

The Toronto Academic Health Science Network

# Unleashing the potential of a world-class research powerhouse



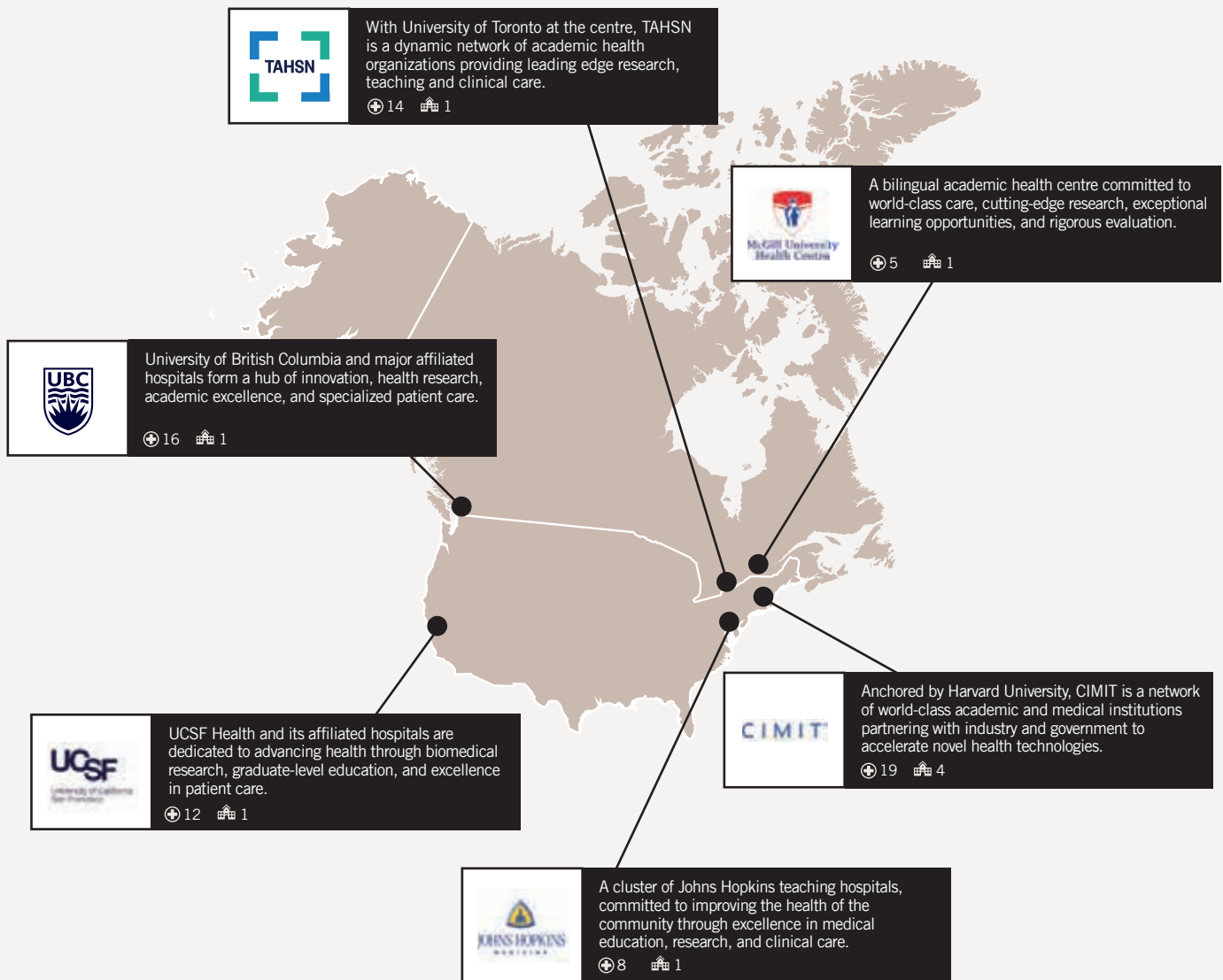
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HEALTH



UNIVERSITY OF  
TORONTO

# TAHSN: A leader in North American Life Sciences Research

Comparing TAHSN to leading life sciences hubs



Number of Affiliated Sites in the Network

Number of Universities in the Network

# #1

life sciences research hub in Canada

# #2

in number of clinical trials among North American hubs

# \$2.2

Billion in investment for life sciences startups in past 5 years

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# Unleashing the potential of a world-class research powerhouse

A lab-manufactured miniature heart ventricle that allows rapid testing of new therapies. A hydrogel that releases medicine over many days, making for easier pain management after surgery. An AI-powered platform that can predict diabetes five years before diagnosis, encouraging patients and doctors to take action now.

