
THE BEST
IS YET
TO COME.
TED ROGERS CENTRE
FOR HEART RESEARCH

THE STORY OF THE TED ROGERS CENTRE FOR HEART RESEARCH

"It's been said that our family's gifts launch people, places and ideas, and that our vision draws others into the dream and the reality of creating a changed and dynamic community. This has always been our intent, and I hope I will be judged to have lived my life that way."—**TED ROGERS**

2015-2017

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WELCOME TO THE TED ROGERS CENTRE FOR HEART RESEARCH

Our story begins in 2008 when Edward (Ted) S. Rogers Jr. passed away from heart failure.

In life Ted was an innovator, optimist and risk-taker who would not take 'maybe' for an answer. It was in this spirit that in 2014 the Rogers family issued a bold challenge to three world-class medical research institutions in Toronto: University Health Network, The Hospital for Sick Children, and the University of Toronto:

How can we radically improve the diagnosis, prevention and treatment of one of the deadliest and fastest-growing diseases today that affects patients young and old?

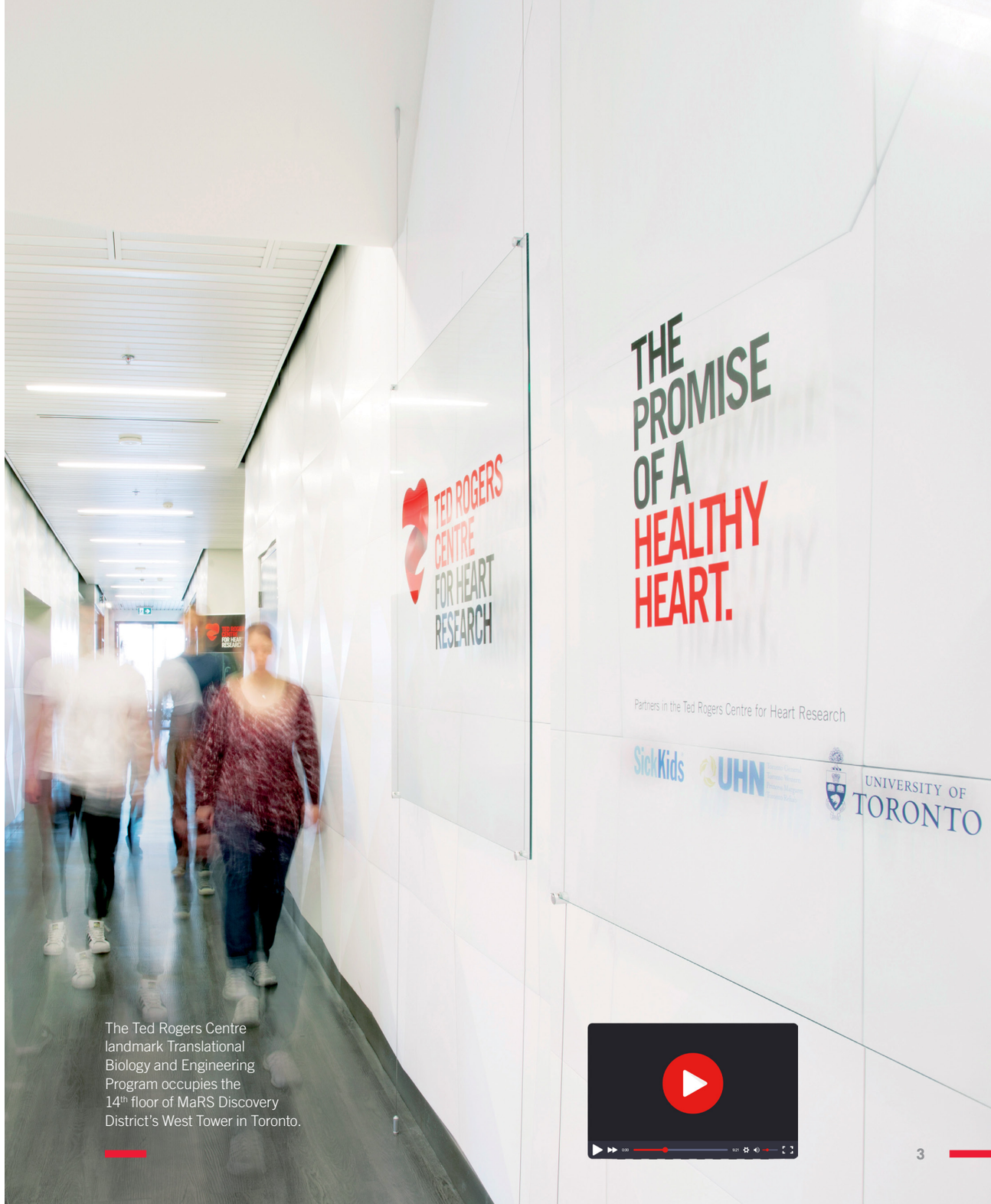
This challenge came in the form of a historic $130 million gift designated for major scientific breakthroughs in cardiovascular medicine. The three partners accepted, matching the amount to bring the total to an incredible $269 million.

