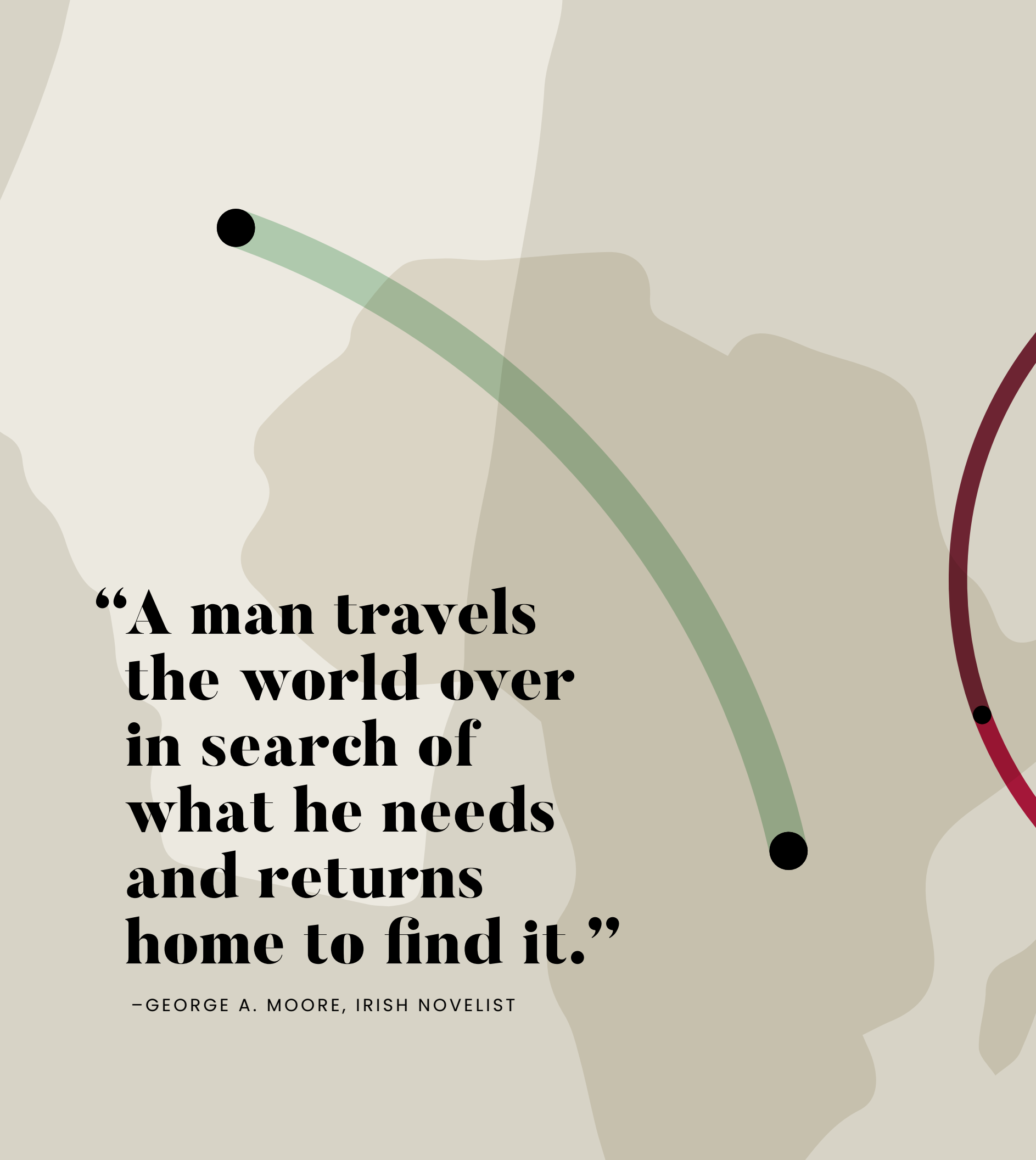




# Global Vision ↔ Local Action





**“A man travels  
the world over  
in search of  
what he needs  
and returns  
home to find it.”**

—GEORGE A. MOORE, IRISH NOVELIST



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# Message from our Co-Directors



We are pleased to share the CVC's Annual Report for 2021. The theme of the report is "Global Vision ↔ Local Action" and showcases some of the CVC's activities that began at a global or national scale and have subsequently translated into local initiatives. For example, the VICTORIA trial enrolled 5,050 patients from 40 countries and found that in patients with worsening heart failure with reduced ejection fraction (HFrEF), vericiguat reduced the risk of cardiovascular death or heart failure hospitalization. As a natural extension of the trial, we developed a North American registry of over 2,000 patients to gather further insight. Indeed, the richness of the global data, coupled with the representativeness of the registry, is leading to a better understanding of patients with worsening heart failure. At the local level, using clinical data linked with provincial administrative health databases, the CVC is gathering real world evidence on the target population of patients with HFrEF and worsening heart failure in the province of Alberta who could potentially benefit from vericiguat treatment.



Other journeys have taken longer but have been equally rewarding. The CVC has focused on the development of systems of care for ST-elevation myocardial infarction (STEMI) for more than two decades. The global ASSENT-3 and ASSENT-3 Plus trials, conducted between 2000-2003, established the importance of early identification and triage of patients, including in the pre-hospital setting. The local, investigator-initiated PROACT trial took this to the extreme by adding point-of-care testing in the ambulance on the way to the emergency department, in patients with chest pain. These studies provided the framework for collaborations with emergency medical services and the development of a regional STEMI registry (Vital Heart Response), which is a major contributing factor to Edmonton having among the lowest STEMI mortality rates in Alberta and in Canada in recent years.



The design of this year's report recalls the aesthetics of a travel magazine, with lines and points of connection used to demonstrate how the CVC aims to bring people from different places together in the collective pursuit of improving cardiovascular care and patient outcomes all over the world. It also makes us nostalgic for a time when we gathered in person with our colleagues from around the globe to celebrate research excellence. We hope to return to that idyllic time in the near future!

The CVC Co-Directors,

**JUSTIN EZEKOWITZ**  
MBBCh, MSc

**SHAUN GOODMAN**  
MD, MSc

**PADMA KAUL**  
PhD

# About the CVC

The Canadian VIGOUR Centre (CVC) was established in 1997 as an academic research organization (ARO) at the University of Alberta, and has since been committed to the enhancement of cardiovascular health.

The CVC is recognized for its pioneering research in cardiovascular medicine, which embraces the translation of research through thought leadership and management of innovative clinical trials. Furthermore, the CVC is focused on the generation of new knowledge from patient registries and population outcome studies, which inform the direction of future pathways.

As an ARO, the CVC is committed to the scholarly value of scientific inquiry and truth, and believes knowledge should be shared openly in an ethical research environment. The CVC's dedications to lifelong learning has also inspired one of our central tenets –engaging the next generation of health professionals in a research culture that embraces curiosity, welcomes new ideas, and seeks to address key unanswered questions in health care.

 [Learn more here](#)

## Vision

Generate, translate, and disseminate knowledge on novel diagnostic and therapeutic strategies in cardiovascular medicine acquired through collaborative research to enhance the health of the citizens of Alberta, Canada, and the world.

## Mission

Aligned with the University of Alberta and the Mazankowski Alberta Heart Institute, our mission is to:

- Design, conduct, analyze, and disseminate findings arising from novel clinical research.
- Interrogate clinical trial, registry, and population health data to evaluate outcomes, identify unmet needs, and inform future basic and clinical research directions.
- Identify, inspire, and nurture the next generation of health researchers and professionals.

## Core Values

### QUALITY

Aspire to the highest standard of work while respecting a balanced life perspective. Attract, mentor, and retain high quality colleagues and collaborators with similar core values.

### INTEGRITY

Perform our roles in an ethical framework, which enhances our reputation as honest, trustworthy, and responsible.

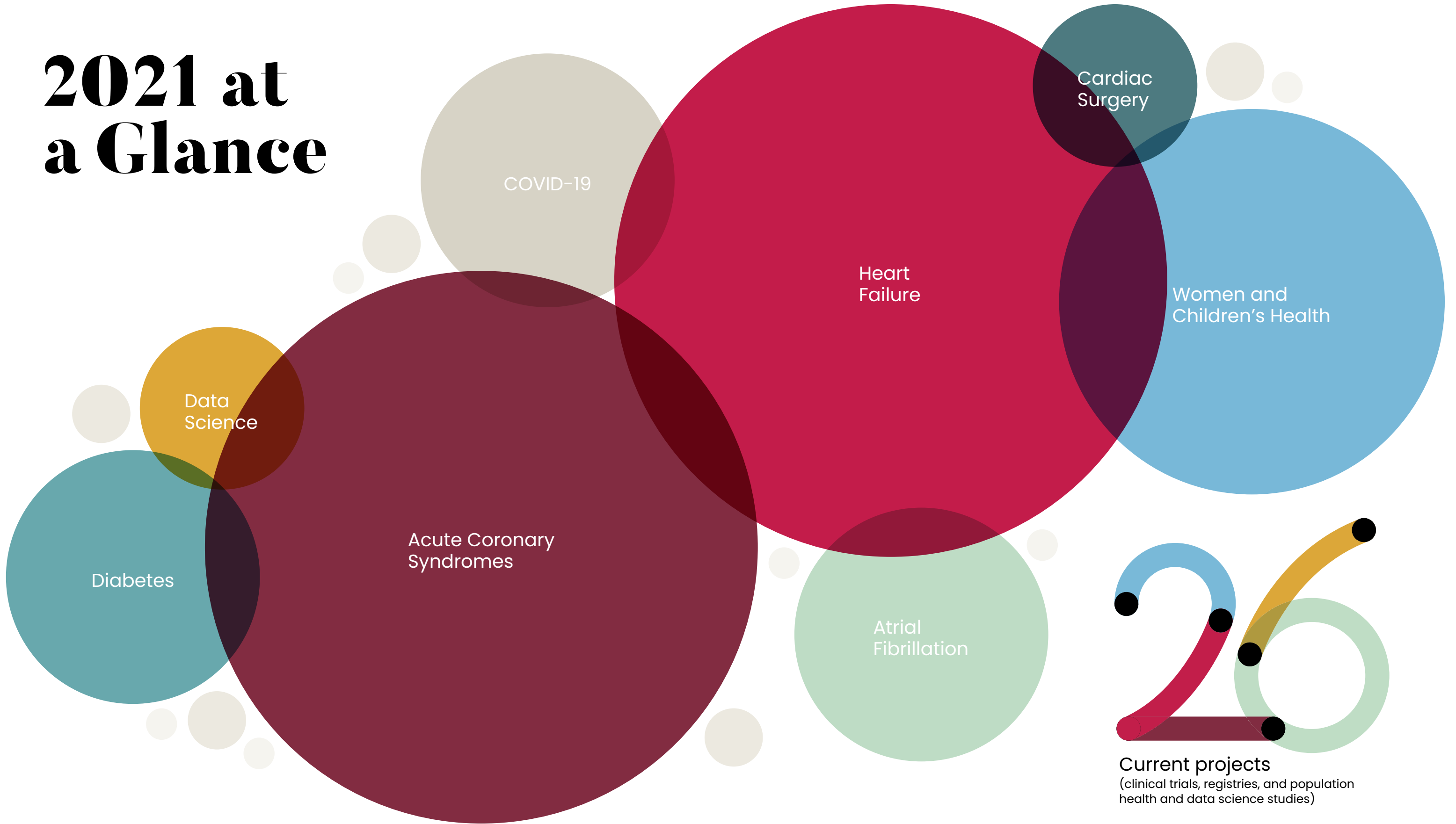
### COLLABORATION

Promote and support an outstanding team that integrates a diversity of knowledge, experience, ideas, and skills supportive of our mission/vision.

### RESPECT

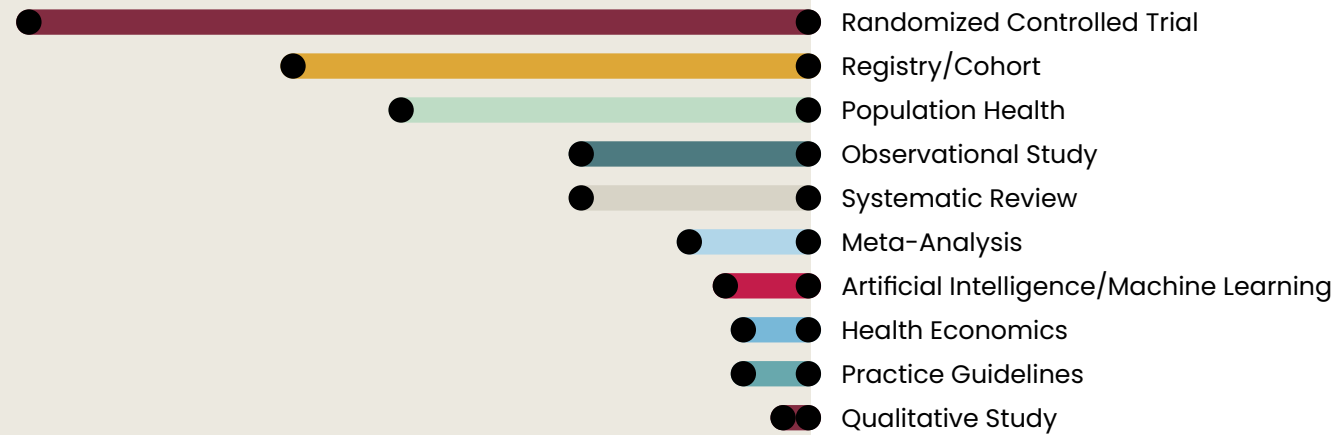
Create an innovative, engaging, and inclusive work environment, appreciative of individual differences and contributions. Our workplace will be conducive to personal growth and development that is aligned with our overall mission.

