
Breaking Barriers
Building Health
UHN 2016 RESEARCH REPORT

UHN Research Snapshot

Appointed Researchers	458
Clinical Researchers	608
Total Researchers	**1,066**

Fellows	325
Graduate Students	495
Total Trainees	**820**

Research Support Staff	325
Institute Staff	1,798
Total Staff	**2,123**

Research Space **971,719 sq. ft.**

Publications **3,418**

Total Funding **$381,043,935**

University Health Network (UHN) includes the Princess Margaret Cancer Centre (PM Cancer Centre), Toronto General Hospital (TGH), Toronto Rehab (TR), Toronto Western Hospital (TWH) and the Michener Institute for Education at UHN. It has five research institutes: Krembil Research Institute (Krembil), PM Cancer Centre, Techna Institute for the Advancement of Technology for Health (Techna), Toronto General Research Institute (TGRI) 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. UHN is a research hospital affiliated with the University of Toronto (UT) and is a member of the Toronto Academic Health Science Network (TAHSN).

Breaking Barriers. Building Health.

Christopher Paige PhD, FCAHS, Senior Scientist, PM Cancer Centre (past Executive Vice President, Science and Research), UHN

Sharing knowledge for better health

A surgeon, an engineer and a physicist are sitting at a bar—you may think a joke is coming but what they are discussing is deadly serious: how to detect residual cancer cells left behind after a primary tumour is resected. Failure to remove or kill these cells allows the cancer to recur. However, by applying their collective knowledge they devise, and eventually test, a device that replaces normal visible light with infrared light and the lurking cancer cells are revealed.

Even a wider mix of talent, including health services researchers, health care professionals, community clinicians, patient advocates, pharmacists, and IT specialists, came together to visualize and implement SCOPE (Seamless Care Optimizing the Patient Experience), a revolutionary virtual interprofessional health team program that aims to improve the patient experience by supporting primary care providers through a single point of access.

These are but two examples of the integrated actions that take place every day at UHN. More than 4,000 people engage in research and their expertise spans nearly all aspects of biomedical sciences, including biology, chemistry, physics, engineering, health services, informatics…and the list goes on. As our understanding of the complexity of human disease has increased it has become abundantly clear that our only hope at making

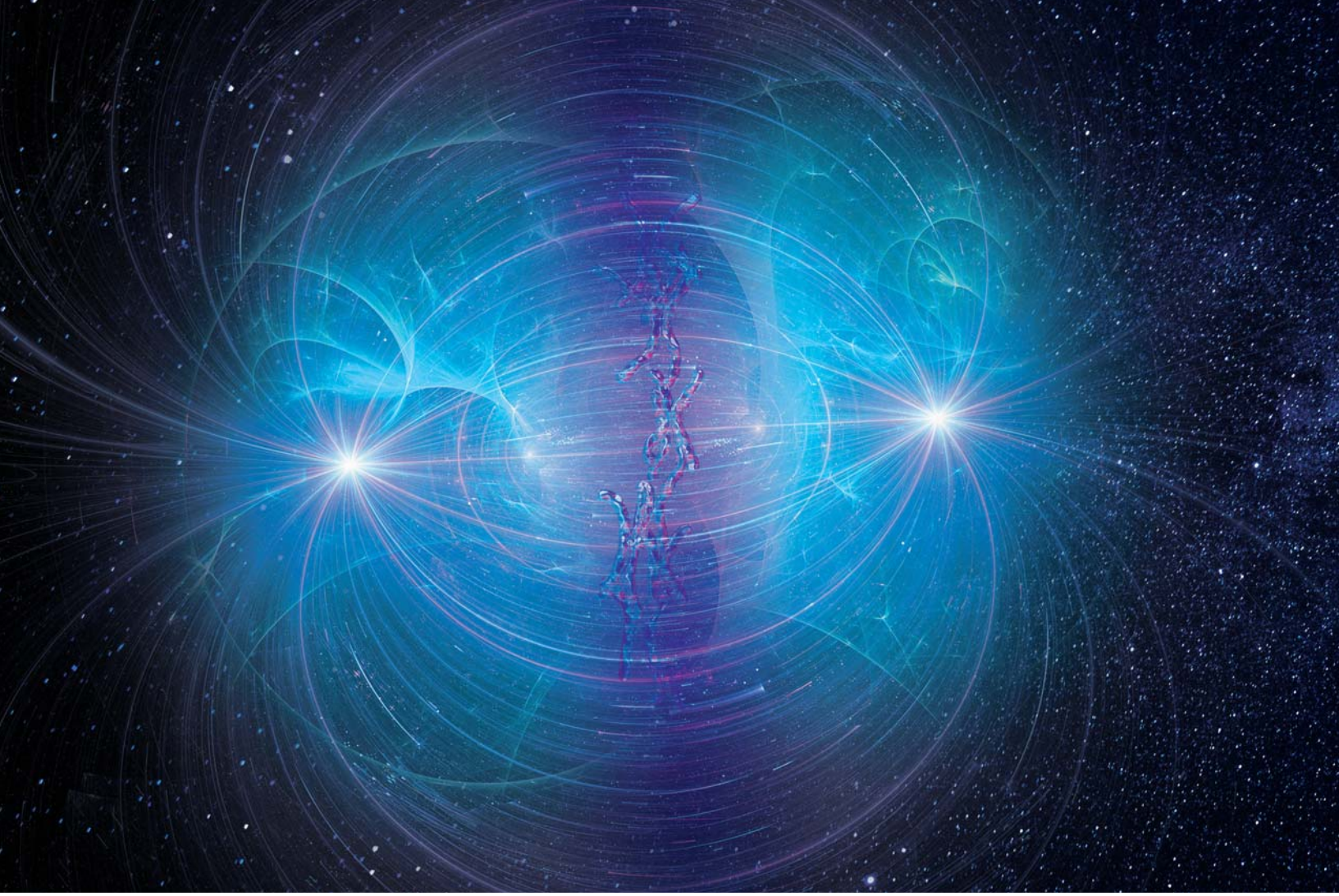
Peter Pisters MD, FACS, President and Chief Executive Officer, UHN

progress towards preventing or reversing disease relies on our ability to draw on the combined knowledge of our diverse research workforce forming teams whose collective skills match the complexity of their targets.

This is only accomplished when barriers are removed; and this task is not as easy as it might sound. The daily pressures of providing health care or running research laboratories can lead to a single-minded focus leaving little bandwidth for group thinking. Granting agencies and promotion committees can contribute to this by rewarding individual impact and, certainly in the past, there was also an inclination of a few of our highly motivated, often brilliant, superstars to build their own empires.

Despite these challenges, the imperative to break barriers, share information and integrate different skill sets is growing. One can see this in something as routine as analysis of data—every year new techniques and tools are developed that allow our researchers to more deeply probe the nature of normal and diseased cells and tissues. By adopting high-throughput technology able to analyze genes, proteins, cells and populations, the volumes of data collected can only be understood by similarly robust information analysis tools. Only by the application of these still evolving processes will critical relationships buried in complex datasets be revealed.

We hope that you enjoy this year's report, which is all about how UHN breaks down barriers, integrates expertise and shares knowledge for better health.



The origin of a macrophage

Study traces the “big bang” moment for certain immune cells

Let’s go back to the beginning. We each developed from one cell. This single cell went through rounds and rounds of divisions, creating daughter cells with the same genetic material that eventually make up the distinct organs and tissues in the body.

But clearly, brains, muscles and bones are very different from one another. Given that these specialized organs arose from a common ancestor cell, this raises the question as to the moment at which each of the estimated 37.2 trillion cells in the human body had its “big bang”—fulfilling its destiny of becoming a brain cell, muscle cell or bone cell.

Dr. **Clinton Robbins** (pictured above) set out to provide new insight on this subject. He focused on uncovering the origin of immune cells that reside in blood vessels—known as arterial macrophages.

His research team analyzed the genetic profiles of macrophages at different stages of life. Using various ‘fate mapping’ techniques, which involve tracing the lineage of cells during development in the womb or after birth, they found that arterial macrophages actually have different origins depending on age.

In the embryo, arterial macrophages come from a partially developed 'precursor' cell that expresses a specific protein on its cell surface, known as CX3CR1. Immediately after birth, however, they originate from a different type of cell, an immune cell known as a monocyte that comes from the bone marrow. Finally, in adulthood, arterial macrophages gain the ability to divide and regenerate; this enables them to increase in number in the absence of both precursor cells and monocytes.

"Our findings underscore the need for more careful examination of the factors that maintain macrophages in tissues," explains Dr. Robbins. "Insights from these studies are critical for research into diseases such as atherosclerosis, the underlying cause of virtually all heart diseases. In atherosclerosis, macrophages accumulate in the arteries and lead to the formation of lesions that interfere with blood flow; determining where these macrophages come from and how they accumulate will help identify new ways to stop or slow this process."

Tracing the origin of a cell type helps to understand its role in health and disease.

Ensan S, et al. Nat Immunol. 2016 Feb. This work was supported by the Canadian Institutes of Health Research, the Ontario Lung Association and the Toronto General & Western Hospital Foundation. C Robbins is the Peter Munk Chair in Aortic Disease Research, M Cybulsky holds a Tier 1 Canada Research Chair in Arterial Wall Biology and Atherogenesis and A Gramolini holds a Tier 2 Canada Research Chair in Cardiovascular Proteomics and Molecular Therapeutics.

