

RI-MUHC

Research Institute of the McGill University Health Centre



DRIVING PERSONALIZED MEDICINE


Adult and Pediatric
Biomedical Research

Centre universitaire
de santé McGill
Institut de recherche



McGill University
Health Centre
Research Institute

2020 ANNUAL REPORT



New discoveries, technologies
and approaches have
revolutionized **personalized
medicine.**

Our scientists

are at the vanguard
of this revolution.

Research Institute
of the McGill University Health Centre
(RI-MUHC)



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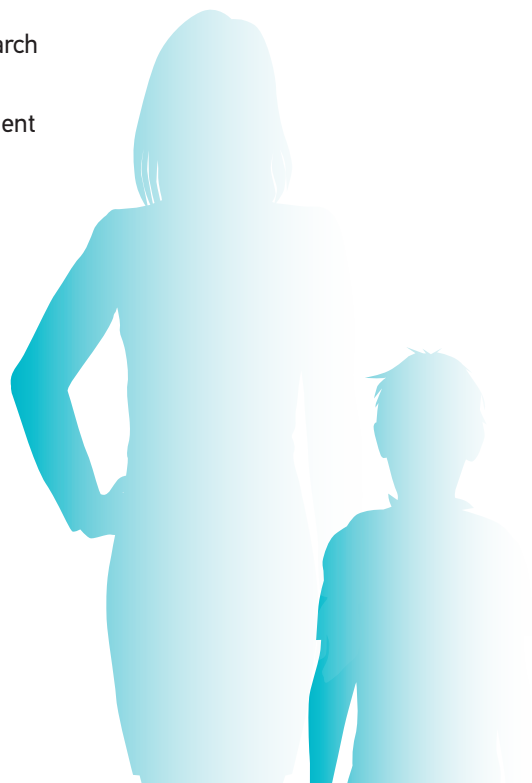
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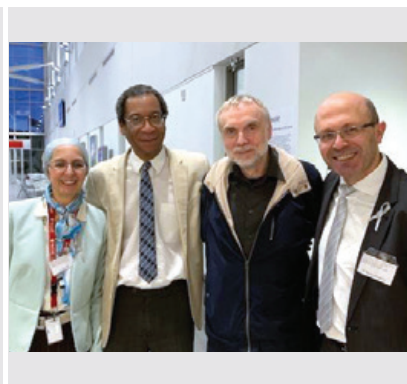
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ABOUT THIS REPORT

Statistics	Represent fiscal year 2020 (April 1, 2019 to March 31, 2020), unless indicated otherwise
Research funds	Grants, contracts (including indirect costs), studentships, salary awards from peer-reviewed agencies, and funding from university and hospital foundations Administered at either the RI-MUHC or McGill University, for RI-MUHC researchers
Researchers	Individuals conducting active and independent research, who have received at least \$5,000 in research funding during the fiscal year
Staff	Administrative and research staff based at MUHC locations
Publications	Selected from July 2019 to June 2020
Counts	Active researchers are counted as of May 2020 Research trainees are counted as of July 2019 Staff are counted as of April 2020. Excludes researchers and trainees as well as staff located at the Montreal Neurological Institute and McGill Campus.
Images	The RI-MUHC respects public health guidelines to reduce transmission of COVID-19. Some images in this report were taken prior to the pandemic.



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458

active members,
including fundamental,
clinical and evaluative
researchers



1,195

research trainees,
including **378** M.Sc. and
453 PhD candidates,
214 postdocs and **150**
clinical research fellows



1,209

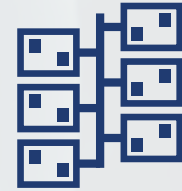
staff in research
and administration



Over **1,900**
peer-reviewed scientific
publications



Over **2,000**
scientific talks given by our
researchers worldwide



32,563
square metres
of research space



408
research contracts and
725 agreements
signed



28
invention disclosures



Ongoing research
collaborations with
61 countries

Message from Bruce Mazer

There is no doubt that 2019-2020 was a year filled with challenges and achievements. Our research community is unique: dedicated, creative, forward-thinking and innovative. Child or adult, every patient who inspires our work at the Research Institute of the McGill University Health Centre (RI-MUHC) is unique, too, and deserves to benefit from exciting new targeted therapies.

Whether it is for landmark public health studies, understanding the implications of a new disease-causing gene in a single

patient or family, planning for a bold new Clinical Innovation Platform, or our robust response to the COVID-19 pandemic, we may take tremendous pride in the successes of the past year. In our community of RI-MUHC researchers, trainees and staff, MUHC clinicians and patients, and committed funding partners, we are all **drivers of personalized medicine.** ◀◀

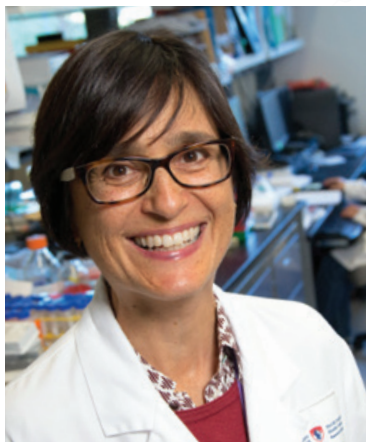


Bruce Mazer, MD
Executive Director and Chief Scientific Officer (Interim), RI-MUHC, October 2016–June 2020

Message from Indra Gupta

As we adapt to the challenging constraints of the pandemic, science has prevailed at the speed of light with landmark pediatric studies in COVID-19 research and innovative therapies in mental health for our most vulnerable and youngest patients. Our pediatric research community quickly demonstrated strength in these and other areas requiring multi-disciplinary collaboration. This would not have been possible without the invaluable partnership of the Montreal Children's Hospital Foundation, whose support safeguards the continuity of our research advancement and shaping of future scientists in child health research.

My sincerest gratitude to **Dr. Bruce Mazer**, whose leadership over the last four years has established the RI-MUHC on the global centre



Indra Gupta, MD
Deputy Executive Director and Deputy Chief Scientific Officer (Interim), RI-MUHC, and Head of Child Health Research (Interim), MUHC

stage, and whose extraordinary steering efforts have sustained the acceleration of pivotal research during these precarious times. ◀◀



Message from the McGill University Health Centre (MUHC)

We are pleased to recognize the accomplishments of the Research Institute of the McGill University Health Centre (RI-MUHC) in the context of this annual report, and to thank researchers, trainees, management and support staff alike for their curiosity, fervour and focus.

As a subsidiary of the MUHC, the success of the RI-MUHC is intertwined with that of the MUHC. Together, we eye the future to change the present. We pivot to adapt to new realities and anticipate other needs. This is why leadership and sustained support are critical. In that regard, we would like to express particular gratitude to **Dr. Bruce Mazer** as

outgoing Interim Executive Director and Chief Scientific Officer. His enthusiastic and extended service has helped the RI-MUHC address opportunities and challenges over the last four years, including those related to personalized medicine and the COVID-19 pandemic. We would also like to express gratitude to the RI-MUHC's teams, partners, funders, and supporters for acting collaboratively with pur-



Peter Kruyt, Chairman, and **Pierre Gfeller, MD CM MBA**, Board member and MUHC President and Executive Director

pose to achieve common goals. We look forward to many more impressive achievements in the year ahead. ◀◀

Message from McGill University

COVID-19 has taught us that in the face of a global health crisis, collaboration is paramount. At the outset of the pandemic, many McGill and RI-MUHC scientists whose research was abruptly interrupted turned on a dime to collectively fight the novel virus.