These are all discoveries from researchers in the Toronto Academic Health Science Network (TAHSN), showcasing Canadian innovation in health research to the world and changing lives. The network's impact rivals the world's leading life sciences hubs, with remarkable strengths in clinical trial activity and research outputs. The findings in this report, however, also show that the success of this hub is at risk. Co-ordinated action and support are needed to overcome challenges and reach global scale.

This report underscores the importance of a strong life sciences sector to Canada's health security and future economic growth. In 2022, the sector contributed \$89.6 billion to Canada's GDP and supported 200,000 jobs in the bio-economy<sup>1</sup>.

TAHSN is core to Canada's competitiveness in this sector. The network brings together the University of Toronto (U of T) — Canada's top ranked research university<sup>2</sup> — with 14 globally recognized academic hospitals throughout the Greater Toronto Area. The critical mass of top health and life sciences talent across TAHSN hospitals and the University of Toronto has helped propel TAHSN to a top 3 health research centre ranking in the world<sup>3</sup>.

This report explores strengths and weaknesses within TAHSN and in its ecosystem, and, for the first time, compares TAHSN to leading Canadian and U.S. life sciences research hubs<sup>4</sup>. It examines 10 quantitative indicators selected to assess the strength of the hubs' research activity, commercialization, innovation and talent development. It was conducted by Shift Health and commissioned by U of T.

TAHSN's strengths include:

- Top-quality research and high rates of collaboration across borders and sectors.
- Leading clinical trial activity to support drug development and innovative therapies.
- Dynamic and advanced training environments that support highly specialized talent development and attraction within the Canadian life sciences sector.

<sup>1</sup> Invest in Canada. Pharmaceuticals and medical manufacturing contribution. <https://www.investcanada.ca/industries/life-sciences>; <https://www.biotalent.ca/national-labour-market-information-study/>

<sup>2</sup> <https://www.timeshighereducation.com/world-university-rankings/2024/world-ranking>

<sup>3</sup> This ranking is based on the Nature Index, an indicator of global high-quality research output and collaboration. <https://www.nature.com/nature-index/brief-guide>; <https://www.nature.com/articles/d41586-023-01867-4>







<sup>4</sup> The clusters are Toronto Academic Health Science Network (TAHSN); Vancouver/University of British Columbia; McGill University Health Centre (MUHC); Consortia for Improving Medicine with Innovation and Technology (CIMIT); Johns Hopkins Medicine; University of California San Francisco Health (UCSF).

However, the report also identifies significant barriers that constrain TAHSN's impact and opportunity for growth, including:

- Underinvestment in the talent pipeline that erodes ability to meet forecasted health and human resource needs.
- Lower wages for researchers and employees in Canada, compared with U.S. hubs.
- Fewer early-phase clinical trials that limit testing of made-in-Canada health innovations.
- Capital constraints that diminish ability for startups to scale in Canada.
- Significant disadvantages in access to government health research funding compared with U.S. peers.

Governments recognize the economic opportunity of the life sciences sector. Through the Biomanufacturing and Life Sciences Strategy, the federal government has made significant initial investments into the country's life sciences research ecosystem. However, these investments are not competitive, even on a per capita basis, with the vast investments the U.S. dedicates to science and health. This report identifies areas of unrealized potential that must be addressed for the network to grow, through new federal and provincial investments that will draw further private capital. While Quebec, British Columbia and Ontario have each developed life sciences strategies, funding levels vary greatly. Quebec has made the most significant commitment, with a \$211-million investment to support its goals. Building on an exceptional foundation of health research excellence, TAHSN has untapped potential to scale and become a leading destination for talent, investment and global partnership.

## TAHSN: A leader in North American life sciences research

	Metrics							TAHSN vs. Canada	TAHSN vs. U.S. hubs
	Total Public Funding (\$M <sup>a,b</sup> )   Funding per Capita (\$)	1,352   361	614   712	492   279	5,098   4,106	4,879   6,036	15,626   18,244	Leading	Lagging
Research	Publications, 2018-2022	63,253	33,863	28,176	55,446	40,631	146,529	Leading	Leading
	Publications in Top-10% <sup>c</sup>	11,586	6,061	5,162	11,261	9,269	34,777	Leading	Leading
	Publications with Industry Collaborations <sup>d</sup>	2,555	1,097	936	2,675	2,677	8,215	Leading	On Par
Commercialization	Total Clinical Trials <sup>e</sup>   Interventional Trials <sup>f</sup>	1910   962	688   365	348   242	1360   824	1350   830	3624   2074	Leading	Leading
	Patents Granted	272	94	55	525	466 <sup>g</sup>	2,048	Leading	Lagging
	Number of VC Deals   Median Size (\$M)	580   4.39	338   3.01	189   4.55	363   4.9	1,945   9.58	2,296   12.32	Leading	Lagging
Talent	Employment	88,214	16,987	58,232	168,847	921,266	315,880	Leading	Lagging
	Average Hourly Wage	\$49.65	\$42.60	\$44.43	\$57.55	\$73.67	\$80.29	Leading	Lagging
	Enrollment in Life & Health Sciences (2021)	13,857	8,131	6,144	5,941	2,236	10,411	Leading	Leading
	% of Advanced Science and Engineering Degrees, by Region	31%	29%	38%	33%	23%	38%	On Par	Lagging

