



**Population Health
Research Institute**

HEALTH THROUGH KNOWLEDGE

2019

Tackling Global Health Challenges

Two Decades of Impact

Research Report





Our Team

Research encompassing
1,500,000 participants
on **6** continents in
102 countries



70
scientists, investigators
and research fellows



300
study team staff



100
studies led by PHRI

Messages from the Leadership

“

Entering its third decade, this joint institute of McMaster University and Hamilton Health Sciences embodies a strong culture of inquiry, collaboration and innovation. The high standards maintained by PHRI draw gifted researchers from around the world to Hamilton.”

Patrick Deane
President and Chancellor,
McMaster University



“

Extraordinary science, consistently high-quality research, is happening at Population Health Research Institute. Their innovative and fundamentally important projects are key to the future health of Canadians, and indeed to all citizens of the world.”

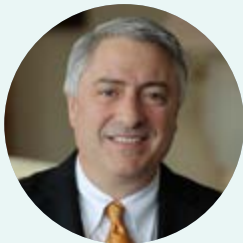
Paul O’Byrne
Dean & Vice-President,
Faculty of Health
Sciences,
McMaster University



“

The research by PHRI has improved clinical practice and disease prevention in Hamilton and Canada.”

Rob MacIsaac
President, Hamilton
Health Sciences



“

I am proud of the impact on health of our studies and of our scientists.”

Salim Yusuf
Executive Director,
Population Health
Research Institute



Our continued gratitude to David Braley for his generous donation to help fund the David Braley Cardiac Vascular Stroke Research Institute building.

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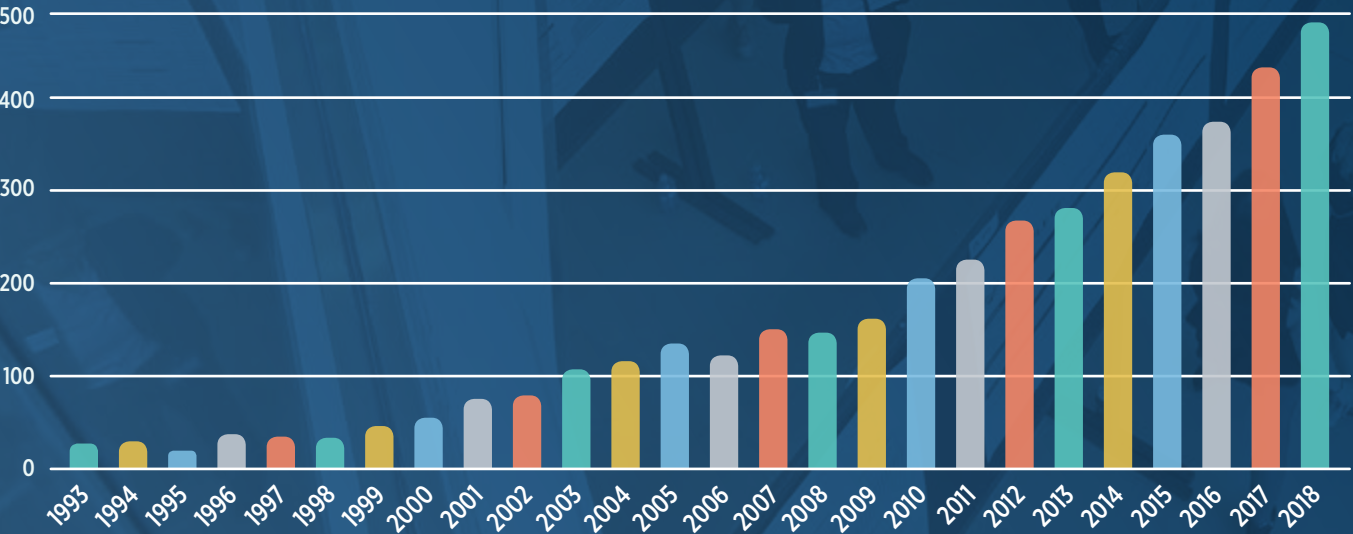
Mission Forward 52

Vital Signs

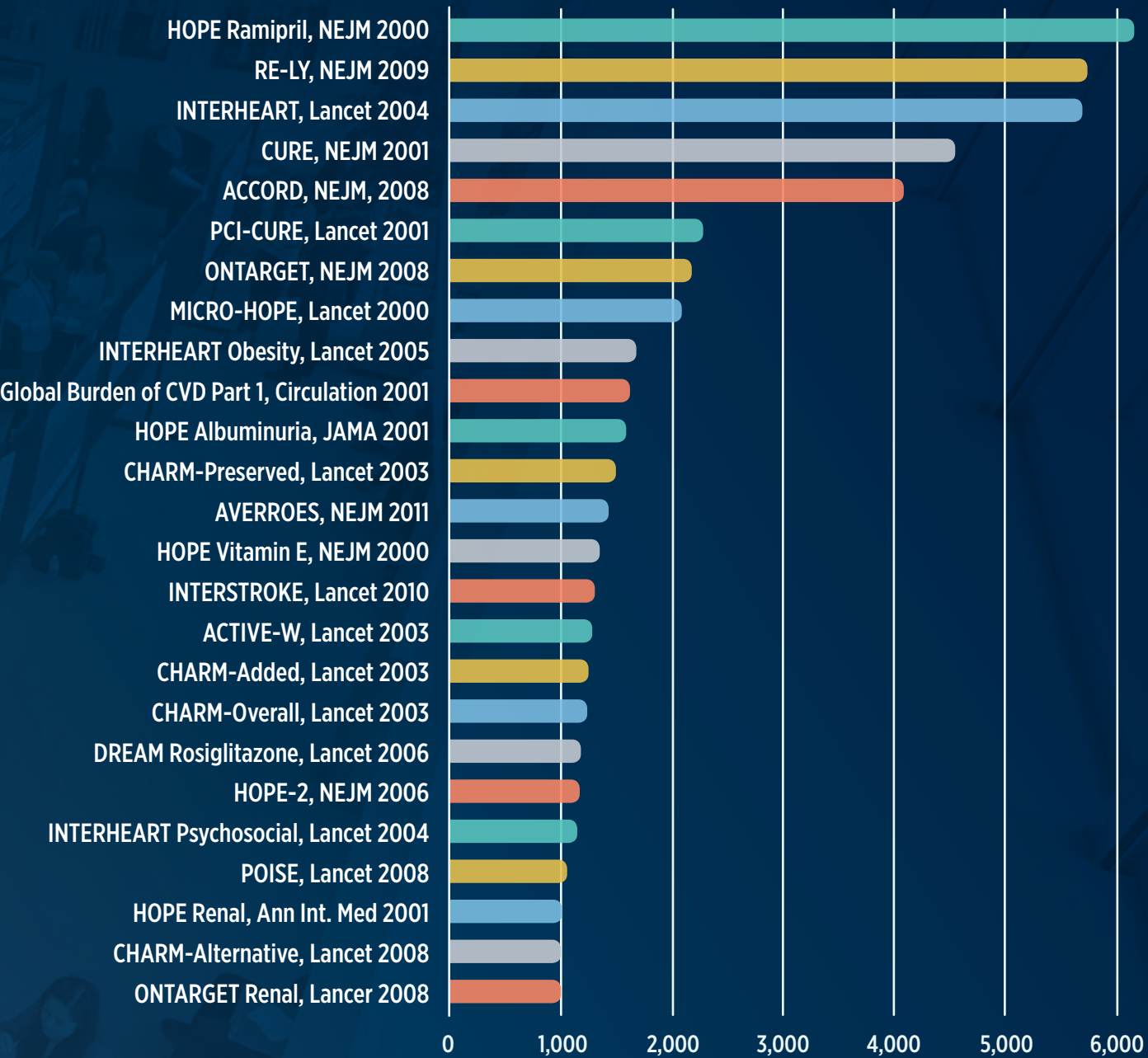
REGULATORY APPROVALS BASED ON PHRI TRIALS

