HEALTH

is in our nature

2019 Research Report

UHN

Toronto General
Toronto Western
Princess Margaret
Toronto Rehab
Michener Institute

UNIVERSITY HEALTH NETWORK

is a research hospital affiliated with the University of Toronto and a member of the Toronto Academic Health Science Network. UHN comprises four academic hospitals, an education institute and six research institutes. Research is supported in part by three foundations. The scope of research and complexity of cases at UHN have made it a national and international source for discovery, education and patient care.

UHN acknowledges that for thousands of years the land on which we gather has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today Toronto is still the home to many Indigenous people from across Turtle Island. We are grateful to have the opportunity to live and work on this land.

UHN is committed to championing inclusion, diversity, equality, equity and accessibility in the learning, work and service environments. We believe that our differences enrich our ability to develop creative and innovative approaches to deliver exemplary patient care, research and education.

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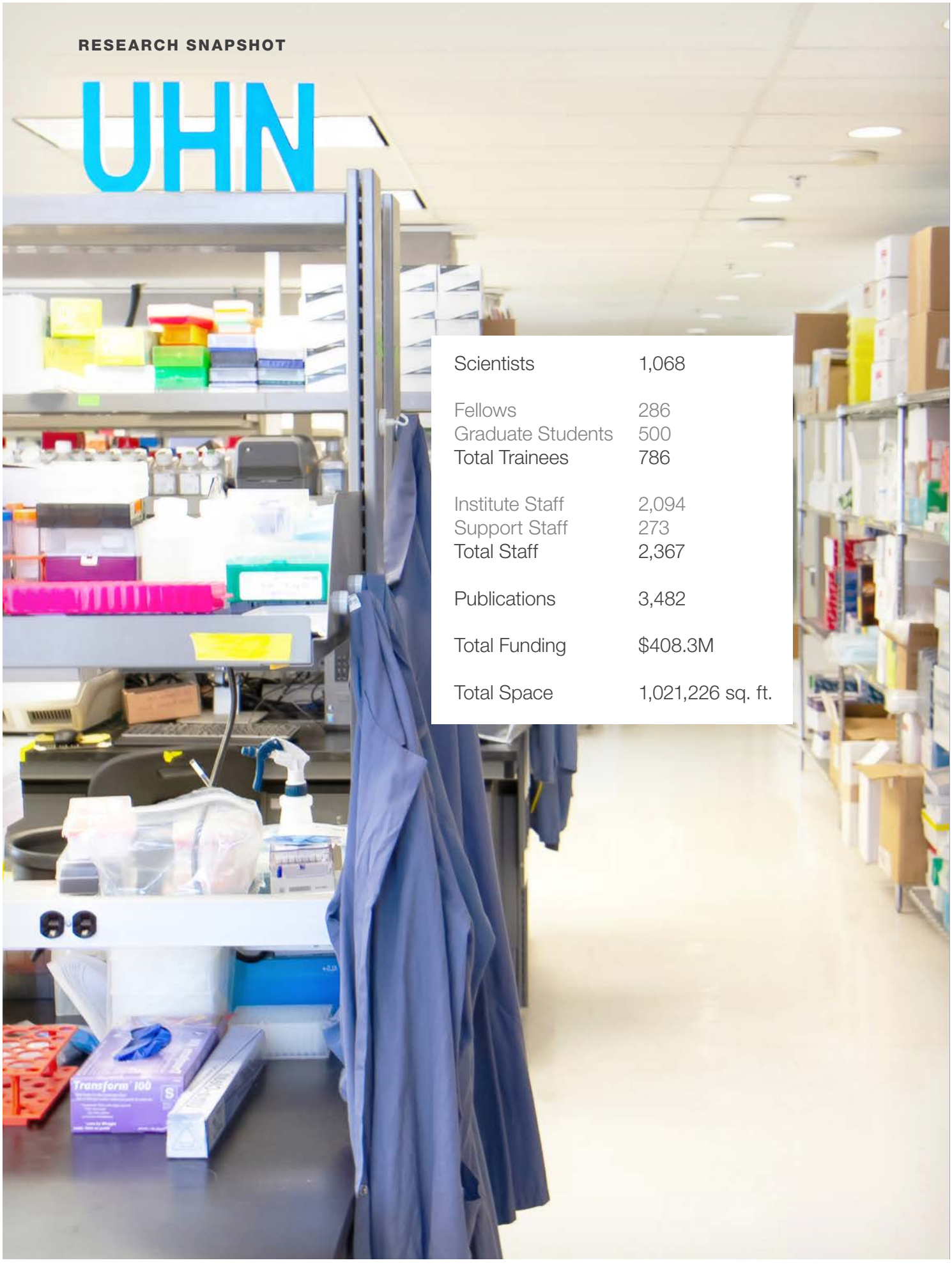
RESEARCH SNAPSHOT



Scientists	1,068
Fellows	286
Graduate Students	500
Total Trainees	786
Institute Staff	2,094
Support Staff	273
Total Staff	2,367
Publications	3,482
Total Funding	$408.3M
Total Space	1,021,226 sq. ft.

Dr. Brad Wouters, Executive Vice President, Science and Research (left); Dr. Kevin Smith, President and Chief Executive Officer (right).

The Nature of Health Research

Science is an exploration of nature. It's a back and forth exchange of questions and answers, with unlimited possibilities for discovery and innovation.

At UHN, our research community of scientists, trainees and staff embraces values that drive this dialogue—towards delivering our shared vision of A Healthier World.

We're curious. We pursue questions of great importance from the fundamental underpinnings of biological processes to the 'health' of health systems. This inherent curiosity enabled us this year to map out the various cells in the liver and to determine the role of nerve cells in controlling breathing—revealing new therapeutic opportunities for liver disease and recovering from spinal cord injury, respectively.

We're creative. We think outside the box to pioneer new techniques and technologies, such as integrating liquid biopsies, epigenetics and machine learning to create a new blood test for cancer or pairing advanced imaging techniques to come up with better ways to diagnose cancers.

Our scientists forge their own unique paths to get where they want to go.

We're courageous. We dream big, undertaking new initiatives with bold visions to change the course of human health and wellbeing. This year, we established institutes to develop cell therapies for regenerating and repairing organs, and to concentrate expertise in neuroscience and neuromodulation. These large-scale initiatives hold the promise to deliver new solutions for patients with unmet needs.

We're collaborative. We can't do it alone, and depend on academia, industry, government, the public and more for resources and expertise. With our partners, we established national initiatives to create frameworks for data sharing and digital health discovery. And our invaluable foundations and sponsors ensure that the most impactful team science is supported to address today's greatest health issues.

It's no wonder that research is second nature to TeamUHN—it's in our DNA. We invite you to read through this report to see what we discovered in the past year.

In It Together

Our strategy to guide us towards A Healthier World

This year, UHN published its *Strategic Research Plan 2019–2023*. The plan defines our **research mission**, **priorities** and **additional values** (opposite page), which will guide the choices that we make over the next five years.

