

## The future of cardiovascular surgery

How world-leading recruits are fulfilling the Centre's vision.

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## Behind the Centre's life-saving surgeries

Implanting devices that are not easily accessible to Canadians.

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## Accelerating groundbreaking discoveries

Top scientists are changing the face of cardiovascular medicine.

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## Building a global footprint

Training the next generation of leading cardiovascular specialists.

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A full-page photograph of two women with long hair, one blonde and one brown, looking at each other in profile. The blonde woman is on the left, wearing a black top. The brown woman is on the right, wearing an orange blazer over a white top.

**Same  
disease,  
same  
treatment,  
right?**

**WRONG**

.....

How the Peter Munk Cardiac Centre wants your genes to inform the care you receive.

PAGE 5

**Peter  
Munk  
Cardiac  
Centre**

WINTER 2020



**UHN**

Toronto General  
Toronto Western  
Princess Margaret  
Toronto Rehab  
Michener Institute



# A LEADER IN CARDIOVASCULAR CARE

Helping patients now – and well into the future.

To be the leading heart and vascular centre in the world, the Peter Munk Cardiac Centre, at Toronto's University Health Network, must focus on the needs of patients today, while anticipating and responding to what they will require one year, five years and 10 years from now.

So, as we look ahead, what are we anticipating?

The medical field has known for a long time that a "one-treatment-fits-all" model of care does not work for every patient, because we are all different. In response, the Peter Munk Cardiac Centre is building personalized and precision cardiovascular medicine programs that will allow us to customize the treatment patients receive.

Recruiting renowned clinicians and investigators, and retaining them through an environment of continuous discovery, is at the heart of delivering the best patient outcomes. Knowing that heart disease is the leading cause of death worldwide, the Peter Munk Cardiac Centre is expanding our ability to lead novel clinical trials that will deliver new and transformative care pathways.

To meet the healthcare requirements of our aging population and the increasing prevalence of chronic diseases like heart failure – and to efficiently manage our healthcare resources – we have developed a world-class digital cardiovascular health platform. This platform will capture every patient's information, including all clinical notes, blood tests, imaging studies such as ultrasound, CT and MRI scans, and genetic data in a digital format. This will allow us to use artificial intelligence to improve the accuracy of the diagnoses we make, and to help us decide on the best treatment options for every patient. Our increasing use of remote patient monitoring will enhance patients' understanding of their own health, and it will allow us to care for them outside of the hospital.

It was humbling to see Toronto General Hospital, in great part due to the care provided at the Peter Munk Cardiac Centre, listed among the top 10 best hospitals in the world by *Newsweek* in 2019. It was not only a reminder of how much we have accomplished, but a reminder of our responsibility to continue raising the bar on how the world defines high-quality cardiovascular care.

Dr. Barry Rubin  
Medical Director, Chair and vascular surgeon, Peter Munk Cardiac Centre  
Division of Vascular Surgery, UHN Sproule Department of Surgery

**Peter  
Munk  
Cardiac  
Centre**

Winter 2020

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# BUILDING THE BIOBANK

The Peter Munk Cardiac Centre has one of the largest cardiovascular biobanks in the country.

There's nothing overly exciting about room 101 on the fourth floor of the Peter Munk Cardiac Centre, save for one thing: the several large stainless-steel canisters situated across the floor. Inside these canisters sit the answers to some of the cardiovascular world's most complicated questions, including why patients respond differently to treatment and what medications might be most effective with our genetic makeup.

Over the past several years, the Peter Munk Cardiac Centre has been collecting patient tissue and blood samples and storing them in its biobank, which now includes more than 150,000 specimens. That makes it one of the largest health-related biobanks in the country. Samples have been used to conduct research on the causes of sudden cardiac death and heart failure.

It plays an integral role in helping to generate billions of data points that, when parsed by artificial intelligence, could help us find new treatments for a variety of cardiovascular diseases.

Researchers can obtain samples from patients by taking blood and removing tissue during surgery – provided the patient gives consent. The specimens are then stored in the biobank without identifying information. “The goal,” says Dr. Phyllis Billia, Director of Research and Co-Director of the Centre’s biobank, “is to use these biospecimens to discover potential new treatments for cardiovascular disease.” ■

Want to know more about how the biobank could revolutionize cardiovascular treatment?

**TURN TO PAGE 5.**



The Georgetown Public Hospital Corporation in Georgetown, Guyana.

to ultimately hand the reins over to the team in Uganda,” says Dr. Ross.

## GUYANA

### Mentoring medical staff

Over the last several years, Dr. Phyllis Billia, Director of Research at the Centre, along with doctors from the University of Toronto and the University of Calgary, have travelled to the Georgetown Public Hospital Corporation in Guyana to provide training to staff in the coronary care unit and heart function clinic. They're also providing guidance on how to perform and interpret echocardiograms. There is a personal reason for Dr. Billia to support the team in Guyana: “My husband is Guyanese, and this is a way for us to give back to his home country,” she says. “We’ve seen progress — that’s what keeps motivating us.”

## MIDDLE EAST

### Training local doctors

For Dr. Jane Heggie, a cardiovascular anesthesiologist at the Peter Munk Cardiac Centre, giving back is a core part of her job. “I want to be part of a better world,” she says. To that end, Dr. Heggie has travelled to the Middle East to provide training to local healthcare workers. Working with the International Committee of the Red Cross, she went to Bajil, Yemen, in 2019, Cox’s Bazar, Bangladesh, in 2018 and Al-Sheikhan, Iraq, in 2017. “I want to continue building capacity in conflict zones and humanitarian disaster areas,” she says. “University Health Network has many talented and innovative teachers who are well-suited to this work.” ■

# BRINGING CARDIOVASCULAR CARE TO THE WORLD

The Peter Munk Cardiac Centre’s clinicians and researchers are encouraged to take their training to underserved parts of the planet. Here are four examples of how they’re helping people not just in Canada, but around the globe.

## GUATEMALA

### Helping hearts

In August 2019, Dr. Douglas Lee, Cardiovascular Program Lead and Ted Rogers Chair in Heart Function Outcomes at the Peter Munk Cardiac Centre, went to St. Pedro Hermano Hospital in Antigua, Guatemala, with a charitable organization called Health Mission Outreach. While there, Dr. Lee provided free cardiology and medical care to locals and gave a talk to 200 physicians in Guatemala City on hypertension and heart failure. “We’ve started a relationship

with the hospital, and they’ve asked us to return next year,” he says. “One of my goals is to encourage more trainees to serve abroad.”

## UGANDA

### Creating new technology

Dr. Heather Ross, Division Head of Cardiology at the Centre, site lead for the Ted Rogers Centre for Heart Research, Loretta A. Rogers Platinum Chair in Heart Function and Pfizer Chair in Cardiovascular Research, has travelled to many locales around the world, but her work

in Kampala, Uganda, stands out. It was there that she, masters student Jason Hearn, Joe Cafazzo, Executive Director, eHealth Innovation at UHN and a team in Uganda implemented a text-based mobile platform to manage heart failure. The platform, called Medly Uganda, an offspring of the original Medly technology developed at University Health Network, is a mobile app where patients can monitor their heart failure symptoms. Based on these symptoms, the patient will receive a text with self-care instructions or a call from a clinician on next steps. “The goal is to grow local capacity



## Q &amp; A



Dr. Paul Oh helps patients recover faster by prescribing pre-surgery workouts.

complications. You'll spend less time in the hospital and recover more efficiently. If we provide structured health and fitness programs while people are waiting for their procedures, they will hopefully do better over the long term.

**Q: How does pre-hab help patients?**

A: At the Centre, we're known for performing the most rare and complex medical procedures. As such, there are sometimes concerns about how well these patients will bounce back, especially when it comes to older Canadians. This is also true for people who live with aortic stenosis – a tightening of the heart valves. They typically have other health problems, like high blood pressure, diabetes, kidney disease or lung disease. Putting them through a conditioning and strengthening program beforehand may help their recovery.

