TED ROGERS CENTRE
FOR HEART RESEARCH



Donor Stewardship Report

APRIL 2023 – MARCH 2024

Presented January 2025

Table of Contents

Presidents' Message 3

Message from the Executive Director 5

Transforming the future of heart health: 2023-24 Highlights 6

Our Strategic Framework 7

Strategic Goal 1: Investing in top talent, high-impact training and global engagement 8

Special Highlight - Driving innovation: Ted Rogers Chair in Cardiovascular Engineering 12

Strategic Goal 2: Unlocking new possibilities in heart disease diagnostics, regenerative therapies 18

Strategic Goal 3: Leveraging innovative technologies to deliver personalized care 22

Special Highlight - Medly and mortality risk calculator pioneer new heart failure care model in Toronto 24

Strategic Goal 4: Enhancing equitable access to high-quality care 26

Strategic Goal 5: Accelerating the real-world application of groundbreaking research 29

Special Highlight - PRIMacCY risk calculator goes live to deliver precision care to children at risk for sudden cardiac death 32

Special Highlight - Groundbreaking heart-brain research leads to potential treatments for cognitive impairment 34

Research Productivity & Impact 36

2023/24 Donor Report Awards 38

Financial Reporting – Overview 47

Presidents' Message



Dr. Ronald Cohn



Dr. Kevin Smith



Professor Meric Gertler

We are pleased to present the 2023/24 impact report for the Ted Rogers Centre for Heart Research (TRCHR). This report details the Centre's remarkable achievements over the past twelve months, made possible by your continued generosity.

This year's report is particularly special. November 2024 marked ten years since the Rogers family made the extraordinary gift that brought together the Hospital for Sick Children, University Health Network and the University of Toronto to accelerate research and care for patients living with heart failure, achieving the significant goal of reducing hospitalizations by 50%.

Your historic investment in the Centre has achieved this and more, spurring a decade of transformative impact on so many patients and their families. And your renewed commitment to 'Rogers 2.0' in 2020 strengthened and expanded this legacy, helping to sustain it in perpetuity.

The Centre's accomplishments over the past year bear witness to how far we've come in bringing precision heart health to patients across Canada and around the world since 2014. This includes implementing an international, multi-centre research network: PRecIsion Medicine in CardiomyopathY (PRIMaCY), developed by the TRCHR Cardiac Precision Medicine Program and SickKids. The network includes a data-driven risk assessment tool that can, with greater than 70% accuracy, predict children at greatest five-year risk of sudden cardiac death from hypertrophic cardiomyopathy.

The Bolz Lab, part of TRCHR's Translational Biology and Engineering Program (TBEP) at U of T, has leveraged a cystic fibrosis drug, lumacaftor, to halt and reverse the cognitive decline that occurs due to cerebral blood flow reduction from heart failure, and will move to a phase-2 trial to test on patients with heart failure by the end of the year.

And Dr. Heather Ross, scientific lead with the TRCHR's Integrated Program for Excellence in Heart Function at the Peter Munk Cardiac Centre at UHN, along with colleagues at U of T and Unity Health, won a $17.5M grant from the Canada Foundation for Innovation to build the Diagnostic Horizons Lab. The Lab will focus on improving access to diagnostics, including for heart failure, for people living in rural communities. In addition, Dr. Ross expanded the Medly patient monitoring program to provide accessibly to care for patients with heart disease in Northern Ontario and Uganda.

Moreover, TRCHR's experts have identified unique pharmacogenomic variants in non-European populations through whole genome sequencing, and engineered soft cardiac connective tissues similar to native heart valves that reduce the need for frequent surgeries.

These are more than just scientific breakthroughs; they represent hope for families whose children have cardiomyopathy, hope for a longer, better quality of life for patients with heart failure, hope for countless people in hard-to-access communities who deserve quality care, and hope for the promise of a healthy heart.

This is the decade-long legacy of the Ted Rogers Centre for Heart Research—a legacy you have enabled with your extraordinary support—and we look forward to furthering its impact with you for many years to come.



Dr. Ronald Cohn
President and CEO,
The Hospital for Sick Children



Dr. Kevin Smith
President and CEO,
University Health Network



Professor Meric Gertler
President,
University of Toronto


TED ROGERS
CENTRE
FOR HEART
RESEARCH
THE
PROMISE
OF A
HEALTHY
HEART.
SickKids
UHN

2023/24 at Ted Rogers Centre
from Executive Director Dr. Mansoor Husain



Dr. Mansoor Husain

As we celebrate the 10th anniversary of the inaugural Rogers Foundation gift, it is a moment to reflect on the incredible progress we've made at the Ted Rogers Centre for Heart Research (TRCHR) over the past decade and the promising future that lies ahead. The remarkable advancements achieved through the collaborative efforts of our community continue to inspire us, reinforcing our pride in being a truly unique research centre comprised of three world-class institutions.

This past year has been distinguished by significant milestones aligned to our strategic initiatives and our mission to transform and dramatically improve heart health for children, adults, and families across Canada and around the globe. We've been diligently integrating our updated strategic framework's goals and objectives across the Centre, influencing everything from our daily operations to the selection of projects championed in our funding competitions.

In this year's report, we are excited to showcase the achievements of our community through the lens of our strategic goals, allowing us to better highlight the collaborations happening within and across each partner institution. Some of these achievements include:

Foster and Promote Our World-Class Talent
We're very excited to welcome Dr. Cedric Manlhiot as our inaugural Rogers Innovator in Cardiovascular Precision Medicine at SickKids, where he will work within the Cardiac Precision Medicine Program and across the Centre on Big Data and AI advancements.

Target the Causes and Progression of Heart Failure
The Cheng lab within the Translational Biology and Engineering Program made exciting strides in their work on improving cardiovascular MRI techniques, creating a new chemical which can bind specifically to the scar tissue left behind after a heart attack. This work is now being tested on tissues from the Peter Munk Cardiac Centre Biobank at UHN.

Create Precise & Predictive Digital Health Solutions
Another significant achievement is that Dr. Heather Ross, Scientific Lead at UHN, will co-lead the new Diagnostic Horizons Lab in Toronto following a $17.5M federal Centre for Research and Applications in Fluidic Technologies grant. This lab will improve access to diagnostics for remote patients with heart failure.

Enable Equitable Access to High-Quality, Person-Centred Care
The Cardiac Genome Clinic at SickKids identified pharmacogenomic variants in non-European populations through whole genome sequencing that were absent on traditional commercial panels, highlighting the need for greater diversity in pharmacogenomics research for medication guidance.

Accelerating The Application of Discovery and Innovation:
The PRIMaCY calculator to predict sudden death for children with hypertrophic cardiomyopathy partnered with SickKids' electronic health record system (Epic) for a first-in-kind integration and is currently being implemented across hospitals in Canada and the US.

These are just a few of the remarkable achievements the TRCHR team has accomplished over the past year, and we are excited to share even more in the following pages. The unwavering support of the Rogers Foundation remains vital in helping us attract top talent, educate future leaders, and solidify our Centre's position as a global leader in heart health research. We extend our deep gratitude for your continued generosity. With our engaged and motivated community, we are confident that we will continue to set and surpass ambitious goals, ultimately transforming the future of heart health in Canada and around the world.

Thank you for your ongoing support and commitment to our mission. Together, we are making extraordinary strides toward a world free from heart failure.



Dr. Mansoor Husain
Executive Director, Ted Rogers Centre for Heart Research
Professor of Medicine, University of Toronto



(L to R) Michelle Di Paola and Dr. Allen Teng working in the Gramolini lab at the Translational Biology and Engineering Program.

Transforming the future of heart health: 2023/24 Highlights

As we celebrate the 10th anniversary of the Ted Rogers Centre for Heart Research and reflect on a decade of impact, we are building on this progress. Thanks to your family's vision and ongoing commitment, we have pushed past our initial goals and set our sights on our ultimate vision of creating a world free of heart failure.

Last year, we shared with you our refreshed Strategic Framework. Since then, we have accelerated our momentum and are thrilled to report on our impact across each of our five strategic goals.

With your generous support, we are working collaboratively across the University of Toronto, University Health Network and SickKids to invest in top talent, unlock new diagnostic and therapeutic possibilities, leverage innovation to deliver personalized care, enhance equitable access and accelerate the application of groundbreaking research.

Our Strategic Framework

OUR MISSION

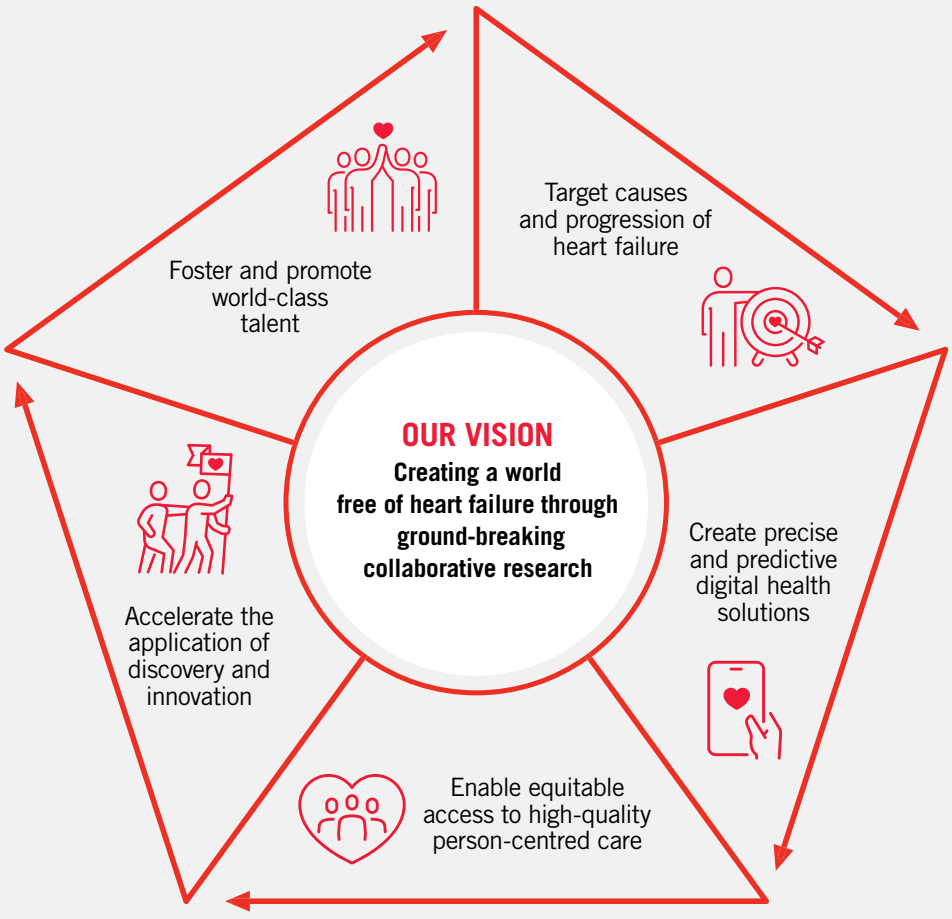
Transform and dramatically improve the future of heart health for children, adults, and families across Canada and around the world, through an integrated program of outstanding research, education, and clinical care.

OVERARCHING GOALS

Increase patient and caregiver engagement

Increase inclusion, diversity, equity, and accessibility

Integrate Artificial Intelligence and Data Science



Investing in top talent, high-impact training and global engagement



STRATEGIC GOAL 1
Foster and promote our world-class talent

Training, developing, and promoting a diverse leadership of scientists, cardiologists, and members of the TRCHR is at the core of the Centre's mission. Within this strategic goal, we strive to:

- Deliver coordinated training and mentorship programs that integrate with career pathways, and span disciplines and sectors
- Implement a recruitment strategy for trainees and faculty that embraces underrepresented groups to attract top talent from across the world
- Grow the Centre's international presence and engagement through existing faculty, trainees, patients, and alumni to amplify our knowledge translation strategies

The Ted Rogers Centre for Heart Research has made bold strides in fostering and promoting our world-class talent—one of five key priorities in our refreshed Strategic Framework. This year saw the launch of high-impact training programs, including the ECHO Discovery initiative and the Cardiovascular Remote Diagnostic & Monitoring Technologies for Health Equity (CaRDM Eq) program for up-and-coming researchers in the field of heart failure. We also welcomed renowned expert Dr. Cedric Manlhiot as the inaugural Rogers Innovator in Cardiovascular Precision Medicine and engaged in top-tier international conferences such as our annual Heart Failure Symposium, which was back in person this past year.