In order to make the plan reality, a series of new initiatives are being developed to ensure that we achieve our **goals for research impact**. Accomplishments that UHN has made over the past year are already providing momentum towards achieving these goals. Examples include:

- **Accelerating discovery and translation to clinical practice.** UHN partnered with the *Centre for Commercialization of Regenerative Medicine* to launch the *Centre for Cell and Vector Production*, a manufacturing facility to support existing and to advance new cell-based therapies.

- **Training and developing tomorrow's research leaders**. Plans are being finalized for the launch of a new UHN education research institute that is positioned at the intersection of discovery, learning and care.

- **Advancing the fundamental understanding of health and disease**. As illustrated in this year's report, our researchers continue to further our understanding of diseases such as heart disease, cancer, arthritis, diabetes and neurological disorders.

The plan also outlines five **goals for organizational excellence**, and we have made advances in these areas as well. For example, we played major roles in establishing two pan-Canadian initiatives this year: the *Marathon of Hope Cancer Centres Network* and the *Digital Health and Discovery Platform*. And, we topped RE$EARCH Infosource Inc.'s lists of *Canada's Top 40 Research Hospitals* and *Hospital Patent Leaders*.

These achievements are just the beginning. As we continue to initiate strategic projects over the next year and beyond, TeamUHN is working together towards achieving our shared vision.

Research Mission

Together we drive excellence in discovery and innovation to create *A Healthier World*

Priorities

ENGAGE every patient to strengthen our learning health system

EMPOWER research teams and collaboration

ACCELERATE the translation of discovery to practice

UNLEASH the power of technology and innovation

GROW research through financially sustainable structures

Additional Values

CURIOSITY ask questions, seek answers, never stop learning
CREATIVITY develop unique approaches, seek novel solutions
COURAGE be bold, take on challenges, push boundaries
COLLABORATION share expertise and resources, work together to amplify impact

UHN is home to great people and great places

Four academic hospitals, an education institute and six research institutes work together to enable researchers to make discoveries, create technologies and gain valuable insights. Below are UHN's six research institutes and a selection of people that reflect the diversity of skills and disciplines required to innovate and advance health research.

Dr. Stephanie Protze
McEwen Scientist

MCEWEN STEM CELL INSTITUTE

TECHNA INSTITUTE FOR THE ADVANCEMENT OF TECHNOLOGY FOR HEALTH

Tracey Lui
Techna, Manager of Strategy

Dr. Paaladinesh Thavendiranathan
TGHRI Scientist

TORONTO GENERAL HOSPITAL RESEARCH INSTITUTE

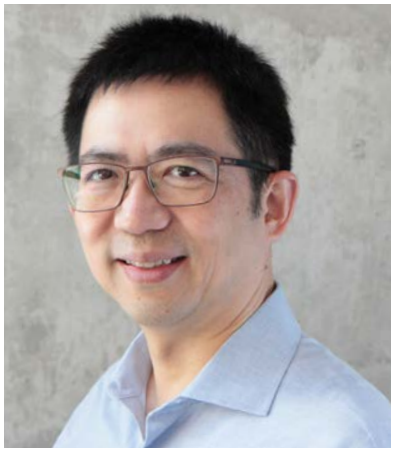
KREMBIL RESEARCH INSTITUTE

Dr. Lorraine Kalia
Krembil Scientist

Aaron Yurkewich
Doctoral Student

THE KITE RESEARCH INSTITUTE

PRINCESS MARGARET CANCER CENTRE



Dr. Gang Zheng
PM Cancer Centre
Senior Scientist

The KITE Research Institute

117
scientists

122
trainees

31 research fellows

91 graduate students

56.0K
sq. ft. research space

$14.4M
external funding

549
publications

157
staff

Exercise at All Ages

Cardiac rehab programs benefit seniors with heart disease

Being diagnosed with coronary artery disease can serve as a wake-up call to change your lifestyle and exercise regularly. Even those with regular exercise routines may have to adapt their lifestyles in the wake of a heart attack.

However, "older adults are less likely to be referred to cardiac rehabilitation programs than younger adults," says Dr. Paul Oh. "This is an unfortunate trend because our findings show that older patients can improve heart fitness when they participate in these programs."

"One of the reasons why older adults are not being referred to these programs may be due to the lack of rigorous studies exploring the potential benefits in older adults. We initiated a study to address this knowledge gap," says Dr. Laura Banks, lead author and a postdoctoral fellow who works with Dr. Oh.

The study included data from 1,450 Toronto Rehab patients with coronary heart disease that completed a six-month cardiac rehabilitation program. It focused on the effect of the exercise component of these programs, which also provide lifestyle education and psychosocial support.

The research team measured heart fitness improvements for different age groups. In summarizing the findings, Dr. Banks said, "We found that adults in their 50s saw a 30% improvement in cardiac fitness after the program while those in their 80s and 90s experienced a 20% improvement. Our study provides strong evidence that these programs benefit all age groups, and that they can help older adults make meaningful improvements to heart health after a heart attack."

Coronary artery disease is the second leading cause of death in Canada and the most common form of heart disease. These results highlight the life-saving benefits of these programs for adults of all ages.

Banks L, et al. J Clin Med. 2019 Mar 5;8(3). pii: E310. doi: 10.3390/jcm8030310. Supported by the Goodlife Fitness Centre for Excellence in Cardiovascular Prevention and Rehabilitation and the Toronto Rehab Foundation.

Dr. Paul Oh on the 200 metre indoor track at Toronto Rehab's Rumsey Centre (above). Dr. Laura Banks on the Rumsey Centre's outdoor track (right).

Walk with your doc

The Cardiovascular Prevention and Rehabilitation Program at UHN is located at Toronto Western's GoodLife Fitness Cardiovascular Rehabilitation Unit and Toronto Rehab's Rumsey Centre. Staff are walking the walk by regularly participating in fundraising walkathons and running groups with patients. Walkathon funds support the Toronto Rehab Chair in Cardiac Rehab, which is currently held by Senior Scientist Dr. David Alter.

When the Rumsey Cardiac Centre (formerly Marina Lodge) was opened in 1968, it was the first facility in the world that exclusively focused on caring for individuals who had experienced a heart attack. The importance of fitness and physical activity to cardiac rehabilitation is reflected in the building's design. It includes a large, window-lined indoor track with views of the surrounding parkland, as well as a larger outdoor track—both of which encourage patients to stay active.

McEwen Stem Cell Institute

5
scientists

22
trainees

9 research fellows

13 graduate students

16.2K
sq. ft. research space

$4.7M
external funding

6
publications

21
staff

Spotlight on Stem Cells

Institute launched to advance regenerative medicine

On December 6, 2018, UHN announced the creation of the McEwen Stem Cell Institute (McEwen). With a focus on stem cell research, regenerative medicine and cell therapies, it became UHN's sixth research institute.

The evolution of this institute, which was formerly known as the McEwen Centre for Regenerative Medicine, signals the progress of the research since the Centre was first eastablished in 2007. In collaboration with research institutions, industry, clinical programs and supporters from around the globe, McEwen investigators will harness stem cell biology to develop treatments for blood cell diseases, diabetes, heart disease and liver disease.

