

ONE TEAM

Research Report • University Health Network 2020





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 seven 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.

We acknowledge the land we are meeting on is the traditional territory of many nations including the Mississaugas of the Credit, the Anishnabeg, the Chippewa, the Haudenosaunee and the Wendat peoples and is now home to many diverse First Nations, Inuit and Métis. We also acknowledge that Toronto is covered by Treaty 13 with the Mississaugas of the Credit. We remember and honour the legacy of the peoples who have been here before us and all who work to make the promise and the challenge of Truth and Reconciliation real. 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.

Featured on the front and back covers are trainees from the laboratory of Dr. Michael Laflamme at the McEwen Stem Cell Institute. Front cover (L-R): postdoctoral fellow Dr. Fanny Wulkan and graduate student Andrew Laskary. Back cover (L-R): postdoctoral fellows Drs. Wahiba Dhabri and Fanny Wulkan.

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Research Committee of the Board of Trustees

RESEARCH SNAPSHOT

Research TeamUHN 4,700

Principal Investigators 1,136

Fellows 366

Graduate Students 596

Other Students 183

Total Trainees 1,145

Institute Staff 2,156

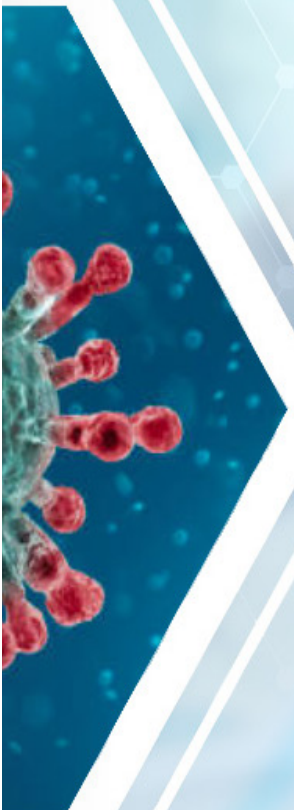
Support Staff 263

Total Staff 2,419

Publications 3,633

Total Funding \$490M

Total Space 1.027M sq. ft.





Dr. Brad Wouters, Executive Vice President (EVP), Science and Research, UHN.

Through Thick and Thin

UHN is Canada's largest research hospital. It is home to world-leading innovations in cancer, heart disease, neuroscience, rheumatology, rehabilitation, transplant and much more.

This year, most of that research came to a halt with the COVID-19 pandemic. When I became the EVP of Science and Research, I never thought that I would be issuing a directive to suspend this invaluable research; however, it was necessary to ensure safety for all.

What has truly inspired me is how quickly TeamUHN and our collaborators came together to advance COVID-19 research. This includes fundamental virology studies, cutting-edge clinical trials, as well as epidemiology and modelling of health system usage, enabling governments to make public health decisions.

I am not surprised that our researchers have stepped up to lead the global fight: our internationally renowned research community has been doing this for decades. It is also a testament to efforts made to diversify our community—by bringing together a mix of strengths, we can tackle bigger challenges.

I invite you to read this year's report, which highlights just some of the ways we are improving human health and wellbeing. Examples include a video monitoring system to detect falls and a trial examining the safety and effectiveness of a diabetes medication that could do away with the need for weekly insulin injections. You can also read about UHN's newest institute—The Institute for Education Research (TIER)—which is dedicated to research on health care education.

These milestones were not achieved by us alone. Team science is what enables us to forge the path forward against disease. In addition to our main academic partner, the University of Toronto, and our three dedicated foundations—The Princess Margaret Cancer Foundation, the Toronto General & Western Hospital Foundation and the Toronto Rehab Foundation—we collaborate with academic organizations, governments, the private sector, non-profit organizations, patients and members of the community that we serve.

We are all in this together, and united, we will continue to discover knowledge, treatments and solutions to create *A Healthier World*.

All Hands on Deck

Researchers across disciplines step up to advance COVID-19 research



TREAT An international research team led by Dr. **Eleanor Fish** showed that the antiviral drug interferon-alpha2b can help speed up recovery from COVID-19. The drug accelerates viral clearance by about seven days on average and reduces the blood levels of two proteins associated with inflammation.

[> read more](#)



TRACK Dr. **Deepali Kumar** is leading a study to determine the prevalence of asymptomatic COVID-19 infection among health care workers at UHN. [> read more](#)



PREDICT Dr. **Shaf Keshavjee** is leading a study to predict early lung injury in COVID-19 patients at risk for Acute Respiratory Distress Syndrome, a potentially fatal condition associated with severe lung inflammation. The study team will use a rapid diagnostic device to analyze plasma samples.

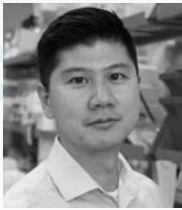
[> read more](#)



DISCOVER Dr. **Brian Raught** is using cutting-edge screening technologies to identify drug targets and existing drugs capable of treating and preventing COVID-19.



ACCELERATE Dr. **Amit Oza** led the establishment of UDEPLOY—a standardized framework to fast-track early phase COVID-19 clinical trials, ethical approval and discovery.



PROTECT Drs. **Steven Chan** (pictured) and **Vikas Gupta** are leading a clinical study to determine whether an established blood cancer drug, known as ruxolitinib, can safely reduce the need for ventilation in patients with severe COVID-19. > [read more](#)



PREVENT Drs. **Ewan Goligher** and **Patrick Lawler** (pictured) are leading an international clinical trial to determine if heparin, a drug used to prevent blood clots, improves outcomes for COVID-19 patients at high risk of developing blood clots in the lungs. > [read more](#)



OBSERVE In a preliminary case series, Drs. **Patrick Nicholson**, **Laila Alshafai** and **Timo Krings** observed evidence of internal bleeding and clotting in the blood vessels of the brain of individuals with severe COVID-19. > [read more](#)



SHIELD Laboratories at UHN have partnered with medical programs to design, manufacture and test medical-grade personal protective equipment. These initiatives are supporting frontline workers by providing them with a reliable supply of protective equipment, including 3D-printed face shields, patient-monitoring components and alternatives to disposable N95 masks. > [read more](#)

Designing our Future

Developing a unified plan that will foster a culture of equity, diversity and inclusion across UHN's research community



Over the last year, UHN's research community has made progress towards building a more equitable, diverse and inclusive (EDI) culture.

This included introducing new policies to support diverse communities, working with human resources to enable best practices in hiring and retention, and launching initiatives to understand the diversity of TeamUHN.

This journey has only just begun. Over the next five years, a new strategy will be implemented that will help integrate EDI into all research-related activities at UHN.

To inform this strategy, UHN has begun consulting with the research community to learn about the barriers that have been experienced by different groups in order to find new opportunities to change and grow together.

UHN is developing practices to ensure that a diverse team of leaders that prioritize team science are attracted, retained and supported.

The institution is also working on establishing alliances with organizations in the community who can help accelerate EDI efforts.

"Diversity is our strength. We want to harness that strength so we can benefit from the different perspectives, experiences and ideas that each team member brings to the table," says Dr. **Brad Wouters**, EVP Science and Research.

"We are committed to this journey and excited to make changes that will make our research community even stronger."



CALL TO ACTION

This year, UHN formed an advisory committee that will provide advice and guidance to research leadership on all matters related to EDI.

Scientists, staff and trainees at all levels were invited to join the committee—particularly those with lived experience or an interest in EDI. The committee membership reflects the diversity of UHN’s research community and includes Indigenous peoples, individuals with disabilities, persons of color, LGBTQ+ members and people from different fields of research who are at various stages of their career.

“Building an equitable, diverse and inclusive environment requires leadership, shared responsibility and a concrete plan to drive change,” explains Dr. [Azadeh Yadollahi](#) (pictured), the appointed Chair of the committee. “We’re excited at this opportunity to help embed EDI in everything that we do.”



SIGNING UP FOR EDI

Last year, UHN joined over 50 academic organizations across Canada in endorsing the Government of Canada’s Dimensions charter. Signing the charter reaffirms UHN’s commitment to foster increased research excellence, innovation and creativity through greater equity, diversity and inclusion.



FINDING OUR FOCUS

UHN launched an initiative to collect diversity data to better understand the overlapping identities, backgrounds and experiences of our researchers, staff and trainees. Collecting this data is an important first step in helping to determine where efforts are needed to build a more diverse community.

Bringing Discoveries to Life

Breakthrough science and commercialization go hand-in-hand in bringing benefits to patients



The path from early innovation in the lab to helping patients is often uphill and filled with scientific and commercial challenges. A critical step in making this leap is getting these innovations into the hands of companies with the resources required to carry them through the research and regulatory journey. This step is where our world-class researchers receive critical support from the commercialization team at UHN's **Technology Development & Commercialization** team.

EXCELLENCE IN COMMERCIALIZATION

UHN has had an exceptionally successful year in research commercialization. Milestones include 20 new spin-off companies in the pipeline, nearly \$1B in cumulative (five-year) risk-capital investment from recent spin-offs and \$37M in licensing revenue cycling back to power the next wave of breakthroughs. UHN has established itself this year as one of the world's top institutions in research commercialization.

2019

SELECTED MILESTONES

TAKARA BIO INC. acquired an exclusive license for technology relating to UHN's next-generation immunotherapy (known as CAR T-cell therapy).

PHOTONAMIC GMBH & CO. KG acquired an oncology business from UHN spin-off **MolecuLight Inc.**

Toronto-based **SQI DIAGNOSTIC SYSTEMS INC.** licensed a UHN lung biomarker technology that will enable the creation of a diagnostic lung platform to assess patients with COVID-19.