# 2021 at a Glance

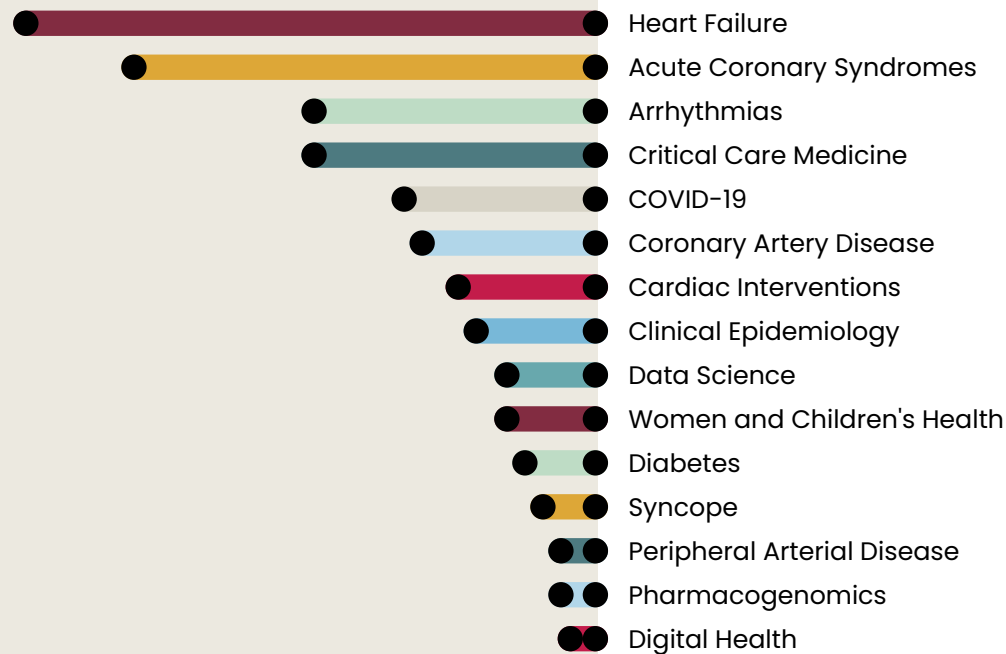




**METHODOLOGY**



**RESEARCH AREA**



**17,167** Citations generated from CVC-authored papers published between 2017- 2021


**2,639** Food records analyzed between 2014-2021

**120** Active sites participating in CVC-managed trials

**2,627** ECGs analyzed

# Research Highlights

## COVID-19 and Cardiovascular Disease

 [Watch Finlay McAlister, MD, MSc discuss COVID-19 and cardiovascular disease](#)

Many studies are now confirming that COVID-19 survivors experience various cardiac complications even during the recovery and post-acute phases. However, research is also now demonstrating that the secondary and tertiary impacts from the COVID-19 pandemic are far broader reaching and more substantial for the general population of patients with cardiovascular disease than just these primary impacts seen in COVID-19 survivors.

Despite the best of intentions, the health care restrictions implemented at the onset of the pandemic caused deferred and delayed

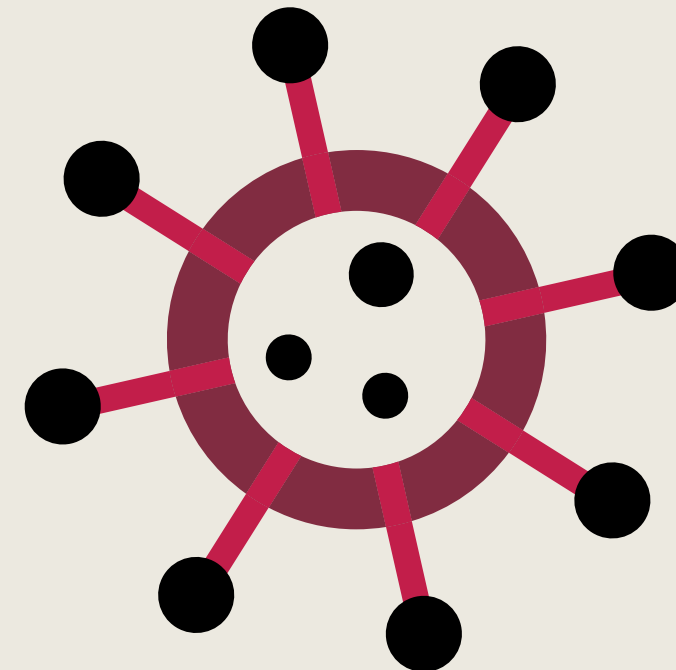
cardiovascular screening and chronic disease management. Further to the impact of the COVID-19 surges in hospital inpatient and diagnostic imaging capabilities, secondary impacts arising from changes in outpatient care patterns also reduced presentations to emergency departments and hospitalizations for non-COVID conditions, including acute cardiovascular emergencies.

Studies have shown that, although cardiovascular deaths in-hospital decreased during the pandemic, cardiovascular deaths at home and in long-term care facilities increased substantially, so that overall, all cardiovascular deaths rose quite significantly during the course of the COVID-19 pandemic. While the official death toll from SARS-CoV-2 infection stands at just over 6.1 million currently, studies of excess mortality demonstrate that more than 18 million people have died prematurely during the pandemic thus far, and many of these deaths were cardiovascular. Further, the influence of pandemic-related psychosocial, economic factors, and deferred primary and secondary prevention will continue to adversely impact cardiovascular health risks and outcomes far into the future. Tackling the pandemic-induced care deficit is the next big challenge in cardiovascular disease!

### Publications:

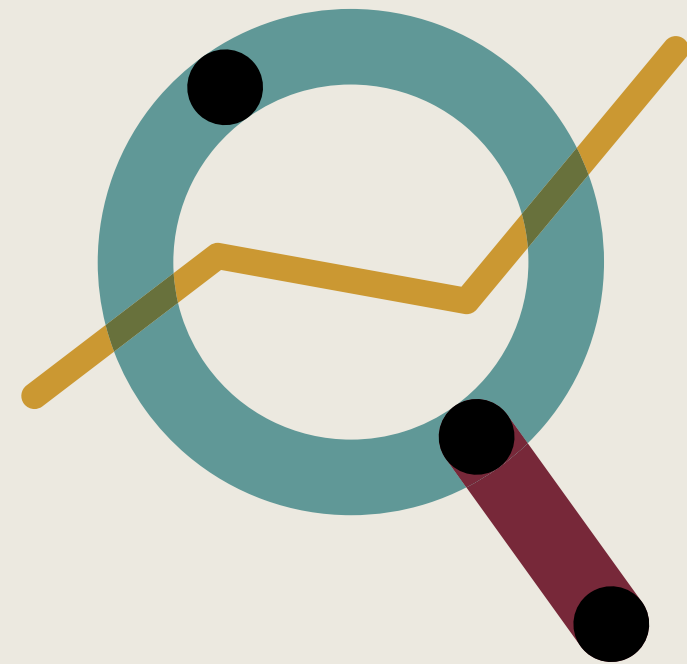
[Can J Cardiol. 2021;37:722-732. doi: 10.1016/j.cjca.2020.11.001.](#)

[medRxiv 2022.03.07.22272032; doi: doi.10.1101/2022.03.07.22272032](#)



# Dr. Padma Kaul Named the Heart & Stroke Foundation Chair in Cardiovascular Research

▶ Watch [Padma Kaul, PhD](#) discuss her work as the Heart & Stroke Foundation Chair in Cardiovascular Research



For example, women with cardiovascular disease present with different symptoms and this may contribute to delaying calling 911 or presenting to hospital after symptom onset. Further, women are less likely to be admitted to hospital when they present to the emergency department with chest pain, and receive fewer cardiovascular procedures than men. Most recently, Dr. Kaul's research has shown that long-term adverse outcomes, such as the development of heart failure or death, are different among men and women.

Most of this research is based on the rich population health data that is available in Alberta. The CVC works in collaboration with Alberta Health and Alberta Health Services to develop large longitudinal cohorts of patients with heart disease in the province. Administrative health data, or claims data, from hospitals, outpatient clinics, and physician billings have been linked to laboratory and pharmaceutical claims as well as to clinical registries such as the [Vital Heart Response Registry](#) and the [APPROACH Cardiac Catheterization Registry](#). These linked data are a tremendous resource for both faculty and trainees. Examples of how the Heart & Stroke Foundation summer interns used these data for their research projects are highlighted in this report's [Training and Mentoring](#) section.

As the Heart & Stroke Foundation Chair, Dr. Kaul plans to continue to support the exciting cardiovascular research that is happening at the CVC, the University of Alberta, and in Canada.

In 2021, Dr. Padma Kaul was awarded the Heart & Stroke Foundation Chair in Cardiovascular Research. Dr. Kaul's research interests are well aligned with the Foundation's primary goal of closing the research gap as it relates to women and heart disease.

Although cardiovascular disease is the second leading cause of death in both men and women in Canada, her research has shown that sex-differences persist at various points in the patient journey.

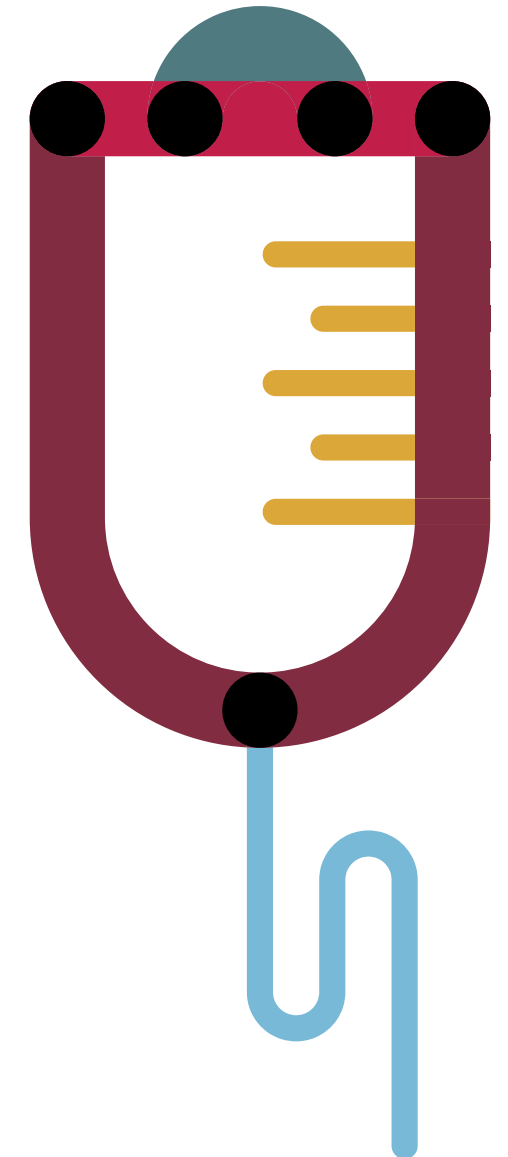
# Evolution in STEMI Care

▶ Watch [Robert Welsh, MD](#) and [Kevin Bainey, MD, MSc](#) discuss evolutions in STEMI care

In 1999, the CVC had an important role in establishing a paramedic-based, pre-hospital fibrinolysis in the [ASSENT-3 Plus](#) clinical trial. This Canadian paramedic-based system with physician oversight proved to be as effective as physicians in the ambulance in treating ST-elevated myocardial infarction (STEMI). This research was further expanded in the [WEST](#) trial, a Canadian collaborative study, testing a pharmacoinvasive approach versus fibrinolysis standard care or primary percutaneous coronary intervention (PCI). This set the stage defining the pharmacoinvasive strategy, which was studied more extensively in the [STREAM](#) trial and was proven to be at least as effective as primary PCI. The current [STREAM-2](#) trial is now examining whether a half-dose pharmacoinvasive strategy is as effective as primary PCI in older STEMI patients.

Further building on the above research, the [Vital Heart Response Registry](#) was created, which collected data from STEMI patients treated in Northern Alberta (either in the pre-hospital or community setting) with a reperfusion strategy. Examination of the collected electrocardiograms (ECGs) from over 5,500 patients in North America demonstrated an improved ST-segment resolution with a pharmacoinvasive approach versus primary PCI, which also translated into an improvement in clinical outcomes.

The ongoing [SONOSTEMI-LYSIS](#) trial is testing the concept of sonolysis (augmented ultrasound impulses) at the time of STEMI with fibrinolysis to determine whether it can disrupt part of the thrombus and improve the ST-segments, hopefully translating towards an improvement in clinical outcome.







