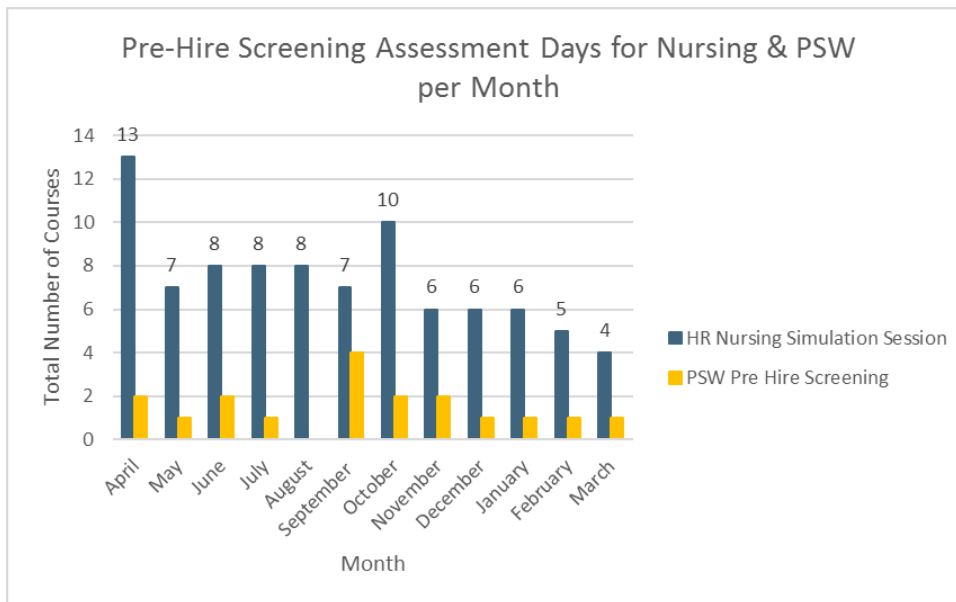
CSTAR 6<sup>th</sup> floor includes the 2 Simulation Rooms, Skills Lab, Kirkley Meeting Room and Advanced Learning Suite

CSTAR 8<sup>th</sup> floor includes the Acute and Chronic Laboratories

# Education & Assessment

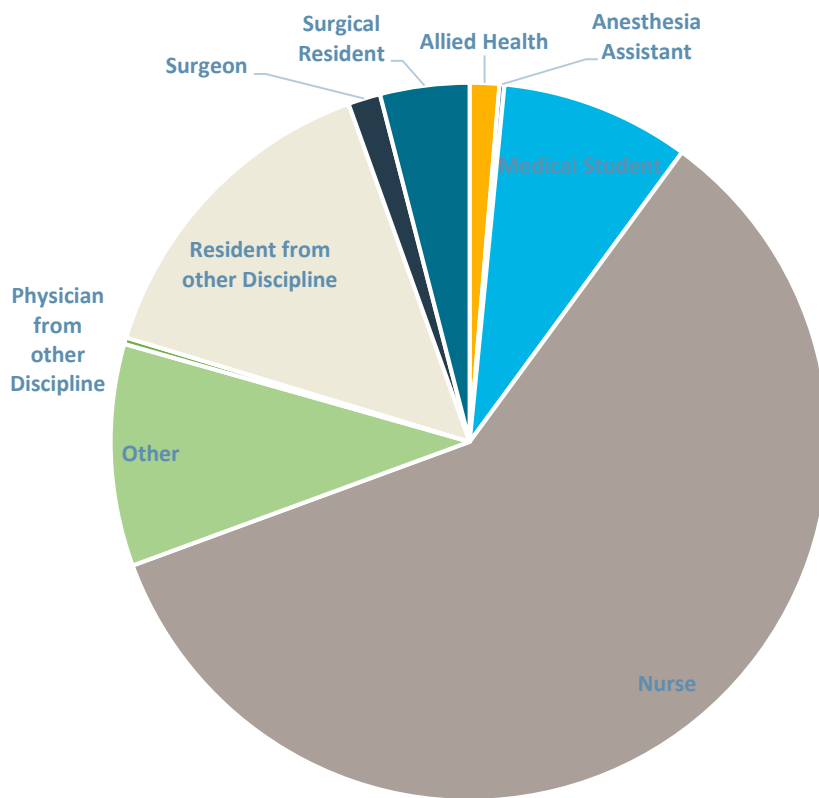


CSTAR provides the framework for high-quality simulation-based education programs for healthcare professionals. Resources include medical and surgical task trainers, virtual reality simulators, and high-fidelity simulation environments.