Prostate cancer patients at UHN become the first in world to be treated with an **AI-DRIVEN RADIATION TREATMENT PLANNING SYSTEM**. The system was engineered at the Princess Margaret Cancer Centre and Techna Institute, and taken to market by **RaySearch Laboratories**.

2020



BLUEROCK ACQUIRED, VALUED AT \$1.3B

In September 2019, pharmaceutical giant Bayer AG fully acquired BlueRock Therapeutics, for which UHN's Drs. **Gordon Keller** and **Michael Laflamme** serve as scientific co-founder and



TREADWELL THERAPEUTICS LAUNCHED

Another milestone in research commercialization was achieved when UHN spin-off Treadwell Therapeutics received a \$35M investment to develop first-in-class oral cancer treatments. The company's origins lie in cutting-edge research at UHN's Campbell Family Institute for Breast Cancer Research at Princess Margaret Cancer Centre. This funding will enable the clinical-stage oncology company to advance two candidate therapies through Phase II patient trials and launch a third one into Phase I trials, continuing its work to develop first-in-class small molecules to address unmet needs for cancer patients.

founding investigator, respectively. The acquisition of BlueRock, inclusive of upfront payments and payments to be made upon the achievement of pre-defined development milestones, corresponds to a total company value of approximately \$1.3B.

BlueRock is focused on developing engineered cell therapies and collaborates with UHN's McEwen Stem Cell Institute on an ongoing basis. This acquisition is critical in bringing UHN's industry-leading stem cell discoveries to the global patient population. It represents the next step in the longstanding legacy of success in the regenerative medicine field at UHN that began here with Drs. Till and McCulloch and the discovery of stem cells more than 50 years ago.



CELEBRATING 5 YEARS OF INNOVATION

The Princess Margaret Cancer Foundation Innovation Acceleration Fund (IAF) celebrated its fifth year of investing in the translation of high-potential cancer discoveries into patient treatments. The IAF was established in recognition of the shortage of funding available at this critical stage of commercialization. Today, having dedicated over \$5M to support 22 carefully selected projects, the IAF's investments are beginning to pay off: close to 50% of IAF-supported technologies have commercial follow-on funding, reflecting a rich pipeline of company formation opportunities.



Krembil Research Institute

Research Team at Krembil 707

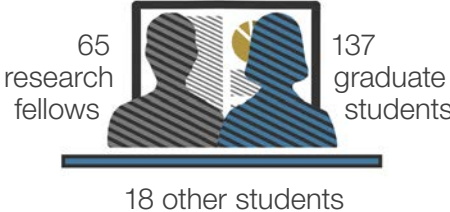
196

Principal Investigators



220

trainees



137.6K

sq. ft. research space



\$70.3M

external funding



882

publications



291

staff



The Missing Piece

Researchers uncover clues into how brain networks develop

A study suggests that a protein known as VLK plays an important role in brain development. The findings of the study were published in the journal *Nature Chemical Biology*.

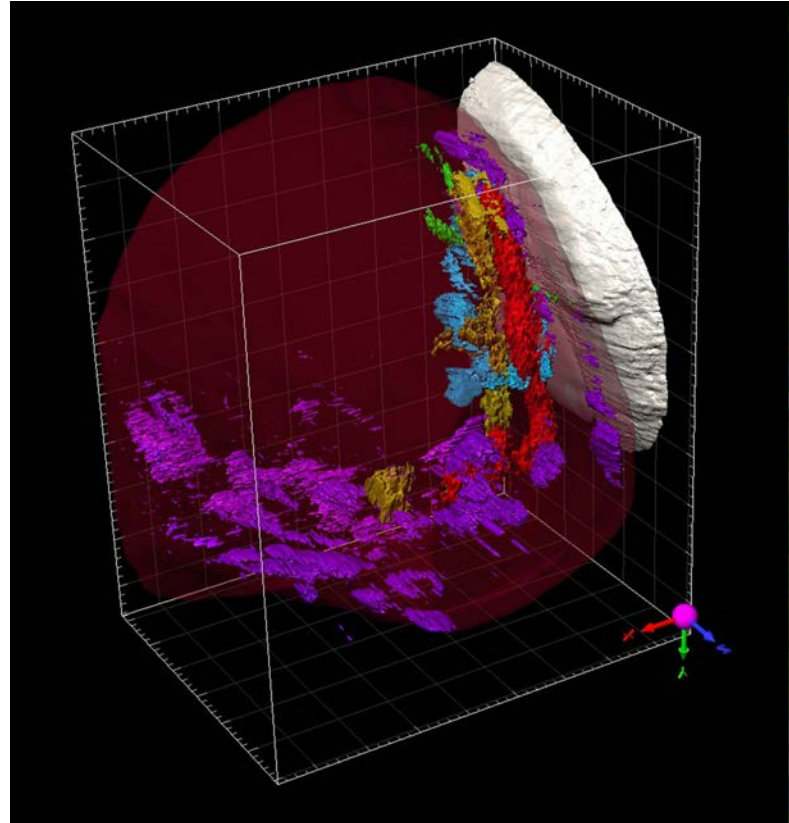
The adult brain consists of 86 billion nerve cells known as neurons, which are highly interconnected and form intricate networks. The activity of these networks underpins all of the brain's functions and processes.

How neurons connect with one another to build these networks during brain development is not entirely understood.

“We found several scientific clues suggesting that the VLK protein, which was discovered only recently, might be involved in this process,” explains Dr. **Philippe Monnier**, who led the study.

VLK is a protein secreted by neurons into their environment. Its role is to add chemical groups known as phosphates onto other proteins, which alters their function.

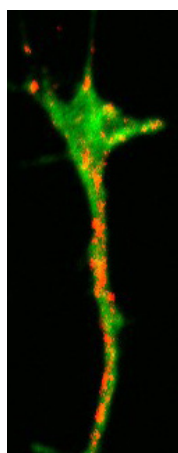
The researchers studied the effect of VLK on the growth and development of the network of neurons that connects the eyes to the tectum—a brain region that processes visual information.



They found that VLK attached phosphates to proteins on the surface of growing neurons. Sophisticated software was used to produce three-dimensional surface renderings of the tectum (pictured above). This data revealed that the pattern of the phosphates on the surface of the neuron controls the direction of growth, enabling it to form connections to other neurons.

“Our findings show that VLK modifies proteins that guide neuron growth and connectivity, and likely has profound effects on brain development, function and disease,” says Dr. Monnier.

Harada H, et al. Nat Chem Biol. 2019 Aug 26. doi: 10.1038/s41589-019-0345-z. Supported by the Krembil Foundation, the Glaucoma Research Society of Canada, the Heart and Stroke Foundation, the Canadian Institutes of Health Research and the Toronto General & Western Hospital Foundation.



(Opposite page) surface-rendered three-dimensional reconstruction of the tectum, showing growth projections of neurons that connect to the eye. (above left) Dr. Monnier and (top of page) Hidekiyo Harada, postdoctoral fellow and first author of the study. (above right) A specialized type of neuron (green) showing proteins phosphorylated by VLK (red).

Research Highlights

FINDING THE ROOT CAUSE

A study led by Dr. **Robert Inman** found that a type of immune cell—known as a CD8+ T cell—is present in the gut and in the joints of those with spinal arthritis. While many studies have found a link between the immune system in the gut and inflamed joints, the identified cell could mediate this crosstalk and be the key to new immune-based therapies. [Full Story](#) / [Scientific Article](#)

UNCOVERING A HIDDEN RISK

Dr. **Frances Chung** found that individuals with unrecognized severe sleep apnea are at greater risk of cardiovascular complications for 30 days after surgery. This finding represents a great opportunity: before surgery, diagnosis and therapy can be tailored to those with sleep apnea to protect them from complications.

[Full Story](#) / [Scientific Article](#)

CONCUSSIONS THAT LEAVE A MARK

Research led by Dr. **Carmela Tartaglia** shows that athletes with a history of repeated concussions display high levels of tau protein in their cerebrospinal fluid. Because not everyone who experiences multiple concussions suffers harmful effects, the levels of tau proteins may serve as a readout to help doctors identify who is at risk.

[Full Story](#) / [Scientific Article](#)

A STEP IN A NEW DIRECTION

Findings from the laboratory of Dr. **Michael Fehlings** are rewriting our understanding of which parts of the brain control our ability to walk. While it is generally accepted that the motor cortex controls the planning and initiation of limb movements, Dr. Fehlings' team found that a different region of the brain—known as the sensory cortex—can control walking in direct response to sensory information.

[Full Story](#) / [Scientific Article](#)

A close-up photograph of a laboratory setting. A person wearing blue nitrile gloves is using metal tweezers to carefully handle a petri dish. The petri dish contains a cell culture, with several small, white, circular colonies visible. The background is slightly blurred, showing a clean, professional laboratory environment with various pieces of equipment and a blue cable. The overall scene conveys a sense of precision and scientific research.

**McEwen Stem Cell
Institute**

Research Team at McEwen 52

5

Principal Investigators



24

trainees

8
research
fellows

16
graduate
students



16.1K

sq. ft. research space



\$9.1M

external funding



8

publications



23

staff



A Change of Heart

Study points to way forward for overcoming cell therapy hurdles

During a heart attack, heart muscle dies and is replaced with non-contracting scar tissue.