PHRI TRIAL	DRUG	INDICATION
COMPASS	Rivaroxaban	Coronary Artery Disease / Peripheral Artery Disease
ACTIVE	Clopidogrel	Prevention of Vascular Events in Atrial Fibrillation
AVERROES	Apixaban	Prevention of Stroke in Atrial Fibrillation
RE-LY	Dabigatran	Prevention of Stroke in Atrial Fibrillation
ONTARGET / TRANSCEND	Telmisartan	Prevention of Cardiovascular Disease
OASIS-6	Fondaparinux	ST Elevation Myocardial Infarction
OASIS-5	Fondaparinux	Unstable Angina/Non-ST Elevation Myocardial Infarction
OASIS-4	Clopidogrel	Unstable Angina/Non-ST Elevation Myocardial Infarction
RESOLVD / CHARM	Candesartan Metoprolol CR	Heart Failure
HOPE	Ramipril	Secondary Prevention

PHRI IN PUBLICATIONS: 1993 THROUGH 2018



PHRI PAPERS WITH MORE THAN 1,000 CITATIONS



HOPE-3 was named by the *New England Journal of Medicine* as one of the most influential studies of 2016, concluding that heart disease could be prevented by giving healthy seniors a pill to lower their cholesterol. The article was one of the NEJM articles deemed “the most meaningful in improving medical practice and patient care.”

A paper on fat intake from the **PURE** study was number one on Altmetric in 2017, and the physical activity paper related to PURE was in the top 100 in 2017. The PURE dairy paper was in the top 10 for 2018.

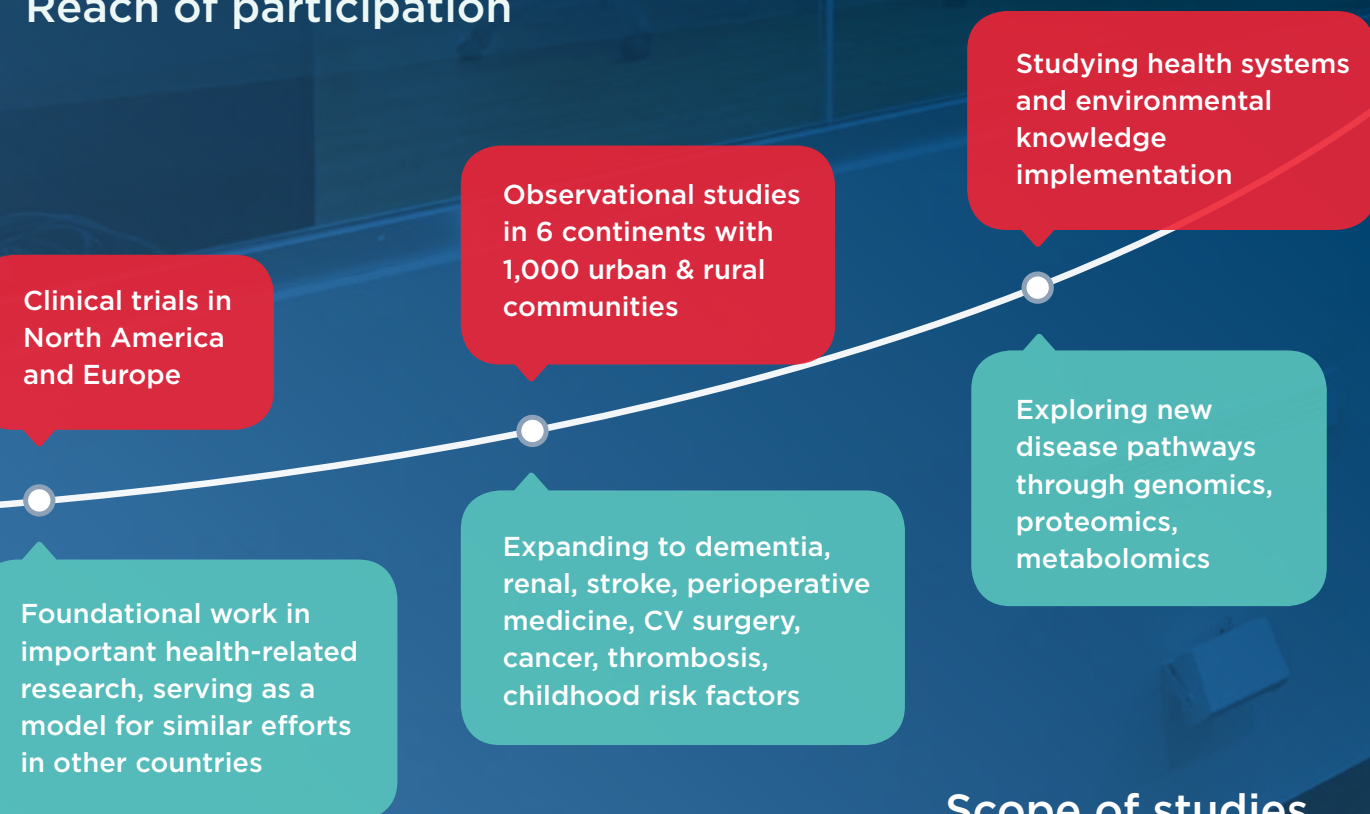
Ahead of the Curve

Our goal is to conduct research that can improve the world's health through transformative discoveries. After first leading the preventive cardiology and therapeutic program for seven years, Salim Yusuf founded PHRI in 1999 to broaden the research agenda.

Key factors behind PHRI's success include an extensive international network of committed collaborators and the wide range of the types of studies conducted, including large and small randomized trials with various designs and large population-based epidemiologic studies in more than 100 countries. These studies have enabled us to answer several questions rigorously.

Our unique Prospective Urban and Rural Epidemiological (**PURE**) study involves studying 200,000 participants in detail, and 500,000 with simple information, from more than 1,000 urban and rural communities in 26 high, middle and low income countries. PURE is investigating the impact of modernization, urbanization and globalization on health behaviours, how risk factors develop and influence cardiovascular disease, diabetes, lung diseases, cancers, kidney disease, brain health and injuries. New ambitious studies document the health status of one million people in Asia.

Reach of participation



Governance of PHRI

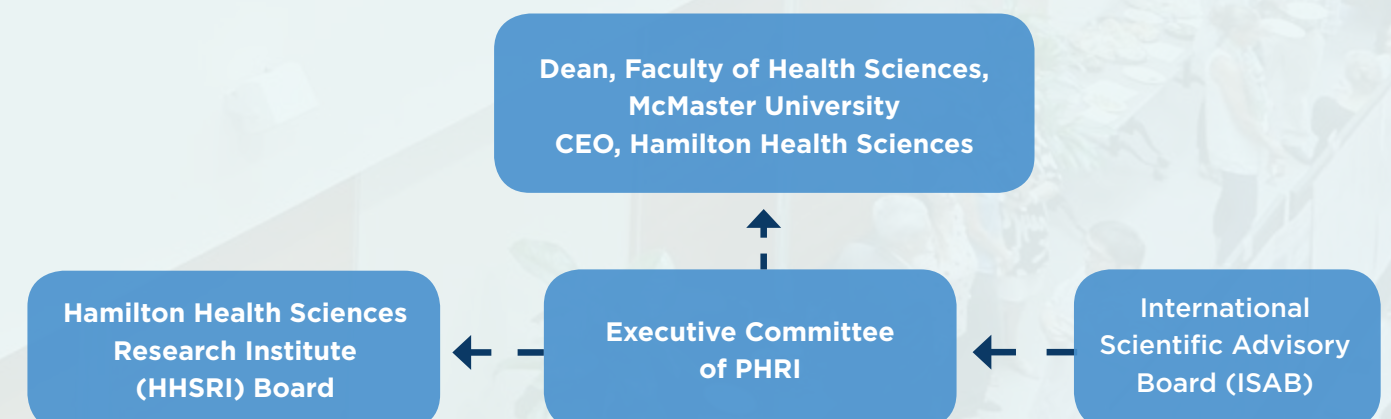
PHRI has two founding organizations, McMaster University, and Hamilton Health Sciences (HHS). As a joint research institute, the Executive Director is responsible to a governing body comprising representatives of PHRI, McMaster and HHS.

