

RI-MUHC

Research Institute of the McGill University Health Centre



ACROSS THE LIFESPAN

Adult and Pediatric
Biomedical Research

Centre universitaire
de santé McGill
Institut de recherche



McGill University
Health Centre
Research Institute

2019 ANNUAL REPORT

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

**Our multidisciplinary
research environment
leverages discovery
to improve
human health**

**across
the
lifespan**





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Statistics	Represent fiscal year 2019 (April 1, 2018 to March 31, 2019), 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 September 2018 to June 2019
Counts	Active researchers are counted as of April 2019 Research trainees are counted as of July 2018 Staff are counted as of April 2019. Excludes researchers and trainees as well as staff located at the Montreal Neurological Institute and McGill Campus



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Le Groupe Quadriscan



446

active members,
including fundamental,
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1,184

research trainees,
including **359** M.Sc. and
461 PhD candidates,
214 postdocs and **150**
clinical research fellows

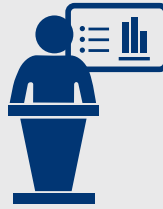


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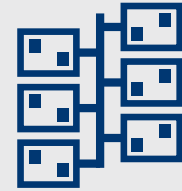
staff in research
and administration



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



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



Over **31,000**
square metres of
research space



412
research contracts and
406 agreements
signed



32
invention disclosures



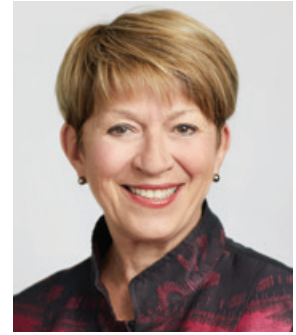
Ongoing research
collaborations with
67 countries

Message from Bruce Mazer and Louise Proulx

Research across the lifespan is one of the most defining features of the Research Institute of the McGill University Health Centre (RI-MUHC). We harness world-class strengths in child health research with top-flight research in related disciplines in adult medicine, surgery, nursing and rehabilitation. In 2018-2019 our successes included ground-breaking work relating to health outcomes in transplantation, infectious diseases, and unique patient self-monitoring applications, as well as fundamental research that stretches across the lifespan

in oncology, respiratory medicine, neurosciences and metabolic disease.

Complementing our Glen site facilities, this fall we will inaugurate newly renovated, state-of-the-art research facilities at the Montreal General Hospital of the MUHC, including a one-of-a-kind Surgical Innovation Platform developed by the McGill Department of Surgery and our Injury Repair Recovery Program.



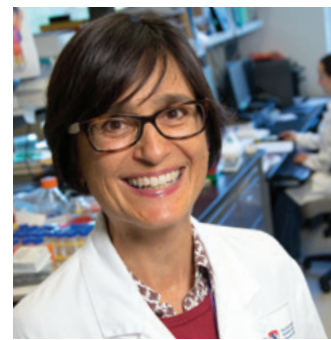
Bruce Mazer, MD, Executive Director and Chief Scientific Officer (Interim), RI-MUHC, and **Louise Proulx, PhD, ICD.D**, Chair of the Board of Directors (Interim), RI-MUHC

Read on to meet RI-MUHC scientists who are committed to innovation, attacking the most perplexing and complex health problems locally and globally. ◀◀

Message from Indra Gupta

Child health research is a fundamental mission of the RI-MUHC. Many ground-breaking medical discoveries have had a significant impact on the diagnosis, treatment and care of children locally, nationally and internationally. With the arrival of new talent, the outlook for research at the RI-MUHC is full of promise. Together, clinicians and scientists will accelerate scientific advances and stimulate cooperation towards providing innovative therapies for children's diseases.

We are thankful for the invaluable partnership and collaboration of the Montreal Children's Hospital Foundation, which provides a new vision for funding and a sustainable environment for the advancement of the health of our children and beyond. Research is the hope of improving children's health for a future filled with more smiles, laughter and play! ◀◀



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

Message from the McGill University Health Centre (MUHC)

In 2018-2019, the Research Institute of the MUHC distinguished itself through interdisciplinary efforts that advanced our understanding of the biological and socioeconomic determinants of health and disease while furthering the goals and skills of over 1,200 trainees (M.Sc., PhD, postdocs and fellows). In parallel, it began charting a course to help it navigate the winds of change caused by Omics, artificial intelligence and the data revolution, etc.

We thank Dr. Bruce Mazer, interim executive director and chief scientific officer, Dr. Indra Gupta, interim deputy executive director

and deputy chief scientific officer, the program leaders, corps of over 440 researchers, and staff for their collective accomplishment. We also recognize our foundations and governmental/non-governmental funders for supporting the pursuit of excellence and innovation.

With the recruitment process for a permanent leader under way, we're setting our sights on a new year of exceptional research that



Peter Kruyt, Chairman of the Board of Directors, and Pierre Gfeller, MD, CM, MBA, President and Executive Director

capitalizes on curiosity, knowledge, collaboration and interaction with patients of all ages. This report presents a glimpse of what's possible. Thank you for exploring it! ◀◀

Message from McGill University

Disease does not discriminate based on age. From birth to end of life, humans must work diligently to maintain their health when confronted with any number of illnesses. Today, researchers at McGill University and the RI-MUHC are shifting the paradigm in the way we approach these challenges, from cancer to infectious and inflammatory diseases to cardiovascular disorders.

The work highlighted in this report provides outstanding examples of how our scientists are collaborating across fields and leveraging data to tackle

some of humanity's greatest health challenges *across the lifespan*. This important research is laying the foundation for more effective and personalized treatments. These, in turn, will reduce health care costs and ultimately keep Canadians healthier, longer. McGill is proud to continue collaborating with the RI-MUHC to support this ground-breaking work.



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



We take this opportunity to congratulate our colleagues and friends at the RI-MUHC on yet another successful year. We look forward to continue pushing boundaries together for the people we serve. ◀◀

Challenging the boundaries of pediatric and adult medicine, scientists at the Research Institute of the McGill University Health Centre (RI-MUHC) are on the front line of studies with a direct impact on patient populations. The result: longer, healthier lives for people with a wide range of conditions.

Biomedical research across the lifespan

Exploring the immune system to redefine aging and delabel allergies *p.7*

Understanding congenital heart disease across the lifespan *p.9*

Headway in the fight against cystic fibrosis *p.10*

Bridging the gap between pediatric oncologists and geneticists *p.11*



Christos Tsoukas, MD (front row, centre) with members of his team

Exploring the immune system to redefine aging and de-label allergies

“I hypothesize that the immune system’s aging is a major factor in why older people are likelier to get cardiovascular diseases and cancers,” says Dr. Christos Tsoukas, member of the Infectious Diseases and Immunity in Global Health (IDIGH) Program at the RI-MUHC. “But we often encounter people who develop cardiovascular disease at an early age, despite living healthily, and others who do everything wrong and live to a ripe old age. So my research team is trying

to develop a definition of age according to a biological rather than a chronological clock.”

This research involves studying the mechanism of aging,

“My research team is studying the mechanisms of aging to develop a definition of age according to a biological rather than a chronological clock.”

