AN INSIDE LOOK AT THE LARGEST SURGICAL PROGRAM IN CANADA

SPROTT

DEPARTMENT OF SURGERY

Innovative
Cutting edge
life-saving
World
renowned
award
winning
groundbreaking
difference
making
transforming
Lives
medical
breakthroughs
disrupting the
Status quo

13 DIVISIONS
140 SURGEONS
Training the
WORLD'S
finest
GLOBAL
REACH

Here's why
Sprott
Surgery
is one of
the best
Surgical
departments
in the WORLD

UHN
Toronto General
Toronto Western
Princess Margaret
Toronto Rehab
Michener Institute

Sprott Surgery on the global stage

Every member of the Sprott Surgery team is vital to our world-class organization.

Spread across the pages of this magazine is the finest surgical team in the world. Nurses solving critical problems and nurturing much-needed innovation. Anesthesiologists stepping in front of danger to protect colleagues from unnecessary contact with COVID-19. Operating room attendants keeping everything running. Surgeons and scientists leading new discoveries that will make all the difference. At University Health Network, our goal is no less than achieving a healthier world, and the Sprott Department of Surgery is leading by example.

A patient has his sight – and confidence – restored because of the technological and medical advances in our Division of Ophthalmology. In our esophageal cancer program, our surgeon-scientists are growing tumours in a lab to better understand and treat the real ones harming our patients. A heart surgeon performs a world-first surgery that gives a young woman her life back. In these pages are only a few examples that tell the collective success story of Sprott Surgery. Every person who contributes to the thousands of surgeries we perform each year is a vital member of the team and necessary if we are to fulfil our mission.

We have the privilege of world-class facilities, well-respected labs and extraordinary teachers. Students and young surgeons come from all over the world to learn from the very best. They then return back to their home countries, ready to contribute their finely honed talents. Exporting our tremendous skill, knowledge and passion means Sprott Surgery is truly on the global stage.

The COVID-19 pandemic has made it clear how small our world is and how interconnected we all are. Small ripples from across the oceans can develop into tidal waves that crash onto our shores. We have felt the impact of this in so many challenging ways this year. But I am also reminded of the grace that comes from using our abilities to save lives, both here and around the world where Sprott Surgery values live on.

We're grateful to be able to do this, and even more so to be able to do it together.

Shaf Keshavjee, O.C., O.Ont, MD, M.Sc., FRCSC, FACS
Surgeon-in-Chief, Sprott Department of Surgery
James Wallace McCutcheon Chair in Surgery
Director, Toronto Lung Transplant Program
Director, Latner Thoracic Surgery Research Laboratories
Professor of Thoracic Surgery, University of Toronto
President, American Association for Thoracic Surgery

PHOTOGRAPHY: TIM FRASER

Sprott Department of Surgery magazine is designed and produced by ALLCAPS Content.

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We want to hear from you! Let us know what you think: **publications@uhn.ca**

DISCLAIMER: All photos were taken either before the COVID-19 pandemic or following appropriate physical distancing guidelines.

INSIDE SPROTT SURGERY

What is the Sprott Department of Surgery?

There's no surgical department quite like the Sprott Department of Surgery. Not only is it where some of the most complex operations take place, but it's also where many of the world's leading procedures and medical innovations are developed. With a department that spans 13 surgical divisions, anesthesia, critical care and three University Health Network hospitals –Toronto General Hospital, Toronto Western Hospital and Princess Margaret Cancer Centre – groundbreaking innovations, many of which have been funded by the Sprott Foundation and get exported globally, happen here all the time.

It's also a place that prizes collaboration. Clinicians, nurses, scientists and OR attendants share their knowledge with one another to provide the best care possible. While COVID-19 caused the number of surgeries completed to decline – it's typically around 35,000 annually – the teamwork and technology that Sprott Surgery has in place means it can tackle almost every medical challenge that comes its way.

"We're building on UHN's proud history of surgical firsts," says Dr. Shaf Keshavjee, Surgeon-in-Chief of the Sprott Department of Surgery. "We can offer such exceptional care because our surgical program trains and attracts the best talent from around the globe."

Sprott Department of Surgery

- ← General
- ← Vascular
- ← Cardiac
- ← Neurosurgery
- → Thoracic
- → Plastics
- ← Surgical Oncology
- → Transplant
- → Orthopedic
- → Urology
- ← Otolaryngology/Head and Neck
- ← Gynecology Oncology
- ← Ophthalmology

Surgeries performed between April 2020 and March 2021 by the Sprott Department of Surgery

19,813

- **10,656** Surgeries performed at Toronto Western Hospital
- **8,240** Surgeries performed at Toronto General Hospital
- **917** Surgeries performed at Princess Margaret Cancer Centre

140+
Surgeons who work in the Sprott Department of Surgery

8,273
Endoscopic procedures performed between April 2020 and March 2021

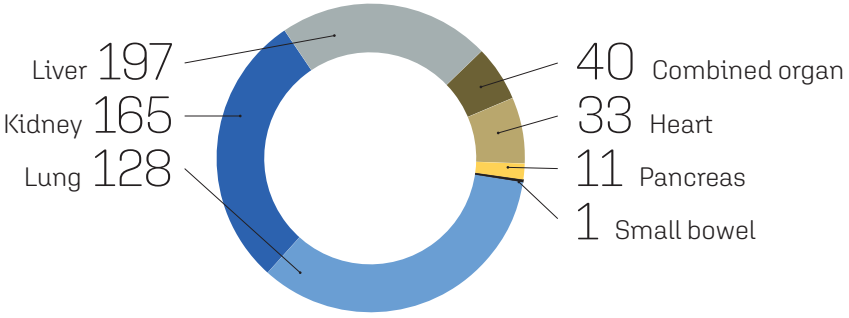
2,149
Cardiovascular and vascular surgeries Sprott Surgery performed with the Peter Munk Cardiac Centre in 2020

39
Operating rooms

260
Robotic surgeries performed between April 2020 and March 2021

Number of transplants Sprott Surgery performed with the Ajmera Transplant Centre between April 2020 and March 2021

575



Nurses, including Heather Wyers (right), work on a training manikin in the Nancy Bell Advanced Training Suite at Toronto Western Hospital.

THE NEW SCHOOL

UHN's perioperative nursing leadership implemented an education program to keep operating rooms staffed during COVID-19, and it's getting national attention.

By Glynis Ratcliffe

When COVID-19 hit Canada last March and operating rooms (ORs) slowed down, nurses from all over University Health Network (UHN) were redeployed to units where they were needed most. Since nursing colleges across Ontario were forced to stop in-person learning, which effectively shut down the clinical portion of their schooling, ORs in the Sprott Department of Surgery at UHN couldn't hire from the traditional source of new talent. That was a problem for Rose Puopolo, Clinical Manager of Perioperative Services in the Sprott Department of Surgery, who had to redeploy 30 nurses during the first wave and needed to continue hiring qualified perioperative – a term used to describe the entire surgery journey for a patient – nurses for the anticipated ramp up of surgeries.

"I couldn't find qualified perioperative nurses. The colleges, because of COVID-19, could no longer meet our immediate needs," she says.

Given how vital these nurses are to the surgical journey – they're an integral part of the team, also providing psychosocial support to patients along with being the surgical safety ambassador – Puopolo needed to find an innovative solution to recruit and retain perioperative nurses. She and Heather Wyers, Advanced Practice Nurse Educator at UHN, had wanted to continue to develop a program – Periop 101 – which was accredited by the Association of periOperative Registered Nurses to supplement existing programs, in part because they needed a way to bring in students throughout the year instead of just when courses are on. The pandemic was the perfect opportunity to expand and continue their plan.

This three-month Periop 101 course gives new recruits a unique opportunity to learn core competencies in an actual OR environment.

New hires also use the Nancy Bell Advanced Training Suite at Toronto Western Hospital, a lab where they practice their skills and start to develop crisis management skills in a safe environment. "Incorporating Sprott Surgery nurses in the simulations allows for team building among colleagues," notes Wyers, making it an easy transition when UHN hires them at the end of the course.

A total of 25 new recruits have come through Periop 101 since November 2019. The program has been so successful that hospitals across the province have reached out for advice on how to implement similar training efforts.

"It just makes sense," says Puopolo. "You can start it whenever, you tailor it to any specialty. It's not only about timing, it's also about integrating a team more efficiently."

Both Wyers and Puopolo decided to expand and continue the program as a more comprehensive Intro to Periop course for students in their final year of nursing school. "This is to give more nursing students an opportunity to fully immerse themselves in the OR," explains Wyers. "We hope they will discover their passion for it and return once they become a registered nurse."

The future is bright, Wyers says. "We have now recruited [nursing students] through the Intro to Periop course with the goal of stimulating interest in the perioperative specialty." ■

PHOTOGRAPHY: COURTESY OF UHN

The Surgical Wait time Information Management System was designed and developed at UHN.

All systems go

Thanks to a new UHN-built data-powered surgery management platform, even a pandemic can't stop Sprott Surgery from running world-class operating rooms.

By Anna Sharratt

In late 2019, the Sprott Department of Surgery built and launched a revolutionary data-centred surgery management system to help run its operating rooms (ORs) more efficiently. The technology couldn't have come at a better time. A few months later the world locked down and countless surgeries had to be postponed. That was a nightmare for most hospitals, but less so for Sprott Surgery, which had a secret weapon.

Managing the steady stream of surgeries is challenging for every medical centre, but especially for one of the best hospitals in the world – number four according to *Newsweek*. Sprott Surgery deals with highly complex cases that involve a lot of moving parts and coordination. While there are scheduled operations – 35,000 in a typical year – emergency procedures can bump previously slotted-in surgeries to another day, which can then create a backlog of operations. It's even harder to manage all of this during a pandemic, when normal surgical routines are completely upended.

Fortunately, Sprott Surgery had the new Surgical Wait-time Information Management System (SWIMS®). This one-of-a-kind innovative system, which was designed and developed at University Health Network (UHN) by the Techna Institute and Sprott Surgery, uses data analytics to support the surgical team's decision-making when determining how many surgeries can get done and in what order of priority.

Kelly Lane
Project Director, Techna Institute at University Health Network

Terri Stuart-McEwan
Executive Director, Surgical Services at Sprott Surgery

Dr. Shaf Keshavjee
Sprott Surgery's Surgeon-in-Chief

Dr. Tom Waddell
Sprott Surgery's Clinical Lead for Pandemic Recovery Planning

It allowed clinicians to have a much better idea of how COVID-19 was impacting their operations than they otherwise would. "Other centres just don't have this," says Dr. Shaf Keshavjee, Sprott Surgery's Surgeon-in-Chief and the James Wallace McCutcheon Chair in Surgery, who adds that there's no product on the market that can create a more consistent surgery flow – called smoothing – and manage the surgical backlog at UHN's size and scale. "This critical information enabled our teams to have much better coordination and let us more optimally and efficiently use the resources we have."