The institute is led by Dr. Gordon Keller and will focus on four areas that have the most potential to benefit patients:

BLOOD Replacing damaged cells in the blood and creating immune-based therapies for cancer (Dr. Keller)

DIABETES Developing ways to regenerate beta cells to treat diabetes and eliminate the need for insulin injections (Dr. Cristina Nostro)

HEART Developing ways to remuscularize and repair the heart (Dr. Michael Laflamme); and creating biological pacemakers to eliminate the need for electronic pacemakers (Dr. Stephanie Protze)

LIVER Creating new liver tissue to repair damaged livers and reduce the need for transplants (Dr. Keller)

"The launch of the McEwen Stem Cell Institute builds on our legacy of innovation in stem cell and regenerative medicine research," says Dr. Brad Wouters, the Executive Vice President of Science and Research. "The institute will help to usher in entirely new forms of cell-based therapies to tackle some of the most devastating human diseases. It is intensively focused on the creation of new therapies and will become an integral part of the life sciences hub in Toronto."

Partnerships are key to research innovation

In tandem with the McEwen launch, the cell therapy company BlueRock Therapeutics announced that it is strengthening ongoing strategic collaborations with McEwen researchers.

The company, which was established in 2016 with a $225M investment, will be funding a new research chair and providing support for engineered cell programs for cardiac disease. BlueRock will also double its operational space in Toronto to enable expanded collaboration.

"Our relationship with BlueRock has been critical in helping us accelerate our work," said Dr. Gordon Keller. "This most recent investment underscores their commitment to our work and will enable us to move more rapidly to bring these therapies to patients."

Dr. Gordon Keller addressing the crowd at the McEwen launch event (top of page); Dr. Cristina Nostro (directly above, left) discussing her research with Drs. Kevin Smith (middle) and Brad Wouters (right); The launch featured fireworks, a musical performance and panel discussions with McEwen researchers (panel of four images directly to the left).

Techna Institute for the Advancement of Technology for Health

58
scientists

27
trainees

10 research fellows

17 graduate students

30.4K
sq. ft. research space

$14.0M
external funding

310
publications

87
staff

Getting the Picture

Combining medical images improves lymphoma care

If every picture tells a story, then two pictures have the potential to tell a more complete story.

This appears to be true when two very different types of medical images—computed tomography (CT) and positron-emission tomography (PET) scans—are superimposed to help diagnose cancer.

While a CT scan provides information about the location of and structure of a tumour, a PET scan can visualize fast-growing cancerous cells. Combined, the two images can create a more accurate snapshot of the location and severity of a patient's cancer—characteristics that are used by physicians to determine the 'stage' of a cancer.

Dr. Ur Metser recently led a study that provided the most conclusive evidence to date that PET and CT are a powerful combination for staging lymphoma—a common type of blood cancer. The study was performed in collaboration with Cancer Care Ontario and cancer centres throughout southern Ontario.

He compared the effect of using combined PET/CT to that of CT alone at diagnosis on the management and outcomes of 850 Ontarians with lymphoma.

The researchers found that combined PET/CT enabled the detection of advanced disease in

18% more patients than CT alone and changed treatment plans for 40% of patients. Importantly, PET/CT was linked to improved survival in patients with aggressive non-Hodgkin lymphoma.

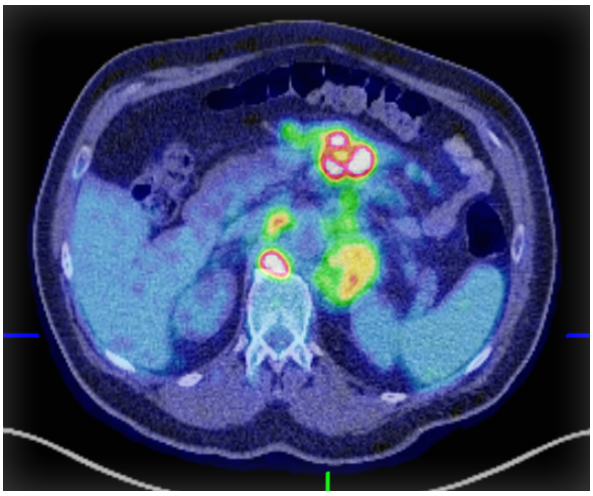
"In this study, we show that combined PET/CT enables doctors to more accurately stage lymphomas at diagnosis and thus design effective treatment plans," says Dr. Metser. "Our findings also suggest that the use of combined PET/CT to inform disease management for certain lymphomas can lead to improved patient survival."

Metser U, et al. Radiology. 2019 Feb;290(2):488-495.
Supported by the Ministry of Health and Long-Term Care, Cancer Care Ontario and The Princess Margaret Cancer Foundation.

Improving clinical care through research

While the use of combined PET/CT for staging lymphomas was recommended by an international committee of experts in 2013, little prospective evidence existed to support the need for the extra PET scan at the time.

Dr. Metser's findings have since helped to bridge this gap in knowledge. By revealing the positive impact of PET/CT on lymphoma care and patient outcomes, the findings have prompted Ontario's Ministry of Health and Long-Term Care to continue funding PET/CT scans for lymphoma care. His findings have also ensured that Ontario clinical guidelines continue to recommend combined PET/CT for lymphoma. As a result, the approximately 4,000 Ontarians that are diagnosed with lymphoma every year continue to benefit from receiving PET/CT scans as part of their care.



Dr. Metser examining PET, CT and the combined PET/CT images of a patient's abdomen (top of page). A combined PET/CT image, in which the CT scan reveals the location and distribution of a tumour and the PET scan highlights fast-growing cancer cells in red (above). Dr. Metser with the combined PET/CT instrument used in the study (right).

Toronto General Hospital Research Institute

411
scientists

201
trainees

82 research fellows

119 graduate students

166.8K
sq. ft. research space

$83.8M
external funding

1,293
publications

482
staff

Liver Atlas Created

Comprehensive map of the liver provides new health insights

Researchers have created a map of the cells in the human liver, revealing the most comprehensive inventory of the different cells that are present in the liver to date.

For the past 20 years, scientists have studied the liver as a mixture of cells. This has made it difficult to fully understand the functions of these cells. To address this issue, Dr. Sonya MacParland and her team used state-of-the-art genetic approaches and software engineering to map out the cells that are present in the liver.

After examining the gene expression profiles of these cells, the team found 20 distinct cell populations, including hepatocytes, endothelial cells, cholangiocytes and various immune cells such as B cells, T cells and natural killer cells. They also discovered two new populations of macrophages.

Dr. Ian McGilvray, a lead scientist in the study explains that, "Until this study, very little was known about the liver macrophage—the 'tank' of the immune system that destroys foreign substances and co-ordinates the immune response. We found that there are two distinct populations of macrophages in the human liver, one increases inflammation while the other decreases it. This type of insight has only been made possible by recent transformative advances in experimental and computational methods."

This map is just the beginning. The team plans to undertake future studies to compare data from healthy liver cells to diseased liver cells, providing further insight into liver biology and disease.