—Dr. Christos Tsoukas

and better defining the rate of aging according to epigenetic changes in DNA. Once biological age can be assessed, Dr. Tsoukas can apply it in his other studies into advanced aging occurring in people with human immunodeficiency viruses (HIV) and other immunological complications that reduce the body’s capacity to fight chronic infections. “So one long-term objective of our research is to learn how HIV accelerates biological age as measured through a biological clock,” he says.



Moshe Ben-Shoshan, MD

Dr. Moshe Ben-Shoshan (IDIGH Program) is transforming how we approach another common immunological condition in pediatric and adult populations: allergies. While almost ten percent of all Canadians, about 3.5 million people, believe they are allergic to penicillin, his research in the last five years with Dr. Tsoukas and others reveals that this number is a gross inflation. Only a small proportion of these individuals—perhaps five percent—are actually allergic, he finds,

and most supposedly allergic responses are in fact responses to viral infections.

The “allergy” label bears significant consequences. “It means these patients are not treated with amoxicillin and penicillin, the main antibiotics used to fight infections. Instead, we use others that have more side effects, are more harmful and expensive, and less effective,” explains Dr. Ben-Shoshan. He has established a cross-Canada registry to collect and interpret data on the diagnosis and management of antibiotic allergies among children. This research has had an immediate

“We challenged all cases presenting with suspected reactions to amoxicillin and found that only two percent had immediate reactions, only four percent had delayed reactions, and all were very mild,” he says. “So we’ve promoted a paradigm shift in how to diagnose these allergies.”

Dr. Ben-Shoshan has also established registries of individuals with food allergies and those experiencing anaphylaxis. “The main knowledge gaps for allergies are related to epidemiology, and we were lacking good Canadian data, which led me to develop large registries of children with these allergies,” he

DID YOU KNOW?

Reducing the number of people labelled with penicillin allergies can minimize detrimental clinical outcomes, optimize operating room time and save costs

impact on how such allergies are diagnosed and treated, and it is attracting international attention.

says. “The data these registries reveal have direct clinical applications.” ◀◀



Understanding congenital heart disease across the lifespan

Not long ago, research in congenital heart disease (CHD) was confined to pediatrics, as

few patients lived beyond childhood. “But while the last three decades have seen a rapidly growing population of adults with CHD, it remains a new field, with robust scientific inquiry lagging behind other cardiovascular specialties,” says Dr. Ariane Marelli, leader of the Cardiovascular Health Across the Lifespan Program. Having joined the MUHC in the late 1990s, in 2005 she established the McGill Adult Unit for Congenital Heart Disease Excellence, or MAUDE (named after CHD pioneer Maude Abbott), which laid the groundwork for the Quebec Congenital Heart Disease Database and the research that followed.

The Quebec Congenital Heart Disease Database draws on Quebec government data that captures every CHD patient in the province from 1982 to 2017, giving Dr. Marelli’s team longitudinal follow-ups from over 30 years—and making it the world’s largest database of its kind.

“Our initial studies after establishing the database were among the first in the world to document the change in prevalence and demographics in the CHD population,” Dr. Marelli notes.



Ariane Marelli, MD (right) with data analyst Chao Li, M.Sc. (left) and biostatistician Aihua Lu, PhD

Subsequently, her team explored specific challenges being faced by patients and their outcomes, then considered how to improve these outcomes by tracking how care was delivered in Quebec and how it could be enhanced. “We found we were able to improve

the Centers for Disease Control and Prevention. “We’re seeing the first generation of many of these patients, so when they ask us what’s going to happen in the future, we can’t really answer that question,” says Dr. Marelli. “We’re following them

for surveillance, for prevention, for complications and treatment of complications, in order to improve their quality of life.” She adds, “What we are learning from

Among the first to document changes in prevalence and demographics in the congenital heart disease population

patients’ lives significantly,” she says.

Dr. Marelli’s research has provided data supporting the creation and promotion of clinical centres for adults with CHD in Canada and abroad, notably in the U.S., through her collaborations with

our research in this population is becoming widely applicable to a growing population of patients with a wide range of conditions that prevail over a patient’s lifespan.” ◀◀

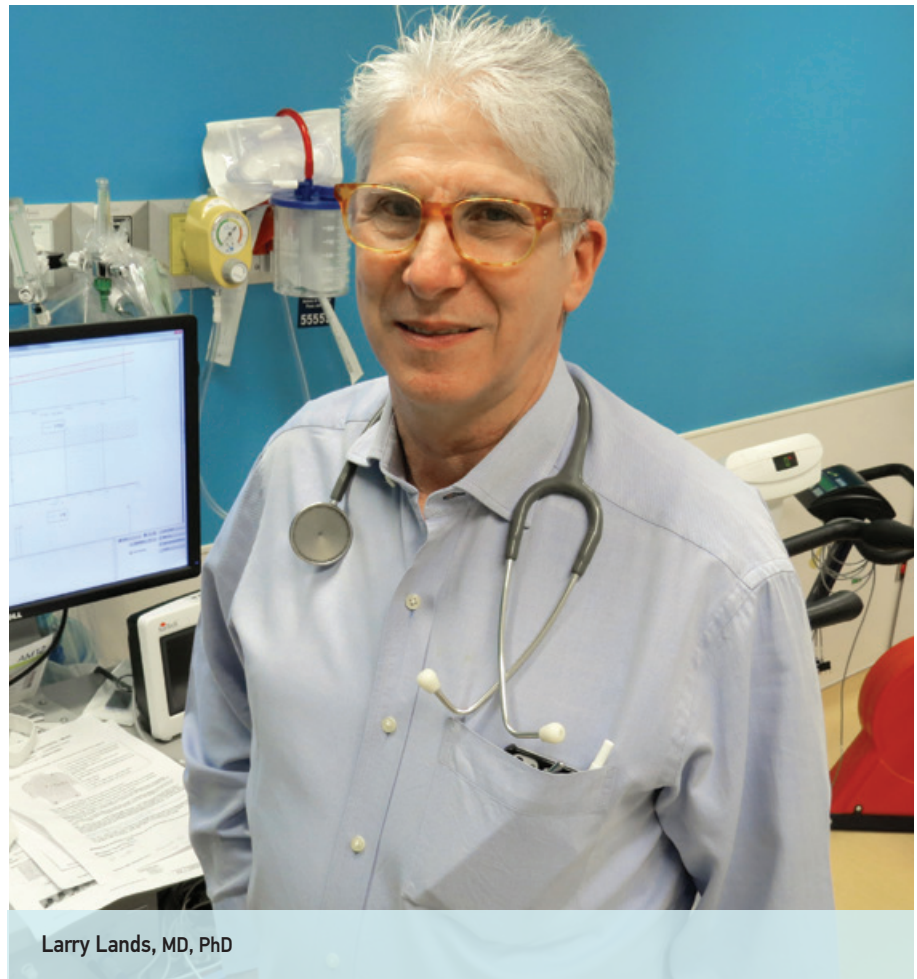
Headway in the fight against cystic fibrosis

Cystic fibrosis (CF) is a genetic disorder that affects one in 3,600 children born in Canada;

currently, some 4,300 Canadians attend specialized CF clinics. That number is on the rise for a good reason: over half of the CF patients in Canada are now adults, thanks to therapeutic breakthroughs enabling patients to live much longer.