Key to this was Sprott Surgery's commitment to adopting and adapting surgical optimization – a system rooted in three key pieces. There's the Institute for Healthcare Optimization (IHO)-UHN surgical planning methodology, which is based on operations management tools and processes. Sprott Surgery took pieces of IHO's methodology and built a personalized system for its own patients. It lets Sprott Surgery's teams know exactly how many ORs are operational versus sitting idle, and what health resources are needed to get through different cases. Implementing this piece required UHN to undergo a comprehensive change management program.

The second is a UHN surgical backlog calculator. It lets everyone see how many cases need to be completed, which is typically hard to determine. Then, SWIMS reveals the types of cases that are in the queue and scores them based on urgency, helping clinicians prioritize which ones to tackle first. "Without this approach, about 20 per cent more patients would be at risk for not having their surgery in a timely manner," explains Dr. Tom Waddell, thoracic surgeon and Clinical Lead for Pandemic Recovery Planning at Sprott Surgery and the Richard and Heather Thomson Chair in Thoracic Translational Research.

All of this enabled Sprott Surgery to dramatically reduce the number of operations it postpones or cancels – because of this system, dedicated ORs are set aside for emergencies – while everyone and everything, including staff time, surgical beds and OR space, is now running at a more optimal and efficient level. That's been critical during COVID-19. "This system removes many of the factors that create uncertainty," says Kelly Lane, Project Director at the Techna Institute at UHN. "We can be far more proactive and have fewer surprises on surgery day."

Going forward, this innovative system will allow surgical teams to ensure that every patient gets the care they need when they need it. "It's taking accountability for all of our patients and their care needs," explains Terri Stuart-McEwan, Executive Director of Surgical Services at Sprott Surgery. "It has been very powerful." ■

PHOTOGRAPHY: TIM FRASER (KELLY LANE, TERRI STUART-MCEWAN, DR. SHAF KESHAVJEE), REGINA GARCIA (DR. TOM WADELL), COURTESY OF UHN (OPERATING ROOM)

Dr. Atul Prabhu (left) and Dr. Coimbatore Srinivas were part of the original 12 person Code Delta team.

Calling Code Delta

Critically ill COVID-19 patients got the care they needed from UHN's early response intubation team.

By Derek Malcolm

In March 2020, Ontario hospitals began filling with COVID-19 patients, threatening to overwhelm intensive care units (ICUs) and their staff. They needed help, and at University Health Network (UHN) that help came in the form of the Code Delta team. The quick-response unit was assembled to take over the critical job of performing endotracheal intubations – inserting a breathing tube in the patient's airway and placing the patient on ventilator support to assist with breathing. This intubation is a precise procedure that comes with an elevated risk of COVID-19 transmission, so it must be done quickly and safely. That's why the Sprott Department of Surgery called upon its intubation experts in the anesthesia department to help bring Code Delta to life.

With most surgeries shut down, Sprott Surgery reached out to more than 70 people across UHN to volunteer for an early-response intubation team. No one hesitated to say yes. Code Delta included roughly 25 anesthesiologists, 36 surgical nurses and 33 anesthesia assistants, as well as multiple attendants, pharmacy staff and operating room employees helping to organize the logistics that go into emergency tracheal intubations in the COVID era. In particular, this meant ensuring team members were dressed in personal protective equipment such as masks and gowns.

"The intention of Code Delta was to have a rapid, high-functioning team to go in and secure a COVID patient's airway, because the risk of infection to staff around them is highest during this procedure," says Dr. Coimbatore Srinivas, Site Chief of Toronto General Hospital in the Department of Anesthesia and Pain Management at UHN, and a member of the original 12-person Code Delta planning team that included leaders from across anesthesia, surgical services, critical care and nursing.

70+

Number of people across University Health Network who volunteered for Code Delta.

SOURCE: UHN

During each wave of the pandemic, the Code Delta team (named after the emergency code that rang out through the overhead speakers at the hospital to mobilize them) performed intubations on critically ill COVID-19 patients whose conditions had worsened to the point of needing a ventilator to survive. "As anesthesiologists, performing endotracheal intubation to assist with patients' respiration is a standard part of our practice," explains Dr. Srinivas. "But with COVID, the patients are extremely sick, and we're working in an infected environment where droplets can spread to staff. Code Delta has helped immensely."

When a Code Delta is called, a team of five – one anesthesiologist, an anesthesia assistant, two nurses and an attendant – rushes, with all the necessary equipment, to wherever the patient is. Only the anesthesiologist, anesthesia assistant and one nurse enter the patient's room to perform the intubation, while the nurse outside acts as a safety officer who carries out the critical role of ensuring that all staff are functioning according to the highest safety standards.

Intubation is only part of their job, though. Helping patients get through such a harrowing time is another. "It's never far from your mind that you may be the last person patients see before they go under for the placement of the endotracheal tube," says Dr. Atul Prabhu, Site Chief of Toronto Western Hospital and Deputy Anesthetist-in-Chief of the Department of Anesthesia and Pain Management at UHN. "It's important to make an instant connection with the patients and reassure them that we're going to look after them."

Over the last 18 months, the Code Delta team carried out hundreds of intubations, but importantly, it proved how much can be done when people pull together. "Code Delta has strengthened the camaraderie that exists between teams and has provided a better understanding of how, working together, we can rapidly and efficiently accomplish the most difficult tasks," says Dr. Prabhu. "There's greater appreciation for our interdependencies during a difficult time. Staff well-being and patient care have improved because of it." ■

ILLUSTRATION: MADE BY EMBLEM

THE CANCER FIGHTER

Sprott Surgery's new Head of the Division of Surgical Oncology, Dr. Girish Kulkarni, wants to combat cancer with cutting-edge research.

By Glynis Ratcliffe

Since joining University Health Network (UHN) a decade ago, Dr. Girish Kulkarni has become one of surgical oncology's pioneering surgeon-scientists. While his research centres around bladder cancer and understanding how this disease impacts different populations and people's overall quality of life, he's also working to bring this field into the future. In January 2021, Dr. Kulkarni was appointed Head of the Division of Surgical Oncology in the Sprott Department of Surgery –which encompasses Toronto General Hospital, Toronto Western Hospital and the Princess Margaret Cancer Centre, all part of UHN –a prestigious position that allows him to combine his passion for helping patients with his drive to further the study of oncology. We spoke to Dr. Kulkarni about his new role and the innovative research happening in his department.

PHOTOGRAPHY: REGINA GARCIA

What's your area of expertise?

GK: I specialize mainly in pelvic malignancies like bladder cancer, prostate cancer and penile cancer, and provide surgical support for other colleagues that need it – for example in the sarcoma and colorectal world, in multi-team cases. From a research perspective, most of my research is in bladder cancer – it happens to be the most expensive cancer to treat. Cancers in the bladder are rapidly recurring, which contributes to the expense. We put out one fire and then three months later it's back and we have to treat it again. Fortunately, bladder cancer-related clinical trials have really taken off because of immuno-oncology and immunotherapies being used in this space, and these will hopefully lead to decreased recurrences.

Why do you think Sprott Surgery has one of the leading surgical oncology divisions in the world?

GK: We tackle the most difficult surgical cases around, so we can give a fighting chance to those individuals who may not have had hope outside our walls. We can also provide the best possible cancer outcomes, in my humble opinion, for those with more straightforward cancers. Why? Because everyone here is dedicated to providing patients with the best-quality surgery – it's a rigorous process to be able to work within Sprott Surgery. The rate of intraoperative errors or perioperative errors is very low, and the chance of having the best possible outcome is greater because Sprott's surgeons are world leaders and understand where we are, where we have been and where we need to go.

Where do you see surgical oncology going?

GK: With new innovations and new systemic therapies, we are moving more toward minimally invasive procedures and more multidisciplinary treatments of cancers. So, it's not just a single surgeon taking out a tumour, but an interplay between radiation oncology, medical oncology and surgical oncology to treat and cure as many patients as possible. For example, one surgical innovation we've talked a lot about at UHN is fluorescent technology. It's being used in robotics, and also in endoscopic resections. In fact, I recently gave a talk on fluorescence in bladder cancer – with certain chemical agents the tumours will glow a specific colour so you can actually see and treat them better, and we have that occurring right now at Sprott Surgery.

What role do you think Sprott Surgery will play in the future?

GK: Toronto General Hospital is the number-four hospital in the world and the best in Canada, and Princess Margaret Cancer Centre is the best cancer centre in Canada, consistently ranking in the top five in the world in terms of research productivity. So, as surgeons, we have a real opportunity to advance the research agenda and improve outcomes for our patients, not only through surgical care but also through advances in precision medicine and improvements in quality of care. I'm hoping we can expand our footprint in the world of clinical trials as well. That could be intraoperative trials, trying one technique over another or a new innovation over another. Also, perioperative trials – where we provide therapy before surgery or right after to improve surgical outcomes. There are countless possibilities.

Do you have any personal goals as the new Head of the Division of Surgical Oncology at Sprott Surgery?

GK: One goal for myself is to ensure we employ surgeons of diverse backgrounds. There are a lot of opportunities to include individuals from different ethnic backgrounds and different sex or gender identities, which can improve representation in our community and contribute to optimal care as well. We'll have different viewpoints and we may also be able to reach different populations knowing their cultural backgrounds. Staying on top of that will help us recruit the best people in the world. ■

Dr. Timothy Leroux is using a mixed reality 3D environment to improve positioning and outcomes of shoulder replacement surgery.

ORTHOPEDIC

Rebuilding better than before

Using advanced 3D imaging and mixed-reality tools, Sprott Surgery is improving the outcomes for patients who need shoulder replacements.

By Nancy Mann Jackson

Tech matters

Innovation at Sprott Surgery

The use of mixed reality in the operating room is taking Sprott Surgery to a new level of precision medicine, allowing surgeons to interact in a meaningful way with a preoperative plan during live surgery.

"You can input the scan into the software and assess pitfalls, troubleshoot problems and consider different styles of implants ahead of time."
— Dr. Timothy Leroux

When a patient has a poor outcome from a shoulder replacement surgery, the reason can be traced back to surgical planning. Why? Because preoperative planning allows surgeons to anticipate and troubleshoot challenges, lessening the risk for error and increasing the likelihood of achieving the optimal implant position and patient outcome everyone was hoping for, says Dr. Timothy Leroux, an orthopedic surgeon in the Sprott Department of Surgery.

A common goal of shoulder replacement surgery is to reconstruct the joint "the way it originally looked, before arthritis caused deformity," he explains. However, this is easier said than done. Historically, planning for shoulder replacement surgery was based on 2D X-ray images. But shoulder deformity is a complicated 3D problem, making a 2D image inadequate to inform and guide the surgeon. For this reason, surgeons have shifted to using computerized tomography (CT) scans, which combine X-rays from different angles to create cross-sectional 3D images of the arthritic shoulder.