**Q: How do you develop a pre-hab program for a patient?**

A: We first do a careful assessment of the patient and consider what other illnesses they might have. We then try different aerobic exercises, such as walking or stationary cycling, to get the heart pumping and blood flowing. There can also be strengthening exercises using very light weights – even soup cans from home. These activities are tracked daily, and we monitor symptoms such as shortness of breath or dizziness.

**Q: What results have you seen?**

A: We have seen fitness levels improve by as much as 40 per cent. This translates into an overall better quality of life, and may reduce hospitalization after surgery. We've also found people with advanced stages of heart failure have improved day-to-day functionality. ■

## FIT FOR SURGERY

How “pre-hab” gets patients physically ready for operations. **BY DEREK MALCOLM**

As advanced as cardiac surgery has become, recovery is still difficult. It can take months for patients to resume their normal activities, even with post-op rehabilitation.

Most people think rest and relaxation are what's needed before surgery, but clinicians at the Peter Munk Cardiac Centre are telling patients to do something else: a rigorous workout.

That might seem counterintuitive, but the Centre has found that “pre-hab” programs, where patients undergo an exercise regimen for weeks or even months before their operation, can speed up the recovery time in

cardiovascular surgery patients.

The Centre is the leader in pre-hab research and implementation thanks to its team, which includes Dr. Paul Oh, Medical Director of the Cardiovascular Prevention and Rehabilitation Program at Toronto Rehab and the Peter Munk Cardiac Centre and GoodLife Fitness Chair in Cardiovascular Rehabilitation and Prevention, and research scientist Dr. Tracey Colella. We spoke to Dr. Oh about the benefits of pre-hab.

**Q: What is cardiac pre-hab?**

A: If you go into your surgery in a better physical state, you'll get through your procedure more rapidly and with fewer

## Pre-hab training

Some of the exercises patients can do before surgery.\*

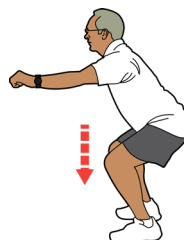
**SEMI-UPRIGHT DUMBBELL ROWS**

Pull dumbbell up in line with shoulder. Squeeze shoulders together at top. Lower dumbbell and repeat.



**HALF-SQUAT**

Keep feet flat on floor and toes slightly pointed out. Push buttocks back and slowly lower body to a half-squat position.



**LEG CURL**

Stand on band. Put one end of band around ankle. Lift heel of foot toward buttocks. Keep knees together; don't let them move forward.



\*Please consult your doctor before starting any pre-hab program.

# A MORE PERS

Thanks to artificial intelligence and a greater focus on personalized and precision medicine, patients will soon receive custom treatments tailored to them.

BY BRYAN BORZYKOWSKI

## Emily Fox

Age: 35

Born:

Windsor

Heart

disease:

Mitral valve prolapse

Diagnosed:

June 2018

Treatment:

Medication



# ONAL TOUGH

## Katie Shea

**Age:** 42

**Born:** Ottawa

**Heart disease:**  
Dilated  
cardiomyopathy

**Diagnosed:**  
November 2018

**Treatment:**  
Defibrillator  
implant and  
medication





**E**mily Fox and Katie Shea have a lot in common. They're young, hardworking and active – and they also both have heart disease. On the outside, they're strikingly similar, but on the inside, at the very cellular level, they are completely different.

These differences matter. Right now, two people could arrive at the hospital and get diagnosed with heart disease, yet one might respond well to treatment, while the other does not. One person could be discharged from the hospital the next day, while the other, despite receiving the same treatment, could require immediate transfer to the intensive care unit and die within days. "It's hard to understand why patients respond so differently to the same treatment," says Dr. Phyllis Billia, Director of Research at the Peter Munk Cardiac Centre.

Fortunately, the Centre is conducting crucial research that will one day allow doctors to use a patient's unique genetic composition to dictate

what treatment they receive. It's called precision medicine, a term that has been around the medical community for a decade, but it's at the Peter Munk Cardiac Centre where meaningful progress is being made.

According to Dr. Billia, precision medicine will help us answer many of the most pressing, and still unsolved, medical questions. This approach, which includes metabolomics, proteomics, transcriptomics and whole-gene sequencing, will allow scientists to better understand the unique characteristics of every individual patient. As Co-Director of the Peter Munk Cardiac Centre biobank, Dr. Billia has overseen the acquisition of 150,000 patient blood and tissue samples – samples that will allow doctors to map human disease.

This information, combined with the power of artificial intelligence (AI) and machine learning, will help the team at the Peter Munk Cardiac Centre better decide how to treat two patients who may seem similar, like Fox and Shea, but who might need to be administered very different treatments in order to see the best outcome.

The potential for precision medicine to dramatically redefine a patient's journey is massive, yet it's also expensive. The Peter Munk Cardiac Centre is currently conducting 23 precision medicine-related projects, but researchers would like to be doing this with every patient. "To say

**"AS A PATIENT,  
YOU WANT TO  
KNOW THE  
THERAPY YOU'RE  
RECEIVING IS  
BASED ON  
EVIDENCE THAT'S  
RELEVANT TO  
YOU, SO YOU CAN  
HAVE GREATER  
CONFIDENCE  
THAT IT WILL  
WORK."**

– Dr. Heather Ross

#### **BIG DATA**

**1.6 BILLION**

Number of data points stored in the Centre's data lake platform.

**315,000**

New pieces of information that go into the data lake every day.

it's an ambitious and expensive goal would be an understatement," explains Dr. Billia. "Yet we're making progress every day."

#### **A PERSONALIZED APPROACH**

In 2018, Shea was diagnosed with dilated cardiomyopathy, a condition that decreases the heart's ability to pump due to an enlarged and weakened left ventricle. Fox has an arrhythmia, which causes the heart to beat abnormally fast. Both diseases are frightening and can be fatal if not treated properly.

When mapping out the optimal treatment plan for patients, clinicians apply past experience, available research, knowledge and intuition to generate the best possible outcomes. However, the majority of heart-related research has been on older white men, and while everyone's physiology is similar, everything from diet to ethnicity to a family's medical history can impact the way a person responds to treatment.

Whether it's a young Black man or an older Indigenous woman, the medical field tends to take a "one-treatment-fits-all" approach. "That's a problem," explains Dr. Heather Ross, Division Head of Cardiology at the Peter Munk Cardiac Centre, site lead for the Ted Rogers Centre for Heart Research, Loretta A. Rogers Platinum Chair in Heart Function and Pfizer Chair in Cardiovascular Research. "As a patient, you want to





Dr. Heather Ross looks over a few of the 1.6 billion data points that are kept in the Peter Munk Cardiac Centre's data lake. This information could dramatically change patient care.

know the therapy you're receiving is based on evidence that's relevant to you, so you can have greater confidence it will work. Unfortunately, so many of the studies clinicians refer to don't reflect the individual in front of us."

This is why, along with the focus on precision medicine research, the Peter Munk Cardiac Centre is working on what's called personalized medicine, an area of medicine that takes into account patient differences outside of genetics, such as age, sex and ethnicity.

For Fox and Shea, that means considering how a 40-year-old woman's response to treatment might differ from that of a 60-year-old man. Through personalized medicine,

doctors will be better equipped to know why person A metabolizes medicine differently than person B, and prescribe two distinct treatments for the same disease. The more patients can be seen as individuals and the more specific research that is generated, the more likely people will experience improved long-term outcomes.

#### **DIGGING INTO DATA**

For someone working in one of the most multicultural cities in the world, the lack of information on diverse patients has frustrated Dr. Ross. Her drive to challenge the status quo led her team to create a specialized "data lake" – a computer platform that collects and stores a massive amount of

patient information gathered from labs, pathology, radiology, echocardiography, electronic medical records, and more. It currently has 1.6 billion data points from two million patients, with 315,000 new pieces of information going into the system every day.

The data lake, which was generously supported by The Peter and Melanie Munk Charitable Foundation and The Rogers Foundation, is essential to making personalized medicine at the Peter Munk Cardiac Centre a reality. "We want to confidently say that based on the data in front of us, in the last 100 Black women between the ages of 40 to 50 we treated, we saw *this* happen," explains Dr. Ross.