“CF is no longer solely a pediatric disease,” says **Dr. Larry Lands**, a member of the Translational Research in Respiratory Diseases Program and clinician-scientist whose thirty-plus years of ground-breaking research have contributed significantly to this development. Most recently, his team’s research contributed to the Quebec government’s implementation of newborn screening for CF in 2018 – becoming the last North American jurisdiction to do so.

Dr. Lands’s analysis of clinical activities demonstrated that screened infants from elsewhere in Canada were less sick in the six years following diagnosis than Quebec children were. “In Quebec we had been playing catch-up, diagnosing children after they had become sick rather than giving them preventative therapies,” he says. “I’m proud that Quebec children can benefit directly from our research, because early screening allows therapies to be put in place right away.”



Larry Lands, MD, PhD

Balancing an active fundamental research laboratory with clinical research, Dr. Lands continues to explore promising new treatments,

inflammation, a major cause of disability and death in CF. This work is the fruit of his longstanding collaboration with RI-MUHC

researchers **Danuta Radzioch, PhD**, and **Elias Matouk, MD**, whose development of a new target for cystic fibrosis was featured in the 2016-2017 RI-MUHC annual report.

“Cystic fibrosis is no longer solely a pediatric disease,” says Dr. Larry Lands— who is no longer solely a child health researcher

expanding his original scope as a pediatric researcher. A major ongoing project, now in Phase II clinical trials, involves fenretinide, a chemical compound related to vitamin A that could help reduce the frequency and severity of lung

“It’s very exciting to see that cell culture work we began in the lab and carried through in animal models is now being evaluated in patients,” says Dr. Lands. ◀◀

Bridging the gap between pediatric oncologists and geneticists

While approximately eight to ten percent of children who develop cancer have an underlying genetic syndrome, pediatric oncologists have had little guidance in identifying and responding to this genetic component.

Currently, the process for referring children for genetics evaluation depends on an institution's policies and the oncologist's level of experience. "This wide range creates an inequity in children being identified with a genetic syndrome," says **Dr. Catherine Goudie** of the Child Health and Human Development Program. That's changing, though, thanks to her collaboration with **Dr. William Foulkes** of the Cancer Research Program.

Now an assistant professor of pediatrics, Dr. Goudie was a hematology-oncology resident when she met Dr. Foulkes to discuss patients they shared at the Montreal Children's Hospital of the MUHC. She then joined his research lab, where

the blend of his genetics expertise and her pediatric oncology focus led to a novel idea: the creation of a guide to help pediatric oncologists refer children with cancer for genetic evaluation.

"We decided to produce an app for phones, tablets or computers," says Dr. Foulkes. "Doctors could click on an icon and get a

A bright future for pediatric cancer genetics research at the RI-MUHC

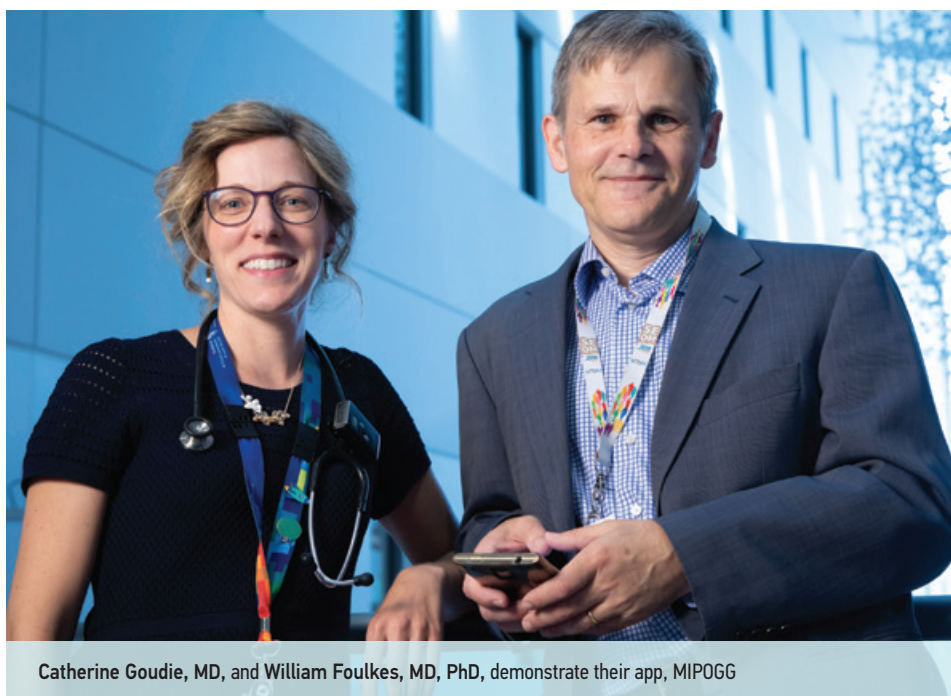
guideline to genetic syndromes and cancer." Dr. Goudie led a global literature review on genetic predispositions to cancer in children and coordinated team efforts in research and algorithm development, enlisting collaborators from the Hospital for Sick Children and RI-MUHC. The result: MIPOGG, or the McGill

Interactive Pediatric Oncogenetics Guidelines.

"MIPOGG fills the gap between pediatric hematologists-oncologists and geneticists," says Dr. Goudie. Doctors answer focused "yes or no" questions related to the type of cancer, where the tumour is localized, the patient's age and family history, and so forth. "Press 'Submit,' and right away you receive a recommendation for whether or not to refer the patient for genetic counseling and testing, along with an educational module explaining the recommendation," explains Dr. Foulkes.

MIPOGG is already in demand. "We get emails from people around the world wanting to use it, and a group in the Netherlands has asked to use it at the national level," says Dr. Goudie. "Responses like that are extremely motivating."

Equally motivating is the mentorship story between two clinician-scientists that opened a bright future for pediatric cancer genetics research at the RI-MUHC. ◀◀



Catherine Goudie, MD, and William Foulkes, MD, PhD, demonstrate their app, MIPOGG

Brain Repair and Integrative Neuroscience Program (BRaIN)



RESEARCH HIGHLIGHTS

Canadians aging well

- Baseline data report (2010-2015) released this year for ground-breaking, 20-year Canadian Longitudinal Study on Aging
- **Christina Wolfson, PhD**, is co-principal investigator



Christina Wolfson, PhD

Regulatory mechanism for sleep

- New mechanism for regulating sleep, discovered in fruit flies, involves glial cells in the brain and their ability to manage a common ingredient in energy drinks
- **Don Van Meyel, PhD**, collaborated with Florida Atlantic University scientists
- First co-author: research associate **Emilie Peco, PhD** (*Current Biology*)



Adult *Drosophila* and its brain (Photo: Emilie Peco)

Youth, depression and cannabis

- **Gabriella Gobbi, MD, PhD**, demonstrated that young people consuming cannabis are at risk of developing depression and suicidal behaviour (*JAMA Psychiatry*)
- Highlights the need for initiatives educating teenagers on risks of cannabis use and skills to resist peer pressure

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Gabriella Gobbi, MD, PhD, and her research team

Cancer Research Program (CRP)



