Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Stem Cell Research 47 (2020) 101890

Contents lists available at ScienceDirect

Stem Cell Research

journal homepage: www.elsevier.com/locate/scr

Stem Cell Network

Jon Draper[a], Cate Murray[b,*]

[a] Program Director, Research for the Stem Cell Network, McMaster University, McMaster Stem Cell & Cancer Research Institute, Hamilton, Ontario, Canada
[b] Executive Director, Stem Cell Network at the Ottawa Hospital Research Institute, Ottawa, Ontario, Canada

1. Introduction

In just under two decades the Stem Cell Network (SCN) has transformed stem cell research in Canada and established an outstanding international reputation. As Canada's only national network and leader for stem cell research and regenerative medicine, SCN has led the way in building a vibrant sector that is yielding scientific advancements, fuelling clinical trials and enabling company creation. SCN's mandate has remained the same since its inception: *to act as a catalyst for enabling the translation of stem cell research into clinical applications, commercial products and public policy*. Today, SCN is driven by a new vision to *capitalize upon Canada's competitive advantage in stem cell research for the benefit of Canadians*. Those within the network are guided by a core set of values that permeate day to day activities and overall direction.

Stem Cell Network Values

- Require research excellence, integrity and a commitment to ethical practice;
- Fostering collaboration;
- Fostering equity, diversity and inclusion;
- Driving innovation; and
- Supporting continual learning and development.

SCN is a not-for-profit organization funded by the Government of Canada. SCN has invested $118 M into stem cell research taking place across Canada. These funds have benefitted 178 world-class research teams. A significant number of women make up the ranks of SCN's investigator community, with 49 percent of projects funded by SCN in the period 2016 to April 2020 led or co-led by women. SCN's community is comprised of Canada's best and brightest stem cell and researchers (e.g. biologists, chemists, bio-engineers, clinicians, policy and legal experts) and their trainees. The network also benefits from partnerships with industry, research institutes, universities and the charitable sector. These partners are key to building on SCN research investments and to date they have invested more than $116 M of in-kind and cash support directly into SCN projects.

> *"SCN has led the way in building multidisciplinary networks, generating industry partnerships, training the next generation of scientific talent and enabling knowledge mobilization. As a result, Canada's stem cell research community is second to none."*
> Dr. Freda Miller, The Hospital for Sick Children, Toronto

When SCN was first launched in 2001, the stem cell research community was scattered and siloed across the country. The network started with a small group of approximately 35 investigators. Canada's stem cell science enterprise was in its infancy and knowledge just starting to build. SCN's leaders knew that to be successful, partnerships and strong networks would be critical. Over the years, SCN has worked tirelessly to build a robust national network through programs that stressed collaboration and a multidisciplinary approach for moving stem cell science forward. Such collaborations led to numerous discoveries by Canadian investigators (see Appendix 1). As the field matured, SCN helped to spinout enabling organizations such as CCRM to support investigators who were generating intellectual property and needed assistance with commercialization strategies and cell manufacturing. In 2013–14, SCN was part of the formation of CellCAN, a knowledge mobilization centre designed to support the development of cell therapies and enable best practices among Canada's cell manufacturing facilities. Today, organizations such as the Ontario Institute of Regenerative Medicine and BioCanRx are based on the Stem Cell Network model. SCN is proud to work with each of these organizations to enable high-quality research, training, outreach and innovation.

Over 20 companies have been spun out with help from SCN. Some are still going strong while others are ramping up, like Montreal based Morphocell Technologies.

"SCN saw the potential & provided critical support to advance our liver disease technology. As a result, I can see foresee a future where our work can have a positive impact on the lives of patients."
Dr. Massimiliano Paganelli, Co-founder, Morphocell Technologies

* Corresponding author.
E-mail addresses: jdraper@stemcellnetwork.ca (J. Draper), catemurray@stemcellnetwork.ca (C. Murray).

https://doi.org/10.1016/j.scr.2020.101890
Received 15 May 2020; Accepted 19 June 2020
Available online 02 July 2020

2. Supporting research

SCN is proud to be an on-the-ground network able to adjust as the science develops. In its current phase of activity SCN is focused on supporting translational research and clinical trials. SCN research is peer reviewed by international experts and the network's Research Management Committee. Funding decisions are confirmed by SCN's 12-member independent Board of Directors. For the 2019–2022 period SCN is providing research support ($12 M+) through a strategic set of research programs described below:

- **Advancing Clinicals Trials**: Focusing on novel cellular or stem cell related therapeutic approaches to tissue repair and regeneration for specific diseases.
- **Accelerating Clinical Translation**: Supports multidisciplinary research projects that are moving toward the clinic within five years.
- **Fuelling Biotechnology Partnerships**: Supports academic partnerships with emerging Canadian regenerative medicine biotechnology companies working to drive an innovative stem cell-based technology or therapy into the clinic/market.
- **Translation & Society Team Awards:** Supports ELSI-led (ethical, legal and social implications) research address issues that impede the translation of innovative stem cell research
- **Innovation Research Program for Early Career Investigators:** Supports early-career investigators (within the first five years of an initial academic appointment) to develop a stem cell research program with a regenerative medicine focus.