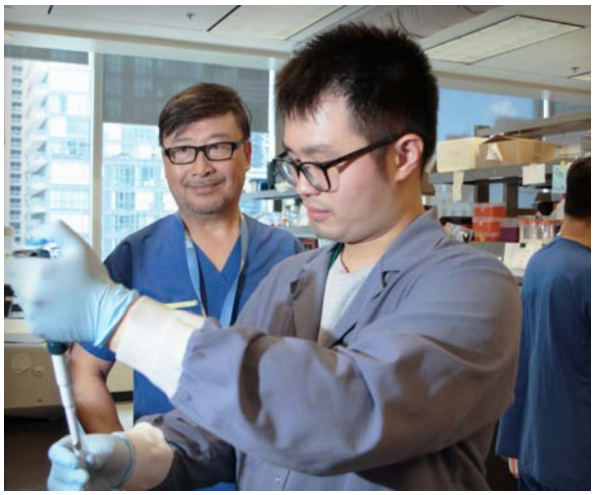
Drs. Ian McGilvray (above, left) and Sonya MacParland (above, right) pictured outside of the original brick façade of the old Toronto General Hospital.

MacParland SA, et al. Nat Commun. 2018 Oct 22;9(1):4383. Supported by the Canada First Research Excellence Fund (Medicine by Design), UHN's Transplant Program and the Toronto General & Western Hospital Foundation. G Keller holds a Tier 1 Canada Research Chair (CRC) in Embryonic Stem Cell Biology; JE Fish holds a Tier 2 CRC in Vascular Cell and Molecular Biology; and MD Wilson holds a Tier 2 CRC in Comparative Genomics.

What does it take to get a clear picture of the liver?

From the ancient maps that depicted the continents to the maps that we now use to navigate through traffic, humans have used cartography to define their environments for centuries.

This project advanced the art of mapmaking by providing a detailed map of each cell type present in the liver. It examined over 8,000 individual cells and involved over 30 multidisciplinary experts, including transplant surgeons, immunologists, hepatologists, regenerative medicine scientists, computer scientists and genomics researchers. These comprehensive results will form part of a larger project known as the Human Cell Atlas, which was created with the aim of defining every type of cell in the human body.



Individuals that made key contributions to the study include Senior Research Associate Xue-Zhong Ma (left; and above, left); graduate student Michael Cheng (above, right); and research technician Justin Manuel (not pictured).

Princess Margaret Cancer Centre

290
scientists

270
trainees

119 research fellows

151 graduate students

329.4K
sq. ft. research space

$146.7M
external funding

966
publications

1,014
staff

Next-Level Cancer Detection

A new method detects and classifies cancer early

There are many ways to stand out in a crowd—one way is to look different from those around you.

As cancer progresses, tumour cells develop a number of changes in their DNA that enable them to be more easily detected. One particular type of change to DNA is known as an epigenetic change. Rather than changing the genetic code, epigenetic modifications control how the code is read.

"A major challenge in treating cancer is detecting it early. Finding rare cancer-specific mutations in the blood, especially at earlier stages is difficult," says Dr. Daniel De Carvalho. "Epigenetic changes, which do not alter the underlying DNA sequence, are not similarly constrained and could provide a new way to detect cancer."

Dr. De Carvalho and his team took advantage of this phenomenon to develop a blood test that can detect and classify cancer at its earliest stages.

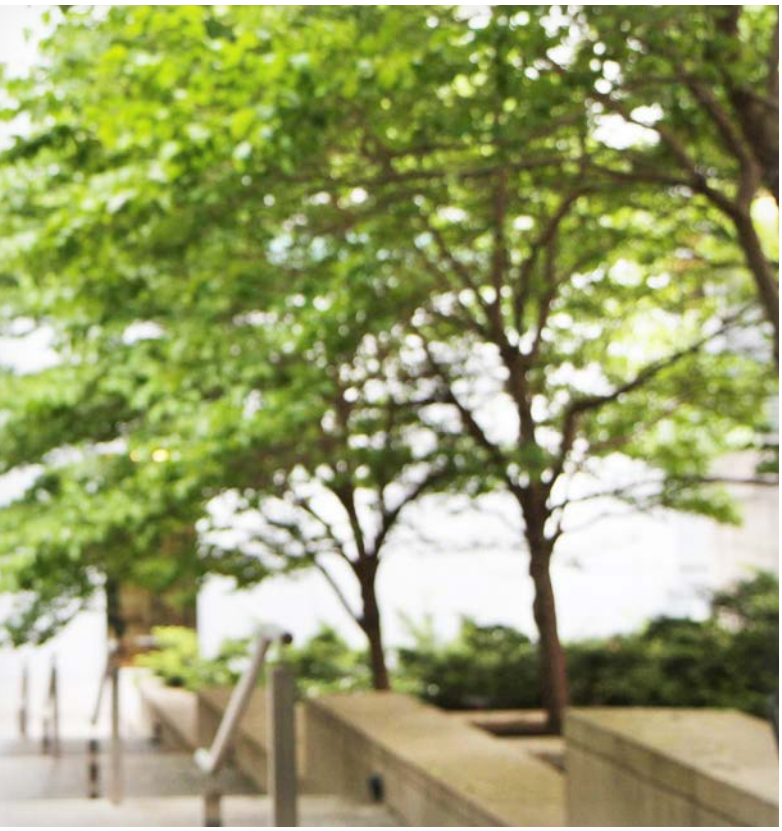
His team profiled thousands of epigenetic changes in multiple cancer types and used the data to predict the presence of cancer DNA in the blood.

They found that epigenetic changes in blood DNA could be used to accurately detect and classify tumours. They have since expanded this research and successfully matched more than 700 tumour and blood samples for a variety of cancer types.

Next steps include testing this method in large studies where blood samples are collected months to years before cancer diagnosis. These studies will help to determine whether the test can be used in the clinic to screen for cancer.

Shen SY, et al. Nature. 2018 Nov;563(7732):579-583. Supported by the University of Toronto's McLaughlin Centre, the Canadian Institutes of Health Research, Canadian Cancer Society, Ontario Institute for Cancer Research, and The Princess Margaret Cancer Foundation. D De Carvalho holds a Tier 2 Canada Research Chair (CRC) in Cancer Epigenetics and Epigenetic Therapy. T Pugh holds a Tier 2 CRC in Translational Genomics.

