Better Performance

Faster Treatment Planning

Stronger Immune System

BETTER. FASTER. STRONGER.

Better Therapies

Faster Diagnosis

Stronger Hearts

2017 Research Report

Health innovation at UHN

UHN Research Snapshot

TOTAL RESEARCHERS	**1,094**
Appointed Researchers	464
Clinical Researchers	630
RESEARCH SPACE	**969,913 sq. ft.**
TOTAL FUNDING	**$386,192,252**
TOTAL TRAINEES	**783**
Fellows	309
Graduate Students	474
TOTAL STAFF	**2,098**
Institute Staff	1,802
Research Support Staff	296
PUBLICATIONS	**3,732**

The cover features six UHN researchers whose work exemplifies how we are making health care better, faster and stronger. They are, from top left (clockwise): Drs. Karen Davis, Thomas Purdie, Pamela Ohashi, Michael Laflamme, Frank Rudzicz and Cristina Nostro.

University Health Network (UHN) is a research hospital affiliated with the University of Toronto and a member of the Toronto Academic Health Science Network (TAHSN). UHN comprises the Michener Institute for Education at UHN and four hospitals: the Princess Margaret Cancer Centre (PM Cancer Centre), Toronto General Hospital (TGH), Toronto Rehab (TR) and Toronto Western Hospital (TWH). It has five research institutes: Krembil Research Institute (Krembil), PM Cancer Centre, Techna Institute for the Advancement of Technology for Health (Techna), Toronto General Hospital Research Institute (TGHRI) and Toronto Rehabilitation Institute (TRI). The scope of research and complexity of cases at UHN have made it a national and international source for discovery, education and patient care.

BETTER. FASTER. STRONGER.

Welcome Message

Pushing the Limits

High-performance athletes train for years to become the best in their field. They consistently push themselves beyond what they are capable of, honing their skills through an unwavering drive. And once they've attained their goal—be it breaking a personal best, winning a gold medal or shattering a world record—it's on to the next challenge.

The same can be said of our researchers.

Our researchers tirelessly work to better understand disease, improve the delivery of care, and the effectiveness and efficiency of the health care system. Along with clinicians, health care professionals, funders and patients, they make a united front to define the most important unmet needs. And together they work to address these needs while setting and achieving goals that are far beyond what would be possible as individuals.

Some of our researchers set their sights on creating a **better** understanding of disease as a path towards improved health. Examples include those who reveal new molecular targets that lead to the development of better, more specific therapeutic drugs; those who identify gaps in care that inform new, more effective clinical tools and policies; and those who find better ways to bring basic research findings to the clinic to help patients. This knowledge can be translated into a better approach to doing something, whether it's a research method, therapeutic strategy or way of performing surgery. These solutions continually enhance and refine the delivery of health care.

Emerging technologies have enabled other researchers to improve care at an increasingly **faster** pace. These technologies include advanced DNA sequencing approaches that reveal the complexities of the human genome with unprecedented speed. Our researchers are also developing machine learning methods to reduce the time it takes to plan treatments, so that patients get the care they need sooner. Both examples demonstrate how our researchers are using these technologies to their fullest potential to accelerate the application of research, the delivery of quality care and to ease the burden on the health care system by reducing wait times.

Others still are building **stronger** systems. Our researchers are experts in regenerative approaches to repair damaged organs, and leaders in developing rehabilitation programs to strengthen patients' minds and bodies as they age or recover from life-threatening situations. Some are translating their work by commercializing new products or founding new companies through history-making investments from private sector partners; these deliverables fortify the bioeconomy and reinforce the profile of Toronto's research ecosystem on the world stage. Regardless of the means, those engaged in these activities strive to build robust systems—from cells, tissues and organs to networks, consortia and companies—towards enriching human health and wellbeing.

We hope you will enjoy the examples we selected in this year's report to highlight how our researchers are helping to make health care better, faster and stronger.

*Dr. **Charlie Chan**, Interim President and Chief Executive Officer; Executive Vice President, Clinical Programs, Quality and Safety; Chief Medical Officer.*

*Dr. **Brad Wouters**, Executive Vice President, Science and Research.*

*Dr. **Peter Pisters**, Past President and Chief Executive Officer.*

Why Some Gain When Under Pain

More flexible communication in the brain could make pain less of a distraction while performing a task

Despite being hampered by painful injuries, many athletes continue to compete and win. For example, Toronto Maple Leafs defenceman Bobby Baun played several playoff games with a broken ankle and helped his team win the Stanley Cup in 1964.

Why is it that some individuals can perform a task—and do it well—while experiencing pain?

"There is a complex relationship between pain and attention, where pain can modulate attention and vice versa. Moreover, the interplay between these two factors differs from one person to the next," explains Dr. **Karen Davis**.

Dr. Davis has shown that individuals can be classified as one of two types depending on how pain affects their performance in doing a task. In P-type individuals, pain impedes their ability to perform a task; whereas, in A-type individuals, like Bobby Baun, pain enhances their performance.

To gain a better understanding of the brain mechanisms that contribute to this divergent behaviour during pain, Dr. Davis and her PhD student Joshua Cheng led a study examining patterns of brain activity in these two groups.

First, 51 healthy participants were classified as either A-type or P-type based on their performance in a complex mental task in the presence and absence of a painful stimulus. Next, the participants underwent a functional MRI (fMRI) scan, while they were not thinking of anything in particular, to measure their spontaneous brain activity.

The researchers focused their study on the activity of brain cells in two networks: the executive control (EC) network and the salience network. The EC network helps to optimize a person's behaviour in response to what's happening around them; whereas, the salience network is normally engaged when something like pain draws your attention.

Through their analysis, Dr. Davis and her research team discovered a link between spontaneous brain activity and task performance with pain. The synchrony of activity between the EC network and the salience network, as well as within the salience network, was more flexible in A-type individuals than P-type individuals. These findings suggest that brain communication is more flexible in A-type individuals—a feature that could be important for prioritizing task performance over pain, producing **better** performance.

Regarding her future work, Dr. Davis says, "We'd like to explore whether communication flexibility is disrupted in chronic pain and how it is altered by treatments for chronic pain—including surgery, medications and cognitive-behavioural therapy. This will improve our understanding of the mechanisms underpinning chronic pain, which will be instrumental for developing more effective and personalized therapies for this debilitating condition."

Cheng JC et al. Neuroimage. 2017 Aug 15;157:61-68. Supported by the Canadian Institutes of Health Research and the Toronto General & Western Hospital Foundation.

“When I play hockey, my mind is so focused on the game and scoring a goal that I don’t feel my recurring back and knee pain,” confides Dr. Davis, an avid hockey player and Leafs fan.


TORONTO

Images: (panel on left) Dr. Davis is pictured in her hockey gear; (on this page) the battle that takes place in the brain between pain and attention is illustrated by two hockey players facing off.

Making Every Move Count

Research exposes a hidden defence mechanism that protects cancer from the body's immune system

The best defence is a good offence. This adage, often applied to sports or military strategies, suggests that attacking one's opponent offers the greatest protection. Researchers and clinicians are taking this approach to fight cancer—developing powerful new therapies that seek out and kill cancer cells.

One such approach is immune therapy: it works by boosting the number and activity of tumour-infiltrating lymphocytes (TILs), immune cells that go on the offensive by migrating into tumours to target and destroy them. Although this strategy holds promise, challenges remain because certain tumours have developed defence mechanisms that block TIL activity.

These tumours, however, are no match for Dr. **Pamela Ohashi**. She is a pioneer in figuring out how the immune system interacts with cancer in order to develop new immune therapies.

In an article published in the prestigious journal *Nature Medicine*, Dr. Ohashi and her research team revealed that an internal battle may be going on: they found that certain ovarian tumours contain other immune cells, called regulatory innate lymphoid cells (ILCregs), that block the activity of cancer-fighting TILs. The ILCregs did this in two ways: they reduced the ability of TILs to grow and multiply, and altered the ability of the TILs to attack cancer cells.

The team also found that the tumours from some patients contained ILCregs, while those from others did not, suggesting that some tumours may be able to attract or promote growth of ILCregs.

"By looking at tumour biology from this different perspective, we have a better understanding of the barriers that prevent a strong immune response," explains Dr. Ohashi. "Our research reveals a promising new strategy to develop combined therapies that simultaneously target ILCregs while promoting TIL growth and function—delivering a **stronger** 'one-two punch' against the disease."

Building on these findings, her team is now developing a test to identify ILCregs in patients, which may help predict whether the patient will respond to immune therapy. Dr. Ohashi says, "This knowledge would help doctors and patients make more informed medical decisions, personalize cancer treatment and ultimately improve the effectiveness of immune therapies."

Immune therapies work by helping the immune system to target and kill cancer.

Crome SQ, et al. Nat Med. 2017 Mar;23(3):368-375. Supported by the Canadian Institutes of Health Research, the Cancer Research Institute/Irvington Institute, the Canada Foundation for Innovation, the Ontario Ministry of Research, Innovation and Science, the Alexander von Humboldt Foundation, the German Research Council, the National Institutes of Health, the Parker Institute for Cancer Immunotherapy and The Princess Margaret Cancer Foundation. P Ohashi is a Tier 1 Canada Research Chair in Autoimmunity and Tumour Immunity.

Image: (opposite page) just as a chess player uses offensive and defensive strategies to win, Dr. Ohashi is finding ways to weaken cancer's defences while boosting the body's immune system.

Reading Between the Lines

New artificial intelligence platform can diagnose and monitor Alzheimer disease using verbal descriptions of an image

How you speak says a lot about you. A hurried voice can show that you are in a rush, while the tone of your voice can reveal emotion and mood.

How you speak can also uncover deeper truths: it can provide insight into your mental health. For example, speech can be used to diagnose aphasia, a disorder caused by brain damage that compromises an individual's ability to speak, write or understand language.

"While speech analysis represents a powerful approach to diagnose certain disorders, this method typically relies on tedious 'paper-and-pencil' tests that are time consuming and costly to administer and interpret," says Dr. **Frank Rudzicz**.

To address the shortcomings of traditional speech-based tests, Dr. Rudzicz's team has combined subtle differences in speech patterns with the power of artificial intelligence (AI) to create a clinical tool that can quickly diagnose Alzheimer disease.