CULTIVATING FUTURE CARDIOVASCULAR ENTREPRENEURS WITH ECHO AND ECHO DISCOVERY

Building on the success of our 12-month national Entrepreneurship for Cardiovascular Health Opportunities (ECHO) program, we launched ECHO Discovery in the fall of 2022. This six-month foundational program, created in a partnership between Translational Biology and Engineering Program (TBEP) and TRANSFORM HF, expands access to entrepreneurial training to trainees at earlier stages.

Together, these programs are bridging the translational gap for cardiovascular innovations by providing new generations of cardiovascular leaders with the opportunity to gain entrepreneurship and research translation skills, learn from a diverse group of mentors and experts and explore potential careers in cardiovascular innovation.

ECHO Discovery: exploring fibrosis-reducing biomaterials and a non-invasive electrocardiogram patch

ECHO Discovery trainees learn the foundations of ideation and entrepreneurship. In the course of hands-on workshops, they start to form teams and work together

to conceive innovative solutions within the cardiovascular health space. Though still in the "ideas" phase, four teams tested their concepts by presenting their ideas at the 2024 ECHO Discovery pitch competition in front of an expert judging panel and live virtual audience. The teams HeartWare and U-MATTR won first ($1,000) and second ($500) prize, respectively. While HeartWare proposed a non-invasive piezoelectric electrocardiogram patch to replace bulky sensors, U-MATTR pitched a new biomaterial that reduces fibrosis to help improve patient recovery following a heart valve replacement. The goal is for ECHO Discovery teams to keep working together, form start-ups and move from ideas to products.

ECHO impact: $250,000 awarded for next-gen precision therapeutics to protect against heart disease progression

For the 2023 annual ECHO PITCH competition, $250,000 was awarded to HDAX Therapeutics, a molecular technology company spun out of the University of Toronto (U of T) focused on developing small-molecule inhibitors that deliver protection against worsening conditions and improve heart function by reducing the physical changes that drives heart diseases. The company was founded in 2016 by Drs. Nabanita Nawar and Pimyupa Manaswiyoungkul, who met at the U of T Mississauga campus. Their new inhibitor is on track to demonstrate efficacy in an animal model of heart failure with preserved ejection fraction (HFpEF), an indication which currently lacks effective treatments.

Since its inception, ECHO has engaged more than 130 mentors and advisors from various sectors; held 194 workshops, webinars and round table discussions focused on entrepreneurship principles and commercialization in the health sector; and trained 56 ventures within the cardiovascular space.

FIRST-OF-ITS-KIND PROGRAM TRAINS NEXT GENERATION OF DIGITAL HEALTH INNOVATORS TO DESIGN FOR EQUITY

TRANSFORM HF launched a new, one-of-a-kind training program called Cardiovascular Remote Diagnostic & Monitoring Technologies for Health Equity, or CaRDM Eq. Funded by a $1.65 million six-year NSERC Collaborative Research and Training Experience (CREATE) grant, this program will train more than 100 of the next generation of digital health innovators to design for equity.

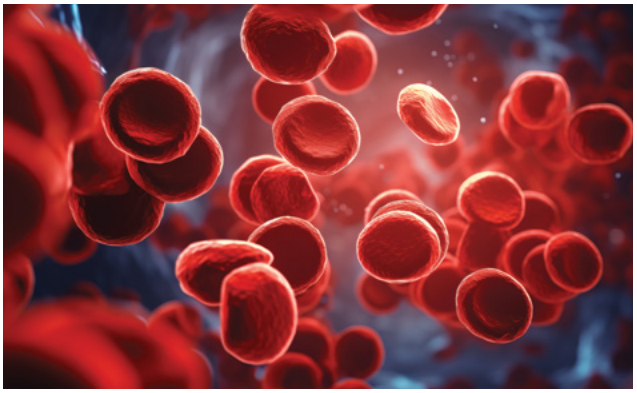
CaRDM Eq's unique approach provides technical training through the lens of digital health care equity, ensuring future digital technology is accessible for all individuals experiencing HF and cardiovascular issues. The program includes 11 U of T and McMaster faculty members and more than 30 industry, community, academic, and clinical collaborators, who will help deliver CaRDM Eq's training components.

The first cohort began in 2024 and includes Natural Sciences & Engineering (NSE) and non-NSE undergraduate, graduate, and postdoctoral fellows from UHN, U of T, and McMaster University. These future leaders will gain technical training in cardiovascular digital health innovation, develop professional skills to design for equity, collaborate across institutions, disciplines, and sectors and engage in experiential learning opportunities.

TRANSLATIONAL BIOLOGY AND ENGINEERING PROGRAM BRINGS TRAINEES TOGETHER ACROSS DISCIPLINES

The Translational Biology and Engineering Program (TBEP) at TRCHR has an impressive history of attracting diverse talent. Currently, 66 TBEP trainees—including 19 Master's students, 40 PhD candidates, and 7 postdoctoral fellows—along with 17 research staff from nine U of T departments, are collaborating to explore and develop promising strategies for diagnosing, preventing, and treating heart failure, as well as repairing and regenerating heart tissue.

In the past fiscal year, these trainees held $585,407 in scholarships and awards and contributed to 47 peer-reviewed publications in high-impact journals. Additionally, the TBEP Undergraduate Summer Research Program (USRP), which provides students the opportunity to train for up to 16 weeks alongside TBEP investigators, welcomed 12 undergraduate students in the summer of 2023. To date, $180,825 in TBEP USRP scholarships have been granted to support 71 undergraduate students, matched by $112,050 in external scholarships and fellowships.



THE CARDIAC GENOME CLINIC PROVIDES NEW STUDENT RESEARCH OPPORTUNITIES

The Cardiac Genome Clinic (CGC) is increasing educational support for up-and-coming researchers in the field of cardiovascular genetics, providing practicum experience for students in the Master of Health Sciences in Medical Genomics Program at the University of Toronto, a field of study dedicated to generating, integrating, and interpreting genetic and genomic data.

In 2023/24, the clinic supported a full-time student working on a research project led by Dr. Lindsay Freud, assessing neurodevelopmental genes in a cohort with transposition of the great arteries, a serious and rare heart problem in which the two main arteries leaving the heart are reversed. Additionally, the CGC hosted an undergraduate summer student through the Starbucks Summer Studentship program who successfully published a first-author paper of her work in Future Cardiology. This paper explored lesser-known genes connected to cardiomyopathy and arrhythmia, helping improve how we understand and catalogue genes related to these diseases.

RECRUITMENT OF ROGERS INNOVATOR IN CARDIOVASCULAR PRECISION MEDICINE

We are thrilled to welcome Dr. Cedric Manlhiot in 2024 as our first-ever Rogers Innovator in Cardiovascular Precision Medicine. A new joint recruitment between the SickKids' Research Institute and the Labatt Family Heart Centre, Dr. Manlhiot will focus on emerging analytical methods for precision medicine, studying the infrastructure for the clinical deployment of prediction models and the life cycle of algorithms in the clinical area.

Dr. Manlhiot has a long history of collaborating with each partner at the TRCHR. After completing his Ph.D. in Medical Sciences at the University of Toronto, he held a variety of positions at SickKids from 2004 to 2019, most notably as an Associate Scientist, Child Health Evaluative Sciences. He also held a joint appointment at UHN as an Associate Scientist in the Toronto General Hospital Research Institute and served as Assistant Professor in the Department of Surgery at U of T. Following the inception of the TRCHR, Dr. Manlhiot led the Cardiovascular Data Management Centre initiatives and research at the Peter Munk Cardiac Centre at UHN, before he was recruited away to lead the Cardiovascular Data Intelligence Initiative at Johns Hopkins University.

TRCHR is delighted to have helped SickKids attract Dr. Manlhiot back to serve in this exciting new position. We look forward to the advancements he will bring to the Cardiac Precision Medicine Program at SickKids.

AMPLIFYING OUR GLOBAL IMPACT THROUGH INTERNATIONAL CONFERENCES AND KNOWLEDGE SHARING

As a global leader in heart health research, the Centre for Heart Research collaborates and shares research findings through a variety of high-impact publications and international conferences. Notable conference highlights from 2023/24 include:

- **The Cardiac Genome Clinic represented the TRCHR at the American College of Medical Genetics, an international medical genetics conference held in Toronto in March 2024**
  The CGC team presented an exciting project in collaboration with Dr. Ian Scott's lab, exploring the impact of mutations in two genes crucial for starting protein production in cells. The researchers created genetically modified zebrafish using CRISPR technology to replicate human genetic mutations. The zebrafish models showed severe congenital and developmental heart issues and early death, mirroring human symptoms and underscoring the critical role of specific mutations in heart development and related disorders. Future research by the CGC team and Dr. Scott's lab will help to better understand and address the impacts of these genetic alterations.

- **The 8th Annual Heart Failure Symposium returns in-person**
  We were thrilled to hold our 8th annual Heart Failure Symposium in 2023 fully in-person for the first time in several years. The day featured engaging keynotes from Dr. Adam Rodman (Harvard), Dr. Susan Quaggin (Northwestern), and Professor Bernice Downey (McMaster); exciting flash science and poster presentation sessions showcasing the work of the Centre's trainees; and an interactive workshop. The event concluded with a cocktail reception, where experts from various fields networked and exchanged insights. We eagerly anticipate hosting many more in-person events this year, including our 9th annual Heart Failure Symposium, to continue nurturing the collaborative spirit at TRCHR.

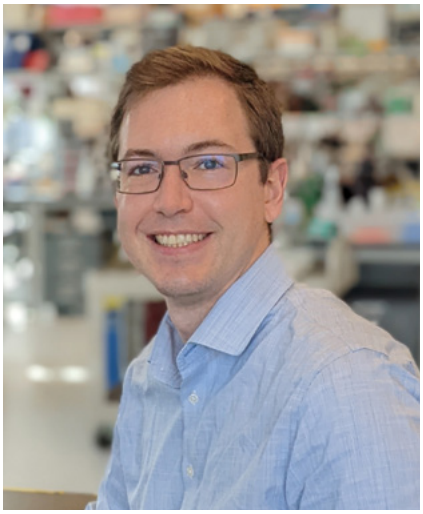


(L to R) Farida Abdelmalek, Anat Usatinsky, and Samantha Unger working in the Franklin lab at the Translational Biology and Engineering Program.

Driving innovation: Ted Rogers Chair in Cardiovascular Engineering

In 2021, Dr. Daniel Franklin was appointed the inaugural Ted Rogers Chair in Cardiovascular Engineering. Drawn by the multidisciplinary team and strong clinical partnerships at the Ted Rogers Centre for Heart Research (TRCHR), Dr. Franklin transitioned from Northwestern University to lead digital innovations in wearables for heart failure care. His work focuses on developing advanced, non-invasive devices to monitor complex cardiovascular metrics, aiming to create technologies that can be trusted in diverse, real-world clinical settings. The Franklin Lab, situated within the Translational Biology and Engineering Program (TBEP) space in the MaRS building, has since embarked on numerous innovative projects made possible by the Chair position's funding and TBEP's cutting-edge laboratory facilities.

Since joining TRCHR, Dr. Franklin has achieved significant milestones, including several high-impact publications and prestigious awards for his pioneering work. He has also been a vital contributor to collaborative initiatives across the Centre, such as TRANSFORM HF and the newly established Translating Cardiovascular Remote Diagnostic & Monitoring Technologies for Health Equity (CaRDM Eq) program.



Dr. Daniel Franklin

Advancing Equity in Wearable Cardiac Monitors

A key area of Dr. Franklin's research is enhancing the accuracy and equity of wearable cardiac monitoring devices. During the COVID-19 pandemic, pulse oximeters became essential in clinical and consumer health settings. Pulse oximeters are routinely used to measure key vital signs for cardiopulmonary function, both for patients in the hospital and at home. However, these devices were found to have limitations in accurately measuring blood oxygen levels in individuals with darker skin tones. These inaccuracies have since been found to lead to missed health issues, as the devices might falsely indicate normal oxygen levels when they are, in fact, too low.