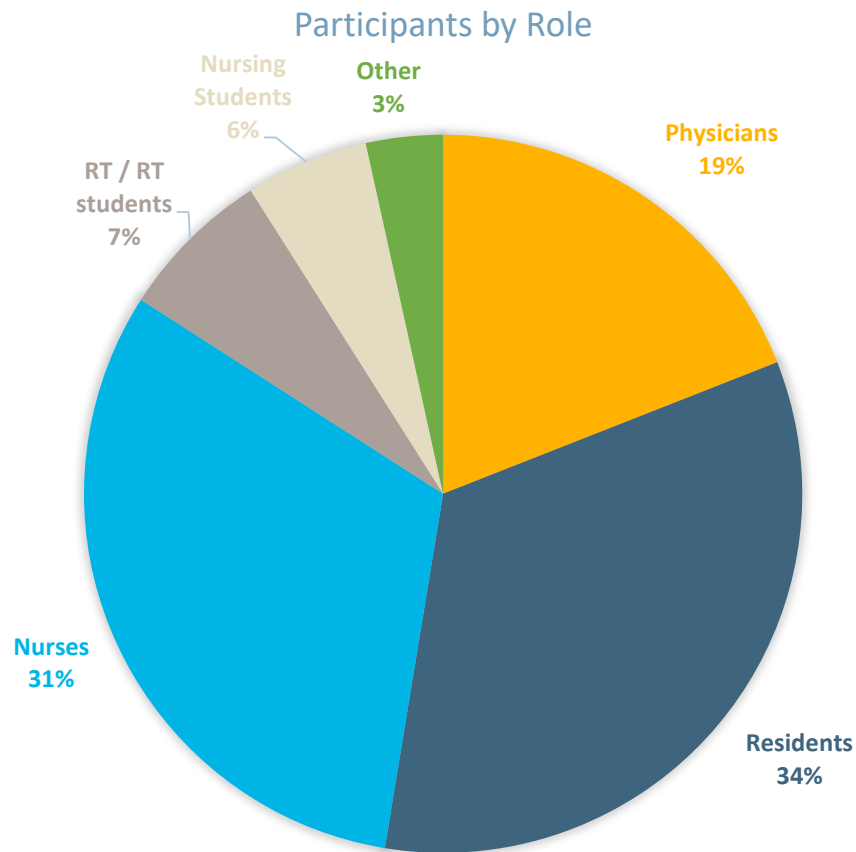
# Learners at CSTAR

Learner Type based on 2019-2020 Fiscal Year



Learner Type	Total
Allied Health	85
Anesthesia Assistant	14
Medical Student	545
Nurse	3792
Other (includes Personal Support Worker)	639
Physician from other Discipline	19
Resident from other Discipline	948
Surgeon	93
Surgical Resident	257
<b>Total # of Learners</b>	<b>6392</b>

# In Situ Simulation



Program	# of sessions	Total participants
CCU	13	111
PACU	3	31
ED	3	28
Anesthesia	27	119
<b>Total</b>	<b>46</b>	<b>289</b>

# Research at CSTAR



Dr. Rajni Patel  
CSTAR Engineering Director

CSTAR operates a collaborative research program between LHSC, Lawson Health Research Institute and Medical & Engineering departments at Western University.

CSTAR provides an environment that enables meaningful collaboration of researchers, engineers and surgery clinicians who, collectively, identify solutions to current and future challenges in surgical care.

## FUNDING:

### Research Grants Under Review:

1. K. Shoemaker (co-PI), R.V. Patel (co-PI) and 8 others, Canada Foundation for Innovation: Innovation Fund: *Immersive Virtual Reality for Health (IVRH)*; Total: \$13,188,858 (CFI: 40%; ORF: 40%; industry/institutions: 20%); 2020-2022.
2. E. Diller (PI, UofT), R.V. Patel and 8 others, Canada Foundation for Innovation: Innovation Fund: *Centre for Hospital to Homecare Robots (CH2R)*; Total: \$9,113,294 (CFI: 40%; ORF: 40%; industry/institutions: 20%); 2020-2022.
3. T. Peters (PI), J. Drake (co-PI, UHN), R.V. Patel and 5 others, Ontario Research Fund (ORF) Research Excellence – Round 10: *OCP-MINI - Ontario Consortium for Precision Minimally Invasive Neuro-Intervention*, \$3,274,713, 2020-2025.