<sup>a</sup> All values are presented in CAD for the years 2018-2022 unless otherwise indicated. USD was converted to CAD using the 5-year annual average exchange rate of 1.30378 CAD/USD. Values for US benchmarks represent total NIH funding. Values for Canadian benchmarks represent total tri-council (CIHR, NSERC, SSHRC) funding. Funding is standardized per capita based on the city(s) in which the cluster's core academic institutions reside.

<sup>b</sup> Only includes SSHRC funding for the years (2018-2021) as 2022 data was unavailable (Based on prior years, 2022 SSHRC funding is estimated to be less than \$1 million CAD per cluster).

<sup>c</sup> The total number of documents that are among the top 10% most cited papers in the world within their respective subject, year, and document type.

<sup>d</sup> Data sourced by the University of Toronto from Clarivate Web of Science.

<sup>e</sup> Active clinical trials include observational and interventional clinical trials (including trials that did not have a phase).

<sup>f</sup> Interventional clinical trials that did not have a phase (e.g. behavioral, devices, etc.) were excluded from this number.

<sup>g</sup> All patents are assigned to the 'The Regents of the University of California'. UCSF accounts for ~35% of all patents granted to the University of California.

## A network with impact

TAHSN is Canada's leading life sciences research hub with each partner advancing crucial areas of research. Hospitals in the network are ranked among the best in the world. Toronto General (UHN) is the world's top publicly funded hospital and the No. 5 ranked hospital in the world<sup>5</sup>, while the Hospital for Sick Children is the #2 pediatric hospital in the world. SickKids and Baycrest are Canada's most research-intensive hospitals by hospital spending on research, and research spending per scientist, respectively. Research institutes at each site provide specialized care and collaborate to enhance health care delivery.

Clients at the **Anne & Allan Bank Centre for Clinical Research Trials** at **Baycrest** access emerging interventions for older adults with memory loss.

Scientists at the **Institute for Mental Health Policy Research** at **CAMH** develop and evaluate prevention and intervention initiatives, including community and digital interventions.

The **Bloorview Research Institute** at **Holland Bloorview** is recognized globally for its leadership in childhood disability research.

At the **SickKids Research Institute** at **SickKids**, more than 2,800 researchers are improving child health outcomes across seven research programs, including in cell biology, genetics and genome biology, and neurosciences and mental health.

**Michael Garron Hospital** (Toronto East Health Network) is a **Patient Partnered Diagnostic Centre of Excellence** dedicated to eliminating diagnostic errors in care.

**North York General Hospital** is transforming health care with **Clinical Trials**, contributing to improvements in medicine and the delivery of health care beyond our walls.

The new **Scarborough Health Network Research Institute** will contribute to the **Scarborough Health Network** becoming a globally recognized leader in population health and health equity research.

The **Lunenfeld-Tanenbaum Research Institute** at **Sinai Health** is affiliated with the **University of Toronto**, and is focused on women's and infants' health, cancer biology, stem cell biology, neurobiology and other areas of work.

The Hurvitz Brain Sciences Program, the Odette Cancer Program and the Precision Diagnostics and Therapeutics Program are only three of the 10 research programs at the **Sunnybrook Research Institute**.

At the **Institute for Better Health (THP)**, researchers are partnering on health services and population health research and transformational innovation.

The **MAP Centre for Urban Health Solutions** at **Unity Health** tackles complex community health issues — many at the intersection of health and equity.

The **Research Institute** at **Humber River Health** drives the hospital's pioneering position in digital healthcare innovation, reflecting its membership within TAHSN as Canada's first fully digital hospital.

At the **McEwen Stem Cell Institute** at **UHN** scientists develop novel stem cell-based therapies to treat heart disease, liver disease, diabetes and blood diseases.

At the **Women's College Research Institute** scientists are expanding knowledge about health conditions that have unique implications for women throughout their lives.

Together, the 15 institutions in the network are serving one of the most dynamic and diverse regions in the world and supporting Canada's health security and economic prosperity.

## TAHSN Member Hospitals

Members of the Toronto Academic Health Science Network (TAHSN) include the University of Toronto and its full and associate affiliated academic hospitals.