The sheer volume of

data and time-sensitive nature of treatment makes it extraordinarily difficult for doctors to interpret this data on their own. As such, the Peter Munk Cardiac Centre is using AI to analyze the data and uncover patterns the human brain can't see. "With the help of AI, we can design a specific treatment plan and create diagnosis models tailored toward an individual patient," says Bo Wang, lead for the Peter Munk Cardiac Centre's AI program.

As more data gets integrated, this infrastructure can recommend medicines or therapies doctors might not have considered before. "It's an iterative process," notes Wang. "We can validate new findings or confirm what people already know."

With research that continues to challenge convention, the Peter Munk Cardiac Centre aims to one day fully incorporate the use of both personalized and precision medicine into a patient's care plan. Personalized medicine will focus on a patient's environment and characteristics such as age, sex and ethnicity, while precision medicine will focus on their unique genetic composition. "It will be tremendous," says Dr. Ross, envisioning how patient outcomes will change with these new approaches.

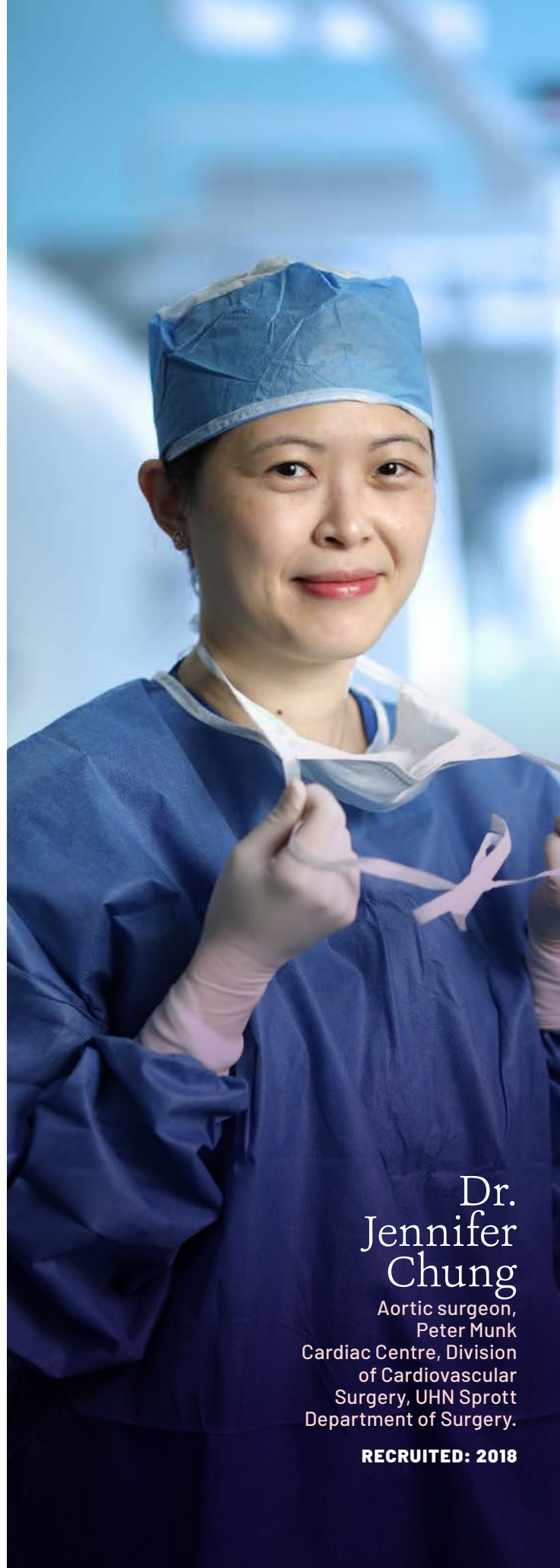
For Fox and Shea, this means greater certainty in their lives. "Treatment applicable to everyone or specific treatment designed for me alone?" Fox asks. "The choice is clear." ■



Dr.  
Tirone  
David

Melanie Munk Chair  
in Cardiovascular  
Surgery and  
cardiovascular surgeon,  
Peter Munk Cardiac  
Centre, Division of  
Cardiovascular Surgery,  
UHN Sprott Department  
of Surgery.

**RECRUITED: 1978**



Dr.  
Jennifer  
Chung

Aortic surgeon,  
Peter Munk  
Cardiac Centre, Division  
of Cardiovascular  
Surgery, UHN Sprott  
Department of Surgery.

**RECRUITED: 2018**



# WHATEVER IT TAKES

Through persistent recruitment and retention of outstanding clinicians and scientists, the Peter Munk Cardiac Centre will shape the future of cardiovascular care.

**BY WENDY GLAUSER**

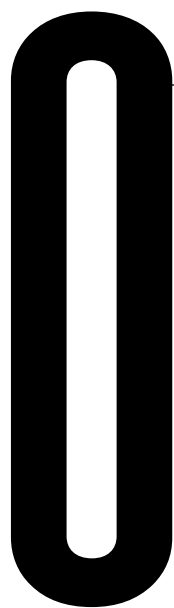
What tough medical challenges will our society face in 20 years? What can the Peter Munk Cardiac Centre do today to meet the needs of patients tomorrow? These are just some of the questions that Dr. Barry Rubin, Medical Director and Chair, Peter Munk Cardiac Centre, Division of Vascular Surgery, UHN Sproule Department of Surgery, are asking about the future of cardiovascular medicine. At the forefront of Dr. Rubin's vision is a diverse team that reflects the population they serve, a priority on interdisciplinary collaboration and an unremitting focus on innovation – one that uses the most advanced equipment in the world. “Things are changing day by day and week by week, so we're always thinking ahead,” he says. “It's invigorating and humbling to know that the techniques we consider the most advanced right now will look completely different in the very near future.” ▶▶



Dr.  
Vivek  
Rao

Peter Munk Cardiac Centre Chair in Advanced Cardiac Therapeutics, Division Head of Cardiovascular Surgery, Surgical Director of the Mechanical Circulatory Support Program, Peter Munk Cardiac Centre, Division of Cardiovascular Surgery, UHN Sproule Department of Surgery.

**RECRUITED: 2001**



ver the next two decades, cardiovascular care will undergo transformational change, says Dr. Vivek Rao, the Peter Munk Cardiac Centre's Division Head of Cardiovascular Surgery. For instance, surgical interventions will evolve into less invasive and more reproducible procedures – and that transition is already well underway. Doctors will use robotic technology to help them in the operating room, while

artificial intelligence will assist in deciding on optimal treatments. The Centre's goal is to reduce recovery times, improve patient satisfaction and outcomes, and lead the development of new cardiovascular therapies.

Personalized medicine will become more important, and doctors will perform more preventive surgeries for those at risk of cardiovascular disease even before an illness becomes detectable. "If you have a family history of heart failure, we could implant 'smart' heart pumps through minimally-invasive techniques that will gradually take over the function of your heart if and when it starts to fail," explains Dr. Rao.

However, having a bold vision for the future of cardiovascular surgery only goes so far – that vision must also become a reality. For Dr. Rubin, this involves recruitment and retention. To be the leading heart and vascular centre in the world, the most talented clinicians, surgeons and researchers must be at the helm. "You can have the fanciest operating rooms and the best imaging equipment, but if you don't have the right people, it's not going to happen," he says.

#### **BRINGING THE BEST TO THE CENTRE**

Recruitment and retention have always been important to the Centre's growth. Dr. Rao was recruited by Dr. Tirone David, the former Division Head of Cardiovascular Surgery. One of the world's foremost experts in cardiac surgery, Dr. David set out to develop an artificial heart program at the Peter Munk Cardiac Centre, and he wanted Dr. Rao,



Dr. Tirone David (centre) conducts a "David Operation."  
Over the last four decades, he's operated on more than 15,000 patients.

whom he had supervised while at the University of Toronto, to lead it. Dr. David advised Dr. Rao to go to Columbia-Presbyterian Hospital in New York City, one of three places in the United States that offered training in mechanical hearts at the time.