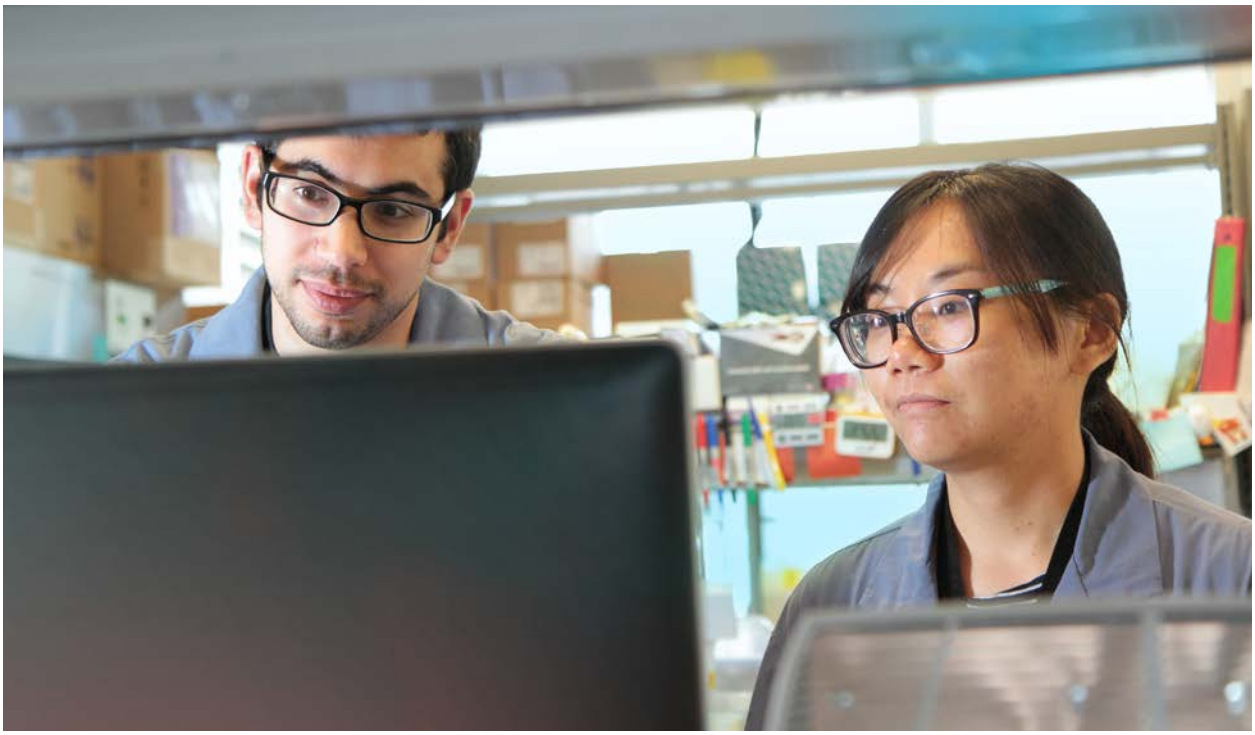
Dr. Daniel De Carvalho (above); and members of the De Carvalho lab, Ilias Ettayebi (opposite page, left) and Roxana Shen (opposite page, right), analyzing the epigenetics of a blood tumour.



Of flowers and cancers

In nature, the colours that are displayed on flowers' petals provide an example of epigenetics in action. Despite having the same DNA, epigenetic changes explain why one species of flower can display a variety of different petal colours. Similarly for cancer, epigenetic changes contribute to the characteristics that differentiate tumour cells from normal cells.

In this study, the researchers looked at a particular type of epigenetic modification called methylation. This alteration includes the addition of tiny chemical structures to DNA that turn genes on and off. By uncovering a new way to profile methylation patterns in blood DNA that are unique to cancer cells, these results reveal a new way to detect cancer. One day, using this technology, individuals may be screened for the earliest stages of cancer using a simple, non-invasive and convenient blood test.



Krembil Research Institute

191
scientists

144
trainees

35 research fellows

109 graduate students

149.8K
sq. ft. research space

$55.6M
external funding

859
publications

333
staff

Saving Your Breath

A discovery that could improve survival after spinal cord injury

Most people breathe spontaneously, without difficulty or concern. However, for those with a traumatic spinal cord injury (SCI), it can be a constant struggle.

Traumatic SCI occurs when the nerve tissue in the spine is damaged by a severe blow to the back or neck, which is most commonly sustained during a motor vehicle accident or a fall. If the damage occurs in the neck area, it can impair the function of—even paralyze—the muscles that control breathing.

As a consequence of their dysfunctional breathing, many patients with SCI in the neck area must be intubated and placed on a ventilator within the first five days after their injury. Breathing-related complications such as lung infections and lung failure account for 80% of deaths associated with SCI in the neck area.

A team of researchers led by Dr. Michael Fehlings has made a discovery that inspires new hope for SCI patients with dysfunctional breathing.

The researchers identified a distinct type of cell in the spinal cord that, when stimulated, increases breathing. These cells are known as cervical excitatory neurons and do not appear to be required for normal breathing.

Importantly, the researchers also showed that stimulating these cells can promote breathing immediately after SCI, when the risk of death is the highest. “Our results have created a lot of excitement in the field,” says Dr. Fehlings. “They are enabling us to develop strategies that could help keep individuals alive by promoting their breathing after spinal cord injury.”

Satkunendrarajah K, et al. Nature. 2018 Oct;562(7727):419-422. Supported by the Krembil Foundation, the Toronto General & Western Hospital Foundation, the Canadian Institutes of Health Research, the Paralyzed Veterans of America, AOSpine North America, the Onassis Foundation and the Dezwirek Foundation.

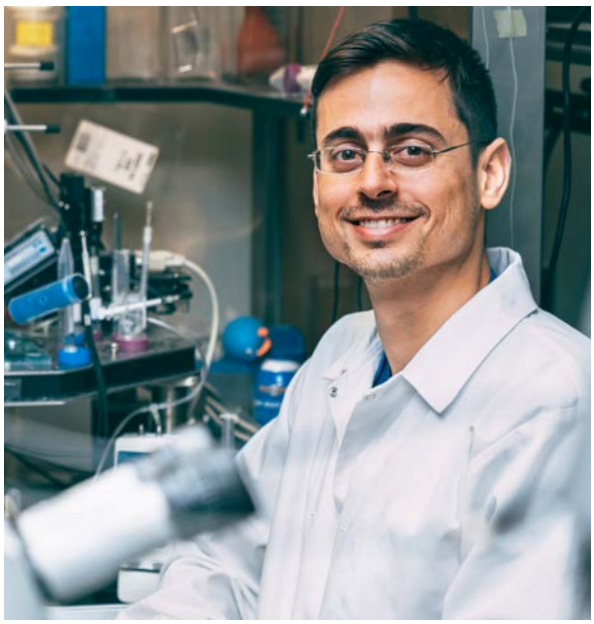
Drs. Spyridon Karadimas (above, left) and Dr. Michael Fehlings (above, right) in the operating room at Toronto Western Hospital. Dr. Kajana Satkunendrarajah (opposite page, left) at the Medical College of Wisconsin. Dr. Karadimas (opposite page, right) at Krembil Research Institute.

Great places attract great people

Talented students and fellows come to UHN to further their research training. Afterwards, many go on to lead their own research groups and make new discoveries. This holds true for the two trainees who led Dr. Fehlings's study.

Dr. Kajana Satkunendrarajah completed her postdoctoral fellowship with Dr. Fehlings. In April 2019, she became an Assistant Professor at the Medical College of Wisconsin in Milwaukee, where she leads her own research program and focuses on developing new treatments to improve breathing after SCI.

Dr. Spyridon Karadimas received his medical degree from the University of Athens in Greece and completed his PhD with Dr. Fehlings. He is currently a neurosurgery resident at the University of Toronto and aims to become a neurovascular surgeon and lead his own research team in the future.