The result was the landmark **Ted Rogers Centre for Heart Research**. In only three short years, it has begun to revolutionize the way we approach heart failure, a disease that affects at least one million Canadians and tens of millions more around the world.

Three years ago, there was no Cardiac Genome Clinic that could help us better understand the genetic basis of heart failure in specific patient populations, no Cardiac Precision Medicine program to identify individualized biomarkers connected to the disease, no integrated research labs dedicated to translating engineering science into 'regenerative' techniques for treating heart failure, and no mobile health platforms to ensure seamless monitoring and transfer of care for patients to prevent having to return to hospital.

Now, preeminent experts in a variety of disciplines including cardiology, bioengineering, computer science, pediatrics, and genomic medicine are working together to accelerate the discovery of new approaches to treating heart failure. The Ted Rogers Centre is not only a model for collaborative medicine, it has reaffirmed Toronto as a global hub for cutting-edge cardiovascular research.

The Ted Rogers Centre for Heart Research is a monument to Ted's legacy. Like him, when it comes to countering the ravaging effects of heart failure, we believe 'the best is yet to come.'



The Ted Rogers Centre landmark Translational Biology and Engineering Program occupies the 14th floor of MaRS Discovery District's West Tower in Toronto.

WHY HEART FAILURE?

Heart failure is the fastest-growing cardiovascular disease in Canada and one that affects people at every stage of life, from newborns to retirees.

A multifaceted condition, heart failure occurs when the heart muscle is either too weak or too stiff to pump blood to the rest of the body. Heart failure can lead to a host of complications and symptoms including fatigue, congestion in the lungs causing shortness of breath (particularly when lying down), and a pooling of fluid in the lower extremities known as “edema.”

Cases of heart failure are on the rise, particularly in Canada where it affects one million people, a number expected to grow by 25 per cent over the next 20 years. It is also lethal, with patients dying on average within two years of diagnosis.

A devastating illness for patients and their families, heart failure also puts an enormous strain on health care providers. It’s a common cause of hospitalization, and patients typically stay a week in hospital—with one in four returning to hospital within 30 days. In Canada, the disease costs the health care system at least $3 billion annually, at a rate of 1.4 million hospital stays per year.

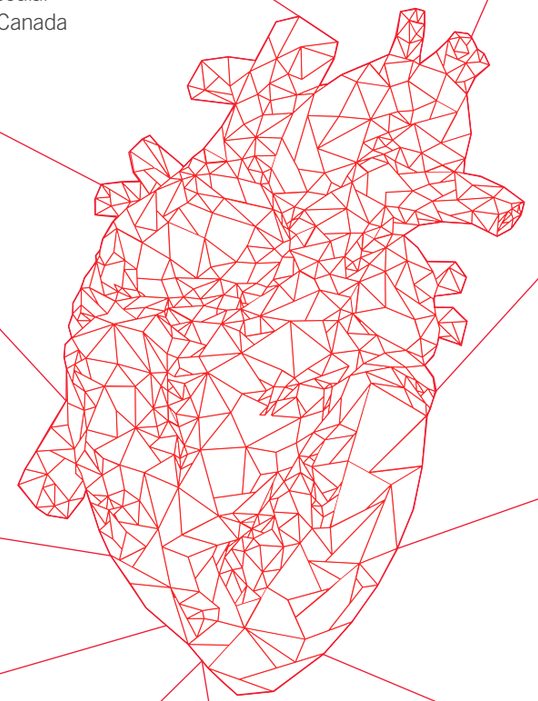
Heart failure does not have a single cause, which complicates matters for physicians. It can result from heart attacks, high blood pressure, heart valve disease, congenital heart defects, obesity, diabetes, kidney disease, genetics, or as a side effect of medications used to treat cancer and other inflammatory diseases.