Alzheimer disease progressively damages the brain, impairing memory. Although memory loss is the most definitive symptom, speech may be a more sensitive indicator of brain function: not only do speech deficits appear early in the disease, but they also worsen as it progresses.

As a first step toward developing the new clinical tool, the research team identified the most prevalent speech deficits in Alzheimer disease. They did this by analyzing brief speech samples from 264 participants (167 with Alzheimer disease and 97 without).

For each audio sample, 370 features of speech were examined, such as vocabulary richness, vowel articulation and pauses between words. Next, the researchers used this data to teach an AI algorithm how to identify Alzheimer disease. The resulting speech-based diagnostic program was able to detect the disease with an accuracy of more than 80%. Not only is the new program just as accurate as traditional assessment methods, but it is **faster**, cheaper and more sensitive.

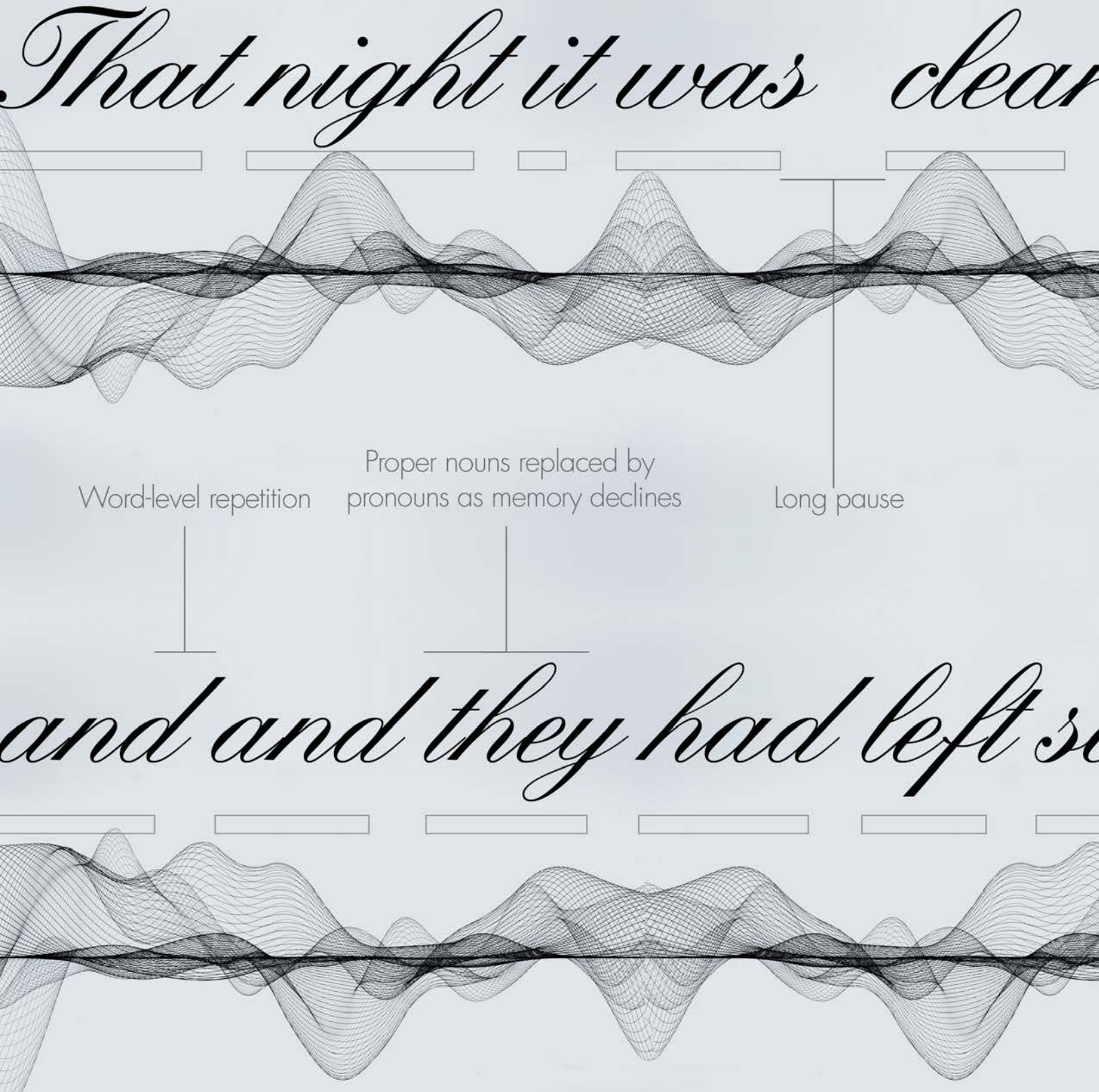
Dr. Rudzicz incorporated these findings into a set of assessment tools that can detect a variety of disorders including aphasia and types of dementia. This platform can also be used to monitor disease progression and the effectiveness of new treatments.

To bring this technology to market, Dr. Rudzicz co-founded the spin-off company WinterLight Labs. The result: an online app that is accessible and easy to use. From the comfort of their own home, patients can upload a short voice recording describing what they see in an image—such as a picture taken during a camping trip. Within seconds, the speech sample is analyzed to generate a set of scores describing speech deficits and mental function, which are then interpreted by clinicians.

WinterLight's app offers a healthier future: one day your phone may be able to notify you at the earliest sign of disease so that preventative therapies could be started to help you stay healthy and active.

Fraser KC, et al. J Alzheimers Dis. 2016;49(2):407-22. Supported by the Natural Sciences and Engineering Research Council of Canada, the Alzheimer's Association, the Alzheimer Society of Canada, the National Institutes of Health and Toronto Rehab Foundation.

“WinterLight’s platform could help doctors make accurate diagnoses faster.”



Images: (panel on left) Dr. Frank Rudzicz; (on this page) within seconds, the WinterLight platform can analyze over 400 features in recorded speech samples to assess a person's mental function. To learn more, please visit the WinterLight Labs website: http://www.winterlightlabs.com/

On Target for Cell Therapy

New method could lead to safer stem cell-derived diabetes treatments

Looking at things from a different angle can often lead to new and better solutions. That's because a fresh perspective can help to inspire creativity, innovative thinking and collaboration.

It's also why Dr. **Cristina Nostro** and her team recently embarked on a new collaborative project to solve a particularly difficult research problem: how to reliably isolate a specific pancreatic cell type capable of improving current treatments for type I diabetes.

Type I diabetes is a chronic condition in which cells in the pancreas—known as beta cells—are destroyed so little to no insulin is produced. Without insulin, the body is unable to keep blood sugar levels within a healthy range. When blood sugar levels remain consistently high for a prolonged period of time, serious conditions can develop, including heart disease, vision loss, kidney disease and nerve damage.

Transplanting healthy beta cells into the pancreas can restore insulin production and decrease the number of insulin injections needed to maintain normal sugar levels. However, widespread use of this treatment is hampered by a limited supply of donor beta cells for transplantation.

Using stem cells, Dr. Nostro has addressed this issue by developing a reproducible method for generating large numbers of cells that can safely give rise to insulin-producing beta cells. The technique, which mimics what occurs during pancreas development, forces stem cells to mature into daughter stem cells (pancreatic progenitors) that then develop into insulin-producing beta cells.

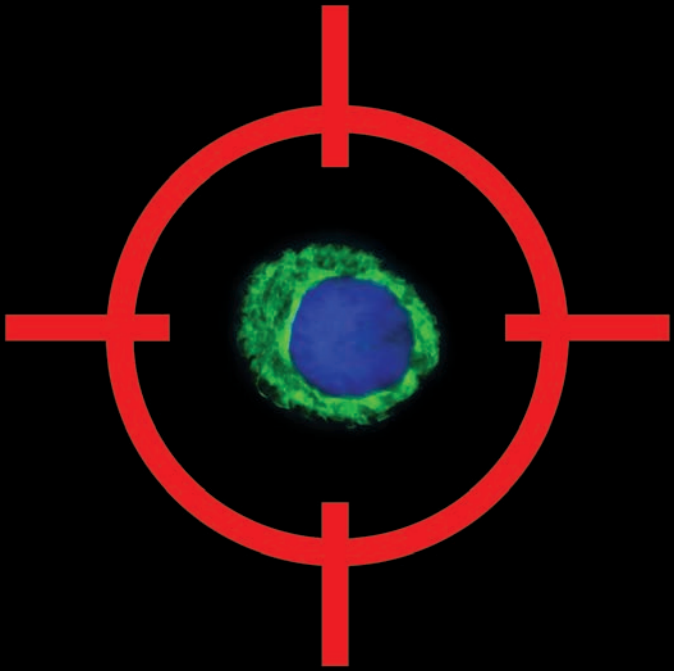
Unfortunately, the technique also produces progenitors that mature into cells that do not produce insulin. The problem: these contaminating progenitors need to be removed before the therapeutic insulin-producing cells can be safely used in the clinic.

Dr. Nostro teamed up with Dr. **Thomas Kislinger** to explore an entirely new approach to solving this problem. Together they identified specific proteins that are found on the surface of the pancreatic progenitors. They then used one of the proteins—known as Glycoprotein 2—to isolate the pancreatic progenitors and remove the contaminating cells. This allowed them to not only control the number but also the purity of the newly generated insulin-producing cells.

"Our long-term goal is to cure type I diabetes using transplants of insulin-producing cells, so it is crucial to have cells that are safe and pure," explains Dr. Nostro. "The technique we've developed provides a **better**, more reliable method for generating large quantities of these cells for use in the clinic."

Cogger KF, et al. Nat Comm. 2017 Aug 24;8(1):331. Supported by the McEwen Centre for Regenerative Medicine and the Toronto General & Western Hospital Foundation, the Banting and Best Diabetes Centre, the Canadian Institutes of Health Research, the Ontario Ministry of Health and Long-Term Care, the National Institutes of Health, the Juvenile Diabetes Research Foundation, the US Department of Veterans Affairs and the Vanderbilt Diabetes Research and Training Center.

“This new approach will help us to develop safer stem cell therapies for diabetes.”



In their quest to improve stem cell-derived diabetes treatments, Dr. Nostro (pictured) and her team developed an approach to reliably target and isolate insulin-producing beta cells (depicted as fluorescently labelled green and blue cells).