Of course, collaboration between our institutions is not new. The pioneering genetic research conducted in RI-MUHC and McGill labs offered the earliest glimpses of where we were heading: personalized medicine, which hailed the next frontier in medical research. Today, genetic testing leads to targeted cancer regimens, which improve outcomes

in ways the first oncologists could never have imagined. We now use **personalized medicine** to treat an increasingly broad array of cancers, as well as for cardiovascular disease, microbiome research and more.

We offer our RI-MUHC colleagues a heartfelt thank-you for their leadership and contributions in fighting the pandemic. Congratulations on the advances



David Eidelman, MD, CM, Vice-Principal (Health Affairs) and Dean, Faculty of Medicine and Health Sciences
Martha Crago, MD, CM, Vice-Principal (Research and Innovation)



achieved this year, be they COVID-19-related or in any of the other areas in which you excel. ◀◀

Drivers of personalized medicine

Physicians, over the course of medical history, have considered a range of individual factors in determining how to treat afflictions. But new discoveries, technologies and approaches have revolutionized personalized medicine, and scientists at the Research Institute of the McGill University Health Centre (RI-MUHC) are at the vanguard of this revolution. Their investigations are leading to greater understanding of our unique bodies, and how best to keep us healthy.

Through this small sampling of their work, discover why our researchers are committed to **driving personalized medicine**.



Ensuring mobility: the “Hip-Mobile”

Hip fractures in elderly patients result in a loss of mobility that diminishes their overall health and well-being.

Dr. Suzanne Morin, of the Metabolic Disorders and Complications Program, is committed to finding ways to ensure patients recover from their fractures and don't suffer a second one. She and her team have developed and are testing a new rehabilitation technology: the “Hip-Mobile,” a “smart” insole that patients insert in their shoe. Patients agreeing to participate in an extended rehabilitation project are given initial training and then monitored over an eight-month period by the smart insole, which communicates with a tablet via Bluetooth. These results are linked to Dr. Morin's lab, allowing her to track the frequency and quality of the patient's rehabilitation and to adjust the program as necessary.

“This approach provides the patient with a personalized rehabilitation program remotely.



Dr. Suzanne Morin developed a personalized rehabilitation program

They benefit from staying in their own home and receiving simple coaching through the program on their tablet,” says Dr. Morin. “There are inevitable challenges

in using new technology with the very elderly, but people as old as 98 have successfully completed the program.” ◀◀

SMALL DIFFERENCES CAN MAKE A BIG CHANGE

Dr. Morin's extended study is providing additional insights. “As participants become more mobile, their perceptions of their health and their abilities change significantly. So, in addition to providing rehab, we are acquiring information about their general strength and mobility, and even their mood,” she says. “We want this approach to translate into better clinical outcomes because as we age, even small differences can make a big change in our ability to do the things we enjoy.”

Introducing your microbial self



Irah King, PhD, studies how a treatment will interact with both the genetic and microbial self

Irah King's research addresses how the microbiome affects the immune system and how that may relate to such autoimmune diseases as psoriasis, inflammatory bowel disease, or even respiratory disease. "The gut holds the most microbial species and the most immune cells, creating an intimate relationship between the two. The microbiome may influence the immune system, which may then influence disease," he says. "We want to understand how a given treatment will interact with both your genetic and your 'microbial' self." ◀◀

Your microbiome, the accumulation of microbes living in and on the body, creates your unique "microbial self." The better you know this self, the better you can understand certain health issues.

"This microbiome can be beneficial or detrimental to human health, depending on its composition," says **Irah King (PhD)** of the Transitional Research in Respiratory Diseases Program. "It can predispose you to a condition that may be dictated by a genetic difference, or you

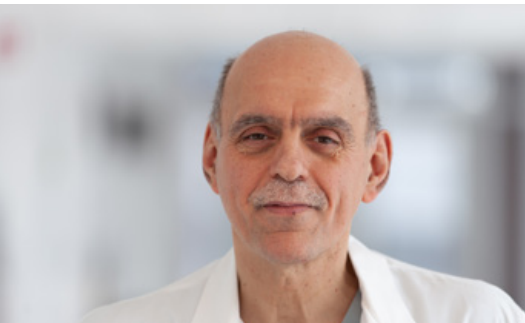
can have a genetic predisposition which might alter the microbiome and therefore lead to a different state of health."



WHY A GNOTOBIOTIC RESEARCH PLATFORM?

Irah King is the director of the RI-MUHC's new **Gnotobiotic Research Platform**, a resource for the study of animal models, primarily mice, that have an identical genetic make-up and are either microbe-free or have a known, controlled microbial composition. The facility, to be opened in the coming year, will enable researchers to control and assess the relationship between genetics and microbiomes. "We will be able to manipulate the microbiota while everything else remains the same," says King. "Then we can focus on causation rather than simply on identifying correlation."

Tapping the inexhaustible capacity of liquid biopsies

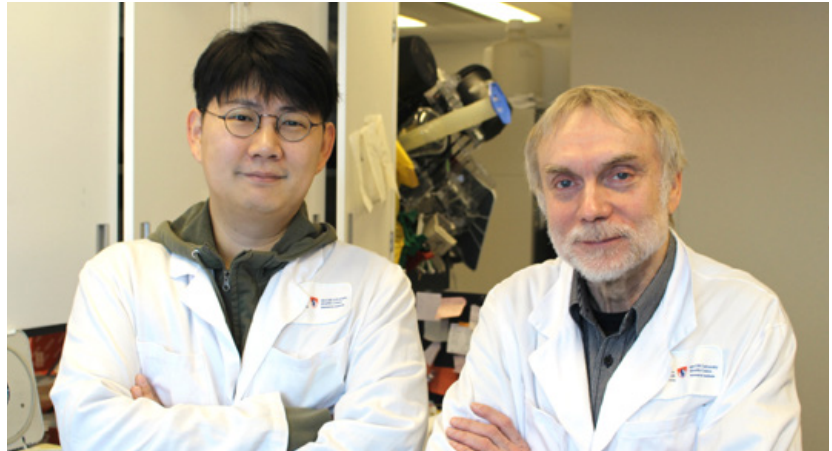


Dr. Peter Metrakos

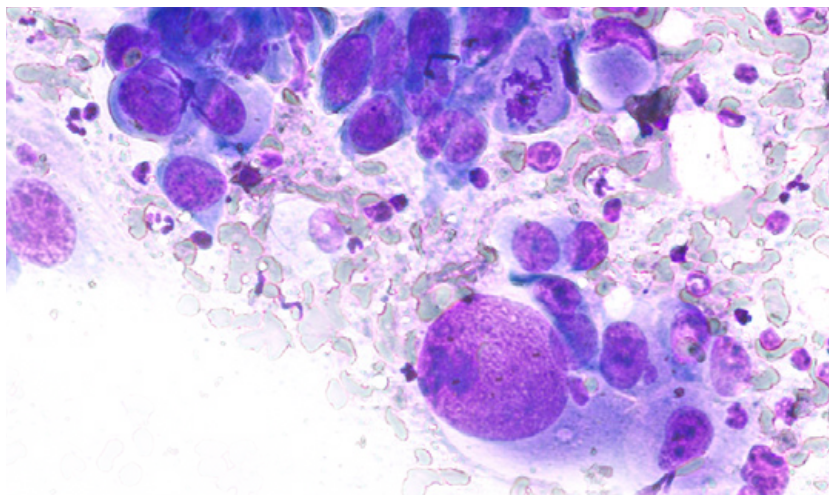
Tumour biopsies for diagnosing cancer and monitoring treatment usually involve removing a tissue sample, but that process collects material from a small portion of the tumour with no guarantee that it bears the most important information. Conversely, liquid biopsies through blood tests allow the physician to collect material from the entire tumour in a timely and considerably less intrusive manner than in traditional biopsy.