Precise diagnosis and treatment of heart failure present a significant challenge. Until recently, doctors relied on a set of blunt tools to assess patients and distinguish underlying causes.

Today, however, there is new hope for heart failure patients as a result of breakthroughs in treatment and self-care, targeted medicines, and cutting-edge genetic research into early detection and prevention.

This hope will be the legacy of the Ted Rogers Centre for Heart Research.

Heart Failure by the Numbers—in Canada



1st
Most rapidly rising cardiovascular disease in Canada

2.1 years
Average survival rate for patients

10
Average length of stay in hospital, in days

26 days
Of hospital resources per average patient in 1st year of treatment

25%
The projected growth of heart failure prevalence in the next 20 years

$3 billion
Annual toll on the Canadian health-care system

1.4 million
Hospital stays each year

60,000
Canadians diagnosed each year

1 million
Canadians have heart failure

THE RARE GIFT

In 2008, the visionary Canadian entrepreneur and philanthropist Ted Rogers Jr. died at age 75 of congestive heart failure. Having built one of the most successful telecommunications and media companies in Canadian history, Ted understood the power of research and technology to change lives.

That's why, following Ted's passing, the Rogers family sought innovative ways to change the fortunes of current and future patients with heart failure.

It quickly became apparent, though, that improving their outcomes would require a radically different approach from the status quo, one that would include collaboration between engineers, scientists, nurse practitioners and clinicians, each with a range of specialized skills and abilities.

Therefore, after consulting Canada's leading experts in genomics, bio-engineering and clinical care, the Rogers family came to a historic decision. To honour Ted Rogers' spirit of innovation and bold ambition, they would give a record $130 million to The Hospital for Sick Children, University Health Network and the University of Toronto to form a new partnership.

All three institutions responded by matching the gift to reach a funding total of $269 million, forming the **Ted Rogers Centre for Heart Research**. The Rogers family's gift not only sets an important precedent in health care philanthropy, but it will also have a lasting impact on heart failure patients from all walks of life for generations to come.

As Ted's wife Loretta Rogers said of the Ted Rogers Centre at its launch in 2014, "it's a testament to Ted's drive for innovation and his commitment to leaving the world a better place. We know Ted would have been proud of this bold initiative that will improve heart health for all."

Loretta Rogers announces a historic $130 million gift to launch the Ted Rogers Centre for Heart Research in November 2014.

A BOLD COLLABORATION

Heart failure is a common outcome from a complex set of causes, many of which we still don't fully understand. It is also indiscriminate, potentially striking at any point across the lifespan, from in utero to older patients.

That's why improving the treatment and diagnosis of heart failure can't be left to any one group of experts, but requires a bold, interdisciplinary approach.

Thankfully, SickKids, UHN and U of T—with respective strengths in genomics research, innovative clinical care, and bioengineering—make ideal partners. All three share an extensive history of collaboration, innovation and research in cardiac care, including the first use of an external pacemaker, the first successful open-heart surgery, and several pioneering pediatric congenital heart operations.

The potential for fruitful work at the Ted Rogers Centre is limitless, an expansive network connecting many dots—students, clinicians, researchers, surgeons, patients and their families—that extend to other hospitals, universities and research labs across the globe.

As the Ted Rogers Centre's executive director Dr. Mansoor Husain explains, "Together, we're breaking new ground, learning lessons that apply to other institutions pursuing similar collaborative partnerships."

Imagine: the genome of an adult with inherited heart failure at the Peter Munk Cardiac Centre provides a rich source of data to researchers at the Precision Medicine program at SickKids, which they can then use to develop more targeted therapies for infants with the same condition. Meanwhile, scientists at the Translational Biology and Engineering Program can apply these discoveries to develop technology for more effective interventions to be used by clinicians at both hospitals, and beyond.

This example is just one of many exciting possibilities.

Finally, when it comes to fixing broken hearts, the Centre's most critical partners are patients and their families. The success of the Ted Rogers Centre in fulfilling its core mission depends on their participation in the Centre's research, their medical literacy and their boundless curiosity and advocacy.

