



François-Philippe Champagne, Minister of Innovation, Science and Industry visits the CL3 and CL2+ / Virology labs at the University of Toronto, St. George campus, with U of T President Meric Gertler. (Photo by Johnny Guatto)

Empowering the Development of the Life Sciences Industry in Canada

The COVID-19 pandemic has brought into focus the importance of strong domestic industrial capabilities needed to respond to public health crises. This includes the capacity to enable talent development, support life science scale-ups, and accelerate the translation of academic research into advanced commercial products.

The University of Toronto (U of T) is continuously advancing the frontiers of knowledge by encouraging and supporting innovative companies, and accelerating the delivery of new products, technologies and services for the benefit of Canadians. Key to this effort is the University's strength as a critical partner in accelerating Canada's industrial development in the health and life sciences sector by:

- leveraging its unparalleled network of world-class medical and research centers,
- supporting the application of research into commercial products that can be moved into domestic and global markets.
- connecting Canadian firms of all sizes, and multinational firms with world-renowned faculty, clinicians and scientists and enabling the development of new ideas and innovations,
- developing a pipeline of skilled researchers and talent able to support industrial activities across the research to commercialization continuum; and

- providing state-of-the-art infrastructure required to understand existing, new and emerging health areas of concern. Such infrastructure is also used to conduct clinical trials for the testing, validation and development of vaccines, drugs, treatments, medical technologies and equipment.

Collectively, these assets serve as enablers of Canada’s domestic life sciences industry.

Sector Profile: Life Sciences

Below are select research and industrial accelerators underway at U of T that enhance Canada’s position as a centre of life sciences innovation and support Canada’s industrial development. These accelerators represent part of U of T’s globally recognized research and innovation ecosystem which collectively has led to the creation of over 500 start-ups and has allowed U of T’s researchers to file over 1000 patent applications in the past 10 years. In 2021, these accomplishments, among others, enabled U of T to be recognized as the most innovative university in Canada by Maclean’s magazine.

The efforts by U of T’s faculty and researchers play a distinctive role in creating and translating knowledge that address the challenges of our time. The select accelerators identified below illustrate the strong link between leading research at the University and the creation of new commercial opportunities for Canadian businesses, start-ups and workers.

[Medicine by Design](#) is a strategic research initiative that is supported by a \$114M grant from the Canada First Research Excellence Fund (CFREF) that is working at the convergence of engineering, medicine and science to advance growth in Canada’s regenerative medicine ecosystem. It’s an entrepreneurial approach that brings together Toronto’s leading researchers, technology developers and clinicians, leveraging the capacity of the University, its world-class affiliated teaching hospitals, and the city’s thriving biotech sector, all located within a few city blocks.

The initiative has become a highly effective “design studio” bringing together specialists from diverse disciplines to convene and collaborate and providing early-stage funding for research and commercialization of novel therapies with a promise to transform human health.

Notable Spin-offs and Industry Partnerships

- Medicine by Design investigators, Laflamme and Keller co-founded **BlueRock Therapeutics**, which is developing a method to regenerate damaged heart muscles using foundational research (funded by Medicine by Design), as well as cell therapies for neurological and immune-related diseases. The City of Toronto will serve as a clinical trial site for BlueRock Therapeutics cell therapy for Alzheimer disease starting in late 2022. Overall, BlueRock Therapeutics has attracted significant venture capital investment, has been valued at \$1 billion, and in 2019 was sold to Bayer AG.
- Medicine by Design investigators Zuniga-Pflucker and Zandstra co-founded **Notch Therapeutics** in 2021 which closed an \$85M (U.S.) Series A financing. Since 2016, Medicine by Design has invested almost \$2.5 million in the immune-engineering team research program led by Zuniga-Pflucker.
- Medicine by Design’s **commercialization partnership with CCRM**, has enabled \$40M in initial investment in Toronto’s biotechnology ecosystem by Cytiva (a Danaher company) and FedDev. In 2021, CCRM renewed its partnership with Cytiva, for continued operation of the Centre for Advanced Therapeutic Cell Technologies (CATCT), which supports the development of cell manufacturing technologies. The Centre for Cell and Vector Production (CCCVP), which is housed at the University Health Network (UHN) and operated by CCRM also scaled its operations for supporting GMP manufacturing for phase 1 and 2 clinical trials.
- In 2021, MbD launched the \$4M **Pivotal Experiment Fund (PEF)**, which aims to bridge a critical gap between research discovery and translatable therapies. The goal of the fund is to build a robust pre-clinical pipeline of regenerative medicine-based therapies, enabling technologies and ventures that can transform the future

of human health. PEF Investments are guided by a review committee consisting of leading players in Ontario's venture capital and biotech communities.