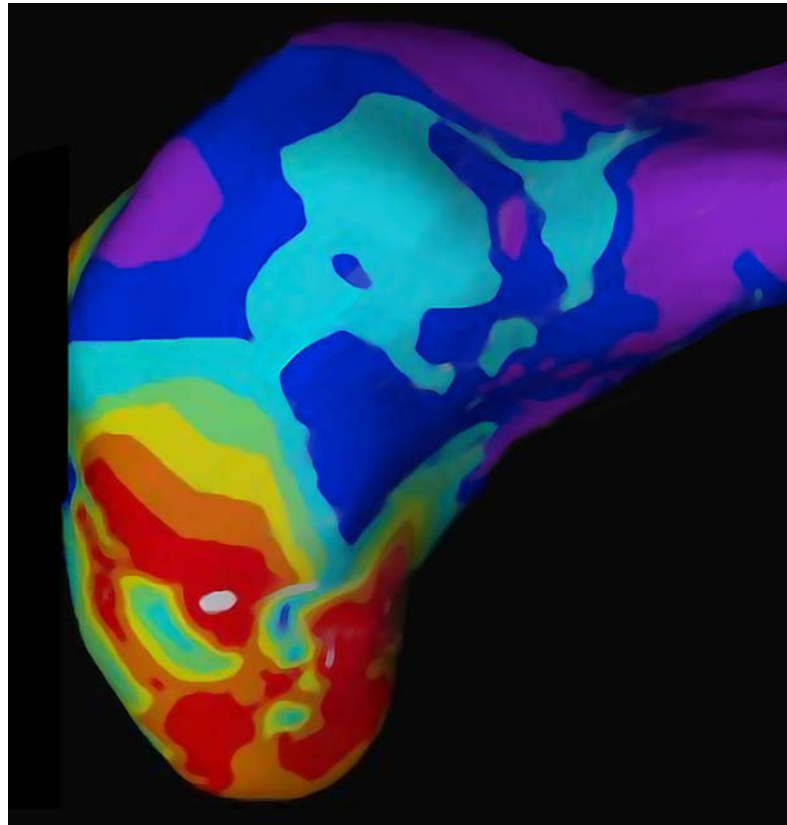
This scar tissue fails to heal and, depending on the degree of damage, can lead to heart failure—a chronic condition for which heart transplantation is the only cure. To address this, new ways to repair damaged hearts are being intensely explored.

Dr. **Michael Laflamme**, a world-leader in an experimental approach known as cell-based therapy, recently led a study to explore the use of heart muscle cells in repair.

When heart muscle cells made from embryonic stem cells are injected in the scar tissue in experimental models, promising results and repair have been seen. However, existing models differ from the human heart in many ways, making it difficult to translate results to patients. To overcome this, Dr. Laflamme developed a model that closely matches the size and heart rate of the human heart.

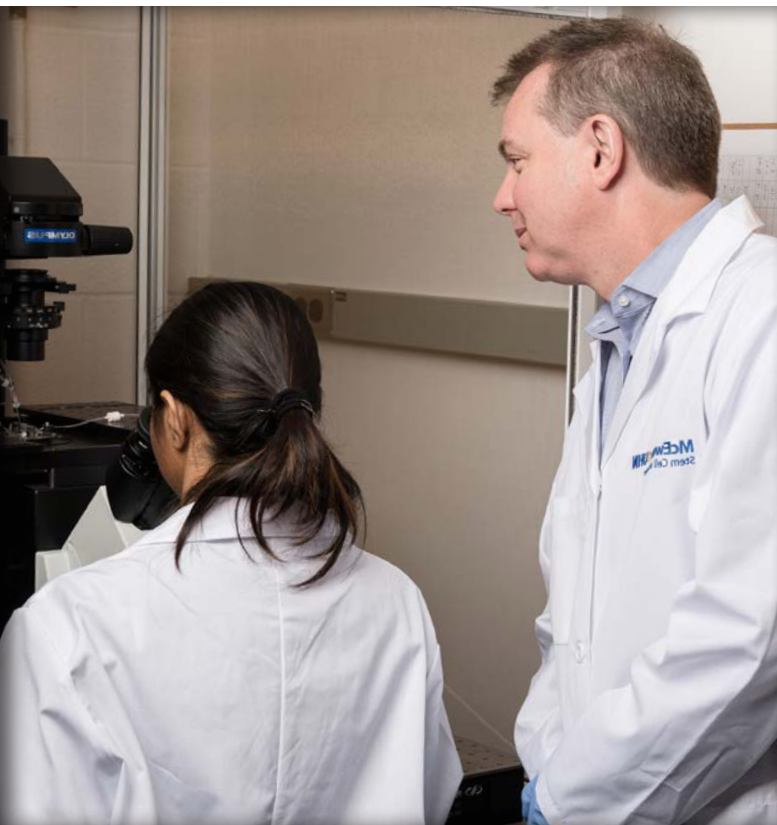
When his team used the model to test cell therapy, they were able to repair around 15% of the scar. However, the therapy led to a side effect: arrhythmia or an abnormally fast heart rate.

“This effect has only been seen to a lesser extent in one other experimental model. Because our model more closely matches the human heart, our findings suggest that this may be a serious issue—one that could prove deadly to patients with



compromised hearts,” says Dr. Laflamme. In collaboration with Peter Munk Cardiac Centre’s Dr. **Kumaraswamy Nanthakumar**, a technique called electroanatomic mapping (pictured above) was used to explore the underlying issue. “Our findings suggest that the arrhythmia—rather than involving the electrical function of the whole heart—seems to originate from injected cells. Future work will address this issue by modifying the injected cells or using heart medications,” says Dr. Laflamme.

Stem Cell Reports. 2019 May 14;12(5):967-981. doi: 10.1016/j.stemcr.2019.04.005. Supported by the Canada Research Chairs program, the Ontario Institute for Regenerative Medicine, the Technion-UHN International Center for Cardiovascular Innovation, the McEwen Stem Cell Institute, the Toronto & Western Hospital Foundation, the Peter Munk Cardiac Centre, the Canada Foundation for Innovation, and the University of Toronto’s Medicine by Design initiative, which receives funding from the Canada First Research Excellence Fund.



Research Highlight

MAKING CELLS TO TREAT DIABETES

New research has revealed a strategy to promote the production of insulin-producing cells—known as beta cells—in the lab. These cells could represent a new therapeutic approach with the potential to treat some types of diabetes.

The study, led by Dr. [Cristina Nostro](#) (pictured below), in collaboration with Dr. Tae-Hee Kim at the Hospital for Sick Children, discovered that supportive tissues surrounding the developing pancreas and gut produce organ-specific signals required for proper development.

The researchers then showed that these signals can be modulated in the petri dish to improve the stem cells' ability to produce pancreatic beta cells.

“We have identified a new strategy for promoting beta cell production. This insight could move beta cell transplantation one step closer to the clinic. In addition, our findings emphasize the importance of environmental cues in the development of different types of cells from stem cells,” says Dr. Nostro. [Full Story / Scientific Article](#)



Dr. Laflamme and postdoctoral fellow (top of page, R-L). Dr. Frankie Poon in Dr. Nostro's lab and co-first author, looking at pancreatic cells (stained green) under a microscope (two photos directly above; image credit: Andrew Downs).



A photograph of the Princess Margaret Cancer Centre building. The building is a multi-story structure with a mix of modern and classical architectural styles. A prominent feature is a tall, cylindrical glass tower on the left side. The main building has a classical facade with columns and arches. A blue banner with white text is hanging from the building, and a Canadian flag is flying in front of it. The sky is blue with some clouds.

Princess Margaret Cancer Centre

TRANSFORMING
CARE AND
THE PATIENT
EXPERIENCE.



Princess Margaret
Cancer Centre
1100 St. George Street
Toronto, Ontario M5G 1Z6

THE PRINCESS MARGARET
CANCER CENTRE

Research Team at PM 1,690

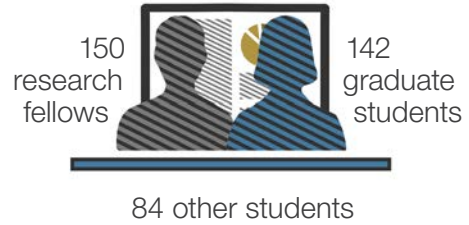
302

Principal Investigators



376

trainees



325.6K

sq. ft. research space



\$254.4M

external funding



1,062

publications



1,012

staff



Redefining Pancreatic Cancer

In depth genetic analysis reveals new cancer subtypes

Despite pancreatic cancer being one of the most deadly forms of cancer, little is known about its genetic and molecular features.

“Most molecular studies on pancreatic cancer examine early stage disease, representing a minority of patients. This is mostly due to difficulty in obtaining sufficient tumour tissue for research from patients with advanced disease,” says Dr. **Faiyaz Notta** (pictured opposite page, top left).

To address this, Dr. Notta and Dr. **Steven Gallinger**, a Clinician Scientist at Princess Margaret Cancer Centre, examined pancreatic tumours collected from 314 patients who participated in the COMPASS trial, including 111 with advanced disease. COMPASS, which was launched by Clinician Investigator Dr. **Jennifer Knox**, comprehensively characterized the genetic content of tumours using cutting-edge pathology and sequencing technologies at UHN and the Ontario Institute for Cancer Research.

The study found that pancreatic cancer could be classified into five different subtypes based on its genetic information. Prior to this, only two subtypes of pancreatic cancer had been described. One subtype, referred to as Basal-like-A, was mostly found in advanced disease.



The study’s findings also indicated that the disease subtypes likely stemmed from specific genetic alterations during disease development.

These findings help to explain why patients with pancreatic cancer display a wide range of responses to the same anti-cancer drug. In addition, they will guide the design of new strategies that are targeted to each disease subtype.

The illustration above depicts the cell’s chromosomes, in which DNA is packaged. The yellow portion of the chromosome represents a genetic change.

Chan-Seng-Yue M, et al. Nat Genet. 2020 Feb 12. doi: 10.1038/s41588-020-0588-3. Supported by the Government of Ontario, the Ontario Institute for Cancer Research, The Princess Margaret Cancer Foundation, the Terry Fox Research Institute, the Canadian Cancer Society and the Pancreatic Cancer Canada Foundation.