New collaboration: Ian Scott (middle, SickKids) and Anthony Gramolini (right, U of T) are examining the role of unexplored proteins in the heart to gauge their potential involvement in heart failure. This contributes to work by Dr. Seema Mital (left, SickKids, Ted Rogers Centre scientific lead) who investigates how genetic defects in these areas contribute to childhood heart disease.

FULFILLING THE PROMISE OF A HEALTHY HEART

The future of effective heart failure treatment is individualized care, an absolute necessity when it comes to saving the lives of patients with heart failure and preventing the disease altogether.

That's why the Ted Rogers Centre for Heart Research is taking **three critical steps** in the race to improve heart failure outcomes:

1

Precise, individually tailored diagnosis and prevention through whole genome sequencing, biomarker discovery, and targeted therapeutics.

2

Radically improved patient care including the use of home monitoring technologies and enhanced electronic medical recordkeeping and analysis.

3

New therapeutic methods for the prevention, diagnosis and treatment of heart failure including heart muscle repair and regeneration.

These steps will allow us to fulfill the promise of a healthy heart.

1 PRECISE HEART FAILURE DIAGNOSIS, TREATMENT AND PREVENTION ACROSS THE LIFESPAN

When faced with a troublesome disease whose causes and triggers overlap, one of the best tools clinicians and researchers have is whole genome sequencing.

The Centre's **Cardiac Genome Clinic** at SickKids works with patients and their families to create a database of individual genomic patient profiles to more fully understand the genetic basis of heart failure. The database will help clinicians develop effective, individually-targeted medicines and methods of care. The clinic is also striving to better understand the psychological, social and economic impact of genetic profiling on the cardiac patient population.

"By finding the genetic cause, not only do we learn why this happened, but we can also learn about implications the diagnosis may have in other areas of the patient's health and how to best manage their care," says Eriskay Liston, a Ted Rogers Centre genetic counsellor. "This gives us a more individualized approach to this person's medical care."

Meanwhile, the **Cardiac Precision Medicine Program** at SickKids is unravelling the genetic signature of every child with heart disease and heart failure, beginning with the inherited childhood cardiovascular ailment Tetralogy of Fallot and both inherited and acquired forms of heart muscle disease, known as cardiomyopathy. The program will develop ground-breaking tools and techniques to predict heart failure before it presents, as well as targeted therapies for children and adults based on their unique genome.

This data will also be used to find new biomarkers and medicines for heart failure and create 'risk calculators' to help predict the likelihood of sudden death and help physicians intervene before it happens.

"Our hope is to individualize therapies for patients as opposed to using a one-size-fits-all approach," explains Dr. Seema Mital, scientific lead of the Cardiac Precision Medicine program.

By better understanding the genetic and biological basis for heart failure, the Ted Rogers Centre will create smarter tools to predict, diagnose and treat the disease.

Now 12, Charlotte Desbiens (middle) was born with hypoplastic right heart syndrome, requiring three surgeries before her third birthday. In 2017, the Desbiens joined the Ted Rogers Centre Cardiac Genome Clinic (genetic counsellor Eriskay Liston, across from Charlotte) and are playing a special role in genetic research and discovery. “In the face of such a diagnosis, you feel powerless,” says Charlotte’s mother, Cindy. “There was so little we could do. But in supporting research, we can help future generations learn from this. We can be part of providing the answers and uncovering new treatments.”

2 IMPROVED CLINICAL CARE FOR PATIENTS WITH HEART FAILURE: IN HOSPITAL AND AT HOME

One of the most significant challenges in treating heart failure is fragmented care. Too often, patients will see a series of clinicians who may not have a complete picture of the patient's medical profile and history of care. Addressing this issue is critical as heart failure patients require careful monitoring and regular clinical interventions.

To accomplish this, the Centre's **Comprehensive Program in Heart Function** is streamlining clinical care for heart failure patients—by 2025, these efforts will reduce re-hospitalization for patients with heart failure by 50 per cent and shorten the length-of-stay in hospital by 20 per cent.

The Centre is taking a multi-tiered approach to achieve these ambitious goals.