Knowing that nearly every major North American hospital was keen to start a mechanical heart program and that Dr. Rao would have other serious offers to consider, Dr. David wanted his offer to be the most attractive. He asked several donors, including the late Peter Munk, for funding to help him and Dr. Rao launch the Peter Munk Cardiac Centre's artificial heart program.

Fortunately, Dr. Rao came back. "I felt there was a debt I had to pay," he explains. "Dr. David had arranged my sub-specialty training with the understanding that I would return for five years and launch the program. It didn't seem right to leverage that training into a more lucrative offer in the U.S. Two decades later, I'm still here, and the program is thriving." The Peter Munk Cardiac Centre's mechanical heart program, which Dr. Rao co-leads with Dr. Heather Ross, Division Head of Cardiology, has outfitted more than 275 patients since 2001.

#### **THE CHANCE TO GROW**

It was never a given that Dr. David would come to Toronto and cement his legacy at the Peter Munk Cardiac Centre. After graduating with his MD in Brazil, he began practising in the U.S. before undergoing training in cardiac and thoracic surgery at Toronto General Hospital in 1975. After three years in Toronto, Dr. David received a number of lucrative job offers. The renowned Cleveland Clinic, where he completed his general surgery residency, wanted him to join its team full time. There was also an offer from St. Vincent Mercy Medical Center in Toledo, Ohio, where Dr. David could partner with a top cardiac surgeon and make more than 10 times what he would earn in Toronto.

Yet, he stayed. One of the key reasons, he says, was because of the uncompromising priority the Centre places on patient care. While it may seem as if every hospital has a patient focus, his experience in the for-profit healthcare system taught him otherwise. The opportunity to treat all patients, not just those who could afford it, was important. "Given the breadth of intricate patient cases I see here, I knew I would never stop learning," he says. "And the opportunity to operate on all sorts of patients would help my practice and allow my research to have





## Ahead of the curve

The Peter Munk Cardiac Centre's medical professionals are taking cardiovascular research and care to the next level. Here's what it takes to be the pre-eminent heart and vascular hospital.

the widest possible impact."

Over the past 41 years, Dr. David has performed surgeries on more than 15,000 patients, and developed or perfected 17 surgical procedures that have changed how hundreds of thousands of patients with heart disease are treated worldwide. One such operation, now referred to by his peers as the "David Operation," is a procedure Dr. David developed whereby you can remove the enlarged aorta near the heart while preserving the normal aortic valve, the main valve in the heart. The ability to retain Dr. David has been integral to building a world-class destination for cardiovascular surgery at the Centre.

### **COLLABORATION IS CRUCIAL**

Now leading the Division of Cardiovascular Surgery, Dr. Rao's goal is to keep the collaborative culture at the Peter Munk Cardiac Centre – which he says is one of its defining attributes – as strong as ever. Before each surgery, there is a team huddle, where the case is reviewed by experts from every division. Even if the case doesn't appear to be directly related to a particular doctor's area of expertise, there is a belief that all perspectives will be invaluable to delivering the strongest patient outcomes. For instance, it's not unusual to see a cardiologist and radiologist commenting on an aortic valve repair. That diversity of voices pre-surgery is critical for success

### **TEAM**

120

Clinicians, surgeons and scientists at the Peter Munk Cardiac Centre.

### **NEW RECRUITS**

13

Clinicians, surgeons and scientists recruited in the last five years.

### **BETTER BALANCE**

50%

Surgeons recruited in the last five years that have been women.

and is consistent with the interdisciplinary approach to patient care that Dr. Rubin has mandated at the Centre.

It was the chance to learn from others that attracted Dr. Jennifer Chung to the Peter Munk Cardiac Centre and Sprott Department of Surgery in 2018. Dr. Chung, a highly skilled aortic surgeon who was the inaugural Advanced Aortic Surgery fellow, considered multiple job offers when she finished her training, but she chose the Peter Munk Cardiac Centre because the opportunities it afforded were most in line with her goals.

It also helped that the hospital was best set up for complex aortic surgeries, which is a high-risk and highly specialized area. "This kind of surgery is like a team sport," she explains. "It's a lot more than just the surgeon; it's anesthesia, nursing and more. The Peter Munk Cardiac Centre has that whole package." With Dr. Chung's recruitment, the Centre became the only program in North America with three female cardiac and vascular surgeons.

### **INNOVATION AND INFLUENCE**

To keep the Centre at the forefront of cardiovascular surgery, there needs to be funding. Thanks to philanthropic support, Dr. Rubin created the Peter Munk Cardiac Centre Innovation Fund. Led by Dr. Harry Rakowski, Medical Director of the Hypertrophic Cardiomyopathy Clinic at the Centre, the Fund provides researchers with anywhere from \$10,000 to \$1 million to test novel, often high-risk ideas that traditional funding avenues are hesitant to support. The proposals are weighed by a group of business executives, medical experts and entrepreneurs. One recently funded project developed a medication that could reduce DNA damage caused by the radiation associated with some medical imaging, like CT scans. "We want to be out there pushing the envelope," says Dr. Rubin.

That freedom and encouragement – to explore new ideas and to perfect patient care – is why Drs. Rao and David have stayed. Dr. Chung is excited to know that every day she will be shaping the future of cardiovascular surgery. She won't forget what Dr. Rubin told her when he was persuading her to join the team: "In terms of how far you want to push yourself in your career, it's up to you. There is no ceiling." ■

# LIFE-SAVING DEVICES

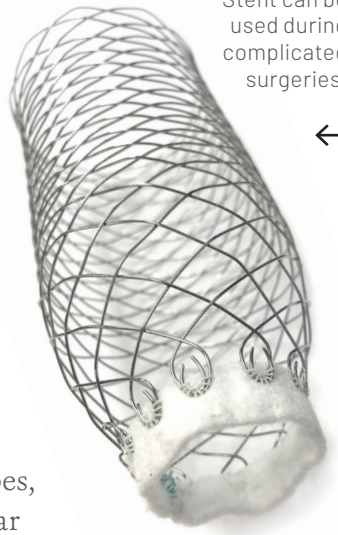
They restore hope and confidence, and they give people a second chance at life, but these devices aren't cheap.

BY DIANE PETERS

"Saving lives does not wait for coverage," says Dr. Thomas Forbes, R. Fraser Elliott Chair in Vascular Surgery, Division Head of Vascular Surgery, Peter Munk Cardiac Centre, UHN Sprott Department of Surgery. This mantra is critical, especially when it comes to the many mechanical devices doctors implant on an almost regular basis. Since the 1990s, the Centre has been outfitting patients with devices that drastically improve their quality of life, but if it weren't for philanthropy, surgeons wouldn't always have access to these costly pieces of equipment.

While the government eventually covers some of the cost, it's because of donors that the Centre's team can perform such complex operations. "We don't turn anybody down for surgery," says Dr. Forbes. This sense of responsibility has become synonymous with the Centre's global identity, and it's also why it's routinely chosen to provide cutting-edge equipment for patients who need it most.

The Ascyrus Medical Dissection Stent can be used during complicated surgeries.



## Repairing ruptures

**ASCYRUS MEDICAL DISSECTION STENT (AMDS)**  
**COST: \$20,000**

Last summer, Emily Keizer, 57, was about to set off into the bush to find chanterelle mushrooms with her husband. As she sat down to put on her boots, a searing pain tore through her chest and up through her shoulder blades. "It was horrible," she says. The professional artist was rushed to the hospital in nearby Timmins, Ont.

A CT scan revealed that an aneurysm in the chest section of her aorta had ruptured and was limiting blood supply to the right side of her brain. Without immediate surgery she would have a severe stroke or die.

Keizer was helicoptered to the Peter Munk Cardiac Centre, where a team led Dr. Maral Ouzounian, cardiac and aortic surgeon, Peter Munk Cardiac Centre, Division of Cardiovascular Surgery, UHN Sprott Department of Surgery, was ready even before she arrived. "When you tear the main blood vessel in your body, every branch that comes off it can be affected by the tear," she says. Surgeons have always struggled to repair this part of the aorta, which supplies blood to the rest of the body. It wasn't going to be an easy operation.