Cells release extracellular vesicles into the blood at a regular rate. These vesicles—in particular, exosomes—mediate intercellular communication and carry cargo such as proteins or nucleic acids. Cancer cells also release unique exosomes, each one being representative of the cell from which it came.

“Exosomes enter into the blood from every cell in the tumour, so with sufficiently sensitive detection methods, we can track mutations within the cancer, giving these exosomes diagnostic potential,” says **Dr. Janusz Rak**, senior scientist in the Child Health and Human Development Program. “We’re reaching the



Dr. Janusz Rak (right) and postdoctoral fellow **Dongsic Choi, PhD**, like Dr. Metrakos, aim to decipher information about cancer from the bloodstream



point in the molecular characterization of cancers where these features could be used for making clinical decisions.”

Research is exploring how to understand the information deposited into the bloodstream by the cancer. “We’re identifying

‘signatures’ in this genetic information so we can determine what a tumour is doing,” says **Dr. Peter Metrakos**, leader of the Cancer Research Program. “If mutations go down, we would know our treatment is working.” ◀◀

A VISION FOR APPLIED NANOMEDICINE

Drs. Rak and Metrakos are co-leads on a Canada Foundation for Innovation application to establish a **Centre for Applied Nanomedicine** at the RI-MUHC. “This facility would support our research into these vesicles in diagnostic and other contexts,” says Dr. Rak. “Liquid biopsies have an inexhaustible capacity to reflect this ever-changing malignant disease that affects people.”

Investigating genetic profiles for cancer patients

It has long been known that genetic make-up affects one's risk of cancer. For instance, while less than one percent of women will develop ovarian cancer, those carrying a particular mutation have a risk of forty to sixty percent. It is important for both the individual and physician to know each patient's genetic makeup and select the best therapy.

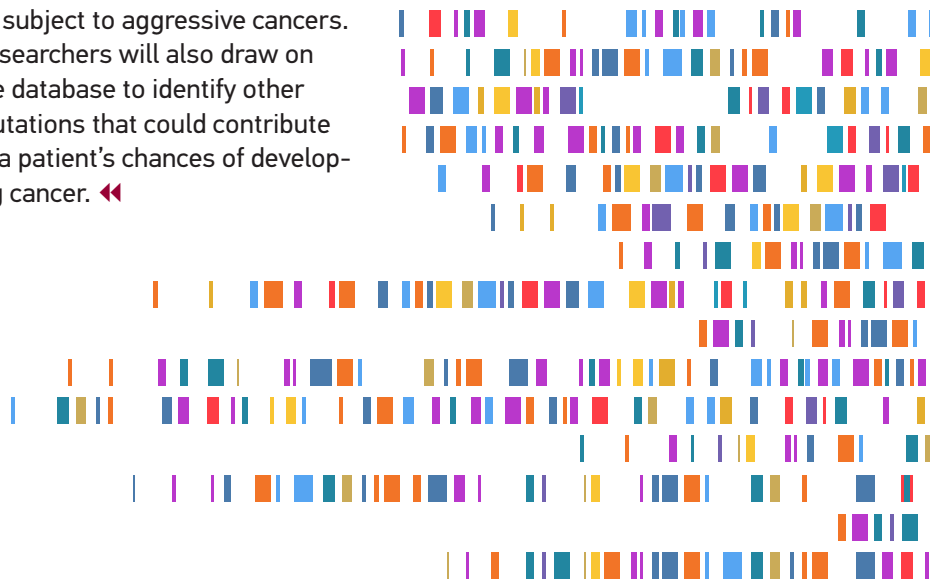
Enter **Oncodrive**, a project led by **Patricia Tonin (PhD)**, associate leader of the Cancer Research Program, who has been involved in the discovery of several genetic mutations that predict the likelihood of developing the disease. "Oncodrive aims to improve the management of cancer patients by deriving the individual's entire genetic sequence," she explains. "Many genetic mutations measurably affect risk, and that information should be provided to people with those mutations and to their physicians. As well, certain genetic mutations can affect a patient's response to specific therapies, which then influences the choice of treatment."

Through Oncodrive databases, physicians will have access to the patient's genetic profile and be able to adapt treatment appropriately, applying more aggressive therapies for patients whose genes suggest they will



Patricia Tonin, PhD, developed Oncodrive to access a cancer patient's entire genetic profile

be subject to aggressive cancers. Researchers will also draw on the database to identify other mutations that could contribute to a patient's chances of developing cancer. ◀◀



STARTING WITH MUHC BREAST CANCER PATIENTS

Oncodrive will initially focus on collecting genetic information from breast cancer patients at the MUHC. "Women with breast cancer tend to be aware of the role of genetic mutations and the uses of genetic testing, and are probably more ready to look at the rest of the genome to see what other factors could be contributing to their risk or affecting their treatment," says Patricia Tonin.

COVID-19: Our researchers answer the call



Made-in-Canada COVID-19 test kits; see p. 12”

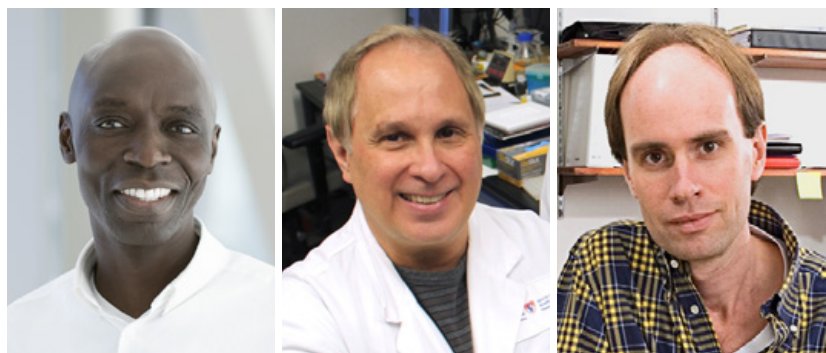
When the COVID-19 pandemic hit, much of the world locked down. But that has not kept scientists at the Research Institute of the McGill University Health Centre (RI-MUHC) from focusing their energies on a new imperative: resolving challenges raised by the pandemic.

Many staff, trainees and funding partners have also pivoted in their work to support this vital research. The McGill University Health Centre (MUHC) Foundation, for instance, quickly organized seed funding for dozens of projects, including several below, through the McGill Interdisciplinary Initiative in Infection and Immunity (MI4) Emergency COVID-19 Research Fund (ECRF). Here we consider only a few frontline projects launched at the RI-MUHC with the aim of locking down the coronavirus.

Blocking the virus

The coronavirus binds to human cells using what is called a “spike” protein, which creates a means for the virus to enter human cells. Researchers around the world are working to develop a vaccine that will interfere with this spike protein, prohibiting the virus from binding.

Momar Ndao (DVM, PhD), Martin Olivier (PhD) and Michael Reed (PhD), colleagues in the Infectious Diseases and Immunity in Global Health Program, are developing a novel approach to obstruct this protein. They lead an effort to explore the use of both the current tuberculosis vaccine and an adenoviral vaccine—already in clinical trials for human use—that was developed to combat Ebola, mal-



Momar Ndao, DVM, PhD, Martin Olivier, PhD, and Michael Reed, PhD

aria and the human immunodeficiency viruses. They are studying whether these vaccines, either alone or in combination, can be used to deliver the COVID-19 spike protein and generate a sustained immune response that effectively blocks the coronavirus from attaching to and entering

human cells, thereby preventing disease.