## Ongoing Research Grants:

1. R.V. Patel (PI), C. Schlachta, and J. Hawel, Intuitive Surgical Technology Grant: *Design, Evaluation and Validation of a Novel Sensorized Training Colonoscopy Device*, US\$60,000; 2020-2021.
2. J. Jagadeesan (PI, Harvard), R.V. Patel, and 3 others (from Harvard and Siemens, USA), National Institutes of Health (NIH, USA) – RO1: Academic-Industrial Partnerships for Translation of Medical Technologies: *Robot-Assisted 3D ICE Catheter for Cardiac Ablation*, US \$2,233,095; 2020-2025.
3. J. Jagadeesan (PI, Harvard), R.V. Patel and D. Sacco, National Institutes of Health (USA), NIH-RO1: *Image-registered, Hand-held, Concentric Tube Robot for Percutaneous Treatment of Calculi*, US\$1,865,755, 2019-2024.
4. R.V. Patel, NSERC Discovery Grant: *Design and Control of Robotic Systems and Devices for Medical Applications*, \$380,000, 2019-2024.
5. R.V. Patel, Tier-1 Canada Research Chair: *Advanced Robotics and Control*, \$1,400,000, 2018-2025.
6. R.V. Patel (PI) and 4 others, CIHR-NSERC Collaborative Health Research Projects Grant: *Novel Haptics-Enabled Robotic Systems for Rehabilitation Therapy*, \$546,792, 2014-2021.
7. R.V. Patel, NSERC Research Tools and Instruments — Category 1 Grant: *A Multimodal Interface for Neurorehabilitation of Movement Disorders*, \$100,607, 2018-2020.
8. T. Peters (PI), R.V. Patel, C. Schlachta and 7 others, Canada Foundation for Innovation: *Minimally-invasive Surgery and Therapy*, Total: \$6,782,283 (CFI: \$2,712,913, ORF: \$2,712,913; industry: \$1,356,457; 2017-2019.
9. R.V. Patel (co-lead) and M. Jog (co-lead): Project WP5.3 in AGE-WELL Network of Centres of Excellence (AGE-WELL): *An In-home Intelligent Exercise System for Physical Rehabilitation, Enhancing Musculoskeletal Function, and Preventing Adverse Events*, \$717,990, 2015-2020.

## PUBLICATIONS

### Peer Reviewed Journal Papers

1. M. Khosravi, S. F. Atashzar, G. Gilmore, M. S. Jog and R.V. Patel, "Intraoperative Localization of STN During DBS Surgery Using a Data-Driven Model," *IEEE Journal of Translational Engineering in Health and Medicine*, vol. 8, pp. 1-9, 2020, Art no. 2500309, doi: 10.1109/JTEHM.2020.2969152.
2. S. Shahtalebi (visiting PhD student), S.F. Atashzar, O. Samotus, R.V. Patel, M. Jog and A. Mohammadi, "PHTNet: Characterization and Deep Mining of Involuntary Pathological Hand Tremor using Recurrent Neural Network Models," *Nature: Scientific Reports*. (2020) 10:2195; 19 pages.
3. M. Bernardinis, S.F. Atashzar, M. Jog, and R.V. Patel, "Differential Temporal Perception Abilities in Parkinson's Disease Patients Based on Timing Magnitude," *Nature: Scientific Reports*, 2019; 9:19638; 15 pages.
4. F. Anooshahpour, P. Yadmellat, I.G. Polushin and R.V. Patel, "A Motion Transmission Model for a Class of Tendon-Based Mechanisms with Application to Position Tracking of the da Vinci Instrument," *IEEE/ASME Transactions on Mechatronics*; vol. 24, no. 2, pp. 538-548, April 2019.
5. A. Usova, I.G. Polushin, R.V. Patel, "Scattering-based stabilization of complex-interconnections of (Q,S,R)-dissipative systems with time delays," *IEEE Control Systems Letters*, vol. 3, no. 2, pp. 1-13, Apr. 2019.
6. S. Shahtalebi (visiting PhD student), S.F. Atashzar, R.V. Patel, A. Mohammadi, "HMFP-DBRNN: Real-time Hand Motion Filtering and Prediction via Deep Bidirectional RNN," *IEEE Robotics and Automation Letters*, vol 4, no. 2, 2019.
7. S. Shahtalebi (visiting PhD student), S.F. Atashzar, R.V. Patel, A. Mohammadi, "WAKE: Wavelet decomposition coupled with adaptive Kalman filtering for pathological tremor extraction," *Biomedical Signal Processing and Control*, vol. 48, pp. 179-188, Feb, 2019.
8. S.F. Atashzar, M. Shahbazi, R.V. Patel, "Haptics-enabled Interactive NeuroRehabilitation Mechatronics: Functionality, Challenges and Ongoing Research," *Mechatronics*, vol. 57, pp. 1-19, 2019.
9. Almamar A, Schlachta CM, Alkhamesi NA. The systemic effect and the absorption rate of aerosolized intra-peritoneal heparin with or without hyaluronic acid in the prevention of postoperative abdominal adhesions. *Surgical Endoscopy*. 2019;33(8):2517-20.
10. Hilsden R, Khan N, Vogt K, Schlachta CM. Staplers vs. loop ligature: A cost analysis from the hospital payer perspective. *Surgical Endoscopy*. 2019;33(10):3419-24.