THE NEXT LEVEL OF IMAGING

Over the past five years, Dr. Leroux has worked collaboratively with the Joint Department of Medical Imaging at University Health Network (UHN) to standardize the use of CT scans to help improve the reconstruction and replacement of arthritic shoulder joints. Compared to 2D X-ray images, evidence suggests that 3D scans improve a surgeon's understanding of deformity and result in more reliable positioning of the implant during surgery. Now, surgeons like Dr. Leroux combine these 3D images with software that enables them to virtually operate before ever entering the operating room (OR).

"With the software you can anticipate and solve problems, optimize implant position, consider different styles of implants and even assess range of motion before taking knife to skin," says Dr. Leroux, who is also part of the Schroeder Arthritis Institute at UHN. While this technology is increasingly common, there is still room for error – a real shoulder is covered with muscle and other soft tissue, making it harder to find the spot on the bone that was so easy to see virtually.

To overcome this challenge, surgeons have used different strategies ranging from 3D printed shoulder models to customized guides for placing their implants in the ideal position. Unfortunately, these strategies are cumbersome and expensive, limiting their use.

With the arrival of mixed-reality, which combines virtual and actual reality, surgeons are considering ways to incorporate this technology into the OR to improve patient outcomes. Dr. Leroux is part of an international group working to translate virtual 3D plans into real-world shoulder replacement surgeries in a reliable, cost-effective and interactive way.

As part of this initiative, Dr. Leroux goes into shoulder replacement surgery wearing a HoloLens, a pair of smart glasses developed by Microsoft. This allows him to be in a mixed-reality environment where he can replace a shoulder in the real world while also interacting with his virtual 3D surgical plan, which is simultaneously in his field of view. "I'm able to make informed decisions in advance and easily act on them because of the planning technology and HoloLens," Dr. Leroux explains. While the technology is still new, the project's goal is for surgeons to plan their surgery in a virtual OR, load that plan into the headset and then use it to help guide placement of their implants without additional equipment or instruments.

Joanna Talotta
trained medical imaging technologists at UHN in the new CT scan techniques used for shoulder replacement surgery.

Chris Alissandratos
manages shoulder replacement equipment and implants, including new technology like the HoloLens.

A TEAM APPROACH

Dr. Leroux performs about 100 shoulder replacements each year, but a successful surgery is always a team effort, he says. Modernizing the approach to shoulder replacements required buy-in and ongoing support from nurses, the CT department and OR implant specialists.

CT scans used for shoulder replacement planning are slightly different from regular scans, so Dr. Leroux needed help educating CT technologists and ensuring each scan was done correctly.

Joanna Talotta, Supervisor of CT Scan and General Radiography in the Joint Department of Medical Imaging at UHN, worked to train technologists on the process. "Once the first case was successful, we then had a blueprint. Now all patients receive a scan protocol," Talotta explains. "From an imaging perspective, patients are being better assessed for their procedures. The images have better spatial resolution and doctors can interact with these CT scans using 3D surgical planning software, so there's less likelihood for mistakes."

"Joanna has been instrumental in the smooth transition from using X-rays to CT scans," Dr. Leroux adds. "A scan order for a shoulder surgery is no longer questioned, and through her tireless efforts these scans are all done right the first time. We have come a long way because of her."

Chris Alissandratos, OR implant specialist in the Division of Orthopedic Surgery within the Sprott Department of Surgery, meets regularly with Dr. Leroux to discuss his cases, ensuring he has the necessary equipment and instruments for each shoulder replacement surgery. He's been critical to bringing in all the new technology Dr. Leroux has been using, including patient-specific guides and custom implants to the HoloLens technology. "The implants have changed – in the materials used to manufacture them, the packaging and the geometry," says Alissandratos. "The HoloLens assists surgeons in performing complex cases with pinpoint accuracy while making adjustments intra-operatively. Dr. Leroux and I work closely to make sure everything is ready for the patient's surgery."

"At UHN, many people behind the scenes have been crucial in helping us become thought leaders in shoulder replacement surgery," says Dr. Leroux. Thanks to their contributions, Sprott Surgery's patients can benefit from tomorrow's surgical tools today. ■

PHOTOGRAPHY: ROBERTO CARUSO (DR. TIMOTHY LEROUX), TIM FRASER (JOANNA TALOTTA, CHRIS ALISSANDRATOS)

IN CONVERSATION

Always on call

There can't be surgery without OR attendants, yet many people aren't familiar with this critical surgical role. We brought together a leading surgeon and a top OR attendant to explain why this position is a key part of every operation.

In most hospitals, it's the surgeons who tend to get the bulk of the glory, but not a single procedure could happen if it weren't for operating room (OR) attendants. They are unsung heroes of the surgical world – responsible for setting up the OR, sterilizing equipment, helping patients get to surgery and many other vital tasks. Marcus George, Manager of Perioperative Support Services in the Sprott Department of Surgery, is one of the best OR attendants in the country, helping countless surgeries go smoothly day after day. In late May, during a brief moment of downtime, Dr. Fayez Quereshy, Clinical Vice President at University Health Network and a surgical oncologist in the Sprott Department of Surgery, spoke with George about how OR attendants are central to the surgical process.

DR. FAYEZ QUERESHY: Marcus, why do you think OR attendants are key to successful surgeries?
MARCUS GEORGE: We have awareness of the importance of our role – to both the patient and our team. We are there at the crack of dawn every day, setting up the ORs and getting patients ready for surgery. We must do whatever it takes to ensure our patient's journey is as pleasant and safe as possible. We are also the ones who take patients from the holding area into the OR, and that's a very important part of the transfer – patients tend to feel like it's their last opportunity to share their feelings before surgery.

DR.Q: What about you? What's your day like?
MG: I arrive at 6 a.m. and get started right away. We have to get patients in the OR by 8 a.m., so I'm reviewing staffing for each OR, I'm catching up with the night crew to see how things went, if there's anything we need to follow up on or pass on to the day staff. We get a handover report from the night staff, including any potential delays to surgeries. I'm also the point person to meet with contractors – we have a lot of construction happening in the ORs right now. I'm talking to them to make sure we don't have any interruptions to patient care. I'm trying to figure out how to get this work done and keep things safe for our patients.

DR.Q: What is the key to success for you?
MG: It's communication, which you can never have enough of. Another part of my job is to bring people together to talk about patients and procedures. You invite everybody who will be in the OR to discuss every detail, because someone will come up with an idea or a plan that we haven't thought of.

DR.Q: What's the first clue to you that a day might be difficult?
MG: I'll tell you something – we spend the entire day, and certainly the morning, when I arrive ensuring that nothing goes badly. We have an incredibly strong team here. Things happen – a patient goes into cardiac arrest, for instance – but in every situation the team pulls together. Even if someone's going on a break in that moment, they instead run into the room and do whatever they can to help that patient. It makes me proud to see people come together, and it's on every level, from the surgeons to OR attendants. Everyone comes to work to do their best for our patients.

DR.Q: What is your favourite part of the job?
MG: There's a lot, but there is one thing that makes me feel good and it's not what you might think. I often go downstairs for lunch and there's always someone who looks like they're completely lost. Sometimes I spend my entire break giving directions, helping people get to where they need to get to. One day I was in a rush and I noticed that a person was lost. I didn't have time to stop, but I had this feeling, this horrible feeling for hours later, thinking that I didn't do whatever I could to help. So, now I make a point of making sure to ask people if they need anything every time, rushed or not.

DR.Q: You could have worked in the intensive care unit (ICU) or dialysis or emergency. Why the OR?
MG: I have worked in all of those places before. I came to the OR in 2002 to fill a temporary position, but there was something about it that grabbed me. It's the sense of wanting to help and do whatever you can. We have people come here for surgery from the ICU and you see them walking out of here weeks or months later, and that is amazing. I love the place and the people. I have trouble going on vacation and am never sick – I don't want to miss anything. And, truthfully, it was 15 years ago that I was last away from the OR. I got chickenpox and I had to stay home for a few weeks.

DR.Q: What's one thing that drives you crazy in this job?
MG: It's when people don't recognize that we're all important members of the team here. When I first started in the OR it bothered me that the OR attendants didn't attend all the important events where people share learnings and teach people how to work better and safer. It made it difficult to see how our work impacted the overall patient experience. No one saw the OR attendant taking an extra few seconds to wipe off an area, which could prevent a patient from getting a surgical site infection, which, if they did, could result in a much longer hospital stay. Fortunately, a lot has been done to correct that. We've helped people understand why we're here, that we have an impact, that we deliver results.

DR.Q: How has COVID-19 affected your work?
MG: At the start we had multiple people running the ORs. We were wearing triple gowns and all kinds of personal protective equipment. We just didn't know, like everyone else, what was happening. Early on, we had a couple members of the team get COVID-19, and while everyone came out of it well, one of our attendants was intubated in the ICU. It was really scary. But we're very safe here – we've put a lot of things in place to keep us that way. We're always talking about ways to make things better because we need to take care of our patients and each other. So, it has impacted us a lot.

DR.Q: Last question: what would the OR be without OR attendants?
MG: I don't even want to imagine what that would be like. If anyone was missing from the equation it would be a disaster. That's how I like to think about it. ■

Speed round Quick questions for Marcus George

1. **What's your best quality?**
I'm just trying to make people laugh. We work in a very stressful environment, and I try to make people see the lighter side of things. I love laughing, I love smiling.

2. **Who is your favourite superhero?**
My mom. I call her every now and then to thank her for having me.

3. **There are two streets ahead of you and you must choose one to walk down: loyalty or truth?**
I'm going down the middle. They're the same to me. But I am a loyal guy. I'll do anything for this place.

4. **If you could have dinner with one person, dead or alive, who would it be?**
Nelson Mandela. He would be a fascinating person to talk to.

5. **Describe Sprott Surgery to a new surgeon.**
This is an amazing place to work and learn. We do a lot of innovative things, like our amazing green team led by Dr. Laura Donahoe to make the ORs more environmentally friendly.

PHOTOGRAPHY: REGINA GARCIA

ADVANCED SURGERY

A breath of fresh air

Cancers of the airway present unique challenges that can often prove fatal. But with innovative surgical techniques employed at Sprott Surgery – and the future plan of full tracheal transplants – such diagnoses don't need to be a death sentence.

By Glynis Ratcliffe

Nancy St. Gelais will be able to see her grandchildren again, thanks to Sprott surgeons.

Dr. Siba Haykal is finding a way to grow a replacement trachea that the body will more readily accept.

Nancy St. Gelais will forever remember the moment she found out that she had a large mass in her trachea. "The emergency room physician just kept saying, 'I'm so sorry,'" says the grandmother from Tillsonburg, Ont. "I remember saying to him, 'I just turned 62 years old. I'm not ready to die.'"