First, it has made significant investments in outpatient clinics—a new heart function "day unit" offers transfusions, outpatient therapy and interventions, diminishing the need for hospital readmission. In its first 18 months, the day unit performed over 400 treatments for patients with heart failure, preventing stressful and costly emergency room visits in many cases. Meanwhile, the nurse practitioner-led Rapid Ambulatory Program for Interventions and Diagnosis in Heart Failure (RAPID) carefully transitions patients from hospital care to a family doctor or cardiologist.

Second, the Ted Rogers Centre is developing a suite of clinical mobility applications to promote patient self-care, improve quality of life and enable seamless communication between health-care partners.

Third, data will be collected and analyzed in real time using remote monitoring technologies. These devices let medical practitioners track heart failure patient progress remotely via smartphone apps and sensors and, if necessary, intervene before the need for hospitalization, preventing a burdensome experience for patients.

Underpinning this work is the Ted Rogers Centre's **Computational Biomedicine and Clinical Mobility Program**, a unique platform enabling machine learning and artificial intelligence-based analytics to generate critical insights from the reams of data now available for analysis. This platform will allow the targeted care of heart failure patients, revolutionize the delivery of care and support innovative research. (To view the potential of this program, please see pages 16–17)

At the same time, the Centre's landmark **Cardiotoxicity Prevention Program** is studying ways to avoid heart failure as a result of the treatment of other diseases and conditions, including cancer and diabetes. This program aims to integrate clinical care with cardiologists and other specialists in oncology, endocrinology, rheumatology, and gastroenterology, to ensure that any risk of heart failure is addressed as part of a patient's treatment. It is already helping manage the care of patients at the Princess Margaret Cancer Centre, protecting their hearts from damage.

"We're leveraging patient-centred mobile health tools to enable self-care and self-management skills, improve patient quality of life and reduce the risk of re-hospitalization," says Dr. Heather Ross, Ted Rogers Centre scientific lead at UHN. "By using patient-level data, machine learning algorithms, and artificial intelligence, we hope to further refine our clinical mobility tools to individualize patient management."

Dr. Heather Ross holds the CardioMEMS™ HF system sensor, a tiny device implanted in the heart to measure pulmonary artery pressure and allow clinicians to monitor heart failure patient health remotely.

Leveraging the Power of Data to Improve Heart Health

The Ted Rogers Centre believes data analysis is one the most important tools available for improving heart health today. That's why the Centre's unique Computational Biomedicine and Clinical Mobility Program will collect, integrate and analyze data from a host of different areas across the Centre and beyond, including genome clinics, biobanks, home monitoring devices and more.

This endeavour will provide an invaluable resource for hospitals, research labs and patients. Through the power of secure data management software, machine learning and artificial intelligence, the program will work to develop more accurate predictive metrics, identify critical biomarkers to improve individual care, and build a database that will fuel scientific discoveries related to heart health both in Canada and around the world.

By collecting, collating and analyzing secure and anonymized clinical data, the Computational Biomedicine & Clinical Mobility Program will provide a level of insight far beyond human capability, and open up new and exciting pathways to an eventual cure for heart failure.

GENOMIC CLINICS AND BIOBANKS

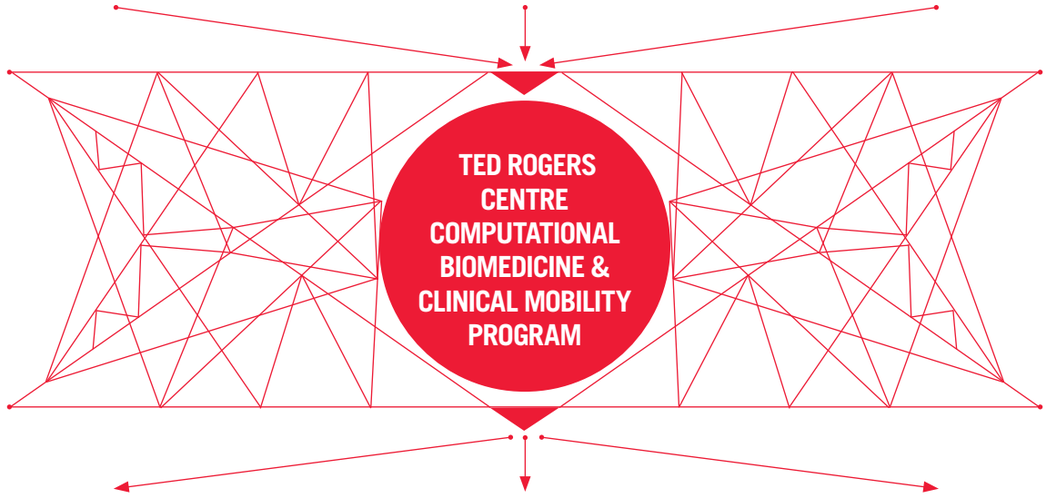
The Cardiac Genome Clinic, Precision Medicine program and the Peter Munk Cardiac Centre Cardiovascular Biobank maintain a wealth of information on the unique profiles of heart failure patients both young and old, from genome sequences to tissue samples to proteomic structures.