# Management and Clinical Outcomes for Atrial Fibrillation

▶ Watch [Sean McMurtry, MD, PhD](#) and [Roopinder Sandhu, MD, MPH](#) discuss management and clinical outcomes for atrial fibrillation

## Atrial Fibrillation Guidelines

In late 2020, the Canadian Cardiovascular Society (CCS) published an important update to its [comprehensive guidelines for the management of atrial fibrillation \(AF\)](#). These guidelines covered all aspects of AF management, including classification and definitions, epidemiology, pathophysiology, the evaluation and screening of patients with AF, stroke prevention, and the management of symptoms and arrhythmias. New to the guidelines, this document uniquely highlighted sex differences in AF and special populations, such as children.

The CCS uses a rigorous process for gathering the best evidence in medical literature, synthesizing it, and producing specific recommendations, centered on the best possible outcome for individual patients across Canada, for clinicians to put this evidence into practice.

## Atrial Fibrillation Quality Indicators

Understanding the quality of AF care delivery is critically important for identifying care gaps, targeting improvement efforts, and guiding resource allocation. In Canada, this effort has been led by the CCS. The following section highlights two publications that utilized data from the CVC Canadian Population Health Laboratory in order to report national data on key AF quality indicators.

In the [first publication](#), researchers examined the trends in incident non-valvular AF (NVAf) hospitalizations, stroke, risk profiles, and associated in-hospital mortality over the time period from 2006 to 2015. The research showed a decline of NVAf hospitalizations of 2% every year over the study period. The majority of hospitalized patients with NVAf/atrial flutter were at high-risk of stroke and this remained consistent over time. The conclusions emphasize the need for further investigations to evaluate whether changes in AF risk factors, emergency department practice patterns, admission standards, and extent of outpatient AF care may contribute to declining hospitalization rates. Determining the risk of stroke for patients with AF, a priority quality indicator, demonstrates that the majority of patients are at high-risk. Finally, hospitalizations provide an important opportunity to initiate oral anticoagulant therapy or document reasons for contrary indication.

In a [following publication](#), investigators further examined the trends in one-year incidence of stroke or systemic embolism, major bleeding, and heart failure for patients discharged after first hospitalization with incident NVAf. Over the 2006–2015 time-period, yearly rates of incident stroke or systemic embolism and heart failure declined while major bleeding remained unchanged, highlighting the need to study process-based quality indicators with increased focus on heart failure prevention.

# Residual Risk and Secondary Prevention

▶ Watch [Shaun Goodman, MD, MSc](#) and [Tracy Temple, BScN, RN, CCRP](#) discuss residual risk and secondary prevention

Low density lipoprotein cholesterol (LDL-C) is an important cause of atherosclerotic cardiovascular disease (ASCVD) and residual risk. Randomized clinical trials (RCTs) led by the CVC, in collaboration with Canadian pharmaceutical affiliates, global sponsors, and other academic research organizations have helped to identify specific LDL-C thresholds in ASCVD patients. These RCTs aim to identify evidence that, along with novel non-statin LDL lowering therapies, can help patients achieve specific thresholds or targets, and most importantly, experience fewer cardiovascular disease events.

Recent examples include the [IMPROVE-IT](#) trial, as well as the [ODYSSEY Outcomes](#) trial, which demonstrated the PCSK9 inhibitor, alirocumab, can further lower LDL-C and residual CVD risk. A number of subgroup analyses further identified high-risk subgroups of patients who appear to derive the greatest absolute risk reductions with these treatments. These findings have helped inform both Canadian and international guideline recommendations.

Additionally, population health research led by the CVC has examined patient care in Alberta and identified specific gaps in LDL-C threshold attainment and ASCVD care in real-world practice.

## Operational Highlights for ODYSSEY Outcomes and IMPROVE-IT

As with many trials over the years, the CVC partnered with our friends and colleagues at the Duke Clinical Research Institute on both IMPROVE-IT and ODYSSEY Outcomes, two large phase III outcomes trials. In both of these trials, the CVC was responsible for leading operations and for monitoring Canadian sites.

The lasting relationships and connections built by the CVC teams with investigative sites across the country contributed to the CVC not only achieving its recruitment targets in both of these studies, but exceeding them. The CVC's extensive experience and work done with Canadian sites helps ensure there is always a good fit between the sites and the clinical trials.

# The APEX-AMI Biomarker Sub-Study

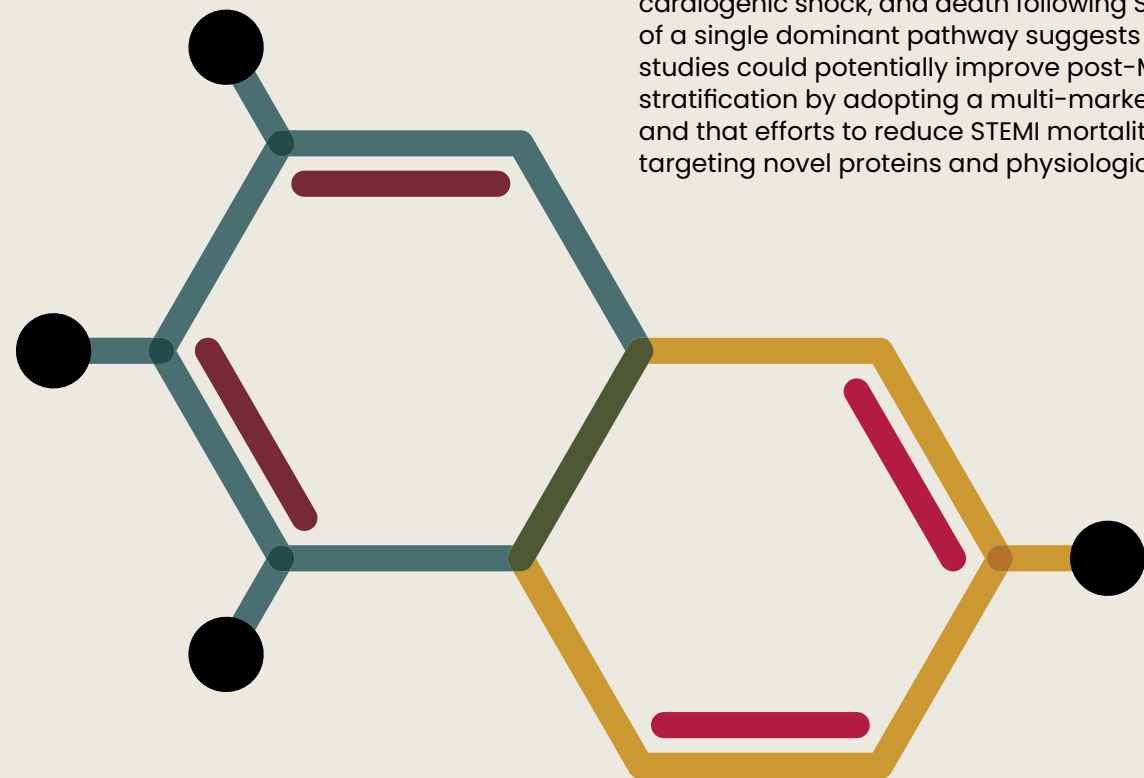
▶ Watch [Sean van Diepen, MD, MSc](#) provide an overview of the APEX-AMI biomarker sub-study

More than 14 years after the publication of [APEX-AMI](#), the trial's biomarker sub-study continues to provide potential mechanistic insights into the pathophysiology of clinical outcomes in patients with ST-segmental elevation myocardial infarction (STEMI). Despite temporal improvement in mortality, early reperfusion has been partially offset by a parallel rise in new onset post-infarction heart failure.

In this [biomarker sub-study](#) of phenotypically matched STEMI patients with paired baseline and 14 hour samples, a high throughput multi-marker proteomic evaluation was used to evaluate the

potential pathobiological axes and potentially yield novel mechanistic insights that may help distinguish patients with and without 90-day heart failure, cardiogenic shock, or death. The study found that relative change in 14 biomarkers linked to myocardial fibrosis/remodeling, inflammation, angiogenesis and signaling, bone and mineral metabolism, and cholesterol metabolism were all significantly associated with the 90-day composite after adjusting for false discovery rates.

Collectively, this hypothesis generating research suggests that multiple cardiovascular pathways appear to synergistically contribute to heart failure, cardiogenic shock, and death following STEMI. The lack of a single dominant pathway suggests that future studies could potentially improve post-MI clinical risk stratification by adopting a multi-markers approach and that efforts to reduce STEMI mortality may require targeting novel proteins and physiologic pathways.



# The VICTORIA Trial

▶ Watch [Justin Ezekowitz, MBBCh, MSc](#) and [Cynthia Westerhout, PhD](#) discuss the VICTORIA trial

The [VICTORIA trial](#) was a large, multinational, multicenter clinical trial that enrolled 5,050 patients at 616 sites in 42 countries. The CVC played a pivotal role as part of the executive committee, the design and management of clinical trial sites, and the data management afterwards.

## 2021 Publication Highlights

A [sub-study of the VICTORIA trial](#) explored the relationship between markers of anemia (including hemoglobin, hematocrit, and other metrics) and vericiguat or placebo. It was found that a greater incidence of anemia developed in patients on vericiguat when compared to placebo. Anemia was present in approximately one-third of patients at the beginning of the trial and a very small percentage of those patients went on to have further anemia. Additionally, there was no change in the outcomes when anemia developed in these patients, and there was no change in the efficacy of vericiguat overall.

The CVC also had an opportunity to participate in the design and development of a [complimentary registry to the VICTORIA trial](#). This registry of 2,056 patients from 51 sites in North America sought to describe patient characteristics, practice patterns, and in-hospital outcomes. They further aimed to characterize the reasons for nonparticipation in randomized clinical trials (RCTs) in a contemporaneous population. The registry identified several easily modifiable reasons relating to the conduct or design of an RCT that could facilitate improved enrollment and generalizability of future heart failure trials. Over a quarter of patients eligible for an RCT had a lack of interest in trial participation, warranting further investigation and understanding.



## Biostatistical Analysis in the VICTORIA Trial

The VICTORIA trial population is well-characterized based on data that has been expertly collected and prepared. This has given the CVC the opportunity to work closely with statisticians, programmers, and data management from industry and academia to achieve a number of analytic goals over the past two years.

One of these analyses, which started with the paper in the [New England Journal of Medicine](#), demonstrated a treatment interaction with natriuretic peptides at randomization. This appeared across the quartiles of this biomarker at randomization, and subsequent work has led to a better understanding by examining the full spectrum of this biomarker at randomization and providing new insight into where treatment may produce the greatest impact. Research that is currently under review is taking the story a step further by looking at the trajectory of natural peptides through the treatment period in these patients to understand how vericiguat may be working in this patient population.

# Impact and Outreach

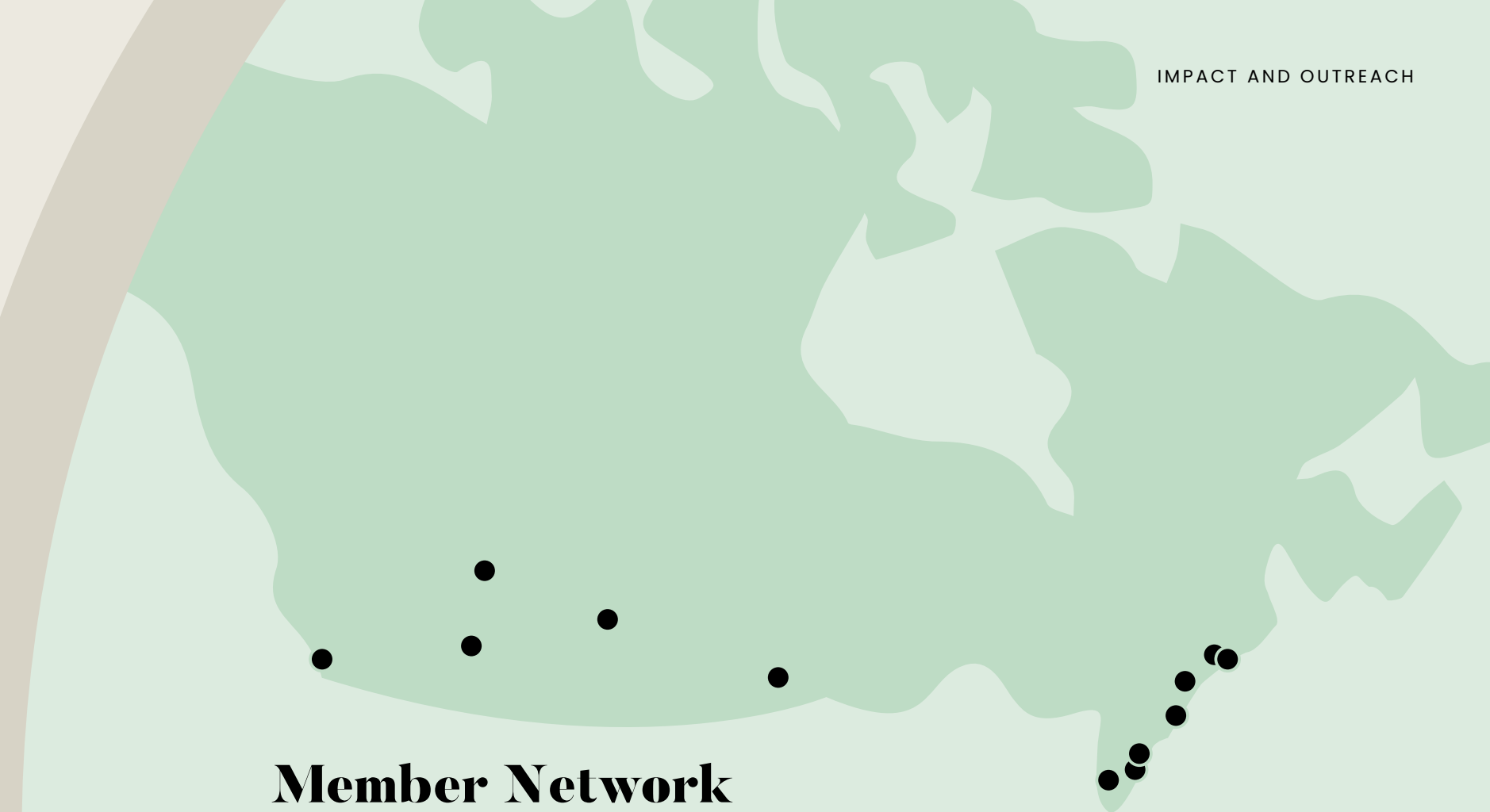
## Canadian Cardiovascular Research Collaboratory (C<sup>3</sup>)



The Canadian Cardiovascular Research Collaboratory (C<sup>3</sup>) is a virtual clinical research network aiming to blend two fundamental elements:

- Collaboration
- Clinical research laboratory

The C<sup>3</sup> provides opportunities for collaborative individuals to identify and study important unanswered questions and address unmet cardiovascular (CV) health care needs that are challenging for a single centre to evaluate definitively. Further, an unmet need exists to strengthen synergies among Canadian researchers to expedite the discovery, evaluation, and application of emergent observational and clinical trial studies, and the application of emergent therapies and strategies for CV disease. C<sup>3</sup> has convened some of Canada's leading CV disease researchers to develop a network of Canadian CV clinician scientists committed to sustained and meaningful collaboration to enhance the prevention, diagnosis, and treatment of CV disease.