To address this, Dr. Franklin and his team made key recommendations for clinicians and bioengineers working with pulse oximeters, including incorporating skin tone quantification during measurements to identify any bias and developing devices that integrate additional sensors to minimize errors.

Dr. Franklin and his team continue to advocate for more inclusive testing standards and robust device validation to enhance the reliability of wearable monitors across diverse populations.

Wearable Photoplethysmography Roadmap

The Franklin Lab recently published an industry-leading roadmap for developing wearable photoplethysmography (PPG) technology. PPG, an optical sensing technique used in wearables like smartwatches and fitness trackers, monitors parameters such as heart rate, blood pressure, and oxygen levels. As a leading expert in wearable technology, Dr. Franklin outlined key areas for advancing PPG designs, including improving algorithms for more precise readings and expanding clinical and consumer applications, such as for detecting cardiac arrhythmias. This roadmap highlights the need for multidisciplinary collaboration across a variety of fields to advance the development of wearables in a timely and efficient manner.

SPECIAL HIGHLIGHT

Breakthroughs in Hemodynamic Monitoring

In collaboration with Dr. Andreas Tzavelis from the University of Toronto and Professor John Rogers at Northwestern University, Dr. Franklin's team recently unveiled a cutting-edge new wearable medical device. This device, featuring a chest patch and a peripheral sensor, integrates multiple sensory modalities to provide a comprehensive assessment of hemodynamic status—an advanced measure of cardiovascular function that surpasses traditional blood pressure monitoring.

The device's primary innovation lies in its ability to measure not only blood pressure but also cardiac output and vascular resistance, crucial for understanding how the body regulates blood pressure. This advancement, published in Nature Biomedical Engineering, allows for remote monitoring in a patient's natural environment, providing valuable data for healthcare providers to make informed decisions.

Following their IP filing, Dr. Franklin's team is now expanding this technology to include additional sensor metrics related to heart failure and enhancing its accuracy in real-world settings through machine learning. This work, in collaboration with Drs. Douglas Lee, Heather Ross, and John Floras at UHN, aims to improve the detection and monitoring of heart failure types and classes in at-home settings.

Recognizing a Rising Star

Dr. Franklin's innovative work has garnered significant attention and external funding. Notably, he was a finalist in the Open Oximetry Project Challenge, a competition established to enhance the safety and accuracy of pulse oximeters across all populations. As part of the competition, Dr. Franklin will deploy his devices in human trials at the University of California, San Francisco – an in-kind contribution valued over $100K USD. Additionally, in 2024 he received the Connaught New Researcher Award from the University of Toronto, created to help early-career faculty members establish their research programs and increase competitiveness for external funding.

As a key collaborator across the Centre, Dr. Franklin has also secured substantial funding for his work, including a CIHR project grant for advancing pulse oximetry accuracy and equity, valued at nearly $900K; a Catalyst Grant, from the Data Sciences Institute and Tanenbaum Institute for Science in Sport, for developing convolutional neural networks for wearable PPG devices, valued at $100K; and a TRCHR Innovation Award for his work on a Smart-Ring and Medly interface, also valued at $100K. Additionally, he has been a co-investigator on several prestigious grants, including the $17.5M CRAFT award to develop the Diagnostic Horizons Lab alongside Dr. Heather Ross and the $2.9M Heart-Brain IMPACT award led by Dr. Douglas Lee.

In total, Dr. Franklin has brought in $2.36M as PI, and $22.15M through 19 local, national, and industrial funding opportunities. This includes support from CIHR, NSERC, CFI, ORF, and the Heart & Stroke Foundation of Canada. He has also been able to foster industrial collaborations that have translated into two funded sponsored research agreements with AMS-OSRAM (a leading semicondutor manufacturer) and Global Health Labs (the research arm of the Bill and Malinda Gates Foundation).



Dr. Daniel Franklin (top left) with his lab.

Looking Ahead

Dr. Franklin's work at the Ted Rogers Centre for Heart Research is just beginning. His lab continues to grow, attracting trainees from diverse backgrounds who collaborate on solving digital health challenges for heart failure patients. Moving forward, his lab will continue to lead advancements in wearable device equity and PPG development.

This work is all possible through Dr. Franklin's interdisciplinary team, which consists of nine graduate students, one postdoctoral fellow and continues to grow rapidly. Within three years, his trainees have collectively won 14 major national/provincial graduate awards – an accumulative value of $189K in addition to the funding listed above.

Dr. Franklin will also continue to play a pivotal role in the newly established CaRDM Eq program within TRANSFORM HF as an expert in wearables and embedded sensors. He will help educate the next generation of students on designing digital technology with an equitable lens to benefit all individuals living with heart failure and other cardiovascular diseases.

EDUCATION FUND WINNERS - 2023/24

Over $120,000
in grants awarded



39 Applicants
in 2024



14 Award
Winners



Education Fund Award Recipients – 2023/24

Post-Doctoral Researcher (4)

Trainee:	**Christopher Yu***
Project:	A Multi-Centre Non-Inferiority Randomized Controlled Trial of STOPping Cardiac MEDications in Patients with Normalized Cancer Therapy Related Cardiac Dysfunction – The STOP-MED CTRCD Trial
Supervisor(s):	Dr. Paaladinesh Thavendiranathan
Institution(s):	UHN
Collaborator(s):	Raymond Kim, Husam Abdel-Qadir, Eitan Amir, Kate Hanneman, Steve Fan, Coleen Power
Trainee:	**Amin Motamed Ektesabi**
Project:	miRNA-based therapeutics for infection-associated left ventricular dysfunction
Supervisor(s):	Dr. Claudia Dos Santos
Institution(s):	UofT
Collaborator(s):	Howard Leong-Poi, Kim Connelly, Phyllis Billia
Trainee:	**Cristine Reitz**
Project:	Investigating the role of key membrane-shaping proteins in the formation and maturation of the cardiomyocyte sarco(endo)plasmic reticulum
Supervisor(s):	Dr. Anthony Gramolini
Institution(s):	UofT
Collaborator(s):	Michael Laflamme, Chris Yip
Trainee:	**Aleksandra Mitina**
Project:	Integrative multiomic analysis of tandem repeat expansions in congenital heart disease
Supervisor(s):	Dr. Ryan Yuen
Institution(s):	SickKids, UofT
Collaborator(s):	Erwin Oechslin, Seema Mital

*Applicant received renewal of Education Fund award.

PhD (10)

Trainee:	**Ting Xiong**
Project:	Medly Caretown: Building an Equitable Family-Centered Digital Health Intervention to Support Patient-Caregiver Dyads Living with Heart Failure
Supervisor(s):	Dr. Quynh Pham
Institution(s):	UHN
Collaborator(s):	Lindsay Jibb, Jill Cameron
Trainee:	**Coulter Montague**
Project:	Enhancing the Force Generation of Human Pluripotent Stem Cell-Derived Cardiomyocytes Using Genome Engineering
Supervisor(s):	Dr. Michael Alan Laflamme
Institution(s):	UHN
Collaborator(s):	Craig Simmons, Sara Vasconcelos, Christoph Haller, Kumaraswamy Nanthakumar, Michael Garton
Trainee:	**Crizza Ching***
Project:	Endothelial-derived extracellular vesicles: a new paradigm in cancer therapy-related cardiac dysfunction
Supervisor(s):	Dr. Jason Fish
Institution(s):	UHN
Collaborator(s):	Seema Mital, Milica Radisic, Dinesh Thavendiranathan, Elana Aikawa
Trainee:	**Doris Adao***
Project:	Investigating the role of miR-9-5p in hypercontractility using a human induced pluripotent stem cell cardiomyocyte model of hypertrophic cardiomyopathy
Supervisor(s):	Dr. Phyllis Billia
Institution(s):	UHN
Collaborator(s):	Craig Simmons
Trainee:	**Luxcia Kugathasan**
Project:	Cardioprotective responses to SGLT2 inhibition in patients at high cardiovascular risk
Supervisor(s):	Dr. David Cherney
Institution(s):	UHN, UofT
Collaborator(s):	Vikas Sridhar, Bruce Perkins, Yuliya Lytvyn, Julie Lovshin
Trainee:	**Kate MacQuarrie***
Project:	Endothelization and perfusion of a tubular D-PHI/PCNU vascular construct using patient-derived HAMVECs supported by VSMCs and monocytes
Supervisor(s):	Dr. Paul Santerre
Institution(s):	UofT
Collaborator(s):	Stefan Hofer, Anthony Gramolini, Michelle Bendeck, Craig Simmons, Mark Friedberg, Heyu Ni

*Applicant received renewal of Education Fund award.

Trainee:	**Megh Rathod***
Project:	Development of Accurate and Equitable Wearable Non-Invasive Optical Devices for Continuous Hemodynamic Monitoring
Supervisor(s):	Dr. Daniel Franklin
Institution(s):	UofT
Collaborator(s):	Daniel Franklin, Heather Ross
Trainee:	**Mimi Deng**
Project:	Evaluating the impact of extended warm ischemic time using ex-vivo heart perfusion in juvenile porcine models of circulatory death
Supervisor(s):	Dr. Osami Honjo
Institution(s):	SickKids
Collaborator(s):	Osami Honjo, Phyllis Billia
Trainee:	**Karem Abdul-Samad**
Project:	Novel Approaches to Enhancing the EHMRG for Mortality Risk Prediction in Acute Heart Failure
Supervisor(s):	Dr. Douglas S. Lee
Institution(s):	UHN
Collaborator(s):	Husam Abdel-Qadir, Chris McIntosh
Trainee:	**Zhiyue Zhu***
Project:	Fabrication and preclinical testing of engineered heart valve tissue
Supervisor(s):	Dr. Craig Simmons
Institution(s):	UofT
Collaborator(s):	Jason Maynes, Matteo Ponzoni

*Applicant received renewal of Education Fund award.

Unlocking new possibilities in heart disease diagnostics, regenerative therapies



STRATEGIC GOAL 2
Target the Causes and Progression of Heart Failure

Addressing the causes and progression of HF is key to the mission of the TRCHR and is an integral part of each program and initiative. Within this strategic goal, we strive to:

- Identify the biological, social, and environmental factors contributing to the onset and development of HF
- Develop practical frameworks for precision diagnosis and staging, allowing for tailored treatments for individual patients
- Establish and refine models of HF to deepen our understanding of the disease and create new treatments aimed at prevention and reversal
- Ensure streamlined access to catalogued data sets, facilities, and resources for all partners involved in research

Researchers across the Ted Rogers Centre for Heart Research continue to target the causes and progression of heart failure—our second strategic goal. Highlights from 2023/24 include the identification of new genetic markers for cardiomyopathy using whole genome sequencing, the development of a new MRI compound for safer and more effective cardiac diagnoses, breakthroughs in research on embryonic cardiac development and 3D printing of heart tissues that closely mirror natural heart tissues.

NEW RESEARCH EXPLORES THE POTENTIAL OF IMMUNE CELLS IN HEART REGENERATION

Immune cells have never been integrated into engineered heart tissue—until now. In a groundbreaking study, Loretta Rogers Chair in Immunobioengineering Dr. Slava Epelman and his lab has explored the use of human embryonic stem cells (hESCs) to generate primitive yolk sac macrophages, an early form of immune cells created in the initial stages of embryonic development and essential for tissue regeneration. Published in the prestigious journal *Nature Cardiovascular Research*, the study demonstrates that these macrophages significantly enhance the development of "mini human hearts," increasing the force of contraction and clearing out stressed and damaged cells. This research not only offers a better model for studying embryonic heart development but also opens new possibilities for regenerative therapies, highlighting the crucial role of immune cells in heart tissue engineering—an area Dr. Epelman's team will continue to explore.