HOME-MONITORING TECHNOLOGY

Devices such as CardioMEMS™ and Medly track patient symptoms remotely via a secure internet connection and specially-designed smartphone apps, allowing heart failure patients to take an active lead in their own care and providing the Centre's clinical team a real-time snapshot of patient health.

CLINICAL EMRs

The Ted Rogers Centre for Heart Research's proprietary Electronic Medical Records (EMR) software will collate patient data from every source within the Centre to allow for real-time monitoring of symptoms and the seamless transfer of care between health-care providers.



LANDMARK DISCOVERIES

The rich repository of patient data at the Centre can fuel cardiovascular research here and around the world, including ways to identify new biomarkers for heart failure and its precursors, improve heart failure prevention and recovery, and develop a host of life-saving medical technologies.

PRECISION CARE

Genome sequencing, EMR data, and other predictive analytics can empower clinicians to offer patients more precise, targeted care. This will vastly improve our predictive ability in treating patients with heart failure, of which no two cases are alike.

FEWER HOSPITAL VISITS

Data analytics can enable the development of algorithms that give clinicians a more accurate range of outcomes based on symptoms, while real-time home monitoring technology allows medical staff to intervene before their patients require a trip to the emergency room. Both will provide relief for the health care system, improve patient quality of life, and help people with heart failure live longer.

3 INNOVATIVE TECHNOLOGIES IN HEART REPAIR AND REGENERATION

The future of health care will depend on the ability of researchers to ensure discoveries made on the lab bench develop into tools used by clinicians. Heart failure is no different, and that is why the Centre's Translational Biology and Engineering Program (TBEP) employs a team of investigators from diverse, complementary disciplines such as biology, engineering, physiology, imaging, microvascular medicine and proteomics.

By leveraging Toronto's growing stem cell expertise, TBEP's goal is to develop ground-breaking methods to repair and regenerate heart muscle. One key is to harness the immune system's innate ability to heal damaged heart tissue while turning off its capacity to trigger inflammation that can lead to greater harm. TBEP experts work in close collaboration, in step with a broad network of national and international experts, to repair affected heart tissue by introducing stem cells, molecules and biomaterials in ways that will work, and which the heart will accept.

"Things are falling in place," says Paul Santerre, one of eight TBEP principal investigators, and winner of a 2017 Governor General's Innovation Award. "The community at the Ted Rogers Centre is poised to make a clinical and commercial impact on fixing broken hearts."

TBEP will also identify unique molecular signatures or biomarkers for early detection and management of cardiovascular disease, as well as engineer heart tissue models to find new ways to test targeted therapies and interventions based on the genomic research conducted by its Ted Rogers Centre partners.

Prof. Paul Santerre (left) confers with research trainees in the TBEP lab.

"We'll have new methods of delivering treatments, we'll have new targets for interventions, and we may even have parts of hearts grown in our centre," says Ted Rogers Centre scientific lead Craig Simmons (TBEP). "We will enable the pipeline from discovery to diagnosis to therapy."

Prof. Craig Simmons (centre), Ted Rogers Centre scientific lead, examines heart tissue at TBEP alongside lab members.

A WORLD-CLASS EDUCATION IN HEART HEALTH FOR CLINICIANS, RESEARCHERS AND PATIENTS

At the Ted Rogers Centre for Heart Research, education in heart failure isn't limited to clinicians, practitioners and researchers—it begins and ends with patients and their families. Lifelong learning is a core part of the Centre's mission, which attracts global talent who will help fulfill the Centre's ambitious goals over the next decade and beyond.