“With vaccines already approved for human use, we don’t need to wait as long for regulatory approval,” says Dr. Ndao. ◀◀

Funding: MUHC Foundation and partners (MI4 ECRF)

Testing hydroxychloroquine

In March 2020 Drs. Todd C. Lee, Emily G. McDonald and Matthew P. Cheng, members of the Infectious Diseases and Immunity in Global Health Program, launched a clinical study coordinated with another in Minnesota, U.S., to explore the potential of hydroxychloroquine in different contexts. Their first trial focused on post-exposure prophylaxis—preventing infection if someone had been exposed—and their second on whether early community treatment improved disease outcome. These were the first randomized controlled trials for COVID-19 to recruit patients in Canada, and the first completed.

The post-exposure prophylaxis trial gained worldwide attention when published in the *New England Journal of Medicine*



Worldwide attention for hydroxychloroquine trials: Drs. Emily G. McDonald, Matthew P. Cheng and Todd C. Lee (left to right)

in June. The second appeared in the *Annals of Internal Medicine* in July.

“Despite a lot of excitement and promise for the drug, we found that hydroxychloroquine does not seem to be effective as either post-exposure prophylaxis or to reduce symptoms in early disease,” says Dr. McDonald.

Dr. Lee adds, “We’re still pooling data with international trials to see if there were fewer hospitalizations for those who received early treatment, but it may be time to move on to evaluate other candidate drugs.” ◀◀

Funding: MUHC Foundation (MI4 ECRF) and MUHC Clinical Practice Assessment Unit

Cardiac conditions and the coronavirus

Dr. Abhinav Sharma of the Cardiovascular Health Across the Lifespan Program is concerned with management of cardiac conditions during the pandemic. “There is controversy around the use of commonly used blood pressure medications, specifically angiotensin converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARB),” he explains. “The COVID-19 virus needs the protein that these drugs bind to in order to enter the cells.”

One hypothesis suggests that people on these medications could experience a more severe infection. Another proposes that these medications may be beneficial, reducing inflammation and fibrosis. Dr. Sharma is studying



Improving patient outcomes: Dr. Abhinav Sharma



the effect of withdrawing ACE inhibitors to learn how that impacts patients hospitalized with COVID-19. “Our study will determine if temporarily withholding these blood pressure

medications is safe and improves patient outcomes,” he says. ◀◀

Funding: MUHC Foundation (MI4 ECRF) and MUHC Division of Cardiology

Tracking international approaches to COVID-19



Harnessing public health informatics:
Dr. David Buckeridge

Dr. David Buckeridge, a researcher in the Metabolic Disorders and Complications Program, is designing new methods of using artificial intelligence to survey online media. He aims to understand which countries are implementing which kind of control measures, when they're doing it, and how people and communities are reacting to it.

"We use online media to build portraits of how countries are controlling the pandemic around the world," says Dr. Buckeridge, "and then we try and tie in more traditional data around numbers

of cases and deaths to see to what extent those efforts are having an effect."

His study aims not only to identify clear differences and patterns regarding approaches used around the world, but also to track popular reactions to those approaches and issues at the forefront in the media. ◀◀

Funding: The Canadian 2019 Novel COVID-19 Rapid Research Funding Opportunity

Made-in-Canada COVID-19 tests



Martin Schmeing, PhD (project lead, McGill University), and **Don van Meyel, PhD**: Delivery of the first 15,000 test kits for Optilab MUHC, Glen site

When COVID-19 hit Canada, most testing kits were made by multinational corporations without obligation to meet Canadian needs. Old hockey buddies **Don van Meyel (PhD)** of the Brain Repair and Integrative Neuroscience Program and **Martin Schmeing (PhD)**, a biochemistry professor at

McGill University, led a team of talented McGill researchers to produce COVID-19 testing kits for which all essential test components were made in Canada.

A pilot project to deliver 15,000 tests to Optilab MUHC served as proof of concept, and collaboration with scientists at the

National Research Council is enabling scale-up to produce millions of tests.

"We want to be able to produce and distribute these tests nationwide when they are needed," says Don van Meyel, who directs the Centre for Translational Biology at the RI-MUHC. "Decisions about who and when to test in Canada should be driven by strong science and public health policy, not by limitations in the number of tests available." ◀◀

Funding: MUHC Foundation (MI4 ECRF), McGill Faculty of Science, National Research Council of Canada, Innovation Science and Economic Development Canada

Supporting healthcare workers

Healthcare professionals have found themselves under tremendous pressure during the COVID-19 pandemic. **Jason Harley (PhD)** of the Injury Repair Recovery Program and **Tina Montreuil (PhD, PsyD)** of the Child Health and Human Development Program have developed a survey of the support and coping strategies that healthcare professionals are using, in order to help inform hospital networks and promote practices that would best support these workers. “That means having a better understanding of the stressors and the psychological distress that healthcare professionals are experiencing,” says Jason Harley.



Jason Harley, PhD, and Tina Montreuil, PhD, PsyD

The pair aims to shed light on issues of physical and emotional exhaustion and high absenteeism among healthcare workers. “The idea is to gain greater insight into what is really going on in the

system so that we’re better able to support the hospitals and their workers,” adds Tina Montreuil. ◀◀

Funding: MUHC Foundation and partners (MI4 ECRF)

First UV-disinfection robot tested in Canada

Like the researchers they support, many RI-MUHC administrative staff took initiative in the pandemic. Notably, our biomedical engineering and environmental health and safety teams worked with MUHC housekeeping and infection control on novel methods of disinfection.

When **Rami Tohme**, director of Infrastructure and Biomedical Engineering (RI-MUHC), came across a robot that disinfects using ultraviolet light at a medical show in Germany, he saw it as a technology that could help hospitals at home lower their infection rates. **Dr. Bruce Mazer** (Translational Research in Respiratory Diseases Program) agreed, and invited his team to help in the first evaluation of this robot inside a Canadian hospital.



Sterilizing a room is a labour-intensive process taking hours, but the UV-disinfection robot can do it in a fraction of the time, sparing cleaning staff the risk of infection

“Our job was not to highlight its capacity for disinfection, because that’s already proven,” says Rami Tohme. “We wanted to test its capability to disinfect without

human intervention.” The evaluation teams delivered a thumbs-up for the acquisition of two robots at the RI-MUHC. ◀◀

Brain Repair and Integrative Neuroscience Program (BRaIN)



rimuhc.ca/BRaIN

RESEARCH HIGHLIGHTS

Managing concussions with just a few clicks

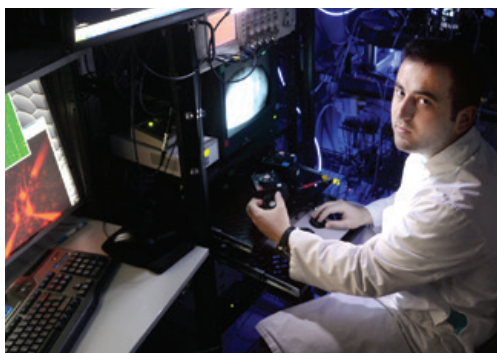
- With an industry partner, **Elaine De Guise (PhD)** developed a free mobile app to fill the information gap on mild traumatic brain injury for emergency care professionals
- Topics range from diagnosis to resumption of daily activities



Elaine de Guise, PhD

How epilepsy arises in the healthy brain

- A study in rodents used laser light to target populations of brain cells and investigate their contributions to seizures
- First author: **Elvis Cela (PhD)**, then doctoral student; senior author: **Per Jesper Sjöström (PhD)**, *Scientific Reports*



Elvis Cela, PhD

SELECTED PUBLICATIONS

Blandine Ponroy Bally, W Todd Farmer, Emma V Jones, **Selin Jessa**, **J Benjamin Kacerovsky**, Alexandre Mayran, Huashan Peng, Julie L Lefebvre, Jacques Drouin, Arnold Hayer, Carl Ernst, **Keith K Murai**. Human iPSC-derived Down syndrome astrocytes display genome-wide perturbations in gene expression, an altered adhesion profile, and increased cellular dynamics. *Human Molecular Genetics*. 29(5): 785-802, 2020.

