Stem Cell Network
Réseau de cellules souches

InFocus

2018

In Ontario

MAKING AN IMPACT

STEM CELL INNOVATION

As Canada's most populous province and host to globally respected research organizations, Ontario is a dynamic centre for stem cell exploration. It was in Ontario where James Till and Ernest McCulloch discovered transplantable stem cells in 1961. Since then, scientists in the province have made critical advances in cancer, multiple sclerosis and cardiovascular disease research. The Stem Cell Network (SCN) has provided more than $33M towards research in Ontario since its inception in 2001, with $3.6M allocated between 2016 and 2018 alone. SCN investigators in Ontario have also leveraged over $6.3M in partner contributions in that same period. This investment will see new therapies move more rapidly towards the clinic in the coming years.

Stem Cell Network Research in Ontario 2016–18

$3.6M 9 HIGH-POTENTIAL Research Projects Funded + $6.3M Partner Support

1	ADULT BLOOD – STEM CELL EXPANSION
1	BRAIN INJURY†
1	CORD BLOOD – STEM CELL EXPANSION†
1	HEART ATTACK REPAIR
1	KIDNEY DISEASE
1	LIVER TRANSPLANT REJECTION
2	OSTEOARTHRITIS
1	SEPTIC SHOCK

$33M invested (2001–2018)

†Research project active and funded in more than one province

**In 2016–2018, SCN funded 25 research projects and 6 clinical trials nationwide.*

DYK?

39% of principal investigators (PIs) and co-investigators for Ontario research projects are women.

Disrupting the Field: Nika Shakiba

Dr. Nika Shakiba is a promising young investigator who supports the search for treatments for countless conditions thanks to her special expertise: how to make stem cells suitable for many types of research and therapies, broadening their availability to other scientists. Through synthetic biology, she aims to control the fate of stem cells, which may help researchers develop better cell manufacturing processes, and better control stem cells in tissues and organs. Once an SCN trainee, Dr. Shakiba is based at MIT in Boston but hopes to return to run her own lab back in Ontario, having forged a strong biomedical engineering network through the University of Toronto.

"By learning how to isolate and control stem cells through research, we are unlocking potential therapies that can change the way we fight diseases. Stem cell research allows us to learn how to stimulate our own body's stem cells to fight degenerative diseases, and treat previously incurable diseases like blindness, diabetes, spinal cord injuries, and beyond."

Dr. Nika Shakiba,
MIT, Boston

Disrupting the Field: Mohit Kapoor

Osteoarthritis (OA) affects 1 in 10 people in Canada today and will affect 1 in 4 by 2040. Because no cure exists, OA's debilitating symptoms are treated with drugs or surgery, impacting the economy to the tune of $33B annually. Dr. Mohit Kapoor, Director of Arthritis Research at the Krembil Research Institute in Toronto, is investigating the role that small ribonucleic acid molecules (microRNA) play in OA. His team pinpointed two microRNAs that contribute to the decay of spinal cartilage and worsen inflammation. This discovery could lead to improved diagnosis and treatments.

"We are currently developing diagnostic tests that can enable us to detect OA in early stages. We are also testing microRNA blockers as a potential therapy to stop joint destruction during OA."

Dr. Mohit Kapoor,
Krembil Research Institute, Toronto

Dr. Kapoor credits SCN funding for recent advances made in OA research and is fully committed to halting cartilage destruction with stem cell therapies. He works with some of Canada's best and brightest stem cell researchers, including Drs. Andras Nagy and Armand Keating. Together, they form a dynamic and talented team with the ability to make tremendous advances using stem cell technologies — advances that will benefit thousands of people in Canada and millions around the world.

Brain Repair & Stem Cells

Dr. Freda Miller,
SickKids Research Institute

On a daily basis thousands of messages are successfully sent from our brain through the central nervous system to move a finger, an arm or to communicate with others, which is often taken for granted. Myelin sheath is an insulating layer of the brain that forms white matter to ensure the messages are sent throughout the body without error. However, when brain injuries or diseases such as multiple sclerosis occur, messages can get damaged, which can leave a person unable to walk or speak.

SCN is proud to support the work of researchers seeking effective treatments for brain repair, such as Dr. Freda Miller at SickKids Research Institute in Toronto. Dr. Miller seeks to understand why a common diabetes drug, metformin, stimulates the production of new brain cells in children treated for brain tumours. The discovery is currently being tested in a phase III clinical trial. If successful, metformin might also treat other diseases, such as Parkinson's or multiple sclerosis.

Multiple Sclerosis & Stem Cells

Multiple sclerosis (MS) is an autoimmune disease that attacks the central nervous system. There is currently no cure, but members of Ontario's research community have discovered ways to halt the disease's progression and in some cases even reverse its debilitating effects. Drs. Harold Atkins and Mark Freedman at The Ottawa Hospital have used chemotherapy and stem cell transplantation to successfully treat patients with severe, aggressive and early onset MS — those who were bedridden are now energetic and able-bodied once more, such as Jennifer Molson, profiled below.