She came to her local hospital about 10 months after she started experiencing breathing troubles, which began in January of 2020 during one of her daily walks. At the time, she didn't think much of it. "Sometimes you just get a little breathless," she says.

She thought it was allergies or asthma, but her breathing worsened through the spring and into the summer. Still, she stayed home – in part because the world was now in lockdown, and she didn't want to risk catching COVID-19.

On the morning of November 26, however, St. Gelais woke up in a panic – she knew immediately that something wasn't right. Her breathing was extremely laboured while lying down, whereas before then it had only given her trouble when she was up and moving around. Worried that it might be a heart issue, she finally made the decision to go to the local hospital.

An EKG confirmed she hadn't had a heart attack, but the ER physician sent her for blood work and a lung X-ray. While she was waiting for those results, the physician also sent her for a CT scan, which ultimately revealed the mass on her airway.

GLIMMER OF HOPE

Within a few days, St. Gelais was referred to a thoracic surgeon at the London Health Sciences Centre. A bronchoscopy and further scans confirmed the worst: the tumour, which was adenoid cystic carcinoma – a rare type of cancer that doesn't respond well to chemotherapy or radiation – was inoperable due to its size and location.

The tumour was growing at the carina, where the trachea, or windpipe, splits into two branches in an upside-down 'Y' shape to reach each lung. While many tracheal tumours are successfully removed, along with part of the trachea itself, removing the carina would leave St. Gelais without a functioning windpipe. To complicate matters, her recurrent laryngeal nerves, which control vocal cord function, were wrapped around the tumour.

The best her clinicians could offer was to insert a stent to keep the trachea open for a short time longer. Soon, however, the tumour would obstruct her windpipe entirely. She was given less than a year to live. St. Gelais, who is very close with her two young grandchildren, feared the worst. "I was afraid that if I passed away now," she says, "that they would forget who I was."

There was one very faint possibility, however: during the departmental meeting in which St. Gelais' case was discussed, someone mentioned that world-renowned Toronto surgeon Dr. Shaf Keshavjee might be able to help. That was on December 2. Two days later she was at Toronto General Hospital for a consultation with Dr. Keshavjee, who scheduled her for surgery on December 15. In a matter of days, St. Gelais had gone from being inoperable – a terminal diagnosis – to having a fighting chance, all because the team in the Sprott Department of Surgery had the expertise and technology to solve a challenging case like hers.

INNOVATIVE PROBLEM-SOLVING

While getting St. Gelais into surgery was fairly effortless, the procedure to help save her was not. Clinicians had to use a cutting-edge, technically difficult surgery with two lead surgeons working in tandem: Dr. Keshavjee, Sprott Surgery's Surgeon-in-Chief, and Dr. Ralph Gilbert, Head of the Department of Otolaryngology/Head & Neck Surgery in the Sprott Department of Surgery.

Dr. Gilbert first needed to dissect the recurrent laryngeal nerves from the outside of the tumour so they could remove it and then repair the trachea without injuring the nerves that moved the vocal cords. Severing these nerves wouldn't have just stopped her from speaking, it would have prevented her from breathing, as the vocal cords act like the lips of a balloon for the lungs.

11 cm

Average length of a human trachea.

SOURCE: MEDSCAPE

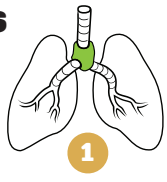
0.1

Number of primary tracheal tumour cases per million.

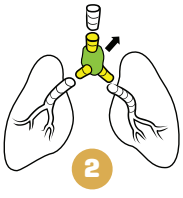
SOURCE: MEDSCAPE

Complex airways

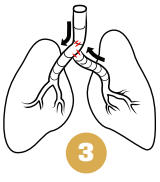
The tumour on Nancy St. Gelais' trachea required Drs. Keshavjee and Gilbert to think creatively when they embarked on her surgery. Here's what they did.



The tumour (green), sits directly on the carina, or upside-down 'Y,' of the trachea.



The carina (yellow) is removed with the tumour, leaving no way for the lungs to stay connected to the trachea.



The bottom of the trachea is sutured to the right lung, and a hole is made in the airway (bronchus) to the right lung to reattach the left lung.

PHOTOGRAPHY: ROBERTO CARUSO (NANCY AND EDWARD ST. GELAIS, DR. SIBA HAYKAL)

Dr. Keshavjee, who is also the James Wallace McCutcheon Chair in Surgery, notes that he regularly removes tumours of the trachea. But in the case of St. Gelais, "I had to take out a big part of the airway itself and part of both arms of that upside down 'Y.' What was left wasn't long enough to come back together." Because only about half of the trachea can be cut out, he moved the right lung closer to her neck, so that what remained of the right arm of the 'Y' could attach to the trachea. He then cut a hole into the side of that right arm to connect the arm to the left lung.

This type of synergistic work between a team of surgeons doesn't happen everywhere. "What we've learned is that when we work as a team, we can harness the expertise we have in upper airway and laryngeal surgery and merge it with the expertise that exists in our thoracic surgery team to produce the best outcomes for patients," says Dr. Gilbert.

After the two surgeons were done, a post-surgery CT scan confirmed St. Gelais' entire tumour was successfully removed and she was released from the hospital three days before Christmas. She's now gradually regaining her stamina, while her breathing has improved dramatically.

THE FUTURE IS ALMOST HERE

The outcome of this case is nothing short of miraculous, but there's even more groundbreaking work happening in the laboratories of Dr. Siba Haykal, a plastic and reconstructive surgeon with Sprott Surgery, and Dr. Tom Waddell, a thoracic surgeon with Sprott Surgery and the Richard and Heather Thomson Chair in Thoracic Translational Research.

The two clinicians are transforming the world of regenerative medicine, a field that deals with growing or replacing human cells, tissues and organs. Dr. Haykal's research focuses on what's known as vascularized composite allotransplantation (VCA) – surgical techniques to help transplant complex, multi-tissue parts of the body like the face, hand or trachea – which is made of cartilage, mucosal lining and muscle, as well as the small blood vessels that supply them.

One problem during transplantation is that donated organs or tissues can be rejected by the recipient. This is why anti-rejection drugs to suppress the immune system are necessary. Dr. Haykal has, however, discovered a potential groundbreaking solution. She realized that, while the immune system may reject a donor's airway scaffold, it won't do the same with a scaffold that's been repopulated with the recipient's own cells.

"My research really focuses on finding techniques to do this effectively and safely, without the need for immunosuppression or anti-rejection medication," Dr. Haykal says.

In 2013, under the tutelage of Dr. Waddell, Dr. Haykal completed her PhD thesis. They created and patented a bioreactor in which a trachea could conceivably be grown and wouldn't be rejected by the recipient post-transplant. The donor trachea is stripped, leaving only the cartilage structure. From there, cells from the recipient's bone marrow and airway are used to grow essentially a new trachea in the bioreactor that is "self."

While the bioreactor isn't yet capable of growing a trachea that will be accepted by the human body, the research is a jumping-off point for other issues surrounding organ transplantation, notes Dr. Waddell. According to research, the epithelium, a very thin protective tissue that lines organs and other body parts that are exposed to the outside world, is a main target of rejection. If the bioreactor is able to grow epithelial tissue from the recipient's own body onto the donor organ, it will reduce the likelihood of rejection, thus potentially eliminating the need for anti-rejection immunosuppressive drugs.

Dr. Waddell refers to this concept as chimeric organs, a mixture of donor transplant and stem cell regenerative medicine, where he and Dr. Haykal could replace only the donor material that the recipient's body is likely to reject. This is extremely innovative work, which will help bridge the fields of transplantation and regenerative medicine to include parts of the body that have been too difficult to transplant until now. "This idea of chimeric organs is what's really interesting about this project, and," Dr. Waddell adds, "how we may be able to move forward just with a few patients who really have no other options."

In the meantime, the Sprott Surgery team continues to help patients like St. Gelais, who can't find hope anywhere else, through innovative surgery and outside-of-the-box thinking. "I'm doing good. I'm looking forward to seeing my grandchildren," she says. "And, you know, it's all thanks to Dr. Keshavjee and Dr. Gilbert, because I'm not sure that I would even be here today if it wasn't for them." ■

Dr. Tom Waddell
is helping bridge the fields of transplantation and regenerative medicine.

Dr. Ralph Gilbert
had to disentangle the laryngeal nerves from St. Gelais' tumour before it could be removed.

Dr. Shaf Keshavjee
used cutting-edge surgery to remove St. Gelais' cancerous trachea.

A multiple award-winning surgeon

Dr. Keshavjee has won two of the biggest surgical awards in the world – in the same year.

Everyone knows that Dr. Shaf Keshavjee is a world-class surgeon, but he's also an award-winning one. Earlier this year, Dr. Keshavjee won the American Surgical Association Flance-Karl Award for his seminal contribution in basic laboratory research and its application to clinical surgery. He's the first Canadian to receive this prestigious honour. He also won the Canadian Medical Association F.N.G. Starr Award, the highest award given to a physician in Canada, in recognition of his outstanding and inspiring lifetime achievements.

PHOTOGRAPHY: REGINA GARCIA (DR. TOM WADDELL), TIM FRASER (DR. SHAF KESHAVJEE, DR. RALPH GILBERT)

Kate Mlacak is a vital part of Sprott Surgery's expanding robotics program.

PHOTOGRAPHY: REGINA GARCIA (KATE MLACAK, DR. TONY FINELLI, DR. TAYMAA MAY, DR. FAYEZ QUERESHY, DR. TOM WADDELL)

ROBOTIC SURGERY

Small cuts, big results

Sprott Surgery has employed minimally invasive machine-powered surgical techniques for many years. Here are just some of the innovators who continue to push the boundaries of robotic surgery today.

By Anna Sharratt

The Sprott Department of Surgery has long embraced innovation and new ways of working. So when technologies present themselves that can help clinicians do even more with their hands, eyes and minds, they jump at the chance to incorporate them into their operations. For more than a decade, Sprott Surgery has been making use of computer-guided robotics and tools to help surgeons access hard-to-reach areas of the body and make minimally invasive incisions. With this tech, clinicians don't have to open patients up for surgery, which then results in faster operations and recovery times. Here is some of the groundbreaking robotics work that Sprott Surgery is leading.

Kate Mlacak: The driver

If it wasn't for Kate Mlacak, a registered nurse and robotics coordinator at University Health Network (UHN), the pace of robotics advancement at UHN would be dramatically slower. That's because Mlacak has been instrumental in expanding the program and training the nursing staff on how to prepare the Da Vinci Surgical System, a multi-armed machine that surgeons use to conduct a wide range of minimally invasive surgeries. The system, which has several tool-holding arms, is operated from a separate console within the operating room (OR).

When Mlacak started her position as a robotics coordinator 10 years ago, robotic surgery at UHN was in its infancy. It was mostly confined to gynecological oncology surgery and prostatectomies. Since then she has watched the scope of treatment grow exponentially. Surgeons now perform everything from oropharyngectomy (a minimally invasive head and neck operation done through a patient's mouth) to nipple-sparing mastectomies. "I've been there to watch the program grow, and it has expanded in leaps and bounds," says Mlacak.