### Member Network

**CALGARY, AB**  
**UNIVERSITY OF CALGARY**

Todd Anderson  
Derek Chew  
William Ghali  
Jonathan Howlett

**EDMONTON, AB**  
**UNIVERSITY OF ALBERTA**

Paul Armstrong  
Kevin Bainey  
Justin Ezekowitz  
Shaun Goodman  
Padma Kaul  
Finlay McAlister  
Brian H. Rowe  
Sean van Diepen  
Robert Welsh  
Cynthia Westerhout

**VANCOUVER, BC**  
**UNIVERSITY OF BRITISH COLUMBIA**

Madeleine Barker  
Christopher Fordyce  
Nathaniel Hawkins  
Karin Humphries  
Jessica Luc  
John Mancini  
Tara Sedlak

**WINNIPEG, MB**  
**UNIVERSITY OF MANITOBA**

Ross Feldman  
Shuangbo Liu  
Ashish Shah  
Shelley Zieroth

**HAMILTON, ON**  
**McMASTER UNIVERSITY**

Sanjit Jolly

**KINGSTON, ON**  
**QUEEN'S UNIVERSITY**

Aws Almufleh  
Amer Johri

**LONDON, ON**  
**WESTERN UNIVERSITY**

Robert Hegele

**OTTAWA, ON**  
**UNIVERSITY OF OTTAWA**

Peter Liu  
Marc Ruel  
Juan Russo  
Derek So

**TORONTO, ON**  
**UNIVERSITY OF TORONTO**

Akshay Bagai  
Warren Cantor  
Michael Farkouh  
Stephen Fremes  
Shaun Goodman  
Dennis Ko  
Patrick Lawler  
Adriana Luk  
David Mazer  
Heather Ross  
Jacob Udell

**LAVAL, QC**  
**UNIVERSITÉ LAVAL**

Jean-Pierre Després  
Josep Rodés-Cabau

**MONTREAL, QC**  
**UNIVERSITÉ DE MONTRÉAL**

Anita Asgar  
Robert Avram  
Marc Jolicoeur  
Guillaume Marquis-Gravel  
Jean-Francois Tanguay

**McGILL UNIVERSITY**

Nadia Giannetti  
Abhinav Sharma

**SASKATOON, SK**  
**UNIVERSITY OF SASKATCHEWAN**

Haissam Haddad  
Jay Shavadia

## Key Aims of the C<sup>3</sup> Network:

- Develop a new framework for trans-Canada collaboration, which facilitates investigator-initiated clinical CV disease research.
- Inspire, nurture, engage, connect, and mentor the next generation of CV disease researchers.

## C<sup>3</sup> Working Groups:



### Prevention



### Coronary Artery Disease (CAD)



### Heart Failure



### Intervention/Surgery



### Population Health

# CVC/C<sup>3</sup> Pharmaceutical Roundtable CV Research Initiative

This research initiative was established in 2020 with the following objectives:

1. Facilitate state-of-the-art CV research projects, including funds that would allow for pilot/vanguard studies initiated and led by C<sup>3</sup> members to be undertaken in support of seeking additional, peer-reviewed funding.
2. Train and mentor the next generation of CV researchers, including cardiologists and CV surgeons in the late stages of their postgraduate training, and faculty in the early stage of their careers.
3. Position Canada as a preferred locale to undertake multinational research development.
4. Develop partnerships with pharmaceutical sponsors and patients in order to enhance best practices in conducting Canadian clinical research, including optimal strategies for the identification, recruitment, and follow-up of patients in trials; this is a continuation of the CVC Colloquium – a previously annual in-person meeting of academic research organizations, Canadian site investigators and study coordinators, and patient partners, that has been supported and attended by medical representatives from several pharmaceutical companies over the prior seven years.

In 2021, funding for this initiative was allocated to support the initiation/completion of planned or ongoing C<sup>3</sup> supported projects in the pilot/vanguard phase. Funding for these projects was awarded through a “Dragon’s Den” approach. Applicants participated in an interactive presentation pitch to C<sup>3</sup> members and a panel of judges comprised of senior Canadian CV researchers. The top three proposals, as ranked by the judges, were awarded. The selected projects were later presented during a dedicated C<sup>3</sup> meeting of invited pharmaceutical supporter representatives in January 2022. The purpose and objectives of the three projects are detailed below:

### 1. Sex Specific Assessment of Chest Pain

Tara Sedlak, University of British Columbia

Led by Drs. Tara Sedlak, Karin Humphries, and John Mancini, at the University of British Columbia, the CAD, Prevention, and Population Health working groups have been supporting the development of a sex-specific assessment algorithm that more accurately identifies obstructive CAD in both men and women. The project objective is to develop an improved algorithm for the prediction of obstructive CAD on imaging, including coronary computed tomographic angiography (CTA) and invasive coronary angiography, for both men and women with suspected CAD, using information that is readily available from routine cardiologist or internist office visits.

### 2. De-Adoption Beta-Blockers in patients with stable ischemic heart disease without Reduced LV ejection fraction, ongoing Ischemia, or Arrhythmias: a pragmatic randomized trial: The ABBREVIATE Trial

Sean van Diepen, University of Alberta

Led by Drs. Sean van Diepen, Kevin Bainey, Justin Ezekowitz, Padma Kaul, and Shaun Goodman, at the University of Alberta, the Intervention/Surgery, CAD, and Population Health working groups have supported the development of a pragmatic, open-label, multi-centre, randomized controlled trial of Canadian patients with stable ischemic heart disease, including those with a remote myocardial infarction (MI) and preserved left ventricular function. The key objective of the study is to evaluate if beta-blocker use will reduce the incidence of the composite of death, non-fatal MI, or hospitalization for resuscitated cardiac arrest, unstable angina requiring urgent revascularization, or heart failure.

### 3. Development of the C<sup>3</sup> Cardiogenic Shock App (The C<sup>3</sup>CAP Pilot Study)

Derek So, University of Ottawa

Led by Drs. Derek So (University of Ottawa), Akshay Bagai (University of Toronto), Adriana Luk (University of Toronto), Sean van Diepen (University of Alberta), Jean-Francois Tanguay (University of Montreal), Robert Avram (University of Montreal), Shuangbo Liu (University of Winnipeg), Christopher Fordyce (University of British Columbia), Juan Russo (University of Ottawa), and Shaun Goodman (Universities of Alberta and Toronto), the Intervention/Surgery and CAD working groups have been supporting the development of a cardiogenic shock initiative. This has included enhancing Canadian participation in the Critical Care Cardiology Trials Network (CCCTN) registry (from 3 to 10 sites), and the development and completion of a national survey of all cardiac catheterization laboratory centres managing cardiogenic shock patients in Canada (n=46), including estimation of annual case volumes, the structure and availability of cardiogenic shock teams and algorithms, mechanical support device use, and regional obstacles/challenges faced.

Financial support for the CVC/C<sup>3</sup> Pharmaceutical Roundtable CV Research Initiative and the Virtual CVC Colloquium Series was provided by Amgen, Bayer, BMS/Pfizer, Boehringer Ingelheim/Lilly, and Novartis.

# Clinical Trials Colloquium

The CVC Clinical Trials Colloquium first began in 2014 when Dr. Paul Armstrong (CVC Founding Director) and Tracy Temple (Associate Director, Clinical Trials), brought together 13 Canadian investigative sites to help:

1. Identify major impediments to timely and efficient participation in clinical trials.
2. Understand how best to add value to the clinical trial experience.
3. Establish a network of high performing sites across Canada.

The Colloquium is an excellent opportunity for the CVC, our sponsors, and sites across Canada to connect, collaborate, and find solutions to key issues affecting clinical research in Canada. Dr. Shaun Goodman (CVC Co-Director) and Tracy Temple continue to spearhead this effort with collaboration and support from the CVC Site Engagement Working Group.

While the pandemic prevented us from gathering face-to-face for the 8th annual Colloquium, it did open up a new opportunity, via a virtual platform, to expand the invitation to our full network of Canadian sites. Given the virtual format in 2021, we held three separate and unique sessions throughout the year with an outstanding line-up of presenters. The themes explored in these sessions included clinical trials during a pandemic, mentoring and diversity in clinical research, and operationalizing clinical research.

We'd like to extend a special thank you to all of our presenters for sharing their insights, experiences, and expertise with the broader research community, as well as the attendees for their participation and engagement throughout the virtual Colloquium series. A final thank you to our sponsors CSL Behring, Bayer, Novartis, BMS/Pfizer, Lilly/Boehringer Ingelheim, and Amgen for their support this year.

More information about these events can be found on the Colloquium website and in the 2021 issues of the Canadian Cardiac Chronicle newsletter.

[!\[\]\(8bba887393ca45b761e5cb49e755e762\_img.jpg\) Colloquium website](#) [!\[\]\(b898b980f2d860cdb0237afbc3664529\_img.jpg\) Canadian Cardiac Chronicle newsletter](#)

# Site Engagement Working Group

As part of our 2019-24 strategic vision, the CVC focused on enriching our organizational framework by engaging Canadian site principal investigators (PIs) and study coordinators (SCs) as true partners in the CVC research programs. Together with co-chairs, Drs. Shelley Zieroth and Warren Cantor, we established the CVC Site Engagement Working Group in 2020. The working group collaborated with PI and SC representatives to establish the following priorities:

1. Provide broad strategic advice on future preferred directions for clinical cardiovascular research.
2. Provide a perspective on regional cardiovascular priorities towards which future research might be directed.
3. Advise the CVC regarding logistics, operations, and funding for studies prior to start-up and throughout the course of the trial.
4. Inform the CVC on optimal ways to support and communicate with sites.
5. Identify and assist the CVC in mentoring new PIs and SCs at established and new sites.

In 2021, the working group was involved in planning and supporting the CVC's virtual Colloquium Series. In particular, they played a key role in the third session focused on operationalizing clinical research with several of the working group's PI and SC representatives amongst the presenters who provided key insights and expert advice on pragmatic approaches to clinical research.

PI Representatives: Nadia Giannetti, Michael Heffernan, Eileen O'Meara, Simon Robinson  
SC Representatives: Kiran Atwal, Tracy Cleveland, Noreen Lounsbury, Kim Robbins

# Town Hall Series

In 2021, the CVC introduced the virtual "Town Hall" series, a new and well-received program that addresses a variety of topics relevant to our mission, and engages all of the CVC family, from our board to our faculty, staff, trainees, and students. These events bring together a variety of voices and perspectives discussing novel, and sometimes controversial, topics in a new and unique manner. The primary presenter identifies why the topic is important to health sciences, pertinent to our mission, deserving of our attention, and what challenge(s) it addresses and who is expected to benefit. An invited discussant then provides context for the topic and is followed by an open and animated discussion with all attendees. A wide range of subjects, including the role of artificial intelligence, the impact of COVID-19, and how social media intersects with our mission, as well as critiques of various research projects in progress, populated these events over the last year.

# Training and Mentoring

“An effective mentor should be available, patient, and dedicated to the best interests of the mentee.”

—DR. M. SEAN McMURTRY



## A Conversation with Dr. M. Sean McMurry on Mentorship

CVC faculty member Dr. M. Sean McMurry currently serves as the program director for the Clinical Investigator Program at the University of Alberta. The aim of this Royal College of Physicians and Surgeons of Canada accredited program is to educate postgraduate medical trainees towards an independent career combining clinical practice and research. In the following section Dr. McMurry shares his insights on mentorship and training.