In addition, the International Scientific Advisory Board provides scientific and strategic advice. Its members include:

- **Sir Rory Collins**, (Chair), University of Oxford, UK
- **Dr. Alan Bernstein**, (Co-Chair), Canadian Institute for Advanced Research
- **Dr. Robert Califf**, Duke University, USA
- **Dr. Mark Lathrop**, McGill University, Canada
- **Lord Ajay Kakkar**, University College London, UK
- **Dr. Alan Lopez**, University of Melbourne, Australia
- **Dr. Sudha Seshadri**, UT Health San Antonio, USA

The board of Hamilton Health Sciences Research Institute (HHSRI) provides stewardship of the PHRI Research Endowment. HHSRI is comprised of:

- **Craig Laviolette**, (Chair), VP, Siemens Canada
- **Rob MacIsaac**, CEO, Hamilton Health Sciences
- **Paul O'Byrne**, Dean and VP, Faculty of Health Sciences, McMaster University
- **Marvin Ryder**, Asst. Prof., Marketing, McMaster University
- **Akbar Panju**, Professor, Medicine, McMaster University
- **Robert Jones**, former Chair of Board, HHS



“

Use of rivaroxaban, a new antithrombotic treatment, reduces heart attacks, strokes, amputations and death in patients with coronary artery disease or peripheral artery disease.”

- Stuart Connolly,
Senior Scientific Lead



Setting the COMPASS

The **COMPASS** trial, involving 26,997 patients with coronary artery disease or peripheral artery disease, showed that rivaroxaban plus aspirin lowered the risk of serious vascular events, including stroke, limb amputation and death — three of the most feared complications of atherosclerotic vascular disease. These findings represent major advances for patients.

COMPASS co-investigators Stuart Connolly, Jackie Bosch, John Eikelboom, Sonia Anand and Salim Yusuf, were joined by stroke researchers Robert Hart and Mike Sharma on **COMPASS-MIND**. That study's results found that low-dose rivaroxaban plus aspirin is effective for primary and secondary stroke prevention in patients with clinical atherosclerosis.



- Rapid approval of rivaroxaban by regulators around the world



- 602 hospitals and clinics in 33 countries



- Approvals by regulatory agencies worldwide of the use of apixaban and dabigatran for the prevention of stroke in patients with atrial fibrillation



- Thrombosis and Atherosclerosis Research Institute (TaARI)
- Canadian Venous Thromboembolism and Outcomes Research Network (CanVECTOR)
- COMPASS network of cardiologists, internists, hospitalists, vascular physicians and surgeons
- INTERBLEED Network of Gastroenterologists



Reducing Bleeding

“

Can we prevent clots without increasing bleeding?”

– John Eikelboom, Senior Scientist

Thrombosis causes one in four deaths in Canada, and kills about 10 million people a year globally. Antithrombotic drugs prevent and treat venous thromboembolism, acute coronary syndromes and stroke. Not all patients benefit equally from drug treatment; wide variations in the levels of active drug could result in under-dosing in some patients (thereby not being effective) and overdosing in others (causing bleeding). Can we avoid both these situations and hit a ‘sweet spot’ to improve patient outcomes?

In the **ACTIVE-A** study, Stuart Connolly and Salim Yusuf found that giving clopidogrel plus aspirin to patients with atrial fibrillation, for whom vitamin-K antagonist therapy was unsuitable, reduced major vascular events, especially stroke, but increased major hemorrhage.

In the subsequent **RE-LY** and **AVERROES** studies, Connolly, Eikelboom and Yusuf proved that the new oral anticoagulants, dabigatran and apixaban, were more effective than conventional anticoagulation (warfarin) or aspirin in preventing strokes in patients with atrial fibrillation and with less intracranial bleeds.

Antithrombotic drugs cause bleeding and avoiding this is as important as avoiding a heart attack or stroke. In **INTERBLEED**, Eikelboom is exploring whether we can separately identify risk factors that predict bleeding and others that predict stroke, in order to tailor antithrombotic therapy to the patient’s risk for either condition.



Silent But Deadly

Atrial fibrillation (AF) is the leading cause of disabling stroke among older adults. Using advanced monitoring with smartphone apps, Stuart Connolly and Jeff Healey showed that many older individuals with cardiac conditions have 'silent' or subclinical atrial fibrillation (SCAF).

How should we treat SCAF? Healey's international trial, **ARTESiA**, of 4,000 patients is evaluating whether apixaban will prevent strokes in SCAF patients, without increasing bleeding.

The large Canadian community cluster trial, **C-CUSP (ED)**, is evaluating Emergency Department efforts to improve stroke prevention and stroke treatment in AF patients who visit the emergency department.

“Can treating people with silent atrial fibrillation improve outcomes?”

– Jeff Healey, Senior Scientist



- Canadian Stroke Prevention Intervention Network (C-SPIN)
- AF-SCREEN International Collaboration: 37 countries on six continents



- Novel oral anticoagulants (NOACs) established for treating AF
- First global registry, **RE-LY AF**, identifying regional differences in AF
- Ongoing global study, **PURE-AF**, to examine risk factors for incident AF
- **SIMPLE** study changed Canadian clinical guidelines to eliminate defibrillation testing at the time of ICD insertion; thousands of dollars saved while avoiding perioperative complications



Reversing Type 2 Diabetes

Increasing in every country and affecting about 500 million people worldwide, diabetes is a major risk factor for death and a wide variety of serious diseases. Hertzell Gerstein has led several large studies, including **MICRO-HOPE**, **DREAM**, **ACCORD**, and **ORIGIN**, to find out how heart attacks, strokes, deaths, kidney disease and other consequences can be prevented in people at low and high risk for cardiovascular diseases.

The **REWIND** trial, involving about 10,000 patients in 24 countries, has determined that dulaglutide (a GLP-1 inhibitor) reduced cardiovascular outcomes. With the **REMIT** series of trials, Gerstein will determine whether combinations of medications and lifestyle approaches will put diabetes into remission.

“Diabetes may not have to be ‘forever.’ If we can put type 2 diabetes into remission, we will dramatically improve life for millions of people.”