One of Mlacak's responsibilities is to stay on top of what's happening in the robotic surgery realm, especially given how quickly technology can change. She spends countless hours watching videos and reading papers on how other teams from around the world put these systems to use. She then shares her learnings with her colleagues. "For every surgery, the OR has a different configuration," she explains, which means she needs to know where to place these robotic tools so that floor space is optimized for the surgical team. "It's exciting that we can do these really massive surgeries and really big cases in a minimally invasive way."

It's the constant learning and improvement in patient care that drives her and her team of nurses. "I'm always doing something new for my patients," she says. "We're doing some really innovative things."

Dr. Tony Finelli: The leader

Dr. Tony Finelli is a master at non-invasive laparoscopic urologic procedures, which involve performing small incisions during radical prostatectomies, the removal of the prostate, and partial nephrectomies, the surgical removal of kidneys. The Head of the Division of Urology in the Sprott Department of Surgery and Chief of Urology at UHN has done more than 1,000 of these procedures since 2008, all of which reduce complications, cut down the length of a patient's hospital stay and lead to better outcomes than open surgery.

So when the robotic system was first introduced at UHN, Dr. Finelli welcomed the opportunity to harness its precision in the treatment of urological malignancies. "The robot accelerated the pace of the adoption of minimally invasive surgery. This technology allows you to spin your 'hands' 360 degrees," he explains, allowing for a tumour to be excised more precisely. Combining magnification with dexterity has enabled robotics for complex surgeries and hard-to-reach areas.

Dr. Finelli looks forward to the day when artificial intelligence (AI) will be integrated into robotic platforms to help surgeons increase safety and more accurately identify internal structures. The development of innovative imaging will help spare nerves, providing patients with better sexual function after the surgery and a higher quality of life.

"Imagine a tracer – an agent that lights up certain areas of the body – that can identify where the nerves exist around the prostate," he says. "That's the exciting future."

Dr. Taymaa May: The pioneer

For women with cervical cancer, treatment used to involve the complete removal of the cervix and uterus, leaving them cancer-free but without the ability to have children, says Dr. Taymaa May, a gynecologic oncologist in the Sprott Department of Surgery. But increasingly, surgeons like Dr. May are using a revolutionary technique called a radical trachelectomy to treat cervical cancer, removing the cervix, the upper part of the vagina, the lymph nodes and the supporting tissues, while preserving the uterus and the ovaries.

The six-hour, computer-assisted surgery, using a robotic arm, allows for minimally invasive laparoscopic incisions, and facilitates precise removal of the cancer tissue and the associated lymph nodes. "The patients have smaller incisions in their abdomen, less pain and they can go home the same day," says Dr. May. In the past they would have been hospitalized for four or five days.

But the biggest advantage of radical trachelectomy is that it preserves fertility. "Women have the option of carrying a pregnancy at a later time," explains May, who's one of fewer than 10 surgeons in Canada to have performed this surgery.

She has also expanded the procedure to treat another rare cancer that affects young women, adolescents and girls under age 18: rhabdomyosarcoma of the cervix, an aggressive cancer that forms in muscle tissue. "I have done this surgery for girls as young as two years old. Thankfully because of the surgery and chemotherapy they have the opportunity to reach adulthood – and the ability to get pregnant if they choose to do so in the future," she says. "It's amazing."

Dr. Fayez Quereshy: The trailblazer

Dr. Fayez Quereshy specializes in intestinal malignancies. So when the opportunity arose in 2011 to study robotic surgery in Hong Kong, a city known for its early adoption of robotic medical procedures, he jumped at the chance. "It was an outstanding experience," Dr. Quereshy says of his training, where he advanced his knowledge of how to use the robotic platform to treat colon and rectal cancers.

Back home, his training was put to use alongside the groundbreaking work of Dr. Finelli. "We were one of the first groups in Canada to do robotic rectal cancer surgery," says Dr. Quereshy, UHN's Clinical Vice President and a surgical oncologist in the Sprott Department of Surgery.

Compared to traditional surgery, which involves a large abdominal incision from above the belly button to the pubic bone, Dr. Quereshy and his team make small keyhole incisions in the abdomen. "The surgical trauma is much less due to the robotic footprint," he says. "Patients have reduced the need for intensive care units, reduced blood transfusion requirements and have a higher probability of completing the surgery with a minimal access approach."

Dr. Quereshy hails the technical advantages of the robotic platform, as tissues can be dissected in tight corners and there's less worry of cancer cells being left behind. Patients recover more quickly, retain anal sphincter function and need a permanent ostomy bag less often. "It's what our patients need," says Dr. Quereshy. "Being robotically enabled lets us get to the next level."

Dr. Tom Waddell: The visionary

Dr. Tom Waddell is a big proponent of video-assisted surgery when performing minimally invasive lung cancer operations. The enhanced ability to see areas within the body, the opportunity to operate without holding a camera, the higher sensitivity and the ability to spin in all directions allow him to perform precise removal of lung tumours. "Each camera goes to a separate eyeball of the surgeon so you have depth perception," similar to a pair of glasses, says Dr. Waddell, a thoracic surgeon in the Sprott Department of Surgery and the Richard and Heather Thomson Chair in Thoracic Translational Research. "And that facilitates a lot of aspects of surgery." He also appreciates the range of motion provided by the robotic platform, which allows a surgeon to access more areas in the lung and eliminates any possible unsteadiness.

He, too, is looking forward to a time when AI becomes integrated into the robotic platform. "We need to participate in the development of technology that's at the leading edge," he says. "What are the things surgeons need to do their job better, and how can we use that to push the limits of what we want to do? This is an exciting time to think about robotic surgery." ■

EDUCATION

21st century teaching tools

Sprott Surgery's innovative education programs train future surgeons and enable specialists around the world to learn from its clinicians, from wherever they are.

By Wendy Haaf

Dr. Allan Okrainec helped pioneer a distance teaching technique called telesimulation to train clinicians worldwide.

Standing in front of a suitcase-shaped simulator, a surgeon across the globe manipulates a set of gripper handles connected to instruments via long thin rods. Using images sent from a camera within the simulator to a nearby monitor to guide his movements, the physician delicately finishes tying a surgical knot, then snips the suture material. Thousands of kilometres away in Toronto, Dr. Allan Okrainec, who specializes in laparoscopic surgery, is watching, too. Via Skype, he offers the other clinician feedback and demonstrates how to improve his technique using a similar simulator.

This session, which took place several years ago, was one of the first-ever uses of telesimulation – a distance-teaching technique Dr. Okrainec helped pioneer – in medical education. And the course it was a part of ultimately would prove just how successful this type of hands-on remote learning could be. Still, back then, Dr. Okrainec couldn't have envisioned the world-class facility that one day would grow out of this remote teaching project: University Health Network's (UHN's) new Temerty Advanced Surgical Education and Simulation Centre (TASESC).

BUILDING BETTER REMOTE LEARNING

Occupying 12,500 square feet, TASESC will offer far more than just remote learning: its cutting-edge surgical simulators, labs and simulated operating room will provide a wealth of opportunities for on-site training. With construction of Phase 1 completed early last year, educational programming was slated to start in April 2020, but COVID-19 put those plans on hold.

TASESC is a natural extension of the considerable expertise that Dr. Okrainec, the Centre's Director, and several colleagues have developed and honed since the 2007 opening of the Temerty/Chang Telesimulation Centre at UHN, a forerunner of the new facility. To date, hundreds of surgeons from around the globe have graduated

from its remote training programs, learning advanced skills in specialty areas such as laparoscopy and anesthesia.

"We're building on this platform and advanced robotic technologies that we've developed over the last 10-plus years," says Dr. Okrainec, Head of the Division of General Surgery in the Sprott Department of Surgery and the Peter A. Crossgrove Chair in General Surgery. "It's a really exciting space that's going to have opportunities for training surgeons of the future in very new and innovative areas."

TOP TECHNOLOGICAL TOOLS

The new centre features several state-of-the-art learning spaces. There's a high-fidelity simulated operating room, which "is as advanced as anything we have on the clinical campuses, and will be a great space for training," Dr. Okrainec notes. "It's not just for surgeons, but the entire operative team, including nurses, anesthesiologists, perfusionists and anesthesia assistants." It will also provide a venue "to rehearse rare scenarios, like CPR in the operating room or a challenging case with a lot of bleeding," he says. "We can simulate those things and bring in the whole team."

Dr. Laura Donahoe
pivoted her teaching style during the pandemic to ensure UHN fellows could practice their skills at home.

Sophisticated educational recording equipment is one feature of a 10-bay self-directed skills lab. Here, learners will have around-the-clock access to tools such as virtual reality modules that will allow them to safely develop and hone their surgical skills, including advanced techniques unique to subspecialties such as neurosurgery and orthopedic surgery.

Concepts conceived in this lab can be trialled and studied across the hall in the innovation hub. Clinical fellows and research trainees across all surgical disciplines will be able to conduct research here, in an atmosphere that promotes the kind of collaboration and shared problem-solving that inspires transformative new ideas.

In addition, the new Centre features telesimulation and remote learning technology that's light-years ahead of the original laptop-and-Skype setup, including a live conferencing system and state-of-the-art tools for video recording and archiving practice sessions as well. "Technologies that facilitate remote learning are built into the entire Centre," says Dr. Okrainec.

SAVING STALLED TRAINING

Sprott Surgery's background in remote learning proved invaluable when the COVID-19 pandemic struck. Six surgeons who had come from other countries for one-year fellowships in lung transplants suddenly saw their training opportunities evaporate. "We were doing very few transplants because we were only open to the sickest patients," explains Dr. Laura Donahoe, a thoracic and transplant surgeon with the Sprott Department of Surgery, and a specialist in surgical education, who was responsible for teaching these senior fellows the advanced suturing skills involved in lung transplants. "You need to know how to load the needle so it goes through the tissue at exactly the right angle and pick it up without pulling hard enough to tear the tissue, especially when it's fragile, so I tried to quickly pivot and think, how could we help fellows practice their skills at home?"

She gathered the group together twice weekly via Microsoft Teams for instruction and feedback. The fellows recorded themselves practicing at home, and the class would review the videos and discuss ways they could improve what they were doing, says Dr. Donahoe.

Dr. Donahoe, who is also part of the Ajmera Transplant Centre at UHN, already had experience with technical skill simulations; she co-teaches an annual four-day bootcamp for thoracic surgery residents from across Canada. "We use pig aortas," which are clipped into metal holders, "and sew them together," Dr. Donahoe explains. Since this wasn't feasible for home study, however, Dr. Donahoe had to come up with an alternative with similar physical properties.