### What does mentorship mean to you?

Mentorship is an informal relationship between a learner – usually a younger, more junior individual with aspirations to learn and grow – and a mentor – usually an older, more senior individual with life experiences, wisdom, and skills to teach. The word mentorship comes from Homer’s *Odyssey*, in which the character, Mentor, is left by King Odysseus at home in Ithaca to raise the King’s son, Telemachus. A central part of the story is that the Goddess of Wisdom, Athena, appears to Telemachus in the form of Mentor, in order to pass on key advice and inspiration for Telemachus to become a proper adult and rid the kingdom of bad influences. The allusion makes clear that mentorship involves the passage of wisdom and experience to a younger, inexperienced person to transform that person into a more mature state with greater knowledge and responsibilities. Mentorship is a key way in which learners, in any field, can advance in their fields and take their places beside their more mature peers.

### In your opinion, what are the qualities and key practices that make someone a successful mentor?

An effective mentor should be available, patient, and dedicated to the best interests of the mentee. The

effective mentor can and should be willing to have difficult conversations in addition to offering praise so that the mentee may improve. The mentor should be open to discussing a range of topics that the mentee may wish to learn about, such as issues in the professional domain, and, if the relationship lends itself to it, in the personal domain also. An effective mentor should be willing to open doors and offer advice to help move the mentee’s career forward, and, if appropriate, advice about living well and finding balance.

### What do you hope the trainees who participate in the Alberta Clinical Investigator Program gain from this experience?

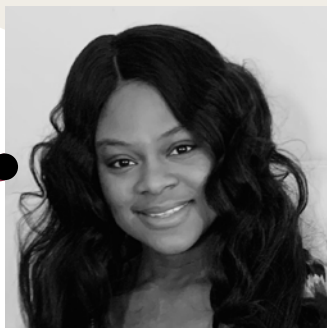
Residents who complete the University of Alberta’s Clinical Investigator Program get formal research experience in a graduate program – either in a Master’s of Science program or a PhD program – as part of their residency years. They get rigorous education about how to perform science, and credentials sufficient to open the door to a career in academic medicine. This program trains the next generation of academic faculty at the University of Alberta and elsewhere in North America.

# Heart & Stroke Summer Internship Program

In 2021, Dr. Padma Kaul was named the Heart & Stroke Chair in Cardiovascular Research. One of her first undertakings in this role was to establish a new Heart & Stroke Summer Internship Program at the University of Alberta. This program has a unique design: it brings together a clinical trainee from the Faculty of Medicine & Dentistry with a School of Public Health Master's student trained in epidemiology/biostatistics. The trainee team collaborates on a specific research question under the close mentorship of a faculty member and a senior statistician. The goal of this training program is to offer the interns a platform to merge clinical knowledge with data analytics, and through this exchange, learn how each impacts the other.



**DR. MUIZZ WAHID**



**VIVIAN AGHANYA**



**DR. OLUWAYOMI (YOMI) OLUGBUYI**



**CHRISTOPHER SMITH**

The inaugural teams included Dr. Muizz Wahid (Clinical Resident, Internal Medicine) and Vivian Aghanya (Master of Public Health Student), who worked together on a heart failure project under the mentorship of Dr. Justin Ezekowitz; and Dr. Oluwayomi (Yomi) Olugbuyi (Clinical Resident, Division of Cardiology) and Christopher Smith (Master of Public Health Student) who worked together on a congenital heart disease project under the mentorship of Dr. Lisa Hornberger. Read more about their experiences with the internship program on the following pages.

## Heart Failure Project

with Dr. Muizz Wahid and Vivian Aghanya

**Briefly describe the project you collaborated on during your internship, and the main goal(s) of this research.**

**Muizz and Vivian:** Guideline-directed medical therapy (GDMT) has shown mortality and morbidity benefits among heart failure patients with reduced ejection fraction (HFrEF) in several clinical trials. Despite proven efficacy, GDMT is under-utilized in clinical practice. The current study examines GDMT utilization among elderly HFrEF patients in Canada after incident hospitalization for heart failure to promote medication initiation and titration to target dosing within a reasonable time period.

**This novel internship program paired together University of Alberta clinical trainees with students from the School of Public Health. How did this unique collaboration benefit your research and what did you learn from working with each other?**

**Muizz:** The unique collaboration between Vivian and myself was crucial for the successful completion of the project. The project itself utilized significant epidemiological, and population data, as well as biostatistics that are far off my area of expertise. The clinical aspects of heart failure and patient care are areas that are primarily my focus. Clearly, a combination of both aspects were required in the development, and completion of the project. The very important non-clinical side of research, specifically interpreting large population data, was an important learning point that I will be able to utilize in future projects.

**Vivian:** The internship program offered a great opportunity for unique skills and knowledge to collaborate. Together, we were able to cover the technical/statistical and clinical experiences required for successful completion of the project. Both my knowledge of epidemiology and biostatistics, and his clinical knowledge of heart failure and patient care were required from the study design step to interpretation of the results. Muizz provided me with clinical specific insights relevant to the project that I would not have ascertained on my own.

**Please describe your most significant takeaway from working with your mentors on this project.**

**Muizz:** The most significant takeaway from working with my mentors was learning how to bridge clinical medicine with epidemiological research. I can now utilize my knowledge in clinical medicine to formulate projects that require large population data. I was previously unaware of the amount of data that is available, and it now makes brainstorming projects much easier.

**Vivian:** The greatest takeaway was improving my ability to bridge concepts and practical application. Prior to the internship, I had minimal experience applying the concepts we learned at the School of Public Health in a practical setting. Working with my mentors, I obtained frequent feedback on my work, which taught me tips and shortcuts to optimize the work process, without sacrificing my conceptual thinking.

**“We have had great experiences as a trainee, and as a mentor, and one of the important skills we learn is working in a scientific team. This internship setup allowed us to partner trainees on a project that would enhance everyone's skills and experience and, at the same time, add to the scientific literature. Working with a trainee who has a good clinical question and a trainee with epidemiologic skills, then combining the two in the right environment is a winning formula.”**

—JUSTIN EZEKOWITZ,  
MBBCh, MSc

# Congenital Heart Disease Project

with Dr. Oluwayomi (Yomi) Olugbuyi and Christopher Smith

## Briefly describe the project you collaborated on during your internship, and the main goal(s) of this research.

**Yomi and Christopher:** The project that we collaborated on during the internship was looking at the relationship between socioeconomic status or remoteness of residence from a pediatric cardiology centre and outcomes among children with congenital heart disease (CHD). Since both surgical and non-surgical pediatric cardiology centres are only found in metropolitan areas, we wanted to understand how that impacted people who either lived outside of metropolitan areas or those who had lower income. We looked at how each of those factors impacted mortality and access to care (which we defined as age and length of hospitalization at first cardiac surgical intervention as well as the number of hospitalizations in the first year of life).

## This novel internship program paired together University of Alberta clinical trainees with students from the School of Public Health. How did this unique collaboration benefit your research and what did you learn from working with each other?

**Yomi:** In this collaboration, Christopher was an excellent team player and quick study. He facilitated the majority, if not all, of the analysis with guidance from his lecturers. I applaud his expertise along with his team of biostatisticians and epidemiologists –thanks to them, I think I learned a tremendous amount in such a short amount of time. Additionally, this project gave a real opportunity to work on Canadian data that will hopefully help highlight the need for further research and implementation of strategies that will improve the care of children with CHD in remote sites and those with lower socioeconomic status.

**Christopher:** One of the things that really drew me to statistics in the first place was being able to work and learn about different disciplines. In this collaboration, I had to lean on Yomi and the other clinicians on the team for their expertise, and thanks to them, I think I learned a ton in such a short amount of time. Additionally, this project gave a real opportunity to work on taking the stats work that I was doing and communicating it in a way that was accurate but also accessible to people with clinical backgrounds. This is something that we talk about in our classes but having real practice doing it is invaluable.

## Please describe your most significant takeaway from working with your mentors on this project.

**Yomi:** For me the dogged persistence of my mentors in completing the project is remarkable, given their tight schedules and jobs. The attention to detail in this project gave me real insight into the work of great minds to which I was lucky to have encountered.

**Christopher:** I think the level of feedback that I got over the course of this project was really awesome and at a level I had not had previously. For me it was really helpful to see where and when the different pieces of what I have been studying over the past couple of years applied in practice and how that helped take my understanding to another level.

**“This experience has spawned two other recently funded research initiatives that explore the adequacy of our healthcare, focusing on CHD outcomes from fetal stages through adolescence within Alberta. Such collaborations, which combine the strengths of clinical and health research teams, are critical for the evolution of timely and effective research and for training of the next generation of investigators. We are truly grateful to the Heart & Stroke Foundation for providing this wonderful opportunity.”**

–LISA HORNBERGER, MD

# Mitacs Globalink Research Internship Program

The Mitacs Globalink Research Internship is a competitive program that pairs undergraduate students from around the world with faculty members from Canadian universities for a 12-week research internship project. Akshay Valsaraj and Vaibhav Sharma were selected to join the CVC data science team to work on a project developing artificial intelligence-machine learning (AIML) prognostic models based on echocardiography. Under Dr. Padma Kaul's supervision, the interns collaborated closely with Drs. Sunil Kalmady Vasu, Nariman Sephrvand, and Justin Ezekowitz, and trainee Weijie Sun from the CVC, and with staff from US2ai, an industry partner. A manuscript resulting from this project is currently in development.

**“The CVC always had a very professional and learning-centered environment, which has given me newfound confidence and motivation to pursue my interests in the research domain and improve my connections globally.”**

–AKSHAY VALSARAJ, BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, INDIA



**“The internship has been a great experience overall. The best thing was to experience the complete project lifecycle from ideating, implementing, improvement and outsourcing.”**

–VAIBHAV SHARMA, ALIGARH MUSLIM UNIVERSITY, INDIA



# Our Team

The CVC is anchored by a dedicated group of internationally recognized thought leaders in cardiovascular medicine and clinical investigation, and is supported by accomplished administrative and clinical operations teams, as well as experienced biostatisticians, data and machine analysts, and ECG Core Laboratory personnel.

Research is a team sport, and our diverse and multidimensional CVC personnel are committed to continuous innovation that has an impact on informing health policy.



**Back row, left to right:** Robert Welsh, Finlay McAlister, Roopinder Sandhu, Sean van Diepen, Shaun Goodman, Kevin Bainey  
**Front row, left to right:** M. Sean McMurtry, Justin Ezekowitz, Padma Kaul, Paul W. Armstrong

## Faculty

The CVC faculty are internationally recognized as thought leaders in their respective areas of interest, and they collectively represent a diverse field of clinical research. Our faculty are passionately dedicated to advancing the frontiers of cardiovascular science through several domains:

- **Clinical Trials** – architecture, operational management, analysis, and interpretation.
- **Registry Development** – providing real-world data on a number of cardiovascular conditions and allowing measurement of quality metrics across a large cohort of patients.
- **Large Population Databases** – informing the impact of research on practice, and pointing towards unmet needs and future directions.

Our faculty play a pivotal role in linking new knowledge to the community, understanding the implications on health outcomes, embracing the quality feedback loop, and discovering science through clinical trials, registries, and population outcomes. They are deeply engaged in identifying, nurturing, and mentoring the health professionals and leaders of tomorrow by grounding them in the discipline of cardiovascular research.