Artificial Intelligence Feeds Need for Speed

Technology is being used to fast-track radiation therapy plans and conserve clinical resources

Radiation therapy is simple in its concept: high-energy radiation can damage and destroy cells, so beams of radiation are directed at a tumour to kill cancer cells. However, the treatment must also carefully minimize the dose to nearby organs.

Actually creating a plan that balances these conflicting requirements can be incredibly complex—it requires dedicated time from a team of highly trained experts. Each patient's anatomy and tumour shape are unique, and it takes a lot of clinical resources and expertise to create a high-quality plan.

That may not be the case for much longer. Dr. **Thomas Purdie** and his team, including Dr. **Chris McIntosh**, have used the power of artificial intelligence (AI) to develop a new system that can create a high-quality plan in minutes—**faster** than current approaches, which can take days. The technology, known as AutoPlanning, uses machine learning to harvest information from a massive database of proven radiation therapy plans from Princess Margaret Cancer Centre.

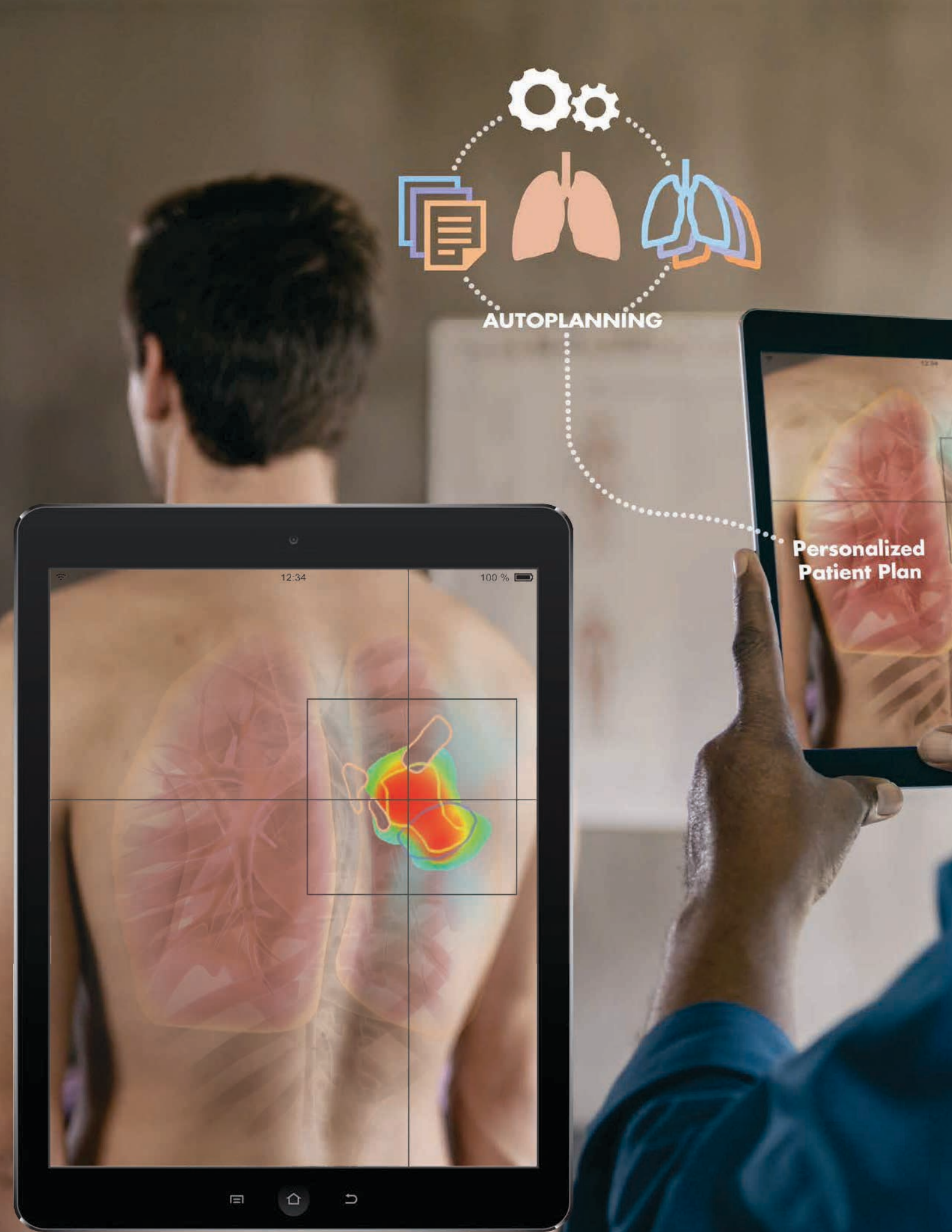
While no two patients are identical, there can be similarities. The AutoPlanning AI can evaluate many features in a patient's images, and find other patients in the database with similar features. Then, it builds a radiation therapy plan for the new patient based on information in the plans of patients with similar features.

With thousands of high-quality plans to learn from, the system rapidly adapts and optimizes the plan to suit the new patient.

"The technology allows radiation medicine teams to take on more complex cases and provide precision medicine to more patients," says Dr. Purdie.

Earlier this year, UHN announced that AutoPlanning has been licensed to RaySearch Laboratories of Sweden with the help of UHN's Technology Development and Commercialization Office. The deep learning algorithms of the AutoPlanning system will be integrated into RaySearch's RayStation treatment planning system next year. Johan Löf, CEO of RaySearch, says, "This technology has the potential to make a huge contribution to patient care. I am delighted to be able to bring its benefits to centers around the world as part of the RayStation platform."

Images: (above) Dr. Thomas Purdie; (opposite page) radiation therapy requires precise targeting and planning to account for a patient's unique anatomy and tumour shape.


AUTOPLANNING
Personalized
Patient Plan
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From Building Blocks to BlueRock

BlueRock Therapeutics receives historic investment to advance stem cell research

Toronto's stem cell and regenerative medicine ecosystem gained a major player with the establishment of a new biotechnology company, BlueRock Therapeutics, in December 2016. The company, co-founded by world-renowned UHN researchers, Drs. **Gordon Keller** and **Michael Laflamme**, will advance novel stem cell-based treatments for a variety of diseases, such as cardiovascular disease and Parkinson disease, in a state-of-the-art 10,000 square foot facility.

One of the first innovations that will be developed by the company is an approach to regenerate and repair damaged heart muscles, co-created by the two UHN researchers. Drs. Keller and Laflamme developed a way to coax stem cells into becoming specialized heart muscle cells called cardiomyocytes. These cells, when introduced into the heart, act like building blocks—incorporating into the heart tissue and making the heart **stronger** by repairing muscle damage caused by heart attacks or abnormal heart rhythms.

"We've had a lot of research breakthroughs in the past several years and with BlueRock we can now move them from the laboratory to the clinic to help patients," said Dr. Laflamme during the launch event, which was attended by federal and provincial ministers and the Premier of Ontario.

BlueRock was made possible by Bayer AG and Versant Ventures, who provided US$225 million in seed funding. The funds, which represent one of the largest biotechnology investments in history, will be used to build and support research and development facilities in Toronto, New York and Boston. The Toronto facility will employ up to 70 scientists and technical staff when fully functional.

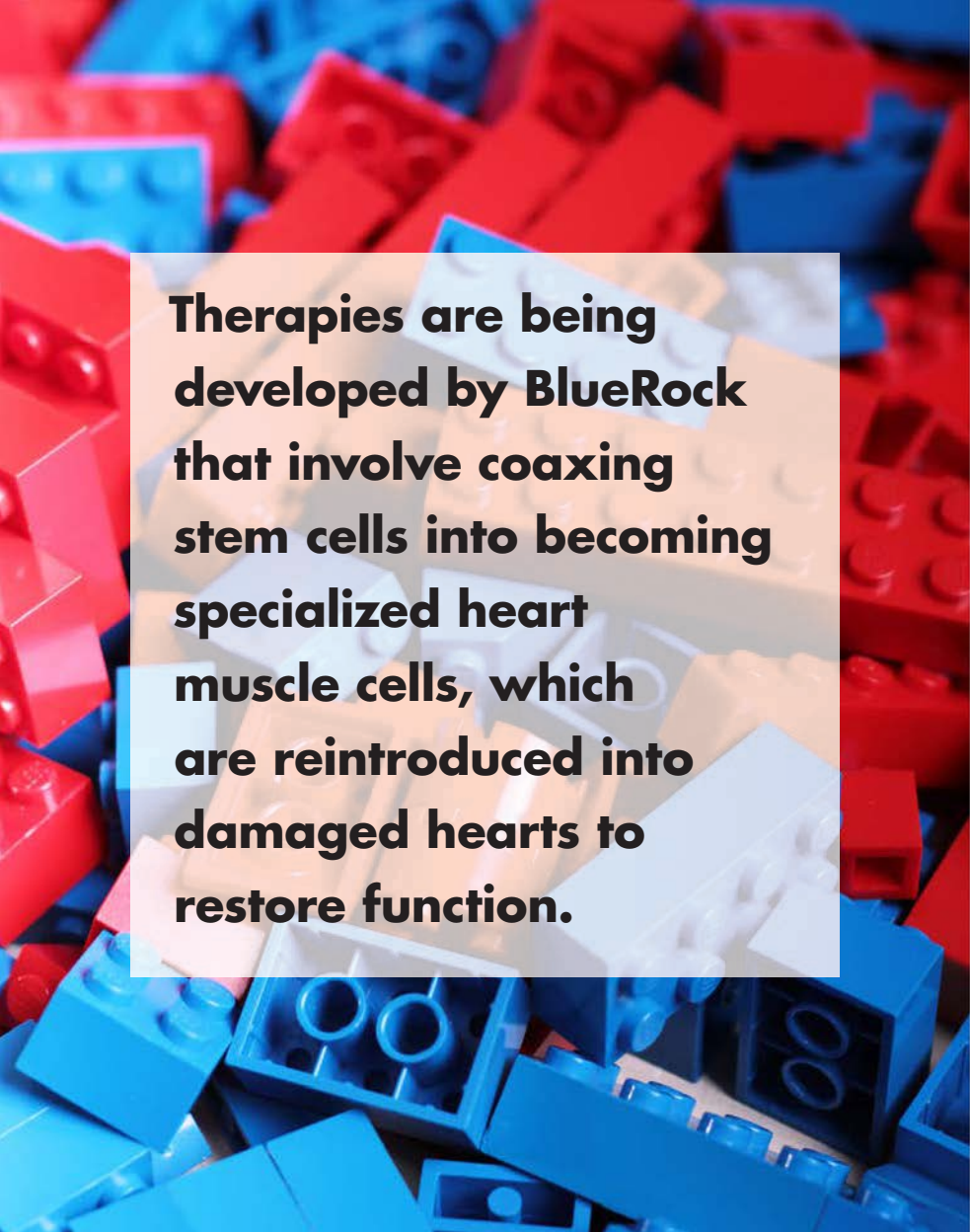
Sparked by the discovery of stem cells at UHN more than 50 years ago, the local stem cell research community is home to leading centres such as UHN's McEwen Centre for Regenerative Medicine and the Centre for Commercialization of Regenerative Medicine. BlueRock now joins this vibrant cluster of excellence in regenerative medicine, reinforcing Toronto's world-class reputation in the field.