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Research associate honoured by Society for Neuroscience (SfN) and Canadian Association for Neuroscience (CAN)

- **Cristian Zaelzer-Perez (PhD)** is co-recipient of the 2019 Science Education Award (SfN) and 2020 CAN Neuroscience Outreach & Advocacy Award
- He founded the Convergence: Perceptions of Neuroscience Initiative to engage the public on the crossover between neuroscience and art.



Cristian Zaelzer-Perez, PhD



Cancer Research Program (CRP)



rimuhc.ca/CRP

RESEARCH HIGHLIGHTS

High-fat diet fuels prostate cancer progression by mimicking key cancer alteration

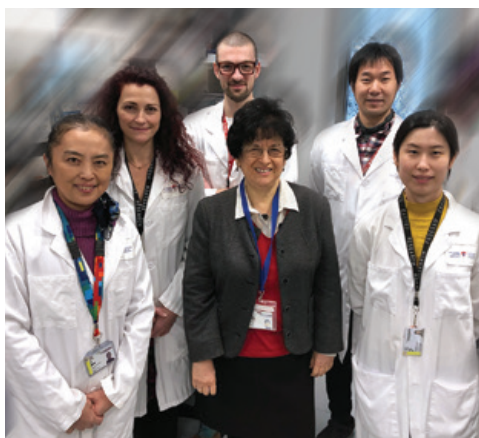


David Labbé, PhD

- New study suggests that dietary intervention to reduce fat consumption could improve prostate cancer outcome
- **David Labbé (PhD)** is study co-lead (*Nature Communications*)
- His team demonstrated that saturated fat intake induces a cellular reprogramming that drives prostate cancer progression and lethality

Estrogen induces liver metastasis immune tolerance in females

- Reported in *Nature Communications* by **Pnina Brodt (PhD)** and team, this study may explain why female sex and liver metastases predict a poorer response to immunotherapy
- Study provides a rationale to explore the potential of anti-estrogens as treatment for hormone-independent cancers that metastasize to the liver.



Pnina Brodt, PhD (centre), and team

SELECTED PUBLICATIONS

Alexis Rompré-Brodeur, **Surashri Shinde-Jadhav, Mina Ayoub, Ciriaco A. Piccirillo, Jan Seuntjens, Fadi Brimo, Jose Joao Mansure, Wassim Kassouf**. PD-1/PD-L1 immune checkpoint inhibition with radiation in bladder cancer: In situ and abscopal effects. *Molecular Cancer Therapeutics*. 19(1): 211-220, 2020.

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Cardiovascular Health Across the Lifespan Program (CHAL)



rimuhc.ca/CHAL

RESEARCH HIGHLIGHTS

Radiation therapy to treat broken hearts

- MUHC cardiologists and radiation oncologists can treat patients with severe arrhythmias using precise radiotherapy, targeting abnormal parts of the heart
- **Dr. Martin Bernier** leads study gathering data on this innovative technique



New targets for treatment of valve disease

- Identification of new genes (*FADS1/2*) involved in aortic stenosis will lead to new treatments and provide options to surgery
- **Jamie Engert (PhD)** and **Dr. George Thanassoulis** lead this study (*JAMA Cardiology*)

Advancing heart imaging research with Canada's most sophisticated MRI

- New cardiac magnetic resonance imaging equipment allows us to develop methods that make cardiovascular diagnostic workups faster, safer and more accurate (see p. 30)
- **Dr. Matthias Friedrich** leads Cardiovascular Imaging Core at the MUHC.



Glen site delivery, Sept. 2019

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Child Health and Human Development Program (CHHD)



rimuhc.ca/CHHD

RESEARCH HIGHLIGHTS

Toward better care for diabetic children

- **Dr. Meranda Nakhla** and colleagues revealed shortfalls in diagnosis of type 1 diabetes in Quebec children, barriers in transition from pediatric to adult care, and mental health problems that follow young diabetic patients

Genomic technologies empower cancer research

- **Dr. Nada Jabado** co-led a *Nature* study that used single-cell sequencing to reveal early origins of childhood brain cancer
- With RI-MUHC and international colleagues, she also identified a potential target for immunotherapy treatments



Drs. Meranda Nakhla and Nada Jabado

Pilot study for gene therapy offers hope

- **Dr. John Mitchell** enrolled the first Canadian patient in a clinical trial using gene therapy to treat a rare metabolic disease, Glycogen storage disease type I.



MUHC patient **Samuel Gauthier**, **Dr. John Mitchell** and team

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Metabolic Disorders and Complications Program (MeDiC)



rimuhc.ca/MeDiC

RESEARCH HIGHLIGHTS

New criteria for diagnosing sarcopenia

- **Stéphanie Chevalier (RD, PhD)** and doctoral student **Anne-Julie Tessier**, with **Dr. Simon Wing, Elham Rahme (PhD)** and **Dr. José Morais**, developed a tool that provides health professionals with a standard to diagnose sarcopenia and implement prevention strategies to delay its effects



Stéphanie Chevalier, RD, PhD, and Anne-Julie Tessier

Mitigation of the risk of kidney transplant loss

- **Dr. Ruth Sapir-Pichhadze** and colleagues including **Dr. Bethany Foster**, Child Health and Human Development Program, demonstrated that donor-recipient matching for specific features of HLA genes would be a useful strategy to decrease kidney transplant failures



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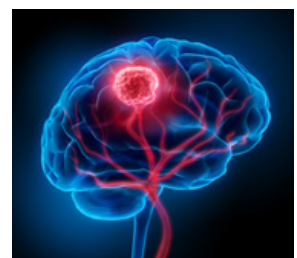
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Overcoming resistance in malignant brain tumours

- **Bertrand Jean-Claude (PhD)** and colleagues, including study lead **Siham Sabri (PhD)** of the Cancer Research Program, demonstrated the anti-tumour activity of a combi-molecule to overcome resistance of glioblastoma stem cells to DNA-damaging chemotherapy.



Infectious Diseases and Immunity in Global Health Program (IDIGH)



rimuhc.ca/IDIGH

RESEARCH HIGHLIGHTS

Montréal sans Hépatite C

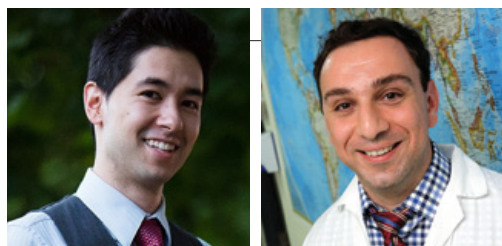
- **Dr. Marina Klein** co-led initiative to make Montreal the first city in North America to eliminate hepatitis C, partnered with CR-CHUM and Lady Davis Research Institute
- Community-oriented approach involves frontline workers



Dr. Marina Klein

Sepsis: Test before starting treatment

- **Drs. Matthew Cheng** and **Cédric Yansouni**, with UBC and Harvard Medical School collaborators, confirmed the importance of obtaining blood cultures before giving antibiotics to septic patients
- Increases likelihood of identifying a pathogen and providing targeted treatment (*Annals of Internal Medicine*)



Drs. Matthew Cheng and Cédric Yansouni

New family of enzymes identified in fungal infections

- **Dr. Don Sheppard** with **Lynne Howell (PhD)**, University of Toronto, identified an enzyme critical for biofilm formation in the fungus *Aspergillus fumigatus*
- Co-first author (*Nature Communications*): postdoc **François Le Mauff (PhD)**.