**PAUL W. ARMSTRONG, MD**

- Founding Director, Canadian VIGOUR Centre
- Distinguished University Professor, Division of Cardiology, University of Alberta
- Formerly Chair of the Department of Medicine, University of Alberta
- Founding Director of TORCH (Tomorrow's Research Cardiovascular Health Professionals), a Strategic Training Program Initiative
- Founding President of the Canadian Academy of Health Sciences
- Officer of the Order of Canada

**Dr. Armstrong's research interests include:**

- Development of novel methods to enhance clinical trial methodology
- Cardiovascular implications of diabetes and aging
- Pathophysiology and novel therapeutic approaches of congestive heart failure
- Diagnosis and management of acute coronary syndromes, with emphasis on timely interventions



**JUSTIN EZEKOWITZ, MBBCh, MSc**

- Co-Director, Canadian VIGOUR Centre
- Professor, Division of Cardiology, University of Alberta
- Director, Cardiovascular Research, University of Alberta

**Dr. Ezekowitz's research interests include:**

- Testing the impact of drugs, existing care, and processes of care for patients with acute and chronic heart failure
- Non-pharmacologic interventions such as dietary sodium or altering the gut microbiome, and existing tools such as biomarkers for discovery or prognosis
- Population health studies on outcomes and interventions
- Clinical trial design and endpoints



**SHAUN GOODMAN, MD, MSc**

- Co-Director, Canadian VIGOUR Centre
- Adjunct Professor, Department of Medicine, University of Alberta
- Associate Head, Division of Cardiology, Department of Medicine, St. Michael's Hospital
- Professor, Department of Medicine, University of Toronto

**Dr. Goodman's research interests include:**

Facilitating collaborative clinical trial, observational, and knowledge translation research in cardiovascular disease in Canada with a focus on:

- Diagnosis, management, and prognosis of acute and chronic coronary syndromes
- Secondary prevention of cardiovascular disease, including those with diabetes mellitus
- Optimal stroke prevention risk stratification and management in atrial fibrillation



**PADMA KAUL, PhD**

- Co-Director, Canadian VIGOUR Centre
- Professor, Department of Medicine, University of Alberta
- Adjunct Professor, School of Public Health, University of Alberta
- Adjunct Professor, Department of Population Health Sciences, Duke University, North Carolina
- Canadian Institutes of Health Research Chair (CIHR), Sex and Gender Differences, Diabetes
- Heart & Stroke Chair in Cardiovascular Research

**Dr. Kaul's research interests include:**

- International differences in practice patterns and outcomes
- Sex differences in treatment and outcomes of cardiovascular disease
- Long term chronic disease implications for pregnancy related complications
- Issues related to access, delivery, and costs of care at a population level



**KEVIN R. BAINEY, MD, MSc**

- Director, ECG Core Laboratory, Canadian VIGOUR Centre
- Interventional Cardiologist, Mazankowski Alberta Heart Institute
- Associate Professor, Division of Cardiology, University of Alberta
- Director, Adult Cardiac Catheterization and Interventional Cardiology Laboratory
- Director, Interventional Cardiology Fellowship Program
- Co-Director, Acute Coronary Syndrome (ACS) Working Group, Alberta Health Services Cardiovascular Health and Stroke Strategic Clinical Network

**Dr. Baine's research interests include:**

- Optimizing reperfusion strategies in ST-elevation myocardial infarction
- Population health outcomes in acute coronary syndromes



**SEAN van DIEPEN, MD, MSc**

- Academic Cardiologist-Intensivist, University of Alberta Hospital
- Co-Director, Coronary Intensive Care Unit, University of Alberta Hospital
- Associate Professor, Critical Care Medicine, Division of Critical Care and Division of Cardiology, University of Alberta
- Associate Editor, American Heart Journal and European Heart Journal: Acute Cardiovascular Care

**Dr. van Diepen's research interests include:**

- Critical care cardiology
- Cardiovascular surgical care
- Critical care resource utilization



**FINLAY McALISTER, MD, MSc**

- General Internist, University of Alberta Hospital
- Professor, Division of General Internal Medicine, University of Alberta
- Scientific Director, Alberta SPOR (Support for Patient Oriented Research) Unit
- Past-Chair, Outcomes Research Task Force, Canadian Hypertension Education Program
- Past-President, Canadian Society of Internal Medicine

**Dr. McAlister's research interests include:**

- Outcomes research in hypertension, heart failure, perioperative care, and coronary artery disease
- Clinical epidemiology methodology with a focus on evidence-based medicine and implementation of evidence at the bedside
- Methodology of trials and systematic reviews



**M. SEAN McMURTRY, MD, PhD**

- Clinician Scientist, Mazankowski Alberta Heart Institute
- Associate Professor, Division of Cardiology, University of Alberta
- Program Director, Clinical Investigator Program, University of Alberta

**Dr. McMurry's research interests include:**

- Thoracic aortic disease
- Peripheral artery disease
- Coronary artery disease
- Sex differences in cardiovascular disease
- Men's health



**ROOPINDER SANDHU, MD, MPH**

- Cardiac Electrophysiologist, Associate Professor Department of Cardiology, Smidt Heart Institute, Cedars-Sinai Medical Center, Los Angeles
- Director of the Device Clinic, Smidt Heart Institute, Cedars-Sinai Medical Center, Los Angeles
- Associate Professor-in-Residence, Department of Medicine, David Geffen School of Medicine, University of California, Los Angeles
- Associate Adjunct Professor, Department of Medicine, Division of Cardiology, University of Alberta
- Visiting Scientist, Brigham and Women's Hospital, Boston
- Co-Director, Edmonton Cardiac Arrhythmia Trials (ECAT) group

**Dr. Sandhu's research interests include:**

- Arrhythmia health services and outcomes research
- Atrial fibrillation
- Cardiac implantable devices
- Syncope

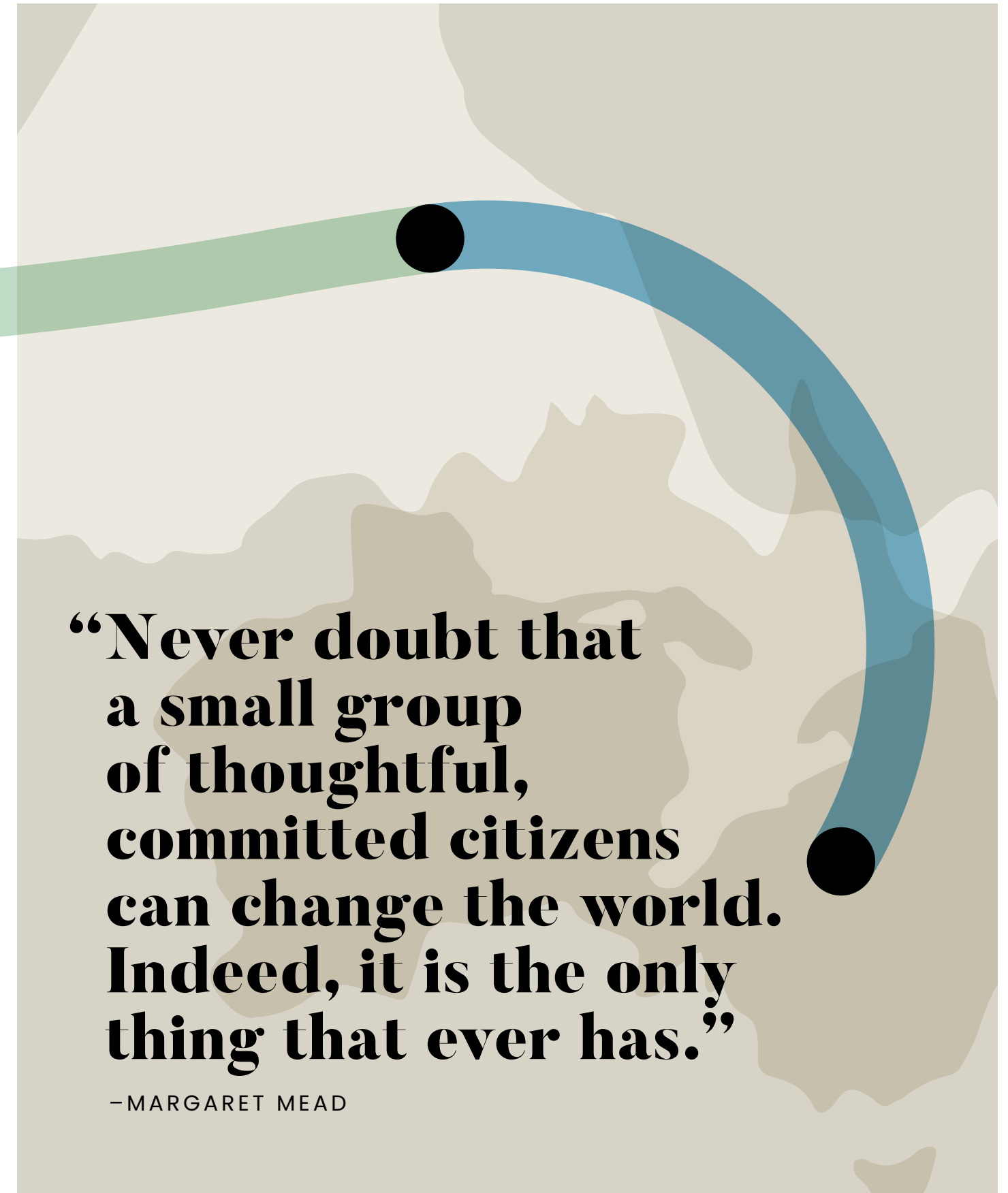


**ROBERT WELSH, MD**

- Interventional Cardiologist, Mazankowski Alberta Heart Institute
- Professor, Division of Cardiology, University of Alberta
- Edmonton Zone Clinical Department Head, Cardiac Sciences
- Chair, Canadian Cardiovascular Society, Percutaneous Coronary Intervention (PCI) Quality Working Group
- Co-Chair, Transcatheter Aortic Valve Implantation (TAVI) Program, Mazankowski Alberta Heart Institute

**Dr. Welsh's research interests include:**

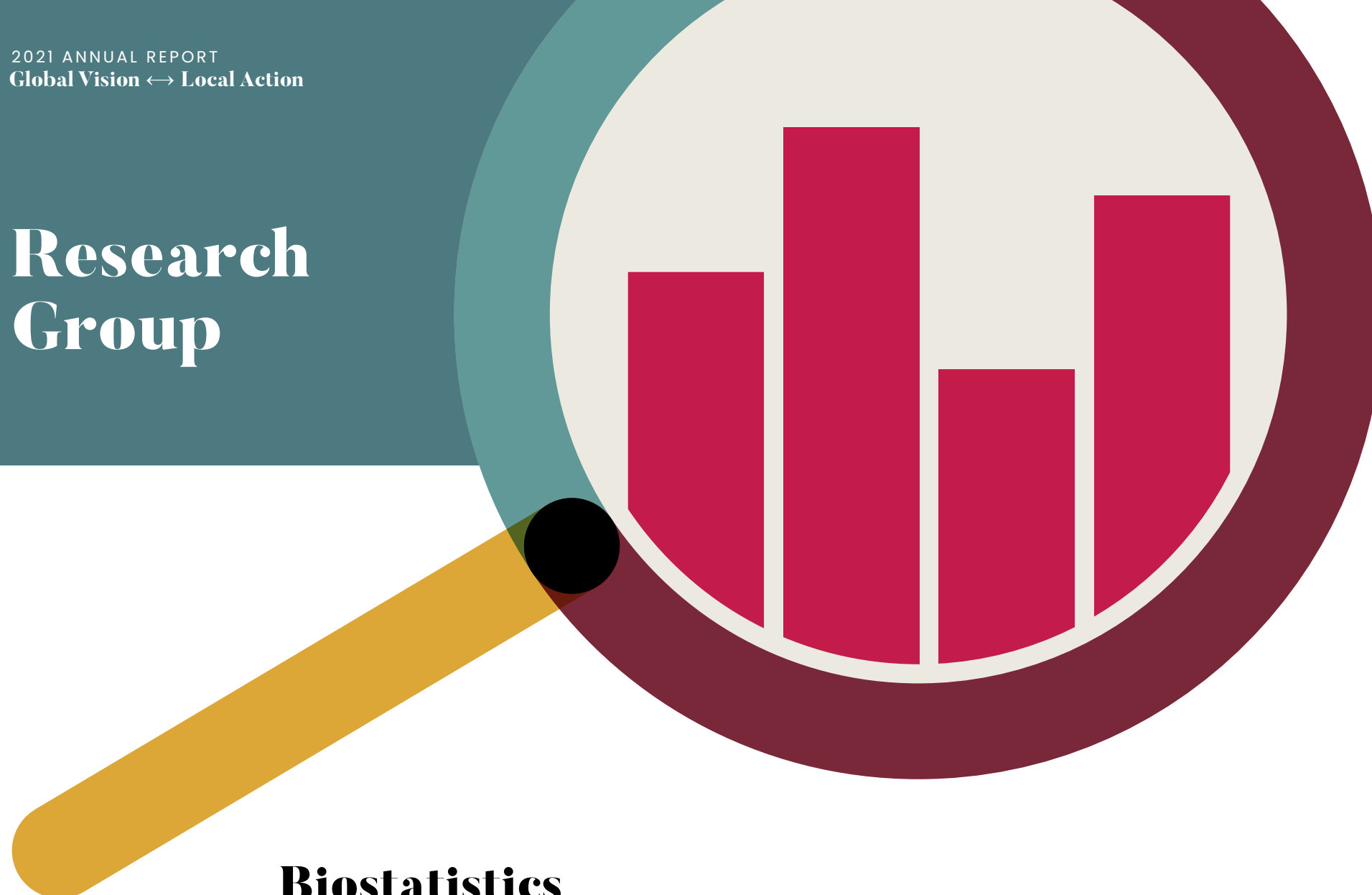
- Acute coronary syndromes and interventional cardiology
- Valvular heart disease
- Atherosclerotic cardiovascular disease
- Cardiovascular disease and diabetes
- Exercise physiology and cardiac physiology
- Pre-hospital management of ST-elevation myocardial infarction, and the interaction of pharmacological (antithrombotic and fibrinolytic) and mechanical interventions (primary and rescue angioplasty)



**“Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.”**

– MARGARET MEAD

# Research Group



## Biostatistics

Biostatistics at the CVC is a collective of applied biostatisticians with diverse training, experience, and practice. We collaborate with local, national, and international investigative teams by applying statistical reasoning and methods to the wide range of research interests in cardiovascular and maternal-child health. Our team contributes to the quantitative aspects of research through study design, conduct, analysis, and interpretation of findings and studies. Our biostatisticians are experienced in working with a wide variety of data sources, both primary and secondary. They are closely involved in generating academic works, such as abstracts and presentations for scientific meetings, and manuscripts published in peer-reviewed journals.

Our biostatisticians are contributing to the leading edge of new methodologies and providing guidance on these evolving applications in health research. We collaborate and network with others in the field at the local level through the Biomedical Analytics Studio and Methods (BALSAM) Network, Alberta SPOR SUPPORT Unit (AbSPORU), and Women's and Children Health Research Institute (WCHRI), and at national/international levels through multiple statistical working groups in national grant teams and multi-centre clinical trials. Our biostatisticians also provide guidance and mentorship to students, residents, and junior clinical researchers.