Research Highlights

OVERCOMING RESISTANCE

Dr. [Steven Chan](#) (pictured below) and his team discovered that antibiotics might be able to help prevent a type of cancer, known as acute myeloid leukemia, from becoming resistant to therapy. Watch a video of Dr. Chan describing his study in the video below.

[Full Story](#) / [Scientific Article](#)



OBESITY AND BREAST CANCER

A study from Dr. [Rama Khokha](#)'s lab (above left) led by Dr. [Purna Joshi](#) (above right) provided new insights into the origins of mammary gland development. The findings revealed that fat cell precursor cells contribute to mammary gland epithelium during breast development, hormone exposure and pregnancy. These results enhance our knowledge of fat cells in the breast and their potential role in breast cancer. [Scientific Article](#)

THE IMPORTANCE OF RADIOTHERAPY

Drs. [Danielle Rodin](#) and [Michael Milosevic](#) demonstrated that even with universal human papillomavirus vaccination, there are significant societal and economic benefits to scaling up radiotherapy to treat cervical cancer in low- and middle-income countries. These published findings were awarded the *2019 Till & McCulloch Paper of the Year Award* (clinical category). [Video](#) / [Full Story](#) / [Scientific Article](#)

BROAD STROKES TO DEFINE DISEASE

Dr. [Thomas Kislinger](#) and collaborators at the University of California, Los Angeles developed an integrated approach to assess biomarkers for prostate cancer. The researchers looked at three types of biological molecules—DNA, RNA and protein—and found that proteins were better at predicting cancer recurrence; however, the best biomarkers included a combination of these molecules. This study won the *2019 Till & McCulloch Paper of the Year Award* (translational category). [Full Story](#) / [Scientific Article](#)



**Techna Institute for
the Advancement of
Technology for Health**

Research Team at Techna 267

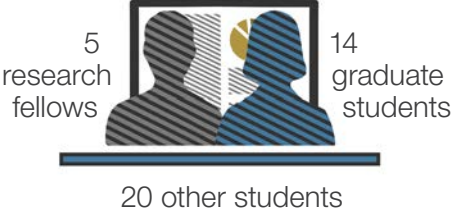
71

Principal Investigators



39

trainees



47.7K

sq. ft. research space



\$14.6M

external funding



340

publications



157

staff



When Seconds Count

Optimizing defibrillator locations could save lives

Dr. **Timothy Chan** (pictured right) and his team developed computer models to optimize the placement of a life-saving device known as an automated external defibrillator (AED).

AEDs can automatically diagnose a cardiac arrest and, if appropriate, provide an electrical shock to restart the heart. However, in order to help during an emergency situation, an AED must be close by and quickly accessible.

Despite the importance of location, Canada has not established clear rules on where AEDs should be placed. Each business, mall, transit station or community centre determines whether or not to host an AED and where to place it.

To explore the benefits of his computer models, Dr. Chan's team ran a simulated clinical trial. A former student, Dr. Christopher Sun, led the study, which brought together expertise in engineering and cardiology from Canada and Denmark. The simulated trial leveraged existing data on AED locations and out-of-hospital cardiac arrests in Copenhagen, Denmark from 2007 to 2016. This data was used to compare the effect of optimally placing AEDs versus the actual placements.

“The benefit of using historical data is that the distance between a cardiac arrest and an AED



is objective. We can thus use it to simulate what benefit to patients would be gained if AEDs had been placed in optimal locations,” says Dr. Chan.

For the real-life placement of AEDs, only 22% of out-of-hospital cardiac arrests had a nearby defibrillator that was used by a bystander. The researchers found that optimizing the placement of AEDs within the network could nearly double that coverage and save up to 13% more lives.

In summary, Dr. Chan says, “Our findings emphasize the importance of establishing a coordinated approach to the placement of AEDs.”

Sun CLF et al. J Am Coll Cardiol. 2019 Sep 24. doi: 10.1016/j.jacc.2019.06.075. Supported by the Danish foundation TrygFonden. Dr. Chan holds a Tier 2 Canada Research Chair in Novel Optimization and Analytics in Health.



Research Highlights

AI TREATMENT PLANS A REALITY

In a world first, radiation treatment plans generated using artificial intelligence are now being used to treat cancer patients at UHN. The technology, developed by Drs. **Tom Purdie** and **Chris McIntosh** (pictured below, L-R) in collaboration with RaySearch Laboratories, enables personalized radiation treatments that can be produced in minutes. Dr. **Alejandro Berlin** is overseeing the deployment of the system to benefit prostate cancer patients at the Princess Margaret Cancer Centre. [Full Story](#) / [Scientific Article](#)



QUICK FIX FOR BROKEN BONES

Dr. **Paul Santerre** and his research team have developed a new adhesive tape for mending broken bones in the face or head. The translucent, bioresorbable tape can be molded to support fractured bones as they heal, eliminating the need for invasive metal plates or screws. The invention is now being commercialized as BoneTape through Cohesys, a company founded and led by postdoctoral fellow Dr. **Michael Floros**. Watch Dr. Floros describe this new technology in the video (left). [Full Story](#) / [Video](#)



The Institute for Education Research



Research Team at TIER 55

35

Principal Investigators



5

graduate students



93

publications



\$1.3M

external funding



15

staff



**TIER was launched in 2019. TIER research is conducted in space that is shared with education and administration activities; these spaces include offices and simulation labs at The Michener Institute of Education at UHN School of Applied Health Sciences, as well as at other sites across the UHN campus.*

Top Tier Education

The Institute for Education Research becomes UHN's seventh research institute

This past year, the research and education communities celebrated the inauguration of The Institute for Education Research (TIER) at UHN.

As UHN's seventh research institute, TIER focuses on health care education research that will significantly impact health science professions. Led by Research Institute Director Dr. **Nikki Woods** and Applied Research Director Dr. **Ann Russell**, TIER's faculty focuses on three main themes: 1) Technology, Innovation and Simulation; 2) Societies, Systems and Structures; and 3) Teaching, Learning and Practice.

"We're excited about the expansion of research at UHN with TIER and the unique focus on education research," says Dr. **Brad Wouters**, EVP, Science and Research. "TIER brings a new focus to our research ecosystem, while complementing our existing strengths. It sits at the intersection of care, education and research—the convergence of which is a key element of UHN's corporate, research and education strategic plans."

TIER is putting a particular emphasis on strengthening the relation between quality education and quality care. Embedded within UHN's care environment, the institute is ideally positioned to develop new models of learning for health care and inspire the next generation



of researchers, educators and caregivers. TIER's future-oriented vision and its integrated and inclusive approach to fostering collaboration will be key factors in its success.

During the launch event, Dr. Russell commented, "Achieving our vision of leading the world in transforming health care education through experimentation, creativity and curiosity will take time and an unwavering commitment." But this is a commitment the co-directors are prepared for and eager to make. Dr. Woods agreed, "There are incredible ideas across the education research community and TIER will give us a chance to bring them to life. Education research plays an important role within the complex structures of our health care system and the care providers of tomorrow are counting on us to deliver meaningful changes to the way we educate."



Research Highlights

LEARNING WITH PATIENTS

A research team led by Scientist Dr. **Paula Rowland** explored the evolution and variations of patient involvement in health profession education. By mapping out key streams of engagement, their research will inform future patient involvement. The published work was recognized with a 2019 *Research Paper Award* from The Association for Medical Education in Europe for its excellence in medical education research. [Scientific Article](#)

SOMETHING TO TALK ABOUT

Oral case presentations are a key mode of communication in medicine and an integral component of medical education. Clinician Teacher Dr. **Lindsay Melvin**, along with Scientists Drs. **Ayelet Kuper** and **Mahan Kulasegaram**, found that the assessment of trainees' presentations can overshadow their learning experience. The research focused on presentations in internal medicine and recommends clearly outlining the expectations for trainees and supervisors. [Scientific Article](#)

IF AT FIRST YOU DON'T SUCCEED

A study led by Scientist Dr. **Maria Mylopoulos** and Education Investigator **Naomi Steenhof** found that students in health professions who experience productive failure—ie, struggle in trying to solve challenging problems without direct instruction—are better prepared for future learning. The study is the first to explore productive failure in health professions education and emphasizes the long-term importance of struggle in learning. [Scientific Article](#)



Dr. Nikki Woods served as TIER's founding Scientific Director (featured in the video above). Dr. Ann Russell is responsible for advancing the Institute's simulation, innovation and research strategies (middle). Students and trainees take an active role in the education research being conducted at TIER (bottom).



**The KITE Research
Institute**

Research Team at KITE 453

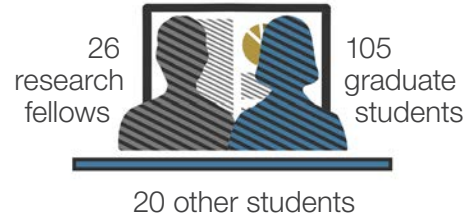
127

Principal Investigators



151

trainees



56K

sq. ft. research space



\$30.6M

external funding



627

publications



175

staff



Watching Your Step

New video-monitoring system could help prevent falls in people with dementia

Falls are a leading cause of emergency room visits in Canadians over the age of 65.

For older adults, a fall does not only cause bruises—it can also cause severe injury or death. Those with dementia are particularly at risk and are four to five times more likely to fall.

Researchers are developing new technologies to detect the risk of falls in older adults. However, most of these systems have only been used in a laboratory and are not yet tailored to assess the risk of falling in real-world situations.