Fortunately, Dr. Ouzounian knew of a device that could make a difference: the Ascyrus Medical Dissection Stent, a dissection-specific hybrid prosthesis. The device, which is approved by Health Canada for use at the Centre but is not yet funded by Ontario's Ministry of Health, resembles a tube of chicken wire made of fabric and metal that gets implanted into the branched-off section of the aorta to help it heal and keep blood flowing through the proper channels.

It's so new that only a few sites in Canada have access to this specialized device. It was this access that enabled Dr. Ouzounian to successfully use this device to repair Keizer's aorta after an intensive five-hour surgery. Had it not been for philanthropy, and the expertise of the Centre's team, they wouldn't have been able to use the stent that allowed Keizer to walk out of the surgery alive.

After a week, she went home, where she picked up where she left off: hunting for mushrooms. "I can't believe someone gave me the chance to be here," she says.

"We would not be able to use the needed devices without philanthropic support."

Dr. Maral Ouzounian

"We're using the best equipment, the best techniques and the best people."

Dr. Thomas Forbes





# Keeping hearts beating

## LEFT VENTRICULAR ASSIST DEVICE (LVAD)

**COST: \$130,000**

When Lina Amaral was just 44, she began to feel sick. “I couldn’t breathe,” she says. “When I bent down, I felt like I would explode.” She was diagnosed with congestive heart failure – doctors suspected it was caused by a virus that had attacked her heart.

By age 51, she was being treated at the Peter Munk Cardiac Centre with end-stage heart failure. “They didn’t think I was going to make it,” says Amaral. A transplant seemed to be the only way to help her, but she needed a perfectly compatible heart since her antibodies were so high. Unfortunately no such hearts were available. In 2009, Dr. Vivek Rao, Division Head of Cardiovascular Surgery, offered Amaral something else: a left ventricular assist device (LVAD).

This “mechanical heart” – a metal, battery-operated pump that gets implanted directly into the heart – has traditionally been used as a temporary bridge to a transplant, keeping a patient alive as they wait to receive a new heart. Now, they’re often used as a permanent support for those who have been deemed ineligible for a transplant. People with LVADs find it life-changing. “They have the energy to resume their daily activities and even do things that were once out of the question,” says Dr. Rao.

It was only in 2017, 16 years after the Peter Munk Cardiac Centre opened its mechanical heart program, that the government started funding the device for patients not eligible for transplant. It now funds 45 implants a year at the Centre. Before then, it was solely philanthropy that funded the first 200 devices, including Amaral’s.

While Amaral is no longer a candidate for a transplant, her LVAD will keep her alive for many more years. “I got a second chance at life,” says Amaral, who is the Centre’s longest-surviving patient with an LVAD.

Last fall, she became a grandmother of two and is grateful she can see her grandchildren grow. “It’s a great sense of satisfaction to see Lina,” says Dr. Rao. “She was so sick before and I know how this device has changed her life for the better.”

TAVIs save lives by replacing diseased valves.



The LVAD is a metal pump that helps the heart do its job.



## Transcatheter aortic valve implant (TAVI)

**COST: \$25,000**

When the valve that connects the heart to the aorta becomes calcified, the opening narrows and prevents blood from flowing properly to the body. “That’s a problem,” says Dr. Ouzounian. “Once the narrowing is severe and patients develop trouble breathing, 50 per cent die within two years.” Fortunately, patients can undergo a TAVI procedure to replace the diseased valve without open-heart surgery. This device gets implanted via a catheter threaded through a blood vessel. The complex and life-saving procedure is only partially covered by the province.

## Custom-made branched and fenestrated endografts

**COST: \$35,000**

An aneurysm is fatal if it ruptures. Those who have an aneurysm in the aorta in their chest must get it repaired so it doesn’t burst, but blood also needs to continue flowing through the aorta’s branches to the legs, kidneys, brain and more. To repair these complex aneurysms in a minimally invasive way, doctors use an endovascular graft, which fits inside the aorta and looks like a “fancy toilet paper roll with branches,” says Dr. Forbes. Since this graft has to fit perfectly, the manufacturer makes a custom device for each surgery. That requires careful imaging of the patient and extensive planning between the surgeon and the manufacturer.

“I thank God I’m alive every day.”

Lina Amaral



# GAME-CHANGING RESEARCH

Researchers at the Peter Munk Cardiac Centre are discovering new ways to prevent and treat heart and vascular disease.

BY ANNA SHARRATT

Imagine this: you're having a heart attack. Almost immediately, scar tissue begins to form around your heart, and it becomes permanently damaged. But what if, when you arrived at the hospital, a doctor could treat you with a drug that helped your heart generate new cells and rebuild itself?

Or, imagine you have breast cancer and you're undergoing long rounds of chemo and radiation therapy, treatments that could harm your heart. Besides monitoring the cancer, your cardiologist could also detect signs of heart trouble early, adjust your chemo regimen – without inhibiting its success – while preventing you from getting heart disease, which is currently the leading cause of death in breast cancer survivors.

Researchers are doing all this and more, pioneering cutting-edge approaches to healing damaged hearts, increasing the number of hearts available for transplant and preventing the risk of stroke. Dr. Kathryn Howe, a vascular surgeon at the Peter Munk Cardiac Centre, Division of Vascular Surgery, UHN Sprott Department of Surgery, says every new research finding is driven by the one question physicians ask themselves daily: "How can we have something better to offer?"

Here's some of the groundbreaking work underway at the Peter Munk Cardiac Centre.



THE TROUBLESHOOTER	
WHO	Dr. Paaladinesh Thavendiranathan, Director, Ted Rogers Cardiotoxicity Prevention Program, Ted Rogers Centre for Heart Research, Peter Munk Cardiac Centre and a cardiologist at the Centre
THE GOAL	Preventing heart damage for patients undergoing cancer treatment.
THE RESEARCH	<p>After having undergone intense radiation or chemotherapy, cancer survivors shouldn't be faced with the burden of a second life-threatening illness, yet unfortunately many can develop heart disease. "Survivors can be left with arrhythmias [irregular beating of the heart], heart muscle dysfunction and heart fibrosis, all of which can lead to heart failure," Dr. Thavendiranathan explains.</p> <p>He's currently studying how the heart is affected in women with breast cancer. Traditionally, assessing a patient's heart is done with an echocardiogram (a photo of the heart) that measures the percentage of blood leaving the heart each time it pumps. But, he says, "at that point, we're too late."</p> <p>Using ultrasound and magnetic resonance imaging (MRI), patients are assessed prior to treatment and every three months thereafter to see if there are early indicators of heart inflammation or fibrosis. "I'm going to pick up on heart dysfunction before anyone else does," says Dr. Thavendiranathan. If he and his team can catch changes early on, patients can have their chemotherapy tweaked or be given heart-protective medications.</p>





## THE SLEUTH

Dr. Kathryn Howe, vascular surgeon, Peter Munk Cardiac Centre, Division of Vascular Surgery, UHN Sproule Department of Surgery

## THE BUILDER

Dr. Mitesh Badiwala, cardiac surgeon, Peter Munk Cardiac Centre, Division of Cardiovascular Surgery, UHN Sproule Department of Surgery and Surgical Director, Heart Transplant Program, Soham & Shaila Ajmera Family Transplant Centre

## THE FIXER

Dr. Phyllis Billia, cardiologist and Director of Research, Peter Munk Cardiac Centre and Co-Director of the Peter Munk Cardiac Centre's biobank

### Preventing strokes by identifying which arterial plaques are dangerous.

Buildup of plaque in the carotid artery can be inactive — or it can be deadly. Unfortunately, physicians can't easily tell which arterial plaques are problematic. "Some of the plaques are stable for a lifetime," says Dr. Howe.

In other cases, increased inflammation causes the plaque to become unstable, which can potentially result in necrosis (cell death). Plaque can also break off and form a blood clot, leading to a stroke.