Finding the right path

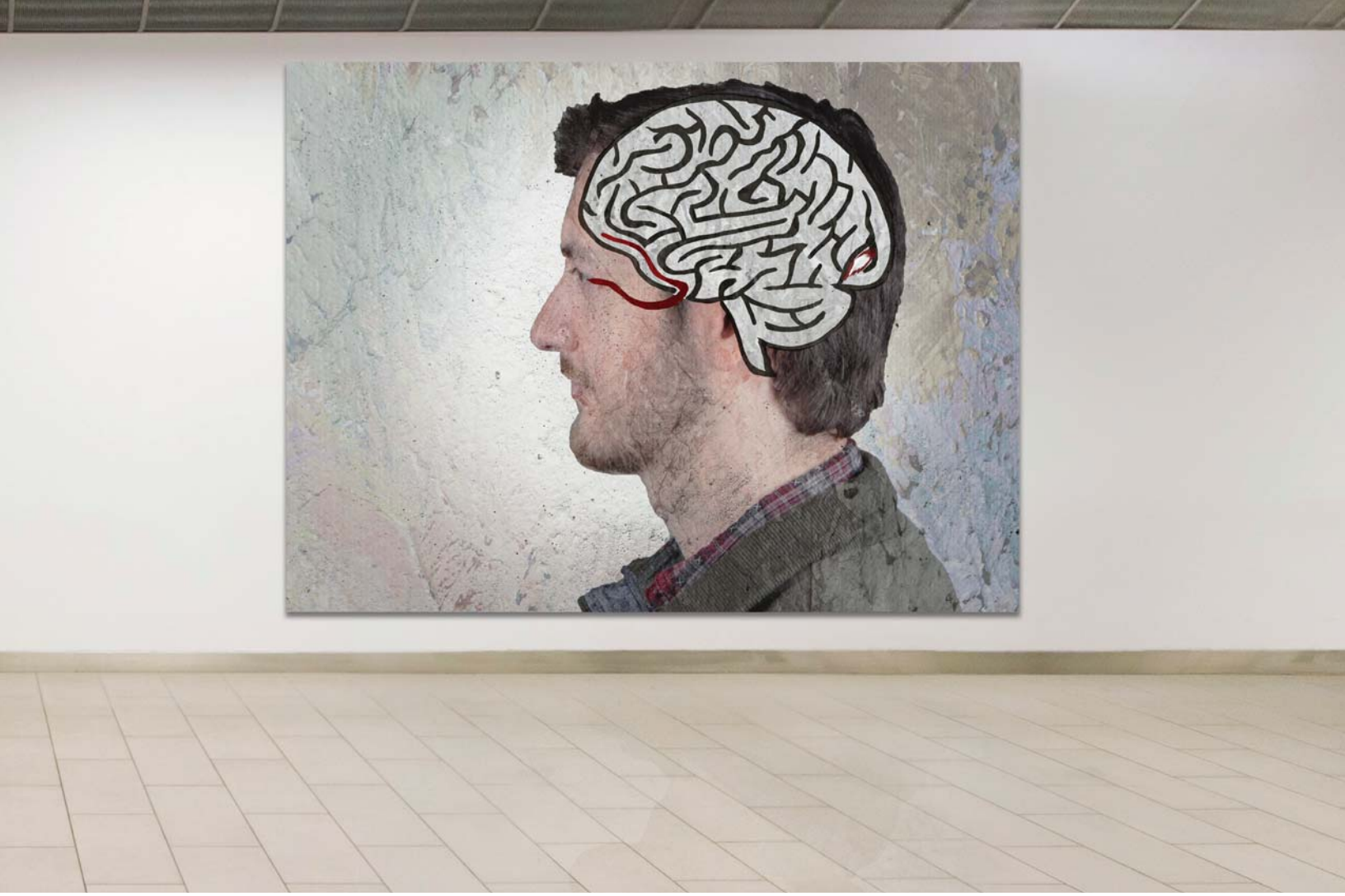
Peptides guide developing nerves toward brain vision centres

When light hits our eyes, it is transformed into an electrical signal. That signal travels along a specialized cable—the optic nerve—to specific brain regions that transform it into images, allowing us to see.

The optic nerve is not just one nerve, but is composed of around 1.5 million nerve fibres called retinal axons. In order for the vision system to function, these retinal axons must be guided and connected to highly specific brain regions—a process that occurs during development and is not well understood.

The process of brain development mirrors the complexity of the human brain: billions of cells are born, grow and connect with each other. These connections, which form the basic brain architecture required for us to interact with the world around us, are made possible by signalling molecules, including peptides (ie, molecules that are similar to proteins, but smaller). These compounds serve as beacons that guide how cells interact with each other.

Retinal axons can be damaged or lost in conditions like glaucoma, leading to irreversible blindness. A major barrier to treatment is a better understanding of how developing nerve fibres connect with the brain regions responsible for processing vision, including the optic tectum.



Recent findings from the lab of Dr. **Philippe Monnier** addressed this problem by shedding light on how retinal axons are able to navigate the maze-like environment of the developing brain. The research team found that two types of signalling molecules within the Repulsive Guidance Molecule a (RGMa) family of peptides serve important yet opposing functions. The N-RGMa subtype promotes deep projections, ensuring that developing axons extend far enough into the optic tectum, while the C-RGMa subtype prevents growing axons from extending too far. Together, these peptides ensure that developing nerve fibres from the eye find the optic tectum layer. "Our work has uncovered the peptides responsible for ensuring that retinal axons integrate into the correct layer of the optic tectum. N-RGMa serves as the gas pedal for axonal growth, while C-RGMa serves as the brake. These insights may help in the development of therapies aimed at repairing retinal axon damage," remarks Dr. Monnier.

Image: Dr. Monnier is depicted enjoying art—an act that would be impossible without the correct neuronal connections. The paintings feature two trainees that contribute to Dr. Monnier's research program (L-R: Hidekiyo Harada; Jason Charish). Superimposed over Jason Charish's portrait is an illustration that emphasizes the maze-like complexity of the path linking the optic nerve with the visual centres in the brain.

Banerjee P, et al. Cell Death Differ. 2016 Mar. This work was supported by the Canadian Institutes of Health Research, the University of Toronto Vision Science Research Program and the Toronto General & Western Hospital Foundation.

One of these is not like the others

Drug targets cancer cells by mimicking viral infection

Things are not always what they seem. That was what a team of researchers led by Dr. **Daniel De Carvalho** found when they decided to explore how a group of anticancer drugs, known as DNA-demethylating agents, target cancer cells. DNA-demethylating agents are approved for use in some blood cancers and are under evaluation for treating different types of solid tumours, including colorectal cancer. Despite their use clinically, there has been ongoing debate about the mechanisms that underlie their clinical efficacy.

Specifically, Dr. De Carvalho's team explored how a DNA-demethylating agent known as decitabine targets colorectal cancer stem cells. These cancer stem cells are believed to be responsible for disease relapse because they are resistant to treatment and can multiply indefinitely. By targeting these cells, decitabine has the potential to improve patient outcomes for colorectal cancer.

Dr. De Carvalho's team found an unlikely mechanism of action: the drug works by making the cells proliferate more slowly and behave like they are infected with viruses. As a consequence of this, the cells are targeted and cleared by the immune system.

Importantly, the researchers found that this strategy is effective against the hard-to-target colorectal cancer stem cells.

"By mimicking a viral infection, the immune system is tricked into 'seeing' the cancer cells as an infection that needs to be destroyed," says Dr. De Carvalho. "Our work demonstrates that viral mimicry is a viable anti-tumour strategy." Currently colorectal cancer recurs in about half of patients and is among the top three types of cancer diagnosed in Canada.

Future studies will be focused on determining whether combining viral mimicry with cancer immunotherapy—a treatment that stimulates the immune system—provides more clinical benefits than either therapy alone.

Image: Dr. De Carvalho is duplicated in the above image to show how similar cancer and normal cells appear to the immune system. The anti-cancer drug decitabine, represented by the mask, serves to flag cancer cells, enabling the immune system to target and attack these harmful cells.

Roulois D, et al. Cell. 2015 Aug. This work was supported by the Cancer Research Society, the Canadian Cancer Society, the Natural Sciences and Engineering Research Council of Canada, the Ontario Institute for Cancer Research with funds from the Province of Ontario, the University of Toronto McLaughlin Centre and The Princess Margaret Cancer Foundation.

Cancer cells treated with the drug behave like they are infected with viruses.

More than just clowning around

Helping hands that enrich the lives of people with dementia

"There is no pill that can do this," says Dr. **Pia Kontos**, referring to the findings of her study that evaluated the effect of elder-clowns on people living with dementia.

Dementia can lead to deficits in memory, language, attention, reasoning and judgement. Often, people living with this illness can become agitated, depressed and apathetic. Given that medications can alleviate only some of these symptoms and can have harmful side effects, researchers are investigating alternative approaches. A recent innovation in arts-based approaches to dementia care is the introduction of elder-clowns into nursing homes. Elder-clowns are professional performers who specialize in the art of clowning with individuals living with dementia. In addition to completing formal studies in acting and the clowning arts, elder-clowns receive training on how to interact with older adults living with dementia. Unlike their circus counterparts, they wear minimal make-up and colourful dress from the 1950s.

Elder-clowns are brought into nursing homes to enrich the lives of older adults with dementia by lessening social isolation, and providing opportunities to express creativity, playfulness and imagination. Their interactions with residents can include verbal, physical

and musical jests that incorporate humour, storytelling and empathy. Importantly, elder-clowns tailor their interaction to the life histories of each person and to the person's mood and responsiveness during each visit.