To address this clinical need, Drs. **Andrea Iaboni** and **Babak Taati** led a research team to develop AMBIENT—a vision-based monitoring system that unobtrusively monitors stability and gait in real-life settings.

The team tested the system by recording episodes of walking in older adults with dementia who had been admitted to the Specialized Dementia Unit at Toronto Rehab.

By carefully analyzing information that was gathered over a two-week period, they were able to identify walking patterns that predicted falls in the study's participants.



“The AMBIENT system gives us the flexibility to frequently and discreetly measure gait in real life, as people move around naturally through their home environment,” says Dr. Iaboni.

“We now have an unprecedented opportunity to develop interventions that are tailored to individual patients to reduce the risk of falling.”

Mehdizadeh S et al. J Gerontol A Biol Sci Med Sci. 2019 Aug. DOI: 10.1093/gerona/glz187. Supported by the Alzheimer's Association, Brain Canada, the Natural Sciences and Engineering Research Council of Canada, FedDev Ontario, the Toronto Rehabilitation Institute, the University of Toronto, the Canadian Institutes of Health Research, AGE-WELL NCE, the Walter Maria Schroeder Institute for Brain Innovation and Recovery and the Toronto Rehab Foundation.



Research Highlights

TIME TO HEAL

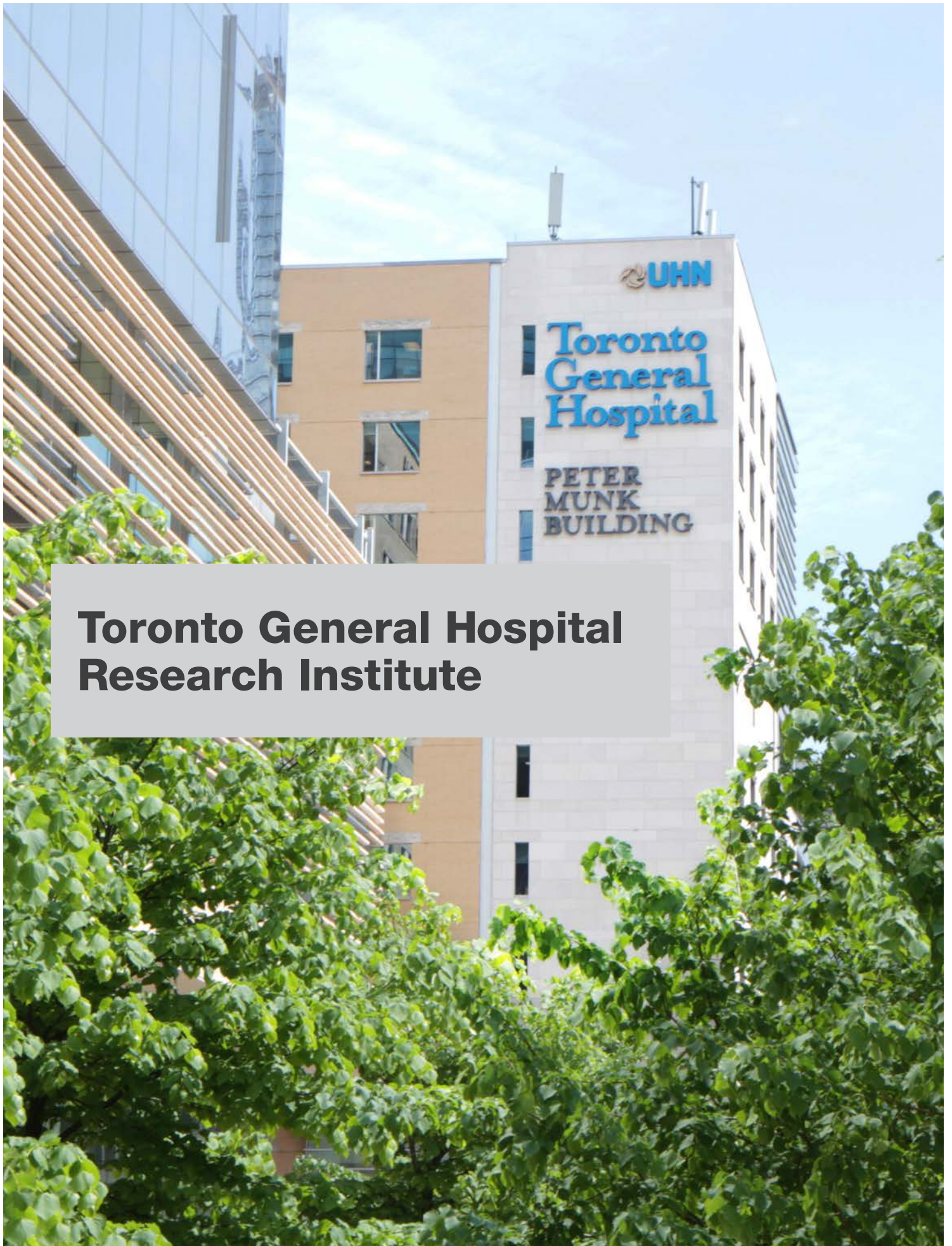
Drs. Reema Shafi and [Angela Colantonio](#) led a study that examined compensation claims for work-related mild brain injuries in Australian workers. The team reported that when the mild brain injury was caused by assault, workers were twice as likely to take days off than when the injury was accidental. [Full Story](#) / [Scientific Article](#)

ROBOTIC GLOVE IMPROVES FUNCTION

Doctoral student [Aaron Yurkewich](#), working with Dr. [Alex Mihailidis](#), developed a robotic glove for rehabilitation. The Hand Extension Robot Orthosis (HERO) Glove has been shown to improve hand function of stroke survivors in a clinical trial. [Full Story](#) / [Scientific Article](#) / [Video](#)

Dr. Andrea Iaboni and a volunteer test the monitoring system (opposite page). Dr. Iaboni (below, left). Aaron Yurkewich demonstrates the HERO glove (below, right).





Toronto General Hospital Research Institute

Research Team at TGHRI 1,231

418

Principal Investigators



330

trainees

112
research
fellows

177
graduate
students



41 other students

156.8K

sq. ft. research space



\$109.7M

external funding



1,347

publications



483

staff



No Pain, All Gain

New pill-form of drug could help persons with type-2 diabetes avoid injections

Learning how to self-administer an injection can be a pain. For people with diabetes, daily or weekly injections are required in order to control blood sugar levels.

Abnormally high blood sugar is a hallmark of type-2 diabetes, and over the long term it can damage the heart and blood vessels. As a result, people with diabetes are two to three times more likely to have a heart attack or stroke than people with normal blood sugar levels.

Several types of medications that lower blood sugar are currently available, and many more are in development. But before any new diabetes medication is approved for widespread use, it must be tested in clinical trials to ensure that it will not increase a person's risk of heart attack or stroke.

Dr. **Mansoor Husain** (pictured opposite page, top left) led a large international clinical trial to ensure that the oral form of the injectable diabetes drug semaglutide is safe.

The trial enrolled over 3,000 subjects with type-2 diabetes at high cardiovascular risk in 21 countries. Half of the patients received the oral semaglutide tablet, with the other half receiving a placebo tablet containing no medicine. Approximately 75% of patients received treatment for at least one year.



The research team found that the semaglutide pill improved blood sugar levels and reduced body weight of participants without increasing their rates of stroke, heart attack or death due to cardiovascular causes.

The study observed a 50% reduction in the risk of death in subjects assigned to oral semaglutide; however, this observation needs to be studied in a larger population to demonstrate causation.

“Injections can be challenging for some patients. We believe that semaglutide in pill form will be easier to take, and promote earlier and broader use of this medication to improve blood sugar,” says Dr. Husain.

Husain M, et al. N Engl J Med. 2019 Jun 11. doi: 10.1056/NEJMoa1901118. This clinical trial was supported by Novo Nordisk. Dr. Husain is supported by the Toronto General & Western Hospital Foundation.



Research Highlights

THE DANGERS OF COTTAGE COUNTRY

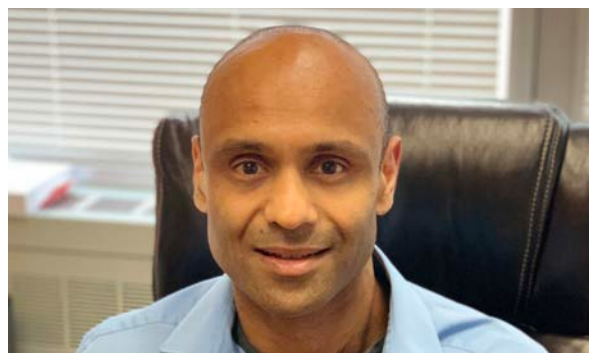
Dr. **Moira Kapral** found that the incidence of stroke-related death was 19% higher in Ontarians who live in the country. The results highlight the need for studies to identify stroke risk factors and prevention strategies in rural settings.

[Full Story](#) / [Scientific Article](#)

LINKING OBESITY AND MENTAL HEALTH

Research from Dr. **Satya Dash** (pictured below) revealed that rare genetic changes previously associated with conditions such as bipolar disease, schizophrenia and autism also contribute to the development of obesity and mental health issues.