Dr. Howe is analyzing how artery-lining endothelial cells use extracellular vesicles (particles released from a cell) to communicate with plaque cells to form plaques. The contents of some extracellular vesicles have been shown to increase vascular damage and inflammation, and they may serve as biomarkers — a biological molecule that indicates the presence of disease — for a future stroke, she says.

Dr. Howe is currently storing samples of patient blood and vascular tissue in the Centre's biobank. By having artificial intelligence analyze these tissues, she hopes to find differences in plaques connected to stroke.

### Increasing the number of donor hearts available for transplant.

Donor hearts are in high demand, but when they do become available, they're not always in optimal condition. "Alarming, 60 per cent of donor hearts are not able to be used due to damage," explains Dr. Badiwala.

Fortunately, there is potential to change course. Echocardiograms performed on the heart following brain death have shown that deterioration can be reversed. Dr. Badiwala hopes to regenerate hearts and make them viable for transplantation through a technique called *Ex Vivo* Heart Perfusion, during which a modified heart-lung machine pumps blood through the organ.

Dr. Badiwala is optimistic that one day, the *Ex Vivo* Heart Perfusion System could be used to repair diseased hearts. "You could repair it outside the body on the machine and make it suitable for transplantation," he explains.

Soon, Dr. Badiwala will test the *Ex Vivo* Heart Perfusion System on donor hearts that aren't eligible for a transplant. "It's exhilarating work, as repairing donor hearts would increase the pool of hearts available for transplant and transform more lives."

### Regenerating heart cells within the heart itself after damage.

No one knows why our heart cells stop regenerating after we're born, but Dr. Billia has a theory: the heart may be protecting itself, because producing cells can increase the risk of cancer. However, if cells regenerated after a heart attack, then the cells in our bodies could repair a damaged heart.

Dr. Billia has identified several key genes that are responsible for re-initiating this process. Altering these genes could potentially kick-start the heart into a state of regeneration. "We want the heart to repair itself from within," she says.

Dr. Billia and her team are injecting a drug that silences RNA — tiny cellular messengers that carry instructions from DNA. If the drug can turn off certain RNA instructions, heart cells could make more of themselves and repair tissue. In collaboration with Dr. Badiwala, she wants to utilize the *Ex Vivo* Heart Perfusion System to test whether she can get adult human hearts to heal themselves.

"We have two goals," says Dr. Billia. "One is to repair hearts. The other is to preserve them. It's imperative we get in there before the damage sets in." ■

# COME FROM AWAY

The Peter Munk Cardiac Centre's international fellowship program attracts doctors from around the world. Many stay the centre, while others take their newfound expertise back home. **BY WENDY HAAF**



Peter Munk  
Cardiac Centre

Dr. Carolina Alba is one of many international fellows who has trained — and built her career — at the Peter Munk Cardiac Centre.



## Just over 10 years ago,

Dr. Carolina Alba was living in Mendoza, Argentina, which is best known for its stunning mountains and world-class wine. Dr. Alba, who did her residency in the city, assumed she'd start a private cardiology practice there. Instead, in 2009, she moved to Toronto, in part to participate in a highly sought after fellowship program at the Peter Munk Cardiac Centre.

It's not easy to get into the Centre's fellowship program which accepts 75 physicians, on average, every year. Knowing the Centre's reputation, Dr. Alba knew she would be competing against top colleagues from around the world to get in. When she received word of her acceptance, she was taken aback. "All my ideas around heart failure management would be put to the test, and I would be challenged to consider whether my approach delivers the best outcomes," she says. "I was nervous, but excited."

Dr. Alba joined a group of researchers and scientists from around the world for a one- to three-year fellowship to learn skills ranging from cardiovascular surgery and transplant to heart failure and vascular surgery. The fellows are drawn to the Centre's high number of complex cases and Toronto's diverse population, which provides unusually rich learning opportunities.

Some fellows stay at the hospital after the program is finished, while the rest take their training back home, bringing the Centre's high-quality cardiac and vascular education to patients around the world.

Competition for fellowships is stiff, says Dr. Sean Balmain, the Centre's education lead, both because of the number of applicants and the stage they're at in their careers. "The people who apply are already qualified specialists in their fields," he says. "They come to us for intensified subspecialty experience." Dr. Balmain, who was an international fellow in 2010, held a full-time faculty position in the U.K. before coming to the Centre. And luckily he did – he had to wait two years for his program to start. Similarly, some of today's programs are booked into 2022.

### WORKING TOGETHER

One of the most attractive aspects of the fellowship is working with the Centre's

pre-eminent experts, says Dr. Caroline Chessex, Cardiology Fellowships Program Director. It's not something all hospitals offer. "Fellows get tremendous mentorship and encouragement to seek extra learning experiences, and to develop specific skills and research networks," she says. "It's not everywhere you can work side by side with leaders in the field."

During her fellowship, Dr. Alba studied why some patients who receive a mechanical heart develop serious complications while others don't.

**"IF I HAVE A  
COMPLICATED CASE,  
THEY'RE JUST A TEXT  
MESSAGE AWAY."**

**- Dr. Patrick Louie Maglaya**

This led to further research showing that heart transplants are safe in a subset of patients with a type of high blood pressure that affects the lungs, a condition that had previously ruled out a transplant. Thanks to her work, more people are now eligible for the life-saving procedure.

Fellows are also given an opportunity to observe complex and rare heart- and vascular-related cases. For instance, the Peter Munk Cardiac Centre has one of the world's first and largest adult congenital heart disease programs. Concentrations of patients with such unique and challenging problems allow doctors to learn highly technical skills and facilitate research, says Dr. Alba.

That was certainly the case for Dr. Patrick Louie Maglaya, a cardiovascular and thoracic surgeon affiliated with the National Kidney and Transplant Institute in Manila, Philippines. At the Centre, he learned multiple techniques to repair the weakening of major arteries without cutting open the chest. "Here in the Philippines, we don't have formal training in endovascular surgery," he says. "At the Peter Munk Cardiac Centre, I learned different approaches to endovascular

aneurysm repair from giants in the field."

Another one of the Centre's strengths is that people from multiple disciplines work together as a team. The result? Patients receive more holistic care, while fellows learn from the close-knit camaraderie of coworkers. It's not uncommon for a fellow to be grappling with a rare case and need to rely on the expertise of colleagues to deliver optimal patient outcomes. "The collaborative environment is outstanding," says Dr. Alba.

### GOING GLOBAL

For Drs. Maglaya and Alba, access to the latest technology and the most sophisticated therapies was what distinguished the Peter Munk Cardiac Centre from institutions in Argentina and the Philippines.

Dr. Maglaya returned to the Philippines in 2017, but he regularly stays in touch with his former mentors. "If I have a complicated case, they're just a text message away," he says. That kind of networking among the Centre's alumni also fosters cross-ocean collaborations through international, multi-centre research trials.

When her fellowship ended, Dr. Alba was tempted to go back to Argentina to work, but she decided to earn her PhD in clinical epidemiology at McMaster University and assume a second fellowship at the Centre to become a specialist in heart failure and transplant.

Hired full time in 2016, Dr. Alba focuses on prognosis research. She aims to help clinicians better identify which heart failure patients are medium-to-high risk, and consequently need the specialized care delivered at heart failure clinics, and which ones can be treated by their family doctor.

Dr. Alba still travels to Argentina every year, returning to Hospital Luis Lagomaggiore where she trained, to meet and exchange ideas with colleagues from around the world. "Coming to the Peter Munk Cardiac Centre was a priceless opportunity," she says. "The heart failure team truly embodies the best of the best. I value feeling like I am a part of a family, where I can contribute, and where, ultimately, I have the opportunity to care for the patients who need it most." ■

# THE PETER MUNK CARDIAC CENTRE BY THE NUMBERS

Over the past few years, the Peter Munk Cardiac Centre has seen tremendous growth across its programs, while doctors have performed incredibly complex procedures, adopted new technologies and launched game-changing initiatives. To put it all into perspective, we've compiled a number of statistics that show just how important the Centre is to people's health – in Canada and beyond.

## A pattern of growth

### CARDIAC IMAGING

#### Cardiac MRI

Using radio waves to identify or monitor the progression of heart disease, we perform 36% of all cardiac MRIs in Ontario.