"We needed to find a high-fidelity material, meaning, similar to what it's like in the operating room," she says. Her solution? Home delivered kits containing metal holders, instruments, sutures and a child's birthday party staple… "Basically they practiced sewing balloons together," Dr. Donahoe says. "We changed the difficulty based on whether [the suturing field] was sitting close to them or deeper in the hole, like it would be in a chest," she adds, using a box or bag to mimic the latter scenario. "We also changed it so that one side was bigger, and they had to size match."

LAUNCHING INTO THE FUTURE

Later this year, work will begin on Phase 2 of the Temerty Centre, which will include a large wet-lab simulation space set up with training bays for working with cadavers and other biological materials. Plans are also underway to establish specialized training academies: one in robotic surgery and the other in artificial intelligence (AI).

"We're interested in AI and machine learning as a way to potentially assess skills and augment surgical teaching," Dr. Okrainec explains. "As an example, we can envision AI analyzing a surgical procedure and giving automated feedback."

The AI academy will also provide a place for researching new uses for machine learning and developing new software applications in surgical training and education.

At the robotic surgery academy, professionals from the entire operating room team, including early career residents, fellows, and practicing surgeons, will be able to learn and master new groundbreaking robotic procedures. The Centre will house several state-of-the-art surgical robots and will be a hub for developing and teaching new robotic surgical techniques to surgeons across North America and around the world.

Dr. Donahoe, for one, is eagerly anticipating the opportunity to deliver a more formalized curriculum for lung transplant fellows, as well as other dedicated thoracic surgery initiatives. "The resources there are amazing," she says. "There are lots of opportunities to really expand and grow." ■

PHOTOGRAPHY: TIM FRASER (DR. LAURA DONAHOE, DR. ALLAN OKRAINEC)

Mark Firth feels like he s been given a second chance at life, thanks to the Sprott Surgery team.

OPHTHALMOLOGY

Light at the end of the tunnel

After a devastating eye injury left him almost completely blind, a patient turned to Sprott Surgery's cutting-edge ophthalmology team. They restored his vision – and renewed his lease on life.

By Elizabeth Chorney-Booth

One morning last June, Mark Firth woke up in an unfamiliar hospital bed and, to his shock, realized that he couldn't see. As the 37-year-old from Kingston, Ont., would soon find out, a sudden and devastating accident had left him with significant trauma in both eyes, rendering him virtually blind. As a relatively young and active person with lots of friends and a job he loved with the City of Kingston, Firth had always taken his 20/20 vision for granted. Waking up without it left Firth stunned and anxious about what the rest of his life would look like.

Immediately after his accident, Firth underwent emergency surgery in Kingston to repair the damaged walls of his eyes, but both eyes were severely compromised. Each was filled with blood and had sustained damage to the lens at the front of the eye and the retina at the back. Since he couldn't work, cook or look after himself, and had to walk with a cane, Firth had to leave his home in Kingston and move in with family in Mississauga. His left eye was more damaged than the right, but the vision in his "good eye" let in only a small amount of light.

Because his sudden disability came as such a surprise, the injuries also took an enormous personal toll. "It was having a huge effect on me mentally. Things were going through my mind that I had never thought before in my entire life," Firth recalls. "I was always such a happy, positive and outgoing individual. I loved life and everything I did in my career, my friendships and where I lived. This just sucked the life right out of me."

A SECOND CHANCE FOR SIGHT

Once in Mississauga, a relative suggested Firth go see the team of surgeons in the Sprott Department of Surgery at Toronto Western Hospital, part of University Health Network (UHN). There, he was seen by Dr. Robert Devenyi, Head of the Division of Ophthalmology and Ophthalmologist-in-Chief and Co-Director of UHN's Donald K. Johnson Eye Institute, who came up with a plan to operate on both of his eyes. In September of 2020 the team worked on Firth's more damaged left eye, performing a retinal attachment. The eye needed to be filled with a silicone oil to replace the vitreous (the gel that fills the space in the eye between the retina and the lens) that was removed during the surgery through a process called a vitrectomy. Firth was left having to lie face down for 10 days while his retina set itself in place. While his vision in that eye remains limited, the operation was successful. His retina was reattached, and he can see more light than before.

PHOTOGRAPHY: REGINA GARCIA

Still, Firth's depression and discomfort grew. Fortunately, Sprott Surgery's team rallied around their patient and reassured him that there was hope for his right eye. He underwent two more surgeries: one in December of 2020 that marginally improved his vision with the insertion of an artificial lens and the removal of a cataract, and another in March of 2021 that changed Firth's life forever.

REBUILDING VISION

Because Firth's right retina was torn but not completely detached, Dr. Devenyi and vitreoretinal surgery fellow Dr. Pieter Van der Merwe were able to perform a far less complicated retinal repair and vitrectomy that didn't require him to rest face down. The day after the surgery, the clinicians were able to take off Firth's bandages and he could see almost perfectly out of his right eye, a result that Firth describes as a "miracle."

While the procedure used to repair the right eye is fairly common in Dr. Devenyi's work week these days, he says that only a few years ago a case like Firth's wouldn't necessarily have had such a positive outcome. "The key to any operation is to be able to visualize and see what you're doing properly. And our techniques for visualization in the operating room are so much better than they used to be," says Dr. Devenyi, who is also the Karen and William Barnett Chair in Ophthalmology. "We have these wide-field viewing and computerized imaging systems that allow us to see at multiple levels. There's not a week that passes when I can't successfully repair several patients who just a few years ago would have permanently lost their sight."

That specialized and constantly updated equipment is also handled by the surgeons' support team, including registered nurses like Rosa Lee, who served as a scrub nurse on Firth's final surgery. Scrub nurses are responsible for handling all sterilized equipment in the operating room, and with ophthalmology that means managing highly specialized tools.

An operating room nurse since 1989, Lee has always gravitated toward ophthalmology, and while she also serves in other settings, it's been her specialty for the past 15 years. That expertise, which also allows her to guide less-senior nurses through these specialized procedures, makes surgeries like Firth's go even more smoothly. "Doing ophthalmology, we have to deal with microsurgical instruments, which are very different from what's used in something like orthopedics," Lee says. "It's fascinating from a nurse's perspective to see the doctors using the technology to work inside the eye."

"The surgeons who work here are extremely experienced and really care about their patients and the value these surgeries can add to their lives."

— Dr. Pieter Van der Merwe

"The key to any operation is to be able to visualize and see what you're doing properly."

— Dr. Robert Devenyi

Additionally, Dr. Allan Slomovic, ophthalmologist and surgeon in the Sprott Department of Surgery, Owen & Marta Boris Chair in Stem Cell Vision Research, Research Director of the Cornea/External Disease Service and Director of the Ocular Stem Cell Transplantation Program at UHN's Donald K. Johnson Eye Institute, spearheaded numerous surgeries on Firth's right eye. "He's been an integral part of my rehabilitation and ability to see again," Firth says. "Truly one of the most caring and professional doctors I've ever met."

SEEING THE IMPACT

While Lee brings experience to the team, a fellow like Dr. Van der Merwe, who is here training from South Africa, represents the future of ophthalmology, learning under the guidance of more seasoned surgeons. Since Dr. Devenyi does 15 to 20 eye surgeries a week, developing an unbelievable wealth of experience, it's important for him to pass his know-how on to younger generations of clinicians who can see the possibilities of modern ophthalmology and the way it changes the lives of patients like Firth.

"The surgeons who work here not only are extremely experienced, but they really care about their patients and the value these surgeries can add to their lives," says Dr. Van der Merwe, who's also part of the Donald K. Johnson Eye Institute. "As eye surgeons, we're very aware of the impact that vision has on our patients' lives, and we celebrate the great results with the ones that are lucky to benefit from these interventions."

As for Firth, his life isn't exactly back to where it was before the accident, but with the vision in his right eye fully restored, he feels like a brand-new person and is looking to get back to his job and regular routines in Kingston. He has plans to give back to the visually impaired community by volunteering with the CNIB Foundation once he's back on his feet, as a means of thanking the Sprott Surgery team for helping to turn his life around.

"In that moment after the last surgery, when I realized I could see, I knew everything happens for a reason, and this experience is part of my story. I've told my doctors I'm going to make good on this. I've been given a second chance at life," Firth says. "I feel like one of the luckiest people on Earth." ■

PHOTOGRAPHY: TIM FRASER (DR. PIETER VAN DER MERWE, DR. ROBERT DEVENYI)

FELLOWSHIP PROGRAM

Training the world's surgeons

Clinicians from around the world come to Sprott Surgery to study from the best. They then take what they've learned to other centres across the globe.

By Diane Peters

The competition to get a job as a specialist surgeon at a prestigious teaching hospital is intense. Candidates need polished skills in the operating room (OR), solid research experience – which many gain via a master's or even a PhD, along with their MD – and stellar interpersonal abilities with patients and colleagues. Along with a five-year-plus surgical residency, physicians seeking these jobs need at least one high-profile fellowship, which is additional training in a subspeciality.

The Sprott Department of Surgery at University Health Network (UHN) attracts some of the most talented surgeons from across Canada and around the world. "UHN is the last resort for many patients in Ontario, which means our fellows are exposed to unique and difficult cases," says Dr. George Oreopoulos, Postgraduate Surgery Education Director and a vascular surgeon in the Sprott Department of Surgery. "We prepare them for the most challenging problems in their specialties."

Rare brain tumours, difficult cardiac conditions and demanding organ transplants are just some of the cases that are routine at Sprott Surgery. Not only do the fellows get plenty of opportunities to sharpen their skills in intricate and sometimes emergency surgeries – only 60 are accepted per year under 13 specialty umbrellas – but they're often working with incredible surgeons and specialists from other disciplines right in the OR.

Competition for these spots is tight. Dr. Oreopoulos, who is also part of the Peter Munk Cardiac Centre at UHN, helps vet the vascular surgery fellows, who must possess strong clinical, academic and interpersonal skills. "Being a fellow is not just about doing surgery," explains Dr. Oreopoulos. "It's about being fully developed as an academic surgeon." Fellows have a busy year-plus in the program, juggling surgical shifts with training junior surgical residents and doing research.

Sprott Surgery also sets itself apart by pressing fellows to further develop superior soft skills. Part of the research component of a fellowship entails developing a research plan and advancing a research project. Fellows also gain experience as part of – and at times by leading – multidisciplinary teams.

After the fellowship is over, the job hunt is on. Sprott Surgery fellows land prestigious positions all over the world – from Bangladesh to the U.S. to Zimbabwe – and, later, frequently call up their former mentors at UHN to ask about recent grads when their centres are hiring. They know they'll find well-rounded clinicians ready for the biggest jobs in surgery. "Our fellows go on to become leaders in their regions and in their specialties," says Dr. Oreopoulos.

Dr. George Oreopoulos is the Postgraduate Surgery Education Director for Sprott Surgery s international fellowship program.