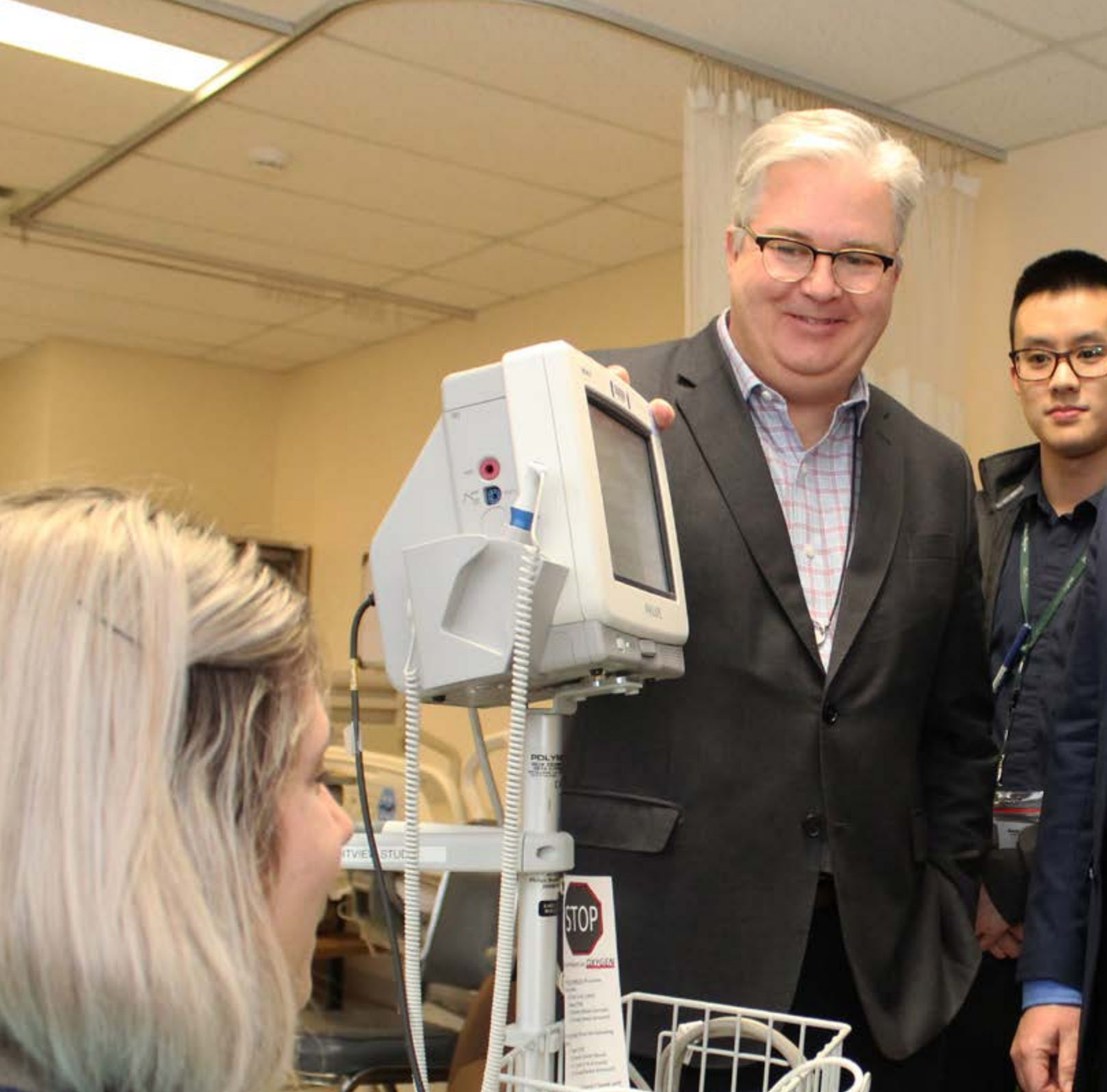
– Hertzell Gerstein, Senior Scientific Lead



- TaARI and McMaster University to investigate cellular mechanisms of diabetes on blood vessels and relationship to CVD
- Basic scientists at McMaster University elucidate the mechanisms through which biomarkers identified in PHRI studies affect diabetes
- Researchers from 30 countries collaborate on diabetes trials and epidemiology studies



- ACE-inhibitors reduce mortality and CVD in people with diabetes
- Therapies to prevent diabetes
- Long-term cardiovascular safety of injected insulin



Halving Perioperative Risk

Modern surgery is very safe, and very few people die during the procedure. Virtually all surgery-related deaths happen within the next 30 days. In the **VISION** study of 40,000 noncardiac surgery patients, PJ Devereaux found that about 2% of patients died in that period of time. A quarter of those deaths occurred after discharge from hospital. Most of those deaths resulted from cardiovascular causes – which was more common than serious infection. About 6% of patients had complications in the first month after surgery and required readmission to hospital.

We believe postoperative deaths and complications can be cut in half, with continuous monitoring in patients' homes as well as in surgical wards. Devereaux and Michael McGillion's **SMarTVIEW** trial assesses whether

monitoring patients who have undergone surgery using a Philips Bluetooth-enabled blood pressure cuff, thermometer, pulse oximeter and weigh scale connected to a computer tablet will detect early signs of potential complications and will allow rapid and early interventions. The **VISION-2** trial focuses on collecting continuous biometric data on 20,000 patients after surgery with a wearable device that measures vital signs. Advanced data analytic methods using algorithms can then alert clinicians.

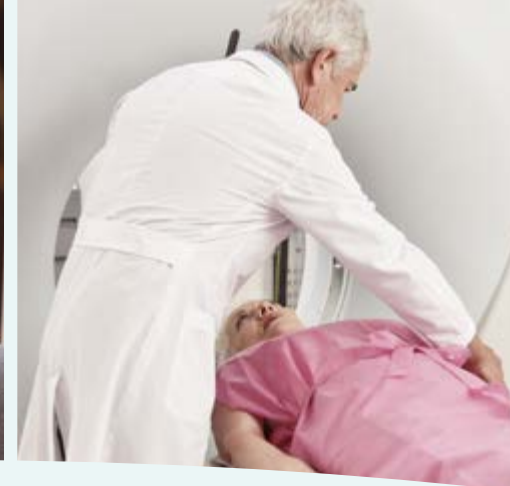
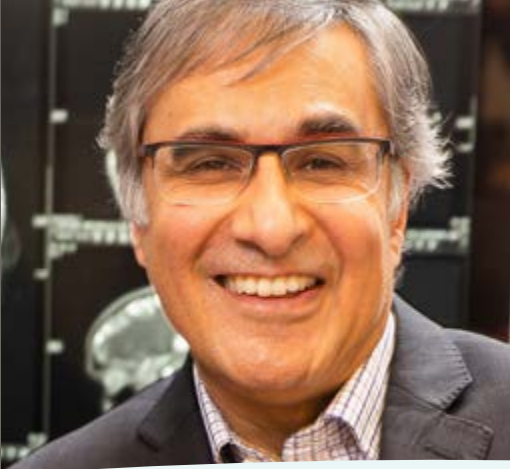
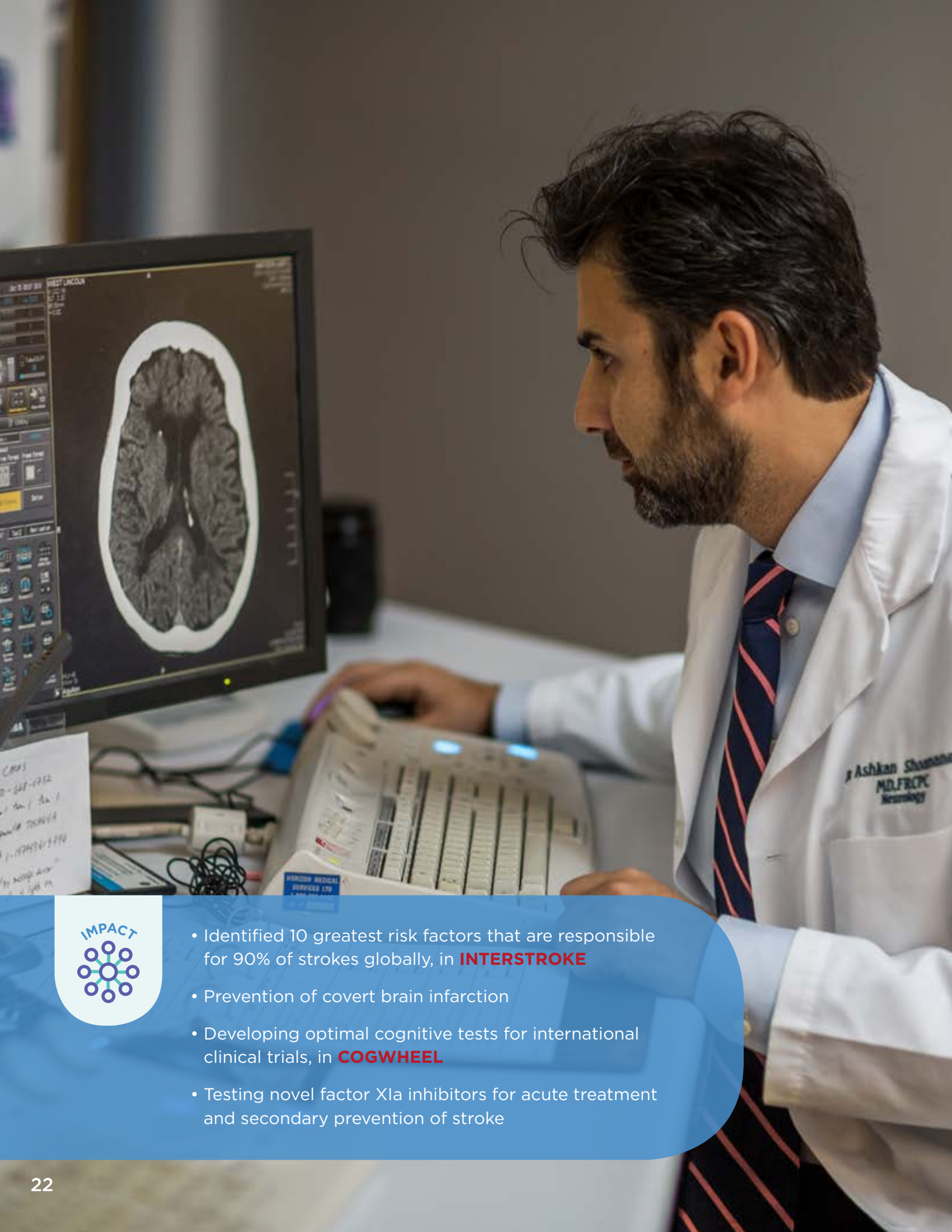
In the area of surgery, Richard Whitlock is seeking to determine if removing the left atrial appendage can reduce stroke and other complications, on top of usual therapy, in 4,700 patients in 27 countries, in the **LAAOS III** trial.