While the art of clowning was adapted for the dementia population in the 1990s, there is limited knowledge of its impact. To explore this issue, Dr. Kontos led a study in which four elder-clowns visited 23 nursing home residents living with moderate to severe dementia.

Dr. Kontos and her colleagues found significant reductions in agitation and increased quality of life in residents after 12 weeks of biweekly elder-clown visits. They also observed that residents would respond to the elder-clowns and engage with them by being deliberately funny, playful and imaginative. The residents also expressed sadness, which is typically suppressed in conventional dementia care, but was instead validated and supported by the clowns.

The findings of the study were two-fold: it revealed that elder-clowning provides therapeutic benefits and dispelled the myth that people living with dementia are incapable of meaningful interactions. By showing that elder-clowning can provide real benefits, these findings will inform new care approaches that aim to improve quality of life and enrich the lives of people living with dementia.

Image: (R-L) Dr. Kontos, and elder-clowns Kathleen Le Roux and Phil Koole. When visiting nursing home residents, elder-clowns bring along ukuleles and other props to support their interactions.

Kontos P, et al. J Am Geriatr Soc. 2016 Feb and Kontos P, et al. Dementia (London). 2015 Apr. *This work was supported by the Canadian Institutes of Health Research and the Toronto Rehab Foundation.*

Nanoparticles combine imaging approaches to target tumours

Advanced imaging techniques are essential innovations to help guide the removal of tumours. Precisely identifying and removing a tumour is especially challenging in head & neck cancer where the anatomy is complex and full of sensitive 'at risk' organs. Prior to cancer surgery, X-ray computed tomography (CT) is often used to construct a detailed three-dimensional image to help the surgeon visualize the tumour within complex healthy structures and to plan the optimal surgical procedure for removal. Another imaging technique called fluorescence optical imaging is also being increasingly used for guidance during surgery, to identify and locate cancer that has spread to the lymph nodes.

Until now, the combined use of these techniques in the operating room for tumour and lymph node visualization has been limited because multiple imaging agents are needed, and existing agents do not have the sensitivity and specificity needed for disease detection. Dr. **Jinzi Zheng** and her collaborators have found a way to improve the usefulness of these imaging methods by developing a single injectable imaging agent that can be used for both modalities.

Dr. Zheng and her team developed the agent by encapsulating, into a single nanoparticle, different imaging molecules that were engineered for use in CT and fluorescence imaging. Data obtained from ten different experimental cancer models showed that the

new imaging agent improved sensitivity when locating the tumour, its boundaries and lymph nodes where the cancer had infiltrated.

Explains Dr. Zheng, "This new technology is particularly useful because it enables us to employ different imaging techniques prior to and during surgery following one injection of the imaging agent. Our results are particularly promising and suggest that this agent could be used to improve the localization, detection and removal of a wide range of cancers."

Using a nanoparticle as the carrier also ensured that the agents remained in the tumour long enough for pre- and intra-operative imaging. This is because nanoparticles exploit defects in a tumour's blood vessels to increase their retention within the body. The nanoparticle components are individually approved with proven efficacy, which should help to accelerate the translation of this development into clinical practice.

Ironically, the need for such advanced tumour imaging agents is driven by improvements in screening and diagnosis. Finding disease earlier is better for the patient's outcome, but challenges surgeons to remove tiny tumours that are often too small to find by touch. Advances in the use of X-ray CT imaging technology during surgery also creates a need for an agent that stays in the tumour for a long time, which is a natural property of the liposomes developed by Dr. Zheng.

Zheng J, et al. Biomaterials. 2015 Oct. *This work was supported by the Fidani Family Chair in Radiation Physics, the Kevin & Sandra Sullivan Chair in Surgical Oncology, the RACH Fund and The Princess Margaret Cancer Foundation.*

Bringing it all together

New leadership takes research enterprise to the next level

Five research institutes. Almost one million square feet of dedicated research space. Over one thousand world-class researchers. Given UHN's standing as Canada's largest research hospital, leading an initiative to *Break Barriers* and *Build Health* is no small task.

Dr. **Bradly Wouters**—UHN's new Executive Vice President, Science and Research—is up to that challenge.

Dr. Wouters assumed the role in October 2016 following a highly competitive international search; but he is already well known throughout UHN, having been at the institution for almost a decade. He was recruited from Maastricht University to PM Cancer Centre as a Senior Scientist in 2008, and he also served as PM Cancer Centre's interim Director of Research from 2014 to 2016. His experience in these roles will undoubtedly help to achieve his vision: to build a more cohesive research enterprise.

"I'm excited to create opportunities that bring the organization closer together," explains Dr. Wouters. "I'm a big believer in group intelligence and team science, and I think that this is really UHN's competitive advantage. Our individual researchers are great, but they would be great anywhere by themselves. It's the environment that elevates research opportunities and innovation to another level. This is one of the things that we're going to be working on: eliminating the divisions that impede team science and fostering the unique environment and synergistic relationships that accelerate integrative research across the institution."

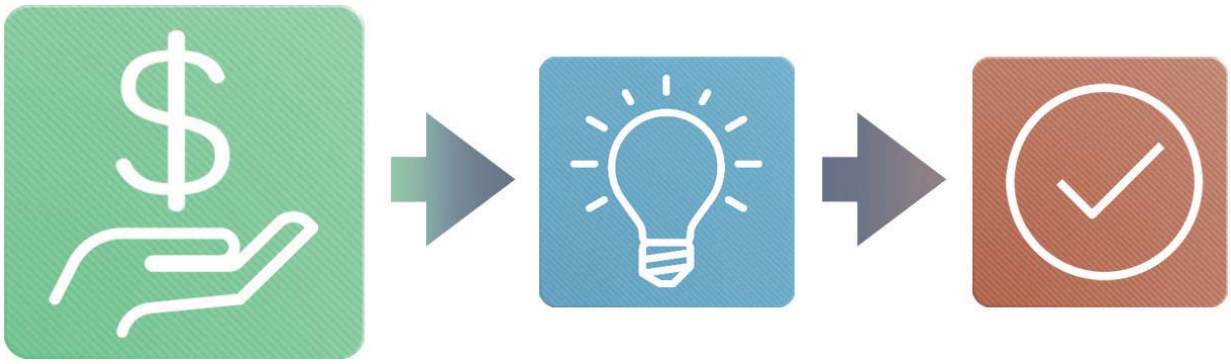
He also sees an opportunity to promote a unified culture of research across UHN as a whole. "It's time for us to realize the idea of a research hospital—as envisioned by Dr. Chris Paige—and to really incorporate research into everything that we do at UHN." A starting point for this is to capitalize on the valuable information that is constantly being generated at UHN, such as that from diverse sources like heart monitors, genomic sequencers, ultrasound machines and patient questionnaires. One of Dr. Wouters' initial areas of focus will be to find new ways of capturing, interpreting and unifying data—and weaving them seamlessly into the fabric of the organization—to help secure UHN's growth in this era of data-driven discovery.

Research is what defines us; it's what makes us different.

"The mission at UHN is really twofold: to deliver the best possible care with the knowledge that we have today and to recognize the limitations of our current treatments in order to develop new solutions for tomorrow. Research is the only tool we have to do this. That's why I support research across the entire spectrum: from curiosity-driven discovery research that reveals new insights into human biology to transformational clinical trials, health services research or rehabilitation programs that are changing policy and the way that the government funds medicine. Research is what defines us; it's what makes us different, and I can't wait to see what we can accomplish when we face today's greatest health issues together."

Year in Funding

A selection of UHN research funding milestones



Applying Genomics to Fight Leukemia

Dr. Jean Wang was awarded $3.4 million from Genome Canada's Genomic Applications Partnership Program (GAPP). The program supports research and development projects in genomics that address real-world challenges and opportunities.

Leukemia is one such challenge: standard chemotherapy treatments for the disease are not completely effective. These regimens, which have remained essentially unchanged since the 1970s, do not completely destroy all of the leukemia cells—enabling them to re-grow and lead to cancer recurrence.

Genomics research is being translated into novel cancer immunotherapies.

To address this, Dr. Wang will use the GAPP funds to advance a promising therapeutic drug for leukemia towards clinical trials. The agent, called SIRP-alpha-Fc, interferes with a protein called CD47 that is found on the surface of leukemia cells. CD47 shields the cells from the host's immune system, enabling the leukemia cells to evade destruction; by blocking CD47, SIRP-alpha-Fc removes this protection and signals immune cells called macrophages to engulf and destroy leukemia cells.

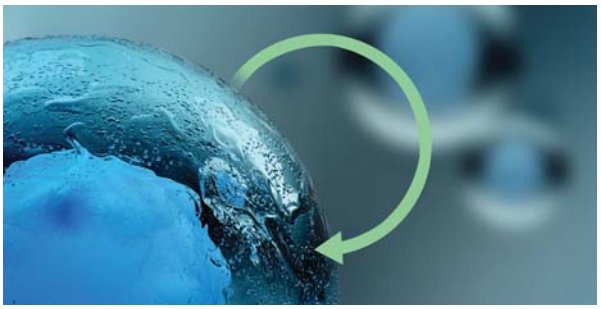
The project is a collaborative effort that brings together Dr. Wang, Dr. Jayne Danska (an immunogeneticist at SickKids) and Trillium Therapeutics Inc. (a biotech company based in Toronto). It was one of five projects nationwide to be awarded funding from this GAPP round.

Federal Funding for Patient-Oriented Research

UHN scientists are playing key roles in two of the five Strategy for Patient-Oriented Research (SPOR) Networks in Chronic Disease funded this year. Awarded through the Canadian Institutes of Health Research, the networks received $12.4 million each to develop transformative and measureable improvements for patients with chronic disease.