YUEN LAB USES WHOLE GENOME SEQUENCING TO REVEAL NEW GENETIC MARKER FOR CARDIOMYOPATHY

In the first study to use whole genome sequencing (WGS) to examine tandem repeat expansions in heart

conditions, scientists at SickKids have laid the groundwork for early detection of and future precision therapies for cardiomyopathy, a condition which affects the structure and function of the heart and can ultimately lead to HF. While over half of all cases of cardiomyopathy are currently of unknown genetic origin, new research led by Dr. Ryan Yuen and published in eBioMedicine, found that tandem repeats—a form of genetic variation—are more often expanded in individuals with cardiomyopathy.

Tandem repeat expansions (TREs) are known to contribute to over 60 conditions, often with a hereditary component. By examining the genomes of over 1,200 people with cardiomyopathy using new computational methods developed by the Yuen lab and The Centre for Applied Genomics (TCAG) at SickKids, researchers noted tandem repeats in genes primarily impacting the heart—specifically the left ventricle, which is responsible for pumping oxygenated blood throughout the body. Uncovering the exact location of TREs could help in the development of precision therapies that allow for individualized treatments for each child.

This research was made possible through the participation of hundreds of families in the SickKids Heart Centre Biobank funded by TRCHR.

MITAL LAB UNCOVERS GENETIC VARIANTS CONTRIBUTING TO CONGENITAL HEART DISEASE IN THE DARK MATTER OF THE GENOME

In the past fiscal year, the Personalized Genomics for Congenital Heart Disease (PROCEED) Study, led by SickKids co-Scientific Lead Dr. Seema Mital, has made key advances in identifying specific genetic variants that disrupt RNA splicing in the heart and contribute to congenital heart disease (CHD) in children.

By combining WGS from over 1,500 CHD patients with RNA sequencing, Dr. Mital's team developed a machine learning model that predicts which genetic variants interfere with heart RNA splicing. The model identified such variants in almost 10% of CHD cases which are not captured by conventional genetic tests.

Launched in 2019 and funded by the European Coordinating Centre for Personalized Medicine Research (ERA PerMed), the PROCEED Study aims to uncover the genomic causes of CHD. It includes partners from Germany, the Netherlands, and Australia, working collaboratively to deepen the understanding of how genetic variations impact heart development.

Looking ahead, this model is being converted into a tool for physicians, geneticists, and genetic testing laboratories, to help find the missing genetic causes of CHD. Ultimately, this research could enable the development of precision therapies that restore gene function in patients with these types of defects.

CHENG LAB DEVELOPS NEW MRI COMPOUND FOR SAFER AND MORE EFFECTIVE CARDIAC DIAGNOSES

This year, Dr. Hai-Ling Margaret Cheng's lab achieved a significant advance in developing a safer and more effective MRI chemical compound for molecular imaging.

Traditionally, MRIs use gadolinium-based compounds, which provide high-contrast images but have safety risks for vulnerable patients and are not able to target specific areas. To address this, Dr. Cheng developed a special, non-gadolinium chemical tracer using manganese porphyrin (MnP). This compound can be used to target disease biomarkers, such as scar tissue, allowing the MRI to focus on specific areas of interest. In mouse models, MnP was shown to provide significant bright contrast of targeted tissue when conventional gadolinium-based compounds yielded no contrast. This new formulation is also two orders of magnitude more stable than gadolinium, increasing safety for patients.

The new compound will soon be tested on human heart tissues from the Peter Munk Cardiovascular Biobank, led by Dr. Phyllis Billia. Following this work, Dr. Cheng plans to commercialize the MRI compound and begin clinical trials on humans, paving the way for safer and more effective cardiac diagnoses.

FERNANDEZ-GONZALEZ LAB EXPLORES TINY HEARTS WITH BIG INSIGHTS INTO CARDIAC DEVELOPMENT

Humans and fruit flies may seem worlds apart at first glance, yet when it comes to early heart development, the similarities are closer than one might expect. In both fruit flies and mammals, the process kicks off with cardiac progenitor cells called cardioblasts forming a tube. Understanding abnormalities in fruit fly heart tube formation could provide crucial insights into potential causes of congenital heart disorders in humans.

New research from Dr. Rodrigo Fernandez-Gonzalez's lab, led by PhD student Negar Balaghi, used high-resolution microscopy imaging of heart development in living fly embryos to discover that the movement cardioblasts is not a smooth continuous process, but occurs in a sequence of forward and backward steps. Their imaging also revealed that cardioblasts changed shape periodically, driven by the activity of a specific myosin protein. In the embryo, the team found that a stiff actin cable runs at the back of the cardioblasts, limiting the backward steps and favouring forward movement. Any disruption in the myosin waves or the actin cables impaired the migration of cardioblasts and the overall formation of the heart.

This work helps illustrate the mechanisms that oversee cell movement in the heart and may pave the way for future therapeutic strategies to prevent or treat congenital heart disorders.

HEXIMER LAB DISCOVERS SURPRISING DIFFERENCES AMONG FIBROSIS-CAUSING CELLS, UNLOCKING NEW POTENTIAL THERAPEUTIC TARGETS

Research from Dr. Scott Heximer's lab has uncovered significant differences between the fibroblasts in the left and right ventricles of the heart, challenging the long-held belief that cardiac fibroblasts are a uniform group and revealing their distinct roles in cardiac fibrosis, a condition marked by the thickening and stiffening of heart tissue that contributes to heart failure. Using advanced RNA sequencing on mouse models, the team identified eight fibroblast subpopulations, including two previously undiscovered ones, with 422 genes differentially expressed between cardiac fibroblasts from the left and right ventricles, indicating differing responses to injury and recovery.

The study found that the left ventricle has more pro-fibrotic fibroblasts after injury, leading to accelerated recovery, while the right ventricle shows a slower response. It also suggested potential sex-specific differences in cardiac fibrosis, highlighting the need for personalized treatments. This research offers potential new therapeutic targets for heart failure treatment and brings us closer to interventions that could halt or reverse heart disease progression.

SIMMONS LAB DEMONSTRATES 3D PRINTING OF LIVING REPLACEMENT HEART VALVES

Tissue engineering, specifically heart bioengineering, has long been a focus of Dr. Craig Simmons, and 2023 yielded an exciting advance in this field from his lab. A project led by PhD candidate Bahram Mirani developed a new method to engineer soft connective tissues with mechanical properties very similar to those of native heart valves, solving a long-standing problem of premature failure of engineered tissues. Soft connective tissues are also nonlinear and anisotropic, meaning they respond differently depending on the direction and magnitude of the force applied, a challenge that this new technique was able to address for the first time.

To achieve this, Dr. Simmon's team used melt electrowriting (MEW), which combines computational modeling, statistical optimization and a new fabrication method. MEW allows for the precise placement of fine fibers in intricate designs. This technique is known for its ability to produce structures with microscopic features that replicate the mechanics of natural tissues, like heart valves. This exciting research opens up avenues for tissue implants in both patients with congenital heart conditions and other fields of medicine where tissue regeneration is used. These engineered tissues may grow and remodel alongside the patient, potentially reducing the need for multiple treatments over their lifetime.

PETER MUNK CARDIOVASCULAR BIOBANK PARTNERS STREAMLINE ACCESS TO ACCELERATE CARDIOVASCULAR RESEARCH

The Peter Munk Cardiovascular (PMCC CV) Biobank, under the leadership of Dr. Phyllis Billia, is one of Canada's leading cardiovascular biobanks, housing approximately 400,000 biospecimens and 5,000 tissue samples from more than 24,000 patients. As part of a broader initiative with five other UHN biobanks, the PMCC CV biobank is adopting a modern Laboratory Information Management System (LIMS) called mBioLIMS, which will enhance efficiency in managing biospecimens, consents, and tracking ongoing studies. Furthermore, leveraging the Canadian Tissue Repository Network (CTRNet), the biobank introduced a dynamic pricing calculator, enabling real-time valuations of biospecimens and consent data. This innovation streamlines research access, improves operational efficiency, and ensures equitable distribution, thereby accelerating cardiovascular research.



Steven Ding working in the Bendeck lab at the Translational Biology and Engineering Program.

Leveraging innovative technologies to deliver personalized care



STRATEGIC GOAL 3
Create precise and predictive digital health solutions

Advancing personalized healthcare through innovative technologies and data integration is the core focus of our third strategic pillar. In line with this objective, we are committed to:

- Developing wearable sensors for both pediatric and adult patients to enable personalized care
- Refining predictive algorithms for risk stratification and management
- Deploying person-centered diagnostic and therapeutic innovations
- Facilitating streamlined access to comprehensive data sets, facilities, and resources across all partners to support and enhance research efforts

The Ted Rogers Centre for Heart Research has made notable progress toward its third strategic goal, to create precise and predictive digital health solutions. In 2023/24, we led numerous advancements in wearable sensor technology and person-centred diagnostic and therapeutic solutions. We are leveraging the Medly platform to optimize heart failure medication doses remotely, leading to better patient outcomes, while expanding the program to include a pediatric version. Additionally, the TRCHR risk-prediction tool PRIMaCY was highlighted in new management guidelines for hypertrophic cardiomyopathy, underscoring its value in improving patient care. Finally, with the support of a $17.5 million grant, a new Diagnostic Horizons Lab currently in development is focused on expanding access to effective diagnostic testing.

NEW DIAGNOSTIC HORIZONS LAB TO EXPAND ACCESS TO EFFECTIVE DIAGNOSTIC TESTING

Effective, portable and adaptable diagnostic testing is critical, especially in remote communities where access has historically been challenging. To address this gap, Dr. Heather Ross is collaborating with Drs. Aaron Wheeler at the University of Toronto, Claudia dos Santos at Unity Health Toronto, and Teodor Veres at the National Research Council of Canada to launch the Diagnostics Horizon Lab (DHL).

This new initiative, supported by a $17.5 million grant to the Centre for Research and Applications in Fluidic Technologies (CRAFT), will focus on developing distributed diagnostic tests that can be easily taken to patients, providing quick results even in remote communities.

The DHL will initially concentrate on diagnostics targeting septic shock and heart failure. Housed primarily on the University of Toronto campus, the lab will be dedicated to the design, prototyping, and manufacturing of new and existing diagnostic technologies. Dr. Ross, along with a team of UHN and TRCHR researchers, will validate these tools in the hospital setting and work with partners to test their deployment in remote communities. Together, the hope is to bring the best of new heart failure diagnostics – a “hospital-in- a-pelican-case” to Indigenous communities in northern Ontario.

OPTIMIZING HEART FAILURE MEDICATION DOSES REMOTELY WITH MEDLY PLATFORM

Optimizing medication doses for patients with reduced ejection fraction has been proven to help patients live longer and reduce their symptoms. But getting the right doses can be challenging, and traditional in-person cardiology appointments often create barriers for titration as they do not occur at the right frequency or timing.

A new study by Drs. Heather Ross and Darshan Brahmbhatt, a cardiologist at Mount Sinai Hospital and former UHN trainee, published in the *Journal of the American College of Cardiology*, investigated the effectiveness of remotely adjusting heart failure medications using the Medly remote monitoring platform.

Out of 108 patients, 56 were assigned to the Medly-based remote program, where a Medly nurse coordinator conveyed increases in medication doses on behalf of the cardiologist, without patients needing to come to the hospital. The other 52 patients received usual care. After six months, 82 per cent of patients in the remote care group reached their target medication doses, compared to 54 per cent in the usual care group. The remote care group also reached their target doses faster (3.4 months vs. 5.5 months), had fewer clinic visits, and experienced fewer hospitalizations.

This study demonstrates that remote medication adjustment using Medly is effective, safe, and feasible—helping more patients achieve optimal doses with fewer hospitalizations. The results will be used to explore how Medly can be leveraged across different heart failure populations to achieve a broader impact.

EXPLORING POTENTIAL OF MEDLY APP AND SMART TEXTILES FOR REMOTE MONITORING IN CHILDREN WITH HEART DISEASE

Building on the impact of the adult-approved Medly remote management program, teams at SickKids and UHN are exploring the potential to apply the innovation to children with heart disease. Researchers are also looking into the potential of a smart textile designed to collect and track physiological data in children.

A qualitative study led by Dr. Sahr Wali examined clinicians' perspectives on using a digital tool to support their patients, identifying the importance of accommodating a multidisciplinary care model, changing care needs over time, the burden and challenges of managing treatment, the transition to adulthood and the potential for digital health to fill care gaps. The need for such a program to be customizable was apparent as children develop at varying intervals. This feedback is informing a user-centric design to modify the existing Medly app for children with heart disease, with the new app set to launch in the coming year. Recruitment for a clinical trial is currently underway.