In early 2020, Canada, like all countries around the world, faced the impacts of the SARS-CoV2 virus. In response, the Stem Cell Network quickly launched a rapid response research initiative to support projects that would seek to address COVID-19 using a stem cell-based approach. SCN funds were allocated for one clinical trial and two innovative research projects. The clinical trial is evaluating the safety of a cell therapy to reduce the impacts and severity of acute respiratory distress syndrome (ARDS) associated with COVID-19, and the two research projects are generating knowledge about how cells in the airway and brain are affected by the virus.

Since its inception SCN has invested in over 200 research projects, including 24 early stage clinical trials. This support has helped numerous Canadian researchers, who rank among the highest impact in the world. In 2010, 14 principal investigators of the Stem Cell Network were among the one hundred most highly cited researchers in the field, globally.[1] Following up on this, an in-depth bibliometric analysis of stem cell research strength was conducted by the Council of Canadian Academies (CCA) and published in March 2017. The CCA analysis found that researchers in Canada published 8187 stem cell related research articles between 2000 and 2014. The impact of Canadian articles as measured by citations was high.[2] The CCA report also noted that the number of publications per year by researchers in Canada increased steadily between 2000 and 2012, at which time the number remained steady. Recent examples of publications that can be credited back to SCN research support include work from the labs of Drs. Glen Tibbits, Freda Miller, Guy Sauvageau & Sandra Cohen, and Tim Kieffer. These SCN investigators have all made important contributions in areas such as: the use of expanded cord blood for treating blood cancers; reversal of type 1 diabetes; understanding the cause of sudden cardiac death in infants; and the mechanisms underlying brain repair. (See Appendix 2 for references.)

3. Training & research networking

The Stem Cell Network has hosted an annual scientific meeting for many years. Over time, these meetings have expanded and now bring together up to 500 experts from across Canada and around the world. They have also been re-named the Till and McCulloch Meetings (TMM), after Drs. James Till and Ernest McCulloch, the two Canadians who demonstrated the existence of stem cells in the early 1960s. These meetings are an annual highlight for Canada's stem cell research community and provide a key training opportunity for the next generation of stem cell researchers. The meetings include interactive workshops for trainees (Masters students, PhD students and Postdoctoral Fellows) on subjects such as scientific communication, commercialization and grant writing. The meetings also give trainees an opportunity to present their work through oral presentations and poster sessions. Trainees have reported how valuable the experience has been for networking, developing professional collaborations and identifying career opportunities.

> Thanks to the Stem Cell Network's annual meeting (TMM) I was able to connect with representatives from STEMCELL Technologies about an employment opportunity. They were excited about my work and it led to me joining the company. I credit SCN with providing trainees with important opportunities that help to build careers.
>
> Matthew Hildebrandt, Associate Product Manager, STEMCELL Technologies

> The workshops and networking activities that are organized every year during the Till & McCulloch Meetings provide a wonderful opportunity to strengthen the soft skills that are integral to any successful career in academia, industry or communications, but that are sometimes lacking from graduate training programs.
>
> Erika Kleiderman,
>
> Academic Associate, Centre of Genomics & Policy, McGill University

The meetings are not only a highlight for trainees but also for established investigators who have the opportunity to share their research and develop new collaborations. Each year, one outstanding investigator is nominated by their peers and selected by the TMM program committee for presentation with the Till & McCulloch award for most influential peer-reviewed paper published within the last year. Award winners have included individuals such as:

- **Freda Miller**, The Hospital for Sick Children, for her work on tissue repair and regeneration
- **Fabio Rossi**, University of British Columbia, for his work in muscle regeneration
- **Guy Sauvageau**, University of Montreal, for his work on hematopoietic stem cells for the treatment of blood diseases
- **Timothy Caulfield**, University of Alberta, for his work on the marketing of unproven stem cell therapies
- **Connie Eaves**, University of British Columbia & the Terry Fox Laboratory at BC Cancer, for her work in cancer research

[1] Bubela. T, et al. (2010). Commercialization and collaboration: competing policies in publicly funded stem cell research?. *Cell Stem Cell*, 7, 25–30.