RESEARCH HIGHLIGHTS

Prize-winning patient empowerment app

- The **Opal** patient portal app gives patients access to contextualized medical data and personalized educational material (opalmedapps.com)
- Developed by Opal Health Informatics Group, co-led by **John Kildea, PhD**, the late **Laurie Hendren, PhD**, and **Tarek Hijal, MD**
- Multiple honours include Prix d'excellence, Réseau de la Santé et des Services sociaux and honourable mention, Institute for Patient- and Family-Centered Care



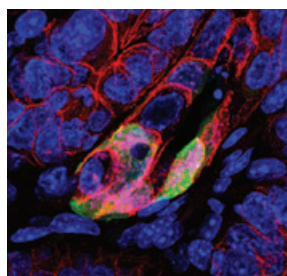
CRP Trainee Council members

New stem cell sheds light on body's defense mechanisms

- RI-MUHC and Lunenfeld-Tanenbaum Research Institute team discovered "revival stem cell" in the gut epithelium
- Understanding these cells—and signals underlying their potent regenerative potential—could lead to novel therapeutic options for illnesses affecting the gut
- **Alex Gregorieff, PhD**, is co-lead study author (*Nature*)



Alex Gregorieff, PhD



Revival stem cells in the gut

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Cardiovascular Health Across the Lifespan Program (CHAL)



RESEARCH HIGHLIGHTS

Infertility treatment and pregnancy complications

- Researchers at ICES, RI-MUHC and St. Michael's Hospital found that women who become pregnant using infertility treatments, such as in vitro fertilization, have a higher risk of serious complications in pregnancy
- Identifying women at risk could help avert negative outcomes
- **Natalie Dayan, MD**, is lead study author (*CMAJ*)



Poster presentations at the Glen site

Minimizing complications from surgery in elderly patients

- International study led by the RI-MUHC and Lady Davis Institute (Jewish General Hospital) evaluated the relationship between frailty and risk of mortality, following transcatheter or surgical aortic valve replacement
- Use of frailty as a risk predictor and therapeutic target could empower clinicians in caring for most vulnerable patients
- **Jonathan Aflalo, MD**, is lead study author (*JACC: Cardiovascular Interventions*)



Cardiovascular Research Day 2019

SELECTED PUBLICATIONS

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Child Health and Human Development Program (CHHD)



RESEARCH HIGHLIGHTS

New approach to genetic kidney disease in children

- **Paul Goodyer, MD**, spearheads North American efforts to develop a novel drug for nephropathic cystinosis—especially prevalent in Quebec
- Strategy bypasses mutation and reverses disease phenotype
- Clinical trial approved by Health Canada



Dr. Paul Goodyer's team



Child Health Research Day 2019

Genetic factors in pregnancy loss revealed

- **Rima Slim, PhD**, discovered genes whose mutations explain why some women repeatedly lose pregnancies
- First step towards finding a way to help these women achieve their dream of creating a family

Rise in suicidal behaviour in children and teens

- Over 100 Canadian and U.S. news outlets interviewed **Brett Burstein, MD**, about finding a steep increase in children's suicidal behaviour between 2007 and 2015 (*JAMA Pediatr.*)
- Underlines critical need to increase resources for mental health services



SELECTED PUBLICATIONS

Dongsic Choi, Laura

Montermini, Dae-kyum Kim, **Brian M. Meehan**, Frederick P. Roth, **Janusz W. Rak**. The impact of oncogenic egfrviii on the proteome of extracellular vesicles released from glioblastoma cells. *Molecular and Cellular Proteomics* 17(10):1948-1964, 2018.

Jan M. Friedman, Yvonne Bombard, Martina Cornelia Cornel, Conrad V. Fernandez, Anne K. Junker, Sharon E. Plon, Zornitza L. Stark, **Bartha Maria Knoppers**. Genome-wide sequencing in acutely ill infants: genomic medicine's critical application? *Genetics in Medicine* 21(2):498-504, 2019.

Ngoc Minh Phuong Nguyen, Zhaojia Ge, Ramesh Reddy, **Somayyeh Fahiminiya**, Philippe G. Sauthier, Rashmi Bagga, Feride Iffet Şahin, Sangeetha K. Mahadevan, Matthew Miles Osmond, Magali Bréguet, Kurosh Rahimi, Louise Lapensée, Karine Hovanes, Radhika Srinivasan, Ignatia B. van den Veyver, Trilochan Sahoo, **A. Ao, Jacek Majewski, Teruko Taketo, Rima Slim**. Causative Mutations and Mechanism of Androgenetic Hydatidiform Moles. *American Journal of Human Genetics* 103(5):740-751, 2018.

Renata H. Bahous, Marta Cosín-Tomás, Liyuan Deng, **Daniel Leclerc**, Olga V. Malysheva, Mingkai Ho, Mercè Pallás, Perla Kaliman, **Barry J. Bedell**, Marie A. Caudill, **Rima R. Rozen**. Early Manifestations of Brain Aging in Mice Due to Low Dietary Folate and Mild MTHFR Deficiency. *Molecular Neurobiology* 56(6):4175-4191, 2019.

Sonia M. Grandi, Kristian B. Fillion, Sarah Yoon, Henok Tadesse Ayele, Carla M. Doyle, Jennifer Anne Nne Hutcheon,

Graeme Neil Smith, Genevieve C. Gore, Joel G. Ray, Kara A. Nerenberg, **Robert W. Platt**. Cardiovascular Disease-Related Morbidity and Mortality in Women with a History of Pregnancy Complications: Systematic Review and Meta-Analysis. *Circulation* 139(8):1069-1079, 2019.

Tamara M. Pringsheim, Yolanda Holler-Managan, Michael S. Okun, Joseph Jankovic, John Piacentini, Andrea E. Cavanna, Davide Martino, Kirsten R. Müller-Vahl, D. W. Woods, Michael Robinson, Elizabeth Jarvie, Veit Rössner, **Maryam Oskoui**. Comprehensive systematic review summary: Treatment of tics in people with Tourette syndrome and chronic tic disorders. *Neurology* 92(19):907-915, 2019.

Tomoko Takano, Eric Bareke, Naoki Takeda, Lamine Aoudjit, Cindy Baldwin, Philip Pisano, **Jun Matsuda, Jasmine El Andaloussi**, Lina Muhtadie, Chantal Bernard, **Jacek Majewski**, Toru Miyazaki, Kenichi Yamamura, **Indra Rani Gupta**. Recessive mutation in CD2AP causes focal segmental glomerulosclerosis in humans and mice. *Kidney International* 95(1):57-61, 2019.

Xun Zhang, Kate M. Tilling, Richard Michael Martin, Emily Oken, Ashley Isaac Naimi, Izzuddin M. Aris, Seungmi Yang, **Michael S. Kramer**. Analysis of 'sensitive' periods of fetal and child growth. *International Journal of Epidemiology* 48(1):116-123, 2019.