Patient Profile: Jennifer Molson

At the age of 21, Jennifer Molson was diagnosed with aggressive multiple sclerosis. Within a few short years, she was confined to a wheelchair, facing a future in which she would need constant care. In 2002, while living full-time at the Ottawa Hospital Rehabilitation Centre, Drs. Atkins and Freedman enrolled Jennifer in a clinical trial that took stem cells from her bone marrow, purified and fortified them, and — after extreme chemotherapy to knock out her immune system — returned the stem cells to rebuild a new, disease-free immune system. The doctors were hoping to stop the disease's progress so that Molson would not get any worse. To their surprise, Molson began to show improvements. By 2005 she was able to walk with a cane and return to part time work. Now, with all traces of the disease eradicated, Jennifer is working full time, can participate in outdoor sports such as skiing and paddleboarding, and has become an advocate for stem cell research.

Jennifer Molson,
Patient Advocate

"The best thing I was hoping for was stability and instead I was getting better. It is because of the courage and dedication of Drs. Atkins & Freedman that I am able to live a healthy and normal life."

DYK?

Canada has the highest number of MS cases worldwide, affecting about 1 in 340 people.

Putting Stem Cell Discoveries to the Test

Dr. Lauralyn McIntyre,
The Ottawa Hospital

Stem Cells for Septic Shock

Each year in Canada, 100,000 patients experience septic shock, a condition that is fatal in 30–40% of cases. This severe infection accounts for half of all critical care costs ($4B per year) and survivors face long-term recovery with the possibility of permanent disability. At The Ottawa Hospital, Dr. Lauralyn McIntyre is testing a potential therapy that uses mesenchymal stem cells (MSCs) to tell the immune system to calm down and let repairs begin. Her team is the first in the world to complete a phase I trial of the treatment and is currently preparing for a larger phase II trial in several Canadian cities.

Before MSCs can be approved for treating septic shock, both phase II and phase III trials need to be completed; the latter will be conducted with industry partners and involve large numbers of patients around the world. If successful, the therapy would save thousands of lives and result in significant health care savings. SCN is proud to fund Dr. McIntyre's research and has provided $1M towards this promising new discovery.

DYK?

Mesenchymal stem cells (MSCs) are a type of stem cell most commonly found in the bone marrow and umbilical cord. Also called "stromal cells", MSCs are known to make bone, fat and muscle cells and are currently being tested for their ability to calm the body's immune response and repair other damaged tissues.

Dr. Bernard Thébaud,
The Ottawa Hospital

Stem Cells for Healthier Lungs

About one third of premature babies have underdeveloped lungs and need mechanical ventilation to survive. One side effect of ventilation is the development of a chronic lung disease known as bronchopulmonary dysplasia (BPD). BPD can affect blood flow to infants' brains, which in turn can lead to physical or cognitive disabilities. Funded by SCN since 2007, Dr. Bernard Thébaud at The Ottawa Hospital has made a dramatic discovery that could potentially treat BPD. His team found that mesenchymal stem cells (MSCs) extracted from discarded umbilical tissue can repair wounded lungs in adults and restore normal function. So, they asked the question: Could they do the same for premature infants diagnosed with BPD?

So far, Dr. Thébaud's research suggests the answer is yes. In preclinical testing, the MSC therapy appears to repair infant lungs and improve oxygen flow, an outcome that Dr. Thébaud's larger goal: of giving premature babies better overall health outcomes. Getting approval for clinical trials involving fragile infants has unique challenges, but the lives and health care costs that could be saved with a breakthrough therapy inspire Dr. Thébaud to forge ahead. His team is planning to launch a phase I clinical trial in 2018 and get MSC therapies for BPD to the clinic in five years.

DYK?

Approximately 31,000 preterm babies (less than 37 weeks of gestation) are born each year in Canada. Preterm birth accounts for two-thirds of all infant deaths and is associated with higher risk of long term health complications.

Cancer & Stem Cells

It is estimated that 1 in 2 Canadians will develop cancer during their lifetime. There are over 100 different types of cancers; diseases that all begin in our cells. Cancerous tissue is composed of stem cells that can grow and divide out of control, forming cancerous growths. The challenge with current treatments is that not all are successful in targeting the cancer-causing cells, which often results in relapse. SCN-funded Drs. Mick Bhatia and Kristin Hope at McMaster University's Stem Cell and Cancer Research Institute are taking on the fight against blood cancers such as leukemia by understanding how blood forming cells operate.

Dr. Mick Bhatia,
McMaster University

Understanding cancer's origins

Dr. Bhatia and his team have researched these diseases for a number of years; from looking at non-cancerous cells to cancer drug screening to reduce relapsing. However, at the core of his research the ultimate goal is to understand how cancer cells initially form, and how it can be stopped. This work, some of which has been funded by SCN since 2003, includes looking closely at stem cells at a molecular level to determine the process leading to a cell's decision to form a new type of cell and how this might go awry in the earliest stage of cancer development. His team is using this knowledge to improved cell reprogramming and drug discovery that they hope will lead to new and better treatments.