Dr. Don Sheppard's lab

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Injury Repair Recovery Program (IRR)



rimuhc.ca/IRR

RESEARCH HIGHLIGHTS

All eyes on the Clinical Innovation Platform!

- Ideally located at the Montreal General Hospital of the MUHC, the **Clinical Innovation Platform (CLIP)** opens its doors to health tech startups in fall 2020
- Collaborative workspaces, modern labs and training will help propel start-ups and commercialize their innovations
- Generating buzz in the medtech industry, the CLIP provides access to mentorship from industry experts, pre-clinical/clinical trial services, rapid prototyping and more. (See p. 26)



The CLIP: Developing health technology products that meet patient needs

Better guidelines for patients with gastrointestinal bleeding

- **Dr. Alan Barkun**, with **Dr. Marc Bardou** (Dijon-Bourgogne University Hospital, France), led a group of international experts to develop new guidelines published in *Annals of Internal Medicine*
- Better management of patients with nonvariceal upper gastrointestinal bleeding could reduce pressures in the ER.



Dr. Alan Barkun

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Translational Research in Respiratory Diseases Program (RESP)



rimuhc.ca/RESP

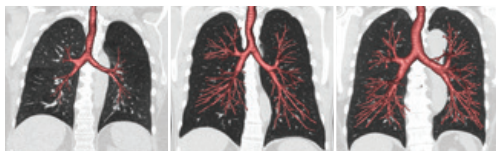
RESEARCH HIGHLIGHTS

Changing the way latent tuberculosis is treated

- New study shows that a rifampin regimen is not only safer, shorter, and as effective as standard isoniazid treatment, but also cheaper
- **Dr. Dick Menzies** is last study author (*Ann Intern Med.*)

Why some non-smokers get COPD

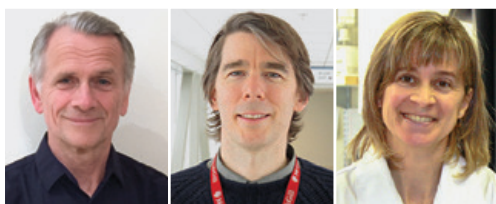
- Dysanapsis, a developmental mismatch between airway and lung size, was proved a yet stronger risk factor for chronic obstructive pulmonary disease (COPD) than smoking
- **Dr. Benjamin Smith** is first study author (*JAMA*)



VIDA Apollo Software images, courtesy of Eric A. Hoffman, PhD, University of Iowa

Understanding the hallmarks of asthma

- Researchers demonstrated that intrapulmonary airway smooth muscle is hypercontractile in asthma and identified several proteins that could be targeted for treatment
- **Anne-Marie Lauzon (PhD)** is last study author (*Eur Respir J.*)



Dick Menzies, MD, Benjamin Smith, MD, and Anne-Marie Lauzon, PhD



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What is our new generation of researchers achieving today?



Left to right: **Kashif Khan**, **Karina Gasbarrino, PhD**, and **Nicolas Bent**

Cooperathon Grand Prize winners invent a prototype that could reduce the impact of heart disease worldwide

Capturing the 2019 Cooperathon grand prize of \$65,000 in start-up funding, an RI-MUHC-trained team beat 250 others with their **PLAKK** prototype, using artificial intelligence to help reduce heart attacks and strokes. **Kashif Khan** and **Karina Gasbarrino** trained at the doctoral level in the Cardiovascular Health Across the Lifespan Program at the RI-MUHC. Entrepreneur **Nicolas Bent** spent time in the Brain Repair and Integrated Neuroscience Program.



Nancy Wu

First-prize presentation at Diabetes Canada Conference

Nancy Wu, a trainee in the Metabolic Disorders and Complications Program, won first prize for her oral presentation at the 2019 Diabetes Canada Professional Conference. Part of her work for an M.Sc. in epidemiology, the study proposes to identify the most important outcomes to measure in a program that aims to prevent diabetes development in women who have glucose intolerance during their pregnancy.



Audrey Kapelanski-Lamoureux

Harnessing the potential of emerging technology applications

Audrey Kapelanski-Lamoureux, doctoral student in the Cancer Research Program, completed an Artificial Intelligence for Genomics program offered by the District 3 Innovation Centre at Concordia University. Taking second place for their project, her team developed a deep learning approach to improve the predictive value of a clinical meta-dataset.



The **Desjardins Centre for Advanced Training (DCAT)** offers structured career support to RI-MUHC trainees alongside their graduate or postdoctoral training.

2020 Highlight: Congratulations to the first cohort of RI-MUHC trainees to complete a novel training program in Clinical and Regulatory Affairs (CRA)! With a grant from the Burroughs Wellcome Fund, DCAT designed the **CRA Experience** to help doctoral students transition into career paths in this domain. ◀



CRA Experience participants, left to right: **Elie Akoury**, **Jason Hu**, **Oli Abate Fulas**, **Alexandra Cooke**, **Amanda McFarlan**, **Michelle Milliones**, **Neera Sriskandarajah** and inset, **Ali Mehdi** (Nov. 2019)

We thank Desjardins for generous support in enhancing career development opportunities for our trainees.

Precision screening tool for early diagnosis of ovarian and endometrial cancers developed through innovative partnerships



Costas Karatzas, M.Sc., PhD, Business Development and Contracts Office, RI-MUHC

Together, ovarian and endometrial cancers represent the fourth leading cause of cancer-related deaths among Canadian women. Although more than 80% of these patients can be cured if their cancer is detected early, most women are only diagnosed *after* the cancer has spread throughout the body—at which point it is incurable. This devastating reality persists because available screening techniques lack the sensitivity and specificity to diagnose these cancers in the early stages of the disease. To combat the evasive nature of these cancers, **Dr. Lucy Gilbert** (Cancer Research Program) and her team have developed an innovative diagnostic tool that is redefining the way we detect ovarian and endometrial cancers.

A clinician-scientist and director of the Women’s Health Research Unit at the McGill University Health Centre (MUHC), Dr. Gilbert spearheaded the development of a first-in-kind precision Pap test called **DOvEEgene** that is

capable of “Detecting Ovarian and Endometrial Cancer Early using **genomics**.” To accomplish this remarkable feat, DOvEEgene evaluates a panel of specific genetic mutations that occur in the early stages of ovarian and endometrial cancers.