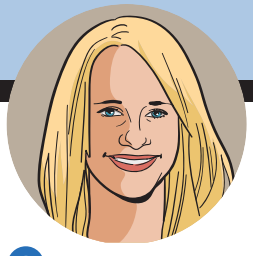
PHOTOGRAPHY: ROBERTO CARUSO

GLOBAL REACH

Fellows around the world

These are the home countries of the many fellows and medical students who have trained in the Sprott Department of Surgery at UHN. They come from nearly every nation on the planet.

Here is what five of Sprott Surgery's hard-working former fellows are doing today.



1 Dr. Genevieve Bouchard-Fortier

Specialty: **Gynecologic oncology**
From: **Quebec City, Canada**
Fellow at Sprott Surgery: **2013-16**

At UHN, Dr. Bouchard-Fortier is working to decrease the risks to patients undergoing cancer surgery by reducing blood transfusions and improving patients' blood sugar control, which is linked with better healing after surgery. She also led the multidisciplinary MiGOS initiative, enabling many more patients undergoing minimally invasive gynecologic oncologic surgery to go home the same day, which was especially important during COVID-19.

2 Dr. Nilto C. De Oliveira

Specialty: **Cardiothoracic surgery**
From: **Curitiba, Brazil**
Fellow at Sprott Surgery: **2001-03**

From the same hometown as UHN's very own Dr. Tirone David, Dr. De Oliveira is now the director of lung transplantation and professor of surgery at the Medical College of Wisconsin, giving many patients a second chance for a better quality of life.

3 Professor Karen Redmond

Specialty: **Cardiothoracic surgery**
From: **Dublin, Ireland**
Fellow at Sprott Surgery: **2007-08**

As the first female thoracic lung transplant surgeon in the British Isles, Prof. Redmond is leading the expansion of lung transplantation and Ex Vivo Lung Perfusion services in Dublin. Together, with fellow UHN alumnus Dr. Donna Eaton, they have led Ireland to a record number of lung transplants.

4 Dr. Claire Karekezi

Specialty: **Neurosurgery**
From: **Kigali, Rwanda**
Fellow at Sprott Surgery: **2017-18**

As the first and only female neurosurgeon in Rwanda, Dr. Karekezi is serving a population of 12 million, alongside five male neurosurgeons, bringing her international training and knowledge to her country's most vulnerable people and advancing neurosurgery care in the country.

5 Dr. Nathan Lawrentschuk

Specialty: **Urology oncology**
From: **Melbourne, Australia**
Fellow at Sprott Surgery: **2008-10**

Dr. Lawrentschuk, the Director of the Department of Urology at the Royal Melbourne Hospital, has a special interest in high-risk cancer surgery of the prostate, kidney, bladder and testis. He credits his fellowship with teaching him advanced robotic surgical skills, how to manage urologic malignancies and friendships that have opened doors for research and mentorship.

ILLUSTRATION: REMIE GEOFFROI

THORACIC SURGERY

The organoid solution

A new way of testing therapies on esophageal cancer proxies in the lab could point the way to safer, personalized treatment for all kinds of cancer.

By Colleen Seto

Organoids are small versions of an organ grown by researchers, thanks to leading edge technology.

People around the world are diagnosed with esophageal cancer every day, all of whom can only hope the therapy they receive will work. But what if instead of simply hoping a treatment is effective, you could know for sure that what your physicians are doing is designed to target your specific illness? It's these kinds of highly personalized treatments that University Health Network (UHN) researchers are working toward with organoids, a groundbreaking technology that allows researchers to grow small versions of an organ – sort of an "avatar" of your tumour. They're creating a representation of a patient's specific esophageal cancer tumours and then using these organoids in a lab to test the effectiveness of different treatments without risking harm to patients.

This kind of world-leading research couldn't come at a better time: esophageal cancer remains one of the most lethal cancers, with just 15 per cent of Canadians diagnosed with the disease surviving beyond five years. It also couldn't happen anywhere else. UHN has an esophageal disease program that's entirely focused on this cancer, while its multidisciplinary approach to care means that clinicians and researchers are always working together to come up with novel solutions to hard-to-solve problems.

Today, surgeons, radiation oncologists, medical oncologists and more collaborate not just on research but to minimize patient visits and provide expert patient care. "Previously we worked in silos, now we work together to improve delivery of care and optimize treatment," says Dr. Gail Darling, a thoracic surgeon in the Sprott Department of Surgery and the Kress Family Chair in Esophageal Cancer at UHN. "Our program's clinical oncologists and pathologists are entirely focused on esophageal cancer. It's not grouped with other GI cancers, and that's what makes the difference."

So far that teamwork has paid off with an operative mortality rate that's the lowest in the province and well below the world benchmark. But more work needs to be done, says Dr. Darling. One big challenge is that every patient's response to treatment remains unpredictable, making esophageal cancer difficult to treat. "There is no way to know what works," she explains. "Unlike other cancers, there are no common gene mutations to target for esophageal cancer, so what works for one patient may not work for another."

That's why this organoid research is so exciting. To create these tumours – which they have successfully done – her team puts cancerous tissue from patients into dishes where hundreds of organoids can grow over a few weeks' time. Because the tiny spherical cultures truly represent their originating tumours, they can be used to see what cancer treatments actually work. "The holy grail of cancer treatment is to treat cancers based on their specific biology," says Dr. Jonathan Yeung, a thoracic surgeon in the Sprott Department of Surgery who leads the translational component of the esophageal cancer program. By treating patient-specific organoids with a battery of cancer drugs available on the market, researchers can determine what works for each patient. "We can provide a targeted second, third or even fourth line of therapy."

Dr. Gail Darling
grows organoids with cancerous tissue from patients to determine the best treatment.

"Organoids are the holy grail of cancer treatment to treat specific mutations."

– Dr. Jonathan Yeung

Dr. Jonathan Yeung
is using organoids to better understand why esophageal cancer recurs frequently.

Researchers can use organoids to track the evolution of a tumour – taking samples before and after chemotherapy as well as post-surgery. If changes occur in the organoids, they can look for similar mutations in patients. "This can help with personalized surveillance," explains Dr. Yeung, which is critical because the recurrence rate is high. "Esophageal cancer spreads easily, and it often comes back elsewhere."

Bolstering its personalization efforts is Molecular Characterization of Esophageal Adenocarcinoma (MOCHA), the team's cancer genome sequencing project. With MOCHA, researchers use a laser to isolate the cells of the cancer. They can then sequence the cancer's genome to learn more about it and predict whether existing drugs might be useful and what still-to-be-developed medications could one day be used to treat it. "This will help us better understand why esophageal cancer comes back and how chemotherapy changes it," says Dr. Yeung.

The genome information is also included in its clinical database, which houses information on more than 800 patients, including such data as how many lymph nodes were removed during surgery to quality of life post-surgery. "Data is key," notes Dr. Darling. "We have very granular clinical data that correlates with lab data so that we can carefully evaluate and refine our techniques, and strive to always improve."

This research, which has been solely supported by donors, shows the potential for personalized care across all types of diseases, says Dr. Yeung. "We can use esophageal cancer as the model, but this paradigm can be adapted to other areas," he explains. "In the future, we won't be treating lung cancer or prostate cancer, we'll be treating Fred's cancer or Sally's cancer. We want to move away from inexact treatment to targeted care." ■

PHOTOGRAPHY: TIM FRASER (DR. GAIL DARLING, DR. JONATHAN YEUNG), COURTESY OF UHN (CELL IMAGE)

NEUROSURGERY

A meeting of the minds

At CRANIA, researchers create game-changing technologies to treat the world's most complex neurological diseases.

By Diane Peters

Dr. Taufik Valiante is helping to develop revolutionary brain related technologies at CRANIA.

PHOTOGRAPHY: REGINA GARCIA

There aren't many clinicians who can say they're creating cutting-edge innovations, improving surgical outcomes and dramatically enhancing people's lives. But that's exactly what Dr. Taufik Valiante does every day. As the Co-Director of University Health Network's (UHN's) CRANIA, which stands for CentRe for Advancing Neurotechnological Innovation to Application, he and his team are creating a variety of highly advanced tools and technologies that will make it easier for surgeons to treat brain-related diseases.

One such innovation is the Neural Interface Processor for Brain-state Classification and Programmable-waveform Neurostimulation (NURIP), an epilepsy treatment device co-developed with Prof. Roman Genov of the Edward S. Rogers Sr. Department of Electrical & Computer Engineering at the University of Toronto. Computer chips implanted in the brain can detect a seizure as it's about to happen and then deliver stimulation to stop it. The system leverages artificial intelligence to learn when and where in the brain a patient's seizures tend to begin, in order to predict and prevent them.

"This is an exciting technology," says Dr. Valiante, who is a neurosurgeon in the Sprott Department of Surgery and Director of the Surgical Epilepsy Program at the Krembil Brain Institute at UHN. "It allows us to personalize implanted devices based on an individual's brain recordings. This means we can accurately detect when seizures are about to start and stimulate at an optimal time point to maximize the treatment efficacy. By avoiding false detections, the device can operate with a long battery life and minimize side effects."

Dr. Valiante received the Connaught Innovation Award to kick-start NerveX Neurotechnologies, a company that will accelerate the clinical deployment of these machine-learning personalized implants for epilepsy treatment.

Researchers at CRANIA are also interested in creating collagen-based electrodes and other innovative circuits, sensors and components for a variety of neuromodulation devices – tech that uses electrical stimulation on the brain and other parts of the body to alter nerve activity to treat Parkinson's disease, epilepsy, Alzheimer's and depression, among other conditions. "Surgeons have always been end users of new technology like this," says Dr. Valiante. "I want to be on the forefront of developing new ones."

A NEW WAY OF WORKING

One of the key benefits to CRANIA, which is housed in a 1,500-square-foot laboratory on the 14th floor of Toronto Western Hospital, is that it brings together researchers and surgeons with engineers, computer scientists and manufacturers. Thanks to this interdisciplinary approach, which can involve scientists from across various departments, Dr. Valiante and his team can learn about, and then target, problems that they wouldn't have thought about on their own. They also work with clinicians to adapt existing technologies to treat other diseases and develop innovations that will ultimately make surgeries more efficient and effective.

To that end, there are plans to build a neuromodulation suite inside CRANIA to act as a high-tech operating room. The space, which will be ready in 2022, will allow surgeons to use new devices and finesse surgical approaches. It will have, among other features, a state-of-the-art magnetic resonance imaging (MRI) machine and an industrial magnet never applied in health care before. "This suite consolidates all kinds of surgical and medical equipment, such as robots, MRIs and neuronavigation to help simplify workflow," he says. "It makes operations easier for surgeons and the anesthesia teams."