#### Cardiac CT Scan

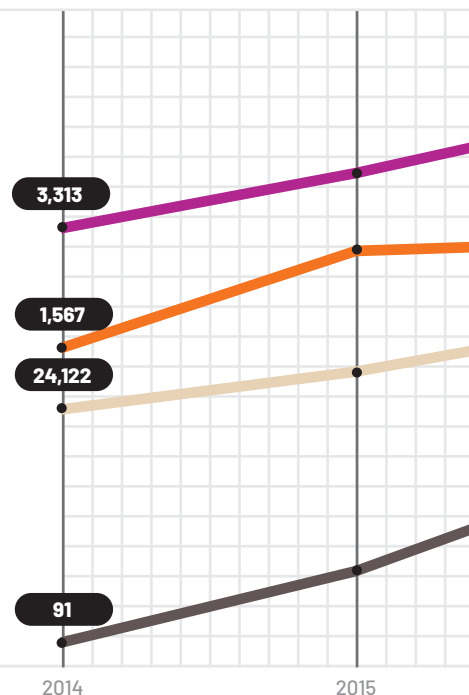
Using X-rays to identify or monitor the progression of heart disease, more people are undergoing cardiac CT scans.

#### Echocardiogram

We perform more echocardiograms – an ultrasound image of the heart – than any other program in Canada.

#### Cardiac PET Scan

Often used with cardiac MRI and CT scans, more patients are relying on cardiac PET scans to search their body for disease.



### SPECIALTY CLINICS

#### Adult Congenital Heart Disease (ACHD)

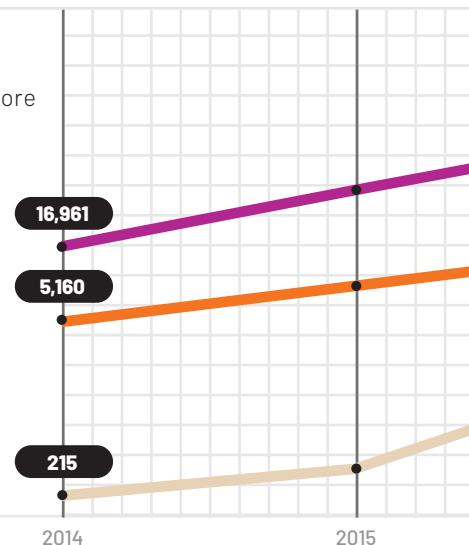
As one of the first programs of its kind, and with more children surviving into adulthood, our ACHD clinic is treating a record number of patients.

#### Heart Function

To consult on advanced therapies for heart failure, more patients are visiting our Heart Function Clinic.

#### Cardiotoxicity

Patients undergoing chemo or radiation therapy for cancer have a greater risk of developing heart disease and are cared for within this clinic.



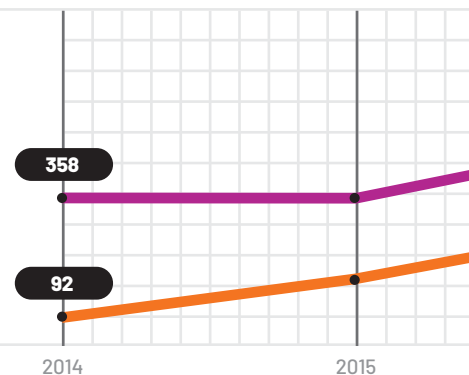
### DEVICES AND PROCEDURES

#### Structural Heart Intervention

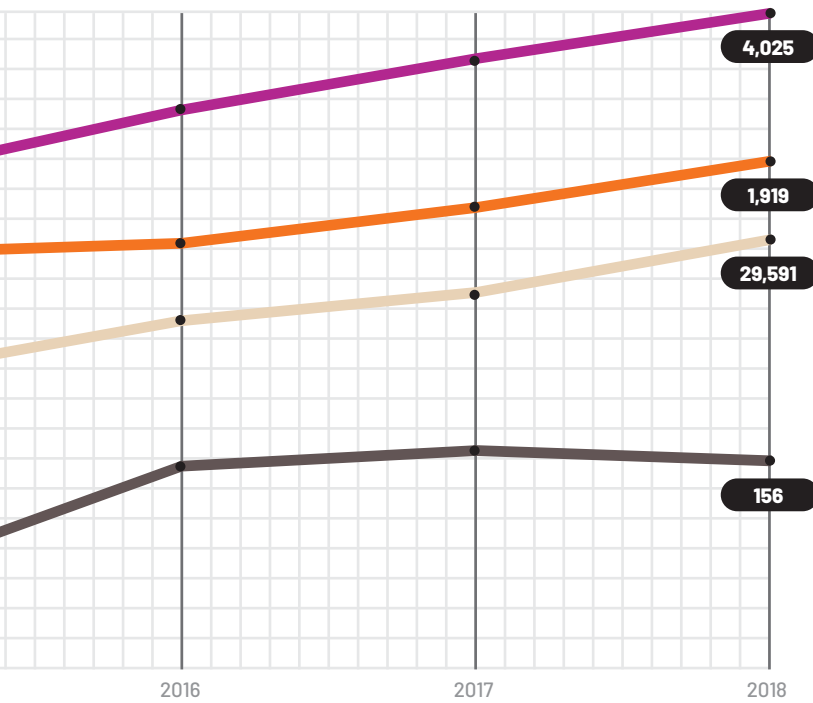
A growing number of procedures are performed to fix heart defects, including holes in the heart that did not close at birth.

#### Transcatheter Aortic Valve Implant (TAVI)

A minimally invasive procedure that addresses the narrowing of the aortic valve. We are performing more TAVIs every year.



INCREASE  
OVER THE PAST  
5 YEARS

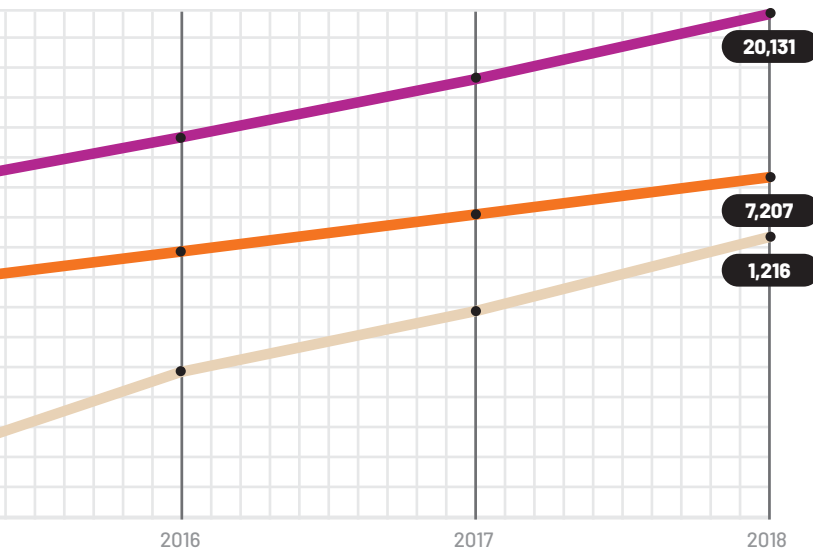


21%

22%

23%

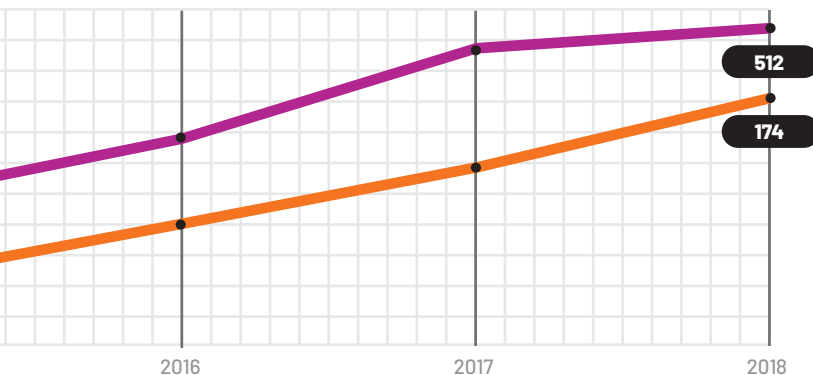
71%



19%

40%

466%



43%

89%

## MORE PATIENTS HELPED

### VASCULAR REPAIRS

700

Vascular surgeries performed every year, including operations to repair aneurysms, prevent strokes and save limbs.