[2] Council of Canadian Academies (2017) *Building Canada's Strength in Regenerative Medicine*. Pg. 40.

2019 TMM Meetings Feedback

- 94% of attendees indicated that TMM's scientific program met or exceeded expectations
- 95% of attendees would recommend TMM to colleagues
- 100% of trainees would recommend SCN training to their peers

*Stats are based on responses to a post event survey.

As SCN works to respond to the needs of its community, small meetings and training workshops are designed and offered on annual basis according to need. Each year, SCN strives to provide up to a dozen training workshops that cover everything from lab-based technical skills, to understanding commercialization and how to take a discovery to the clinic. These events are highly popular, and SCN is able to provide 300–400 training support opportunities annually.

Of particular interest was a new training activity offered in January 2020 entitled, *Navigating the Regulatory Steps in Biotherapeutic Translation*. This unique offering brought 11 lab teams (a senior investigator and two trainees) together for 2.5 days to learn from experts about the necessary steps for translating research discoveries into a clinical trial. Participants learned about Canada's regulatory landscape, challenges of reproducibility, and requirements for cell and virus manufacturing. Overall, participants found this workshop to be extremely valuable for moving their specific research projects forward and also for creating 'lab memory.' More information about the impact of SCN training and the career trajectories of trainees can be found in a 2019/20 study conducted by SCN, available at stemcellnetwork.ca/about-us/reports/.

SCN also provides support to bring groups of researchers together to discuss issues of particular interest or importance. For example, SCN has provided support for relevant investigators to meet and discuss how best to use stem cells in the fight against type 1 diabetes. In 2017, SCN convened a series of policy workshops focused on genetic reproductive technologies relevant to Canada's Assisted Human Reproduction Act (AHRA). In 2021 SCN will convene Canada's policy community to consider the notion of 'serious' disease, a concept that carries with it significant ethical, legal and financial implications.

4. Stem cells outside the lab

Everywhere we look today – in online, traditional and social media, and among patient groups, families and health care providers – stem cells are a hot topic of discussion. They have become synonymous with the promise of better health. *SCN believes in this promise!* However, we know that it will take time, effort and greater knowledge before innovative new treatments will be widely available.

In the meantime, unscrupulous providers offering unproven stem cell treatments are taking advantage of vulnerable people. SCN receives inquiries on a weekly basis from members of the public who are looking for a stem cell treatment that will cure their loved one. As such, over the years SCN and its partners have produced plain language videos about stem cell research, launched an interactive traveling museum exhibit (experienced by over a million people), and developed online content providing lay-friendly information about stem cells.

In recent years, SCN has held events for stem cell researchers to present to legislators and science policy experts about the state of stem cell science and the risks associated with unproven treatments. It is clear that the Stem Cell Network voice can't do it alone, so the network collaborates with ISSCR and researchers from around the world in sharing information and calling for ethical practices. Thanks in part to the work of members of Canada's Stem Cell Network, in 2019 Health Canada started to take decisive action against those individuals and businesses who offer unregulated therapies and treatments.

SCN is also committed to encouraging young Canadians to take up a career in health research. SCN has been a partner of Let's Talk Science for the past decade in offering StemCellTalks, an interactive program for high school students that takes place in major centres across Canada. It connects SCN researchers and senior high school students in day-long symposia to discuss the ethics, advancements and opportunities and challenges in the field of stem cells.

5. Looking to the future

Canada's growing knowledge economy is dependent on a robust science and technology enterprise, one where highly-skilled workers are able to generate the knowledge, discoveries, technologies and other types of innovation that will spur productivity. SCN has the track record, expertise and ability to continue to deliver on the promise and power of stem cells. The network will continue to provide leadership and work with like-minded organizations, industry partners and governments to develop a path forward that will see regenerative medicine flourish. In the years to come a focus on training talent, accelerating clinical trials, collaborating globally, building manufacturing capacity, and working with receptors and patients on the delivery of effective and affordable therapies will be at the heart of all that we do. This will be achieved through a culture that embraces equity, diversity and inclusion, and above all supports research excellence.