A BETTER WAY TO BUILD

CRANIA's origins date back 13 years, when Dr. Milos Popovic, CRANIA's Co-Director and Director and senior scientist at KITE Research Institute at Toronto Rehab, which is also part of UHN, had an idea to create an interdisciplinary research group focused on developing neuromodulation devices that could both improve patient outcomes and make surgeries easier to do. He secured funding from the Canada Foundation for Innovation (CFI) but it failed to attract a matching grant from the province. There was another problem: while he had some neurosurgery partners on board, they weren't as committed to the project as he would have liked.

4,000,000

Number of Canadians living with a neurological condition or injury.

SOURCE: CRANIA

Things started coming together when a colleague at UHN connected Dr. Valiante, who also had an idea to create a CRANIA-like lab, and Dr. Popovic. "We immediately developed a great relationship," recalls Dr. Valiante, who admires Dr. Popovic's big-picture thinking and positivity. For his part, Dr. Popovic says Dr. Valiante "has a lot of skills that your typical neurosurgeon does not have," including understanding engineering and computer science. The trust between them spurred the project forward, he says.

In 2017, the two received $20 million from CFI and the Ontario government and philanthropic gifts through UHN Foundation to launch CRANIA. While the Centre develops devices and surgical techniques in-house, it also seeks collaborations from industry. "It becomes one-stop shopping," explains Dr. Popovic. "If you're a company, you can find us and come work with us."

Projects will be further propelled forward by PhD and postdoctoral fellows registered with the CRANIA Neuromodulation Institute. "Our vision is to train the next generation of researchers and surgeons on novel devices, but also to train them for jobs in industry and government," says Dr. Valiante.

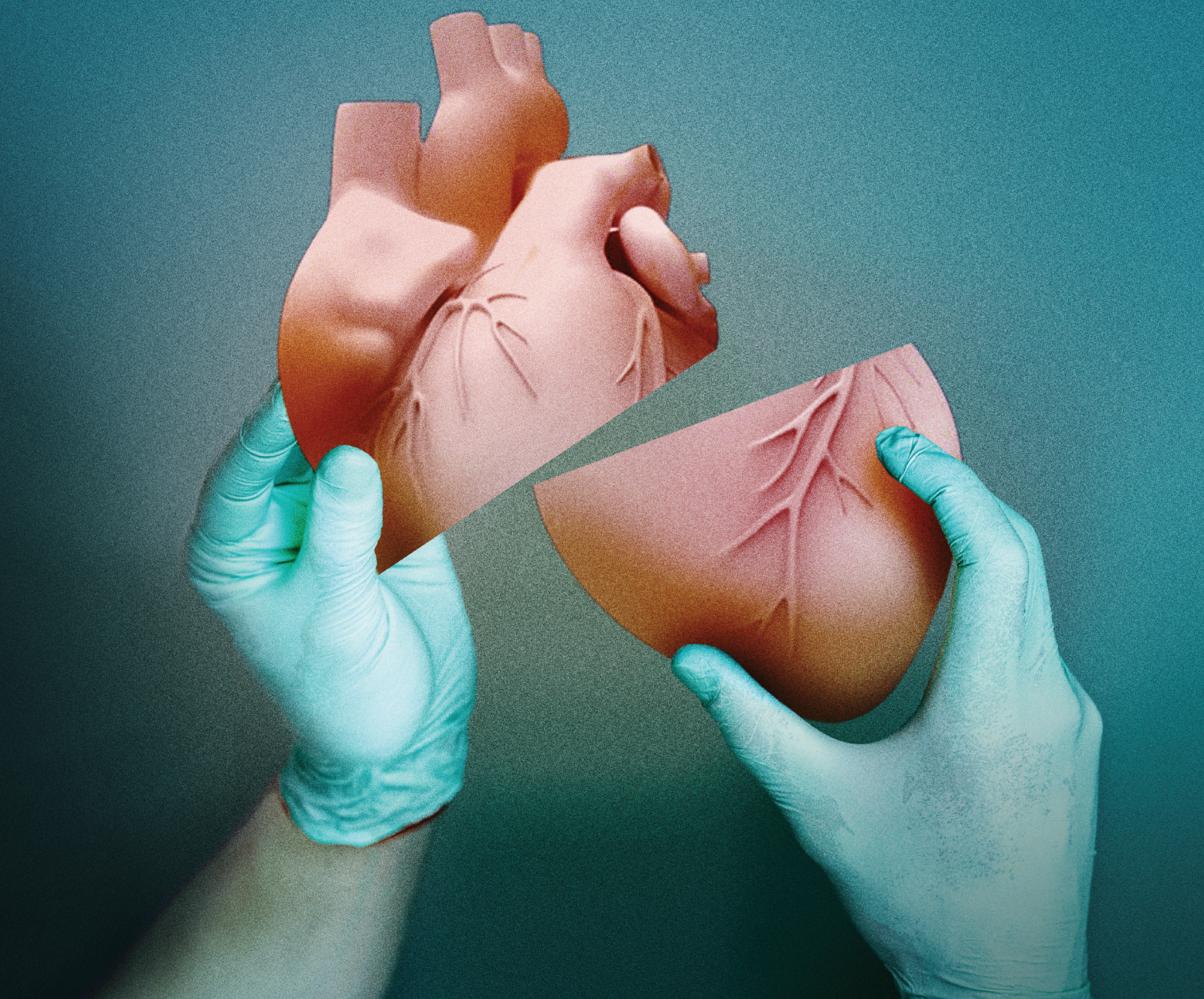
But the ultimate goal is getting products to market – which means into clinics and operating rooms to treat patients. "When you have surgeons and clinicians who really look at outcomes," he says, "you can make a significant difference in the lives of patients." ■

CARDIAC

How to heal a broken heart

How a Toronto mom got a second chance thanks to an experimental procedure to repair a leaky heart valve.

By Claire Gagné



Charissa Bell is the first to admit that she used to be hard on her body. Last year, the now-36-year-old mother from Toronto was a skateboarding, motorcycle-riding restaurant and bar worker who drank a lot of alcohol and smoked cigarettes. She was also addicted to opioids, which she was first prescribed to ease the pain resulting from a car crash.

Still, Bell was shocked to learn that a high fever she developed in early 2020 was the result of endocarditis – an extremely serious inflammation of the lining of the heart, brought on by her lifestyle. She was given antibiotics for the infection, which helped, but only for a while. A few months later her legs and abdomen swelled up, while she found herself gasping for air.

It turns out the infection had damaged one of the valves on the right side of her heart, called the tricuspid valve. This valve has three flaps, called leaflets, which typically open and close to allow blood to flow from the right atrium to the right ventricle of the heart, but not back again. Unlike other valves, it can't simply be replaced by an artificial device – it ideally needs to be fixed using the patient's own tissue.

"Because of that previous infection, the leaflets of that valve were completely destroyed," explains Dr. Vivek Rao, Head of the Division of Cardiovascular Surgery in the Sprott Department of Surgery. Instead of closing after each heartbeat, the valve stayed open, allowing blood to flow backward. This put pressure on her liver and kidneys and caused fluid to build up in her body.

"On the ultrasound, the valve looked like a barn door blown open," Bell recalls. Any lasting solution was going to require some unconventional thinking.

Before the valve could be fixed, Bell had to do her part. She quit smoking and drinking, worked on getting off the opioids and took medication to get the swelling under control. She felt better, although she was still short of breath. In January 2021 she met with Dr. Rao, who is part of the Peter Munk Cardiac Centre at University Health Network (UHN) and holds the Peter Munk Cardiac Centre Chair in Advanced Cardiac Therapeutics, about surgery to fix her leaky valve. The solution he offered would require a leap of faith.

"The tricuspid valve is a difficult one for us to treat," says Dr. Rao. Because the blood flow across the tricuspid valve is at a lower pressure than the rest of the heart, there's a higher chance of a clot forming. While other valves in the heart can be replaced with a prosthetic material such as metal, clinicians will often use a pig valve for the tricuspid valve – but those only last somewhere between seven and 10 years. "At which point you'd be at square one, requiring something new," Dr. Rao explains. Given Bell's young age, he didn't think this was the best this solution for her.

Thankfully, in 2014, Dr. Rao developed a highly innovative procedure to help people like Bell. At the time, he had been using a U.S.-made product created from the inner lining of the bowels of a pig to replace certain parts and linings of the human heart. The same product, he thought, could also be used to replace the tricuspid valve. "What's remarkable about this is that it acts as a scaffold," he says. "So the product itself dissolves between eight and 12 weeks after implant, and it gets replaced by the patient's own cells and tissue."

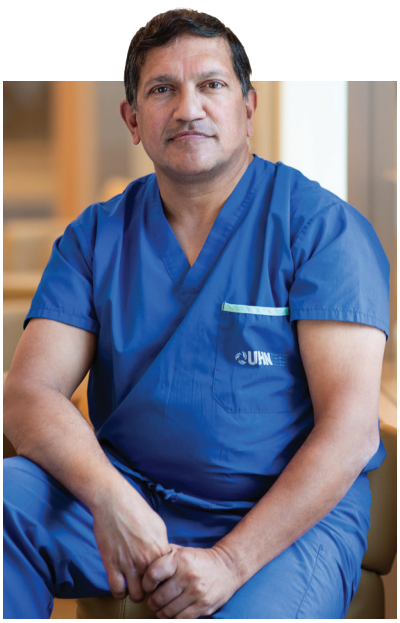
That year, Dr. Rao successfully used the product to replace a patient's valve, a world first, and then performed a few more similar surgeries, as did other clinicians around the globe. Unfortunately, Dr. Rao had to stop doing those procedures for a while because the product was discontinued. By the time Bell arrived, though, Dr. Rao discovered it had returned to Canada but was being sold under another name for a different purpose – and asked Bell if she was willing to give the surgery a shot.

Fortunately, she was game. In March, she underwent open-heart surgery. Everything went well, although the system that paces her heart was damaged, a common complication of valve surgery. "We always put in a pacemaker lead – the wires that connect a pacemaker to the heart – in these types of operations in the event that the patient requires it, which she ended up needing before she went home," says Dr. Rao.

Since this technique is new, it's hard to know how long the restored valve will last, but Bell is well past the most critical point in this process – eight weeks after surgery – when the artificial valve detaches from the heart, leaving her own regrown tissue to do the job. Dr. Rao will continue monitoring her, to collect more evidence that his innovative procedure works. "This is one of the things that we do here at UHN," he says. "We innovate and continually evaluate our results, striving to do better or learn why a technique doesn't work and develop alternative solutions."

Bell can now rest easy and regain her strength. She's left the bar industry and is working in graphic design, while caring for her 10-year-old son. She's also looking forward to getting back to motorcycling and skateboarding, though more cautiously. "I'm not going to be pushing my body to the limits," she says. ■

40%
Cardiovascular surgeries performed at UHN that are considered complex.
SOURCE: UHN



Dr. Vivek Rao
developed an innovative procedure to replace a patient's heart valve.

PHOTOGRAPHY: TIM FRASER (DR. VIVEK RAO) **ILLUSTRATION:** MADE BY EMBLEM

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