- Baycrest
- Centre for Addiction and Mental Health (CAMH)
- Holland Bloorview Kids Rehabilitation Hospital
- The Hospital for Sick Children (SickKids)
- Humber River Health
- Michael Garron Hospital (Toronto East Health Network)
- North York General Hospital
- Scarborough Health Network
- Sinai Health
- Sunnybrook Health Sciences Centre
- Trillium Health Partners (THP)
- Unity Health Toronto
- University Health Network (UHN)
- University of Toronto
- Women's College Hospital (WCH)

Sinai Health is a leading academic health science centre and a trailblazer for integrated care across the health continuum.



<sup>5</sup> <https://uhnfoundation.ca/stories/toronto-general-hospital-named-one-of-the-top-5-hospitals-in-the-world-for-fourth-year-in-a-row/>

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# Research that fuels economic growth

*TAHSN is among the most productive and collaborative life sciences research hubs in the world, driving discovery that leads to new products and companies.*



The Toronto High Containment Facility has supported the GTA's biomedical ecosystem for over 20 years and is a critical lab for collaboration within the TAHSN network and with industry partners.

Economic prosperity, health innovation and improved patient care depend on groundbreaking discovery. Each hub in this study is a regional and national engine of scientific research<sup>6</sup>. Across the hubs, thousands of publications and collaborations are laying the groundwork for innovations in health care. Much as the 1961 discovery of blood stem cells at what is now the research institute at Princess Margaret Cancer Centre opened the door to decades of advancement in regenerative medicine, today's research is setting the stage for new discoveries and applications that will transform health care delivery and the life sciences industry.

Research at TAHSN ranks among North American leaders in two of the three research indicators examined.

## High impact research

- Between 2018 and 2022, publications from TAHSN researchers achieved the highest citation impact among Canadian health research hubs and were second only to those at Harvard/CIMIT in rankings for the top 10 per cent of most cited papers in clinical, pre-clinical and life sciences.

<sup>6</sup> The life sciences research hubs discussed in this report are composed of 1 or more academic institutions and hospitals that are formally affiliated in a defined network. While these hubs demonstrate the characteristics of clusters as defined by Michael Porter, the networks evaluated here are smaller than the regions in which they are located and do not include all complementary or similar institutions in the region. For a discussion of clusters, see <https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition>.

- U of T is the top-ranked North American public university in the world in the 2023 National Taiwan University Rankings,<sup>7</sup> which measure scientific publication performance.

## Strong collaboration with industry and across borders

- TAHSN is also significantly ahead of Canadian peers and on par with Johns Hopkins and the University of California San Francisco network (UCSF) in industry co-authorship, reflecting the commercial potential of TAHSN research. On international collaborations, TAHSN is a North American leader.

## Investments that support transformational research

TAHSN is a model for collaboration and a magnet for attracting investment. Over the past five years, more than \$1.9 billion in philanthropic donations have been made to institutions in the network. Significantly, U of T’s Institutional Strategic Initiatives (ISIs) are increasing the university’s capacity to advance large-scale, high-impact research across disciplines. In 2022, initiatives related to life sciences attracted \$637-million in funding from philanthropic, institutional, government and private investment sources. These initiatives address national and provincial strategic priorities by accelerating discovery, innovation and skills development in high-demand areas. Through the ISIs, TAHSN pursues research on the frontier of regenerative medicine, genomics, precision medicine, AI and robotics, data sciences, neurodegenerative disease and cardiovascular disease.

The initiatives’ interdisciplinary model brings strengths from every area to tackle complex conditions, a model also deployed at Harvard/CIMIT’s Wyss Institute for Biologically Inspired Engineering and the Broad Institute of the Massachusetts Institute of Technology and Harvard University.

## Key Institutional Strategic Initiatives at U of T in the life sciences



<p>Creating and translating interdisciplinary approaches in regenerative medicine and cell therapy to transform human health.</p>	<p>Leveraging multidisciplinary approaches to create new diagnostic tools and develop therapeutic strategies that deliver on the promise of precision medicine.</p>	<p>Harnessing the potential of a diverse community of experts to more effectively combat infectious diseases and prevent future pandemics.</p>	<p>Developing self-driving artificial intelligence-guided robotic labs that accelerate the discovery of advanced materials and small molecules.</p>	<p>Developing a community of researchers, older adults, caregivers, partners and future leaders to accelerate the delivery of technologies and services for health aging.</p>
<p>MbD-funded researchers are partnering with Moderna to develop next-generation RNA platform technologies.</p>	<p>UHN Researchers are leveraging PRIME’s multidisciplinary network to collaborate with AmacaThera on the development of non-opioid analgesics to improve post-surgical pain management.</p>	<p>Led and anchored by EPIC, the Canadian Hub for HI3 is galvanizing industry collaboration to strengthen Canada’s pandemic preparedness and biomanufacturing capacity.</p>	<p>The Acceleration Consortium is bringing together academics, government, and industry to expedite drug development and commercialization timelines.</p>	<p>Hosted by UHN, AGE-WELL-supported products are helping older adults maintain their independence, health and quality of life.</p>