Awards and Distinctions

Selected honours awarded to UHN scientists

Dr. Joanne Bargman
2018 Gabor Zellerman Lectureship, International Society of Peritoneal Dialysis

Dr. Timothy Chan
Tier 2 Canada Research Chair in Novel Optimization and Analytics in Health (renewal)

Dr. Tom Chau
2018 Governor General's Innovation Award

Dr. Angela Colantonio
2019 Women in Rehabilitation Science Award, American Congress of Rehabilitation Medicine

Dr. Catharine Craven
2019 Fellow of the American Spinal Injury Association

Dr. Karen Davis
President-Elect, Canadian Pain Society
2019 Distinguished Career Award, Canadian Pain Society

Dr. Daniel De Carvalho
Top 10 Cancer Research Publications, European Association for Cancer Research

Dr. John Dick
2019 ISSCR Award for Innovation, International Society for Stem Cell Research

Dr. Michael Fehlings
President, International Neurotrauma Society

Dr. Dafna Gladman
2018 Distinguished Clinical Investigator Award, American College of Rheumatology

Dr. Igor Jurisica
Doctor of Medical Sciences, Slovak Academy of Sciences
Top 100 AI Leaders in Drug Discovery and Advanced Healthcare, Deep Knowledge Analytics

Dr. Mohit Kapoor
Tier 1 Canada Research Chair in the Mechanisms of Joint Degeneration (new)

Dr. Tony Lam
Tier 1 Canada Research Chair in Diabetes and Obesity (advancement)

Dr. Anthony Lang
2018 Weston Brain Institute International Outstanding Achievement Award

Dr. Sonya MacParland
2018 Bhagirath Singh Early Career Award in Infection and Immunity, Canadian Institutes of Health Research

Dr. Rosemary Martino
Tier 2 Canada Research Chair in Swallowing Disorders (renewal)

Dr. York Pei
Lillian Jean Kaplan International Prize, Polycystic Kidney Disease Foundation

Dr. Milos Popovic
Engineering Medal – Entrepreneurship, Ontario Professional Engineers Awards

Dr. Milica Radisic
Engineering Medal – Research and Development, Ontario Professional Engineers Awards

Dr. Frank Rudzicz
2018 CIFAR Artificial Intelligence Chair

Dr. Beate Sander
Tier 2 Canada Research Chair in Economics of Infectious Diseases (new)

Dr. Susan Tarlo
2018 Assembly on Environmental, Occupational and Population Health John Peters Award, American Thoracic Society Assembly on Critical Care

Dr. Zahi Touma
2018-2020 CRA (CIORA) Arthritis Society Clinician Investigator Award, Canadian Rheumatology Association

Dr. Valerie Wallace
Tier 1 Canada Research Chair in Retina Regeneration (new)

Dr. Bo Wang
2018 CIFAR Artificial Intelligence Chair

Dr. Andy Kin On Wong
2019 Early Career Award, Canadian Society for Epidemiology and Biostatistics

Dr. Gang Zheng
Tier 1 Canada Research Chair in Cancer Nanomedicine (new)

Inventors of the Year

Making a difference

Every year, UHN's *Technology Development and Commercialization Office* presents the *Inventor of the Year Award*. This distinction celebrates a UHN inventor or team that has demonstrated excellence in translating their findings into new technologies, services and products that improve health.

In 2018, the award was presented to Drs. **Gordon Keller** and **Michael Laflamme** for their pioneering work in the field of regenerative medicine. They have demonstrated that stem cells can be coaxed to become functional, beating heart cells, laying the foundation for the development of therapies to restore damaged hearts.

In 2019, Drs. **Shaf Keshavjee** and **Marcelo Cypel** received the award for developing the Toronto Ex Vivo Lung Perfusion (EVLP) system. EVLP involves perfusing a special fluid through donated lungs while ventilating them with oxygen outside of the body. The invention has doubled the number of annual lung transplants performed at UHN and has now been adopted worldwide.

Full Steam Ahead

The *Where Incredible Happens* campaign raises $100M for research

The Toronto Rehab Foundation (TRF) raises and stewards funds that support Toronto Rehab's mission to develop solutions for those living with the consequences of illness, injury and aging.

This past September, TRF's *Where Incredible Happens* campaign achieved its $100M goal—a new fundraising landmark for rehabilitation in Canada.

"With a thousand Canadians turning 65 every day, Toronto Rehab has an important place in the continuum of care—through prevention and rehab programs as well as the research behind them," says Cindy Yelle, former President and CEO of TRF.

"The funds raised by the Campaign will help accelerate the pace of scientific discoveries and their translation into meaningful patient treatments. It will enable scientists at The KITE Research Institute to create revolutionary technologies that bring hope to millions of people in Canada and the world."

The *Where Incredible Happens* campaign will support research by establishing *The Walter and Maria Schroeder Institute for Brain Innovation & Recovery* (a photo from the launch is pictured below) and providing targeted support through scholarships, fellowships and new research chairs in key research areas such as pain, concussion, multiple sclerosis, sleep apnea and swallowing.

Thank you to everyone who has helped The KITE Research Institute continue to be *Where Incredible Happens.*

TEAM "I WILL" CHARITY BOOT CAMP Toronto's best trainers led this group interval training workout in May

2ND ANNUAL GOLF CLASSIC Golfers raised over $180,000 in June to support Toronto Rehab

ROCKET RIDE FOR REHAB Toronto's top instructors led 300 spinners in a fun Spin-a-Thon in October

(top, left) Rehab Golf Classic at the Thornhill Golf & Country Club, in support of Toronto Rehab's renowned Hull-Ellis Concussion and Research Clinic. (top, right) Rocket Ride for Rehab at Nathan Philips Square. (bottom) The inaugural 2018 Team "I Will" Charity Boot Camp at the Harbourfront Centre.

Future Care Now

Donor funds advance immunotherapy and cutting-edge therapeutics

Each day, game-changing research is being conducted at the Princess Margaret Cancer Centre, leading to breakthrough discoveries such as those of the cancer stem cell and the T-cell receptor—but none of this would be possible without the generous support of our donors.

Together with the Cancer Centre's new Research Director, Dr. Aaron Schimmer, and UHN's Executive Vice President of Science and Research, Dr. Brad Wouters, The Princess Margaret Cancer Foundation is committed to raising crucial funds to support this work.

Enabling world-leading research takes a community. Through fundraising events, major gifts and donors, the life-saving work being done at Princess Margaret Cancer Centre becomes possible.

A $50M campaign for cancer research was launched and was a success thanks to the generosity of donors. This included a $10.5M anonymous gift to support Dr. Tak Mak and the Therapeutics Group, as well as a $5M donation from Canadian gold mining company Agnico Eagle Mines to support promising immunotherapy research.

More work still needs to be done and fundraising efforts for research continue to be a priority. Donors enable *Future Care Now* by accelerating cancer research, education and clinical care to benefit patients at Princess Margaret Cancer Centre, across Canada and around the world.

Visit ThePMCF.ca to learn more.