The *Chronic Pain* SPOR Network will bring together researchers from Krembil Research Institute, Toronto General Research Institute and Techna to enhance access to care for those suffering from chronic pain and to advance the translation of research into clinical practice.

The *Diabetes and its Related Complications* SPOR Network, led by UHN's Dr. Gary Lewis, will create a national registry and risk assessment tools to develop effective, evidence-based tests and preventative strategies for diabetes and its related diseases.



Investment in Cancer Stem Cell Research

A research project led by Dr. John Dick was awarded $6.2 million over five years from the highly competitive Terry Fox New Frontiers Program Project Grant. The award will be used to advance our understanding of cancer stemness, which is the ability of cancer cells to self-renew and generate more cancer cells. The project will be focused on uncovering ways to improve the detection and treatment of three high-risk cancers: acute myeloid leukemia, myeloma and brain cancer.

Securing Cutting-Edge Infrastructure

Through its John R. Evans Leaders Fund, the Canada Foundation for Innovation announced funding for over $1.5 million in infrastructure to advance research at UHN. These projects have diverse aims: overcoming immunosuppression to fight infections and cancer; defining the role of macrophages in cardiovascular disease; examining retinal development, injury and repair; preventing falls in vulnerable populations; targeting mitochondrial dysfunction in leukemia; and unravelling the mechanisms of joint damage in osteoarthritis.

Year in Discovery

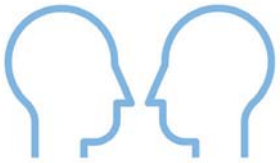
A selection of research publications from UHN

Arthritis and Heart Health

Ankylosing spondylitis (AS) is a form of arthritis that commonly affects the spine. In addition to suffering from chronic back pain, people with AS are at increased risk of heart disease and stroke; however, it is not clear whether these people are also at risk for mortality as a consequence of these events. A recent study led by Dr. Nigil Haroon addressed this gap in knowledge. His research team analyzed health data from over 21,000 patients and found that those with AS are at higher risk for death from heart disease and stroke than those without AS. Major risk factors for death include age and chronic kidney disease. This indicates that screening and treating modifiable risk factors could help prevent vascular disease in people with AS. *Haroon NN, et al. Ann Intern Med. 2015 Sept.*

Take the Bad with the Good

Chemotherapy is an effective treatment for early stage breast cancer. Despite this, studies have shown that certain drugs can increase the risk of heart failure in older women (>65). To date, these studies have not addressed whether these risks affect younger women (<65)—a demographic that comprises the majority of people diagnosed with the disease. To determine whether younger women are also at risk, Dr. Paaladinesh Thavendiranathan analyzed the health data of 18,540 women over the age of 18 that were treated for early-stage breast cancer. He found that all women treated with chemotherapy—regardless of age—are at increased risk for heart failure. He cautions that the benefits of chemotherapy far outweigh the risks, and that monitoring younger women for heart disease may help curb these risks. *Thavendiranathan P, et al. J Clin Oncol. 2016 Jul.*



Two Sides to Recovery

Recovering from treatment in the intensive care unit (ICU) is challenging. Dr. Margaret Herridge found that the success of ICU recovery could be predicted based on a patient's age and length of stay in the ICU. This model could help tailor long-term rehabilitation plans. A complementary study by Dr. Jill Cameron focused on the challenges faced by caregivers of recovering ICU patients. She found that caregivers experienced clinical depression, which in some cases did not improve up to one year later. These studies highlight the need to consider the experiences of the patient—and the caregiver—during ICU recovery. *Herridge MS, et al. Am J Respir Crit Care Med. 2016 Oct. and Cameron JI, et al. New Engl J Med. 2016 May.*

Research Tool Senses Damage

The production of energy in the body is essential, but it also generates by-products called reactive oxygen species (ROS). If left unchecked, ROS can cause significant damage to cells. Fortunately, antioxidant pathways 'scavenge' ROS and stop harmful effects. To help researchers study these processes, Dr. Jonathan Rocheleau developed a molecular sensor that reveals the balance between ROS and antioxidant pathways in a cell. The sensor, called Apollo-NADP+, measures this balance with higher accuracy and precision than existing systems. This tool will help shed light on a wide range of diseases associated with ROS, which include diabetes and age-related cancers. *Cameron WD, et al. Nat Methods. 2016 Apr.*

Excess Fluids Affect Sleep

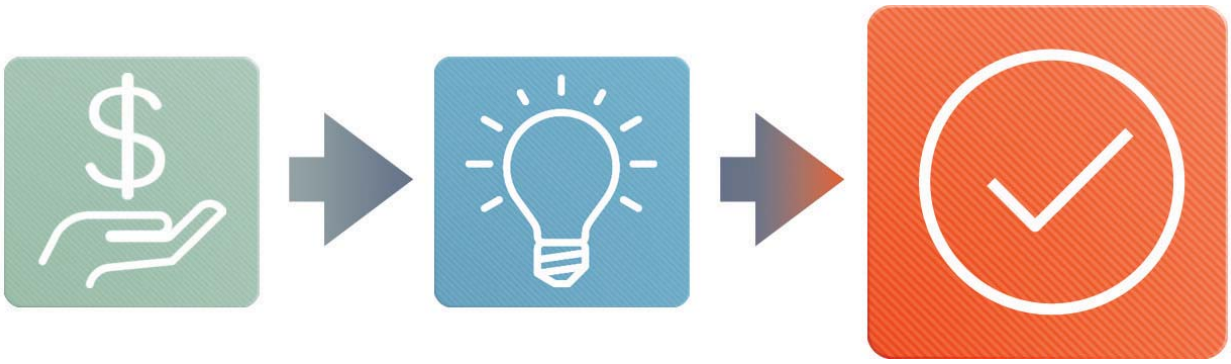
People with end-stage renal disease (ESRD) have malfunctioning kidneys and have to regularly undergo dialysis to manage fluid buildup. These people also often have sleep apnea, a potentially serious disorder in which breathing repeatedly pauses during sleep. One explanation for this may be that excess fluids shift from the legs towards the head when lying down—restricting the airway. To test this possibility, Dr. T Douglas Bradley used a method called ultrafiltration to remove excess fluid in people with ESRD. He found that this markedly improved sleep and reduced symptoms of sleep apnea. This suggests that targeting fluid buildup is a potential treatment for sleep apnea. *Lyons OD, et al. Am J Respir Crit Care Med. 2015 Jun.*

Overcoming Tumour Resistance

Glioblastoma is a brain cancer that is particularly resistant to treatment. This is partly due to a subtype of tumour cells that are capable of replicating themselves. Exactly what enables some glioblastoma cells to regenerate is unknown. Drs. Mathieu Lupien and Peter Dirks (SickKids) have shed light on this by exploring the function of a protein called MLL5. They found that in glioblastoma cells, MLL5 represses the levels of another protein known as H3.3. In turn, reduced H3.3 levels were found to cause DNA to become more compact, which turns on genes involved in tumour regeneration. The team also identified two chemical compounds that may prevent this process. Further development of these compounds may lead to new drugs to treat this aggressive type of cancer. *Gallo M, et al. Cancer Cell. 2015 Dec.*

Discoveries to Reality

Real-life applications born from UHN research



AVROBIO Launches Gene Therapy Programs

The UHN spinout company AVROBIO launched two programs based on research by Drs. Christopher Paige and Jeffrey Medin (now at the Medical College of Wisconsin). The programs—which are ready for Phase I clinical trials—leverage cell and gene therapy platforms for cancer and rare diseases.

The first program is developing a therapy that triggers the immune system to detect and destroy cancer cells. A patient's cancer cells are isolated and genetically modified to produce an immune signalling molecule called IL-12. The modified cells are then infused back into the patient; as they begin producing IL-12, the immune system is activated to target and eliminate the cancer cells.

The second program is developing a similar approach to treat Fabry disease, a rare genetic disorder. People with Fabry disease have genetic mutations that lead to reduced levels of the enzyme alpha-galactosidase A. Deficiencies in this enzyme result in defects in metabolism that can cause pain, kidney failure and heart disease. AVROBIO's therapy involves isolating cells from a Fabry disease patient, modifying them by introducing a functional copy of the gene and infusing them back into the patient.

Cell and gene therapy platforms may offer innovative therapies for patients with cancer and Fabry disease.

AVROBIO raised $25 million in Series A financing, co-led by Atlas Venture, Clarus and SV Life Sciences, towards accelerating the development of these programs.

UHN Companies Awarded JLABS Residency

Two UHN-based startup companies, AVROBIO and Nanovista, were awarded residency at JLABS @ Toronto, Johnson & Johnson Innovation's life sciences incubator. Located in the MaRS Discovery District, the facility houses 40,000 sq. ft. of space for emerging companies to move products along the path to commercialization.

Nanovista is developing multimodal visualization agents that are designed to improve the performance of image-guided high-precision cancer therapies. The early-stage company was co-founded by Drs. Jinzi Zheng, David Jaffray and Christine Allen (UT).

AVROBIO is focused on developing novel gene therapies for cancer and rare diseases. It was founded based on the work of Drs. Paige and Medin (see page 20).

Medication Labelling System Licensed

A medication labelling system co-invented by Drs. Ludwik Fedorko and Joe Fisher was licensed to Assure Medical Systems Inc.—a start-up company co-founded by Dr. Fedorko. The system uses electronic barcoding to label the medications that will be delivered via syringes during surgeries. Each label is automatically populated with information including the drug name, concentration and time of preparation. As such, the system significantly reduces the risks of labelling errors and misinterpretation that arise from traditional hand-written labels—improving patient safety.