The Ted Rogers Centre for Heart Research is at the forefront of global education when it comes to the latest therapies, treatment regimens and best practices in heart failure care. Through the Centre's Education Fund, 19 trainees from all levels of academia have received 23 grants for studies in basic and applied sciences, engineering and clinical health sciences. These funds help support the next generation of scientists and introduce them to an inspiring and supportive community of fellow researchers.

The Centre also holds an international scientific conference every year in Toronto, bringing together the world's best and brightest to learn from one another and share new ideas and innovations. In spring 2017, the Centre partnered with the Canadian Heart Failure Society to host *Heart Failure Update*, Canada's largest meeting ever to focus solely on heart failure, with 460 participants.

Among the Centre's web resources is a patient education website (TedRogersHeartFunction.ca), which is both a valuable learning aid for patients and their families, and an extension of the medical advice they would receive from their health-care partners. Medical literacy is a critical component of effective heart failure treatment, and resources like this enable patients to play a vital role in improving their outcomes.

The Ted Rogers Centre encourages collaboration and cooperation among students, training the next generation of scientists to help improve the lives of patients with heart failure.

WE'RE ALREADY MAKING A DIFFERENCE

In three short years, the Ted Rogers Centre for Heart Research has made remarkable progress in the way we diagnose, treat and prevent heart failure. Its partners have already invested nearly $72 million in world-leading research and innovation. The Centre has established innovation grants for "moonshot" projects that demand researchers leave their comfort zones, work together, and think big in their approach to treating heart failure.

A truly international effort, a scientific advisory panel of world-class thought leaders oversees the work at the Ted Rogers Centre. This distinguished group features six leading investigators from Oxford, Harvard, Stanford, Yale, Boston University, and the University of Ottawa.

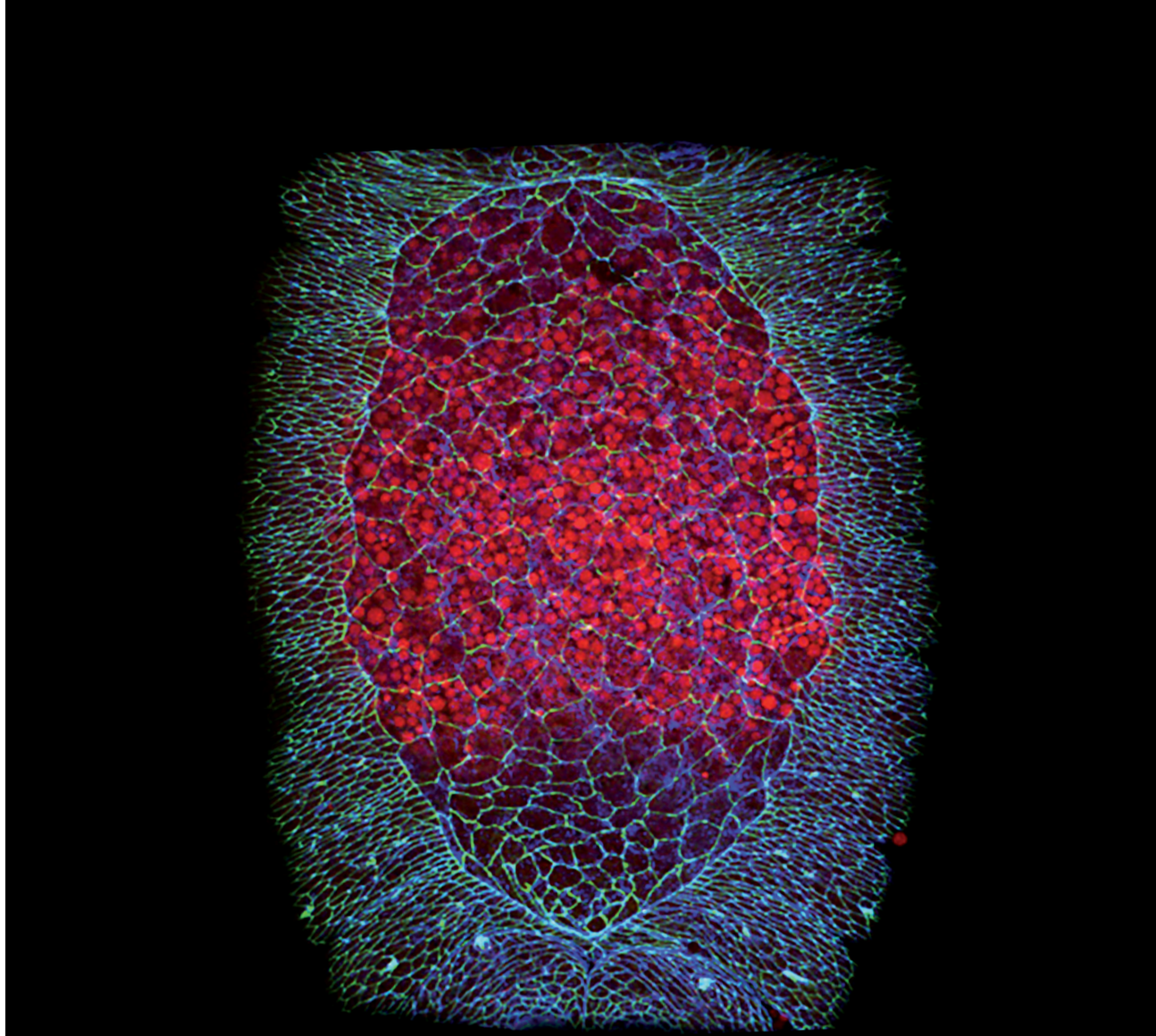
The Centre oversaw the first Canadian patient implanted with a wireless device, the CardioMEMS™ HF system sensor, which lets clinicians monitor cardiovascular health in real time, then take preemptive measures to alleviate symptoms and help patients avoid a hospital visit.