## Population Health and Economic Outcomes

The CVC Population Health and Economic Outcomes team is actively involved in examining population-level issues related to access, delivery, treatment, and outcomes of heart disease in Alberta and Canada. Health care administrative databases have become a cornerstone in the process of assessing performance and providing feedback to improve quality of health care delivery at a population-level. The CVC has one of the largest repositories of cardiovascular data at the University of Alberta. This repository currently includes data on over 21 million hospitalizations for nearly 5 million Canadians, and data on hospitalizations, outpatient care, medications, and vital status for over 1.3 million Albertans suffering from heart disease over the last decade.

Our team utilizes empirical data from the population-health data repository to develop prediction models to estimate the current and future economic burden of cardiovascular disease on health care systems. In addition to the impact of interventions on mortality and morbidity, there is increasing interest in assessing their impact on patient reported outcomes such as health-related quality of life (HRQoL). Our team has led the examination of HRQoL outcomes for some of the largest multinational cardiovascular clinical trials.

## Artificial Intelligence and Machine Learning

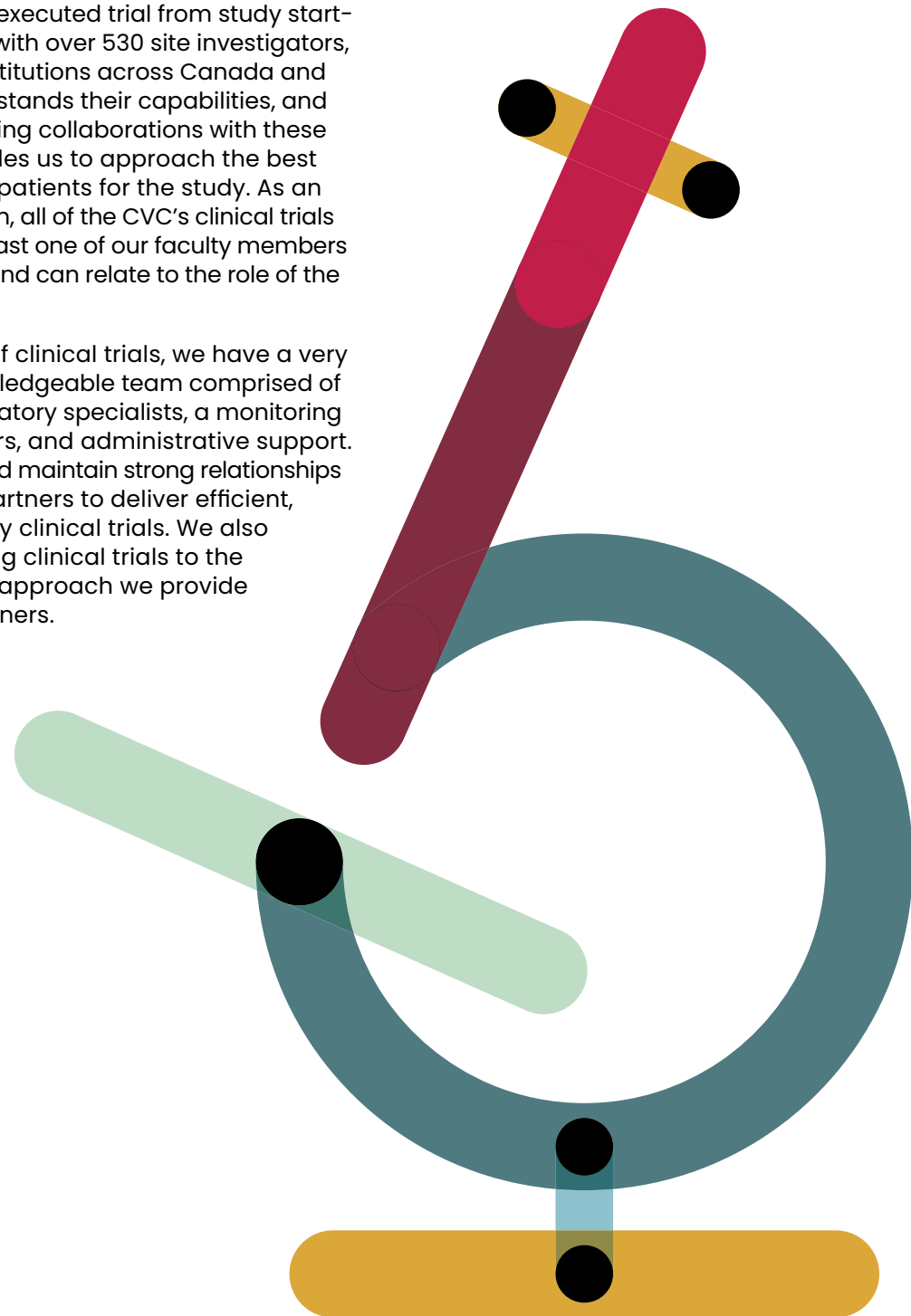
The Artificial Intelligence and Machine Learning (AI/ML) team at the CVC is working with large-scale population level datasets to uncover novel and actionable insights that can potentially assist clinical decision making. To this end, our team develops predictive algorithms with the primary goal of deploying clinician-facing applications to identify high-risk patients at point of care.

Our team applies cutting-edge data science methods, starting from customized data processing pipelines, extensive feature engineering, a variety of conventional and deep learning algorithms, robust model validation schemes, all the way to development of web applications. Our focus is particularly on ML methodology research with strong applications in medicine, such as individualized survival distribution, model fairness, federated learning, and data privacy aspects. Our group serves at the interface between the departments of Computing Science and Medicine at the University of Alberta, as well as with the Alberta Machine Intelligence Institute. We are focused on developing collaborations with national and international partners in academia and industry. Supporting trainees, both local and international (through collaboration with Mitacs), is also a major part of our mandate.

# Clinical Trials

With over 20 years of experience in clinical trial operations for Phase II/III/IV, registry, and investigator-initiated studies, the CVC clinical trials team has the expertise and knowledge to deliver a high quality and well-executed trial from study start-up to closeout. Having worked with over 530 site investigators, representing more than 275 institutions across Canada and internationally, our team understands their capabilities, and has built and maintained ongoing collaborations with these sites. This understanding enables us to approach the best sites who can deliver the right patients for the study. As an academic research organization, all of the CVC's clinical trials include the involvement of at least one of our faculty members who are practicing physicians and can relate to the role of the investigator and site.

Led by our associate director of clinical trials, we have a very experienced, diverse, and knowledgeable team comprised of clinical trial project leads, regulatory specialists, a monitoring lead, regionally-based monitors, and administrative support. Our team works hard to build and maintain strong relationships with our sites, sponsors, and partners to deliver efficient, cost-effective, and high-quality clinical trials. We also attribute our success managing clinical trials to the hands-on, collaborative team approach we provide to our sites, sponsors, and partners.



# ECG Core Laboratory

The CVC ECG Core Laboratory aims to translate research results into clinically relevant applications. Using the electrocardiogram (ECG) – a venerable but powerful biomarker – we can improve understanding of the pathophysiologic processes involved in acute coronary syndromes, thereby enabling not only better prediction of outcomes, but also assessing treatment effectiveness. These insights serve to further stimulate cardiovascular research. Over the past year, we have expanded the target populations of interest to evaluate the ECG characteristics of the VICTORIA trial heart failure population to enhance prognostic insights in this high-risk population.

Our team has a mandate of conducting quality analyses using clinical research data. The Vital Heart Program, led by Dr. Robert Welsh in collaboration with Dr. Kevin Bainey, has used the Core Laboratory to illuminate the timeliness and efficacy of reperfusion therapy in the Edmonton region. Plans are now underway to evaluate the ECG signals from heart attack patients with suspected COVID-19 infection. To date, ECGs from over 100,000 patients enrolled in studies around the world have been analyzed. This provides an excellent database for planning the design of future clinical trial opportunities exploring 'big-data' using an AI/ML approach.

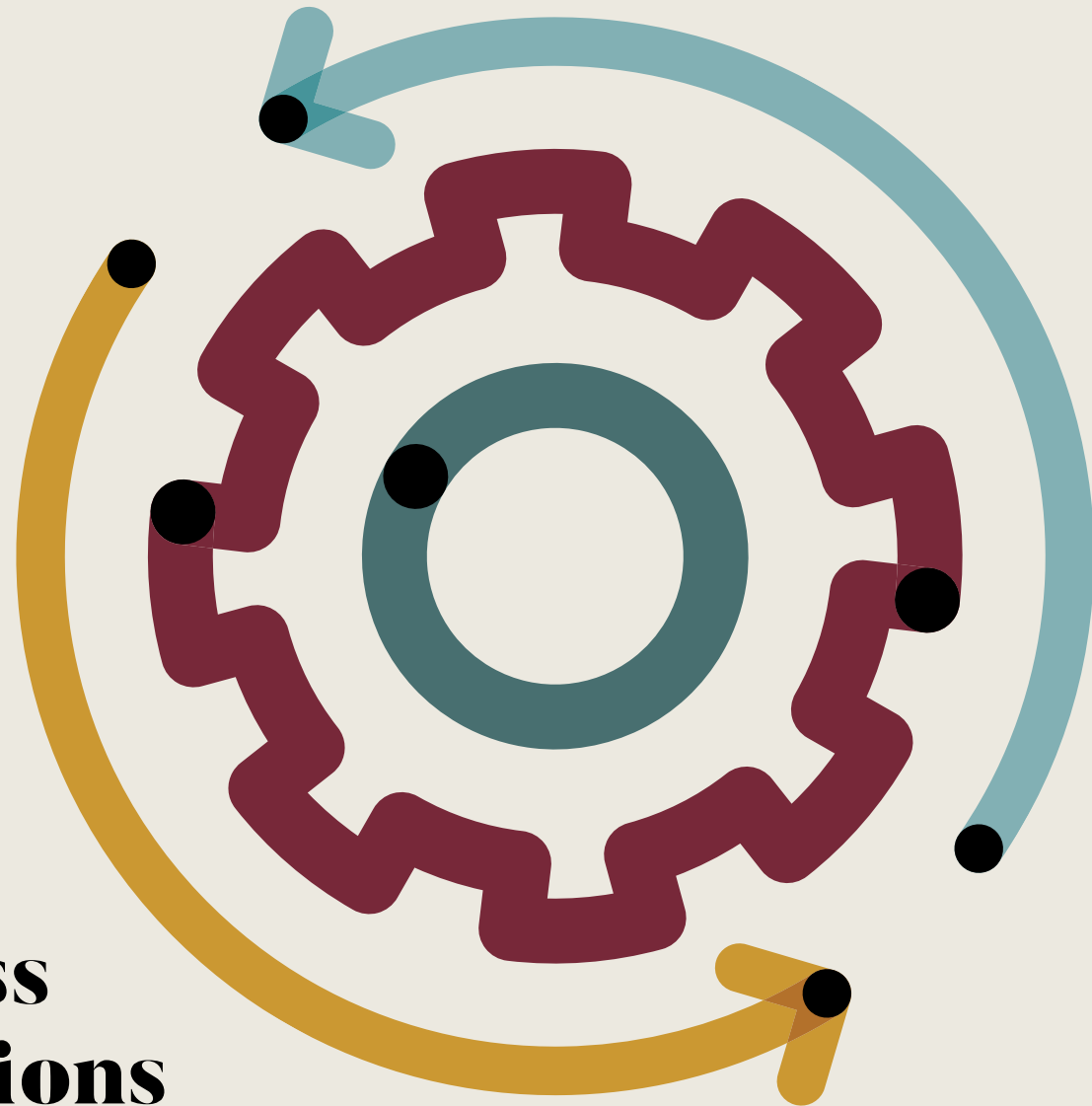


## Business Operations

The business operations group is fundamental to the organizational and financial underpinnings of the CVC. Our knowledgeable team provides expert service and oversees the negotiation and administration of agreements and contracts, budget development, financial operations and accounting, and human resources management. We are also committed to the progress of information systems management, strategic planning, process improvement, and the promotion of learning and development initiatives.

Dynamic communication strategies are a key component of our mandate, as we endeavour to share the CVC's vision and mission with both a local and global audience. Our team is dedicated to developing strong brand awareness by creating and distributing content that promotes our organization's wide array of activities and initiatives. We are responsible for managing the CVC's website, social media portfolio, newsletter, and annual report, and we also provide visual design support to our staff, faculty, and trainees.