Additionally, in collaboration with industry partners, a second study was initiated at SickKids exploring the pediatric validation of Skiin® by Myant, a Bluetooth-enabled smart textile designed to collect and track physiological data in children. Initial work has focused on feasibility and patient experience in high-risk pediatric cardiac populations. In the coming year, the team plans to conduct a multi-center pilot clinical trial involving children with cardiomyopathy to evaluate the use of wearable technology for remote patient monitoring, assessing feasibility, acceptability, patient experience, and physiological trends across subtypes. This research aims to better understand and optimize the use of this technology in diverse urban, rural, and remote communities.

RISK-PREDICTION TOOL PRIMACY HIGHLIGHTED IN NEW MANAGEMENT GUIDELINES FOR HYPERTROPHIC CARDIOMYOPATHY

Hypertrophic cardiomyopathy (HCM) is a genetic condition characterized by abnormal thickening of the heart muscle, which can obstruct blood flow and affect the heart's ability to pump blood effectively. In children, this condition can be especially challenging to diagnose and treat. Dr. Seema Mital, TRCHR scientific co-lead at SickKids, recently served on the expert writing committee to create updated HCM guidelines for the American Heart Association/American College of Cardiology and the Canadian Cardiovascular Society. The use of a hallmark TRCHR-funded tool, the PRIMaCY risk prediction tool, was recommended as a key guideline by the American Heart Association, the American College of Cardiology, and the Canadian Cardiovascular Society, for risk stratification of sudden cardiac death and to guide which patients may benefit from an implantable cardioverter defibrillator to prevent this tragic event. The PRIMaCY research consortium that developed this tool also generated crucial evidence to create accurate, updated guidelines for family screening and exercise testing as part of these guidelines.

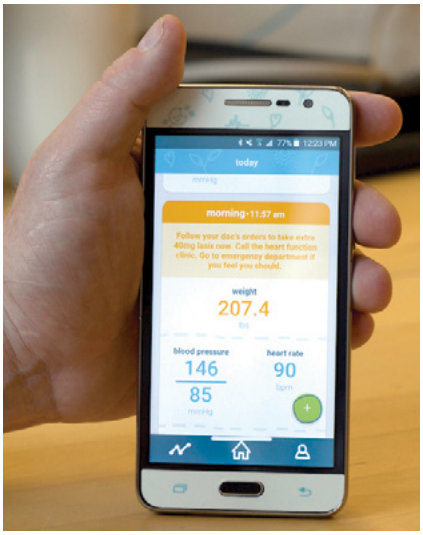
SPECIAL HIGHLIGHT

Medly and mortality risk calculator pioneer new heart failure care model in Toronto

Two innovations from the Ted Rogers Centre for Heart Research—the Medly remote management program and the Emergency Heart Failure Mortality Risk Grade (EHMRG) Calculator—are at the core of an exciting new project led by Dr. Heather Ross and colleagues at UHN, Women's College and Sinai Health.

Heart failure (HF), a chronic and progressive condition, ranks among the top five causes of hospital admissions in Ontario, costing approximately $233 million annually. Improving HF care requires coordinated efforts across various healthcare sectors and is a provincial priority. In 2022, Ontario Health challenged its teams (OHTs) to develop innovative models of HF care that would inform future service and funding models.

UHN and partners within the Mid-West Toronto Health Team (MWT-OHT), including Sinai Health, Women's College, Parkdale Queen West Community Health Centre, and Unison Health and Community Services, were recognized as a collaborative demonstration site. The goal of their two-year project was to explore how integrating Medly and the EHMRG score in treating HF patients could create a more equitable care model, reduce hospitalizations and death, and improve quality of life for patients and their families.



The Medly Program allows patients to enter their health data into an app.

Current HF care heavily relies on in-person and inpatient services, which are less readily available and more expensive. Many individuals living with HF in the MWT-OHT region face barriers to accessing care, such as identifying as a visible minority and/or low income, having limited proficiency in English or French, and experiencing higher rates of being uninsured. As equitable access to high-quality, person-centred care is a strategic goal of the TRCHR, Dr. Ross saw an opportunity to demonstrate how the Medly remote management program could address this gap within the MWT-OHT institutions.

Addressing the high number of emergency department (ED) visits and hospitalizations for HF patients was another gap. For ED physicians, determining who needs in-patient care and who can be safely sent home can be challenging. The EHMRG Calculator, a first-in-class tool developed by Ted Rogers Chair in Heart Function Outcomes Dr. Douglas Lee, provides a seven and 30-day risk of mortality score to support clinical decision-making in the ED. This tool helps to clarify who is low, medium or high risk of dying, to support safe discharge, improve quality of life and ensure in-patient care is available for those who need it most.

Innovative Implementation of Medly and EHMRG Score

The Medly program allows patients to enter their health data into an app, receive instructions immediately and be remotely managed by their HF team. These ongoing check-ins allow for treatment adjustments without in-person appointments, saving time for both patients and healthcare teams while ensuring personalized care. To introduce Medly to patients across MWT-OHT hospitals, patients were provided necessary equipment, such as blood pressure cuffs, scales, and smartphones, as required. This ensured equitable access for all eligible patients, removing a common barrier to at-home self-management. This nurse-led model, supported by cardiologists, onboarded and managed heart failure care in three sites.



Dr. Heather Ross has spearheaded the Medly Program since its inception in 2015.

Dr. Darshan Brahmbhatt, Cardiologist at Mount Sinai Hospital, shared, "We were able to leverage the benefits of close collaboration with TRCHR, between both clinicians and management, to implement the Medly program at Mount Sinai. We improved care for our patients who tell us they feel more empowered in managing their condition. Hopefully this successful demonstrator project will facilitate sustainable funding models to help patients across Ontario and beyond."

The EHMRG calculator was integrated into UHN's ED, enabled by an Integrated Care Lead (ICL) nurse who oversaw the score's implementation for relevant HF patients. Once a HF patient was identified, the ICL obtained the EHMRG score and brought it to the ED care team to help inform their clinical decision-making. Low-risk patients were discharged with follow-up in an outpatient clinic coordinated by the ICL. For high-risk patients who were admitted, the ICL ensured a smooth transition to the cardiology or general internal medicine department. Once there, enrollment in the Medly program could be discussed with patients and their families when appropriate.

Heart Failure Care Reimagined

At the end of the two-year demonstration project in March 2024, the results were promising. Across all sites, 500 new patients were enrolled in the Medly program, with half utilizing the UHN Virtual Device Lending Library for necessary at-home supplies. Dr. Ross highlighted the program's impact: "Equity has always been at the heart of what we do, and these demonstration results emphasize that Medly can positively reduce barriers to care. By providing the supplies needed, having a nurse-led care team and working collaboratively with CHCs, patients were able to play a key role in their healthcare decision-making and reduce the need for costly in-person care."

The EHMRG score implementation also saw significant success. Over 700 ED patients had a score generated, covering approximately 97% of eligible patients. The score's recommendations strongly correlated with the care decisions made by ED physicians. Following this success, the EHMRG score was directly integrated into UHN's electronic medical records system, Epic, in the spring of 2024, ensuring all UHN ED physicians could easily access the tool for any HF patient.

Looking Ahead

With these promising results, the UHN team and MWT-OHT partner sites aim to maintain the momentum they've experienced and increase reach with a new standard of HF care. Dr. Natasha Aleksova, Cardiologist and Lead of the MWT-OHT at Women's College Hospital, expressed her outlook for the future, "We're very happy with these initial findings. The next step will be to secure funding and continue rolling out these tools to all hospitals across Ontario, and hopefully, beyond."

Future goals include sustaining champions at each hospital, ensuring sufficient nursing and Medly Coordinator resources, creating a Medly pathway for patients in General Internal Medicine at UHN and engaging more patient partners. The UHN team is excited to continue sharing these TRCHR-funded advancements with others in the HF world, helping bring equitable access to those who need it most.

Enhancing equitable access to high-quality care

STRATEGIC GOAL 4
Enable equitable access to high-quality person-centred care

Enabling access to high-quality person-centered care is the focus of our fourth strategic pillar. Our aim is to ensure that everyone who needs care can receive it. We are committed to addressing disparities in heart failure care through collaboration, partnership, and co-creation. By 2027, we strive to:

- Form and deepen partnerships to better understand and tackle inequities in heart failure care
- Develop and implement new care models with input from the community, patients, and providers to enhance local capacity and access to quality care
- Build infrastructure to integrate equity into operations



From whole-genome sequencing research advocating for greater diversity in pharmacogenetic testing panels to the launch of the iPeer2Peer mentorship program for adolescents living with heart failure, the Ted Rogers Centre for Heart Research has made significant progress toward its fourth strategic goal of enabling equitable access to high-quality person-centred care. Additional highlights from 2023/24 include The Heart Hub's creation of a comprehensive guide to assist individuals navigating life with advanced heart failure, Medly's partnerships in Ontario and Uganda enhancing equitable access to care and a TRANSFORM HF workshop engaging individuals living with cardiovascular disease to become active partners in research.

WHOLE-GENOME SEQUENCING RESEARCH HIGHLIGHTS NEED FOR GREATER DIVERSITY IN PHARMACOGENETIC TESTING PANELS

Pharmacogenetic testing helps tailor drug prescriptions based on an individual's genetic makeup, however existing commercial testing panels often miss significant genetic variations, especially in individuals of non-European descent. These panels typically focus on common variants prevalent in European populations, leading to potential misinterpretations in other ethnic groups.

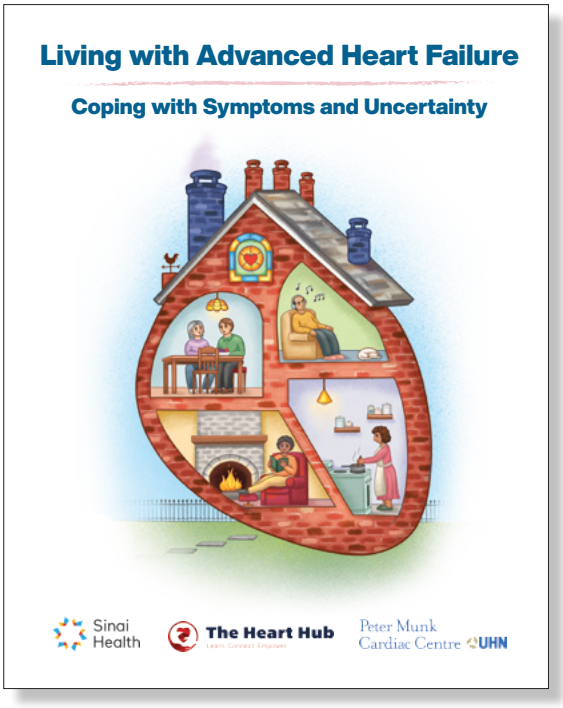
A recent Cardiac Genome Clinic study underscored the need for more inclusive and globally representative pharmacogenetic testing. Led by Ms. Iris Cohn, Director of the Pharmacogenomics Program within the Division of Clinical Pharmacology & Toxicology at SickKids, the research compared genetic variations identified by whole-genome sequencing to those detected by a commercial pharmacogenomics panel in 308 individuals with a family history of pediatric heart disease.

The research identified rare variants in some participants missed by the commercial panel. Three participants from diverse backgrounds had significant genetic variants that were only detected by whole-genome sequencing. These variants impacted the interpretation of their drug metabolizer status, which is crucial for accurate medication dosing.

These findings highlight the need for more diversity in pharmacogenetic testing to ensure accurate and effective drug treatments across all patients with cardiovascular conditions.