AGNICO EAGLE MINES GIFT Canadian gold mining company Agnico Eagle Mines made a $5M investment in cancer research focusing on immunotherapy

BEHIND-THE-SCENES DONOR IMPACT EVENT Over 250 guests attended to learn how donor support is enabling *Future Care Now*

ENBRIDGE RIDE TO CONQUER CANCER The 11th ride raised $18.3M for cancer research and took place in June with 4,555 riders cycling from Toronto to Niagara Falls

(above, top) Representatives from the Heme Team, which includes members of Princess Margaret Cancer Centre's Malignant Hematology Program, at the Enbridge Ride to Conquer Cancer. The Heme Team has participated in every ride since the annual event was launched. (above, middle) The Behind-The-Scenes Donor Impact Event included two engaging panel discussions, through which donors learned how their generosity is transforming cancer care. Speakers included established scientists and rising stars such as Dr. Mathieu Lupien (pictured). (opposite page) Members of Agnico Eagle Mines' senior leadership team pose for a group photo with members of The Princess Margaret Cancer Foundation and Princess Margaret Cancer Centre's Tumour Immunotherapy Program during a tour of research labs following the company's $5M investment in immunotherapy research.

Fueling Success

Donor gifts enable leading-edge research and knowledge

Thanks to incredible donors and volunteers, the Toronto General & Western Hospital Foundation (TGWHF) had an exceptional year, raising over $152.4M in net fundraising revenue, from a record 85,182 individual gifts.

In 2018/2019, grants made by TGWHF to UHN totalled $81.8M, with over 80% supporting research at the Krembil Research Institute, the McEwen Stem Cell Institute and the Toronto General Hospital Research Institute. The remaining 20% funded patient care and education initiatives. Central to this past year's success are several transformational gifts that were made to talented scientists across UHN.

Transforming UHN's Sprott Department of Surgery. Eric and Vizma Sprott, through The Sprott Foundation, made a second $25M commitment to support the Sprott Department of Surgery at UHN, bringing their total gift to over $50M. This latest gift will address a range of crucial priorities that enable world-leading surgical research and innovation under the direction of Surgeon-in-Chief Dr. Shaf Keshavjee.

Creating a Flagship Centre to Support Brain Research. A landmark gift from The Rossy Foundation will create the new *Rossy Progressive Supranuclear Palsy Centre* at the Krembil Brain Institute. The Centre will nurture the future of research in this area, and more effectively translate the latest research developments to patient care. The Rossy Foundation was inspired to donate by Dr. Anthony Lang's world-renowned research.

Advancing Pacemaker Cell Research. To further propel the creation of novel cell-based therapies to treat heart disease, BlueRock Therapeutics helped establish a Chair in Cardiac Regenerative Medicine at the McEwen Stem Cell Institute. Dr. Stephanie Protze, the inaugural chairholder, has successfully differentiated human stem cells into functional cardiac pacemaker cells and is collaborating with BlueRock to bring these potentially life-saving cell therapies to the clinic.

DIWALI - A NIGHT TO SHINE The 8th annual gala raised $1.2M for emergency medicine and research at UHN (event pictured below)

GRAND CRU CULINARY WINE FESTIVAL The 14th annual event combined the finest wine, cuisine and top medical talent to raise $4M for research at UHN

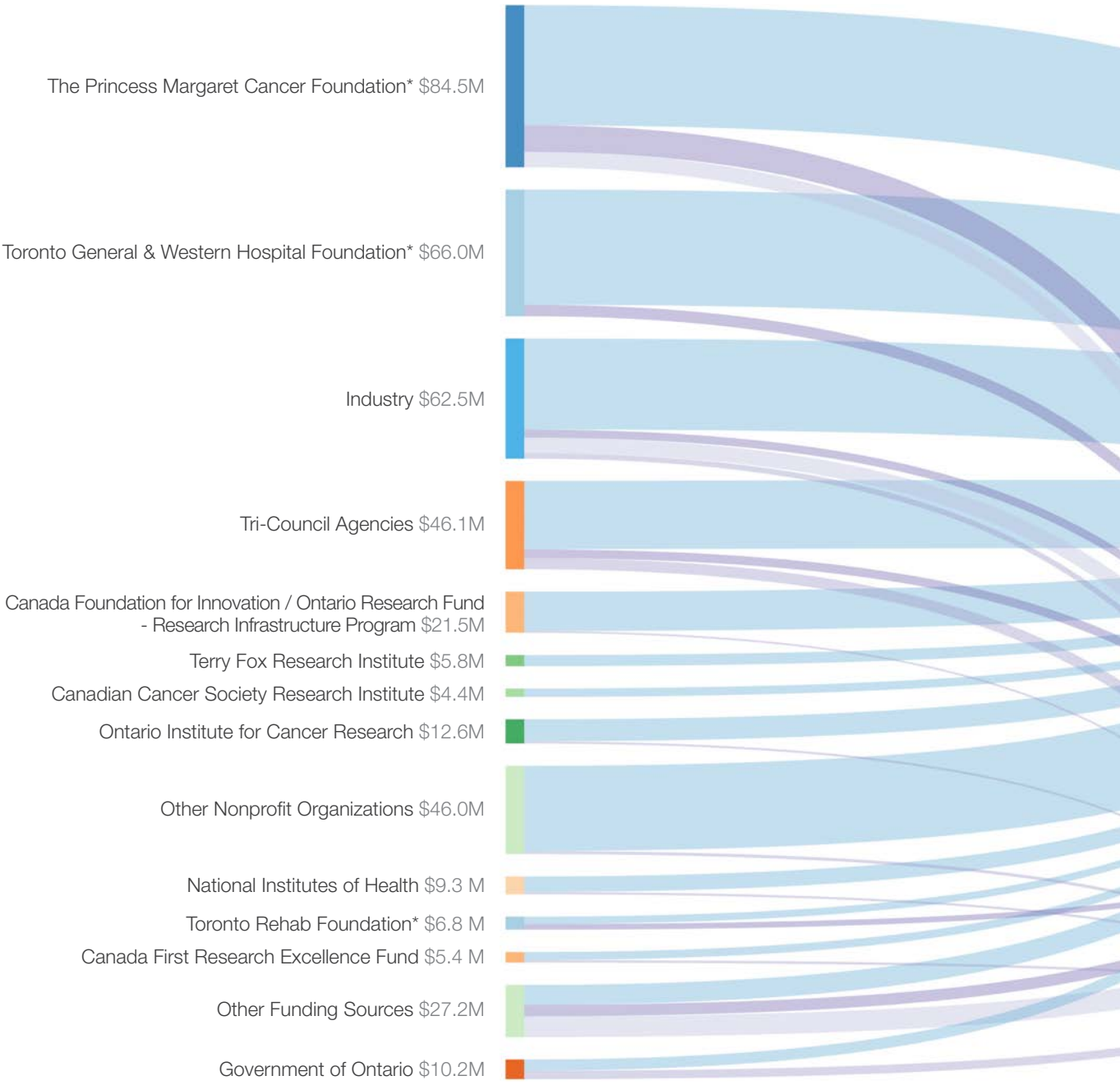
(clockwise from left) Dr. Stephanie Protze, McEwen Stem Cell Institute Scientist; Dr. Anthony Lang, Krembil Senior Scientist; Dr. Shaf Keshavjee, Toronto General Hospital Research Institute Senior Scientist.