[Full Story](#) / [Scientific Article](#)



CLEARING THE AIR FOR RECOVERY

Dr. **Ewan Goligher** developed a way to identify patients at risk for poor recovery from mechanical ventilation. The findings will help doctors develop better treatment plans for those who require this life-saving intervention due to illnesses such as cancer or COVID-19. [Full Story](#) / [Scientific Article](#)

THE LANGUAGE OF HEALTH

Drs. **Angela Cheung** (pictured left) and Shail Rawal found that limited English proficiency may be a barrier to recovery for patients with chronic diseases (eg, heart failure) that require complex follow up treatment plans. [Full Story](#) / [Scientific Article](#)

Awards and Distinctions

Selected honours awarded to UHN researchers



Dr. Mamatha Bhat

2019 John Charles Polanyi Prize in Physiology/
Medicine, Government of Ontario

Dr. David Cherney

2019 Distinguished Researcher Award, American
Society of Nephrology
2019 Young Scientist Award, Diabetes Canada

Dr. Daniel De Carvalho

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

Dr. Phedias Diamandis

New Investigator Award, Terry Fox Research
Institute and the Canadian Institutes of Health
Research

Dr. John Dick

2020 Pezcoller Foundation-AACR International
Award for Extraordinary Achievement in Cancer
Research, The Pezcoller Foundation and the
American Association for Cancer Research
2019 Dr. Chew Wei Memorial Prize in Cancer
Research, University of British Columbia Faculty
of Medicine

Dr. Michael Fehlings

2019 Ryman Prize, The Ryman Foundation

Dr. Jason Fish

Tier 2 Canada Research Chair in Vascular Cell and
Molecular Biology (renewal)

Dr. John Floras

2019 Senior Investigator Award, Hypertension
Canada

Dr. Paul Fortin

2020 Distinguished Investigator Award, Canadian
Rheumatology Association

Dr. Monique Gignac

2019 Addie Thomas Service Award, Association of
Rheumatology Professionals

Dr. Shiphra Ginsburg

Tier 1 Canada Research Chair in Health Professions
Education (new)

Dr. Mary Gospodarowicz

Gray Medal, International Commission on
Radiation Units & Measurements

Dr. Sherry Grace

Fellow, American Association of Cardiovascular
and Pulmonary Rehabilitation

Dr. Benjamin Haibe-Kains

2019 Bernard and Francine Dorval Prize, Canadian
Cancer Society

Dr. Doris Howell

2019 Lifetime Achievement Award, Canadian
Association of Nurses in Oncology

Dr. Gordon Keller

2019 Ogawa-Yamanaka Stem Cell Prize, Gladstone
Institutes

Dr. Sidney Kennedy

Fellow, Royal Society of Canada

Dr. Rama Khokha

Tier 1 Canada Research Chair in Adult Tissue Stem Cell Niches (new)

Dr. Gabor Kovacs

2019 Franz Burda Award, International Association of Parkinsonism and Related Disorders

Dr. Lauren Lapointe-Shaw

2019 Rising Star Award, CIHR Institute of Health Services and Policy Research

Dr. Lothar Lilge

2019 Lifetime Achievement Award, International Photodynamic Association

Dr. Mingyao Liu

2019 CPAC Professional Achievement Award, CPAC

Dr. Charmaine Lok

2019 Garabed Eknayan Award, National Kidney Foundation

Dr. Tak Mak

2018 CIHR Gold Leaf Prize for Discovery, Canadian Institutes of Health Research
11th Annual Weinman Award, Weinman Foundation Fund for Innovation

Dr. Alison Novak

Early Researcher Award, Ontario Ministry of Economic Development, Job Creation and Trade

Dr. Karen Okraïneç

Early Researcher Award, Ontario Ministry of Economic Development, Job Creation and Trade

Dr. Milos Popovic

Fellow, The Canadian Academy of Engineering

Dr. Heather Ross

2019 Annual Achievement Award, Canadian Heart Failure Society

Dr. Aaron Schimmer

2019 Paper of the Year Award, Canadian Hematology Society

Dr. Michael Sefton

Member, U.S. National Academy of Engineering

Dr. Frances Shepherd

University Professor, University of Toronto

Dr. Lillian Siu

2020 Targeted Anticancer Therapies Honorary Award, European Society for Medical Oncology

Dr. Zahi Touma

Early Researcher Award, Ontario Ministry of Economic Development, Job Creation and Trade

Dr. Sowmya Viswanathan

Elected Member PhD of Board of Directors, International Society for Cell and Gene Therapy

Dr. Donald Weaver

2020 Harrington Scholar-Innovator, Harrington Discovery Institute

Dr. Kazuhiro Yasufuku

Japan Medical Research and Development Grand Prize

Improving Lives

Donors are helping to propel innovation in rehabilitation science

Toronto Rehab Foundation's donors and volunteers are bolstering the infrastructure of The KITE Research Institute. They are enabling scientists and clinicians to improve the lives of people living with disability, illness and injury. Philanthropy helps propel the development of new treatments, devices and products.

SUPPORTING RESEARCH INTO TRAUMATIC BRAIN INJURY

In 2013, while returning to medical school, Dr. **Matthew Galati** (pictured, opposite page) faced a near-death motor vehicle accident that resulted in a severe traumatic brain injury. After three days in a medically induced coma, he was sent to Toronto Rehab where his journey to recovery began. Under the supervision of Dr. **Robin Green**, Matthew overcame his cognitive and physical deficits, and graduated from medical school. Inspired by the care he received, the Galati family made a transformational investment in 2019 that helped launch the *Brain Changes Initiative* to support research into traumatic brain injury.

RELIEVING PRESSURE

Pamela Hallisey and her family founded the *Hallisey Fellowship in Technology for Family Caregivers*. This support is helping our researchers develop innovative interventions, technology and caregiver educational tools to improve the quality of life for individuals at risk of developing pressure injuries. Pressure injuries reduce quality of life, cause tremendous pain and suffering, and are common in individuals with limited mobility.

RESEARCH-BASED CONCUSSION CLINIC

Through support from **Tim and Sheila Casgrain**, **Ron Ellis** and the *Toronto Rehab Golf Classic* (pictured below) presented by Scotiabank, Toronto Rehab opened a research-based concussion diagnosis and treatment clinic that is poised to change the traditional landscape of concussion recovery. The clinic will help to standardize the assessment of concussions (which number 150,000 annually in Ontario) in order to improve diagnosis and fast-track referrals and treatments.





Tim Casgrain (above). Andrew Hallisey, Hallisey Fellow Dr. Sharon Gabison and Pamela Hallisey (above left, L-R). Dr. Matthew Galati (left).



TEAM "I WILL"

The team has raised over \$500,000 through events such as the Scotiabank Toronto Waterfront Marathon.

ROCKET RIDE FOR REHAB

Presented by BMO, the event was held at First Canadian Place and raised over \$358,000.



Bringing Home Health

Donors support state-of-the-art cancer research and care

Every finding, discovery and breakthrough shifts the course of global cancer research and advances our vision to *Conquer Cancer In Our Lifetime*.

But none of this can happen without critical support from the broad range of programs and initiatives, which help to direct philanthropic support to world-class research.

PRINCESS MARGARET HOME LOTTERY

Since its inception in 1996, the lottery has raised over \$400M to help the Princess Margaret Cancer Centre become one of the world's top five cancer research centres. Funds from the initiative are fueling innovation in research and care by supporting programs in clinical trials, next-generation technology and genomics, and core research services, which provide our researchers with access to cutting-edge technologies. These enable our researchers to make top-tier discoveries and publish in the world's most prestigious medical journals.

THE PRINCESS MARGARET HOME LOTTERY The 2019 lotteries were the largest ever, with more than 38,000 prizes offered.

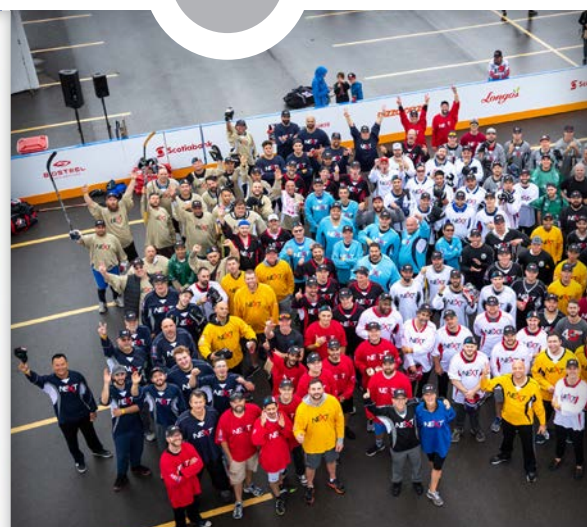
INNOVATION ACCELERATION FUND

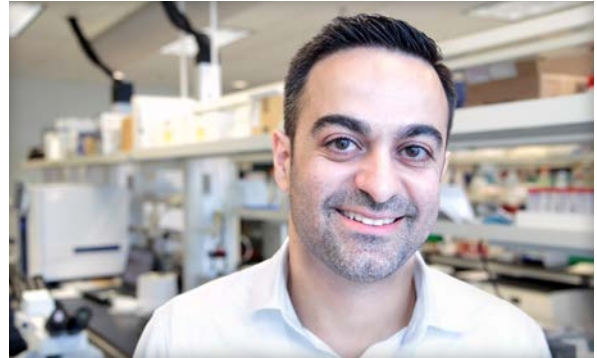
Advancing discoveries from bench to bedside continues to be a major hurdle in cancer research. In collaboration with UHN's Technology Development & Commercialization Office, The Princess Margaret Cancer Foundation supports researchers in translating their findings to improve cancer care. This support is enabling investigators to test immunotherapies and anti-cancer drugs for some of the most hard-to-treat cancers.

INVEST IN RESEARCH COMPETITION

Thanks to generous donors, the *Invest in Research* program once again made funds available to support high-risk, high-reward research. Drs. [Marianne Koritzinsky](#) and [Phedias Diamandis](#) received funding to lead projects that will provide a better understanding of the biology underlying pancreatic cancers, and to develop drugs to treat aggressive brain cancers. This program enables donors to select projects that they believe will have the greatest impact in the fight against cancer.