BlueRock builds upon Toronto's excellence in stem cell research.

"The concentration of stem cell research resources and expertise that we have is unparalleled," says Dr. Keller, who is also the Director of the McEwen Centre. "Establishing BlueRock Therapeutics is a visionary move that will lead to new therapies for currently untreatable diseases."

UHN's Technology Development and Commercialization Office worked closely with all partners to negotiate and execute the license agreements for the foundational intellectual property, as well a master research agreement to fund future work.

Image: (L-R) Dr. Gordon Keller and Dr. Michael Laflamme.



Therapies are being developed by BlueRock that involve coaxing stem cells into becoming specialized heart muscle cells, which are reintroduced into damaged hearts to restore function.

Support

New funding spurs world-class innovation

Federal Support for Basic Research

UHN was the top-funded research hospital in the Canadian Institutes of Health Research's 2016–2017 Foundation and Project Grant Program competitions.

For the Foundation Grant Program competition, UHN recieved a total of $22.9 million in funding for eight awards—representing the second highest number of awards given to a single institution and a success rate almost double the national average.

These projects were led by Dr. **Cheryl Arrowsmith** (gene packaging in cancer), Dr. **Robert Chen** (brain connections in movement disorders), Dr. **Myron Cybulsky** (immune cells in blood vessel disease), Dr. **John Dick** (leukemia stem cells), Dr. **Mitsu Ikura** (the role of calcium in cancer growth), Dr. **Rama Khokha** (genetic and environmental factors driving cancer), Dr. **Aaron Schimmer** (therapeutic strategies for leukemia) and Dr. **Gang Zheng** (nanotechnology for anti-cancer drug delivery).

Similarly, UHN fared well above the national average in the Project Grant Program competition, with 22 projects receiving a total of $17.9 million.

Funding Proactive Research

A team of researchers led by Dr. **Rosemary Martino** received US$8.5 million from the Patient-Centered Outcomes Research Institute. The funding will support a multi-site study, called PRO-ACTIVE, that will focus on evaluating the effectiveness of proactively providing therapy to help those with head and neck cancer who experience difficulty swallowing. These patients often experience serious difficulties swallowing as a result of the location of the tumour or the radiotherapy used to treat it.

Multidisciplinary expertise across UHN will support the study: Quantitative Imaging for Personalized Cancer Medicine will provide medical imaging and radiation therapy solutions to enhance the reliability of study data; and Health Informatics Research will customize technology solutions to support the high-quality collection of patient-reported outcomes and clinical research data.

PRO-ACTIVE was selected through a highly competitive review process in which patients, caregivers and other stakeholders joined scientists to evaluate the proposals.

Building Capacity for Innovation

The Canada Foundation for Innovation awarded $20.9 million to UHN for state-of-the-art research infrastructure. Through its Innovation Fund, two projects received large-scale awards. The first was the Princess Margaret Cancer Centre Precision Medicine Program (led by Dr. **Brad Wouters**), which was granted $11.8 million—the second largest award in this competition—to develop new ways of profiling tumours. The second, CenteR for Advancing Neurotechnological Innovation to Application (CRANIA) (led by Dr. **Milos Popovic**), was awarded $6.5 million to create new therapies for neurological diseases and conditions.

Through the John R. Evans Leaders Fund, UHN secured $2.6 million for projects led by Dr. **Bryan Coburn** (personalized microbiology); Dr. **Adam Gehring** (immune therapy for viral hepatitis); Dr. **David Jaffray** (robotic radiobiology); Dr. **Michael Laflamme** (repair of injured hearts using stem cells); Dr. **Tracy McGaha** (tumour immunology); Dr. **Philippe Monnier** (retinal and neurodegenerative diseases); and by Dr. **Mathieu Lupien** (new treatments for difficult-to-treat cancers).

Advancing Cancer Immune Therapy

Two projects, led by UHN researchers Dr. **Pamela Ohashi** and Dr. **Mathieu Lupien**, were selected for funding by the Terry Fox Research Institute.

Dr. Ohashi will receive $5.41 million to advance her investigations into the use of cancer immune therapy—a strategy that uses the body's immune system to kill cancer cells. A world-renowned pioneer in this field and the Co-Director of UHN's Tumour Immunotherapy Program, Dr. Ohashi will use the funds to develop and evaluate new immune therapies for high-grade serous ovarian cancer, the deadliest type of ovarian cancer.

Dr. Lupien will receive $2.25 million towards his immune therapy research. His project will focus on advancing immune therapy for women with triple-negative breast cancer, a type of cancer that tends to have lower survival and higher recurrence rates.

These projects were two of six funded projects, representing approximately 30% of total funds awarded nationally.

Discovery

A selection of top research findings

Clearing the Way

Nanoparticles are microscopic particles that can be linked to anti-cancer drugs for delivery to tumours. While effective in experimental systems, nanoparticles often fail in patients because they become trapped in the liver and do not reach the tumour.

To identify the reason for this, a team led by Dr. **Ian McGilvray** and the University of Toronto's Dr. Warren Chan examined how nanoparticles interact with liver cells. They found that nanoparticles slow down upon entry into the liver from the blood stream—giving liver cells time to eliminate them from the body.

These results suggest that future strategies should consider ways to condition the liver to reduce nanoparticle removal. *Tsoi KM, et al. Nat Mater. 2016 Nov;15(11):1212-1221.*

The Magnificent 17

A research team led by Dr. **Jean Wang** has developed a genetic test that better predicts which leukemia patients will respond to standard therapies. The test's prediction is based on 17 genes found in leukemia stem cells, which are instrumental in disease initiation and recurrence.

The test was created to help those with a type of leukemia known as acute myeloid leukemia, which is notoriously difficult to treat: standard therapies fail in up to 60% of young adults and 85% of older adults with the disease.

By identifying which patients will not respond to standard therapies, the test could help avoid unnecessary treatments, and identify those who may benefit from more experimental or intensive treatment strategies. Plans are underway to evaluate the test in a clinical trial. *Ng SW, et al. Nature. 2016 Dec 15;540(7633):433-437.*

Stroke of Genius

This year, a first-of-its-kind app was launched to provide clinicians with best practice rehabilitation strategies for patients with arm impairments due to stroke.

The ViaTherapy app, developed through a global collaboration led by rehabilitation researchers Drs. **Mark Bayley** and Steven Wolf (Emory University), is the result of more than five years of research by a panel with expertise in physiatry, neurology and physical and occupational therapy.

The app assists physicians in recalling established stroke therapies and in learning about new ones, making it easier for them to evolve their treatment plans based on how far along the patient is in their recovery. *www.viatherapy.org.*

A Gut Reaction

A study led by Dr. **Robert Inman** showed that immune cells originating in the gut may promote disease in a form of arthritis known as ankylosing spondylitis (AS).

This type of arthritis is characterized by painful swelling in the back and neck joints that occurs when the immune system attacks the body's cells.

Dr. Inman discovered a type of immune cell that develops in the gut—known as a mucosal-associated invariant T cell—and that promotes harmful joint inflammation.

These findings strengthen the possibility that immune cells originating in the gut play a role in AS, while providing new molecular targets that could inform the development of new treatments. *Gracey E, et al. Ann Rheum Dis. 2016 Dec;75(12):2124-2132.*

Assisted Dying at UHN

A report describing UHN's implementation of an assisted dying program, led by Dr. **Madeline Li**, was published in the *New England Journal of Medicine*.

Since February 2016, medical providers in Canada have been delivering medical assistance in dying (MAiD) to eligible patients. However, there is little information on the best way to implement MAiD in a hospital. UHN's report is intended to help address this knowledge gap.

Briefly, UHN's program consists of voluntary medical teams who assess eligibility, ensure informed consent and deliver the intervention. It also includes a committee that provides oversight, reports metrics and stewards data. During its first year of operation, the program provided MAiD to 19 patients. *Li M, et al. N Engl J Med. 2017 May 25;376(21):2082-2088.*

Protecting Brains

More than 216 million people worldwide suffer from malaria, a disease caused by parasite-infected mosquitos. If left untreated, it can progress to cerebral malaria, which can cause irreversible brain damage and death.

Based on the observation that people with cerebral malaria have low levels of the protein Ang-1, Dr. **Kevin Kain** used experimental models to gain a better understanding of the role of Ang-1 in the disease. He found that Ang-1 protects blood vessels in the brain during cerebral malaria, and that treatment with Ang-1 improved survival compared to treatment with conventional therapy. These exciting findings suggest that Ang-1–based therapies can be developed and tested to improve outcomes for this globally relevant disease. *Higgins SJ, et al. Sci Transl Med. 2016 Sep 28;8(358):358ra128.*

Impact

How research at UHN is improving health care

Safety Device Inspired by Nature

NeuroShield has been referred to as an 'airbag for the brain'. It was launched by Bauer, a leading hockey equipment manufacturer, at a press conference attended by the company's spokesman and hockey legend Mark Messier.

The collar-like device sits around an athlete's neck and applies a slight pressure, increasing the volume of venous blood in the brain. The excess blood creates a 'cushion' between the skull and the delicate tissues of the brain, protecting the latter against the microscopic damage caused by blows to the head. The concept for the device was inspired by the woodpecker's physiology, which protects the bird's brain while drumming its beak against trees.

Dr. **Joseph Fisher** was one of the three clinicians who developed NeuroShield. The device was evaluated for safety in clinical trials involving high school soccer and football players, although device's ability to protect against concussions has not yet been validated. Q30 Innovations, a US-based research and development company, acquired the commercial rights for the device and partnered with Bauer to bring it to market.