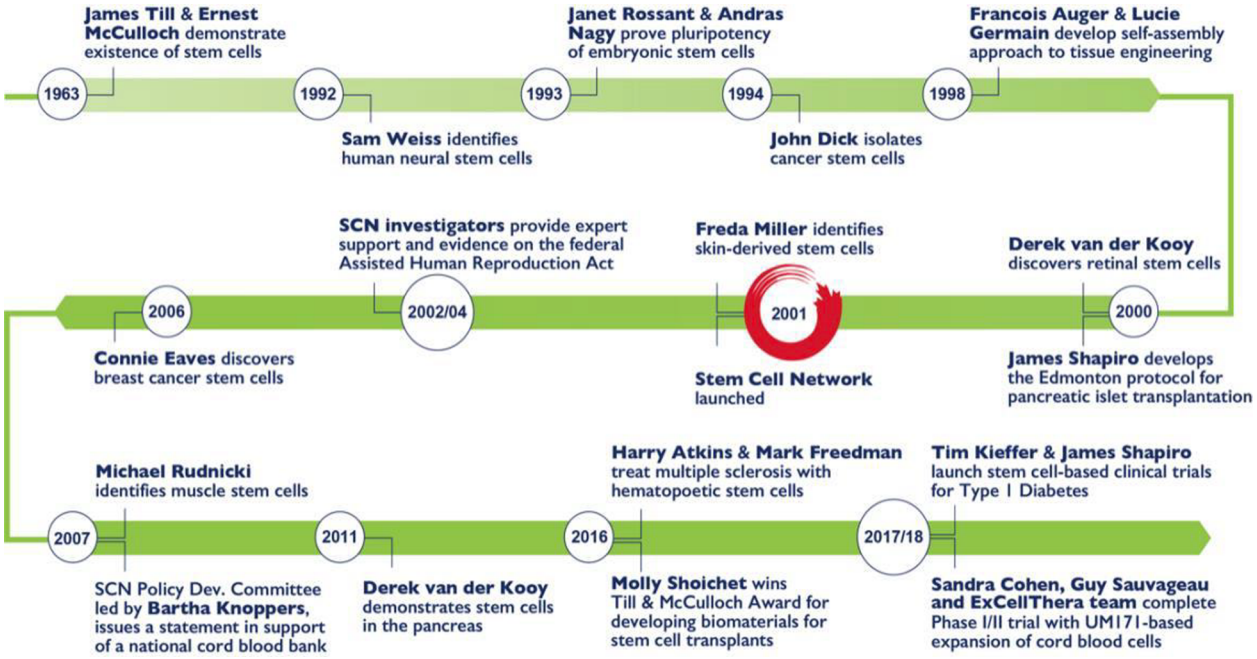
Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

Cate Murray & Jon Draper are supported via their employment at the Stem Cell Network, a not-for-profit funded by a direct contribution from the Government of Canada.

Appendix 1. Canadian stem cell research contributions



Appendix 2. Reference list of recent high impact papers supported by SCN

Shafaattalab S, Li AY, Lin E, Stevens CM, Dewar LJ, Lynn FC, Sanatani S, Laksman Z, Morin RD, van Petegem F, Hove-Madsen L, Tieleman DP, Davis JP, Tibbits GF. In vitro analyses of suspected arrhythmogenic thin filament variants as a cause of sudden cardiac death in infants. Proc Natl Acad Sci U S A. 2019 Apr 2;116(14):6969–6974. doi: https://doi.org//10.1073/pnas.1819023116. Epub 2019 Mar 18. PMID: 30886088; PMCID: PMC6452669.

Yuzwa SA, Yang G, Borrett MJ, Clarke G, Cancino GI, Zahr SK, Zandstra PW, Kaplan DR, Miller FD. Proneurogenic Ligands Defined by Modeling Developing Cortex Growth Factor Communication Networks. Neuron. 2016 Sep 7;91(5):988–1004. doi: https://doi.org//10.1016/j.neuron.2016.07.037. Epub 2016 Aug 18. PMID: 27545711.

Cohen S, Roy J, Lachance S, Delisle JS, Marinier A, Busque L, Roy DC, Barabé F, Ahmad I, Bambace N, Bernard L, Kiss T, Bouchard P, Caudrelier P, Landais S, Larochelle F, Chagraoui J, Lehnertz B, Corneau S, Tomellini E, van Kampen JJA, Cornelissen JJ, Dumont-Lagacé M, Tanguay M, Li Q, Lemieux S, Zandstra PW, Sauvageau G. Hematopoietic stem cell transplantation using single UM171-expanded cord blood: a single-arm, phase 1–2 safety and feasibility study. Lancet Haematol. 2020 Feb;7(2):e134-e145. doi: https://doi.org//10.1016/S2352-3026(19)30202-9. Epub 2019 Nov 6. PMID: 31704264.

Rezania A, Bruin JE, Arora P, Rubin A, Batushansky I, Asadi A, O'Dwyer S, Quiskamp N, Mojibian M, Albrecht T, Yang YH, Johnson JD, Kieffer TJ. Reversal of diabetes with insulin-producing cells derived in vitro from human pluripotent stem cells. Nat Biotechnol. 2014 Nov;32(11):1121–33. doi: https://doi.org//10.1038/nbt.3033. Epub 2014 Sep 11. PMID: 25211370.