- A simple blood test (Troponin T) can identify patients with heart injury after surgery that puts them at high risk of death and recurrent heart complications, in the **VISION** study
- The blood thinner, dabigatran, reduced deaths, heart attack, stroke and other vascular complications in patients who suffered a heart injury following major, non-cardiac surgery, in the **MANAGE** study of patients with elevated troponin



- Reducing Global Perioperative Risk - online resource center with *American Journal of Medicine*, *American Journal of Cardiology*, and *Canadian Journal of Cardiology*



Brain Health

Stroke and cognitive decline are more common as populations age. One of dementia’s underlying culprits is brain ischemia, which causes damage due to reduced blood flow, but does not cause an obvious stroke.

PURE-MIND involves 5,000 people in Canada, India, Poland and China to determine the prevalence, natural history, genetic and environmental determinants and consequences of covert brain ischemia and silent brain infarction.

With advanced brain imaging, we have discovered that four in 10 patients with atrial fibrillation have clinically unrecognized brain infarcts even when they do not have an obvious stroke.

Ashkan Shoamanesh is looking at cerebral microbleeds as part of our **NAVIGATE ESUS** trial involving 7,000 people in 31 countries. That study explores the prevention of stroke and systemic embolism in patients with a recent stroke that are embolic but with no clear source of an embolus.

“ We’re going beyond preventing the obvious effects of stroke [increased death and immobility] to better understand how cerebrovascular diseases affect thinking and memory.”

– Robert Hart, Senior Scientific Lead



- Identified 10 greatest risk factors that are responsible for 90% of strokes globally, in **INTERSTROKE**
- Prevention of covert brain infarction
- Developing optimal cognitive tests for international clinical trials, in **COGWHEEL**
- Testing novel factor XIa inhibitors for acute treatment and secondary prevention of stroke



- **INSPIRE**, the first large stroke registry in a developing country (India) with PHRI International Fellows Denis Xavier and Martin O'Donnell
- Canadian Hemorrhagic Stroke Trials Initiative (CoHESIVE)
- Canadian Stroke Consortium



- Dual antiplatelet therapy (clopidogrel + aspirin) prevents recurrent heart attacks, in **CURE**
- Fondaparinux as effective as low-molecular heparin and halved bleeding, in **OASIS 5**
- A radial approach for vascular access is as effective as a femoral approach, yet causes fewer complications and better clinical outcomes, in **RIVAL**
- Early coronary intervention benefits high-risk patients, in **TIMACS**



Preventing Deaths After Heart Attacks

“ More people survive heart attacks today with coronary interventions, novel drugs and technologies like advanced imaging and safer stents - but we can do better.”

– Shamir Mehta, Senior Scientific Lead

We have spent two decades focusing on how, when and where to best treat heart attacks, a form of acute coronary syndromes (ACS).

In the **COMPLETE** study, Shamir Mehta is determining whether we should open only the blockage causing a heart attack, or whether

opening other coronary arteries, which are narrowed, would improve patient outcomes.

Sanjit Jolly is evaluating anti-inflammatory and aldosterone-blocking drugs in ACS patients in the **CLEAR SYNERGY** trial. It is the ninth in the **OASIS** series of large trials assessing strategies to improve outcomes in acute ischemic syndromes.

The **EPIC-STEMI** trial evaluates whether acute and rapid lowering of LDL cholesterol, using a novel, injectable cholesterol-lowering monoclonal antibody, is feasible and safe to administer in patients after a heart attack.



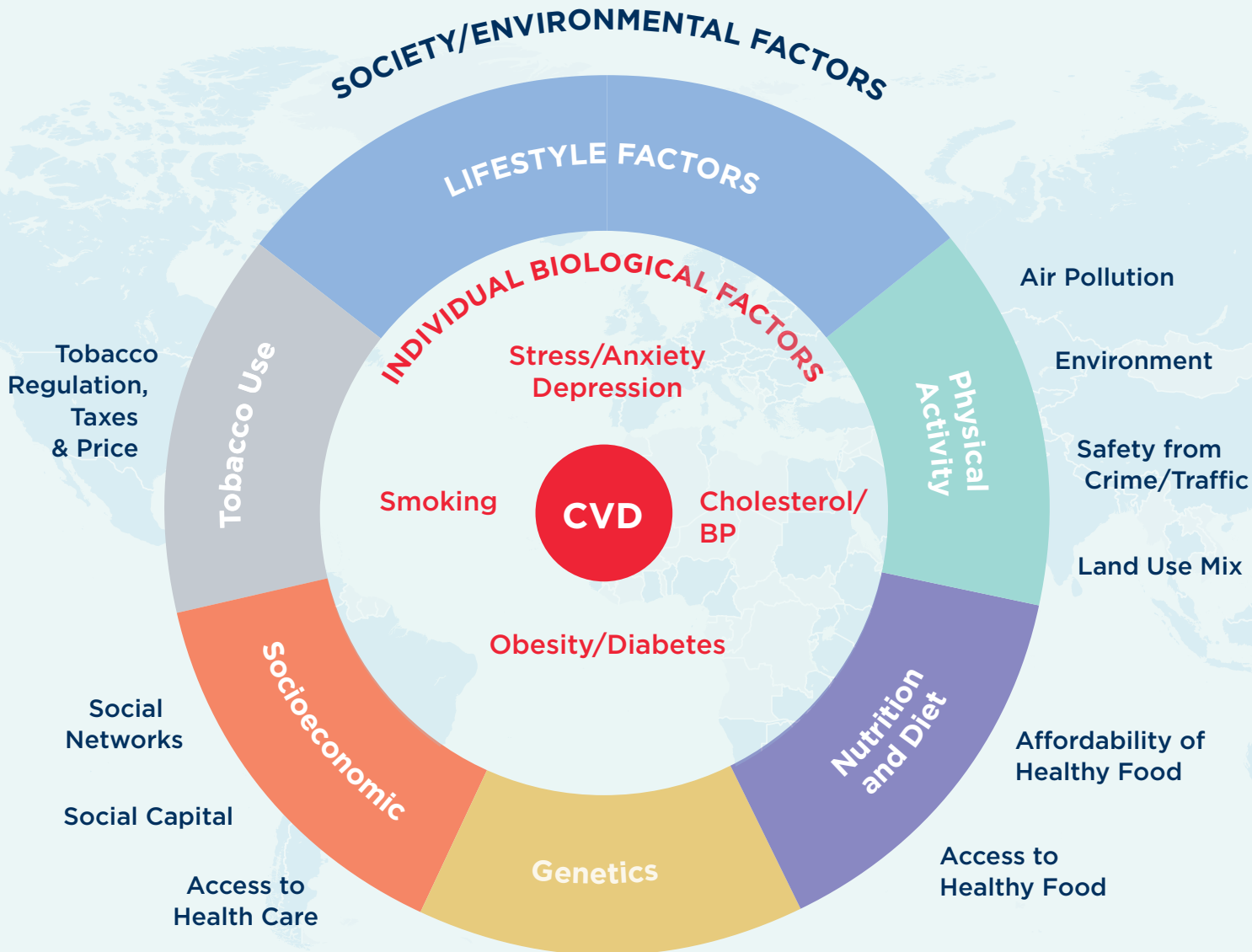
- Canadian Cardiovascular Society
- Heart and Stroke Foundation of Canada
- Canadian Association of Interventional Cardiology
- Heart failure and CVD prevention teams within PHRI