### PROTECTING PREGNANCIES

850

Clinical visits to pregnancy and heart disease specialists.

### SURGERIES PERFORMED

1,500

Cardiovascular surgeries performed annually, including coronary artery bypass grafting, aortic valve repair and mitral valve repair.

### CARDIAC CARE

2,400

Patients seen by the Cardiovascular Prevention and Rehabilitation Program each year, the largest cardiac rehab hospital program in North America.



# THE PETER MUNK CARDIAC CENTRE DEFINED BY FIRSTS

## MEASURING CLINICIAN BURNOUT

The first program in Canada that measures the well-being of its own doctors, nurses, pharmacists, and physical and respiratory therapists, using a confidential assessment tool developed at the Mayo Clinic.

## ARTIFICIAL INTELLIGENCE

The first healthcare program to partner with the Vector Institute for Artificial Intelligence.

## REDUCING RISK

The first program globally to develop a cardiovascular risk prediction model for women with breast cancer.

## DEDICATED PROGRAMS

The world's first program to have a dedicated cardio-oncology clinic for patients with chronic myelogenous leukemia.

## INTERNATIONAL QUALITY BENCHMARKS

The first Canadian hospital to participate in the international Vascular Quality Initiative, which compared the outcomes of vascular surgery procedures with 400 U.S.-based hospitals.

## EMPLOYING TOP TECH

The first program in Canada to use state-of-the-art biplane imaging, with the Azurion system by Philips, for the management of patients with structural heart disease or abnormal heart rhythm.

## SCREENING FIRST RESPONDERS

The first program in Canada to partner with a major metropolitan police force to offer screening for heart disease. In the last three months of 2019, six Toronto Police Service precincts were visited and 280 officers and staff were screened for cardiac and vascular disease.

# PATIENT OUTCOMES

## CARDIOVASCULAR SURGERY

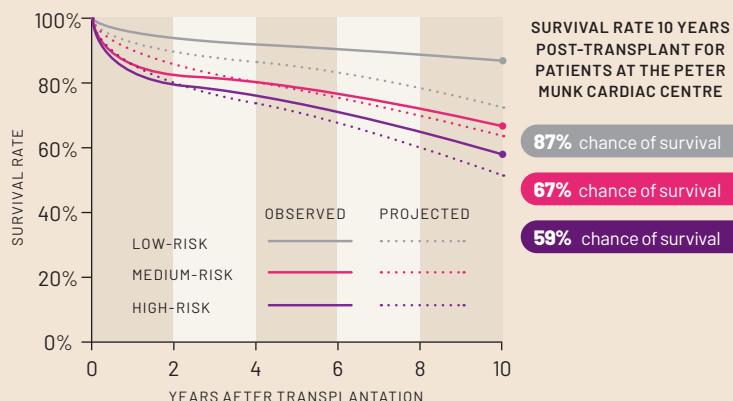
Peter Munk Cardiac Centre patients had significantly lower mortality rates, and a lower chance of developing pneumonia or kidney failure after cardiac surgery, when compared to similar heart surgery patients at other hospitals in North America.



## HEART TRANSPLANTS

When compared to similar centres internationally, patients who had a heart transplant at the Peter Munk Cardiac Centre had a greater chance of survival than anticipated 10 years post-transplant.

**This includes a 13% greater chance for low-risk patients, 3% for medium-risk patients, and 6% for high-risk patients.\***



\* Data from the International Society for Heart and Lung Transplantation

# Complex procedures

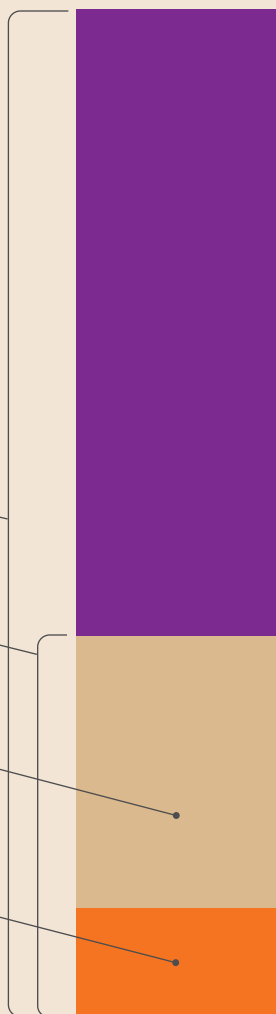
The Peter Munk Cardiac Centre specializes in complex aortic aneurysm repair. Surgeries involve a partnership between the divisions of Cardiac and Vascular Surgery and the Department of Medical Imaging.

Out of the  
**370**  
aortic aneurysm repairs performed annually

**140**  
repairs are complex aortic aneurysm repairs

**100**  
of the complex cases have repairs performed surgically

**40**  
of the complex cases are minimally invasive, **the highest volume in Canada.**



## CONGENITAL HEART DISEASE

**60%**

Patients treated within the Adult Congenital Heart Disease Clinic at the Peter Munk Cardiac Centre who have congenital heart defects of moderate or great complexity.

## ABNORMAL HEART RHYTHM

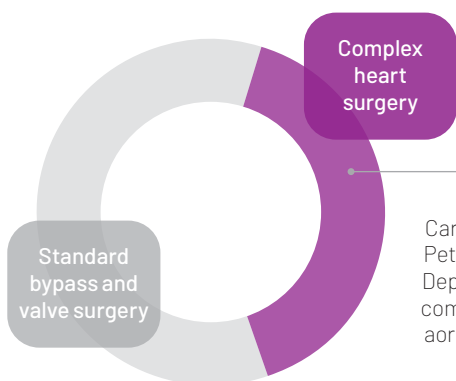
**58%**

Patients with abnormal heart rhythms treated with ablations that require an advanced mapping technique.

## CARDIAC SURGERY

**40%**

Cardiovascular surgeries performed at the Peter Munk Cardiac Centre and UHN Sproule Department of Surgery that are considered complex, including the "David Operation," an aortic valve-preserving operation invented by the Centre's Dr. Tirone David.



# OUR ADVANTAGE

## ARTIFICIAL INTELLIGENCE (AI)

The only cardiovascular program in Canada to integrate an AI team and computer scientists who are machine learning experts into our clinical program.

## DIGGING INTO DATA

**2 MILLION**

Patients that have their information stored in the Peter Munk Cardiac Centre's Digital Cardiovascular Health Platform.

**1.6 BILLION**

Number of data points (including blood tests, clinical notes, imaging studies and genetics) stored in the Centre's data lake platform.

## COMPARING OUTCOMES

The only Canadian cardiovascular program that has mandated that outcomes for every cardiac surgery, vascular surgery and cardiology patient be compared with patient outcomes at thousands of U.S. centres.

## REMOTE PATIENT MONITORING

**300+**

Patients who rely on Medly, a digital heart failure management program that enables real time, rapid assessment through a mobile app. It was launched by the Peter Munk Cardiac Centre in collaboration with eHealth Innovation at UHN and the Ted Rogers Centre for Heart Research.



A man in blue scrubs and a surgical cap stands in an operating room, looking directly at the camera. Two large surgical lights are visible above him, and medical equipment is in the background.

# We embrace the tough cases.

This relentless pursuit of answers,  
treatments and cures is what the  
Peter Munk Cardiac Centre is built on.

Watch a virtual tour and support this  
pursuit at [\*\*inaheartbeat.ca\*\*](http://inaheartbeat.ca).

Dr. Barry Rubin,  
Medical Director and Chair,  
Peter Munk Cardiac Centre

Toronto General & Western  
Hospital Foundation  **UHN**

WHAT  
KNOWLEDGE  
CAN DO