UHN's Inventor of the Year 2015

This annual award was presented to creators of BresoDx®—a device that is used to diagnose sleep apnea at home—by UHN's office of Technology Development and Commercialization (TDC). At UHN's annual general meeting, TDC's Dr. John Reid (pictured third from the left) presented the award to (L- R) Drs. Geoff Fernie, T Douglas Bradley and Hisham Alshaer.

Because diagnosis of sleep apnea is traditionally carried out in a sleep laboratory, few people undergo testing. The wireless, at-home features of BresoDx® help overcome this barrier. The device is licensed to BresoTec Inc. and has received regulatory approval from Health Canada.

Research Distinctions

Selected honours bestowed upon UHN researchers

Dr. Cheryl Arrowsmith
Fellow, American Association for the Advancement of Science

Dr. Joanne Bargman
2016 International Distinguished Medal, National Kidney Foundation

Dr. Tom Chau
2016 Jonas Salk Award, March of Dimes Canada

Dr. Angela M Cheung
Tier 1 Canada Research Chair in Musculoskeletal and Postmenopausal Health

Dr. Hance Clarke
2016 Early Career Award, Canadian Pain Society

Dr. Angela Colantonio
Fellow, Canadian Academy of Health Sciences

Dr. Myron Cybulsky
Tier 1 Canada Research Chair in Arterial Wall Biology and Atherogenesis

Dr. Abdallah Daar
Fellow, African Academy of Sciences

Dr. Tirone David
2016 Scientific Achievement Award, American Association for Thoracic Surgery

Dr. John Dick
2016 Fellow, American Association for Cancer Research Academy

Dr. Eleanor Fish
Fellow, African Academy of Sciences

Dr. Herbert Gaisano
Member, Order of Ontario

Dr. Mary Gospodarowicz
2016 O. Harold Warwick Prize, Canadian Cancer Society

Dr. Robin Green
Tier 2 Canada Research Chair in Traumatic Brain Injury – Cognitive Rehabilitation Neuroscience (Renewal)

Dr. Nigil Haroon
2016 Young Investigator Award, Canadian Rheumatology Association

Dr. Susan Jaglal
Fellow, Canadian Academy of Health Sciences

Dr. Kevin Kain
Tier 1 Canada Research Chair in Molecular Parasitology (Renewal)

Dr. Marianne Koritzinsky
2016 Michael Fry Research Award, Radiation Research Society

Dr. Ren-Ke Li
Fellow, International Academy of Cardiovascular Sciences

Dr. Aravind Namasivayam
2016 Excellence in Applied Research Award, Speech-Language & Audiology Canada

Dr. Pamela Ohashi
Tier 1 Canada Research Chair in Tumour Immunity and Immunotherapy (Renewal)

Dr. Milica Radisic
2015 Hatch Innovation Award, Canadian Society for Chemical Engineering

Dr. Frank Rudzicz
2016 Excellence in Applied Research Award, Speech-Language and Audiology Canada

Dr. Michael Sefton
2016 Terumo Global Science Prize, Terumo Foundation for Life Sciences and Arts

Dr. Frances Shepherd
Officer, Order of Canada

Dr. Katherine Siminovitch
Fellow, Canadian Academy of Health Sciences

Dr. Catriona Steele
2016 Lifetime Achievement Award, Speech-Language & Audiology Canada

Dr. Antonio Strafella
Tier 2 Canada Research Chair in Movement Disorders and Neuroimaging (Renewal)

Dr. Murray Urowitz
Lifetime Achievement Award, Lupus Ontario

Dr. Pascal van Lieshout
2016 Excellence in Applied Research Award, Speech-Language & Audiology Canada

Dr. Donald Weaver
Tier 1 Canada Research Chair in Drug Design for Protein Misfolding Disorders

Dr. Daniel Winer
Tier 2 Canada Research Chair in Immunometabolism

Dr. Gang Zheng
Fellow, American Institute for Medical and Biological Engineering

UHN Foundations

The Princess Margaret Cancer Foundation

Toronto General & Western Hospital Foundation

Toronto Rehab Foundation

The Princess Margaret Cancer Foundation

Billion Dollar Challenge: the Home Stretch

In April 2012, The Princess Margaret Cancer Foundation (The PMCF) embarked on the largest single fundraising campaign in the history of Canadian health care—*the Billion Dollar Challenge*. This five-year initiative aims to secure $1 billion to enable personalized cancer medicine at The Princess Margaret Cancer Centre.

The PMCF has met this challenge ahead of schedule: in January 2017, the Foundation announced that a total of $1,052,000,000 has been raised, with $532 million coming from philanthropy and $520 million from grants secured by cancer centre researchers.

The Foundation also achieved a new record in net annual fundraising with a total of $104 million raised. This includes $15.5 million raised for the $50 million Research Campaign, which launched in 2015.

For the second consecutive year, The PMCF raised an all-time record of $24.8 million in net income from its lotteries through continuous innovation in ticket purchase options, prizing and use of social media to reach more people. The *Enbridge Ride to Conquer Cancer* had another strong year, raising over $19.3 million with 4,853 riders and *OneWalk to Conquer Cancer* made its debut with 4,523 participants raising over $7.7 million.

Thanks to the cancer research enabled through these programs and the generosity of the community, the landscape in cancer diagnosis and treatment is changing rapidly. The Tumour Immunotherapy Program led by Drs. Pamela Ohashi and Lillian Siu is an excellent example of how The Princess Margaret is leading the way in personalized cancer medicine by testing promising new cancer therapies. This treatment harnesses the natural power of the immune system to combat cancer growth, and is an emerging anticancer strategy has already been shown to be effective at improving patient outcomes.

Left photo: The inaugural OneWalk to Conquer Cancer fundraiser united a powerful community of cancer survivors and their supporters to raise money for cancer research. Right photo: An RCMP officer at the 2016 Billion Dollar Challenge event.

Toronto General & Western Hospital Foundation

Renamed Krembil Research Institute Honours Donor Giving

The Krembils—Bob, Linda, Mark, Jake and Stacey—are among Canada's leading investors in research. Their philanthropic support of Toronto Western Hospital began with a gift that established the *Krembil Family Chair in Neurology*. That gift was a catalyst for building a world-leading research program bar none.

Nearly 20 years and $80 million later, that beacon of excellence now exists with the renaming of Toronto Western Hospital's research arm to the Krembil Research Institute (or simply 'Krembil')—branding that coincided with a new, multi-million dollar pledge from the family last fall.

On November 13, 2015, Her Royal Highness, Sophie, The Princess Edward, Countess of Wessex, patron of Toronto Western Hospital, acknowledged the family's generosity at a tribute event unveiling the Institute's new name.

"Our world-leading scientists now have a renewed sense of pride in their life's work to find cures for diseases of the brain, spine, bones, joints and eyes," she said. "And it will bring tremendous hope to our patients who will ultimately be the beneficiaries of discovery research."

Dr. Donald Weaver, Krembil's Director, sees the Krembil family's commitment as a driving force behind work in the Institute's state-of-the art laboratories. "We have a saying here at Krembil: If we're not here to find a cure, then why the hell are we here? The Krembils chuckle every time I say it, but there's an understanding between us. They know the phrase is not hyperbole, and every time we get a little closer to solving the mystery of these diseases, we can honestly say that it's a combination of great science and great philanthropy that will help patients live not just longer, but better lives."

Photo (L-R): Mark Krembil; Stacey Krembil; Lieutenant-Governor Elizabeth Dowdeswell; Jake Krembil; Sophie, The Princess Edward, Countess of Wessex; Linda Krembil; and Bob Krembil.

Toronto Rehab Foundation

Accelerating Concussion Treatment and Research

Toronto Rehab's new and unique *Hull-Ellis Concussion and Research Clinic* sees patients within one week of sustaining a brain injury—providing care and management of their symptoms, and enabling research on their progress.

Donor support—including the *TWIINS Gala* that raised $700,000—enabled the clinic to come to fruition. The Hull-Ellis Clinic, aptly named in honour of hockey legends Dennis Hull and Ron Ellis, provides patients with a weekly assessment and comprehensive care program, as well as follow-ups at weeks 8, 12 and 16 post-injury. In addition to physician assessments, other assessments that measure cognition, balance and mobility, and mood and personality are conducted.

"Our goal is to find faster ways to help people recover and to prevent long-term complications of traumatic brain injury," explains Dr. Mark Bayley, Medical Director of the Brain & Spinal Cord Injury Research Program, who leads the clinic. "We want to identify the people who have the most challenging symptoms and accelerate their recovery. Our rigorous evaluation of techniques and treatments will enable the development of a best practice model that others can emulate across the province, country and globally."

To celebrate the first anniversary of the Hull-Ellis Clinic at Toronto Rehab in June, donors and volunteers joined Ron Ellis for breakfast and an informative session titled *Concussion Across the Spectrum of Injury*. The session provided attendees with key information about the resource and equipment needs required to advance the research mandate of the clinic.

Through donor support, scientists and clinicians are making an incredible difference in the lives of people who have experienced concussion and brain injury. Our community of supporters plays a key role in helping Toronto Rehab uphold its position as the number one rehabilitation research centre in the world.

Photo: (L-R) Ron Ellis and Dennis Hull cut the ceremonial ribbon to officially open the Hull-Ellis Concussion and Research Clinic.