By the numbers

- **\$13.5M received by MbD investigators in leveraged investments** from over 25 industry partnerships (2020 – 2021)
- **55** regenerative medicine and related industry area start-up companies created in Toronto (2015-2021)
- **\$1.58B USD** investments attracted into recent life science companies spun out of the Medicine by Design research community (2015-2021)
- **446 invention disclosures** made by Mbd funded researchers (2015-2021)
- **520 patent applications filed** for MbD funded researchers (2015-2021)

[The Emerging and Pandemic Infections Consortium \(EPIC\)](#) creates an ecosystem of collaboration that empowers clinicians, scientists, engineers and public health experts at U of T and its affiliated hospitals to combat infectious diseases and build a rapid pandemic response capacity that can address emerging pathogens before they become established as a global pandemic. EPIC is anchored by U of T's Toronto High Containment Facility (THCF), which includes Toronto's CL3 facility, as well as the CL2+ aerosol containment facility and Biobank. EPIC's virtual research and training ecosystem is the leading initiative on infectious disease research and training from discovery to policy, a magnet for world-leading talent, and an authority on infectious disease-focused education and science-based advocacy.

Notable Industry Partnerships & Collaborations

- **Providence Therapeutics** in partnership with CL3 researchers adapted a messenger RNA vaccine against HIV to prevent SARS-CoV-2 infections. This vaccine is currently in phase 2 trials and Providence has recently entered into Canadian and international marketing and distribution agreements.
- **Treadwell Therapeutics'** used the CL3 facility to validate the utility of a novel transgenic mouse model to be used in pre-clinical testing of three Canadian-developed SARS-CoV2 vaccine candidates. The project relied heavily on the resources and expertise at the U of T CL3 Facility, including training and support of Treadwell scientists, SARS-CoV-2 strain acquisition and management, animal infection and monitoring protocols, tissue processing, and development of methods to test viral neutralization by immune serum.
- **I3 BioMedical Inc** utilized the CL3 lab to validate the company's innovative antimicrobial coating which deactivates more than 99% of SARS-CoV-2 on the outer surface of medical masks. This study provided critical validation for this Canadian technology that enables mask and ventilator re-use.
- **Edesa Biotech** engaged with CL3 lab researchers to study the efficacy of a drug with the potential to limit the inflammatory immune response that leads to acute respiratory distress syndrome – the main cause of death in people with COVID-19. Enrollment in the Phase 2/3 drug trial is ongoing in Canada.
- **EYAM Vaccines & Immunotherapeutics** has ongoing pre-clinical testing taking place in the CL3 facility for second-generation mRNA vaccine constructs, producing Canadian innovation within the new field of RNA biologics.
- **Moderna Inc.** established partnering opportunities for EPIC members to participate in a new "mRNA Access" program being launched at U of T. This program will initially connect researchers focused on emerging infectious disease targets with the validated Moderna pipeline, allowing for provision of clinical grade materials to use in research projects.

[The Precision Medicine Initiative \(PRiME\)](#) brings together researchers to collaborate and build knowledge towards a shared

goal of advancing innovation, training, and fundamental science in the area of precision medicine therapeutics and diagnostics. Interdisciplinary teams and innovative approaches to research are integral to furthering the science of precision

medicine and for the development of enabling technologies required for novel therapeutics discovery and development.

PRiME's researchers bring diverse expertise together for target identification and validation, therapeutic and diagnostic development, and novel drug discovery.

Notable Industry Partnerships & Collaborations

- PRiME has a sponsored research agreement with **Amgen** nearing completion, to test a high-throughput cell-screening device that can enable the engineering of cells with superior antibody bioproduction capabilities. The UofT-Amgen team will use this technology platform to develop new approaches for antibody bioproduction. This collaborative project aims to develop new approaches to increase the efficiency of the production of therapeutic antibodies.
- PRiME continues to develop **a strong talent pipeline** by providing graduate students and postdoctoral fellows the opportunity to work with industry partners through its [Fellowship Program](#). It has also helped connect its research faculty with industry partners, small and medium sized enterprises, and start-ups who were looking for additional expertise as they expanded, or pivoted, their business models to address COVID-19.
- PRiME has been able to help **facilitate knowledge sharing** amongst researchers and industry through knowledge sharing events such as the PRiME annual symposium, Pan-Canadian Innovation Showcase, and a virtual speaker series.