A Superior Test for Sleep Apnea

An at-home sleep apnea test known as BresoDx is now available to Ontario patients for the first time as the result of a unique MaRS program.

The breakthrough device—invented by Drs. **Hisham Alshaer**, **T Douglas Bradley** and **Geoff Fernie**—is available at sleep clinics across the province. Ontario patients can use BresoDx to test for sleep apnea in the comfort of their homes rather than in a sleep laboratory. It is the first technology to complete the MaRS EXCITE program, an innovative initiative that accelerates the adoption of health technology in Ontario.

Sleep apnea affects around 10% of adults, yet fewer than 15% of North Americans who have the condition have been diagnosed. Left untreated, sleep apnea leads to chronic sleeplessness and an increased risk of developing more serious conditions such as stroke and heart failure.

By enabling the launch of BresoDx across the province, the Ministry of Health and Long-Term Care is paving the way for early diagnosis and treatment of sleep apnea.

Sights Set on Helping the World

MolecuLight i:X is a handheld device that uses fluorescence imaging to visualize bacteria in wounds. The device provides doctors with a quick readout of the status of wounds and infections—providing important health insights that are otherwise invisible to the naked eye.

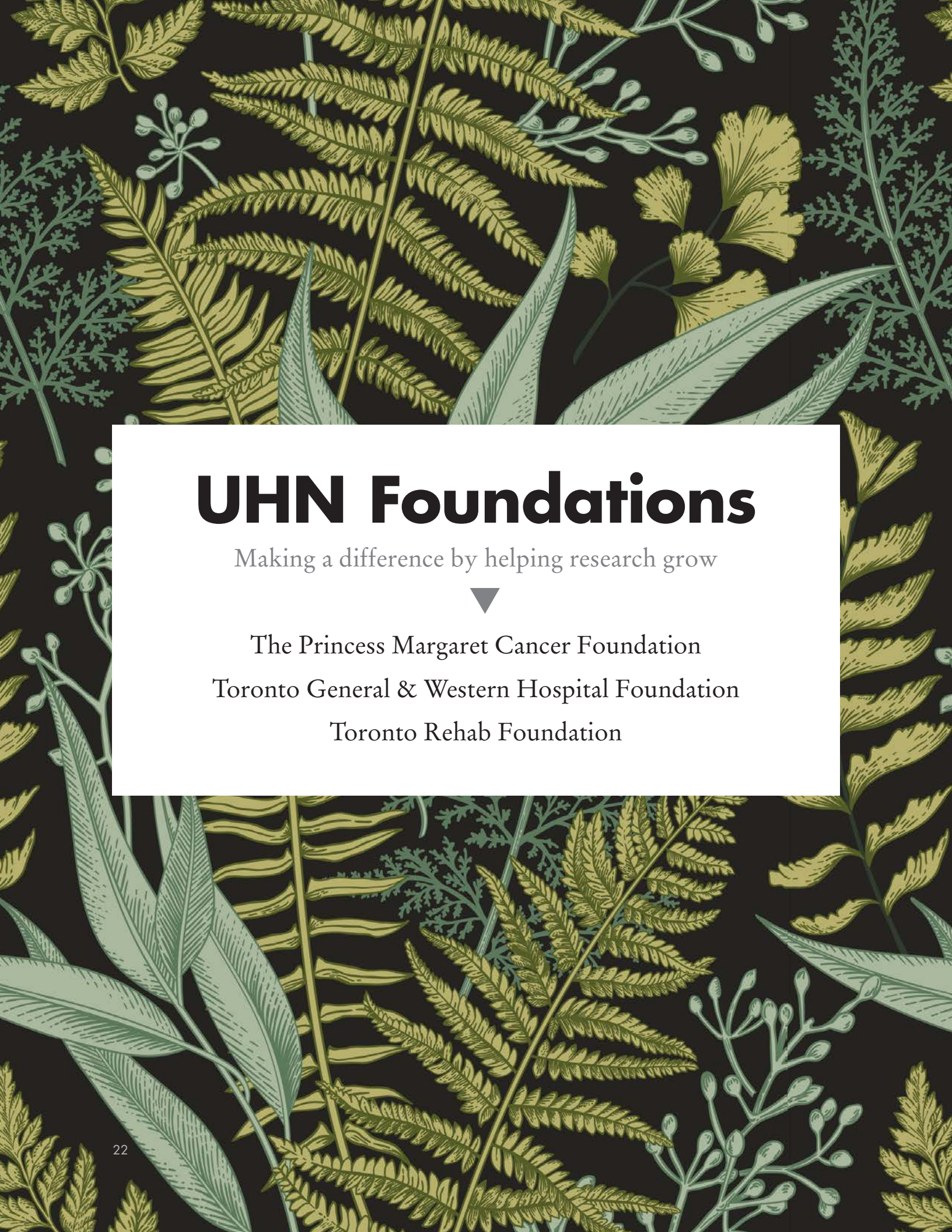
The technology was developed at UHN by Dr. **Ralph DaCosta** and spurred the creation of the MolecuLight spin-off company. Now, it is poised for world-wide adoption: a distribution agreement has been signed between MolecuLight and UK-based Smith & Nephew that will put the technology into the hands of clinicians and patients around the world.

"MolecuLight i:X enhances clinicians' ability to choose the right therapy, at the right time for their patient," says Dr. Andy Weymann, Chief Medical Officer at Smith & Nephew. The device's ability to visualize wounds and infections will help guide wound management and treatment, contribute to the monitoring of hospital-acquired infections, and aid hospital-based programs that aim to minimize unnecessary use of antibiotics.

Inventor of the Year

DR. CHRISTOPHER PAIGE

Dr. Christopher Paige received the 2016 award for his work in immune-oncology. He developed a therapeutic approach whereby a patient's cancer cells are removed, engineered to produce certain chemical messengers and re-introduced to the patient, which then stimulates immune cells to have potent anti-cancer activity. A clinical trial is now underway and the technology was licensed by the UHN company AvroBio Inc.



UHN Foundations

Making a difference by helping research grow

The Princess Margaret Cancer Foundation

Toronto General & Western Hospital Foundation

Toronto Rehab Foundation

Putting Patients First

The Princess Margaret Cancer Foundation

The transformation, which started in May 2017, includes renovation of the Blood Collection Centre (artist's rendering, left) and a fully redesigned and renovated Murray Street entrance (artist's rendering, right)—both of which will improve the patient experience.

This year, The Princess Margaret (PM) Cancer Foundation launched its *Transformation Campaign*. With a goal of raising $50 million in donations, the campaign supports a multi-phase project to transform the facilities at PM Cancer Centre—improving the patient experience from the moment they step through the doors.

Approximately one in six patients volunteers to participate in a clinical trial during their cancer journey. These patients collectively donate more than 26,000 blood samples each year toward finding new and improved ways of treating cancer. The efficient collection, management and storage of these precious samples are critical to bench-to-bedside research.

To this end, part of the *Transformation Project* will include a redesign of the *Blood Collection Centre*. It will undergo an expansion and reorganization to accommodate three more accessible collection stations, an expanded reception and waiting area and key functional upgrades.

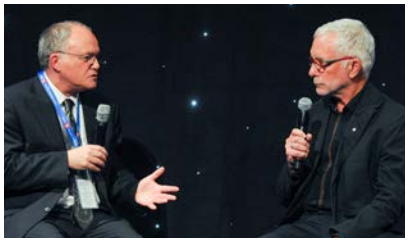
The redesigned facility will enable blood samples to be analyzed in a more rapid and efficient manner, delivering robust information to scientists for discovering new ways to individualize cancer care. One such approach is the examination of circulating tumour DNA, which comprises genetic material that is released into the blood by certain tumours. By decoding the sequence of this genetic material, scientists can develop tests to monitor a patient's response to therapy or to predict the effectiveness of novel anti-cancer drugs.

"This project will facilitate clinical research, helping to ensure that our world-class team can meet the individual needs of every patient," explains Dr. **Mary Gospodarowicz**, Medical Director of the PM Cancer Centre.

By providing a seamless integration of research throughout the cancer journey, this highly functional transformation will advance the institution's committment to patient-centered care. It will also accelerate research and innovation of new treatments and technologies that put patients' needs first.

A Night of Discovery

Toronto General & Western Hospital Foundation



(Left image) The Discovery Ball featured live music; (top right image, L-R) an on stage discussion between Krembil Director Dr. Don Weaver and science communicator Jay Ingram; (bottom right image) buttons for scientific attendees.

The first *Discovery Ball*—a fundraising initiative led by Toronto General & Western Hospital Foundation—took place on October 15, 2016. The goal of the event was to promote the Krembil Research Institute's research successes and raise money to support research into cures for diseases of the brain, spine, bones, joints and eyes.

A candid conversation between Krembil Director Dr. **Donald Weaver** and science communicator Jay Ingram was featured on the main stage. Researchers in attendance wore "ask me about my research" buttons, encouraging discussions on the valuable work happening at the Krembil and giving the philanthropists an opportunity to understand how important their contributions were to developing cures, while creating an air of collaboration and discovery.

The Discovery Ball was the brainchild of Stacey Krembil, who was also co-chair of the planning committee with Dr. Michael Baker, who hosted the event. The night was well attended, with nearly 400 distinguished guests, including philanthropists, UHN leadership and Krembil-affiliated researchers.

The event included a raffle for prizes such as a diamond rivière necklet and a live auction, hosted by broadcaster, award-winning writer and producer Husein Madhavji capped the event. The highest bidders won the opportunity to tour the labs of Dr. Weaver and Krembil Senior Scientist Dr. Mohit Kapoor, a prize that further underscored the discovery theme.

The event pairs people committed to advancing health care with Krembil researchers.

The event raised nearly $1 million to support research at the Krembil. Because of its success, the Discovery Ball will continue as a staple of the Toronto General & Western Hospital Foundation's fundraising efforts, with the next event scheduled for October 2018.

Where Incredible Happens

Toronto Rehab Foundation

(Left and middle images) Dr. Milos Popovic (red tie) and his trainees demonstrating the capabilities of REL's specialized equipment; (right image, L-R) Maris Uffelmann and Dean Connor, donors who pledged $1 million in support of REL.