To transition DOvEEgene from the research laboratory into a clinical-grade diagnostic test, Dr. Gilbert worked in close collaboration with the RI-MUHC Business Development Office team directed by **Costas Karatzas (PhD)** and with **Julie Quenneville**, President and CEO of the MUHC Foundation, to establish scientific networks,

commercial partnerships and secure financing. Through these interactions, Dr. Gilbert, in partnership with Optilab-MUHC and the launch of a \$2 million campaign by the MUHC Foundation, was recently awarded a prestigious \$6.24 million grant from Genome Canada’s Genomic Applications Partnership Program (GAPP). This funding will enable the bench-to-bed-side transition of DOvEEgene into gynecology clinics, bringing DOvEEgene one step closer to saving the lives of thousands of women worldwide. ◀◀



Dr. Lucy Gilbert developed the life-saving precision Pap test, DOvEEgene

Salary awards

FONDS DE RECHERCHE DU QUÉBEC-SANTÉ

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Nada Jabado
Edward Ruthazer
Donald Sheppard

RESEARCH SCHOLARS

Carolyn Baglole
Andrea Benedetti
Boris Bernhardt
Marie Brossard-Racine
Amrita Daftary
Bratislav Mistic
Nitika Pant Pai
Simon Rousseau
Madeleine Sharp
Per Jesper Sjoström
Aparna Suvrathan
Christine Tardif
Jeremy Van Raamsdonk
Bettina Willie

CLINICAL RESEARCH SCHOLARS

Deborah Assayag
Moshe Ben-Shoshan
Geneviève Bernard
Amal Bessissow
Brett Burstein
Inés Colmegna
Cecilia Costiniuk
Stella Daskalopoulou
Natalie Dayan
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Jason Shahin
Abhinav Sharma
Benjamin Smith
Jonathan Spicer
Myriam Srouf
George Thanassoulis
Donald Vinh
Julia von Oettingen
Pia Wintermark
Cédric Yansouni
Michael Zappitelli
George Zogopoulos

RESEARCH SCHOLARS EMERITUS

Christopher Pack

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Geneviève Bernard

NEW INVESTIGATOR: COMMUNITY-BASED PRIMARY HEALTH CARE

Patricia Li

NEW INVESTIGATOR: INFECTION AND IMMUNITY

Martin Richer

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Marcel Behr
Edward Fon
Marina Klein
Bartha Knoppers
Mark Lathrop
Leonard Levin
Heidi McBride
Marc McKee
William Muller

Madhukar Pai
Guy Rouleau
Michael Sullivan
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Brian Chen
Kolja Eppert
Reza Farivar-Mohseni
Ahmad Haidar
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Richard Hoge
Jason Karamchandani
Benjamin Lo
Bratislav Mistic
Adrien Peyrache
Madelaine Sharp

Awards and recognition

GENEVIÈVE BERNARD

Prix d'excellence – Specialist of the Year award for Region 4, Royal College of Physicians and Surgeons of Canada

JEAN BOURBEAU

Distinguished CHEST educator, American College of Chest Physicians

CHARLES BOURQUE

ELHAM EMAMI

ZU-HUA GAO

LEONARD LEVIN

ERROL MARLISS

CÉCILE ROUSSEAU

KEVIN SCHWARTZMAN

Fellows, Canadian Academy of Health Sciences

CHARLES BOURQUE

President, Canadian Neurological Association

FRANCESCO (FRANCO) CARLI

Chairman, American Prehabilitation Society

NATALIE DAYAN

New Investigator Award, Canadian Society of Internal Medicine

GEORGE FANTUS

Lifetime Achievement Award, Diabetes Canada

EMMETT FRANCOEUR

Prix Letondal, Association of Pediatricians of Quebec

CATHERINE GOUDIE

Junior Faculty Career Development Award: Childhood Cancer Survivor Study, St. Jude Children's Research Hospital, U.S.

WASSIM KASSOUF

Quebec's Distinguished Research Scholar Award, Canadian Urological Association

DICK MENZIES

Research prize, Fédération des médecins spécialistes du Québec

MARTIN OLIVIER

Bernhard Cinader Award, Canadian Society for Immunology

OPAL HEALTH INFORMATICS GROUP, MUHC

Co-led by **Tarek Hijal**, **John Kildea** and the late **Laurie Hendren**

Grand Prix de l'année, Le Gala des Prix TI en Santé et Services Sociaux

LOUISE PILOTE

Member, federal Scientific Advisory Committee on Health Products for Women

RONALD POSTUMA

World's most cited and influential researchers list, Web of Science

BERNARD ROBAIRE

Jansen Distinguished Service Award, Society for the Study of Reproduction

GIADA SEBASTIANI

Guidelines panel, the European Aids Clinical Society

MAIDA SEWITCH

Fellow, Canadian Association of Gastroenterology

ROBYN TAMBLYN

Fellow, Royal Society of Canada

SPECIAL PRESENTATIONS

SUSAN BARTLETT

Keynote speaker, PROMIS Health Organization Scientific Meeting, U.S.

SASHA BERNATSKY

Plenary oral and Spotlight presentations, American College of Rheumatology Annual Scientific Meeting

NADINE KRONFLI

Keynote speaker, Canadian Liver Meeting

NITIKA PANT PAI

Innovation Panel and presentation, Forum on Microbial Threats, U.S. National Academy of Science



The MUHC Data Warehouse is live!

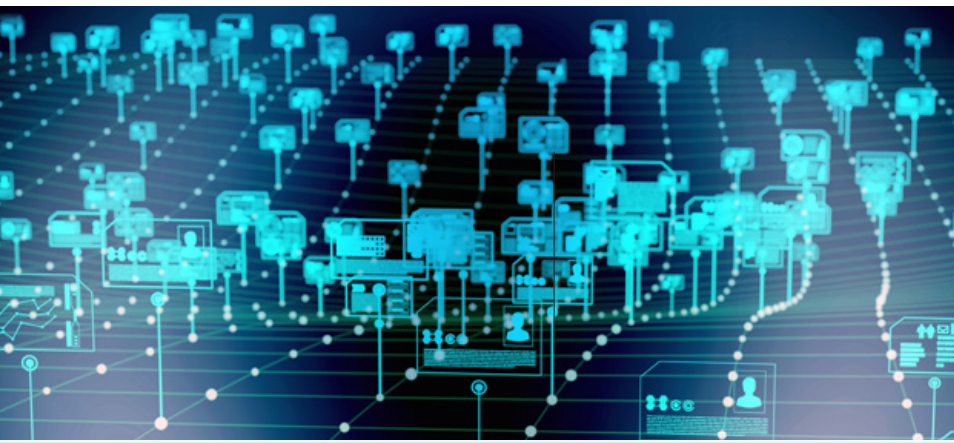
Launched September 2019, the McGill University Health Centre (MUHC) Data Warehouse centralizes healthcare data from many clinical and administrative systems.

Reinforcing the strictest data security requirements, this valu-

able resource improves the ability of MUHC staff and researchers at the Research Institute of the MUHC (RI-MUHC) to analyze complex health care-related data, increasing opportunities for new discoveries in research and innovative approaches in health-care delivery.

“The MUHC Data Warehouse will advance patient care and protect privacy by accelerating data-driven research and ensuring data security,” explains **Dr. David Buckeridge**, who conducts research at the RI-MUHC’s Centre for Outcomes Research and Evaluation. He is medical director of the MUHC Anonymized Data Warehouse, an important segment of the project that provides data without patient identifiers.

The MUHC Data Warehouse project was made possible by an infrastructure grant from the Canada Foundation for Innovation and carried out through exceptional collaborative efforts by teams at the RI-MUHC and MUHC. ◀◀



Roads to innovation: Centralized healthcare data

Introducing the Clinical Innovation Platform

The RI-MUHC will soon celebrate the launch of a bold new concept. Designed to foster health tech startups, the Clinical Innovation Platform (CLIP) is a state-of-the-art facility within the Montreal General Hospital of the MUHC.

“Our responsibility is to ensure that the practice of medicine tomorrow will be better than

the practice of medicine today,” says **Dr. Gerald Fried**, RI-MUHC researcher and medical director of the CLIP. “By identifying unmet clinical needs in the hospital, we can work with engineers and business experts to develop novel health technology products to meet these needs.”

As an interface for clinicians, engineers and entrepreneurs,

he explains, “the CLIP is a hub where ideas can be developed, prototypes created and tested, so these solutions can be brought to the marketplace and benefit the largest possible population.”