A team led by Dr. Douglas Lee has developed a first-of-its-kind algorithm, the Emergency Heart Failure Mortality Risk Grade (EHMRG). This tool analyzes a large sample of patient data to better predict 7- and 30-day outcomes for heart failure patients, and is now used by emergency physicians around the world to determine which patients to admit and which to send home safely.

The landmark Cardiac Genome Clinic has recruited 135 families for whole genome sequencing, providing invaluable data for research into a more accurate diagnosis of heart failure in children. Work is also underway to begin testing a 'living tissue' heart valve that will eliminate the need for multiple heart surgeries for pediatric heart failure patients.

Another team of biologists, engineers, geneticists and clinicians led by Prof. Paul Santerre at TBEP is working to develop a biodegradable cardiac patch that will encourage heart muscle repair in the wake of a heart attack and prevent the body's natural inflammatory response, a game-changing tool that will help prevent heart failure in patients recovering from heart attacks.

And this is only the beginning.



In the Rodrigo Fernandez-Gonzalez lab in TBEP, researchers examine how wounds are repaired—naturally—in the embryos of fruit flies. This image shows the injury (the red oval), and the cells beyond the wound that will begin to close over it, leaving behind no scars. Understanding the mechanisms behind this ability will enable the development of new therapeutic approaches to promote scarless repair of heart tissue in people—including patients with heart failure.

CONCLUSION

Though the Ted Rogers Centre has already made significant strides, as Ted Rogers often said, "the best is yet to come." There are countless opportunities to forge significant inroads in the way we address heart failure across the lifespan, make breakthroughs in precision medicine and targeted diagnosis, improve patients' quality of life, understand the inner workings of a complex disease, develop individually-targeted treatments, and engineer new ways to repair the heart.

Over the next decade, the Centre will redefine how we care for people with heart failure. We will develop cutting-edge medical technologies, collaborate with the world's leading researchers, scientists and clinicians, and partner with patients in giving them greater control over and understanding of their own care.

This is the first chapter of the Ted Rogers Centre for Heart Research. Our work has only just begun. The possibilities are endless, and new hope for patients with heart failure is just around the corner.

"When it comes to the diagnosis, treatment and management of heart failure, the Ted Rogers Centre will pioneer the way we understand our patients. We will make major advances in all three areas, whether that means discovering new biomarkers, using cutting-edge technology in patient monitoring and data analysis, or regenerating damaged heart tissue."

–Ted Rogers Centre executive director Dr. Mansoor Husain

Partners in the Ted Rogers Centre for Heart Research

SickKids UHN Toronto General Toronto Western Princess Margaret Toronto Rehab UNIVERSITY OF TORONTO

TED ROGERS CENTRE FOR HEART RESEARCH