<sup>7</sup> <http://nturanking.csti.tw/>

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# Innovation that is ready to scale

*TAHSN contributes to Ontario's innovation ecosystem with robust clinical trial activity, patent generation, company creation and private capital attraction.*



Students at the University of Toronto Mississauga campus participate in the Interdisciplinary Summer Program in Research and Entrepreneurship, which introduces them to drug discovery and innovation.

It is well established that Canada suffers from weak performance in business research and development (R&D) and has lagging productivity compared with OECD peers. However, in the life sciences sector, expenditures on R&D have increased. Recent government investment in bioinnovation has spurred further growth<sup>8</sup>. This evaluation of TAHSN's commercialization performance demonstrates the importance of R&D to the life sciences sector as well as the barriers that limit potential to scale in Canada.

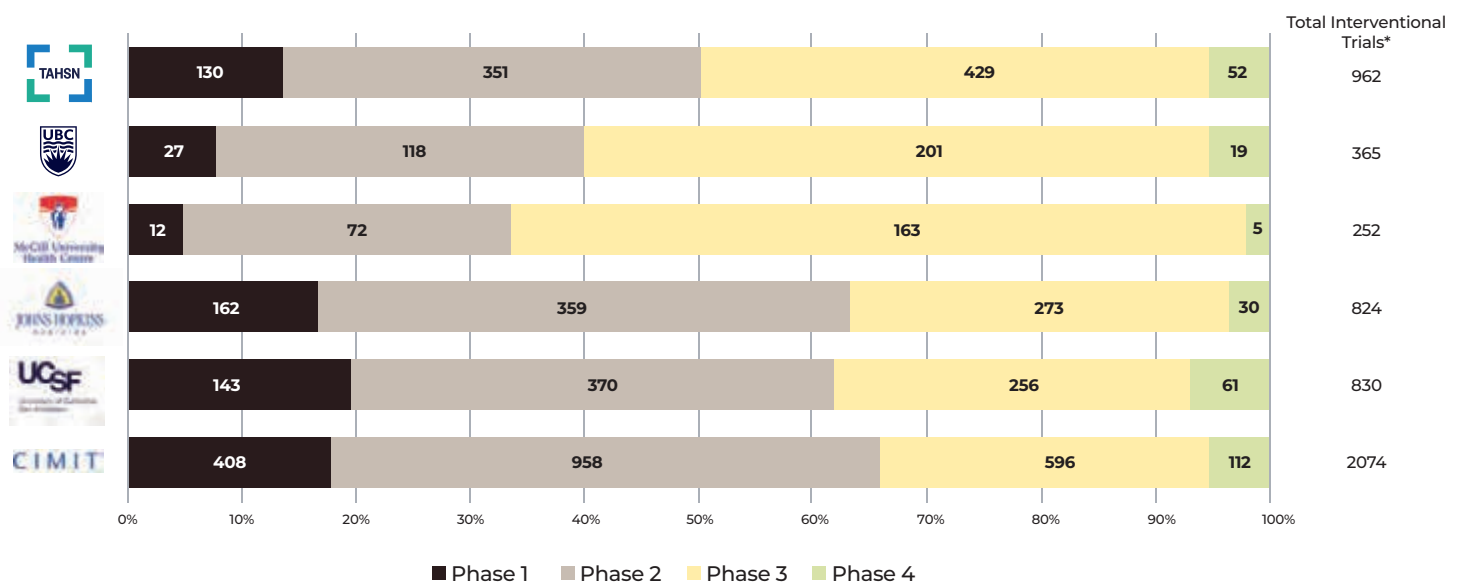
<sup>8</sup> <https://ised-isde.canada.ca/site/canadian-life-science-industries/en/biopharmaceuticals-and-pharmaceuticals/pharmaceutical-industry-profile>



## A global hub for clinical trials

- TAHSN is second only to Harvard/CIMIT among North American benchmarks in total number of clinical trials, as well as clinical trials with industry partners.
- The Canadian Institutes of Health Research’s study of Canada’s clinical trial landscape identified early trials (pilot, Phase 1 and 2) as important to growing the country’s drug development and biomanufacturing sectors<sup>9</sup>. Our study validates the need for attention in this area, as the proportion of Phase 1 trials in Canada is smaller than that of U.S. health research hubs. Recent consultations and investments<sup>10</sup> by the federal government and Ontario aim to support Canadian startups to launch and scale by increasing access to Phase 1 clinical trials. Addressing the clinical trial landscape remains a focus for TAHSN members.