PURE World

Since 2002, PHRI has been leading the Prospective Urban and Rural Epidemiological (**PURE**) study - the only prospective study examining simultaneously the influence of societal, behavioural and genetic influences on the development of risk factors and a number of chronic diseases affecting adults (cardiovascular diseases, cancers, respiratory diseases). Early findings from PURE have demonstrated that a large proportion of patients who can benefit from proven and

simple therapies did not receive them, especially if they were from poorer countries. Therefore the large differences in death rates between the poor and the rich countries were likely due to differences in health care, rather than differences in risk factors. This identifies practical opportunities to improve health by the greater provision of simple but effective treatments.



- London School of Tropical Medicine and Hygiene (Martin McKee on health systems)
- University of British Columbia and Oregon State University (Michael Brauer and Perry Hystad on air pollution) on **PURE-AIR**
- National University of Ireland Galway and University of Calgary (Martin O'Donnell and Eric Smith) on cognition in **PURE-MIND**
- Universities in 26 countries



Dietary Dialogue

What and how much to eat are complicated questions. We have spent the last two decades conducting the world's most extensive study on diet and health. Andrew Mente and Mahshid Dehghan have analyzed the food intake data of 250,000 people from 50 countries in Africa, North America, Europe, South America and Asia, in PURE and several other studies.

They have found that increased consumption of both saturated and unsaturated fats is associated with a lower risk of death. The impact of fats and carbohydrates on blood lipids was also studied in PURE, showing that LDL cholesterol is not reliable in predicting effects of saturated

fat on future cardiovascular events. As well, they found that dairy intake is associated with lower cardiovascular disease and mortality, irrespective of the type of dairy product or the amount of fat.

PURE also showed that consumption of fruit and vegetables is low worldwide, particularly in low-income countries, and that three daily servings of fruits, vegetables and legumes are related to lower mortality. PURE also shows that the optimal intake of sodium is between 3 and 5 grams per day (1½ to 2½ teaspoons of salt).

“

Food guidelines have been based largely on Western populations, but do they apply to people from other countries where under-nutrition is the major problem.”

– Andrew Mente, Scientist, Global Health

“

Large parts of the world face the combined challenges of poverty-related infectious diseases and undernutrition, epidemics of heart disease, stroke, diabetes, cancers, and poorly developed health systems.”

– Salim Yusuf, Executive Director



Global Health

The **TIPS-3** study evaluates whether the polypill could have a large impact on cardiovascular disease. We are making progress in treating neglected heart diseases on several continents, such as tuberculous pericarditis which affects about one million people, half of whom die within a year after diagnosis. In the **IMPI** study across eight Sub-Saharan nations, we tested whether steroids and a novel vaccine might help.

In the **BENEFIT** study, we demonstrated that benznidazole, a commonly used drug for Chagas disease, was ineffective in chronic Chagas disease.

Rheumatic heart disease (RHD) affects six million people (mostly children and young adults) and causes about 330,000 deaths each year. In the **REMEDY** and **INVICTUS** registries of patients with RHD, we are studying 20,000 people from 30 countries to understand complications and deaths. Also in INVICTUS, we are evaluating whether a new oral anticoagulant, rivaroxaban, will be as effective and safe as warfarin in preventing stroke or systemic embolism in 4,500 patients with rheumatic valvular heart disease and atrial fibrillation. The **OSCAIL** study looks at the effectiveness of low-cost post-stroke rehabilitation programs in Africa and India.



- Developed the 4-drugs-in-1 'polypill'
- PURE showed that weak health systems and access to care were responsible for the higher mortality in low-income countries



- Working with governments in Asia and Africa, we have developed systems for surveillance of risk factors, health behaviours, disease incidence and mortality in nationally representative populations. This approach has the potential to serve as a model for countries where reliable statistics on deaths, diseases and risk factors are not available.



“

The best care for patients is the main goal of our research. We're looking at how to put evidence-based medicine into practice with novel but inexpensive technologies.”

- JD Schwalm, Investigator



Research into Action

Many people who have had a heart attack do not receive effective treatments, so we are developing interventions to improve the use of low-cost, effective treatments in Canada and many other countries. In Ontario, we are investigating whether repeated educational reminders - delivered via post and phone - will improve medication adherence and attendance at cardiac rehabilitation, in the **ISLAND** study.

Locally, we use existing registries to implement and evaluate interventions to improve patient adherence

to cardiovascular secondary prevention medication (**MIPAD**), and to optimize the use of invasive cardiac investigations (**CarDIA**). We are exploring if remote monitoring technologies, after surgery, in patients' homes, improves efficiencies in care and quality of life in **REdireCT TAVI**. We are partnering with a local outreach program (**HAMSMART**) to develop programs that provide care to vulnerable populations.



- WHO's Hearts Implementation Package adopted the non-physician health worker training curriculum from **HOPE-4** and **ISLAND**
- Improved medication/cardiac rehab adherence post-MI
- Optimizing use of angiography in our region



- Thirty communities and six academic institutions in Colombia, Malaysia, the UK and Canada
- Knowledge Translation Canada, Women's Health College, University of Toronto, Ottawa Hospital Research Institute, University of Ottawa
- Government agencies and hospital corporations in Ontario
- Centre for Evidence-Based Implementation in Hamilton



Health Starts Early

We study children, starting at birth, to better understand how diet, exercise, and other health and lifestyle behaviours affect people as they grow up. Koon Teo leads our long-running birth cohort study, **FAMILY**, which investigates if the mother's lifestyle and health behaviours (diet and exercise) in childhood determines the development of risk factors in adolescence and early adulthood.

Sonia Anand is studying South Asian babies and their mothers in Canada in the **START** study, comparing them with babies born in urban and rural India, to understand why South Asians are at greater risk of developing abdominal obesity and type 2 diabetes when they live in more urbanized settings. Obesity may be programmed early, and is likely influenced by both genetics and very early environment when the baby is in the uterus.

More than a third of the pregnant women in the START study had gestational diabetes mellitus (GDM). This has led Russell De Souza to study whether delivering lifestyle advice for exercise or healthy diet using text messaging can prevent diabetes in high-risk pregnant South Asian women, in the **DESI-GDM Digital** study.

The Aboriginal birth cohort study, **ABC**, examines the impact of in-utero and early childhood environments on childhood obesity and metabolic disorders in Aboriginal people in Canada.

Katherine Morrison is monitoring overweight children's responsiveness to treatments, to identify potential obesity phenotypes, in the Canadian Pediatric Weight Management Registry (**CANPWR**).

“ Childhood factors affect the health of people throughout their lives.”

– Sonia Anand, Senior Scientific Lead



Nature or Nurture?

How much do each of genetics, environment and behaviour matter when it comes to health? This crucial question is under the microscope at our Genetic and Molecular Epidemiology Laboratory (GMEL). Guillaume Paré and his team are exploring the genetic risk of heart attacks, strokes, obesity and dementia. They have discovered key genes and biological pathways involved in such late-onset diseases as heart disease, kidney disease and stroke. The GMEL has also helped establish the clinical importance of polygenic risk scores in individuals with premature heart attacks.