Dr. Kristin Hope,
McMaster University

Expanding cells for cancer therapy

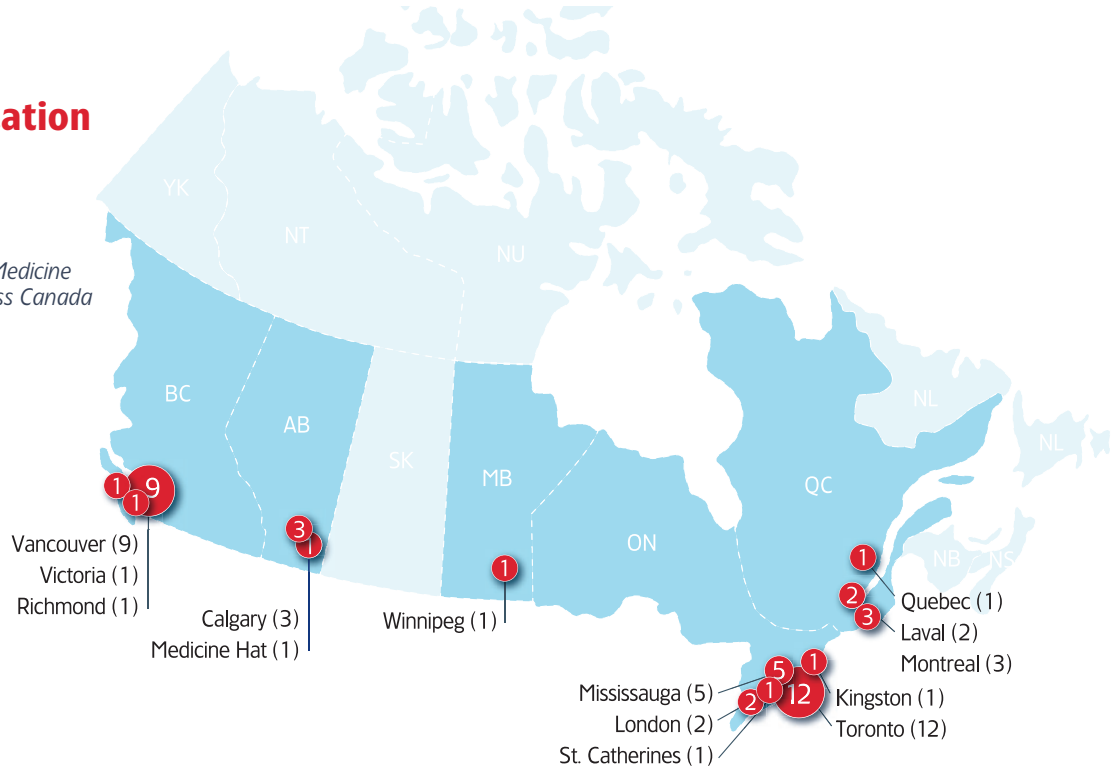
Dr. Hope's lab is focused on mapping the genes and pathways of the blood system to fully understand how hematopoietic stem cells (HSCs) — the stem cells in our blood — self-renew in healthy bodies on a molecular level. Dr. Hope and her team wish to redirect the way HSCs design themselves, which could lead to therapies that can replenish leukemia patients' blood with healthy cells. In 2016–2017, SCN awarded Dr. Hope's lab $100,000 to help her team's pursuit, in a project that sought to identify ways to obtain more usable stem cells from umbilical cord blood. This source of valuable HSCs is currently limited by the small number of cells in a single unit, but Dr. Hope and her team successfully identified potential drugs that increase the number of HSCs by suppressing the molecular mechanism that normally prevents these cells from expanding. These findings are now being tested for possible use in a clinical setting.

DYK?

Stem cell transplants are commonly used to treat blood cancers such as leukemia.

Commercialization

44 Active Regenerative Medicine Biotech Companies across Canada



Canada is home to a thriving regenerative medicine (RM) commercial sector — there are approximately 44 active RM biotech companies nationally, providing 2,000+ high-quality jobs. Many of these companies grew out of leading-edge scientific work conducted by Canada's academic researchers, and many are valuable SCN partners. BlueRock Therapeutics, for example, is a new, large-scale venture with a global reach based in Toronto that focuses on cardiovascular and neurological conditions. Trillium Therapeutics in Mississauga, a *Globe and Mail* "Top 100" company in 2016, is innovating promising cancer therapies to thwart the molecule that encourages tumour growth. Both companies have benefitted from discoveries made by some of Ontario's top stem cell researchers, including Drs. Aaron Schimmer, Michael LaFlamme and Gordon Keller.

We are just beginning to develop a robust biotech sector with a strong focus on regenerative medicine. This science-driven sector will only advance thanks to the outstanding stem cell research taking place across Canada and in Ontario.

There is enormous potential for stem cell therapies to treat chronic diseases and debilitating illnesses such as:

Parkinson's disease	*Kidney disease*	*Leukemia and other cancers*	*Diabetes*
Crohn's disease	*Septic shock*	*Respiratory diseases*	*Heart disease*
Muscular dystrophy	*Multiple sclerosis*	*Brain injury*	*ALS*
Retinal degeneration			

The Stem Cell Network is Canada's stem cell research organization. It is committed to working with researchers from coast to coast to get new therapies and medicines to market and to those who need them most.