SICKKIDS LAUNCHES IPEER2PEER MENTORSHIP PROGRAM FOR ADOLESCENTS LIVING WITH HEART FAILURE

SickKids has long recognized the importance of interpersonal and peer-to-peer support for children and families living with health conditions. In 2023, the hospital launched a new program focused on peer mentorship for adolescents living with heart failure. The iPeer2Peer program, led by Dr. Samantha Anthony, a Health Clinician Scientist at SickKids, recruits young adult mentors with heart failure to provide peer support and mentorship to adolescent patients as they transition to adult care. The program is available in both English and French and uses a virtual platform to facilitate one-to-one connections between mentees and mentors. Mentors offer support in various areas, including medical self-management, coping strategies, navigating healthcare teams, and maintaining relationships while living with heart failure. The program is funded by the CIHR Canadian Heart Function Alliance, under the leadership of Drs. Mital and Jeewa, and has also received funding from the Heart & Stroke Foundation of Canada to expand its reach to young adults who have recently transitioned to adult care teams.



THE HEART HUB DEVELOPS A NEW GUIDE TO NAVIGATING LIFE WITH ADVANCED HEART FAILURE

For people living with heart failure, thoughts about what the future may hold can bring about feelings of anxiety and uncertainty. To help patients and caregivers navigate the later stages of life with heart failure, UHN and The Heart Hub team collaborated with palliative care experts from Sinai Health and people with lived experience to develop a comprehensive new guide, *Living with Advanced Heart Failure: Coping with Symptoms and Uncertainty.* The guide was designed to help patients and caregivers manage common symptoms at home, plan for the future and develop coping and self-care practices. Advanced care planning can be challenging for patients and families, but this new guide provides helpful tips and strategies for navigating tough conversations around substitute decision makers, the typical advanced heart failure trajectory, and what's truly important to the individual living with heart failure.



(L to R) Mali Worme (Cardiologist at UHN), Heather Ross, Anne Simard (Staff Scientist at UHN and Director of Strategy and Translation at TRANSFORM HF), Donna Lee (Sonographer at UHN), Kristin Beck (Registered Practical Nurse and WAHA Medly Coordinator), and Kyeretwie Bosomtwe (Nurse Practitioner at WAHA) at Attawapiskat Hospital.

MEDLY DEEPENS PARTNERSHIPS IN ONTARIO AND UGANDA TO ENHANCE EQUITABLE ACCESS TO CARE

The Weeneebayko Area Health Authority (WAHA) provides healthcare that is holistic, reflective of community needs and as close to home as possible to six communities throughout the James and Hudson Bay region. As many communities in the region are remote with limited access to specialized cardiac care, travelling is a necessity and can often limit who is able to receive treatment.

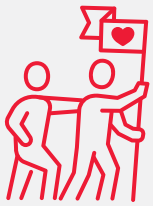
To help address this issue, UHN's TRANSFORM HF team, led by Dr. Heather Ross, began working to bring digital cardiac tools to WAHA in 2017. In 2023, they signed a five-year memorandum of understanding to continue supporting the needs of James and Hudson Bay communities with a renewed focus on direct care and remote management using the Medly program. UHN and WAHA are also developing a screening program for earlier detection and primary prevention of heart failure. Additionally, the partnership will support ongoing community-based qualitative and quantitative research with a focus on field-testing digital devices, point-of-care testing, and mentorship programs for cardiology residents and fellows. This new agreement will ensure more of WAHA's community is able to access diagnostics and treatment as close to home as possible.

TRANSFORM HF also recently collaborated with the Uganda Heart Institute (UHI) and Yale University to realize an expanded research partnership called Medly Uganda. In the pilot, the team adapted Medly as a support for heart failure patients in Uganda. Now with funding from the National Institutes of Health, the team is expanding to offer Medly program in six remote regions in the north of Uganda. This research collaboration will explore how the mobile technology and community connections fostered through the initiative can enhance care and health education on cardiovascular disease in the country.

TRANSFORM HF WORKSHOP INVITES PEOPLE LIVING WITH CARDIOVASCULAR DISEASE TO BECOME PARTNERS IN RESEARCH

Ensuring people with lived experience (PWLE) feel informed and comfortable sharing their experience, knowledge, and insights for a wide variety of research projects is crucial. With patient engagement at the heart of TRCHR's mandate, the TRANSFORM HF team hosted a special in-person workshop in October 2023 for people with cardiovascular disease interested in participating in research projects as a patient partner. The workshop attracted PWLE from across Canada to build a knowledgeable community of patient partners and was co-hosted with HeartLife and the Canadian Heart Function Alliance. Through a mix of theoretical content, experiential learning, and case studies, participants explored the Canadian health research landscape, learned about the roles and impacts of PWLE in research, and developed practical strategies to overcome engagement barriers. The workshop emphasized breaking down research jargon and fostering a collaborative environment for meaningful PWLE engagement in cardiovascular research initiatives within TRCHR and beyond. Its 22 graduates are now engaged in research projects at TRCHR and beyond.

Accelerating the real-world application of groundbreaking research



STRATEGIC GOAL 5
Accelerate the Application of Discovery and Innovation

The final goal of the strategic framework aims to expedite the translation of research discoveries into practical applications. This goal prioritizes active engagement with patients and caregivers, effective knowledge mobilization, technology development, policy changes in health, and commercialization. To achieve this, we strive to:

- Develop a comprehensive roadmap for supporting and tracking projects through their various stages
- Strengthen external relationships and pathways for quicker implementation of innovations
- Foster a dynamic culture of co-development to ensure discoveries and innovations are accessible to our diverse community

By cutting down the time it takes between new research insights and their potential to enhance heart failure diagnostics, treatment and care, the Ted Rogers Centre for Heart Research drives tangible benefits for patients and the healthcare community. In 2023/24 we have made significant progress toward our fifth goal of accelerating the application of discovery and innovation. Our Emergency Heart Failure Mortality Risk Grade (EHMRG) calculator, which helps emergency department physicians determine mortality risk, was recently launched at UHN and is being integrated across other hospitals in Ontario. New discoveries related to fatal cardiac conditions are paving the way to clinical trials for potential new diagnostics and treatments. We are working collaboratively to deepen our understanding of the genetic insights within our extensive Peter Munk Cardiovascular (PMCC CV) Biobank, and investing in commercialization and translation of research across the TRCHR.

BY GENERATING BEATING HEART CELLS WITH GENETIC DEFECTS, RESEARCHERS FIND POTENTIAL TREATMENT FOR PEDIATRIC HYPERTROPHIC CARDIOMYOPATHY

Pediatric hypertrophic cardiomyopathy (HCM) is a genetic condition characterized by abnormal thickening of the heart muscle, which impairs its ability to pump blood effectively. Current treatments for children with HCM only provide symptom relief without addressing the root cause, highlighting a significant need for more effective therapies

Drs. James Ellis, Seema Mital, Craig Simmons, Phyllis Billia, and Milica Radisic recently collaborated on a TRCHR Innovation Grant Award, featured in our 2022/23 donor report, to explore whether emerging therapies targeting the root cause of cardiomyopathy in adults could also benefit children. Now, their work is paving the way for innovative pediatric clinical trials.

Led by Ms. Caroline Kinnear from the Mital lab, the team's study generated beating heart cells and beating heart tissues from blood or skin cells from children with the condition, which is primarily caused by variants in certain myosin genes. They found that myosin inhibitors were able to rescue the heart muscle abnormalities in patients with many different types of gene defects, suggesting that these targeted drugs could benefit pediatric HCM patients.

Building on these promising results, international clinical trials by Bristol Myers Squibb and Cytokinetics are set to launch in 2024, aiming to expedite the approval and delivery of these treatments to children with HCM.

UNLOCKING GENOMIC INSIGHTS THROUGH EXCITING PETER MUNK CARDIOVASCULAR BIOBANK AND CARDIAC GENOME CLINIC COLLABORATION

Not only are we increasing access to the valuable data samples within the Peter Munk Cardiovascular Biobank, but collaboration is also deepening our understanding of the samples themselves—uncovering key insights. Over the past year, the Peter Munk Cardiovascular Biobank and the Cardiac Genome Clinic (CGC) have worked closely to facilitate genome sequencing for tissue samples from aortopathy patients and to combine genome data with families sequenced through the CGC. This work expands knowledge of the samples within the Biobank so they can be leveraged for new and additional studies not previously possible. This exciting collaboration will continue to evolve in the coming years, unlocking further insights from the tissues at the Peter Munk Cardiovascular Biobank.

ADVANCING HEART FAILURE CARE IN EMERGENCY DEPARTMENTS WITH TOOL TO CALCULATE MORTALITY RISK

Building on the impact of the Emergency Heart Failure Mortality Risk Grade (EHMRG) calculator, emergency department physicians at the University Health Network (UHN) are now able to leverage this innovative tool through UHN's Epic electronic medical record.

The EHMRG calculator's integration into Epic is a first in Canada, and its use has demonstrated improved patient outcomes and reduced rehospitalization rates. The EHMRG score, developed by Dr. Douglas Lee and funded by the Ted Rogers Centre for Heart Research and Institute for Clinical Evaluative Sciences, assesses heart failure patients' risk of death within seven and 30 days using 13 key metrics. This tool supports decisions on whether to discharge or admit patients, enhancing clinical decision-making and resource allocation within the hospital.



Dr. Allen Teng working in the Gramolini lab at the Translational Biology and Engineering Program.

The tool's success marks an advancement in the management of heart failure in emergency departments, transforming care quality and efficiency at UHN, and is currently being implemented in additional hospitals across Canada.

HAMILTON LAB DISCOVERIES SET TO ENHANCE DIAGNOSIS AND TREATMENT FOR FATAL CARDIAC CONDITIONS

Through years of research into inherited and acquired cardiac conditions affecting children and young adults, Dr. Robert Hamilton's lab at SickKids has discovered several biomarkers with significant potential for enhanced diagnosis and treatment.

Many of the biomarkers they have discovered are autoantibodies to cardiac proteins, where the immune system mistakenly targets and attacks its own heart proteins. This work has recently led to exciting commercialization opportunities with transformative potential for patients.

Notably, the lab discovered that anti-Desmoglein-2 antibodies are a highly accurate biomarker for diagnosing arrhythmogenic cardiomyopathy, a condition where the heart muscle gets replaced by scar tissue and fat. This discovery launched a startup called ARVADA Therapeutics and collaborations with European groups to further validate this biomarker.

Additionally, the lab identified a set of autoantibodies as a biomarker for Brugada Syndrome, a disease that is difficult to diagnose and can cause fatal cardiac arrythmias and is completing studies to use this as a diagnostic test.

Finally, the team discovered antibody biomarkers in the cardiac sodium and potassium pump alpha subunit that can predict which pregnancies of at-risk mothers will result in fetal autoimmune congenital heart block. These antibodies are currently being assessed in tissue and animal models. Collaborating with J & J Innovations, the lab aims to use this biomarker as a companion to a proposed drug therapy, with a clinical trial scheduled to begin in 2025.

COMMERCIALIZATION AND TRANSLATION ACROSS TRCHR BRINGS GROUNDBREAKING RESEARCH TO THOSE WHO NEED IT MOST

Within the TRCHR, bringing research and innovations to patients and families navigating heart failure is always top of mind. The Centre's Translation and Commercialization Committee (TCC), Chaired by Dr. Paul Santerre, meets regularly to explore opportunities for scientists and clinicians to apply their work in real-world settings. Some of the ongoing translational projects include expanding Medly's access to additional remote communities and new heart failure populations, supporting ECHO participants and ECHO PITCH winners as they move their innovative solutions to clinical trials, and assisting scientists such as Dr. Hai-Ling Cheng, who is bringing her new MRI chemical formula for vulnerable heart failure patients to market. Additionally, the team at SickKids plans to continue advancing wearable monitors to help prevent sudden cardiac death, and the team at UHN will lead new heart failure diagnostic technologies with the creation of the new Horizon Diagnostics Lab. These are just a few examples of TRCHR's commitment to bringing groundbreaking clinical and basic research to those who need it most.



SPECIAL HIGHLIGHT

PRIMaCY risk calculator goes live to deliver precision care to children at risk for sudden cardiac death

For children diagnosed with complex heart conditions like hypertrophic cardiomyopathy (HCM), the diagnosis can be frightening for families and challenging for healthcare providers.

HCM is a leading cause of sudden cardiac death in adolescents and young adults, however, the trajectory of the condition is often uncertain. It is difficult to predict outcomes for each individual child.