### Proportion of Interventional Clinical Trials by Phase (2018-2022)



N.B. Interventional clinical trials that did not have a phase (e.g. behavioral, devices, etc.) were excluded from this analysis. \*Interventional clinical trials that did not have a phase (e.g. behavioral, devices, etc.) were excluded from this analysis. “Early Phase 1”, “Phase 1 | Phase 2” and “Phase 2 | Phase 3” were re-categorized as “Phase 1”, “Phase 2” and “Phase 3” respectively.

## Promise in moving from lab to market

- TAHSN works closely with industry, securing over \$376 million in contracts from 2018 to 2022 for research and development projects with private companies. The network also has partnerships with each of Canada’s top 10 pharmaceutical firms.
- Between 2018 and 2022, TAHSN generated more patents than the next two largest Canadian hubs at Vancouver/UBC and McGill University Health Centre (MUHC). However, the number of patents is still lower than in the top U.S. centres. Studying how U.S. health research hubs encourage patenting

<sup>9</sup> [https://cihr-irsc.gc.ca/e/documents/wwh\\_clinical\\_trials\\_en.pdf](https://cihr-irsc.gc.ca/e/documents/wwh_clinical_trials_en.pdf)

<sup>10</sup> For example, see a summary of Ontario’s support for clinical trials <https://www.investontario.ca/success-stories/ontario-has-secret-recipe-thriving-clinical-trials-environment>; and federal investments including the \$250-million CIHR investment in increasing clinical trial capacity <https://ised-isde.canada.ca/site/canadian-life-science-industries/en/biopharmaceuticals-and-pharmaceuticals/clinical-trials-environment-canada>.

could help Canadian regions learn and improve in this area.

- The life sciences companies emerging from TAHSN are a key factor in attracting private investments to the region. More than one-third of venture capital investments in life sciences in the Greater Toronto Area (GTA) were invested in startups affiliated with the University of Toronto, which itself ranks second in North America for research-based startups and fifth in the world for its business incubators<sup>11</sup>. Companies arising from the TAHSN ecosystem include Deep Genomics (\$220M, Series B and C), Notch Therapeutics (\$89M, Seed and Series A), AmacaThera (~13M, Seed and Series A), and Signal 1 (\$10M, Seed).

## Investment attraction, but need for scale is evident

- Infrastructure investments are needed for a world-class research ecosystem. A prior report conducted by Shift Health found a shortage of wet lab space in the GTA informs decisions by Canadian life sciences companies to locate in U.S. clusters such as Boston<sup>12</sup>. SpinUp, the university's first wet lab incubator, located in the University of Toronto Mississauga's Centre for Medicinal Chemistry, responds to this demand for space.
- Like many small and medium-sized companies in Canada, life sciences startups also struggle to find enough funding to grow and expand. While the GTA leads in the total amount of money raised, it's still not as developed as top U.S. startup hubs like Boston and San Francisco. The average and median deal sizes in the GTA are smaller.

## Startups from the TAHSN ecosystem



Spun out of the University of Toronto Early Stage Technology incubator, Deep Genomics was founded by biomedical engineering professor Brendan Frey, to develop treatments for genetic diseases. Its proprietary platform, AI Workbench, uses machine learning to decode the enormous complexity of RNA biology to find novel targets, mechanisms, and molecules that are not accessible through traditional methods. Deep Genomics has raised more than \$223-million (CAD) from investors, has 10 drug candidates in pre-clinical development and is one of Canada's significant entries in the AI in genomics market.



Building on a history of discovery in stem cell research, Notch Therapeutics is developing a pipeline of cellular immunotherapies engineered to address the underlying biology of complex disease systems. Notch was co-founded by Juan Carlos Zúñiga-Pflücker, immunologist at Toronto's Temerty Faculty of Medicine and a senior scientist at Sunnybrook Health Sciences Centre, and Peter Zandstra, professor in the School of Biomedical Engineering at UBC. With early support from MaRS Innovation and the Centre for Commercialization of Regenerative Medicine, the company has raised more than \$85-million in Series A financing.



GEMINI is a hospital data and analytics platform co-founded by Unity Health physicians to help measure the quality of care being provided in hospitals and identify opportunities for improvement. Over the last five years, Gemini has grown to a collaborative team of 40 researchers working with almost 30 hospitals across the province to support an Ontario quality improvement program.