SCOTIABANK ROAD HOCKEY TO CONQUER CANCER The ninth annual event, held in September 2019, broke all records by raising \$3.1M.





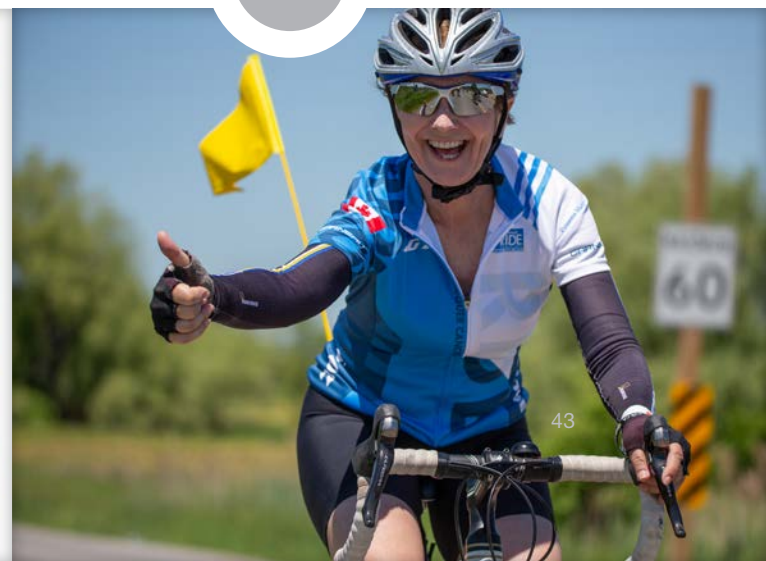
Winners of the 2019 Invest in Research competition: Dr. Marianne Koritzinsky (above left); and Dr. Phedias Diamandis (top right). Dr. Rob Laister, PM Cancer Centre Scientific Associate (above right), conducting research in an environment that fosters discovery by linking clinical care with world-class research.

JOURNEY TO CONQUER CANCER

The 2019 event raised over \$1.7M, during which participants ran or walked courses of one, three or five kilometers.

THE ENBRIDGE® RIDE TO CONQUER

CANCER® The 12th annual bike ride, which was held in June 2019, raised a total of \$19.2M.



Serving up Knowledge

Spectacular events raise awareness and support for critical research

Toronto General & Western Hospital Foundation exceeded its financial goal by raising more than \$147.9M and granting \$126.2M to UHN, with over 65% directed to support research.

The fiscal year ended with the urgent call to support research in the midst of the COVID-19 pandemic. In a few short weeks, more than \$11M in donor support was raised for critical COVID-19-related priorities, with the majority of the funds supporting over 40 research projects.

A highlight of the year was a landmark gift to name UHN's transplant program. Soham (Sam) and Shaila Ajmera have always been strong advocates for health research. When the opportunity arose to lend the family's name to the leading transplant program in North America, they decided to create the *Soham & Shaila Ajmera Family Transplant Centre*. "Through the course of making this gift, my family had the great pleasure to meet with and learn about the tremendously

talented team of transplant clinicians, support teams, researchers and educators at UHN," says Mr. Ajmera. "To have our family's name associated with such incredible and dedicated people is an honour."

The Ajmera family's gift has also established the *Soham & Shaila Ajmera Family Chair in Molecular Diabetes Research* to support the efforts of Dr. **Minna Woo**, who is the Director of UHN's Division of Endocrinology and Metabolism and a Senior Scientist at Toronto General Hospital Research Institute (TGHRI). Her research is revealing the molecular mechanisms that underlie the pathogenesis of insulin resistance in type-2 diabetes, with the goal of developing new therapies and preventing diabetes complications.

It was also a successful year for signature events, including a record-breaking *Grand Cru Culinary Wine Festival*, *Diwali – A Night to Shine*, *UHN Transplant Evening: Be Amazed!*, and a new community event: *Porridge for Parkinson's*.

GRAND CRU CULINARY WINE FESTIVAL

The 15th annual event (pictured below) raised \$33M and featured wines from 80 vintners, gourmet dinners prepared by 33 world-class chefs, and participation from 30 UHN clinicians and scientists.

PORRIDGE FOR PARKINSON'S

Held at Steamwhistle Brewery, the 2019 event raised \$285,000 to support the *Edmond J Safra Program in Parkinson's Disease* at Krembil Brain Institute.





Dr. Minna Woo (top, left). Pictured at 'Diwali - A Night to Shine': Roberta Ajmera, Patrons Shaila and Sam Ajmera, Honorary Patrons Megan and Brian Porter, Shaila Kothari and Raj Kothari (Gala Chair) (above). Pictured at the Grand Cru Culinary Wine Festival: Rob and Cheryl McEwen (event Co-Chairs), Drs. Brad Wouters and Maria Cristina Nostro, chef Arpi Magyar, and Todd and Ellen Halpern (event Co-Chairs) (opposite page, L-R). Pictured at the 'Be Amazed!' event: Dr. Roberto Ribeiro, Dr. Phyllis Billia, Dr. Liming Xin, Joanne Kearney, Brendan Cahill, Mitesh Badiwala and Frank Yu (below, L-R). Joanne and Brendan served as event Co-Chairs.

BE AMAZED!

Presented by Scotiabank, this event (pictured below) was held in May 2019 at Toronto's Four Seasons and raised \$1.5M to support the *Soham & Shaila Ajmera Family Transplant Centre*.