For Dr. Seema Mital, Scientific Co-Lead at the Ted Rogers Centre for Heart Research (TRCHR) and Head of Cardiovascular Research at SickKids, this uncertainty prompted her interest in precision medicine and led to the development of the TRCHR Cardiac Precision Medicine Program. Precision medicine uses unique characteristics including the genome of a child with heart failure to deliver customized care, prevent complications, and improve outcomes.

For children and teens with HCM, precision medicine is currently being used to determine which patients might benefit from the insertion of an implantable cardioverter defibrillator (ICD) to stop abnormal heartbeats and resume regular heart rhythms in the case of a cardiac emergency. ICDs can be lifesaving for those who need them, but can unfortunately also cause potentially serious complications, especially in young children. This makes it challenging for physicians to know how best to proceed for each patient in order to deliver the right outcomes.

Driven by a desire to help children with HCM and fueled by funding from TRCHR and guidance from the Translational Commercialization Committee (TCC), Dr. Mital and her team established an international multi-centre research network called PRecIsion Medicine in CardiomyopathY (PRIMaCY). Through this collaoration, they developed the PRIMaCY risk prediction tool, which predicts five-year risk of sudden cardiac death from the first time a patient is found to have HCM. PRIMaCY incorporates many different risk factors such as the age of the child, medical, genetic, and family history, and diagnostic measurements to create a holistic and objective risk of sudden death in coming years. The calculator was created and validated using data from many hundreds of HCM patients and is over 70% accurate in distinguishing children at greatest risk, a first in its field.

As of November 2023, PRIMaCY became the first such tool to be launched in Epic, the electronic health records system at SickKids, for physicians to use on children with HCM, with the goal of reducing sudden cardiac death among those most vulnerable. Following successful integration of the calculator at SickKids, PRIMaCY continues to be implemented across Canadian and US pediatric centres.

In addition to helping prevent devastating outcomes for children with HCM, Dr. Mital's work was featured in SickKids Foundation's new campaign, "Heal the Future". The video is based on the true story of a 10-year-old boy, Nathan, who died of a fatal arrhythmia while playing at school four years after having been diagnosed with HCM. In the SickKids campaign, however, the story has a happier ending thanks to precision medicine that helps the healthcare team identify that he is at high risk of sudden cardiac death and implant an ICD while he is still a child, which activates and eventually saves him as a teenager in the video. Dr. Mital discussed the impact of the PRIMaCY tool for children with HCM in detail during an episode of the SickKids VS Podcast.

For Dr. Mital, this is a story she hopes will change the future of care for children with HCM. "The goal of precision medicine is to make sure we are providing effective therapies and tailoring them to the needs of the child, and this can now be done for children with hypertrophic cardiomyopathies in hospitals across the country", said Dr. Mital. Precision medicine tools like PRIMaCY continue to change the lives of hundreds of children diagnosed each year with HCM in Canada.



Groundbreaking heart-brain research leads to potential treatments for cognitive impairment

When a person is diagnosed with heart failure (HF), they enter a complex world of cardiology appointments, treatment options, and strategies for managing symptoms. To make matters more complicated, HF patients are often diagnosed with cognitive issues that can create additional challenges in managing care and maintaining a good quality of life, such as difficulties remembering appointments and adhering to medication schedules.

Interest in the heart-brain connection has grown over recent years, since dysfunction in one organ can increase the risk of disease in the other. Imaging studies have revealed that cerebral blood flow can decrease by up to 30% in patients with chronic HF and the prevalence of cognitive impairments is high, being observed in up to 70% of these patients. Anxiety and depression are also common in HF and are independent predictors of poor outcomes.

To better understand how HF impacts brain function, in 2022 the Heart & Stroke Foundation and the Brain Canada Foundation awarded $2.9M to a team of over 50 researchers from the TRCHR and other institutions, led by Dr. Douglas Lee, Ted Rogers Chair in Heart Function Outcomes. A significant part of this award focused on the work of Dr. Steffen-Sebastian Bolz, a principal investigator with the Translational Biology and Engineering



Dr. Steffen-Sebastian Bolz

Program and a Professor of Physiology at the University of Toronto. Since establishing his microvascular research lab in 2008, Dr. Bolz and his team have been investigating microvascular dysfunction in disease models like hearing loss, diabetes, HF, and stroke. Their initial research in HF mice investigated the mechanism where reduced cardiac output increases cerebral artery resistance, reducing blood flow through the brain's vessels and tissues, which can ultimately lead to cognitive deficits. Dr. Bolz's lab looked to uncover the molecular mechanism underlying microvascular dysfunction in the brain in HF.

Their research identified a protein called CFTR as a key molecular driver of cognitive impairment in HF. They found that CFTR is present in high concentrations in the brain's arteries, which is downregulated in HF, and plays a crucial role in the signals regulating cerebral artery resistance and maintaining cerebral blood flow. Building on this discovery, Dr. Bolz's team explored different drugs targeting CFTR, including a known CFTR-corrector medication lumacaftor, one component of the medication ORKAMBI® (lumacaftor/ivacaftor), a drug typically used to treat mutated CFTR in cystic fibrosis. Their experiments in HF mice comparing control, disease, and treatment conditions showed that CFTR-correctors target the cerebral microvessels and restore deficient CFTR-expression, and this effect brings vessel function, cerebral blood flow, and neuronal health back to normal. Additional behavioural tests in these mice demonstrated that by restoring vascular function cognitive deficits were significantly reduced or eliminated.

These novel findings led to the formation of Qanatpharma (QP), a biopharmaceutical company specializing in microvascular research and medicine. Since its creation in 2021, QP has been developing clinical trials in Toronto to test whether lumacaftor could yield similar results in humans. In 2023, the company initiated a Phase 1 trial involving 35 healthy adults comparing its lumacaftor to the drug component contained

in ORKAMBI®, which was recently completed and confirmed that the two drugs were bioequivalent. This success has paved the way for an upcoming Phase 2 proof-of-concept trial.

The next step towards establishing lumacaftor as a treatment for cognitive impairment is the upcoming trial, LYRIC-HF (Lumacaftor Yields Reversal of Impaired Cerebral Blood Flow in Heart Failure), which will test the drug's effects on brain blood flow and cognitive function in individuals with HF. This trial, set to begin in 2024, will involve 60 patients with HF with reduced ejection fraction (HFrEF), a condition where the left ventricle of the heart fails to pump blood effectively. The trial will be headed by Drs. Kim Connelly and Tom Schweizer at St. Michael's Hospital and will be conducted in collaboration with UHN, including Drs. Phyllis Billia and Jay Udel. Participants will undergo MRI scans to measure cerebral blood flow and cardiac function to establish a baseline, along with other validated tests that assess cognitive function, anxiety and depression, and overall quality of life. After 30 days of lumacaftor treatment, MRI scans and cognitive testing will be performed again to detect changes in cerebral blood flow and cognitive function, followed by cognitive testing at three months to assess the durability of the improvements. The team is optimistic that the results from this trial will provide the necessary evidence to advance to dose-ranging studies and subsequent Phase 3 efficacy trials in the future.

As the LYRIC-HF trial progresses, there is growing optimism that lumacaftor could represent a breakthrough in the treatment of cognitive impairment in HF patients. The work, spearheaded by Dr. Bolz and his team, not only deepens our understanding of the intricate relationship between heart and brain health but also paves the way for innovative therapies that could significantly improve the quality of life for those living with HF. This research marks an exciting step forward in the path to enhance the longevity and cognitive well-being of HF patients, offering hope for a future where the debilitating cognitive effects of this condition can be effectively managed and even reversed.



Research Productivity: 2019 – 2023

100

RESEARCHERS AT THE TED ROGERS CENTRE FOR HEART RESEARCH PUBLISHED



435

IN TOP JOURNAL (IMPACT FACTOR: >10)



754

IN HIGHER IMPACT JOURNALS (IMPACT FACTOR: 5-10)

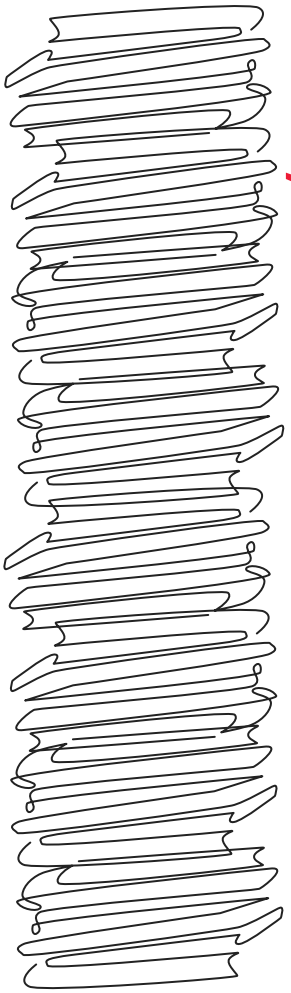
2,328

PEER-REVIEWED JOURNAL ARTICLES AND REVIEWS

55

CONFERENCE PAPERS





2,383 PUBLICATIONS

~5

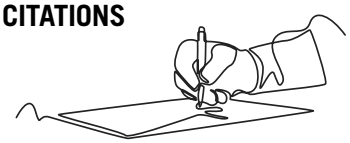
AVERAGE PAPERS PER RESEARCHER PER YEAR



FIRST OR LAST AUTHOR ON OVER 40% OF PUBLICATIONS

46,861

CITATIONS

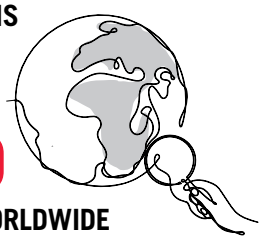


20%

OF PUBLICATIONS WERE IN THE

TOP 10

MOST CITED WORLDWIDE



Productivity

MEASURING RESEARCH PRODUCTIVITY AND IMPACT

Common measures of productivity and impact for a research centre include a) the number of publications produced and b) the frequency with which these publications are referenced or cited by other researchers. The following seven metrics, build up on these measures and provide insight into the Centre's productivity and impact over the past five years (2019-2023).

METRICS

a. Number of researchers

The Centre currently has 100 investigators, including 27 involved in discovery; 36 involved in personalized medicine and 37 involved in heart failure outcomes.

b. Number of publications

Our researchers published a total of 2,383 publications during the five-year period (2019-2023) or nearly 5 papers per researcher per year. Articles, reviews, proceedings papers, indexed in Clarivate's Web of Science with a TRCHR researcher in the author list were included in this count.

c. Number of citations

The Centre's 2,383 publications generated 46,861 citations or almost 20 citations per publication on average. This is 1.7x the number of citations of the average paper published globally in the same field and year. Citation metrics are from Clarivate's Web of Science and are current as of September 1, 2024.

d. Number of articles in:

i top journals and

ii higher Impact Factor journals

Journal Impact Factor (JIF) is a numerical score based on the citations of the journal that a paper is published in and has been traditionally used to assess a journal's impact on the research community. JIF is often used as a proxy for the importance of a journal to its field and can range from a high of over 500 to a low of less than 1.

In journals classified as Cardiac & Cardiovascular Systems in *Clarivate's SCIE Journal Citation Report*, journals in the top 10th percentile have a JIF > ~10 ("Top Journals") while journals ranked between the 10th and 30th percentile have a JIF of ~5-10 ("Higher Impact Journals")

i. Number of articles in top journals

Our researchers published 435 articles in journals with an impact factor of greater than 10 during 2019-2023. This represents 18 per cent of our total papers and includes papers in *CA-A Cancer Journals for Clinicians* (IF 508.7); *New England Journal of Medicine* (IF 176.1); *Lancet* (168.9).

ii. Number of articles in higher impact factor journals

Our researchers have published 754 articles in journals with an impact factor between 5-10. This represents 31 per cent of our total papers and includes *Advanced Healthcare Materials* (IF 10.0); *Cell Reports* (IF 9.99); and *Cardiovascular Diabetology* (IF 9.95).

e. Highly cited publications

Of our 2,383 publications, 20 per cent were in the top 10th percentile of the most cited publications world-wide.

f. Type of publications

The majority of our 2,383 publications were peer-reviewed journal articles or reviews (2,328). The remaining publications were conference papers (55).

g. Senior author publications

In addition, our researchers were either first or last author on 42 per cent of the publications, indicating leadership and or oversight of the related research

2023/24 Donor Report Awards



(L to R) Tenzin Yangzom and Matthew Lee working in the Franklin lab at the Translational Biology and Engineering Program.