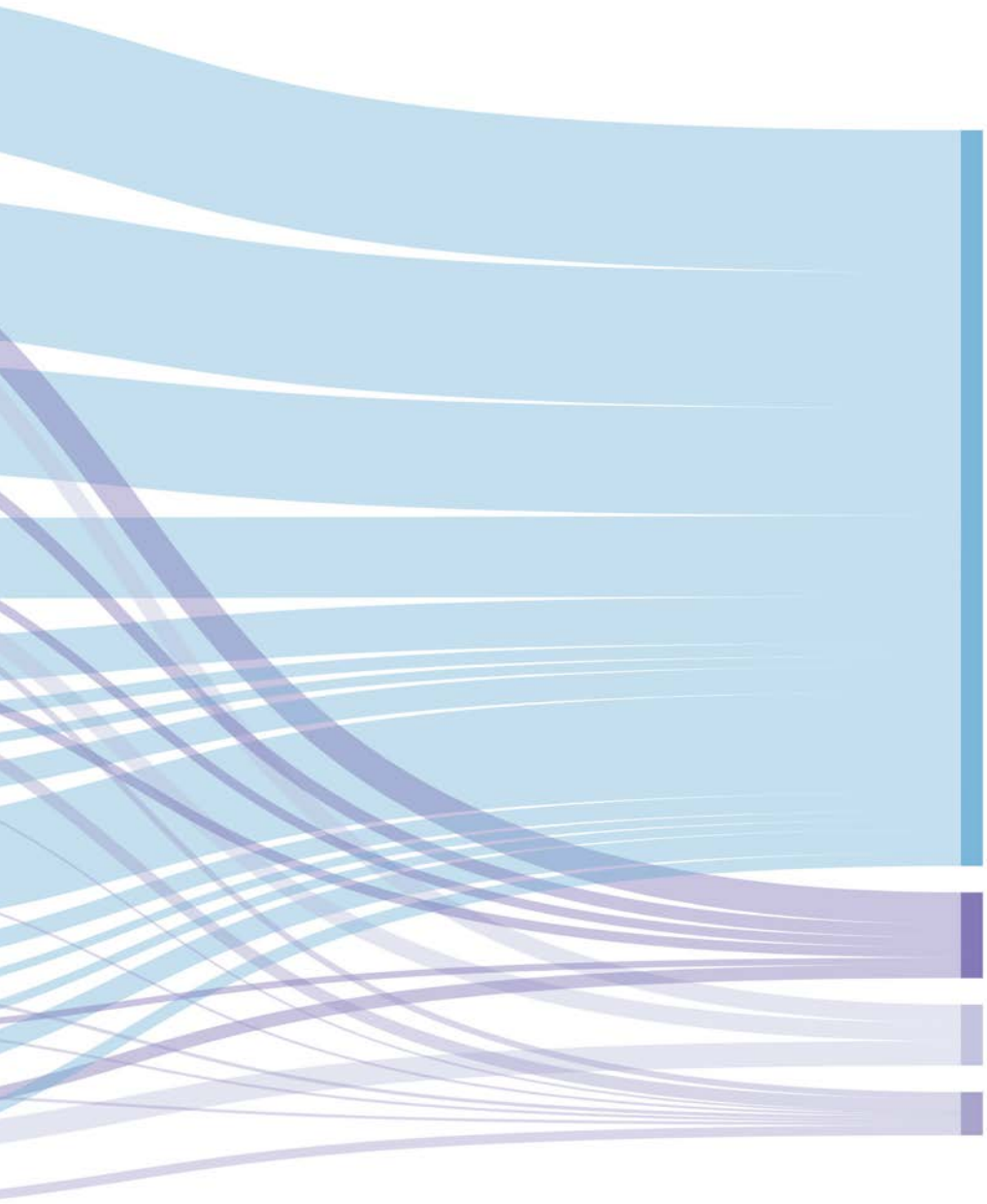
EXCELLENCE IN CARE On March 20, 2019, the Toronto General Hospital was cited by *Newsweek* as one of the world's top 10 hospitals

WORLD FIRST In April 2019, the President of the State of Israel, Reuven Rivlin, unveiled cutting-edge holographic imaging technology at the Peter Munk Cardiac Centre

Financials

Flow of research funding by source for the 2018/2019 fiscal year





Research Projects $324.6M

Institute Operations $37.8M

Space $26.8M

Research Support Services $19.1M

TOTAL $408.3M

The above diagram shows how research funding was utilized towards UHN's research mission for the fiscal year ended March 31, 2019. Values are rounded to the nearest $100,000. Funding from the Government of Ontario includes support from the Ministry of Health and Long-Term Care, and the Ministry of Economic Development, Job Creation and Trade (excludes the Ontario Research Fund - Research Infrastructure program). Funding agencies/organizations that contributed $3,500,000 or more are listed.

**These values are based on expenses incurred at UHN and categorized according to research-specific spending. For UHN's audited financial statements, please visit www.UHN.ca.*

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Disclaimers

All data are accurate as of March 31, 2019 with the exception of awards and distinctions (pp. 34-35), which lists data in the April 2018 to June 2019 timeframe; financial data are reported for the 2018/19 fiscal year ending on March 31, 2019.

Research Snapshots *Metrics reported in the Research Snapshots for UHN (page 2) and individual research institutes (pages 9, 13, 17, 21, 25, 29) include data for all appointed scientists. Scientists affiliated with two or more institutes are included once in the Research Snapshot for UHN.*

Scientists *Data provided by UHN's Research Strategy and Planning. UHN-appointed scientists aligned with each institute are included in the funding and publication data reported in the institute Research Snapshots.* **Publications** *Data provided by UHN's Research Strategy and Planning. Publications include articles, reviews and proceeding papers indexed in the Web of Science Core Collection; those authored by more than one UHN scientist are included once in the UHN and institute Research Snapshots.* **Staff** *Data provided by UHN Human Resources.* **Trainees** *Data provided by UHN's Office of Research Trainees. Values reflect the number of trainees who spend more than 50% of their time at UHN and who are supervised by scientists with a primary UHN research appointment.* **Space** *Data provided by UHN's Facilities Management - Planning, Redevelopment & Operations (FM-PRO). Institute space values include institute-specific space only. UHN space values include all institute space, core facilities (STTARR, flow cytometry facilities, the Genomics Centre, BioBank, Centre for Cell and Vector Production and the Advanced Optical Microscopy Facility); Research Solutions and Services (RSS) space; and external companies and programs on UHN premises.* **Financials** *Data provided by UHN's Research Financial Services. See disclaimer on page 41. The external funding data reported in the institute Research Snapshots include total research project funding held at UHN by appointed scientists that are primarily affiliated with a specific institute.*

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1 metric ton of wood
9 trees

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585 kg CO_2
2,332 km driven by car

16 GJ
71,882 60W light bulbs for one hour

3 kg non-methane VOCs
2,828 km driven by car

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