Metabolic Disorders and Complications Program (MeDiC)



RESEARCH HIGHLIGHTS

Artificial pancreas regulates glucose levels

- **Ahmad Haidar, PhD**, led a team of MeDiC and Child Health and Human Development Program (CHHD) researchers to develop an artificial pancreas
- Dual-hormone, electromechanical system delivers insulin and pramlintide to regulate glucose levels in type 1 diabetes
- Achieved better glucose control than a first-generation, insulin-alone system in clinical trial

Helping young people cope with diabetes stigma

- **Kaberi Dasgupta, MD**, with national team including MeDiC colleagues and **Meranda Nakhla, MD (CHHD)**, created a Virtual Patient Network (youngdiabetes1.ca) for youth with type 1 diabetes to exchange experiences and strategies
- Peer-to-peer network provides platform to reduce stigma and live with type 1 diabetes



Patient co-author **Michael Wright**, Dr. **Kaberi Dasgupta** and research assistant **Debbie Chan**

SELECTED PUBLICATIONS

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Cécile Aenishaenslin, Barbara Häslér, André Ravel, Jane Parmley, Katharina D.C. Stärk, **David Llewellyn Buckeridge**. Evidence needed for antimicrobial resistance surveillance systems. *Bulletin of the World Health Organization* 97(4):283-289, 2019.

David D. Cheishvili, Surabhi Parashar, **Niaz Mahmood**, Ani Arakelian, **Richard B. Kremer, David Goltzman**, Moshe Szyf, **Shafaat Ahmed Rabbani**. Identification of an Epigenetic Signature of Osteoporosis in Blood DNA of Postmenopausal Women. *Journal of Bone and Mineral Research* 33(11):1980-1989, 2018.

Erin S. Coyne, Nathalie Bédard, Yingjia Gong, May Faraj, André Tchernof, **Simon S. Wing**. The deubiquitinating enzyme USP19 modulates adipogenesis and potentiates high-fat-diet-induced obesity and glucose intolerance in mice. *Diabetologia* 62(1):136-146, 2019.

G.B. John Mancini, Alice Y.Y. Cheng, Kim Connelly, David H.

Fitchett, Ronald M. Goldenberg, Shaun Goodman, Lawrence A. Leiter, Eva Marie Lönn, Brey W. Paty, Paul P. Poirier, James A. Stone, David M. Thompson, Subodh Verma, Vincent C. Woo, **Jean François Yale**. CardioDiabetes: Core Competencies for Cardiovascular Clinicians in a Rapidly Evolving Era of Type 2 Diabetes Management. *Canadian Journal of Cardiology* 34(10):1350-1361, 2018.

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Stephen J. Marx, **David Goltzman**. Evolution of Our Understanding of the Hyperparathyroid Syndromes: A Historical Perspective. *Journal of Bone and Mineral Research* 34(1):22-37, 2019.

Ziyun Wu, Megan M. Senchuk, Dylan J. Dues, Benjamin K. Johnson, Jason F. Cooper, Leira Lew, Emily Machiela, Claire E. Schaar, Heather DeJonge, T. Keith Blackwell, **Jeremy M. Van Raamsdonk**. Mitochondrial unfolded protein response transcription factor ATFS-1 promotes longevity in a long-lived mitochondrial mutant through activation of stress response pathways. *BMC Biology* 16(1):147, 2018.



MeDiC Program Research Day 2019

Infectious Diseases and Immunity in Global Health Program (IDIGH)



RESEARCH HIGHLIGHTS

“Bubble boy” symptoms discovered in adults

- Don Vinh, MD, discovered a new disease, “combined immunodeficiency,” and its genetic cause in an adult Quebec patient
- Link to “Bubble Boy disease” in children opens the door to potential treatment
- First study author (*JEM*): research associate Lucie Roussel, PhD

Arthritis drugs potentially safe for expectant mothers

- Évelyne Vinet, MD, PhD, and colleagues showed that pregnant women may use certain rheumatoid arthritis drugs without increased health risks to the unborn baby (*Arthritis Rheumatol.*)

Equitable access to treatment for low-income HIV patients

- Jean-Pierre Routy, MD, demonstrated the need to consider socio-economic factors to better control the HIV epidemic in Canada
- First study author (*JIAS*): postdoc Vikram Mehraj, PhD



IDIGH Program Research Day 2019

SELECTED PUBLICATIONS

Dušan Garić, Juan B. De Sanctis, Juhi D. Shah, Daciana Catalina Dumut, Danuta Radzioch. Biochemistry of very-long-chain and long-chain ceramides in cystic fibrosis and other diseases: The importance of side chain. *Progress in Lipid Research* 74:130-144, 2019.

Évelyne Vinet, Cristiano Soares de Moura, Christian A. Pineau, Michal Abrahamowicz, Jeffrey R. Curtis, Sasha R. Bernatsky. Serious Infections in Rheumatoid Arthritis Offspring Exposed to Tumor Necrosis Factor Inhibitors: A Cohort Study. *Arthritis and Rheumatology* 70(10):1565-1571, 2018.

Fernando Alvarez, Roman Istomine, Mitra Shourian, Nils Pavey, Tho Fakar Al-Aubodah, Salman T. Qureshi, Jörg. Hermann Fritz, Ciriaco A. Piccirillo. The alarmins IL-1 and IL-33 differentially regulate the functional specialisation of Foxp3+ regulatory T cells during mucosal inflammation. *Mucosal Immunology* 12(3):746-760, 2019.

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Michelle Le, **Sofianne Gabrielli, Ann Elaine Clarke, Harley O. Eisman, Judy Morris, Jocelyn Gravel, Edmond S. Chan, Rodrick K. Lim, Andrew W. O’Keefe, Greg Shand, Moshe Ben-Shoshan.** Emergency Management of Anaphylaxis Due to an Unknown Trigger: An 8-Year Follow-Up Study in Canada. *Journal of Allergy and Clinical Immunology: In Practice* 7(4):1166-1173.e1, 2019.

Sophie Restellini, Cheyung Chao, Myriam Martel, **Alan N.G. Barkun, Omar Kherad, Ernest G. Seidman, Gary E. Wild, Alain Bitton, Waqqas Aff, Talat Bessissow, Péter László Lakatos.** Clinical Parameters Correlate With Endoscopic Activity of Ulcerative Colitis: A Systematic Review. *Clinical Gastroenterology and Hepatology* 17(7):1265-1275.e8, 2019.

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Injury Repair Recovery Program (IRR)



RESEARCH HIGHLIGHTS

Prehabilitating patients for surgery

- **Francesco Carli, MD**, who leads the MUHC Peri-Operative Program (POP), has shown that strengthening a patient's physical, nutritional, medical and mental conditions before surgery can shorten recovery time and improve outcomes



Francesco Carli, MD (left), and research coordinator Rashami Awasthi (right), with a patient optimizing fitness before surgery

Revolutionary app monitors wound care

- **Gregory Berry, MD**, worked with Swift Medical to develop Swift Skin and Wound, an app that measures and charts wound progression
- Accurate wound tracking allowed for objective evaluation of treatment strategies and greater patient engagement



Sheila Wang, MD, of Swift Medical and Gregory Berry, MD

SELECTED PUBLICATIONS

Alison Fraser, Zishuai Zhang, Géraldine E. Merle, Uwe Gbureck, Siyu Ye, Jeff T. Gostick, Jake E. Barralet. Composite Carbon Nanotube Microsphere Coatings for Use as Electrode Supports. *Advanced Functional Materials* 28(46), 2018.

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Nicholas Mikolajewicz, Elizabeth A. Zimmermann, Bettina M. Willie, Svetlana V. Komarova. Mechanically stimulated ATP release from murine bone cells is regulated by a balance of injury and repair. *eLife* 7:e37812, 2018.