Paré is studying whether patients' response to certain antithrombotic drugs depends on the person's genes or their health behaviours. The GMEL uses several advanced platforms to analyze the whole genetic structure

and a large number of proteins and other markers of metabolism in blood of a large number of people. Analyzing samples of serum and genetic material we've banked, collected from 300,000 people in our studies from across the globe combined with advanced data analysis methods, will shed new insights into the causes of several chronic diseases.

The lab has next-generation sequencers, two genotyping platforms that enable typing as many as five million genetic variants per DNA sample, a proteomics platform measuring more than 1,000 proteins per sample, as well as DNA methylation and gene expression analysis, and more than 200 terabytes of data processed using computer and bioinformatics infrastructure.



- Identified genetic determinants of bleeding risk with the novel anticoagulant dabigatran in the **RE-LY** study
- Identification of CSF1 and CXCL12 as causal mediators of coronary artery disease in the **ORIGIN** study
- Mendelian randomization showed that diabetes causes coronary heart disease. We have also shown that HER2 is likely a mediator of the protective effect of ACE inhibitors on kidney function, in ORIGIN



- RHDGen, a rheumatic heart disease genetics consortium in Africa, to identify why siblings of those people with RHD are at higher risk of also suffering from the condition
- International Stroke Genetics Consortium, and the SCALLOP consortium, which share information on protein biomarkers that cause diseases

“ Genomics will enhance the predictiveness of clinical risk factors and improve prevention of diseases.”

– Guillaume Paré, Director, Genetic and Molecular Epidemiology Laboratory



Many Minds, One Goal

We have developed an extensive network of investigators, at 1,600 sites in 102 countries, who are our “boots on the ground.” This network, led by experts in each of these countries, enables us to rapidly conduct large, global studies. Their scientific leadership and close oversight of trial conduct in each country is critical to ensuring the high quality of our studies.

Leaders in our network collaborate closely with several of the world’s leading health organizations, governments, and industry. This means that our discoveries help to shape and influence global health policies.

These are highly productive, independent researchers who have extensively collaborated with, or have trained for several years at PHRI.

PHRI SENIOR INTERNATIONAL FELLOWS

- Colin Baigent**, University of Oxford, Oxford, UK
- Rafael Diaz**, Instituto Cardiovascular Buenos Aires, Buenos Aires, Argentina
- Hans-Christoph Diener**, University of Essen, Essen, Germany
- Bernard Keavney**, University of Manchester, Manchester, UK
- Scott Lear**, Simon Fraser University, Vancouver, Canada
- Johannes Mann**, Ludwig Maximilians University of Munich, Munich, Germany
- Martin McKee**, London School of Hygiene and Tropical Medicine, London, UK
- Martin O'Donnell**, National University of Ireland Galway, Republic of Ireland
- Prem Pais**, St. John's Research Institute, Bangalore, India
- Srinath Reddy**, Public Health Foundation of India, Delhi, India
- Dan Sessler**, Cleveland Clinic, Cleveland, USA
- Karen Sliwa**, University of Cape Town, Cape Town, South Africa

PHRI INTERNATIONAL FELLOWS

- Alvaro Avezum**, Hospital Alemao Oswaldo Cruz, San Paulo, Brazil
- Bruce Bicard**, University of Cape Town, Cape Town, South Africa
- Tali Cukierman-Yaffe**, Tel Aviv University, Tel Aviv, Israel
- Clara Chow**, University of Sydney, Sydney, Australia
- Perry Hystad**, Oregon State University, Oregon, USA
- Ganesan Karthikeyan**, All India Institute of Medical Science, Delhi, India
- Dorairaj Prabhakaran**, Public Health Foundation of India, Delhi, India
- Sadeesh Srinathan**, University of Manitoba, Winnipeg, Canada
- Wojciech Szczeklik**, Jagellonian University, Krakow, Poland
- Denis Xavier**, St. John's Research Institute, Bangalore, India

LEARNING FROM INTERNATIONAL EXPERTS

We have established four prestigious international lectureships in different areas of health research.

Annual **Arnold L. Johnson Memorial Lectureship in Cardiology**

2018:	Robert A. Harrington , Stanford University, Stanford, USA
2017:	Sir Rory Collins , University of Oxford, Oxford, UK
2016:	Milton Packer , Baylor University Medical Center, Dallas, USA
2015:	Hugh Watkins , British Heart Foundation Centre of Research Excellence, Imperial College London, London, UK
2014:	John McMurray , University of Glasgow, Glasgow, Scotland
2013:	Eugene Braunwald , Harvard Medical School, Cambridge, USA
2012:	Thomas D. Lüscher , University Hospital Zurich, Zurich, Switzerland
2011:	Harry R. Buller , Academic Medical Center, Amsterdam, The Netherlands
2010:	Marc Pfeffer , Brigham and Women’s Hospital, Boston, USA
2009:	Peter Sleight , John Radcliffe Hospital, Oxford, UK
2008:	Robert Hart , University of Texas Health Science Center, San Antonio, USA
2007:	John Camm , St. George’s Hospital, London, UK
2006:	Terrence Montague , University of Montreal, Montreal, Canada
2005:	Sir Richard Doll , University of Oxford, Oxford, UK
2004:	Philip James , International Obesity Task Force, London, UK
2001:	Sir Richard Peto , University of Oxford, Oxford, UK
2000:	Richard Horton , The Lancet, London, UK
1999:	Robert Califf , Duke University, North Carolina, USA
1997:	Curt Furberg , Wake Forest School of Medicine, North Carolina, USA
1996:	Thomas W. Smith , Brigham and Women’s Hospital, Boston, USA
1995:	Richard Gorlin , Mount Sinai Hospital, New York City, USA

Annual **PHRI International Lectureship on Population Health Sciences**

2019:	Mark Lathrop , McGill University Genome Quebec Innovation Centre, Montreal, Canada
2017:	Richard Horton , The Lancet, London, UK
2016:	Giuseppe Mancia , University of Milano-Bicocca, Milan, Italy
2015:	Stephen MacMahon , The George Institute for Global Health, University of Sydney, Sydney, Australia
2014:	Simon Capewell , University of Liverpool, Liverpool, UK
2013:	George Davey Smith , University of Bristol, Bristol, UK
2012:	Walter C. Willett , Harvard School of Public Health, Cambridge, USA
2011:	Martin McKee , London School of Hygiene and Tropical Medicine, London, UK

PHRI Lectureship in Anesthesiology, Perioperative Medicine & Surgical Care

2014:	Alison Halliday , University of Oxford, Oxford, UK
2012:	Paul Myles , Monash University, Melbourne, Australia
2011:	Greg Hirsch , Dalhouse University, Halifax, Canada

Annual **Janice Pogue Lectureship in Biostatistics**, named for the late founder of PHRI’s statistical group

2019:	Lisa M. LaVange , University of North Carolina, Chapel Hill, USA
2018:	Amy H. Herring , Duke University, North Carolina, USA
2017:	Thomas Fleming , University of Washington, Seattle, USA



The Next Generation

We have a long-standing and rich tradition of training and mentoring the next generation of leaders in health research. Many of our current leaders (Sonia Anand, PJ Devereaux, Jeff Healey, Shamir Mehta, Richard Whitlock, Andre Lamy, among others) are homegrown through mentoring and sustained support. Senior researchers teach by example and inspire younger scientists to tackle major research questions.

More than 120 scientists have been trained by PHRI and are contributing to research capacity in their countries. Our scientists Salim Yusuf, Hertzell Gerstein and Jackie Bosch contributed funds from a patent they owned to create the Canada HOPE-CIHR Scholarship. This scholarship supported 20 scientists from Africa and India to obtain advanced research training in Canada.

Yusuf initiated the Emerging Leaders program of the World Heart Federation during his term as President. This program, which has since been named after him, had trained 125 mid-career leaders from 50 countries by 2018, and expects to train an additional 25 people each year.

Early-Career Scientists



Emilie Belley-Côté

is researching the epidemiology and treatment of critically ill patients with elevated troponins.



MyLinh Duong

is investigating respiratory epidemiology in the areas of global health (neglected diseases) and cardio-respiratory issues.



Philip Joseph

is researching heart failure and atrial fibrillation in different populations.