<sup>11</sup> <https://entrepreneurs.utoronto.ca/ute-annual-report-2022-2023/>

<sup>12</sup> <https://torontoglobal.ca/our-industries/wet-labs>

## U of T's commercialization highway

The University has created over 12+ Acceleration programs including The University of Toronto Early Stage Technology (UTEST) program to provide support to U of T entrepreneurs creating new IP-based companies. In partnership with Toronto Innovation Acceleration Partners (TIAP) and with the financial support of the Connaught Fund, UTEST provides companies with investment capital, mentoring, business strategy and incubation space at the University of Toronto St. George Campus. This multi-disciplinary “lab-to-market” program has created over 130 companies to date, which have collectively raised over \$3-billion over the past decade. The vast majority of these new companies remain active and headquartered in the Greater Toronto Region.



Dr. Molly Shoichet is the co-founder and Chief Scientific Officer of AmacaThera and a Professor at U of T. The company is a clinical-stage biotechnology firm developing a novel drug delivery platform to improve patient outcomes.

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# Talent that advances innovation and competitiveness

*The TAHSN training ecosystem supports researchers to compete with the best hubs in the world, but resource constraints risk the hub's ability to meet the future needs of the labour market.*



The Schwartz-Reisman Innovation Campus will be home to 650,000 SF of AI and life sciences spaces, the country's largest concentration of student and faculty-led startups.

## The workforce of tomorrow

- Highly qualified personnel (HQP) are the foundation of innovation and economic growth. This fundamental principle informed the Advisory Panel on the Federal Research Support System as well as 2017's landmark Fundamental Science Review<sup>13</sup>. TAHSN leads all North American benchmarks in total enrolment in health and life sciences with ~13,000 students enrolled across three campuses and research opportunities that start at the undergraduate level. These degrees prepare students to meet the health needs of Ontarians. For example, U of T launched the Scarborough Academy of Medicine and Integrated Health as its newest academic health science academy<sup>14</sup>. Fuelled by Ontario's expansion of medical school education, this investment establishes U of T as Canada's largest medical school and, when in full operation, will provide an additional 467 new graduates in life sciences and health care professionals who will address the undermet health needs of the eastern GTA.

<sup>13</sup> <https://ised-isde.canada.ca/site/canada-fundamental-science-review/en>

<sup>14</sup> <https://news.ontario.ca/en/release/1001773/ontario-training-more-doctors-as-it-builds-a-more-resilient-health-care-system>

- Through targeted programs such as the Training Program in Regenerative Medicine offered by the Institute for Medical Sciences and CANSSI Ontario Stage, TAHSN is also supporting the development of highly specialized life sciences talent with capabilities in disciplines facing shortages across Ontario's life sciences sector.

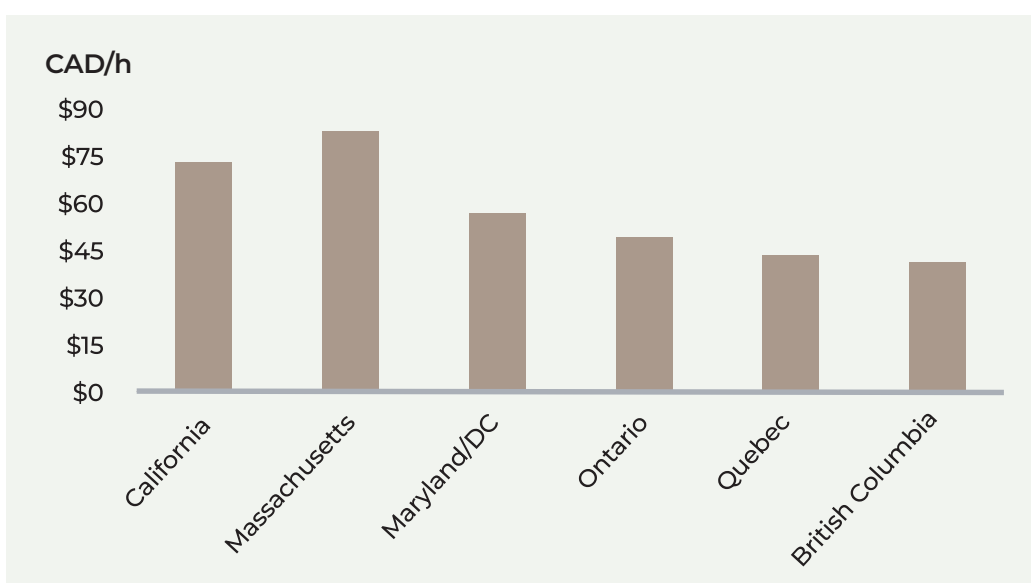
## Labour demand exceeds expected supply

- Labour market demands are growing. The current talent pool lags North American leaders and is not sufficient to meet forecasted demand: According to labour market projections<sup>15</sup>, an additional 36,000 bio-health sector employees will be needed in Canada by 2029, including 14,400 in Ontario and 9,000 in the GTA.
- Importantly, there is a need to focus on developing highly-qualified personnel as the GTA has a lower proportion of advanced (i.e., master's and PhD) science and engineering degrees than is found in the Montreal, Massachusetts and Maryland regions. Canada's lagging production of advanced degrees compared with OECD peers is a barrier to building a highly competitive life sciences workforce. There is a critical need to make developing health research talent a national priority to ensure companies have the people they need as they scale.