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Translational Research in Respiratory Diseases Program (RESP)



RESEARCH HIGHLIGHTS

Anti-TB drugs can increase risk of TB re-infection

- **Irah King, PhD, Maziar Divangahi, PhD, and Dick Menzies, MD**, investigated whether changes in composition of microbes living in our gut may influence tuberculosis (TB) infection
- Results show that anti-TB drugs cause changes in gut microbiota, compromising immunity
- First study author (*Mucosal Immunology*): postdoc **Nargis Khan, PhD**

New means to fight “un-killable” bacteria in healthcare settings

- **Dao Nguyen, MD**, identified a new cellular target to weaken the bacterium *P. aeruginosa* – a severe threat to patients with cystic fibrosis
- Promising cellular target could expand utility of antibiotics and make new ones more effective
- First study author (*PNAS*): postdoc **Dorival Martins Jr., PhD**



Trainees at Respiratory Research Day 2019



SELECTED PUBLICATIONS

Thierry Troosters, François Maltais, Nancy Kline Leidy, Kim L. Lavoie, Maria Fernanda Sedeno, Wim Janssens, J. Garcia-Aymerich, Damijan Erzen, Dorothy de Sousa, Lawrence Korducki, Alan L. Hamilton, **Jean C. Bourbeau**. Effect of bronchodilation, exercise training, and behavior modification on symptoms and physical activity in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine* 198(8):1021-1032, 2018.

Basil J. Petrof. Diaphragm Weakness in the Critically Ill: Basic Mechanisms Reveal Therapeutic Opportunities. *Chest* 154(6):1395-1403, 2018.

Dorival Martins, Geoffrey A. McKay, **Gowthami Sampathkumar**, Malika Khakimova, Ann M. English, **Dao Nguyen**. Superoxide dismutase activity confers (p)ppGpp-mediated antibiotic tolerance to stationary-phase *Pseudomonas aeruginosa*. *Proceedings of the National Academy of Sciences of the United States of America* 115(39):9797-9802, 2018.

Erwan Pernet, Jeffrey Downey, Donald C. Vinh, William S. Powell, Maziar Divangahi. Leukotriene B₄-type I interferon axis regulates macrophage-mediated disease tolerance to influenza infection. *Nature Microbiology* 4(8):1389-1400, 2019.

Gijs Ijpma, Chuqiao Liang, Linda Hussein Kachmar, **Alice Panariti, Andrea L. Benedetti, Jean Pierre Lavoie, Anne Marie. Lauzon**. Maintenance of contractile function of isolated airway smooth muscle after cryopreservation. *American Journal of Physiology–Lung Cellular and Molecular Physiology* 315(5):L724-L733, 2018.

Hedi Zhao, Vanessa Moarbes, Véronique Gaudreault, Jichuan Shan, Haya Aldossary, Louis Cyr, Elizabeth D. Fixman. Sex Differences in IL-33-Induced STAT6-Dependent Type 2 Airway Inflammation. *Frontiers in Immunology* 10:859, 2019.

Mitra Shourian, Salman T. Qureshi. Resistance and tolerance to cryptococcal infection: An intricate balance that controls the development of disease. *Frontiers in Immunology* 10(JAN), 2019.

Nargis Khan, Laura E. Mendonça, Achal Dhariwal, Ghislaine Fontés, **Dick Menzies**, Jianguo Xia, **Maziar Divangahi, Irah King**. Intestinal dysbiosis compromises alveolar macrophage immunity to *Mycobacterium tuberculosis*. *Mucosal Immunology* 12(3):772-783, 2019.

What is our new generation of researchers achieving today?

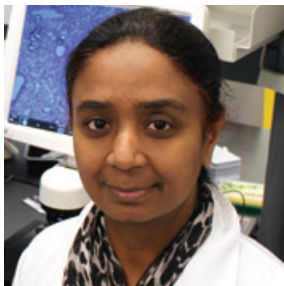


Two awards at 2019 International AIDS Society Conference on HIV Science

Stéphane Isnard, PhD, postdoctoral fellow

Supervisor: **Jean-Pierre Routy, MD**, Infectious Diseases and Immunity in Global Health Program

The only Canadian to receive an award at this “gold standard” conference, Stéphane Isnard earned both the **Dominique Dormont Award** and **Lange/van Tongeren Prize for Young Investigators** for his top-scoring abstract in the Basic Science track. His work is on gut permeability in human immunodeficiency virus (HIV).



First author of study published in *Mucosal Immunology*

Nargis Khan, PhD, postdoctoral fellow

Supervisor: **Maziar Divangahi, PhD**, and **Irah King, PhD**, Translational Research in Respiratory Diseases Program

Nargis Khan holds a CIHR fellowship supplemented by the FRQS. She is first author of the study featured on page 19 of this report, showing that anti-tuberculosis (TB) drugs caused changes to gut microbiota—the diverse community of microbes living in our intestines—and increased susceptibility to *Mtb* infection (*Mucosal Immunology* 12, 772–783, 2019).

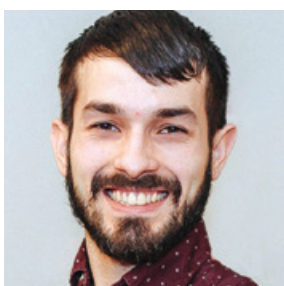


Human Frontier Science Program (HFSP) Long-Term Postdoctoral Fellowship

Claire Gizowski, doctoral student

Supervisor: **Charles Bourque, PhD**, Brain Repair and Integrative Neuroscience (BRaIN) Program

Ranked first of 626 in the CIHR postdoctoral competition, Claire Gizowski will be forging ahead with a prestigious international fellowship instead. The HFSP funds frontier, potentially transformative research addressing an important problem or barrier to progress in a life sciences field. Her project aims to better define the mechanisms by which the brain measures internal body temperature.



Marika Zelenka Roy Innovation Prize, McGill Clinical Innovation Competition

Liam Carroll, Master's student

Supervisor: **Shirin Abbasinejad Enger, PhD**, Cancer Research Program

With Gustavo Kertzscher, PhD (Arhus University, Denmark), Liam Carroll and his supervisor developed **BetaSense**, a high-performing detector that could allow nuclear medicine imaging techniques to be performed non-invasively in a greater number of clinics. The detector will enable non-invasive dynamic positron emission tomography (PET), leading to early diagnosis of cancer and neurodegenerative diseases and earlier cancer treatment outcomes.



Liam Carroll explains high-performing detector, BetaSense

Rigorous scientific training and career development is an integral part of our mission at the RI-MUHC

Preparing our trainees for careers in science and beyond, the **Desjardins Centre for Advanced Training (DCAT)** is the only centre within a Quebec health research institute that offers structured career support alongside graduate or postdoctoral training.

Through year-round events and training sessions, DCAT helps RI-MUHC trainees

- Explore different careers
- Set career goals
- Make faster career transitions

Where are some of our recent trainees now? Here are only a few, succeeding in high-profile sectors on and off the beaten path!



Career Day Networking Event, RI-MUHC Atrium, November 2018



Christina Sooklall, M.Sc.

RI-MUHC trainee from 2015 to 2018

To launch her consulting career, Christina Sooklall combined research on online patient communities during her M.Sc. with a Graduate Certificate in Business Administration, offered by DCAT with the John Molson School of Business at Concordia University. She now works as a **Business Technology Analyst** with **Deloitte**.