UHN Research Institutes

Krembil Research Institute

Princess Margaret Cancer Centre

Techna Institute

Toronto General Research Institute

Toronto Rehabilitation Institute

Krembil Research Institute*

**formerly the Toronto Western Research Institute*

Senior Scientists	36
Scientists	12
Affiliate Scientists	16
Emeritus	2
Clinician Investigator	31
Total Appointed Researchers	**97**
Clinical Researchers	122
Total Researchers	**219**

Fellows	42
Graduate Students	76
Total Trainees	**118**

Research Space	**146,568 sq. ft.**

Total Staff	**275**

External Funding	**$41,203,837**

Publications	**901**

Research Council

Director and Chair, Krembil Research Institute Donald Weaver
Co-Director, Donald K. Johnson Eye Institute Valerie Wallace
Division Head, Healthcare Outcomes & Research Elizabeth Badley
Division Head, Fundamental Neurobiology Peter Carlen
Division Head, Brain, Imaging & Behaviour – Systems Neuroscience Karen Davis
Division Head, Genetics & Development James Eubanks
Division Head, Orthopaedics; Director, Arthritis Program Nizar Mahomed
Clinical Representative, Arthritis Program Robert Inman
Chair, Trainee Affairs Committee Frances Skinner
Executive Director, Research Operations Lisa Alcia
Senior Vice President, UHN and Executive Lead, TWH (Interim) Janet Newton
*Executive Vice President, Science and Research** Christopher Paige
**role filled by Bradly Wouters as of Oct 1, 2016*

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
Jonathan Dostrovsky
Mark Guttman
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
Philippe Monnier
Lyanne Schlichter
Elise Stanley
Florence Tsui

Joan Wither

Scientists

W Mark Erwin
Nigil Haroon
Lorraine Kalia
Suneil Kalia
Armand Keating

Affiliate Scientists

Arjun Sahgal
Sowmya Viswanathan

Health Care & Outcomes Research

Emeritus

Murray Urowitz

Senior Scientists

Elizabeth Badley
J David Cassidy
Aileen Davis
Dafna Gladman
Nizar Mahomed

Scientist

Anthony Perruccio

Affiliate Scientists

Vinod Chandran
Cheryl Cott
Paul Fortin
Monique Gignac
Rosemary Martino

Patient-based Clinical Research

Senior Scientists

Anthony Lang
Colin Shapiro

Vector Core

Senior Scientist

Jeffrey Medin

Vision Science

Senior Scientists

Christopher Hudson
Martin Steinbach
Graham Trope
Valerie Wallace
Agnes Wong

Scientist

Jeremy Sivak

Affiliate Scientists

Moshe Eizenman
John Flanagan
Brenda Gallie

Clinician Investigators

Mark Bernstein
Anuj Bhatia
Michael Brent
Daniel Buchman
Melanie Cohn
Robert Devenyi
Dean Elterman
Alfonso Fasano
Susan Fox
Kenneth Fung
Rajiv Gandhi
Timothy Jackson
Sukhvinder Kalsi-Ryan
Efrem Mandelcorn
Daniel Mandell
Shane McInerney
Roger McIntyre
Renato Munhoz
Laura Passalent
Anahi Perlas
Fayez Quereshy
Y Raja Rampersaud
David Rootman
Mohammed Shamji
Allan Slomovic
David Tang-Wai
Carmela Tartaglia
Zahi Touma
Christian Veillette
M Elizabeth Wilcox
Mateusz Zurowski

Clinical Researchers

Ronit Agid
Jamil Ahmad
Danielle Andrade
Yaron Avitzur
Heather Baltzer
Paul Binhammer
Jeff Bloom
Claire Bombardier
Arthur Bookman
Vera Bril
Richard Brull
Yvonne Buys
Simon Carette
Leanne Casaubon
Rodrigo Cavalcanti
Jas Chahal
Clara Chan
Vincent Chan
Kenneth Chapman
Caroline Chessex
Angela C Cheung
Angela M Cheung
Ki Jinn Chin
Frances Chung
Maria Cino
Paula Cripps-McMartin
Michael Cusimano
J Roderick Davey
J Martin del Campo
Michael Easterbrook
Sherif El-Defrawy
Richard Farb
David Frost
Fred Gentili
Alberto Goffi
Allan Gordon
Brent Graham
Clement Hamani
Patricia Harvey
Cheryl Jaigobin
Harry Janssen
Sindhu Johnson
Benjamin Kaasa
Rita Kang
Moira Kapral
Hans Katzberg
Ron Keren
Edward Keystone
Kyle Kirkham
Diana Kljenak
Paul Kongkham
Stephen Kraft
Timo Krings
Richelle Kruisselbrink
Jeffrey Kwong
Jan Lackstrom
Robert Lam
Wai-Ching Lam
Carolina Landolt-Marticorena
Johnny Lau
Stephen Lewis
Joel Lexchin
Mark Mandelcorn
Pirjo Manninen
Samuel Markowitz
Connie Marras
Theodore Marras
K Wayne Marshall
Eric Massicotte
Steven McCabe
Kenneth Melvin
Ali Naraghi
Mary Ann Neary
Ahtsham Niazi
Ivy Oandasan
Darrell Ogilvie-Harris
Allan Okrainec
Karen Okrainec
Christian Pagnoux
Philip Peng
Vitor Pereira
Aleksandra Pikula
Atul Prabhu
Arun Prasad
Theodore Rabinovitch
Sidney Radomski
Sapna Rawal
Shail Rawal
Aylin Reid
Lisa Richardson
Rowena Ridout
Cheryl Rosen
David Salonen
Jorge Sanchez-Guerrero
Paul Sandor
Michael Schwartz
Hemant Shah
Sanjay Siddha
Frank Silver
Martin Simons
Shaun Singer
Jeffrey Singh
Mandeep Singh
Sumeet Sodhi
Peter St George-Hyslop
Matthew Stanbrook
Amanda Steiman
Khalid Syed
Peter Tai
Susan Tarlo
Maria Tassone
Karel terBrugge
Karen Tu
Lashmi Venkatraghavan
Herbert von Schroeder
Adam Weizman
Richard Wennberg
Robert Willinsky
David H Wong
David T Wong
Jean Wong
Eric Yu

Princess Margaret Cancer Centre

Senior Scientists	48
Scientists	16
Affiliate Scientists	15
Assistant Scientists	1
Total Appointed Researchers	**80**
CCRU Members	293
Total Researchers	**373**

Fellows	91
Graduate Students	103
Total Trainees	**194**

Research Space	**388,591 sq. ft.**
External Funding	**$154,058,701**

Total Staff	**855**
Publications	**1,312**

Research Council on Oncology (RCO)

*Director, PM Cancer Centre; Chair, RCO; Chair, Executive Committee (Interim)** Bradly Wouters
Executive Committee Mitsuhiko Ikura, Rama Khokha, 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 (Interim) Amit Oza
Head, Radiation Medicine Fei-Fei Liu
Chief, Surgical Oncology Jonathan Irish
Executive Director, Research Operations Lisa Alcia
Senior Vice President, UHN and Executive Lead, PM Cancer Centre Marnie Escaf
*Executive Vice President, Science and Research*** Christopher Paige
**role filled by Rama Khokha as of Oct 1, 2016. ***role filled by Bradly Wouters as of Oct 1, 2016.*

Researchers

Senior Scientists
Kenneth Aldape
Cheryl Arrowsmith
Sylvia Asa
Norman Boyd
Robert Bristow
David Brooks
Avijit Chakrabartty
Gerald Devins
John Dick
Shereen Ezzat
Lucia Gagliese
Razqallah Hakem
David Hedley
Richard Hill
Naoto Hirano
Doris Howell
Mitsuhiko Ikura
Norman Iscove
David Jaffray
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
James Till
Ming-Sound Tsao
I Alex Vitkin
Brian Wilson
Bradly Wouters
Gang Zheng
Camilla Zimmermann

Scientists
Laurie Ailles
Scott Bratman
Steven Chan
Ralph DaCosta
Daniel De Carvalho
Kim Edelstein
Benjamin Haibe-Kains
Housheng Hansen He
Michael Hoffman
Jennifer Jones
Marianne Koritzinsky
Nadeem Moghal
Catherine O'Brien
Trevor Pugh
Rodger Tiedemann
Gelareh Zadeh

Assistant Scientist
Chris Marshall

Affiliate Scientists
Eric Chen
Mary Jane Esplen
Anthony Joshua
C Anne Koch
Paul Kongkham
Jason Moffat
Michael Moran
Michael Reedijk
Paul Ritvo
Leonardo Salmena
Michael Sherar
Sachdev Sidhu
Suzanne Trudel
Jean Wang
Wei Xu