11. Alsowaina KN, Ahmed MA, Alkhamesi NA, Elnahas AI, Hawel JD, Khanna NV, Schlachta CM. Management of colonoscopic perforation: A systematic review and treatment algorithm. *Surgical Endoscopy*. 2019;33(12):3889-98.
12. Koichopolous J, Hawel J, Shlomovitz E, Habaz I, Elnahas A, Alkhamesi NA, Schlachta CM. Correlation of surgical trainee performance on laparoscopic versus endoscopic simulation. *Surgical Endoscopy*. 2020;34(5):2007-11.
13. Vourtzoumis P, Alkhamesi N, Elnahas A, Hawel JE, Schlachta C. Operating during COVID-19: Is there a risk of viral transmission from surgical smoke during surgery? *Canadian Journal of Surgery*. 2020;63(3):E299-301
14. Lau E, Alkhamesi NA, Schlachta CM. Impact of robotic assistance on mental workload and cognitive performance of surgical trainees performing a complex minimally invasive suturing task. *Surgical Endoscopy*. 2020;34(6):2551-9

## Refereed Conference Papers

1. V. Mehrabi, S.F. Atashzar, H.A. Talebi, R.V. Patel, "Design and Implementation of a Two-DOF Robotic System with an Adjustable Force Limiting Mechanism for Ankle Rehabilitation," IEEE International Conference on Robotics & Automation (ICRA2019), Montreal, Canada, May 20-24, 2019..
2. M. Shahbazi, S.F. Atashzar<sup>†</sup>, C.D.W. Ward, H.A. Talebi, R.V. Patel, "Multimodal Sensorimotor Integration for Expert-in-the-Loop Telerobotic Surgical Training," IEEE International Conference on Robotics & Automation (ICRA2019), Montreal, Canada, May 20-24, 2019.
3. M. Khosravi, S.F. Atashzar<sup>†</sup>, G. Gilmore, M. Jog, R.V. Patel, "DBS Electrode Selection in Deep Brain AStimulation Surgery using a Neural Network Model," 41<sup>st</sup> Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Berlin, Germany, July 23-27, 2019.
4. M. Bernardinis, S.F. Atashzar, M. Jog, R.V. Patel, "Visual Temporal Perception in Parkinson's Disease Analyzed using a Computer-Generated Graphical Tool," 9th International IEEE/EMBS Conference on Neural Engineering (NER), San Francisco, CA, March 20-23, 2019.
5. M. Khosravi, S.F. Atashzar, G. Gilmore, M. Jog, R.V. Patel, "Unsupervised Clustering of Micro-Electrophysiological Signals for Localization of Subthalamic Nucleus During DBS Surgery," 9th International IEEE/EMBS Conference on Neural Engineering (NER), San Francisco, CA, March 20-23, 2019.

# Thank You

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FOR SUPPORTING CSTAR IN 2020