Martin Rupp, DPharm, PhD

RI-MUHC trainee from 2014 to 2018

Acting on DCAT's advice to secure an internship at the end of his doctoral work, Martin Rupp gained valuable industry experience to complement his research in drug discovery. This led to his most recent position of **Medical Affairs Fellow in Oncology** at **Pfizer Canada**.



Saber Ghadakzadeh, MD, M.Sc., PhD

RI-MUHC trainee from 2014 to 2018

Dr. Saber Ghadakzadeh brings a wealth of clinical and translational research experience, together with project management skills, to **Imagia Cybernetics Inc.** as **Clinical Research Liaison**. DCAT supported Dr. Ghadakzadeh by providing him with access to the RI-MUHC's professional and business networks.

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

Awards and Recognition

ALAN BARKUN

Visiting Clinical Professorship Award, Canadian Association of Gastroenterology
Gene and Lyn Overhold Lecturer, American Society for Gastrointestinal Endoscopy

MARCEL BEHR

Fellow, American Academy of Microbiology

SASHA BERNATSKY

Knowledge Translation Practice Award, The Arthritis Alliance of Canada, sponsored by Amgen Canada

JAMES BROPHY, NADA JABADO, LILY HECHTMAN

Fellows, Canadian Academy of Health Sciences

THERESA GYORKO, NITIKA PANT PAI, AMRITA DAFTARY

Nominated to first Canadian Women in Global Health List in 2018, Canadian Society for International Health

CAROLYN FREEMAN,

ISSAM EL NAQA (University of Michigan) and postdoc MARTIN VALLIÈRES

Physics in *Medicine & Biology (PMB)* citations prize

LUCY GILBERT, KRIS JARDON, and MUHC colleague XING ZENG

Discovery of the Year 2018 People's Choice Award, *Québec Science* magazine

PHIL GOLD

Grand officier, Ordre national du Québec
Honourary doctorate, University of British Columbia

LAURIE HENDREN (IN MEMORIAM)

2019 Dahl-Nygaard prize, senior researcher category, Association Internationale pour les Technologies Objets

LAURIE HENDREN, JOHN KILDEA, TAREK HIJAL

Coup de Coeur des ministres honour, Réseau de la Santé et des Services sociaux, for patient empowerment app, Opal

NADA JABADO

Pediatric Academic Leadership–Clinician Investigator Award, Pediatric Chairs of Canada

BARTHA KNOPPERS

Henry G. Friesen International Prize in Health Research, Friends of Canadian Institutes of Health Research

EMILY MCDONALD

Prix Jeune femme en sport, santé et mieux-être, Women's Y Foundation

THOMAS MANIATIS

Chair, Royal College Specialty Committee in Internal Medicine

DICK MENZIES

Distinguished Lecturer Award in Respiratory Sciences, Canadian Thoracic Society and Institute of Circulatory and Respiratory Health, Canadian Institutes of Health Research

MADHUKAR PAI

Participant, first UN High Level Meeting on Tuberculosis

NITIKA PANT PAI

Member, College of New Scholars, Artists and Scientists, Royal Society of Canada

LOUISE PILOTE

Member, Scientific Advisory Committee on Health Products for Women, Government of Canada

ROBYN TAMBLYN

Laureate 2018, Justice Emmett Hall Memorial Foundation and Peggy Leatt Award, University of Toronto

GEORGE THANASSOULIS

John J. Day M.D. award of excellence, Heart and Stroke Foundation

ÉVELYNE VINET

50th Anniversary Young Investigator Award, Laurentian Rheumatology Conference

DAVINIA WITHINGTON

Dr. R.A. Gordon Research Award, Canadian Anesthesiologist Association



Salary Awards

FONDS DE RECHERCHE DU QUÉBEC-SANTÉ (FRQS)

SUPPORT FOR RESEARCH IN TECHNOLOGY ASSESSMENT AND EVIDENCE-BASED MEDICINE IN UNIVERSITY HOSPITALS

James Brophy

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Tania Janaudis-Ferreira
David Labbé
Ives Levesque
Ivan Litvinov
Mary Macdonald
Christine Maheu
Bratislav Mistic
Cristian O'Flaherty
Nitika Pant Pai
Simon Rousseau
Madeleine Sharp

CLINICAL RESEARCH SCHOLARS

Faiz Ahmad Khan
Inés Colmegna
Cecilia Costiniuk
Kaberi Dasgupta
Stella Daskalopoulou
Simon Ducharme
Vidal Essebag
Lorenzo Ferri
Patricia Fontela
Isabelle Gagnon
Marta Kaminska
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Jonathan Spicer
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George Thanassoulis
Évelyne Vinet
Donald Vinh
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CANADIAN INSTITUTES OF HEALTH RESEARCH (CIHR)

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David Buckeridge

GLAXOSMITHKLINE- PARTNERED CHAIR

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Jonathan Afilalo
Geneviève Bernard
Per Jesper Sjöström

NEW INVESTIGATOR: COMMUNITY-BASED PRIMARY HEALTH CARE

Patricia Li

KRESCENT NEW INVESTIGATOR

Ruth Sapir-Pichhadze

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Marina Klein
Bartha Knoppers
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Leonard Levin
Heidi McBride
William Muller
Madhukar Pai
Guy Rouleau
Ernest Seidman
Michael Sullivan
Silvia Vidal

Tier 2

Brian Chen
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Reza Farivar-Mohseni
Ahmad Haidar
Dennis Jensen
Irah King
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Richard Hoge
Jason Karamchandani
Benjamin Lo
Bratislav Mistic
Madelaine Sharp

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 **\$204 million** this year.

	2018–2019 \$
Canadian Institutes of Health Research	47,358,479
Fonds de recherche du Québec—Santé	12,074,002
Canada Foundation for Innovation	11,001,243
Ministère de l'Éducation et de l'Enseignement supérieur du Québec	8,766,788
Canada Foundation for Innovation—Research Hospital Fund	7,227,914
National Institutes of Health	6,796,518
McGill University Health Centre (MUHC) Foundation	5,881,739
The Montreal Children's Hospital Foundation	5,719,631
Brain Canada Foundation	5,643,080
Génome Québec and Genome Canada	5,482,315
Research Support Fund (Government of Canada)	5,019,166
Natural Sciences and Engineering Research Council of Canada	4,749,133
The Montreal General Hospital Foundation	3,291,330
Canada Research Chairs	3,130,000
International Progressive MS Alliance	2,486,758
Ministère de la Santé et des Services sociaux	2,361,635