The CLIP is managed by the **Injury Repair Recovery Program** at the RI-MUHC; **Dr. Jake Barralet** serves as administrative director. ◀◀



The CLIP: Developing health technology products that meet patient needs

Oversight

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**Trainee Council representatives*

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SCIENTIST, WOMEN'S COLLEGE HOSPITAL



We are proud of our researchers' success in funding competitions and grateful to the wide range of organizations, including many not named here, whose support totalled **\$206 million** this year.

	2019–2020 \$
Canadian Institutes of Health Research	50,129,587
Foundations of the McGill University Health Centre (MUHC)*	28,600,000
Fonds de recherche du Québec—Santé	13,136,267
National Institutes of Health	6,113,753
Canada Research Chairs	5,815,000
Canada Foundation for Innovation—Research Hospital Fund	5,522,311
Natural Sciences and Engineering Research Council of Canada	5,015,349
Research Support Fund (Government of Canada)	4,984,870
Génome Québec and Genome Canada	4,473,234
Ministère de l'Économie et de l'Innovation	4,471,644
CQDM	2,419,068
Brain Canada	2,411,580
U.S. Department of Defense	2,285,793
International Progressive MS Alliance	2,221,603
Amyotrophic Lateral Sclerosis Society of Canada	1,538,923

Our worldwide network

Ongoing research collaborations with **61** countries



Biogen Inc.	1,478,372
Merck & Company, Inc.	1,405,643
Canadian Cancer Society (CCS) and CCS Research Institute	1,114,522
European Commission	1,095,747
Terry Fox Research Institute	1,083,560
Cancer Research UK	976,844
Public Health Agency of Canada	976,513
Bill & Melinda Gates Foundation	859,515
Michael J. Fox Foundation for Parkinson's Research	824,811
MITACS	747,001
Ministère de l'Éducation et de l'Enseignement supérieur	633,327
Gouvernement du Québec—Other departments	617,000
International Development Research Centre	606,023
Weston Brain Institute	601,914
Fonds de recherche du Québec—Nature et technologies	504,899
Multiple Sclerosis Society of Canada	484,545
Heart & Stroke	481,003

F. Hoffmann–La Roche Ltd.	462,981
Cystic Fibrosis Canada	453,656
Fonds de recherche du Québec—Société et culture	424,417
Sanofi Genzyme	410,606
MEDTEQ	410,413
Foundation for Innovative New Diagnostics	391,830
Costello Bequest Foundation	341,181
Structural Genomics Consortium	312,500
Other Industries	24,603,288
Other granting agencies	23,368,177
Other revenues	1,291,771

** The foundations of the MUHC include: Montreal General Hospital Foundation; McGill University Health Centre Foundation; Montreal Children's Hospital Foundation; Cedars Cancer Foundation; and The Auxiliary of the Montreal General Hospital. Their valuable contributions to research are highlighted on pages 30-32.*



Together we have the means to leverage discoveries that improve the health of patients across their lifespan



Dr. Marcel Behr, co-director of MI4 and senior scientist at the RI-MUHC

McGill University Health Centre Foundation (MUHCF)

Support for the RI-MUHC in 2019-2020: **\$16.8 million**

The McGill Interdisciplinary Initiative in Infection and Immunity (MI4) has received more than **\$4.6 million** from the MUHC Foundation for its **COVID-19 Emergency Fund**. This funding is driving dozens of ambitious research projects with principal investigators and researchers from the RI-MUHC, aiming to stop the spread of COVID-19 and to treat those hardest hit.

In addition to supporting the hospital's most urgent needs, the MUHC Foundation provided more than **\$1 million** to support recruitment and retention of top research talent at the RI-MUHC.

The Courtois Foundation made a historic **\$18 million** donation to the MUHC Foundation's \$50 million **Fix Broken Hearts Campaign**, which will transform cardiovascular care at the MUHC through cutting-edge research and innovation. This extraordinary gift will allow researchers and clinicians to jointly pioneer tomorrow's precision medicine in cardiovascular diseases. ◀◀

muhcfoundation.com



Researchers transforming cardiovascular care: **Drs. Ariane Marelli, Nadia Giannetti and Renzo Cecere**

A boon to patients and heart research!

The MUHC Foundation funded the purchase of a flagship **Cardiac Magnetic Resonance (MR) machine**, the 3T GE SIGNA™ Premier from GE Medical Systems, in September 2019.

The machine, which performs cutting-edge scans of the heart and vascular system, will provide the MUHC with unprecedented expertise in heart research, while considerably enhancing patient experience. ◀◀



Delivery of cutting-edge cardiac MRI machine to Glen site

The Montreal General Hospital Foundation (MGHF)



The MGHF is honoured to have contributed **\$7.7 million** to research projects during the last year. Our changing world makes innovation more vital than ever as we strive to overcome new challenges. That is why the MGHF is proud to support the RI-MUHC's new **Clinical Innovation Platform** (see p. 26).

In the early days of the COVID-19 crisis, the MGHF spurred innovation by launching the **Code Life Ventilator Challenge** in collaboration with the RI-MUHC. In just two weeks more than 2,600 individuals from 94 countries joined the sprint to design a simple, low-cost, easy-to-manufacture and easy-to-maintain ventilator, which could be deployed anywhere needed to save lives.

Thanks to our generous donors and sponsors for their vital support. ◀

codelife.ca



Reza Farivar-Mohseni, PhD, supervises tests for the Code Life Ventilator Challenge (top); Allergy and immunology team at the 2019 Research Awards Gala

The Auxiliary of the Montreal General Hospital



Working closely with the Montreal General Hospital (MGH) Foundation, MGH Auxiliary volunteers raise funds for the care and comfort of patients

and for medical research and medical equipment at the MGH site of the MUHC.

The Hospitality Corner at the MGH traditionally contributes tip money to the RI-MUHC. The **\$75,000** donation of "Tips for Research" in 2019 will help purchase

a cutting-edge microscope for the new **Clinical Innovation Platform** at the RI-MUHC (p. 26). ◀

mghauxiliary.ca



Tips for Research donation, November 2019

YOUR SUPPORT



Montreal Children's Hospital hematology-oncology team with **Julie Jaskolski**, Welcome and Family Services Adviser, Leucan, in 2018

The Montreal Children's Hospital Foundation

Support for the RI-MUHC in 2019-2020: **\$3,927,647**

The clinical studies of the RI-MUHC Child Health and Human Development (CHHD) Program are crucial to the development of treatments for pediatric diseases. Cancer is one of these pernicious diseases.

With the essential support of **Leucan**, the CHHD Program and Division of Oncology at the Children's work collaboratively with provincial and national partners on **clinical trials that provide hope** for a better future to children and teenagers stricken with cancer. Thank you, Leucan! ◀◀

fondationduchildren.com/en

Cedars Cancer Foundation

Thirty riders set out on the third annual Cedars Ride for Hope and Gratitude in the Eastern Townships, raising over **\$125,000** in support of the **Cedars-Laneuville Cell Therapy and Immunotherapy Initiative** for blood cancers led by **Dr. Pierre Laneuville**. Funds raised allow doctors, researchers and patients to benefit from this promising area of research in the fight against cancer.



"Hope and gratitude are the words I live by every day," explained **Rob Callard**, cancer survivor and the driving force behind this epic ride. "They are a constant reminder of the hope that we conquer this complicated disease, and the gratitude for life and for the wonderful people I have met who surround me in my life." ◀◀

cedars.ca

Research Institute of the McGill University Health Centre (RI-MUHC)

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rimuhc.ca

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