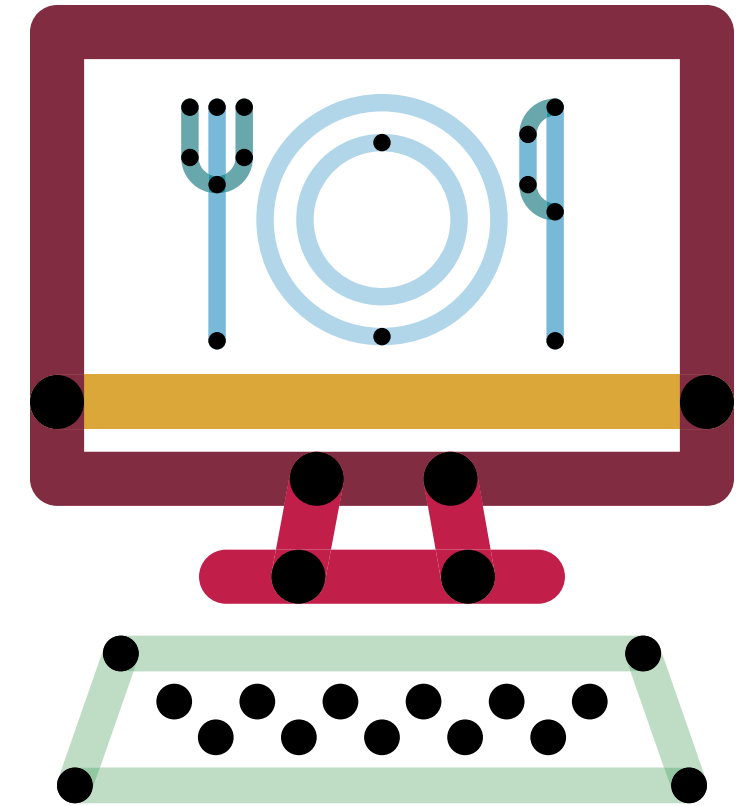
The business operations group plays a key role in leading communications between the CVC and its many institutional partners both within Canada and globally. We are dedicated to upholding these strong partnerships, which are essential to the day-to-day operations of the CVC.



## The Food Record Core Laboratory

The Food Record Core Laboratory is pivotal to the ongoing success of the SODIUM-HF and FEAST-HF trials. Working alongside the project lead for these studies, our team carries out the following activities:

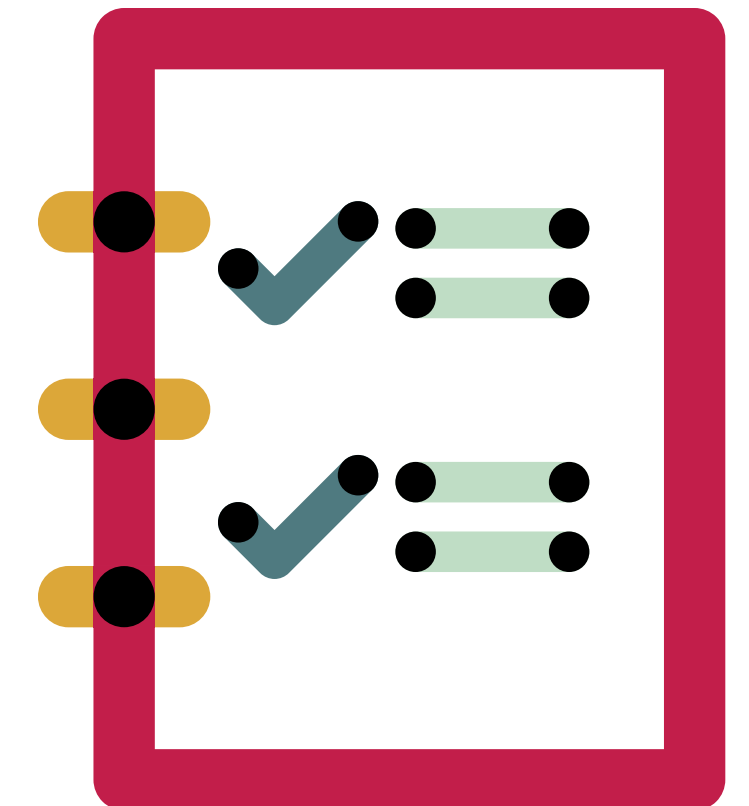
- Receiving, tracking, and analyzing Food Records in Food Processor, a powerful nutrition analysis software.
- Initiating and following up on Food Record queries directly with the site.
- Entering Food Record data (from Food Processor) into REDCap for site access and use.



## Academic Research Administration

The CVC supports investigator-initiated research by acting as a bridge between internal and external stakeholders throughout the research lifecycle. Academic research administration works with CVC Faculty and investigators to develop novel and competitive proposals for local, national, and international funding opportunities.

Advice and support are also provided for budgets, contract negotiations, and reporting for nascent studies. Expertise in the communication and dissemination of knowledge, including effective data visualization, helps to bring the CVC's research endeavors to life and impacts a variety of audiences.



# Collaborators

The CVC has forged strong partnerships with a number of institutions and centres around the world in the pursuit of novel research directions and the advancement of cardiovascular research. The CVC takes great pride in our relationships with these collaborators, who are internationally recognized leaders in the advancement of cardiovascular research.

**APPLIED HEALTH RESEARCH CENTRE, UNIVERSITY OF TORONTO**  
Toronto, Canada

**CHARITÉ – UNIVERSITÄTSMEDIZIN BERLIN**  
Berlin, Germany

**CHINESE UNIVERSITY OF HONG KONG**  
Shatin, Hong Kong

**CHRISTCHURCH HEART INSTITUTE, UNIVERSITY OF OTAGO**  
Christchurch, New Zealand

**CPC CLINICAL RESEARCH**  
Aurora, USA

**DUKE CLINICAL RESEARCH INSTITUTE, DUKE UNIVERSITY**  
Durham, USA

**GREEN LANE COORDINATING CENTRE**  
Auckland, New Zealand

**THE HEART AND STROKE RICHARD LEWAR CENTRE OF EXCELLENCE, UNIVERSITY OF TORONTO**  
Toronto, Canada

**ICAHN SCHOOL OF MEDICINE, MOUNT SINAI**  
New York, USA

**INOVA HEART AND VASCULAR INSTITUTE, INOVA FAIRFAX HOSPITAL**  
Falls Church, USA

**LEUVEN COORDINATING CENTRE, UNIVERSITY OF LEUVEN**  
Leuven, Belgium

**LIBIN CARDIOVASCULAR INSTITUTE, UNIVERSITY OF CALGARY**  
Calgary, Canada

**NATIONAL UNIVERSITY HEART CENTRE, NATIONAL UNIVERSITY OF SINGAPORE**  
Singapore

**PERFUSE STUDY GROUP, HARVARD MEDICAL SCHOOL**  
Boston, USA

**PETER MUNK CARDIAC CENTRE, UNIVERSITY HEALTH NETWORK**  
Toronto, Canada

**POPULATION HEALTH RESEARCH INSTITUTE**  
Hamilton, Canada

**SAMU URGENCES DE FRANCE**  
Pontoise, France

**SOUTH AUSTRALIAN HEALTH AND MEDICAL RESEARCH INSTITUTE**  
Adelaide, Australia

**STANFORD CENTER FOR CLINICAL RESEARCH, STANFORD UNIVERSITY**  
Stanford, USA

**STATENS SERUM INSTITUT**  
Copenhagen, Denmark

**UNIVERSITY MEDICAL CENTER GRONINGEN**  
Groningen, Netherlands

**UNIVERSITY OF MONTREAL**  
Montreal, Canada

**UPPSALA CLINICAL RESEARCH CENTRE, UPPSALA UNIVERSITY**  
Uppsala, Sweden



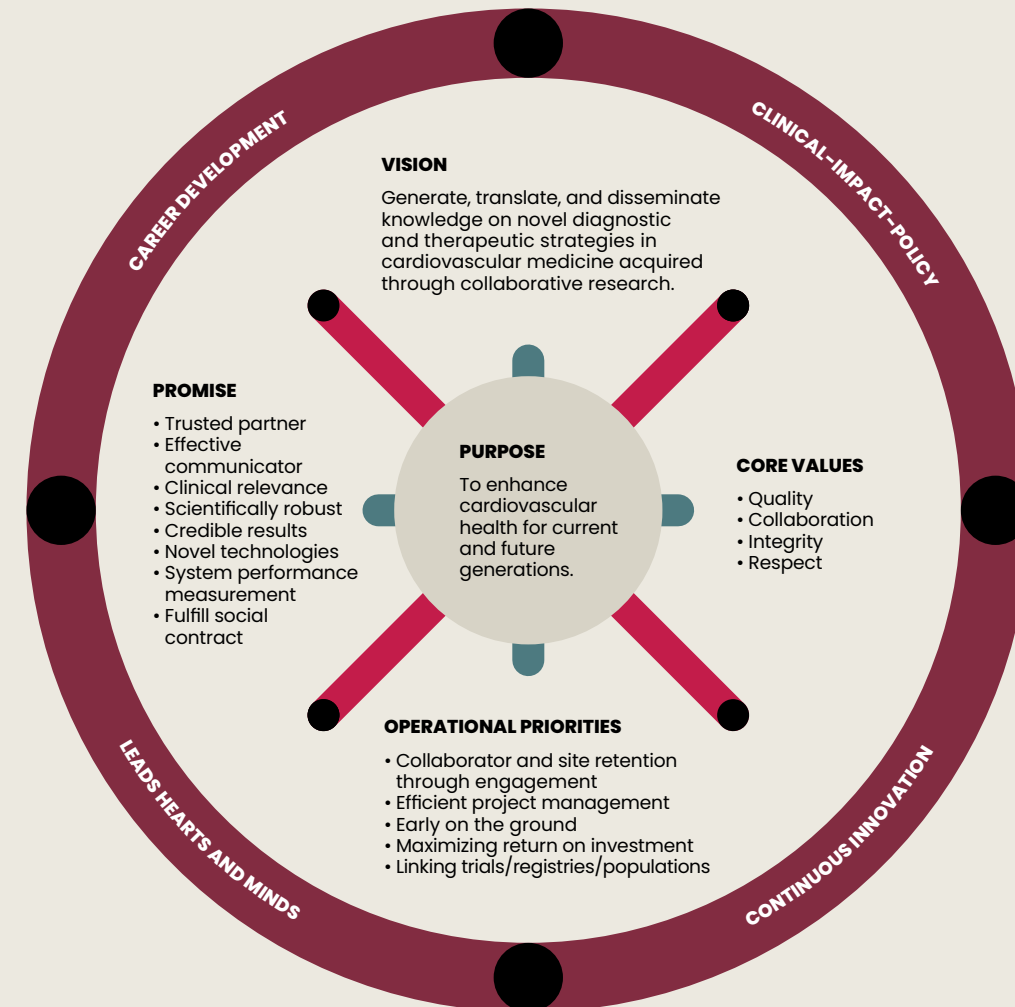
# Closing Message



Annual reports are a fine tradition. Ours at the CVC is a collective effort that stimulates a contemplative look back at some of the prior year's activities. For several years this report was originally published as a tangible booklet that could sit on a side table, the current digital edition (and second of its genre), that you are possibly now reading, may or may not be something you are inclined to download and peruse further at your leisure. Such is the signature of the global shift to virtual publishing.

Why produce an annual report? Certain potential target audiences are obvious to the authors. As an official research centre embedded in the University of Alberta, we at the CVC have reporting relationships and obligations to our President, Provost, Dean, Department and Divisional Heads. To our many national friends and colleagues who participate in patient recruitment, training, and CME events, it serves as a good way to inform and continually engage with them in these socially distant times. So too is this vehicle a reach out to many of our international academic colleagues and key industry partners with whom we collaborate on new ventures aimed at advancing cardiovascular care. At a more local level – as suggested by the theme of this year's report – it is a good and readily digestible way of introducing potential new trainees and employees to who we are and what we do as an organization. Finally, it instills a broader and deeper appreciation of the accomplishments of our work family within the various domains of the CVC; this is a compelling reminder of the unsung contributions of so many key individuals that work behind the scenes to cement the synergies of a great team.

As one pauses to reflect in the rear-view mirror on this past year, it necessarily reasserts the overarching responsibility of leadership to move forward with vision and purpose. There exists a tension between the gratification of past accomplishments and the timeless need to take risks and innovate. The CVC compass crafted several years ago, and depicted herein, continues to provide a healthy vision, mission, and set of core values.



Yet a compass is only good to guide you once a direction has been set. As in ocean sailing, it is one thing to set a direction and quite another to risk exposure to external elements you cannot control such as the weather, the wind direction, the running of the tides, and flow of currents. For me this metaphor is uncannily apt to characterize where we find ourselves today. Navigating to a preferred destination amidst these remarkably disruptive times – unfolding at local, regional, national, and global levels – will test our team's mettle in new and different ways. We at the CVC aim to stay afloat and move forward with tenacity and a passionate commitment to raise all of the boats in the water. Keep a weather eye out for us on our journey and come along for the ride if it beckons.

PAUL W. ARMSTRONG, MD

# The CVC gratefully acknowledges and thanks:

- The patients, for their willing participation in our trials and registries. They are the true heroes of clinical research and we honor their volunteer spirit.
- The CVC faculty, external advisors, and collaborators for their enriching contributions and for providing ongoing research opportunities. We look forward to providing continued support and to future collaborations in advance of our mission.
- The CVC staff and management for their outstanding dedication, professionalism, excellent contributions, and ingenuity, which enhances the quality of our research work.
- Our trainees for their commitment, ideas, and enthusiasm. You are the next generation of researchers and health care providers.
- The sponsors and granting agencies; without their generous financial support our research and educational activities would not be possible.
- The excellent work of our communications group for their time and the dedication required to produce this report.
- The team at AM/FM for the concept and design.





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**UNIVERSITY  
OF ALBERTA**

4-120 Katz Group Centre for Pharmacy and Health Research  
University of Alberta  
Edmonton, Alberta, Canada T6G 2E1