Our Worldwide Network

Ongoing research collaborations with 67 countries

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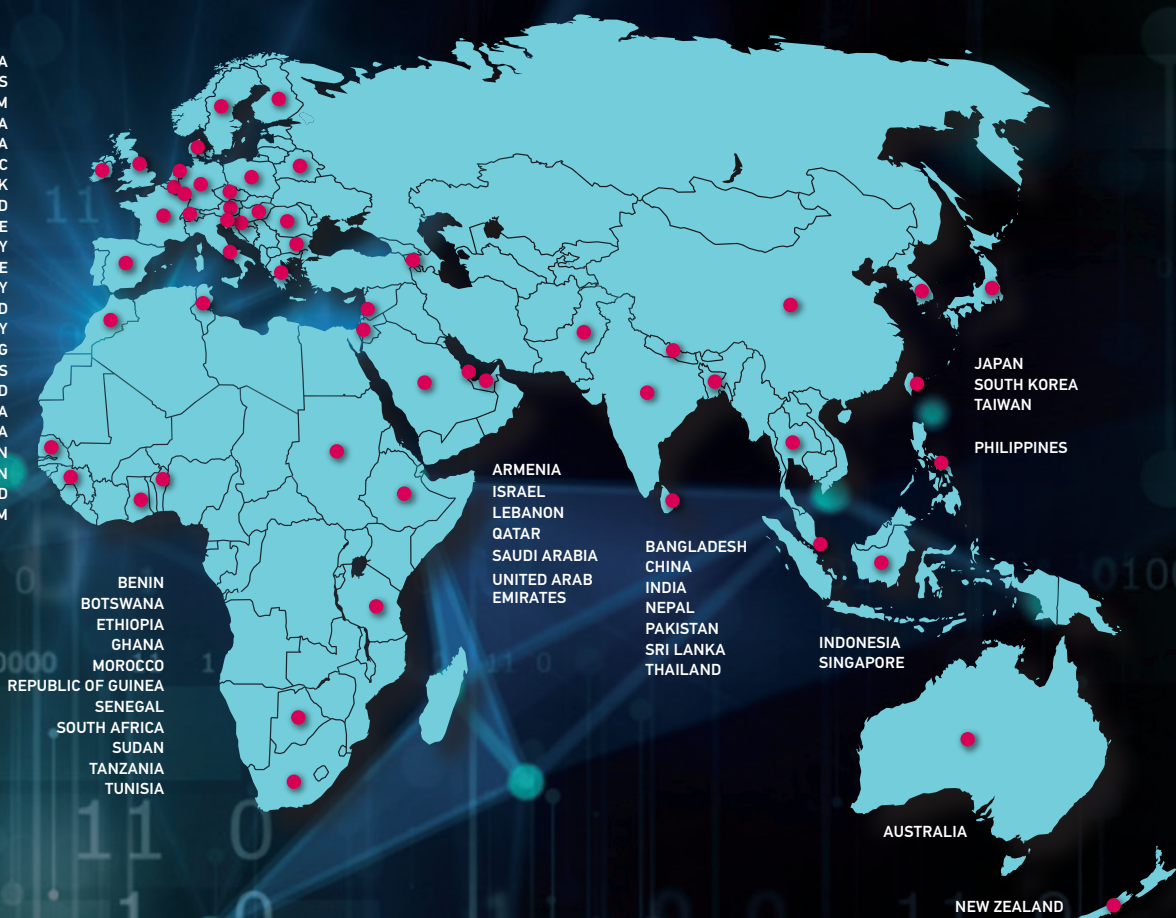
BAHAMAS
BARBADOS
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McGill University	2,047,235
U.S. Department of Defense	1,920,710
Terry Fox Foundation and Research Institute	1,421,151
Public Health Agency of Canada	1,317,821
Cancer Research Society	1,018,090
CQDM	969,242
Amyotrophic Lateral Sclerosis Society of Canada	940,407
Ministère de l'Économie et de l'Innovation	880,365
MS Society of Canada	827,446
Michael J. Fox Foundation	823,463
Canadian Cancer Society (CCS) and CCS Research Institute	807,527
Bill & Melinda Gates Foundation	687,076
Muscular Dystrophy Association	638,331
Cystic Fibrosis Canada	635,204
Fonds de recherche du Québec-Nature et technologies	586,907
MITACS	540,000
International Development Research Centre	518,721
Fondation de l'Ataxie Charlevoix-Saguenay	487,700

Foundation for Innovative New Diagnostics	477,870
Agence nationale de la recherche (France)	471,345
Fonds de recherche du Québec-Société et culture	470,971
Canadian Partnership Against Cancer	449,630
Heart & Stroke	418,775
JDRF	403,136
Networks of Centres of Excellence of Canada	392,379
American Association for Cancer Research International-Canada	383,398
Costello Bequest Foundation	378,481
Bladder Cancer Canada	375,996
AllerGen	323,436
Merck & Company, Inc.	319,779
The Kidney Foundation of Canada	308,188
Structural Genomics Consortium	300,000
Industry (various)	24,071,657
Other granting agencies	14,236,318
Other revenues	6,306,583

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

At the Research Institute of the McGill University Health Centre (RI-MUHC) we are deeply grateful to our donors and volunteers, and to the foundations and auxiliaries affiliated with the MUHC.



McGill University Health Centre (MUHC) Foundation

A \$15 million donation by the **Doggone Foundation** helped launch the McGill Interdisciplinary Initiative in Infection and Immunity (MI4). Researchers at the RI-MUHC, McGill and affiliated research partners are now leveraging the power of translational research to battle infectious and immune-related diseases.

Dr. Bruce Mazer, Dr. Marcel Behr, Paul Marchand, Susan Avon, Dr. Don Sheppard



The **Cruess Campaign**, launched in June 2017, contributed \$11 million for excellence in research at the RI-MUHC, including the establishment of the prestigious Trotter-Webster Innovation Award.

Claire Trotter, Norman Steinberg, Julie Quenneville, Dr. Pierre Gfeller, Lucy Riddell, Drs. Richard and Sylvia Cruess

muhcfoundation.com

The Montreal Children's Hospital Foundation

Funding research in the Child Health and Human Development Program is a Montreal Children's Hospital Foundation priority. We thank our partners, the **Fondation Charles-Bruneau** and **Sarah's Fund for Cedars**, for their far-reaching support of research in pediatric cancer (**Dr. Nada Jabado's** laboratory and team).

Fondation Charles-Bruneau: Pierre Bruneau (left), Simon-Luc (patient, second right) and his family, and Dr. Nada Jabado (right)

Sarah's Fund for Cedars (left to right): Christina Miller, Jeff J. Shamie, Dr. David Mitchell, Lorena Cook, Sarah Cook and Stephanie Butt

fondationduchildren.com/en
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Richard S. Ingram, Satoko Ingram, Chantal Souigny, Amelia Joucdar, Virginia Lee and Alain Biron

The Montreal General Hospital (MGH) Foundation

In 2018 the MGH Foundation awarded close to 80 grants, for a total of \$1.5 M, at the Annual MUHC Research Institute Awards Gala. The MGH Foundation is pleased to help young researchers pursue their innovative projects. In many instances, initial support enables recipients to qualify for even more prestigious grants or to secure public funding. The MGH and McGill University are known around the world, allowing us to attract foreign researchers for the benefit of the community at large.

codelife.ca



The Auxiliary of the Montreal General Hospital

Working closely with the MGH Foundation, the 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.

mghauxiliary.ca

Cedars Cancer Foundation

The annual Cedars Run for Ovarian Cancer, under the leadership of **Dominique Dagenais** and **Max Joly-Smith**, is dedicated to supporting The DOvEE Project under the leadership of **Dr. Lucy Gilbert**. The DOvEE Project is committed to raising awareness of ovarian and endometrial cancers, advocating for early diagnostic testing, and supporting ovarian cancer patients and their families.

Inset: Dominique Dagenais and Dr. Lucy Gilbert

cedars.ca



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

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