Grant Awards

Investigator Name:	**Dr. Ana C. Alba**
Grant/Award Title:	Referral pattern and risk profiles of heart failure patients followed in family practice
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$436,050
Grant/Award Type:	Project Grant
Research Focus Area:	Health Services Evaluation & Interventions Research
Investigator Name:	**Dr. Samantha Anthony**
Grant/Award Title:	"The isolation I feel is profound": The iParent2Parent Online Peer Support Program for parents of pediatric solid organ transplantation recipients
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$180,000
Grant/Award Type:	Project Grant
Research Focus Area:	Digital Health
Investigator Names:	**Dr. Samantha Anthony, Dr. Aamir Jeewa & Dr. Seema Mital**
Grant/Award Title:	Canadian Heart Failure Transformation Alliance: A Network of Likeminded Canadians Committed to Improving the Lives of Persons Living with Heart Failure
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$1,250,000
Grant/Award Type:	Network grant
Research Focus Area:	Artificial Intelligence, Remote patient monitoring, Digital health, Enabling equitable access

Investigator Names:	**Dr. Melanie Barwick & Dr. Seema Mital**
Grant/Award Title:	Implementing a Sudden cardiac death Risk assessment Tool in childhood hypertrophic cardiomyopathy (INSERT-HCM)
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$631,126
Research Focus Area:	Digital health
Investigator Name:	**Dr. Michelle Bendeck**
Grant/Award Title:	Peptide Coated Nanoparticles to Inhibit Vascular Stenosis
Funding Agency:	HSF
Total Amount Awarded:	$258,000
Grant/Award Type:	Grant-in-Aid
Investigator Name:	**Dr. Michelle Bendeck**
Grant/Award Title:	Peptide-Nanoparticles to Inhibit Pediatric Vascular Stenosis
Funding Agency:	TBEP
Total Amount Awarded:	$200,000
Grant/Award Type:	Team Grant
Investigator Name:	**Dr. Steffen-Sebastian Bolz**
Grant/Award Title:	Identification and validation of novel microvascular smooth muscle cell targets for the treatment of heart failure
Funding Agency:	MITACS
Total Amount Awarded:	$225,000
Grant/Award Type:	Accelerate
Investigator Name:	**Dr. Hai-Ling Cheng**
Grant/Award Title:	Rapid Hi-Fi Magnetic Resonance Imaging
Funding Agency:	NSERC
Total Amount Awarded:	$121,000
Grant/Award Type:	Idea to Innovation - Phase I
Investigator Names:	**Dr. John Coles & Dr. Jason Maynes**
Grant/Award Title:	Neonatal cardiac stem cell-derived proteins induce cardiac regeneration in HLHS
Funding Agency:	Additional Ventures
Total Amount Awarded:	$447,600
Research Focus Area:	Regenerative medicine

Investigator Name:	**Dr. Slava Epelman**
Grant/Award Title:	Differential type I interferon responses drive sex-specific vulnerability to viral myocarditis
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$1M
Grant/Award Type:	Project Grant
Investigator Name:	**Dr. Slava Epelman**
Grant/Award Title:	Macrophage support of cardiomyocyte mitochondrial homeostasis underlies enhanced function of human bioengineered cardiac microtissues
Funding Agency:	TRCHR
Total Amount Awarded:	$100,000
Grant/Award Type:	Project Grant
Investigator Name:	**Dr. Slava Epelman**
Grant/Award Title:	Understanding the Pressure Stressed Right Ventricle at Single Cell Resolution
Funding Agency:	TBEP
Total Amount Awarded:	$200,000
Grant/Award Type:	Team Grant
Investigator Name:	**Dr. Rodrigo Fernandez-Gonzalez**
Grant/Award Title:	Orchestrating cell adhesion and cytoskeletal rearrangements during embryonic wound repair
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$1M
Grant/Award Type:	Project Grant
Investigator Name:	**Dr. Rodrigo Fernandez-Gonzalez**
Grant/Award Title:	Quantitative live imaging of human heart organogenesis
Funding Agency:	University of Toronto
Total Amount Awarded:	$120,000
Grant/Award Type:	EMHSeed
Investigator Name:	**Dr. Daniel Franklin**
Grant/Award Title:	Biophotonic Wearables and Implants for Clinical Translation
Funding Agency:	CFI
Total Amount Awarded:	$45,000
Grant/Award Type:	IOF

Investigator Name:	**Dr. Daniel Franklin**
Grant/Award Title:	CRAFT Project Award 2023
Funding Agency:	NRC
Total Amount Awarded:	$70,000
Research Focus Area:	CRAFT Project Award
Investigator Name:	**Dr. Daniel Franklin**
Grant/Award Title:	Development of Convolutional Neural Network for Motion Artifact Mitigation in Wearable PPG Devices
Funding Agency:	University of Toronto Data Sciences Institute Catalyst Grant
Total Amount Awarded:	$100,000 for two years
Grant/Award Type:	Project Grant
Investigator Name:	**Dr. Daniel Franklin**
Grant/Award Title:	Development of Smart-Ring and Medly Interface for Continuous, Remote, Vasomodulation Monitoring
Funding Agency:	TBEP
Total Amount Awarded:	$200,000
Grant/Award Type:	Team Grant
Investigator Name:	**Dr. Daniel Franklin**
Grant/Award Title:	Development of Wearable Devices for Continuous Vasomodulatory Monitoring
Funding Agency:	NSERC
Total Amount Awarded:	$12,500; $185,000
Grant/Award Type:	DGECR Discovery Launch Supplement; Discovery Grant
Investigator Name:	**Dr. Anthony Gramolini**
Grant/Award Title:	Phospholamban regulation in the heart
Funding Agency:	HSF
Total Amount Awarded:	$277,050
Grant/Award Type:	Grant-in-Aid
Investigator Name:	**Dr. Anthony Gramolini**
Grant/Award Title:	The role of reticulon homology domain (RHD) protein and related family members in the sarco(endo)plasmic formation and regulation in the cardiac myocyte
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$807,075
Research Focus Area:	Project Grant

Investigator Name:	**Dr. Robert Hamilton**
Grant/Award Title:	Determining the fetal conduction target proteins of autoantibodies in congenital heart block: developing a sensitive and specific biomarker of pregnancies at risk
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$589,050
Grant/Award Type:	Project Grant
Research Focus Area:	Accelerating application to innovation
Investigator Name:	**Dr. Robert Hamilton**
Grant/Award Title:	Risk classifier validation and assay development for autoimmune congenital heart block (aCHB)
Funding Agency:	Momenta Pharmaceuticals, Inc.
Total Amount Awarded:	$1,230,411
Research Focus Area:	Accelerating application to innovation
Investigator Names:	**Dr. Kathryn L. Howe & Dr. Jason E. Fish**
Grant/Award Title:	Maintenance of endothelial identity guards against atherosclerosis
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$1,189,575
Research Focus Area:	Project Grant
Investigator Name:	**Dr. Christopher K. Macgowan**
Grant/Award Title:	Advanced Fetal MRI Methods to Evaluate Prenatal Organ Development and Predict Postnatal Outcome in Congenital Heart Disease
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$1,048,050
Research Focus Area:	Project Grant
Investigator Name:	**Dr. Luc Mertens**
Grant/Award Title:	Precision Health for patients with Univentricular Hearts across the Lifespan (PHUR4Life)
Funding Agency:	Heart & Stroke Foundation of Canada
Total Amount Awarded:	$1,750,000
Grant/Award Type:	Team Grant
Research Focus Area:	Precision Medicine, Single Ventricle
Investigator Names:	**Dr. Seema Mital & Dr. Mike Seed**
Grant/Award Title:	Brain Injury and Dysmaturation in Newborns with Congenital Heart Disease Born Preterm
Funding Agency:	National Institutes of Health
Total Amount Awarded:	$1,514,764
Research Focus Area:	Imaging, neurodevelopment, genomics

Investigator Name:	**Dr. Thavendiranathan Paaladinesh**
Grant/Award Title:	A Multi-Centre Non-Inferiority Randomized Controlled Trial of STOPping Cardiac MEDications in Patients with Normalized Cancer Therapy Related Cardiac Dysfunction - The STOP-MED CTRCD Trial
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$2M
Grant/Award Type:	Project Grant
Investigator Name:	**Dr. Stephanie Protze**
Grant/Award Title:	An embryo-like 3D model of human heart development to provide novel insights into congenital heart diseases
Funding Agency:	NFRF
Total Amount Awarded:	$250,000
Grant/Award Type:	Exploration
Investigator Name:	**Dr. Clinton S. Robbins**
Grant/Award Title:	Unveiling the Mechanisms of Cigarette Smoking-Induced Abdominal Aortic Aneurysms: A Focus on Atherosclerosis and Macrophage Subtypes
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$967,725
Grant/Award Type:	Project Grant
Investigator Names:	**Dr. Paul Santerre & Dr. Christine Bear**
Grant/Award Title:	Mapping delivery of genetic medicines at the single cell level
Funding Agency:	Cystic Fibrosis Foundation
Total Amount Awarded:	$111,000
Grant/Award Type:	Path to a Cure (PTAC) Pilot and Feasibility Awards program
Investigator Names:	**Dr. Ravi Selvaganapathy, Dr. Craig Simmons, Dr. Julie Audet, Dr. Michael von Massow & Dr. Michelle Bamji-Miraz**
Grant/Award Title:	Omics guided technologies for scalable production of cultured meat
Funding Agency:	Genome Canada/ORF-RE
Total Amount Awarded:	$10,068,869
Grant/Award Type:	Climate-Smart Agriculture and Food systems (CSAFS) Interdisciplinary Challenges Teams (ICT) Grant
Investigator Name:	**Dr. Craig Simmons**
Grant/Award Title:	Melt electrowrite system for biofabrication of complex
Funding Agency:	NSERC
Total Amount Awarded:	$150,000
Grant/Award Type:	Research Tools & Instruments - Category 1

Investigator Name:	**Dr. Craig Simmons**
Grant/Award Title:	Preclinical evaluation of tissue engineered pulmonary valve material for pediatric valve augmentation
Funding Agency:	TBEP
Total Amount Awarded:	$200,000
Grant/Award Type:	Team Grant
Investigator Name:	**Dr. Ulrich Tepass**
Grant/Award Title:	Dynamic molecular and cellular mechanisms driving epithelial cell ingression
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$960,076
Grant/Award Type:	Project Grant
Investigator Name:	**Dr. Sahl Wali**
Grant/Award Title:	Health System Impact Embedded Early Career (ECR) Researcher Award
Funding Agency:	Canadian Institutes of Health Research
Total Amount Awarded:	$400,000 over four years
Grant/Award Type:	Research Grant
Research Focus Area:	Urban and Rural Care Pathways
Investigator Names:	**Dr. Azadeh Yadollahi & Dr. Craig Simmons**
Grant/Award Title:	Translating Cardiovascular Remote Diagnostic and Monitoring Technologies for Equitable Healthcare (CaRDM Eq)
Funding Agency:	NSERC
Total Amount Awarded:	$1,650,000
Grant/Award Type:	CREATE

Non-Grant Awards

Name:	**Dr. Douglas Lee**
Award Title:	Research Achievement Award
Conference/Organization:	Vascular Conference 2023
Grant/Award Type:	Conference award
Name:	**Dr. Douglas Lee**
Award Title:	2024 Eaton Scholar Researcher of the Year for Clinical Research
Conference/Organization:	University of Toronto
Grant/Award Type:	Research Award
Research Focus Area:	Clinical Research

Name:	**Dr. Slava Epelman**
Award Title:	2023 Highly Cited Researcher
Conference/Organization:	Clarivate
Grant/Award Type:	bibliometrics and analytics
Research Focus Area:	Immunobioengineering
Name:	**Dr. Phyllis Billia**
Award Title:	2023 Local Impact Award for Commercialization
Conference/Organization:	Commercialization @ UHN
Research Focus Area:	Diagnostic Testing Platform to Predict Critical Events in At-Risk Patients



Anat Usatinsky working in the Franklin lab at the Translational Biology and Engineering Program.



Thank You.