## Compensation lags leading research hubs

- Finally, Ontario's average salary for employees in the health care and life sciences sector — while on par with B.C. and slightly higher than Quebec — is significantly lower than top American jurisdictions. The competition for health research talent is global. Current wages in Canada cannot compete with leading North American life sciences research hubs and may limit Ontario and Canada's potential to attract and retain the talent needed to scale startups to globally competitive enterprises.

### Average Hourly Wage in the Life Sciences Sector by Region



<sup>15</sup> <https://www.biotalent.ca/wp-content/uploads/BioTalent-Canada-LMI-National-Report-13OCT2021-1.pdf>

# Conclusions and recommendations

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By examining the performance of leading life sciences research hubs in Canada and the United States, this study underscores TAHSN's leadership potential within a North American context. The network attracts funding, drives discovery and enables research translation mechanisms that rival the best in the world, including in commercializing research through the full spectrum of clinical trials.

Looking at the characteristics that contribute to the success of leading hubs highlights areas for further support that will be key to ensuring that TAHSN — and the wider GTA and Ontario life sciences sectors — achieves the scale, critical mass and renown of world-leading life sciences research clusters in Boston and San Francisco:

- Top-ranked research universities are at the centre of each of the identified research hubs. Their talent and networks are creating discipline-specific knowledge and powering transformative interdisciplinary approaches to solving health challenges. ***Reinvestment in research that supports the foundation of innovation is critical to health security and economic growth, as recommended by the Advisory Panel on the Federal Research Support System.***
- Each hub's impact extends beyond research. Clusters catalyze multiple elements in the continuum of innovation, including commercialization accelerators, venture capital, entrepreneurship training and advanced technologies that spur discoveries and interdisciplinary solutions in the life sciences. ***The role of TAHSN as an engine for health security and economic growth can be strengthened through strategies to facilitate collaboration with industry and other stakeholders in the sector.***
- Leading research hubs like Johns Hopkins Medicine and Harvard/CIMIT are in regions that benefit from strong life sciences brand awareness (BioHealth Capital Region and Boston's Technology Corridor). As this benchmarking study shows, in many measures, TAHSN and the wider GTA life sciences sector are in a tier of excellence that includes the best life sciences clusters in the world, but that is not widely recognized globally. ***There is an opportunity to re-articulate Canada's position of strength through reinvestment that builds confidence and awareness with key audiences, including talent, industry and investors.***

Taking strategic action now to strengthen investment in health research and innovation will ensure that Canadian life sciences research hubs realize new levels of economic growth and accelerate innovation that can improve Canada's health security and prosperity.

# Methods

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This report follows the definition of life sciences outlined in government strategies with an emphasis on health research and biomanufacturing. The analysis of metrics does not include public health care workers (e.g., physicians and nurses not conducting research) or the agricultural sciences, a field that makes significant contributions to Canada's life sciences sector.

While this report developed, collected and analyzed quantitative data on each research cluster, the authors acknowledge that available measures of research quality, influence and impact are imperfect. These metrics have been selected as a proxy for research quality but may have some limitations such as those described by the Declaration on Research Assessment.

Funding data were obtained from tri-council award databases (Canada) and the NIH funding database (USA); clinical trial data were obtained via [clinicaltrials.gov](https://clinicaltrials.gov); patent data were obtained from [lens.org](https://lens.org); employment data were obtained from Statistics Canada and the United States Census Bureau; venture capital data were obtained via [pitchbook.com](https://pitchbook.com); research output data were sourced by the University of Toronto from Clarivate Web of Science; enrollment and degrees granted data were collected from benchmark university websites and Statistics Canada and the US National Center for Education Statistics. Data analysis was completed between July 2023 and September 2023.

For a complete list of the hospitals in each hub, see individual hospital sites and contact Shift Health or U of T.

## Acknowledgements

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This study was conducted by Shift Health and commissioned by the University of Toronto.

Founded in 1827, the University of Toronto is Canada's top university with a long history of challenging the impossible and transforming society through the ingenuity and resolve of its faculty, students, staff, postdoctoral researchers and alumni.

Shift Health brings a science mindset to strategy consulting for the health research and innovation ecosystem. Blending scientific depth, sector leadership and global perspective, Shift Health delivers sharp insights and customized solutions to create the future of healthcare.

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