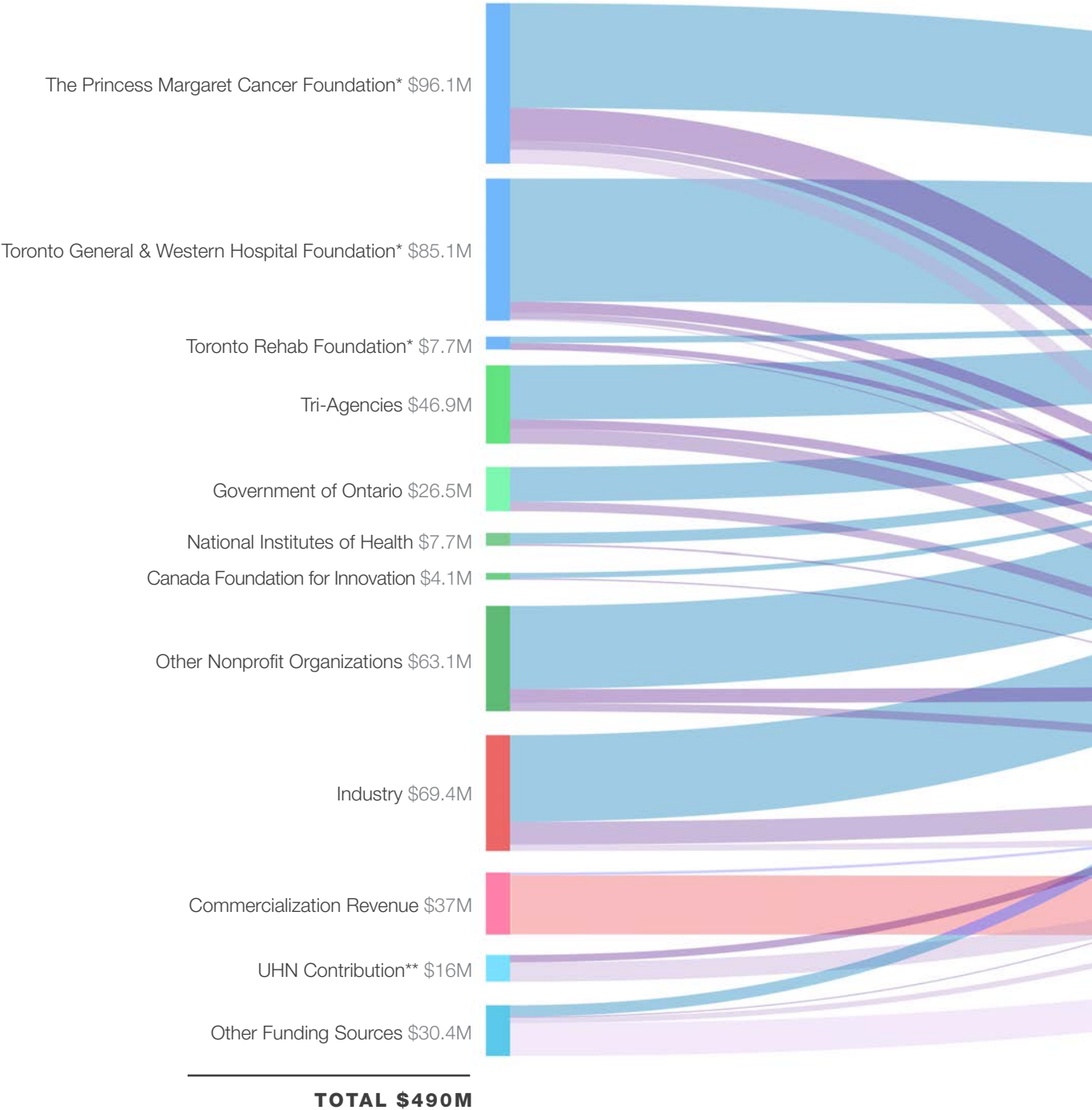
DIWALI - A NIGHT TO SHINE

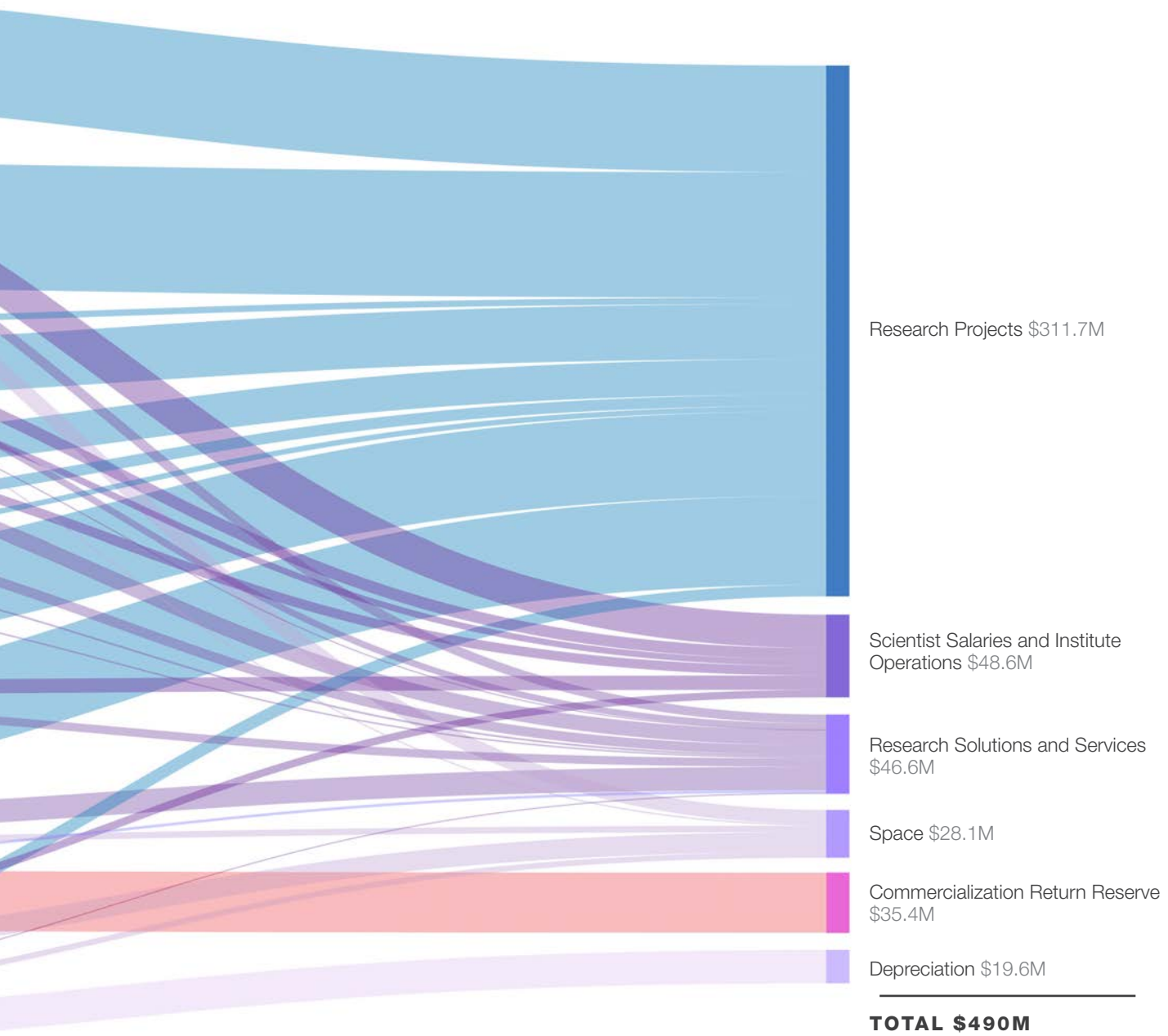
This year's event was presented by Scotiabank and was held in October 2019 at the Beanfield Centre. Over \$1.8M was raised in support of TGHRI research.



Financials

Flow of research funding by source for the 2019/2020 fiscal year





The above diagram shows how research funding was utilized towards UHN’s research mission for the fiscal year ending on March 31, 2020. Values are rounded to the nearest \$100,000. The methodology used in this year’s Research Report has been updated to reflect the full revenues and expenses related to research support services and commercialization activities, along with full amortization of deferred capital grants and depreciation expenses related to research space. Previously these had been reported as net values. These figures are consistent with UHN’s audited financial statements. *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. **Funds in this category do not originate from the Ontario Ministry of Health and Long-Term Care.

Research Committee of the Board of Trustees

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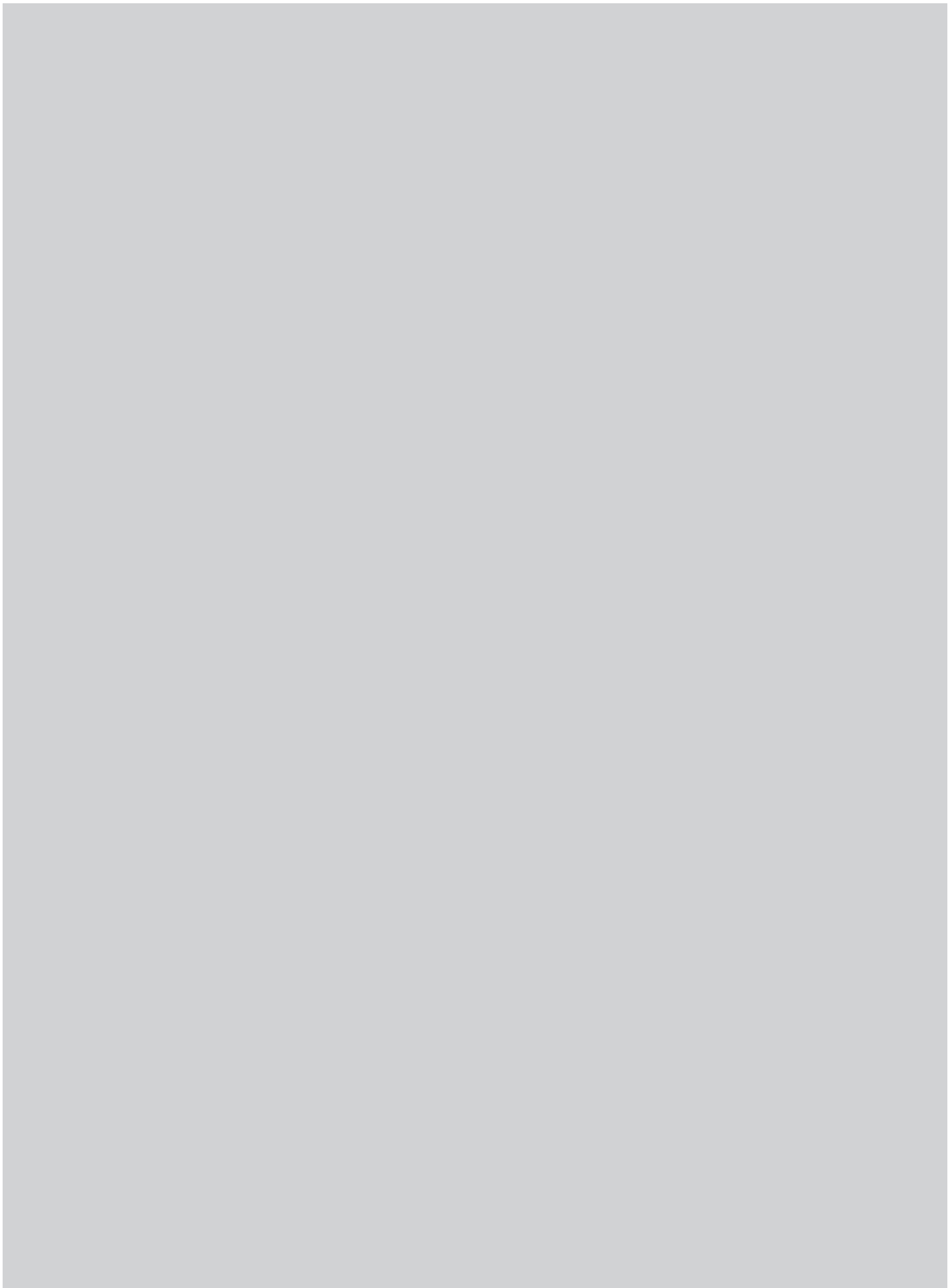
Disclaimers: All data is accurate as of March 31, 2020. Publication data is reported for the previous calendar year. Financial data is reported for the 2019/20 fiscal year ending on March 31, 2020.

Research Snapshot Metrics reported for UHN (page 2) and individual research institutes (pages 11, 15, 19, 23, 27, 31, 35) include data for all Principal Investigators (PI). PIs either have a formal appointment at a UHN research institute or are aligned to a UHN research institute as either a clinician scientist or a clinician investigator. PIs affiliated with two or more institutes are included only once in the total Research Snapshot for UHN.

PI Data provided by UHN Research Strategy and Planning. **Publication Data** provided by UHN Research Strategy and Planning. Publications include articles, reviews and proceeding papers indexed in the Web of Science Core Collection that were published in the previous calendar year with at least one UHN PI in the author list. Those authored by more than one UHN PI are included once in the UHN and institute Research Snapshots. **Staff and Trainees Data** provided by UHN Human Resources. Trainee values reflect the number of students whose primary supervisor is appointed at UHN.

Space Data provided by UHN Facilities Management - Planning, Redevelopment & Operations (FM-PRO). Institute space values include institute-specific space only. UHN space values include all institute space, as well as core research facilities, Research Solutions and Services (RSS) space, and external companies and programs on UHN premises. **Financial Data** provided by UHN Research Financial Services. See disclaimer on page 47. Research institute external funding data are calculated based on the institute affiliations of PIs.

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 **UHN** Toronto General
Toronto Western
Princess Margaret
Toronto Rehab
Michener Institute



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