At Toronto Rebilitation Institute (TRI), researchers work tirelessly to develop new therapies and products that restore function after illness or injury and enable independent living within the community.

In October 2015, the Toronto Rehab Foundation launched its *Where Incredible Happens* campaign, which aims to raise $100 million to support TRI researchers, programs and facilities, which are instrumental in developing life-changing inventions. Inspired by TRI's work, Dean Connor, the President and CEO of Sun Life Financial and a Vice-Chair of UHN's Board of Trustees, agreed to lead the campaign.

Dean and his wife, Maris Uffelmann, demonstrated their personal commitment to the campaign through an incredible $1 million gift to support TRI's Rehabilitation Engineering Lab (REL). REL is located at Toronto Rehab's Lyndhurst Centre, home of Canada's largest rehabilitation program devoted to spinal cord injuries.

"There are few moments in life when you have the power to significantly improve the lives of people around you," says Dean. "We are happy to be able to help."

REL is led by Dr. **Milos Popovic**, the TRI Chair in Spinal Cord Injury Research, and employs more than 40 researchers, trainees and staff. Dr. Popovic's research has yielded novel technologies—such as functional electrical stimulation therapy—that produce unparalleled levels of recovery in people affected by stroke or spinal cord injuries: they have improved patients' balance and restored their ability to walk, reach and grasp objects. His research is also making important advances in brain-machine interfaces, functional assessment tools, rehabilitation techniques and neuroprosthesis systems.

Dean and Maris's generous gift is enabling REL to undertake two high-risk, high-payoff projects. The funds are supporting trainees and staff examining the use of electrical stimulation to treat depression and of brain-machine interfaces to restore upper-limb function in stroke survivors.

Research Distinctions

Selected honours bestowed upon UHN researchers

Dr. Elizabeth Badley
2017 Distinguished Scholar Award, Association of Rheumatology Health Professionals

Dr. Philippe Bedard
2017 William E. Rawls Prize, Canadian Cancer Society

Dr. David Cescon
2017 Dr. Elizabeth Eisenhauer Early Drug Development Young Investigator Award, Canadian Cancer Trials Group

Dr. Vinod Chandran
2017 Young Investigator Award, Canadian Rheumatology Association

Dr. B Catharine Craven
2017 Award of Merit, Canadian Association of Physical Medicine & Rehabilitation

Dr. Marcelo Cypel
Tier 2 Canada Research Chair in Lung Transplantation (renewal)

Dr. Karen Davis
2017 Outstanding Pain Mentorship Award, Canadian Pain Society

Dr. Daniel De Carvalho
Tier 2 Canada Research Chair in Cancer Epigenetics and Epigenetic Therapy

Drs. Daniel De Carvalho and **Mathieu Lupien**
2017 Bernard and Francine Dorval Prize, Canadian Cancer Society

Dr. Eleftherios Diamandis
2017 Lifetime Achievement Award, Ontario Society of Clinical Chemists

Dr. John Dick
2017 Tobias Award Lecture, International Society for Stem Cell Research
2016 Gold Leaf Prize for Discovery, Canadian Institutes of Health Research
Tier 1 Canada Research Chair in Stem Cell Biology (renewal)
2017 Keio Medical Science Prize, Keio University

Dr. Michael Fehlings
2017 David Lostchuck Memorial Research Award, Canadian Spinal Research Organization

Dr. Eleanor Fish
2017 Leadership in Advocacy Award, Research Canada

Dr. Mary Gospodarowicz
2017 Wendy Lack Women of Action Scientific Award, Israel Cancer Research Fund

Dr. Housheng Hansen He
2017 New Investigator Award, The Terry Fox Research Institute

Dr. Mitsuhiko Ikura
Tier 1 Canada Research Chair in Cancer Structural Biology (renewal)

Dr. Jonathan Irish
President, American Head & Neck Society

Dr. Michael Jewett
2017 Exceptional Leadership in Patient Involvement in Cancer Research Award, Canadian Cancer Research Alliance

Dr. Anthony Lang
2017 MDS Pan-American Section Leadership Award, International Parkinson and Movement Disorder Society

Dr. Gary Levy
2017 Lifetime Achievement Award, Canadian Society of Transplantation

Dr. Andres Lozano
2017 Khwarizmi International Award, Iranian Research Organization for Science and Technology
2017 Bachmann-Strauss Prize for Excellence in Dystonia Research, Michael J. Fox Foundation for Parkinson's Research

Dr. Mary Pat McAndrews
2017 Excellence in Research Award, Canadian League Against Epilepsy

Dr. Brian O'Sullivan
2017 O. Harold Warwick Prize, Canadian Cancer Society

Dr. Amit Oza
GOC Presidential Medal, Society of Gynecologic Oncology of Canada

Dr. Christopher Paige
2017 Leadership in Advocacy Award, Research Canada

Dr. Kara Patterson
2017 Innovation and Advancement Award, Ontario Physiotherapy Association

Dr. Trevor Pugh
2017 New Investigator Award, The Terry Fox Research Institute

Dr. Milica Radisic
2017 Steacie Prize for Natural Sciences, E.W.R. Steacie Memorial Fund
Tier 2 Canada Research Chair in Functional Cardiovascular Tissue Engineering (renewal)

Dr. Gary Rodin
2017 Bernard Fox Memorial Award, International Psycho-Oncology Society

Dr. Frances Shepherd
2017 Addario Lectureship Award, Bonnie J. Addario Lung Cancer Foundation
2017 Women for Oncology Award, European Society for Medical Oncology

Dr. Lillian Siu
Member, Board of Directors, American Association for Cancer Research

Dr. Charles Tator
Officer, Order of Canada (promotion from Member)

Dr. Ming-Sound Tsao
2016 Dr. Joseph Pater Excellence in Clinical Trials Research Award, Canadian Cancer Trials Group

Dr. Michael Tymianski
Member, Order of Canada

Dr. Murray Urowitz
2017 Distinguished Clinical Investigator Award, American College of Rheumatology

Dr. Sharon Walmsley
Member, Order of Canada

Dr. Minna Woo
Tier 2 Canada Research Chair in Signal Transduction in Diabetes Pathogenesis (renewal)

Dr. Bradly Wouters
Tier 1 Canada Research Chair in Hypoxia and the Tumour Microenvironment

Dr. Azadeh Yadollahi
Early Researcher Award, Ontario Ministry of Research, Innovation and Science

Dr. José Zariffa
Early Researcher Award, Ontario Ministry of Research, Innovation and Science

UHN Research Institutes

Krembil Research Institute

Princess Margaret Cancer Centre

Toronto General Hospital Research Institute

Techna Institute

Toronto Rehabilitation Institute

Krembil Research Institute

TOTAL RESEARCHERS	216	RESEARCH SPACE	154,001 sq. ft.
Total Appointed Researchers	92	EXTERNAL FUNDING	$52,659,561
Senior Scientists	31		
Scientists	11	TOTAL TRAINEES	120
Affiliate Scientists	15	Fellows	48
Emeritus	2	Graduate Students	72
Clinician Investigators	33		
		TOTAL STAFF	276
Clinical Researchers	124		
		PUBLICATIONS	947

Research Council

Director and Chair, Krembil Research Institute **Donald Weaver**
Division Head, Fundamental Neurobiology **Peter Carlen**
Division Head, Healthcare & Outcomes Research **Aileen Davis**
Division Head, Brain Imaging & Behaviour – Systems Neuroscience **Karen Davis**
Division Head, Genetics & Development **James Eubanks**
Co-Director, Donald K. Johnson Eye Institute **Valerie Wallace**
Clinical Representative, Arthritis Program **Robert Inman**
Research Director, Arthritis Program **Mohit Kapoor**
Medical Director, Arthritis Program **Nizar Mahomed**
Chair, Trainee Affairs Committee **Frances Skinner**
Executive Director, Research Operations **Lisa Alcia**
Vice President and Site Lead, Toronto Western Hospital **Janet Newton**
Executive Vice President, Science and Research **Bradly Wouters**

Researchers

Brain, Imaging & Behaviour-Systems Neuroscience

Senior Scientists
Jonathan Brotchie
Robert Chen
Karen Davis
William Hutchison
Sidney Kennedy
Andres Lozano
Mary Pat McAndrews
David Mikulis
Antonio Strafella

Scientists
Jonathan Downar
Mojgan Hodaie

Affiliate Scientists
Mark Guttman
Clement Hamani
Walter Kucharczyk

Fundamental Neurobiology

Senior Scientists
Peter Carlen
Frances Skinner
Shuzo Sugita
Michael Tymianski
Donald Weaver

Scientists
Jérémie Lefebvre
Ivan Radovanovic
Taufik Valiante

Affiliate Scientists
Magdy Hassouna
Liang Zhang
Georg Zoidl

Genetics & Development

Emeritus
Charles Tator

Senior Scientists
Cathy Barr
James Eubanks
Michael Fehlings
Robert Inman
Mohit Kapoor
Lyanne Schlichter
Elise Stanley
Joan Wither

Scientists
Nigil Haroon
Lorraine Kalia
Suneil Kalia
Armand Keating

Affiliate Scientist
Sowmya Viswanathan

Healthcare & Outcomes Research

Emeritus
Murray Urowitz
Senior Scientists
Elizabeth Badley
Aileen Davis
Dafna Gladman
Nizar Mahomed
Scientist
Anthony Perruccio
Affiliate Scientists
Vinod Chandran
Paul Fortin
Monique Gignac
Rosemary Martino

Patient-based Clinical Research

Senior Scientist
Anthony Lang

Donald K. Johnson Eye Institute

Senior Scientists
Philippe Monnier
Christopher Hudson
Valerie Wallace
Agnes Wong
Scientist
Jeremy Sivak
Affiliate Scientists
Moshe Eizenman
John Flanagan
Brenda Gallie
Esther González

Clinician Investigators

Dimitri Anastakis
Danielle Andrade
Heather Baltzer
Mark Bernstein
Anuj Bhatia
Michael Brent
Daniel Buchman
Frances Chung
Melanie Cohn
Robert Devenyi
Dean Elterman
Alfonso Fasano
Susan Fox
Kenneth Fung
Rajiv Gandhi
Timothy Jackson
Efrem Mandelcorn
Daniel Mandell
Shane McInerney
Roger McIntyre
Renato Munhoz
Laura Passalent
Fayez Quereshy
Y Raja Rampersaud
David Rootman
Cheryl Rosen
Allan Slomovic
David Tang-Wai
M Carmela Tartaglia
Zahi Touma
Christian Veillette
M Elizabeth Wilcox
Mateusz Zurowski