Darryl Leong

is assessing what causes frailty in middle and old age.



Michael McGillion

is exploring remote automated monitoring and virtual recovery support for people after cardiac and vascular surgery.



Marie Pigeyre

is searching for novel predictive biomarkers of type 2 diabetes and its vascular complications.



Ashkan Shoamanesh

is leading the pan-Canadian hemorrhagic stroke research collaboration, investigating hemorrhage-prone cerebral small vessel disease, and studying high-risk atrial fibrillation patients with prior intracranial hemorrhage.



Deborah Siegal

is investigating treatment of acute bleeding.



Harriette Van Spall

is evaluating health care resources utilization in heart failure, and clinical and health economic outcomes of new models of health care delivery.



Michael Walsh

is exploring how to prevent cardiovascular disease in people who receive dialysis for renal failure.



Jorge Wong

is examining the relationship between subclinical atrial fibrillation and heart failure rehospitalization.



Optimized Operations

Our operational staff support researchers and study teams from protocol through the life of each study. Our statisticians perform methodological work and ensure accurate analyses and reporting. Information and communication technology teams develop software as needed, including for off-line data collection on tablets. More than 50,000 randomizations and drug resupplies annually, and more than five million study case reports and data records, are maintained in a secure, resilient data centre.

Contracts and finance teams navigate international laws and currencies to establish multi-level agreements and study budgets. Quality assurance, education and administrative staff support activities relevant to the study teams.

Program Directors and Managers oversee study teams, who manage clinical sites and receive data from around the world.

“ Our teams operate as an integrated whole to innovate relevant, effective and optimal study processes.”

– Janette Panhuis, Chief Operating Officer





Our Research Community



The **Chanchlani Research Centre** works in the areas of 'omics, led by Sonia Anand. Established in 2011 by Vasu and Jaya Chanchlani, the Centre includes research by PHRI's Anand, Paré and de Souza. Featured projects include the nutrition, metabolomics and genomics in birth cohorts project, Genetics of Opioid Addiction (GENOA), and the contextual map analysis of Canadian communities as part of the Canadian Alliance of Healthy Hearts and Minds (**CAHHM**) led by PHRI.



The **Thrombosis & Atherosclerosis Research Institute**, led by Jeff Weitz, shares space with us in the David Braley Cardiac, Vascular and Stroke Research Institute building. PHRI's Eikelboom, Paré, Gerstein and Anand collaborate with TaARI on the themes of experimental thrombosis and atherosclerosis, and in clinical thromboembolism programs.



The **Ontario Bariatric Network**, led by Mehran Anvari, Scientific Director and CEO of the Centre for Surgical Invention & Innovation (CSii), is affiliated with McMaster University and St. Joseph's Healthcare in Hamilton. PHRI is the data management centre of the **OBN**, and coordinates the provincial bariatric registry.



The **Firestone Institute for Respiratory Health**, led by Martin Kolb at St. Joseph's Healthcare in Hamilton, and affiliated with McMaster University, conducts basic and clinical research into airway inflammation, asthma, COPD, and other areas. PHRI collaborates with investigators in respiratory research, such as MyLinh Duong, to lead one of the world's largest studies in lung health.



The **Farncombe Family Digestive Health Research Institute**, led by Stephen Collins, is an integrated group of clinical and basic scientists focused on developing new strategies for the diagnosis, treatment and prevention of intestinal diseases such as Crohn's disease and ulcerative colitis, and researching diseases of other organ systems that may be influenced by digestive health and nutrition. Farncombe Institute's Paul Moayyedi and PHRI collaborate on the **IMAGINE-SPOR** Network, a large observational cohort seeking better targeted treatment of people with irritable bowel syndrome and inflammatory bowel disease.



The **Escarpment Cancer Research Institute**, led by Mark Levine, conducts clinical trials as well as quality health care and knowledge translation in cancer. Scientists at PHRI collaborate with ECRI to develop studies in cardio-oncology and cancer epidemiology.

Our research community includes clinical trials and patient care at teaching hospitals affiliated with McMaster University, through both of the city's health care systems **Hamilton Health Sciences** and **St. Joseph's Healthcare Hamilton**.

Major Funders (>\$1 million) of PHRI since 2013

Wellcome Trust • Canadian Institute of Health Research
Heart and Stroke Foundation • Ontario Ministry of Health and Long-Term Care

AstraZeneca • Bayer • Boehringer Ingelheim • Boston Scientific • Bristol-Myers Squibb
Canadian Partnership Against Cancer Corporation • Eli Lilly and Company • Ionis
Medtronic • Novartis • PaceSetter • Portola • Sanofi-Aventis • St Jude Medical



Helping Those in Need

At Home

The community garden on the grounds of the David Braley Cardiac, Vascular and Stroke Research Institute, yields enough vegetables a year to feed 800 people. These are donated to food banks and kitchens in Hamilton.

Several members of PHRI and Hamilton General Hospital volunteer to maintain the garden. Patients and their families enjoy visiting and helping in the garden.

Elsewhere in Hamilton, we support the Neighbour to Neighbour Jack Parent Reading Program that helps children in grades 1 through 3 in poor neighbourhoods improve their literacy.

We contributed generously to help fellow Canadians recover from the devastating forest fires in 2016 in Fort McMurray, Alberta.

Around the World

We rallied to help bring relief to victims in low-income countries struck by natural disasters. The 2010 Haiti earthquake; Typhoon Haiyan that ravaged the Philippines in 2013; major earthquakes in Nepal, 2015; Hurricane Matthew in 2016 that slammed Haiti and other Caribbean islands; Cyclone Idai in 2019 that caused catastrophic damage in Mozambique, Zimbabwe, and Malawi. Each time, PHRI contributed generously – as individuals and as an organization – to UNICEF’s efforts to bring survivors clean water, sanitation facilities, and child-friendly spaces.

Following the typhoons in the Philippines, PHRI contributed to the establishment of a boat building factory in Tacloban, owned and operated by local fisherfolk. This restored their livelihoods and created sustainable employment. Of the 70 boats supported by PHRI, six of them were named after our studies (including INTERSTROKE, PURE, TIPS-3 and HOPE-3), most of those given to fisherwomen.

“Tackling health challenges requires helping people directly, at home as well as abroad.”

– Salim Yusuf, Executive Director



Mission Forward

Advanced Data Analytics

Neural networks capture complex patterns in multidimensional datasets, and are well-suited to the analysis of health and biological data. PHRI has created one of the world's largest databases of comprehensive health information, with more than 400 terabytes of high-quality, curated health data from more than four million bio-specimens - collected over 25 years from 80 studies. With recent emphasis on whole genome-wide scans, proteomics and metabolomics, the complexity of data will require new approaches to data analysis such as artificial intelligence and machine learning. This program will detect interactions between genetics, biomarkers, and lifestyles to identify potentially causal mediators of various diseases, individuals at high risk, and optimize prevention and treatment strategies.



Perioperative Outcomes

Anesthesia and aseptic techniques, introduced in the mid-1800s, dramatically reduced deaths and complications during surgery. Our research has uncovered a third approach that can further improve outcomes. Most deaths after surgery occur once patients leave the operating room and while they are not monitored intensively. Remote Automated Monitoring (RAM) technologies can monitor patients in the wards and at home. By detecting complications early, they can be managed immediately, and we can expect to halve mortality, complications, hospital readmissions, and brain damage.

Brain Health

The PHRI Brain Health Initiative, a series of innovative studies aimed at understanding and preserving brain health, will include assessing global variations in dementia in a prospective study in 26 countries (the PURE study), exploring the impact of environmental factors, lifestyle and genetics on dementia.

Aging, Frailty and Health

The process of aging starts early and occurs throughout the human lifespan. By studying 200,000 people from several countries on five continents, we will assess whether genetics, lifestyle, environmental and social factors influence the development of frailty and the process of aging.

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Our Team

Research that makes a difference to the world's health



**Population Health
Research Institute**
HEALTH THROUGH KNOWLEDGE

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