Cancer Clinical Research Unit (CCRU)
Ayman Al Habeeb
Hamideh Alasti-Hamed
Zishan Allibhai
Dominick Amato
Eitan Amir
Mostafa Atri
Michael Baker
Subrata Banerjee
David Barth
Eric Bartlett
Andrew Bayley
Nathan Becker
Philippe Bedard
J Robert Beecroft
Akbar Beiki-Ardakani
Alejandro Berlin
Hal Berman
Marcus Bernardini
Lori Bernstein
Mark Bernstein
Andrea Bezjak
Jean-Pierre Bissonnette
Ivan Blasutig
Scott Boerner
Jette Borg
Penelope Bradbury
Anthony Brade
Donald Branch
Savtaj Brar
Stephen Breen
William Brien
James Brierley
Dale Brown
John Bryson
Ronald Burkes
Marcus Butler
Marco Carlone
Charles Catton
David Cescon
Hong Chang
William Chapman
Tanya Chawla
Christine Chen
Terry Cheng
Douglas Chepeha
Runjan Chetty
Carol Cheung
Frederick Cheung
Charles Cho
John Cho
Young-Bin Cho
James Chow
Caroline Chung
Peter Chung
Tae Bong Chung
Tulin Cil
Blaise Clarke
Sean Cleary
Catherine Coolens
Timothy Craig
Jennifer Croke
Michael Crump
Pavel Crystal†
Christine Cserti-Gazdewich
Bernard Cummings
Marcelo Cypel
Gilda da Cunha Santos
Norma D'Agostino
Andrei Damyanovich
Gail Darling
Laura Dawson
John de Almeida
Marc de Perrot
Jan Delabie
Neesha Dhani
Eleftherios Diamandis
Phedias Diamandis
Robert Dinniwell
Susan Done
James Downar
Daniel Drucker
Alexandra Easson
Saibishkumar Elantholi Parameswaran
Elena Elimova
Mary Elliott
Christine Elser
Jaime Escallon
Andrew Evans
Hannaneh Faghfoury
Ronald Feld
Louis Fenkell
Peter Ferguson
Sarah Ferguson
Antonio Finelli
Neil Fleshner
Jeremy Freeman
Anthony Fyles
Steven Gallinger
William Geddie
Fred Gentili
Sandeep Ghai
Sangeet Ghai
Danny Ghazarian
Ralph Gilbert
Meredith Giuliani
Rebecca Gladdy
David Goldstein
Pamela Goodwin
Chiara Gorrini
Mary Gospodarowicz
Rashmi Goswami
Anand Govindarajan
David Grant
David Green
Paul Greig
Robert Gryfe
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
Aaron Hendler
David Hodgson
Stefan Hofer
David Hogg
Andrew Hope
David Hwang
Jonathan Irish
Mohammad Islam
Hyun-Jung Jang
Raymond Jang
Jeffrey Jaskolka
Michael Jewett
Kartik Jhaveri
Sarah Johnson
John Kachura
Suzanne Kamel-Reid
Zahra Kassam
Edward Kassel
Ebru Kaya
Armand Keating
Harald Keller
Erin Kennedy
Shaf Keshavjee
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
Daniel Létourneau
Wilfred Levin
Stéphanie Lheureux
Madeline Li
Patricia Lindsay
Jeffrey Lipton
Christopher Lo
Helen Mackay
Ernie Mak
Myles Margolis
Warren Mason
Andrew Matthew
Taymaa May
J Andrea McCart
David McCready
Allison McGeer
Ian McGilvray
Andrea McNiven
Tatiana Melnyk
Cynthia Ménard
Hans Messner
Ozgur Mete
Ur Metser
Fotios Michelis
Barbara-Ann Millar
Kim Miller
Naomi Miller
Michael Milosevic
Eric Monteiro
Chantal Morel
Carol-anne Moulton
Anna Marie Mulligan
Kieran Murphy
Rumina Musani
Rinat Nissim
Nancy Olivieri
Martin O'Malley
Anne O'Neill
Brian O'Sullivan
Amit Oza
Prodipto Pal
Sophia Pantazi
Demetris Patsios
Narinder Paul
Bayardo Perez-Ordonez
Andrew Pierre
Anca Prica
Thomas Purdie
Fayez Quereshy
Graeme Quest
Dheeraj Rajan
A Michael Rauth
Albiruni Razak
Donna Reece
G Jolie Ringash
Alexandra Rink
Lorne Rotstein
Marjan Rouzbahman
Anabel Scaranelo
Heidi Schmidt
Andre Schuh
Jack Seki
Stefano Serra
Patricia Shaw
Nadine Shehata
Frances Shepherd
Liran Shlush
David Shultz
E Rand Simpson
Lillian Siu
Joyce So
Anna Spreafico
Boraiah Sreeharsha
Srikala Sridhar
Teodor Stanescu
Alexander Sun
D Robert Sutherland
Carol Swallow
Joan Sweet
Eva Szentgyorgyi
Tony Tadic
Ian Tannock
Mojgan Taremi
Bryce Taylor
Santhosh Thyagu
Anne Tierens
Ants Toi
Emina Torlakovic
John Trachtenberg
Richard Tsang
Hubert Tsui
Rajkumar Vajpeyi
Theodorus van der Kwast
Monique van Prooijen
Auro Viswabandya
Thomas Waddell
John Waldron
Julia Wang
Richard Ward
Padraig Warde
David Warr
Robert Weersink
Alice Wei
Ilan Weinreb
Woodrow Wells
Kirsten Wentlandt
Lawrence White
Daniel Winer
Ian Witterick
Jason Wong
Rebecca Wong
Robert Wood
Jay Wunder
Jiong Yan
Kazuhiro Yasufuku
Karen Yee
Erik Yeo
Bruce Youngson
Eugene Yu
Toni Zhong
Alexandre Zlotta

Techna Institute

Core Leads	9
Scientists	4
Affiliated Faculty	37
Total Researchers	**50**

Fellows	24
Graduate Students	39
Total Trainees	**63**

Research Space **12,484 sq. ft.**

Total Staff **95**

External Funding **$12,492,230**

Publications **279**

Techna Leadership Team

Director, Techna Institute David Jaffray
Director, Clinical Processes Howard Abrams
Director, Operations & Engineering Luke Brzozowski
Director, Knowledge Transfer Nicole Harnett
Director, Research Faculty, Clinical Jonathan Irish
Director, Research Faculty, Physical Sciences
J Paul Santerre
Director, Commercialization Mark Taylor
*Executive Vice President, Science and Research**
Christopher Paige
**role filled by Bradly Wouters as of Oct 1, 2016*

Researchers

Design & Engineering for Health

Core Lead
Joseph Cafazzo
Affiliated Faculty
Emily Seto
Patricia Trbovich
Leonard Tse

Guided Therapeutics

Core Leads
Jonathan Irish
David Jaffray
Walter Kucharczyk
Scientists
Margarete Akens
Arash Zarrine-Afsar
Jinzi Zheng
Affiliated Faculty
Dionne Aleman
Jean-Pierre Bissonnette
Timothy Chan
Catherine Coolens
John de Almeida
Jonathan Downar
James Drake
Gabor Fichtinger
Justin Grant
Mojgan Hodaie
Andrew Hope
Mohammad Islam
Daniel Létourneau
Andres Lozano
Claire McCann
Cynthia Ménard
Kieran Murphy
Narinder Paul
Thomas Purdie
Dheeraj Rajan
Alexandra Rink
Michael Sharpe†
Michael Sherar
Teodor Stanescu
Robert Weersink
Bernd Wintersperger
Kazuhiro Yasufuku

Informatics & Communications Technology

Core Leads
Igor Jurisica
Peter Rossos
Affiliated Faculty
Brenda Gallie
Alejandro Jadad
Michael Jewett
Gordon Tait
Christian Veillette

Nanotechnology & Radiochemistry

Core Leads
Ur Metser
Gang Zheng
Affiliated Faculty
John Valliant

Photonics

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

Toronto General Research Institute

Senior Scientists	58
Scientists	33
Affiliate Scientists	46
Assistant Scientist	1
Total Appointed Researchers	**138**
Clinical Researchers	235
Total Researchers	**373**

Fellows	138
Graduate Students	184
Total Trainees	**322**

Research Space	**237,840 sq. ft.**

Total Staff	**456**

External Funding	**$83,018,937**

Publications	**1,308**

Research Council

Director, TGRI; Research Division Head (Acting), Experimental Therapeutics Mansoor Husain
Research Division Head, Advanced Diagnostics Myron Cybulsky
Research Division Head, Support, Systems & Outcomes David Urbach
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, TGRI Appointments Committee Thomas Waddell
Group Lead, Cardiovascular Douglas Lee
Group Lead, Metabolism Michael Wheeler
Group Lead, Respiratory & Critical Care Mingyao Liu
Group Lead, Communities of Health Shabbir Alibhai
Executive Director, Research Operations Lisa Alcia
Vice President, UHN and Executive Lead, TGH Scott McIntaggart
*Executive Vice President, Science and Research** Christopher Paige
**role filled by Bradly Wouters as of Oct 1, 2016*

Researchers

Advanced Diagnostics

Senior Scientists
Johane Allard
Peter Backx
Daniel Cattran
Myron Cybulsky
I George Fantus
Eleanor Fish
Joseph Fisher
John Floras
Tony Lam
Gary Lewis
Mingyao Liu
Kumaraswamy Nanthakumar
York Pei
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
Jason Fish
Anthony Gramolini
Tianru Jin
Ana Konvalinka
Bruce Perkins
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

Experimental Therapeutics

Senior Scientists

T Douglas Bradley
Mark Cattral
Marc de Perrot
Niall Ferguson
Herbert Gaisano
Atul Humar
Mansoor Husain
Harry Janssen
Kevin Kain
Rupert Kaul
David Kelvin
Shaf Keshavjee
Lakshmi Kotra
Michael Laflamme
Gary Levy
Ren-Ke Li
Nancy Olivieri
Vivek Rao
Thomas Waddell
Sharon Walmsley
Richard Weisel

Scientists

Vijay Chauhan
Chung-Wai Chow
Marcelo Cypel
Jordan Feld
Michael Gollob
Margaret Herridge
Keyvan Karkouti
J Andrea McCart
Ian McGilvray
M Cristina Nostro
Nazia Selzner
Lena Serghides
Kazuhiro Yasufuku