Clinical Researchers

Ronit Agid
Jamil Ahmad
Peter Ashby
Yaron Avitzur
Brian Baker
Paul Binhammer
Jeff Bloom
Arthur Bookman
Sarah Brode
Richard Brull
Esther Bui
Yvonne Buys
Simon Carette
Leanne Casaubon
J David Cassidy
Rodrigo Cavalcanti
Jas Chahal
Clara Chan
Vincent Chan
Kenneth Chapman
Caroline Chessex
Angela Cheung
Ki Jinn Chin
Maria Cino
Michael Cusimano
J Roderick Davey
J Martin del Campo
Sherif El-Defrawy
W Mark Erwin
Richard Farb
Paul Fraser
David Frost
Alberto Goffi
Eyal Golan
Ewan Goligher
Allan Gordon
Brent Graham
Barry Greenberg
Raed Hawa
Robert Iwanochko
Sindhu Johnson
Ron Keren
Kyle Kirkham
Stephen Kraft
Timo Krings
Debbie Kwan
Jeffrey Kwong
Robert Lam
Wai-Ching Lam
Johnny Lau
Stephen Lewis
Joel Lexchin
Charles Lynde
Angela Mailis-Gagnon
Mark Mandelcorn
Pirjo Manninen
Katie Marchington
Samuel Markowitz
Patricia Marr
Connie Marras
Theodore Marras
Eric Massicotte
Steven McCabe
Azadeh Moaveni
Rakesh Mohankumar
Ali Naraghi
Ahtsham Niazi
Ivy Oandasan
Darrell Ogilvie-Harris
Allan Okrainec
Christian Pagnoux
Daniel Panisko
Christine Papoushek
Sagar Parikh
Philip Peng
Vitor Pereira
Anahi Perlas
Aleksandra Pikula
Atul Prabhu
Sidney Radomski
Sapna Rawal
Shail Rawal
Aylin Reid
Rowena Ridout
Jennifer Robblee
Sandra Robinson
Arjun Sahgal
David Salonen
Jorge Sanchez-Guerrero
Paul Sandor
Monica Scalco
Michael Schwartz
Hemant Shah
Colin Shapiro
Abdu Sharkawy
Sanjay Siddha
Frank Silver
Martin Simons
Jeffrey Singh
Mandeep Singh
Elizabeth Slow
Sumeet Sodhi
Neilesh Soneji
Martin Steinbach†
Barbara Stubbs
Khalid Syed
Peter Tai
Susan Tarlo
Maria Tassone
Karel terBrugge
Graham Trope
Karen Tu
Paul Tumber
Andrea Veljkovic
Alexander Velumian
Lakshmi Venkatraghavan
Herbert von Schroeder
Adam Weizman
Richard Wennberg
Robert Willinsky
David K Wong
David T Wong
Jean Wong
Eric Yu

Princess Margaret Cancer Centre

TOTAL RESEARCHERS	333	RESEARCH SPACE	416,488 sq. ft.
Appointed Researchers	82	EXTERNAL FUNDING	$142,847,824
Senior Scientists	44		
Scientists	16	TOTAL TRAINEES	259
Affiliate Scientists	18	Fellows	124
Assistant Scientist	1	Graduate Students	135
Emeritus	3		
		TOTAL STAFF	857
Cancer Clinical Research Unit (CCRU) Members	251	PUBLICATIONS	1,192

Research Council on Oncology (RCO)

Director, PM Cancer Centre; Chair, RCO; Chair, Executive Committee (Interim) **Rama Khokha**
Executive Committee **Mitsuhiko Ikura, Rama Khokha, Mathieu Lupien, Pamela Ohashi, Gary Rodin, Aaron Schimmer, Vuk Stambolic, Ming-Sound Tsao, Brian Wilson, Gang Zheng**
Chair, Appointments Committee **Rama Khokha**
Medical Director, Cancer Program **Mary Gospodarowicz**
Medical Director, Laboratory Medicine Program **Runjan Chetty**
Head, CCRU **Amit Oza**
Head, Medical Oncology and Hematology **Amit Oza**
Head, Radiation Medicine **Fei-Fei Liu**
Chief, Surgical Oncology **Gelareh Zadeh**
Executive Director, Research Operations **Lisa Alcia**
Senior Vice President and Site Lead, PM Cancer Centre **Marnie Escaf**
Executive Vice President, Science and Research **Bradly Wouters**

Researchers

Emeritus
Norman Boyd
Richard Hill
A Michael Rauth

Senior Scientists
Kenneth Aldape
Cheryl Arrowsmith
Sylvia Asa
David Brooks
Avijit Chakrabartty
Daniel De Carvalho
Gerald Devins
John Dick
Shereen Ezzat
Razqallah Hakem
David Hedley
Naoto Hirano
Doris Howell
Mitsuhiko Ikura
Norman Iscove
David Jaffray
Jennifer Jones
Igor Jurisica
Gordon Keller
Rama Khokha
Thomas Kislinger
Lothar Lilge
Fei-Fei Liu
Geoffrey Liu
Mathieu Lupien
Tak Mak
Tracy McGaha
Mark Minden
Benjamin Neel
Pamela Ohashi
Emil Pai
Christopher Paige
Linda Penn
Gilbert Privé
Brian Raught
Gary Rodin
Robert Rottapel
Aaron Schimmer
Vuk Stambolic

Ming-Sound Tsao
I Alex Vitkin
Brian Wilson
Bradly Wouters
Gang Zheng
Camilla Zimmermann

Scientists
Laurie Ailles
Scott Bratman
Steven Chan
Ralph DaCosta
Kim Edelstein
Benjamin Haibe-Kains
Housheng Hansen He
Michael Hoffman
Marianne Koritzinsky
Mohammad Mazhab-Jafari
Faiyaz Notta
Catherine O'Brien
Trevor Pugh
Rodger Tiedemann
Gelareh Zadeh

Assistant Scientist
Christopher Marshall

Affiliate Scientists
Mark Bray
Eric Chen
Phedias Diamandis
Ryan Dowling
Mary Jane Esplen
Anthony Joshua
C Anne Koch
Paul Kongkham
Robert Kridel
Benjamin Lok
Michael Moran
Michael Reedijk
Leonardo Salmena
Liran Shlush
Suzanne Trudel
Jean Wang
Paul Waterhouse
Wei Xu

Cancer Clinical Research Unit (CCRU)

Ayman Al Habeeb
Dominick Amato
Eitan Amir
Mostafa Atri
Michael Baker
Dwayne Barber
David Barth
Andrew Bayley
Nathan Becker
Philippe Bedard
J Robert Beecroft
Akbar Beiki-Ardakani
Jennifer Bell
Robert Bell
Alejandro Berlin
Hal Berman
Marcus Bernardini
Lori Bernstein
Andrea Bezjak
Ivan Blasutig
Scott Boerner
Penelope Bradbury
Anthony Brade
William Brien
James Brierley
Robert Bristow
Dale Brown
Karina Bukhanov
Ronald Burkes
Marcus Butler
Jeannie Callum
Marco Carlone
Angela Cashell
Charles Catton
David Cescon
William Chapman
Tanya Chawla
Christine Chen
Terry Cheng
Douglas Chepeha
Runjan Chetty
Carol Cheung
Charles Cho
John Cho
Young-Bin Cho
James Chow
Caroline Chung
Peter Chung
Tae Bong Chung
Tulin Cil
Blaise Clarke
Sean Cleary
Tatiana Conrad
Tim Craig
Andrew Crean
Jennifer Croke
Michael Crump
Christine Cserti-Gazdewich
Bernard Cummings
Gilda da Cunha Santos
Norma D'Agostino
Laura Dawson
Jan Delabie
Uday Deotare
Neesha Dhani
Robert Dinniwell
Susan Done
James Downar
Daniel Drucker
Alexandra Easson
Elena Elimova
Christine Elser
Jaime Escallon
Andrew Evans
Hannaneh Faghfoury
Ronald Feld
Peter Ferguson
Sarah Ferguson
Carina Feuz
Antonio Finelli
Neil Fleshner
Warren Foltz
Jeremy Freeman
Anthony Fyles
Lucia Gagliese
Steven Gallinger
William Geddie
Fred Gentili
Sandeep Ghai
Sangeet Ghai
Danny Ghazarian
Ralph Gilbert
Caitlin Gillan
Meredith Giuliani
Rebecca Gladdy
David Goldstein
Pamela Goodwin
Chiara Gorrini
Mary Gospodarowicz
Rashmi Goswami
Anand Govindarajan
Paul Greig
Patrick Gullane
Abha Gupta
Vikas Gupta
Sara Hafezi-Bakhtiari
Masoom Haider
Sarah Hales
Robert Hamilton
Kathy Han

Anthony Hanbidge
Breffni Hannon
Aaron Hansen
Robert Heaton
Joelle Helou
Aaron Hendler
David Hodgson
Stefan Hofer
David Hogg
Shao Hui Huang
Hyun-Jung Jang
Raymond Jang
Jeffrey Jaskolka
Kartik Jhaveri
Sarah Johnson
John Kachura
Suzanne Kamel-Reid
Zahra Kassam
Ebru Kaya
Harald Keller
Erin Kennedy
Korosh Khalili
Tim-Rasmus Kiehl
Dennis Kim
John Kim
Raymond Kim
Tae Kyoung Kim
Jennifer Knox
Hyang Mi Ko
Hatem Krema
Monika Krzyzanowska
Vishal Kukreti
Vathany Kulasingam
Girish Kulkarni
Supriya Kulkarni
Kevin Kuo
John Kuruvilla
Stéphane Laframboise
David Lam
Normand Laperriere
Natasha Leighl
Wey-Liang Leong
Wilfred Levin
Stéphanie Lheureux
Madeline Li
Winnie Li
Patricia Lindsay
Jeffrey Lipton
Christopher Lo
Helen Mackay
Ernie Mak
Lisa Martin
Warren Mason
Andrew Matthew
Catherine Maurice
Taymaa May
Dawn Maze
David McCready
Allison McGeer
Andrea McNiven
Maurene McQuestion
Hans Messner
Ozgur Mete
Fotios Michelis
Barbara-Ann Millar
Naomi Miller
Michael Milosevic
Nadeem Moghal
Eric Monteiro
Chantal Morel
Lyndon Morley
Douglas Moseley
Carol-anne Moulton
Anna Marie Mulligan
Rumina Musani
Alice Newman
Rinat Nissim
Martin O'Malley
Anne O'Neill
Brian O'Sullivan
Amit Oza
Demetris Patsios
Bayardo Perez-Ordonez
Andrew Pierre
Katherine Pisters
Anna Porwit
Anca Prica
Graeme Quest
Albiruni Razak
Donna Reece
Julia Ridley
Jolie Ringash
Paul Ritvo
Tara Rosewall
Lorne Rotstein
Marjan Rouzbahman
Anabel Scaranelo
Heidi Schmidt
Andre Schuh
Jack Seki
Stefano Serra
Patricia Shaw
Nadine Shehata
Frances Shepherd
David Shultz
Hassan Sibai
Lillian Siu
Joyce So
Anna Spreafico
Boraiah Sreeharsha
Srikala Sridhar
Alexander Sun
Carol Swallow
Joan Sweet
Tony Tadic
Ian Tannock
Anne Tierens
Ants Toi
Emina Torlakovic
John Trachtenberg
Richard Tsang
Hubert Tsui
Theodorus van der Kwast
Michael Velec
Auro Viswabandya
John Waldron
Richard Ward
Padraig Warde
David Warr
Ilan Weinreb
Kirsten Wentlandt
Lawrence White
Ian Witterick
Rebecca Wong
Jay Wunder
Karen Yee
Erik Yeo
Ivan Yeung
Eugene Yu
Toni Zhong
Alexandre Zlotta

Toronto General Hospital Research Institute

TOTAL RESEARCHERS	397	RESEARCH SPACE	171,800 sq. ft.
Appointed Researchers	149	EXTERNAL FUNDING	$72,491,550
Senior Scientists	63		
Scientists	35	TOTAL TRAINEES	281
Affiliate Scientists	47	Fellows	104
Assistant Scientist	4	Graduate Students	177
Clinical Researchers	248	TOTAL STAFF	459
		PUBLICATIONS	1,454

Research Council

Director, TGHRI; Chair, TGHRI Research Council; Research Division Head (Acting), Experimental Therapeutics **Mansoor Husain**
Research Division Head, Advanced Diagnostics **Myron Cybulsky**
Research Division Head, Support, Systems & Outcomes **Murray Krahn**
Clinical Program Head, Transplantation **Atul Humar**
Clinical Program Head, Peter Munk Cardiac Centre **Barry Rubin**
Physician-in-Chief; Clinical Program Head, Medical & Community Care **Edward Cole**
Surgeon-in-Chief; Clinical Program Head, Surgical & Critical Care **Shaf Keshavjee**
Chair, TGHRI Appointments Committee **Thomas Waddell**
Group Lead, Communities of Health **Shabbir Alibhai**
Group Lead, Cardiovascular **Slava Epelman**
Group Lead, Infection & Immunity **Adam Gehring**
Group Lead, Respiratory & Critical Care **Mingyao Liu**
Group Lead, Metabolism **Minna Woo**
Executive Director, Research Operations **Lisa Alcia**
Senior Vice President and Site Lead, Toronto General Hospital **Scott McIntaggart**
Executive Vice President, Science and Research **Bradly Wouters**

Researchers

Advanced Diagnostics

Senior Scientists
Johane Allard
Peter Backx
Daniel Cattran
Myron Cybulsky
I George Fantus
Eleanor Fish
Jason Fish
Joseph Fisher
John Floras
Tony Lam
Gary Lewis
Mingyao Liu
Kumaraswamy Nanthakumar
York Pei
Bruce Perkins
Barry Rubin
James Scholey
Katherine Siminovitch
Michael Wheeler
Eldad Zacksenhaus
Li Zhang

Scientists
Moumita Barua
Filio (Phyllis) Billia
David Cherney
Bryan Coburn
Shannon Dunn

Slava Epelman
Anthony Gramolini
Tianru Jin
Ana Konvalinka
Heather Reich
Clinton Robbins
Jonathan Rocheleau
Paaladinesh Thavendiranathan
Daniel Winer
Minna Woo

Affiliate Scientists

Donald Branch
Hong Chang
Peter Liu
Philip Millar
Anna Sawka
William Stansfield
Florence Wong

Assistant Scientist

Sonya MacParland

Experimental Therapeutics

Senior Scientists

T Douglas Bradley
Mark Cattral
Marc de Perrot
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Techna Institute

TOTAL RESEARCHERS	47
Core Leads	9
Scientists	3
Affiliated Faculty	35
RESEARCH SPACE	27,820 sq. ft.
EXTERNAL FUNDING	$11,586,816
TOTAL TRAINEES	21
Fellows	8
Graduate Students	13
TOTAL STAFF	106
Technology Development Team	45
Other Staff	61
PUBLICATIONS	346

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Alejandro Jadad
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Affiliated Faculty
John Valliant

Photonics

Core Lead
Brian Wilson
Scientist
Ralph DaCosta
Affiliated Faculty
I Alex Vitkin

Toronto Rehabilitation Institute

TOTAL RESEARCHERS	118	RESEARCH SPACE	55,965 sq. ft.
Appointed Researchers	111	EXTERNAL FUNDING	$16,402,393
Senior Scientists	23		
Scientists	21	TOTAL TRAINEES	102
Affiliate Scientists	67	Fellows	25
		Graduate Students	77
Clinical Researchers	7		
		TOTAL STAFF	104
		PUBLICATIONS	508

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Canadian Association of Radiation Oncology
Canadian Blood and Marrow Transplant Group
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Canadian Breast Cancer Foundation
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Canadian Heart Research Centre
Canadian Hematology Society
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Canadian Radiation Oncology Foundation
Canadian Rheumatology Association
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Lupus Foundation of America
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McGill University
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Medical Council of Canada
Medical Decision Modeling
MedImmune
Medivir
Medtronic
Merck & Co.
Merrimack Pharmaceuticals
Merz Pharma
Mesothelioma Applied Research Foundation
Microbot Medical
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Ministry of Health and Long-Term Care
Ministry of Labour
Ministry of Research, Innovation and Science
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MolecuLight
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Promobilia Foundation

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Proteon Therapeutics
Prothena
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Public Health Agency of Canada
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Vertex Pharmaceuticals
Virginia Commonwealth University
Wake Forest University
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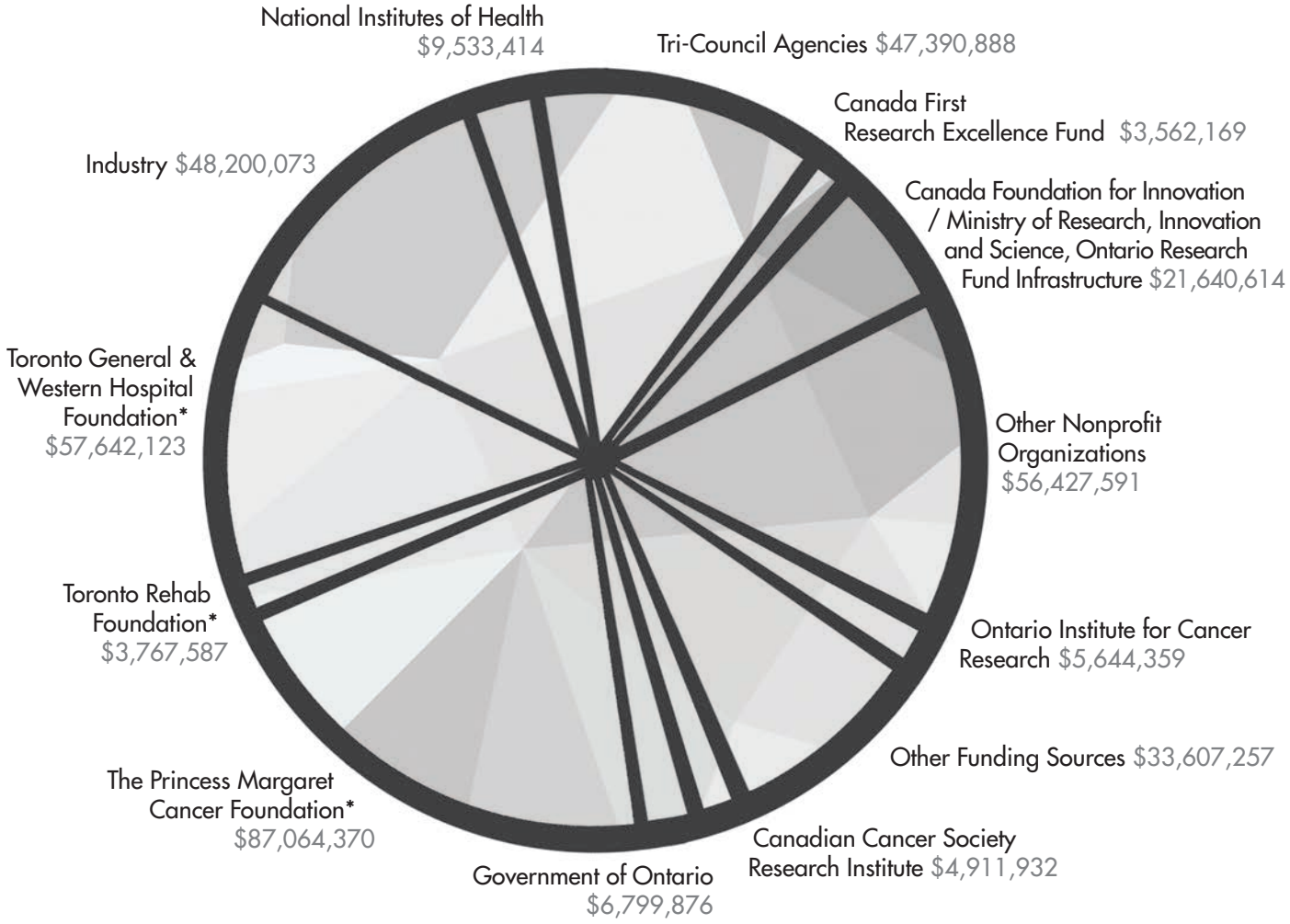
Research funding by source



TOTAL FUNDING $386,192,252

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