Affiliate Scientists

Marisa Battistella
Mamatha Bhat
Gail Darling
Gregory Downey
Anand Ghanekar
David Grant
Raymond Hui
Shahid Husain
David Hwang
Stephen Juvet
Joel Katz
Thomas Lindsay
Tereza Martinu
Cheri McGowan
Milica Radisic
Raymond Reilly
Sheila Riazi
Heather Ross
Coleman Rotstein
Michael Sefton
Markus Selzner
Morris Sherman
Darrell Tan
Terrence Yau

Assistant Scientist

Sara Santana Nunes Vasconcelos

Support, Systems & Outcomes

Senior Scientists

Shabbir Alibhai
Anne Bassett
Claire Bombardier
Angela M Cheung
Peter Cram
Abdallah Daar
Gunther Eysenbach
Alastair Flint
Allan Kaplan
Moira Kapral
Murray Krahn
Douglas Lee
Charmaine Lok
Robert Nolan
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Toronto Rehabilitation Institute

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Scientists	22
Affiliate Scientists	65
Total Appointed Researchers	**110**
Clinical Researchers	6
Total Researchers	**116**

Fellows	30
Graduate Students	93
Total Trainees	**123**

Research Space **65,378 sq. ft.**

Total Staff **117**

External Funding **$17,551,095**

Publications **445**

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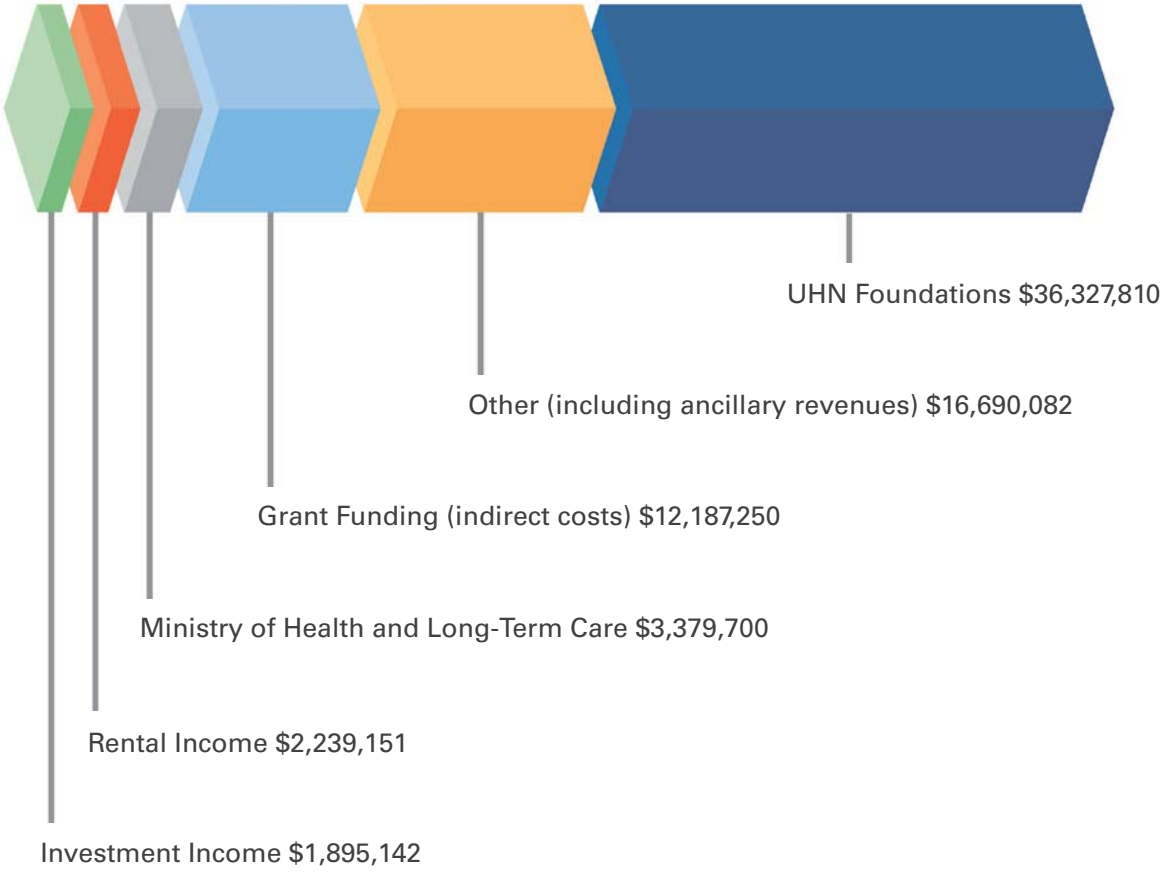
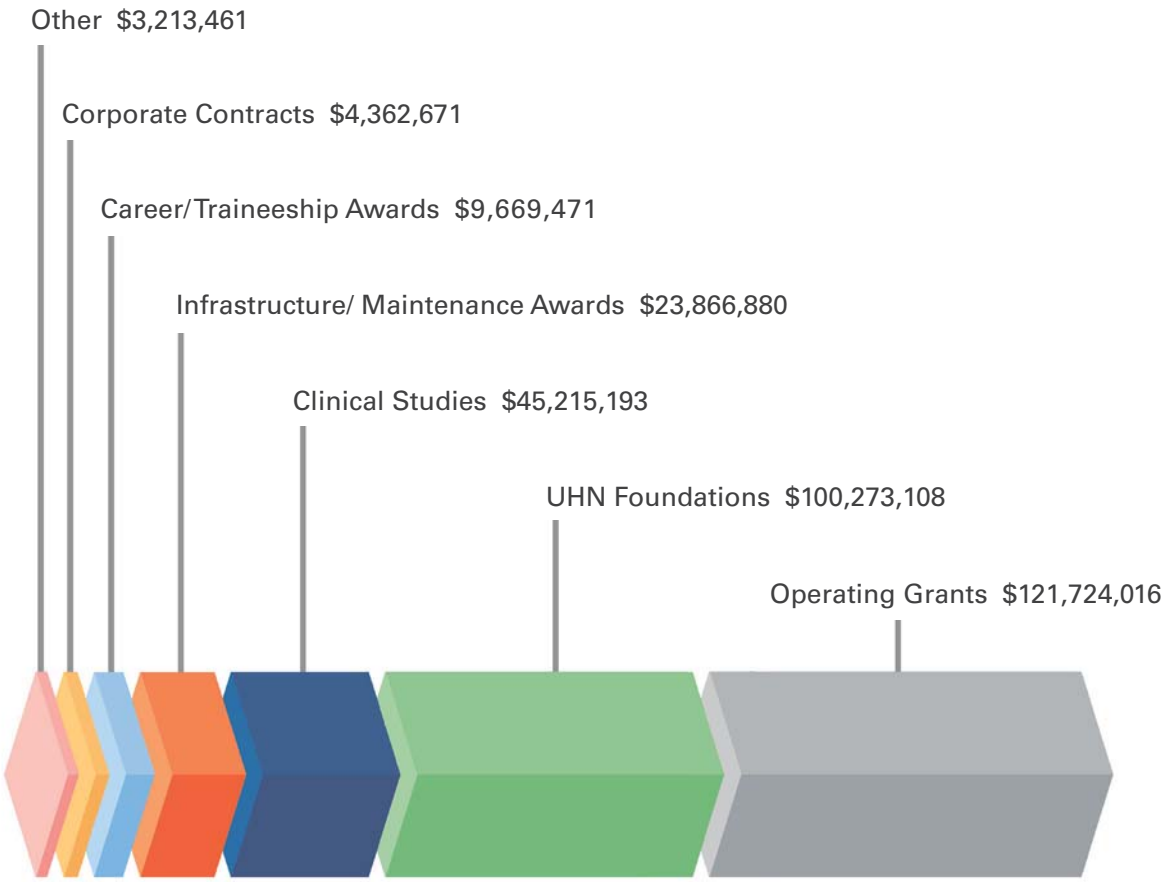
University of Rochester
University of Saskatchewan
University of Texas
University of Toronto
University of Washington
University of Waterloo
University of Zurich
Vancouver Coastal Health Research Institute
VistaGen Therapeutics
Western University
Wings for Life
Women's College Hospital
YM BioSciences
York University

Financials 2015/2016

Total Core Research Funding $72,719,135



Total External Project Funding $308,324,800



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Trainees: Institute trainee counts are accurate as of August 1, 2016 and were provided by UHN's Office of Research Trainees. They reflect only those trainees supervised by researchers with a primary appointment at the institute and who spent more than 50% of their time at UHN.

Space: Data provided by UHN Research Facilities Planning & Safety and based on space audited by September 30, 2016 across UHN sites. Core facilities and Research Solutions and Services spaces are not included in institute space totals.

Financial Data: All figures represent the fiscal year ending March 31, 2016, and include the Krembil, PM Cancer Centre, TGRI, TRI, Techna and Research Operations. Figures have been provided by UHN Research Financial Services. Total funding includes External and Core Funding amounts and is listed within the UHN Research Snapshot on the inside front cover.

Production Credits: This report is published by the Office of the Executive Vice President, Science and Research, UHN. Graphic design, writing and production by UHN's Strategic Research Initiatives Development Team.

About the cover: In business culture, silo mentality is an attitude that occurs when departments or groups within an organization work in isolation and do not share information with other individuals in the same organization. The cover image is a graphic representation of silos being broken down in a research hospital to enable sharing of knowledge between different disciplines, departments, fields and health professions—a key requirement for translating research discoveries into clinical practice. The cover photograph features the Canada Malting Silos located on the Toronto waterfront, which were built in 1928.

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